Emotion word processing: Evidence from electrophysiology, eye movements and decision making

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Submitted for the degree of PhD to the Higher Degree Committee of the Faculty of Information of Mathematical Sciences, University of Glasgow.

January, 2009

Abstract

A degree of confusion currently exists regarding how the emotionality of a textual stimulus influences its processing. Despite a wealth of research recently being conducted in the area, heterogeneity of stimuli used and methodologies utilized prevented general conclusion from being confidently drawn. This thesis aimed to clarify understanding of cognitive processes associated with emotional textual stimuli by employing well controlled stimuli in a range of simple but innovative paradigms. Emotion words used in this thesis were defined by their valence and arousal ratings.

The questions asked here concerned early stages of processing of emotional words, the attention capturing properties of such words, any spill-over effects which would impact the processing of neutral text presented subsequently to the emotional material, and the effect of emotional words on higher cognitive processes such as attitude formation.

The first experiment (Chapter 2) manipulated the emotionality of words (positive, negative, neutral) and their frequency (HF – high frequency, LF – low frequency) while ERPs were recorded. An emotion x frequency interaction was found, with emotional LF words responded to fastest, but only positive LF words responded to fastest. Negative HF words were also associated with a large N1 component. Chapter 3 investigated the attention-capturing properties of positive and negative words presented above and below a central fixation cross. The only significant effects appeared when a positive word was presented in the top condition, and a negative word in the bottom condition. Here saccade latencies were longer and there were a fewer number of errors made. Chapter 4 reports an eye tracking study which examined the effect of target words' emotion (positive, negative, neutral) and their frequency (HF, LF). The pattern of results, produced in a variety of fixation

time measurements such as first fixation duration and single fixation duration, was similar to those reported in Chapter 2.

The existence of any spill-over effect of emotion onto subsequently presented neutral text was examined in a number of ways. Chapter 5 describes priming with emotional primes and neutral targets but no effect of emotion was found. Chapter 6 employed the same design as Chapter 4 but presented positive, negative or neutral sentences in the middle of neutral paragraphs. It was found that the positive sentences were read fastest, but the neutral sentences following the negative sentences were read faster than those following neutral sentences.

Chapters 7 and 8 employed a version of the Velten mood-induction tool to examine the effect of mood when reading emotional text. Chapter 7 was a replication of Chapter 4 with 4 participant groups: positive, negative and neutral mood. While the neutral group showed similar results to those produced in Chapter 4, the positive group only fixated on the positive HF words faster, the negative group showed a frequency effect within each emotional word type, but within HF words positive words were viewed for less time than neutral words.

Chapter 8 had participants read 4 product reviews and then afterwards rate each of the products on a set of semantic differentials. This was a 3 (mood: positive, negative, neutral) x 2 (message type: positive negative) x 2 (word type: positive negative). There was no effect of mood but positive messages were read quicker when they contained positive words and negative messages were read quicker when they contained negative words. Participants were asked to recommend each product to individuals in either a prevention in a promotion focus. When the focus was prevention there were additive effects of message and word type, but when the focus was positive there was an interaction, with the positive message conveyed using negative words being rated highest. The same pattern also emerged in the series of semantic differentials.

Possible mechanisms to account for these findings are discussed, including many incarnations of McGinnies's (1949) perceptual defense theory. Future studies should possibly aim to combine the current knowledge with motivational, goal-orientated models such as Higgins's (1998) theory of regulatory focus.

Declaration

This thesis has been composed by the undersigned. It has not been submitted or accepted in any previous application for any degree at this or any other university. This thesis has been completed by myself unless otherwise indicated in the text.

Graham George Scott

Acknowledgements

First and foremost I would like to thank my supervisor, Dr. Sara C. Sereno, and my second supervisor, Prof. Paddy J. O'Donnell, without whose help and support I would no doubt be quivering and drooling in a padded room somewhere rather than handing in a completed thesis. The time and patience they invested answering my inane and repeated questions, listening to my ill-considered theories and gently tempering my more audacious and risqué proposals deserves more reward than a couple of scrawled sentences atop a page in a thesis.

Thank you to Dr. Hartmut Leuthold for assisting in the analysis of electrophysiological data. I could also not have completed this work without the assistance of students Maria Spedsberg, Mellissa Warrander, Abbas Ali, Katie Low and Lauren McAllister, who helped with data collection and generally brightened up many of my days with their antics.

I would also like to thank the other members of the University of Glasgow's Department of Psychology not only for their support and stimulation throughout my postgraduate tenure but also for the relief they provided during the more intense moments of my degree. In particular my gratitude is extended towards Chris Hand and Dr. Jessica Price for respectively providing comic relief and cake.

The completion of this work would of course not have been possible without the help of the many support staff of the department. Linda Young, Anne Toner, Lyndsey McGinley, Carol Sheridan, Claire Robertson, John McClure, John Shaw, Danny Hastie – and those I have forgotten – thank you.

The most important factor not only in my achievement in completing this thesis but also in my survival these last few years is undoubtedly the unwavering love and support of Eileen Murray. I am forever in your debt.

I would also like to acknowledge the financial support provided by the Economic and Social Research Council who deemed me worthy of a 1+3 postgraduate research award and allowed the completion of this work.

Previous Published Dissemination

Scott, G.G., O'Donnell, P.J., Leuthold, H., & Sereno, S.C. (2008). Early emotion word processing: Evidence from event-related potentials. Biological Psychology, 80, 95-104.

Scott, G.G., O'Donnell, P.J., & Sereno, S.C. (2009). The good, the bad, and the so-so: Emotion words affect eye fixations in reading, submitted

Scott, G.G., O'Donnell, P.J., Leuthold, H., & Sereno, S.C. (2006, August). Emotion word processing: Behavioural and electrophysiological evidence. Presented (poster) at the Architectures and Mechanisms for Language Processing (AMLaP) meeting, Nijmegen.

Scott, G.G., O'Donnell, P.J., & Sereno, S.C. (2006, November). Emotion word processing: Evidence from eye movements. Presented (poster) at the Psychonomic Society meeting, Houston.

Sereno, S.C., Scott, G.S., Leuthold, H., & O'Donnell, P.J. (2007, July). Emotion word processing: Behavioural, electrophysiological, and eye movement evidence. Presented (talk) at the EPS / Psychonomic Society meeting, Edinburgh.

Sereno, S.C., Scott, G.S., Leuthold, H., & O'Donnell, P.J. (2008, June). Emotion word processing: Behavioral, electrophysiological, and eye movement evidence. Invited presentation (talk), The Third China International Conference on Eye Movement Studies, Sun Yat-Sen University, Zhuhai, China.

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Chapter 1

Our emotions are the most influential forces in our lives. They colour our perception and drive our behaviour. Everything we encounter elicits an emotional reaction of some sort, whether directly or through associations. These feelings then form a filter through which future experiences are judged and evaluated. Ambiguous, even trivial stimuli can lead to radically different responses depending on the emotional orientation of the person who encounters it.

Consider the following example. Imaging you were to step outside the Psychology Department of the University of Glasgow and see two school children crossing the street. Were you to be in a positive mood, feelings of happiness, satisfaction and pride swimming round your head, possibly as the result of having just told a postgraduate candidate they had been successful in their VIVA examination, you might view this spectacle as uplifting. You would smile, if only to yourself, maybe recall fond memories of your own children having fun and consider the bright future which lies in front of them. If, on the other hand, you had crushed a young candidate's hopes and dreams, denying them reward for years of dedicated work, you might instead be in a rather negative mood, feeling justifiably sad, disappointed, shameful and guilty. This could result in the same observation being scrutinized with trepidation. You might recall a newspaper article discussing rising knife crime among youths, and experience fear. You could conceivably judge the youngsters in question, jumping to the conclusion they are playing truant from class or engaging in illicit or unlawful behaviour. You might start to worry about the well-being of your own offspring and reflect on the declining state of the world in which they have been raised.

Our emotions form the window through which we view the world, the looking glass through which we view ourselves, and the platform from which we launch ourselves on cognitive journeys whenever we are required, consciously or subliminally, to make a judgment, evaluation or decision. These emotions are constantly being influenced from numerous directions – sights, sounds, smells, touches, tastes – as well as by internal associations and memories.

One area which has received growing attention in the past decade is that of emotion in language, specifically the contrast of effects between positive words (e.g., *success*, *doctor*, *graduate*) and negative words (e.g., *fail*, *revision*, *unemployed*). The current thesis presents a collection of studies which provides unique insight into the cognitive processes underlying the reading of emotional text. These experiments range in focus, considering the low level cognitive mechanisms involved in emotional and lexical access to the impact of such language on subsequent reading and upon decision making and attitude formation.

The thesis begins by conducting further analysis on the electrophysiological data gathered for my MSc. thesis. This will add to the existing knowledge in the literature to expand the picture of how early emotional processing takes place and the mechanisms involved. This will be followed by investigations into the attention capturing properties of such words.

Further investigations examine the reading of emotion words in a variety of paradigms using a range of different measures. Reaction times will be recorded in a priming study and several measures of eye movements will be examined in a series of reading studies aimed at unraveling the depth of impact emotion words have on cognition – from emotional access to their impact upon subsequent text and stimuli.

The final experiment of the thesis implicates emotional language in decision making and attitude formation.

The current situation as defined by the literature regarding the processing of emotional words is unclear. There is much uncertainty surrounding the question of how the emotional content of words affect the way in which they are processed. This is largely due to a marked inconsistency in the methodology employed in, and hence the results gained from, recent experiments investigating these issues. This thesis attempts to cast light on what has become an increasingly and unnecessarily cloudy subject by carrying out the progression of innovative studies described above.

The shortcomings of preceding studies contributing to the current state of confusion are analysed in terms of stimuli used and methodology employed. Issues still under contention will then be summarised, a review of pertinent work published thus far presented, and the role of the current composition in attempting to answer these questions and simplify the overall understanding of the facts explained.

Stimuli

In early experiments, cognitive responses to emotionality were investigated by gauging participants' responses to pictorial stimuli (e.g., Janke, 1993). In the last few years, however, there have been enough investigators using emotional language (i.e., words and sentences) for this sub-division of emotion research to become a field in its own right. While it is good for the area to be receiving such eager attention, some of those involved seem to have jumped in head first without stopping to consider what others around them are doing, and what value their contributions will have to the field as a whole.

Despite a considerable number of studies being carried out, it is still unclear after reading the literature what constitutes a positive, negative or neutral word. In the literature, the term ‘emotion words’ or ‘emotional words’ has typically been used to mean one of two things. In one case, the authors refer to words expressing emotions (e.g., *happy*, *joyful*, *sad*, *dejected*). In the second case, words are defined as being positive, negative or neutral by their categorization on two dimensions: arousal, a measure of internal activation; and valence, a measure of value or worth. Here emotional words are not mere synonyms for emotional states, but elicit them (e.g., *puppy*, *birthday*, *mutilate*, *bomb*).

In the majority of publications arousal and valence values have been defined by ratings attributed to them. The most popular values in recent papers (e.g., Lewis et al., 2007) come from the Affective Norms for English Words (ANEW), a database of 1000 words (Bradley & Lang, 1999). Here, arousal is fully defined as the extent to which a word is judged to be calming or arousing/exciting; valence is defined as the extent to which a word is judged positive or negative. Although research has consistently shown these to be the dominant factors regarding how we respond to words, exactly what effect each has remains a matter of debate.

One drawback of adopting this two-dimensional model of emotional words is the constrictions it immediately places on the scope of such stimuli able to be realistically employed – and controlled – in any experiment designed to investigate the discrete influences of the two factors. Take, for example, Bradley and Lang’s ANEW database, the largest published word-set at time of writing to rate stimuli for both valence and arousal (amongst other variables such as dominance). In order to perform an experiment to assess the impact of arousal and valence independently from each other, an equal spread of words across each of the spectrums would need to be employed. This is not the natural order of things, however. Any word at the extremes of valence will usually have a high arousal rating, as extremely positive or negative words would intuitively be accompanied by at least some arousal. Similarly, words at the low end of the arousal scale tend to have mid-ranging valence scores. This natural arrangement makes it easy for researchers to create categories of positive, neutral, and negative words, but leaves little choice if high-arousal mid-valence, low-arousal mid-valence, or mid-arousal low-or-high valence categories were also required (at least without succumbing to the temptation of repeating stimuli, a gripe which will be addressed promptly). Thus, at least until a much larger data set is constructed, we must try to unravel the twinned mysteries of arousal and valence using only a limited subset of examples from each continuum.

A more recent division in the arena of emotion word research is a shift in interest from some investigators from general emotional states (i.e., positive, negative and neutral) to specific or discrete emotions (e.g., fearful, angry, guilty). It has been shown consistently that, for certain tasks, discrete emotions of the same valence can produce diverging results (e.g., Lerner and Keltner, 2001). This approach has been particularly popular with proponents of goal-driven theories such as Higgins (1998), champion of the theory of regulatory focus. Such theories attribute different emotions of the same valence to different mindsets – for example, joy and sadness are associated with an approach strategy or promotion focus, while relief and anxiety are associated with an avoidance strategy or prevention focus.

Another study to demonstrate this divergence of response within a specific valence is Zemack-Rugar et al. (2007). They non-consciously primed both sadness and guilt in participants and found that guilty participants showed lower indulgence (they allotted more money for necessary vs. indulgent shopping items) and more helping (they were more likely to carry out a boring task for charity) than sad participants.

These studies are, for the most part, neat and well constructed, and certainly offer a valuable contribution to the scientific knowledge. They are, however, just one subsection of the ever-growing field of emotional linguistics. To totally abandon exploration into general emotional states, and the language associated with such states, to jump on the discrete-emotion bandwagon would be foolhardy and undermine the good work of many researchers over the past two decades.

Despite the heterogeneous nature of studies dedicated to tackling problems in this area, consistent findings have generally been produced. Reliable differences in reaction time between positive, negative and neutral words have been shown to transcend task. There are constant advances being made in this area.

Recently, the emotionality of a word has been investigated in conjunction with its frequency. So far only a handful of published work has explored this issue, and all of these – Nakic et al. (2006), Kuchinke et al. (2007), and Scott et al. (2005), the findings from which are amongst those discussed in chapter 2 – found compatible results.

This thesis, therefore, will concentrate solely on these wider, more general emotional categories of positive, negative and neutral. Papers dealing with distinct emotions will not be considered in conjunction with the current work not because they are irrelevant to contemporary knowledge in the field, but because our understanding of the topic in hand is still infantile enough to render us unable to form any coherent theories to bring such a subtopic together.. The following experiments will employ positive, negative and neutral words then, most of which will be taken from Bradley and Lang's (1999) ANEW compilation.

Methodology

During the recent period of interest in emotional language, experimenters have attempted to gain insight into cognitive processing strategies by using a number of different techniques. These include lexical decision (LD), emotive decision (ED), forced choice tasks (Kakolewski et al., 1999), Stroop paradigms (Smith & Waterman, 2005), odd-ball paradigms (De Pascalis et al., 2004), memory tasks (Van Strien & Luipen, 1999), self-referential judgments (Lewis et al., 2007), and attention tasks (Bernat et al., 2001), as well as imaging studies using ERPs (Kanske & Kotz, 2007) and fMRI (Lewis et al., 2007). Within these different experiments, stimuli have been presented both masked (Windmann et al., 2002) and unmasked, supraliminally and subliminally (Bernat, Bunce, & Shevrin, 2001), repeated and unrepeated, blocked (Hamann & Mao, 2002) and randomly presented, visually and auditorily (Wurm et al., 2003), in normal type and in capitals, lateralised and centrally (Kanske & Kotz, 2007), and horizontally and vertically. Some experiments also primed their participants using mood induction techniques (e.g., Olafson & Ferraro, 2001). In addition to the other issues concerning the nature of the stimuli described above, many studies also limited their investigation to a particular grammatical category of word. Klauer, Roßnagel and Musch (1997), for example, used only adjectives, while Ortigue et al. (2004) employed only nouns.

These constraints are used in addition to the previously stated problem of stimuli selection. Quite apart from what constitutes an emotional word, the literature demonstrates an emphasis thus far on negative words, particularly comparing how they are responded to in comparison to neutral words. Some studies have also compared negative words to positive words (Estes & Verges, 2008), while others have grouped them together, comparing ‘emotional words’ to neutral words (Ortigue et al., 2004). One study, Bernat et al. (2001), opted to forego the employment of a baseline completely, instead comparing negative words only to their positive counterparts. Also, studies occasionally choose to only employ subcategories of these words, for example, Wurm et al. (2003) saw fit to present only ‘danger’ words rather than ‘negative’ words and ‘usefulness’ words as opposed to ‘positive’ words.

Despite occasional follow-up studies and replications, the majority of research carried out in the literature has been unrelated to that of other researchers and potential collaborators. The external validity of many experiments has been low and thus, despite significant effort being applied by many individuals, their success in contributing to the greater understanding has not been as substantial as one might have hoped.

The Present Understanding

A brief review of the literature to date will now be presented. Exempt from this will be electrophysiological findings, which will be addressed in the next chapter, and papers controlling the word frequency as well as the emotionality of targets. The number of papers in this latter category is so small it will also be addressed in Chapters 2 and 3, when the findings can be considered in a more specific context. Below will be presented behavioural results, as it is these that comprised the foundation of the work currently being undertaken. Excluded for the moment are papers dealing with mood induction (e.g., Olafson & Ferraro, 2001), as this issue will be addressed in more detail in Chapters 7 and 8. Also not included in the section below are any studies dealing with clinical or non-normal populations (e.g., Kiehl, Hare, McDonald, & Brink, 1999) as it is the processing of emotional text in normal individuals in everyday contexts which is of ultimate interest in the current thesis. Papers employing lexical decision tasks (LDTs) will be addressed first, then studies reporting emotive decision tasks (EDTs), sometimes referred to as valence decision tasks, as they are the two paradigms most frequently employed. Finally, studies utilizing other methods of investigation will be attended to and the theoretical implications of the findings discussed.

Lexical Decision Tasks

Wentura (2000) carried out three primed LD experiments in German to investigate possible mediating mechanisms by which the target evaluation is influenced by the prime presentation. The first of these used a Latin-square design with 40 negative adjectives, 40 positive adjectives, and 40 non-words controlled for length. Primes were presented for 200 ms, followed by a 100 ms ISI (inter-stimulus interval), then the target was presented until response. A significant effect of prime-target relation was found, confirming the hypothesis of affective priming in the LD task.

In the second experiment, the same procedure was used, but each prime was presented twice – once preceding a word and once preceding a non-word – and 96 word and 96 non-word targets were used. There was no significant effect of valence found here. The procedure of the third experiment was identical to that of the second, but the materials of affectively congruent and incongruent prime-target pairs were completely replaced with (affectively neutral) associatively related and unrelated pairs. Also, for half the related materials, the associate of a given stimulus served as the target (symmetrical priming), while for the other half it was the prime (backward priming). The results were that associated pairs were responded to significantly faster than unassociated pairs.

Windmann, Daum and Güntürkün (2002) ran 2 experiments to investigate at what stage of perceptual processing hemispheric asymmetries may occur. The first of these was a lexical decision task, where a fixation cross was displayed for 2000 ms before the stimulus was flashed for 160 ms to either the left or right visual field, before being masked by a “noisy pattern”. Two sets of 40 negative and neutral German words were used, all of which were controlled for length, number of syllables, and frequency. The results from this showed that negative items were shown to be discriminated better than neutral items, but there was no hemispheric advantage associated with valence.

Experiment 2 was identical to the first except that the words were presented in block capitals, at a vertical orientation (to minimize the words’ familiarity and deny ‘whole word’ access), for 175 ms. Negative words here were again discriminated better than neutral ones. A visual field x valence interaction was found which demonstrated that a RVF/LH advantage was shown for neutral but not negative words.

Parrott, Zeichner and Evces (2005) used 90 words – a selection of positive, negative and neutral – in a lexical decision task with 52 healthy subjects. A fixation cross was presented for 500 ms, and ISI of 200 ms, then the stimulus until response or 3000 ms. It was found that participants’ reaction times to anger words were significantly faster than to all other words, and that anger facilitation was significantly higher among participants with high trait-anger. This supports Bower’s (1981)

Semantic network theory which proposes that each emotion is like a node which is linked to all aspects of one's behaviour such as action, speech, etc. This would mean that high trait-anger individuals would be more likely to process cognitive biases towards anger-related stimuli without becoming angered.

In 2007, Lee and colleagues conducted a follow-up study to two earlier experiments, Wurm and Vakoch (2000) and Wurm et al. (2003). They approached the issue from the perspective of how the 'danger' and 'usefulness' ratings of words were associated with the approach and avoidance mindsets of participants. In 2003 Wurm et al. had conducted a single word naming task where subjects heard the words read by a male voice and were asked to repeat them into a microphone as quickly and accurately as possibly. This study investigated Murphy and Zajonc's (1993) Affect Primacy hypothesis: our unconscious mental system makes judgments about whether something is positive or negative. It also tested Bargh et al.'s (1992) assumption that the early evaluative process is extremely fast, automatic, and occurs as part of normal perception. The stimuli were the same as those used by Wurm and Vakoch (2000) – 200 nouns, half of which were selected at random and changed into pseudo-words by changing their vowels, rated for 'danger' and 'usefulness'. In addition to these a further 115 'highly recognisable' English words were used as filler items and all were controlled for, among other things, frequency and word length. Reaction times were shown to be significantly shorter in words rated as high danger and high usefulness. This is consistent with results from earlier LD studies, suggesting that semantic effects are present very early on in word recognition.

Lee et al.'s 2007 study employed the same stimuli as the previous two experiments. In this task participants heard target words presented auditorily in one ear and had to make a lexical decision. Amongst the many effects reported, it was found that participants were faster for HF, concrete, and usefulness words. There was also a significant interaction between danger and usefulness. Higher danger ratings were associated with faster RTs for words rated low on usefulness, but high danger ratings were associated with slower RTs for words rated high on usefulness. Also, increased danger led to significant facilitation for men only. Women showed an advantage on animate words, and for men there was an ear x animacy interaction.

Estes and Verges (2008) carried out LDT and valence judgments of 20 negative and 20 positive words. Relative to positive words, negative words elicited as slower LDT RT but a faster valence decision RT. From this, the authors concluded that negative stimuli do not lead to generalized motor suppression, but rather elicit selective responding with faster responses on tasks for which stimulus valence is response-relevant.

Emotive Decision Tasks

Another popular experimental method for investigating how we process emotion words has been the emotive decision (ED) task. Klauer, Roßnagel, and Musch (1997) conducted a set of two ED experiments in German. They wanted to investigate the claim made by Fazio, Sanbonmatsu, Powell, and Kardes (1986); and Hermans, De Houwer, and Eelen (1984) that the evaluative priming effect was eliminated when stimulus onset asynchrony (SOA) reached 1000 ms. In the first of these, a fixation cross was shown for 300 ms, then a blank screen for 200 ms, then the prime was presented for 200 ms. The target was presented until response or a maximum of 4 s at one of the SOAs (0, 100, 200, 600, or 1200 ms). Participants had to judge whether the words were positive (+) or negative (–), and feedback was given after each trial. Primes and targets were German adjectives denoting personality traits. Each subject received 5 blocks, each containing 12 +/+ pairs, 12 –/– pairs, 4 +/– pairs and 4 –/+ pairs (in a random order). Participants were asked to read both words but to respond only to the target. Here evaluation priming was found at prime-target SOAs of 0 ms and 100 ms but not at SOAs greater than 100 ms.

The second experiment tested specifically for a consistency proportion effect. Different groups were used for this experiment and worked with lists containing 25%, 50% and 75% of evaluatively consistent word pairs. A second between-subjects variable was prime-target SOA with levels of 0, 200, and 1200 ms. Other than these differences, everything was the same as in the first experiment. An effect of consistency proportion was found at SOAs of 0 and 200 ms, but not 1200 ms, when properties of the prime-target pairs were evaluatively related, and manipulated.

Earlier, Greenwald, Draine, and Abrams (1996) had investigated basic unconscious priming effects and their results suggested that unconscious priming effects were strong but short-lived. Klinger, Burton, and Pitts (2000) used this study as a starting point. In the first experiment they replicated Greenwald, et al.'s results in a blocked ED task measuring reaction time. Upon presentation of a fixation cross, participants were required to press both response keys simultaneously, causing the cross to be replaced by a black illuminated rectangle for 500 ms. A premask consisting of a letter string was then presented for 150 ms, followed by the prime for 50 ms, a post-mask letter string for 17 ms, and finally the target for 333 ms. The offset of the target signaled the start of a 133 ms response window. The words used here were the same polarized words (25 negative and 25 positive) and pseudowords used by Greenwald et al. On half the trials the prime and target were congruent, and on the other half they were incongruent. This was followed by a lexical decision task in which the same set of words plus an equal number of pseudowords were used. The results produced here matched those reported by Greenwald et al. (1996).

The second experiment was a LD task in which reaction time was measured. Conditions were the same as those in Experiment 1, but targets were presented for 300 ms rather than 333 ms (although this difference had no meaningful influence on the results). The words used in the first experiment, plus an additional 50 words and non-words, were used. Here, when participants judged the lexical status of target stimuli, only the lexical status of priming stimuli influenced target judgments. These results, together with those taken from the first experiment, show that when primes vary on the same dimensions as target judgments, priming stimuli influence target judgments.

The third experiment was the same as Experiment 2, except that half the words were semantically related, and the other half were not. The words used previously were replaced by 17 pairs of semantically related words which were matched for length. It was shown that as participants' conscious perception of the priming stimuli increased, the amount of priming influence did not change. This implies that the lexical status of primes was analyzed and influenced target judgments without corresponding conscious awareness of the lexical status of those primes. Also, inconsistent with previous findings, the semantic relatedness of prime and target words did not influence target judgments.

In the fourth experiment, the same procedure was again employed, this time with the participants deciding if the stimulus presented was living or non-living. The stimuli comprised of 12 nouns in each of the following conditions: positive affect, living; positive affect, non-living; negative affect, living; and negative affect, non-living. The semantic relatedness between prime and target word did not influence target judgments for dimensions of meaning that were irrelevant to the target judgment (even though subjects were obliged to judge the semantic qualities of target words). This is consistent with the claim that only response congruency effects are observed with the response window priming procedure.

Taken together, these results support the claim that word meaning can be unconsciously activated, but not that unconscious perception effects, as suggested by Greenwald et al., are caused by automatic spreading activation. They are, however, consistent with the claim that unconsciously perceived words trigger response tendencies that facilitate or interfere with target responding. They do point to a model positing priming of a specific response.

Dahl (2001) carried out two ED tasks to investigate asymmetries in the processing of emotionally valenced words. In the first of these, participants were shown a word which, depending on their assigned group, they either read or rated as negative, neutral, or positive within a 2000 ms response window. Subsequently, they were shown another word at either 20%, 50%, or 80% degradation and asked to decide whether it was the same one presented in the first part. In valence categorisation conditions, the words were shown for 1200 ms, but in read-only conditions, they were presented for 500 ms. Stimuli were 120 negative, 120 positive and 120 neutral words, plus an additional 180 neutral words for distracters and were controlled for frequency and word length (it is not specified whether this was done on an overall or on a stimulus-by-stimulus basis).

In the second experiment, the procedure remained the same but there was no neutral category – 120 words were divided into positive and negative categories, and an additional 120 neutral words were used as distracters. The positive and negative words were controlled for frequency and length. Words were presented for 900 ms and participants were asked to make a positive or negative judgment. Prolonged response latencies were shown for negative compared to positive words in a subsequent decision task when using an affective orienting task in both of the above experiments.

Tabert et al. (2001) carried out a basic EDT followed by a recognition task employing 30 unpleasant and 30 neutral words. Participants were presented with a set of three words and were asked to select most negative/threatening or most neutral/non-threatening. Each word presented twice and ERPs were recorded. Participants correctly recognized more negative than neutral words and also remembered more negative words in a subsequent recognition task

Other Tasks

In addition to LD and ED experiments, other methods have been used to investigate emotional word processing, particularly within the context of hemispheric bias. Van Strien and Luipen (1999) attempted to find a difference in accuracy of recall between threatening and non-threatening words. In their experiment, each word was displayed to the subject for 2500 ms in the centre of the screen and after a 1300 ms fixation interval, a 3-letter stimulus was presented unilaterally for 110 ms. The participant had to immediately recall the word and the 3-letter stimulus. In a baseline condition, a string of 9 uppercase 'X's were presented instead of a word, and participants only had to recall the 3-letter stimulus.

It was shown that overall there was a right visual field (RVF), or left hemisphere (LH), advantage and that performance was better for control than negative word presentations, but there was a failure to replicate previous findings (Van Strien and Morpurgo, 1992) of right hemispheric (RH) facilitation as a consequence of the concurrent presentation of threatening words. In the blocked condition, participants who were shown the non-threat condition first showed a RVF/LH advantage which continued throughout the task. Those who were presented with the threat condition first only showed a RVF/LH advantage in the final block.

Kakolewski, Crowson, Sewell, and Cromwell (1999) wanted to investigate the hypothesis that the right hemisphere showed a bias in processing negative information, while the left hemisphere showed a bias in processing positive information. They used a vertical partition to split the viewing areas to inhibit exposure contralaterally to alternate retinal fields in cases of off-target fixations. They presented the fixation cross for 1 s, followed by 100 ms of blank screen, then a pair of words for 730 ms, replaced by coloured bars (red, blue, or green), and asked participants which bar they thought appeared first. There were three groups of 36 words (euphoric/dysphoric, euphoric/neutral, neutral/dysphoric). The presentation of these words was counterbalanced, and pairs were presented in a random order. Words were selected from a list compiled by Myers (1980). Finally, participants were asked to write down all the words they could remember seeing in a free recall task. A depressed group (those scoring above 16 on the Beck Depression Inventory (BDI)) and a non-depressed group (those scoring between 2 and 3) were used. Results showed that participants identified coloured bars following euphoric words presented to the LH (RVF) more often than when they were presented in the RH (LVF). Also, non-depressed participants made identifications following euphoric words more often than depressed ones.

Enole, Ilardi, Atchley, Cromwell, and Sewell (2001) followed on from the work of Kakolewski et al., also dividing the screen using a vertical partition. A blank screen was shown for 3 s, then one fixation cross was shown on each side of the partition in the center of the screen. After 1 s, a pair of adjectives of positive (P) or negative (N) polarity were presented, one on each side of the screen (either P-P, P-N, N-N or N-P). The words were matched for length and frequency. There were 18 trials for each word pair combination, the words and crosses were shown together for 730 ms. Finally different coloured bars appeared on each side of the screen masking the words and crosses – participants were required to say which colour of bar they perceived coming onto the screen first. A depressed group (diagnosed with a major depressive disorder), a remitted group (in remission, having had a previous depressive episode, but not within the previous month), and a control group were used.

Overall, positive words were selected more quickly when presented in the RVF, and negative words were selected more quickly when presented in the LVF. The effect was significant only for the non-depressed control group, although the remitted group showed an overall similar pattern. The depressed group showed a pattern in the opposite direction for positive words. These results suggest that the valence-effect theory (e.g., Davidson, 1993), that the left hemisphere is specialized for the processing of positive material and the right for the processing of negative material, is applicable for the normal population. It is less clear what is happening with depressed individuals.

Fox, Russo, Bowles, and Dutton (2001) presented a prime (positive, negative, or neutral) then a target in differing positions with respect to a fixation cross. The fixation cross was presented for 1000 ms, the prime for 100 ms, with a 50 ms ISI before presentation of the target. Participants had to decide if the target was on the same or different side of the fixation cross than the prime. The authors found that on valid trials (same side) the prime facilitated the judgment regardless of emotionality. On invalid trials, however, targets were identified more slowly when the prime was negative than when it was neutral or positive. They suggested that attention disengages slowly from a negative stimulus, rather than being attracted more quickly to a positive one.

Ortigue et al. (2004) utilized 112 letter string stimuli, all of which were 4-7 characters long. These included: 8 emotional French abstract nouns (of both negative and positive valence), 8 neutral French nouns; and 96 non-words (produced to have structures resembling the nouns used). The 8 emotional and neutral words were rated by a separate group and were controlled for frequency. Letter-strings were presented in pairs, one either side of a central fixation point. Each word was repeated three times and appeared with a non-word, and could appear, with equal likelihood, on either side of the screen. The same type of word never appeared on more than three consecutive trials and stimuli were presented for 13 ms. Participants pressed the right or left button corresponding to the word's screen position, or no button if both letter strings were non-words. The ISI varied randomly from 1500 to 2000 ms. Participants completed 5 blocks, each containing 120 trials while ERPs were recorded. Participants performed better with emotional words and with words appearing in the RVF. There was also a slight interaction, indicating that LDs to neutral words were more affected by word position than were those with emotion words. This emotional word advantage was also shown to be higher for words presented in the LVF than for those presented in the RVF.

Smith and Waterman (2005) presented 50 male and 50 female participants with words taken from the MRC psycholinguistic database, matched for length and frequency, in a Stroop task. The words used were 20 direct aggression, 20 indirect aggression, 20 positive, 20 negative, 20 neutral, and 20 colour words. These were independently rated for aggression with a Kappa coefficient of 0.7. A fixation cross was presented to subjects for 500 ms, followed by the target word in red/green/blue until the participants vocally responded.

Participants were slower on aggression than emotion words, and slower for negative than positive words. Males were significantly slower on direct aggression words, while females were slower on indirect aggression words (but not significantly). Physical aggression was found to be the best predictor of Stroop interference on direct aggression words, and verbal aggression the best predictor of interference on indirect aggression words.

Sim and Martinez (2005) asked 62 healthy participants to recall words presented to them. Thirty two positive and 32 negative words, controlled for length, word frequency, and syllable length, were presented auditorily either to the participants' left or right ear before an arithmetic distracter task. More emotion words which had been presented in the left ear (right hemisphere) were recalled, while more neutral words which had been presented in the in right ear (left hemisphere) were recalled.

Harris and Pashler (2004) and Aquino and Arnell (2007) both employed digital parity tasks, where two numbers are presented on either side of a central word and the participant must decide if they are both odd or even. Harris and Pashler used stimuli taken from McKenna and Sharma's (1995) data set consisting of 27 'emotionally charged' words, and found that RT slowed only with the first presentation of a negative word.

Aquino & Arnell (2007) presented 25 neutral, 25 threat, 25 sexual and 25 'school' words randomly, each repeated once over two blocks. They displayed a fixation cross for 500 ms, a blank screen for 500 ms, then the stimuli until a response was made. Only the sexual words, relative to all other word categories, led to an increase in parity RTs (but only in the first block). There was no such effect for threat words. Afterwards, the participants were asked to rate the words for valence and arousal. Arousal and not valence ratings predicted the parity RTs.

Schutzwohl and Borgstedt (2005) used a modified dot-probe task to investigate 68 healthy participants' responses to 30 pleasant and 30 unpleasant words from 'sport' and 'animal' categories. Two words appeared one above the other, and a dot appeared 0.5 cm above or below the word. The stimuli remained on the screen until response or for 1500 ms. SOA times were 0, 500, 1000, or 1500 ms. Participants rated their surprise after seeing the words on each trial. RTs were found to be significantly longer in unpleasant than pleasant conditions. It should be noted that these results were possibly influenced by category effects and so not much confidence should be placed in the assumption that the effects reported were only due to the effect of valence.

Kanske and Kotz (2007) had participants attend to words. They displayed a lateralized presentation of concrete and abstract positive, negative, and neutral words, with each word type blocked and repeated once while ERPs were recorded. They found shorter RTs for concrete words and words presented in the LH, as well as shorter RTs for positive than negative words, and for negative than neutral words. There was also an interaction of concreteness and emotion. The difference between positive and negative words was significant only for concrete words.

Lewis et al. (2007) used fMRI while participants were shown emotional words (taken from the ANEW database) and were asked to indicate by pressing a button whether the word could refer to themselves. There was a significant correlation between valence and self-description, indicating that participants tended to respond 'yes' for more positive information. No effect of arousal was shown.

Table 1.1: Summary of Main Behavioural Literature Findings Concerning Emotion Words

Authors	Year	Findings
Klauer, Roßnagel, & Musch	**1997**	Experiment 1: Evaluation priming was found at prime-target SOAs of 0 ms and 100 ms but not at SOAs greater than 100 ms; Experiment 2: effect of consistency proportion was found at SOAs of 0 and 200 ms, but not 1200 ms, when properties of the prime-target pairs were evaluatively related
		Experiment 2: effect of consistency proportion was found at SOAs of 0 and 200 ms, but not 1200 ms, when properties of the prime-target pairs were evaluatively related
Van Strien and Luipen	**1999**	In a recall task, advantage of control vs. negative words, and RVF vs. LVF
Kakolewski, Crowson, Sewell, and Cromwell		Participants identified coloured bars following euphoric words presented to the LH (RVF) more often than when they were presented in the RH (LVF)
Wentura	**2000**	Significant congruence effect in affective priming task
Wurm and Vakoch	**2000**	Shorter RT for repeating high danger and high usefulness words
Klinger, Burton, and Pitts	**2000**	Experiment 2: when participants judged the lexical status of target stimuli, only the lexical status of priming stimuli influenced target judgments
		Experiment 3: as participants' conscious perception of the priming stimuli increased, the amount of priming influence did not change
		Experiment 4: The semantic relatedness between prime and target word (positive affect, living; positive affect, non-living; negative affect, living; and negative affect, non-living) did not influence target judgments for dimensions of meaning that were irrelevant to the target judgment
Dahl	**2001**	In a degraded identification task after attending to a word prolonged latencies for negative vs.positive words
Tabert *et al.*	**2001**	Participants correctly recognized more negative than neutral words in an EDT, and remembered more in a subsequent recognition task
Enole, Ilardi, Atchley, Cromwell, and Sewell	**2001**	Positive words were selected more quickly when presented in the RVF, and negative words were selected more quickly when presented in the LVF
Fox, Russo, Bowles, and Dutton	**2001**	On valid trials (prime on same side of fixation cross as target) the prime facilitated the judgment regardless of emotionality. On

		invalid trials, however, targets were identified more slowly when the prime was negative than when it was neutral or positive
Windmann, Daum and Güntürkün	**2002**	Negative items discriminated better than neutral items in LDT, RVF/LH advantage shown for neutral words when stimuli presented vertically, capitalised for 175ms
Wurm *et al.*	**2003**	Shorter RT for repeating high danger and high usefulness words
Ortigue *et al.*	**2004**	There was also a slight interaction, indicating that LDs to neutral words were more affected by word position than were those with emotion words
Harris and Pashler	**2004**	Disparity task: RT slowed only with the first presentation of a negative word
Parrott, Zeichner and Evces	**2005**	In LDT longer RTs to anger words
Smith and Waterman	**2005**	Participants were slower on aggression than emotion words, and slower for negative than positive words in an emotional stroop
Sim and Martinez	**2005**	More emotion words which had been presented in the left ear (right hemisphere) were recalled, while more neutral words which had been presented in the in right ear (left hemisphere) were recalled
Schutzwohl and Borgstedt	**2005**	RTs significantly longer in unpleasant than pleasant conditions in a modified dot probe task
Lee *et al.*	**2007**	Faster RT for repeating high danger words low on usefulness, slower RT for high danger words high on usefulness
Aquino and Arnell	**2007**	Disparity task: Only sexual words, relative to all other word categories, led to an increase in parity RTs (but only in the first block)
Kanske and Kotz	**2007**	Shorter RTs for concrete words and words presented in the LH, as well as shorter RTs for positive than negative words, and for negative than neutral words. There was also an interaction of concreteness and emotion
Lewis *et al.*	**2007**	significant correlation between valence and self-description, indicating that participants tended to respond ‘yes’ for more positive information
Estes and Verges	**2008**	Negative words produced a slower LDT RT but a faster EDT RT than positive words

Theoretical Explanations

Overall the behavioral results, regardless of methodology, generally show a processing advantage for emotional over neutral textual stimuli. Some show the advantage specifically for positive over neutral words (e.g., Kakolewski, Crowson, Sewell, & Cromwell, 1999; Kanske & Kotz, 2007) and others for negative over neutral words (e.g., Ortigue et al., 2004; Tabert et al., 2001; Windmann, Daum, & Güntürkün, 2002). Those which have included both negative and positive words in their stimulus set tend to show an advantage for positive over negative words (e.g., Bernat, Bunce, & Shevrin, 2001; Dahl, 2001).

Despite the many reservations expressed about the stimuli used, and the methodologies employed (described in the 'stimuli' and 'methodology' sections of this introduction) these studies represent the bedrock of our accruing knowledge of emotion word processing. Each study presented emotion words (at least by their own definition) in isolation. The behavioural data gathered in such ways over the past decade have shaped the theories which currently drive emotion word research and serve as the basis for examining emotion word research using brain imaging, words integrated into contexts and, more recently, eye tracking.

Although many interpretations of these effects have been superficially disparate, common foundations can often be identified. One long-standing but still popular explanation for why negative words are sometimes found to be responded to faster than neutral words is because they represent a threat or danger and are therefore prioritised by some mechanism in our brain, speeding up their processing. On the other hand, the explanation for why negative words are responded to slower is because of an evolutionary 'perceptual defense' mechanism (e.g., McGuinnies, 1949) which shields us from the detrimental effects of these words, increasing our response time.

These two opposing explanations are similar if one assumes that defense necessitates prior recognition. If there are two discrete stages – recognition and evaluation – then these behavioural differences can be reconciled. In his 2001 paper, Dahl pointed to two similar theories which attempt to further detail McGuiness's original perceptual defense mechanism – Pratto & John's (1991) Automatic Negligence Function (ANF) and Taylor's (1991) Mobilisation-Minimisation hypothesis.

The ANF proposes simply that because of their increased 'danger' content, negative words require additional cognitive resources in order to be processed than do positive or neutral words. The Mobilisation-Minimisation hypothesis subdivides the progression of processing into two stages. It states that, no matter the nature of the stimuli or situation, the initial mobilisation stage of processing is associated with strong physiological and cognitive responses if the stimulus is negative. This pattern is then reversed in the second minimisation stage in order to diminish the effects of the negative stimulus or event in the long term.

The results from Dahl's two word detection experiments support the Mobilization-Minimization hypothesis. Participants were required to either read words or categorise them (positive, negative or neutral) before deciding whether a subsequently presented degraded stimulus was the same word or not. Dahl found significantly prolonged latencies for negative words vs. positive words when an affective orienting task (rather than a non-affective orienting task) was used. This was consistent with the prediction that negative stimuli would occupy more cognitive resources than positive stimuli. It must be considered, though, that the negative stimuli may have been semantically more complex and therefore demanded more cognitive resources (Peeters & Czapinski, 1990); or that there was a differentiation in the semantic context where negative words were perceived as more important (Lazarus, 1991). The poor control of stimuli across many other experiments makes it difficult to rule out such alternative explanations and to draw conclusions from the literature as a whole.

Rather than focusing on the effect of the negative stimuli on participants, Kakolewski et al. (1999) posit 'euphoric bias' in normal individuals to explain their results. This is essentially an extension to the defensive self-serving attribution of 'unrealistic optimism' (e.g., Harris, 1996; Klein, 1996). The basis of this viewpoint is that the natural human condition is one of optimism, where the individual is overly optimistic, focusing more on positive stimuli and processing positive stimuli more quickly. This theory explains both why depressed individuals are more 'pessimistic' (actually realistic) than healthy individuals and why they fail to show a positive word bias in tasks such as the LDT and EDT.

The diversity of explanations suggested for what have been essentially similar findings produced over a decade demonstrates the importance of continuing investigation into this area using more controlled and thought-out paradigms. Particularly, it would be of help to utilize methodologies which are capable of reflecting different stages of processing in real time. Despite the fact that there is general accord between many of the above studies, the inconsistency in experimental designs means that the relatively few number of conclusions reached thus far is poor return for all the time and effort recently directed towards emotional word processing. This issue is itself just the first step in the potentially vast area of emotional language processing, and it is imperative that a solid foundation is laid at this early stage. As stressed before, it must be agreed upon what are acceptable measures for the emotional content of words, and stimuli used in experiments must be much better controlled than many have been in the past.

Schutzwohl and Borgstedt (2005), for example, investigated the processing of positive and negative words while also grouping their stimuli into the categories 'sports' and 'animals'. Whatever results the study produced would then have to be considered severely confounded by additional category effects. Many results could, and should, also be dismissed due to the unrecognised effects of stimulus repetition and lack of stimulus control in terms of psycholinguistic variables.

There has also been no attempt thus far to define the temporal locus of the effect of emotion and thus to tie any theory into the wider framework of word processing in general. It is still not known if this occurs in the early information processing stream or if it is delayed until a decision point. At this point, we cannot even be sure that it is the same system being influenced by positive and negative words, or that the variables of arousal and valence are inherently related in terms of their influence on the processing mechanism.

As mentioned earlier in this chapter the two-dimensional approach of breaking down emotional words by their constituent 'arousal' and 'valence' properties is just one of the approaches which can be seen in the literature as researchers diverge into all manner of sub-investigations and related inquisitions.

Kissler, Assadollahi and Herbert (2006) report that Osgood et al. (1957) were the first to effectively demonstrate a dimensional approach to emotion word processing. They assessed the affective connotations of words differing on 3 dimensions: evaluation, potency, and activity. They used a three-dimensional semantic differential technique and factor analysis to find that the first two factors accounted for the majority of variance (Kissler et al.'s Fig 1, p. 148).

This dimensional approach and, indeed, these specific dimensions, were at the core of similar theories of affect which would surpass that of Osgood and his colleagues. In 1979, Lang carried out a similar experiment using the dimensions of valence, arousal, and dominance and found the first two to be most important. It was as a result of this study that it was first shown that emotional pictures, sounds and words cluster in a U-shape on a 2-D graph of valence and arousal (Kissler et al.'s Fig 2, p. 149). Words have been assessed and published in this way ever since, the most celebrated being Bradley and Lang's (1999) ANEW database, but there is a general feeling that results for words are more restricted than those for pictures.

Russell (1980) proposes that this blunting of affect when stimuli is textual makes sense when approached from an evolutionary point of view such as that touted by proponents of McGuiness's perceptual defence theory, and that of its successors. If we view emotions as universal and old, and relating to those primal areas of the brain necessary for evolution and survival, then they should be more attuned to pictorial stimuli such as scenes and faces than a relatively new specialisation such as writing.

Reading is sometimes seen as a secondary process which utilizes the processing capabilities of earlier, more basic systems once visual analysis of the word form is complete. If this is the case, if the linguistic areas of the brain draw on the resources of the more basic regions honed to perceptual defence, it is intuitive that any lag in processing time would result in a dulling of effects. Such an area is still wide open to investigation. At this point in time it is uncertain how the 'emotional' and 'linguistic' areas of the brain interact. Some suspect emotional connotations to be linked to linguistic expressions in semantic networks (Bower, 1981; Lang, 1979), while others think they are represented in dynamic networks relating to ideas or objects, different parts of which can be differentially activated (e.g., Pulvermüller, 1999). It has been proposed that emotion areas of the brain might be included within semantic circuitry much like how motor areas and mirror neurons are activated when body movement verbs are heard or produced (Pulvermüller, 2001).

Top-Down Approach: Grounded Cognition and Situation Models

Much has been made in this introductory chapter of the need to better control the definitions of 'emotion words', and the stance adopted by the majority of researchers to conform to the use of the two factors of arousal and valence as the central components of classification. While this is necessary for progress to be made, it focuses the mind of the researcher towards contemplating features of the stimulus rather than how it is represented in the mind of the participant. A novel way of approaching the question of emotion word processing is from the perspective of embodied – or grounded – cognition. This concept (although not new, as its origins can be traced back to the thinkers of Ancient Greece) has been enjoying a revival in recent years championed by Barsalou (who summarises progress in his 2008 review).

A number of similar formal theories have been proposed (e.g., Barsalou, 1999). Proponents of such theories make a case against traditional concepts of objects, events, etc. being represented cognitively as amodal symbols in a modular system They argue instead that modal simulations, bodily states and situated action underlie cognition. Their premise is that when an object (e.g., a chair) is 'experienced' everything about it will be stored in the relevant cognitive areas. The appearance of the chair will be stored in the visual system; the act of sitting will be engrained into the motor system; the word 'chair' will be activated in the language system, etc. Associations of relaxation and comfort will also be stored. In this way the concept of 'chair' takes on not a 'mental image' of a chair in one's mind, complete with an attached list of features and affordances, but a 'functional web' (Pulvermüller, 2002) of neurons representing every aspect of the chair and our experience of it.

The majority of grounded cognition accounts focus on the roles of simulation in cognition. They state that an object (e.g., a chair) is not represented as a symbol but rather as 'simulation' or re-enactment of the perceptual, motor and introspective states acquired during initial experience (whether it be with the world, body, or mind). It is assumed that cognitive and bodily states can cause and be caused by each other (e.g., Barsalou *et al*., 2003, Lakoff & Johnson, 1980), and that objects and events are stored in a multimodal fashion in memory.

Other accounts of grounded cognition focus more on situated action, social interaction and the environment (e.g., Barsalou *et al*., 2003), arguing that the cognitive system evolved primarily to support goal attainment through interaction. Such theories can involve processes based on "mirror neurons" (e.g., Hauk, Johnsrude and Pulvermüller, 2004). An example of their application is simulating pain to experience someone else's pain, thus producing empathy and an ability to see things from the other's perspective (Decety & Grèzes, 2006).

All these theories, though, are based on the assumption that cognition is 'grounded' in multiple ways (i.e., simulations, situated actions, bodily states). Several of these theories will now be discussed, with a particular emphasis on Barsalou's (1999) theory of perceptual symbol systems (PSS).

Barsalou (1999) devised the theory of PSS in which the grounded theory implemented symbolic functions usually associated with traditional theories. The basis of the PSS is that, when an object is perceived, several of its features are stored in long-term memory (LTM) through selective attention and function symbolically to constitute the representations that underlie cognition. This theory was based on Barsalou's 6 'core properties'. The first property is that the symbols involved in neural representations in sensory-motor systems are records of the neural states that underlie perception. The suggestion is that the neural systems common to imagery and perception also underlie conceptual knowledge. The second property is that perceptual symbols are dynamic rather than discrete, and so are not merely stored and represented as a single, rigid symbol. The third property is that multimodal perceptual symbols can occur from any sense or introspection (e.g., textures and temperatures from touch, perceptual symbols for hand and body movements and positions) and are stored in the relevant modal area of the brain. The fourth property is that perceptual symbols in LTM become organised together into a simulator so that the cognitive system can construct specific multi-modal simulations of an event or entity even in its absence. Such a simulator would contain 2 structural levels: an underlying frame to integrate perceptual symbols across category instances; and a potentially infinite set of simulations that can be constructed from the frame. The fifth property is that these frames are integrated systems of perceptual symbols that are used to construct specific situations of a category. The sixth and final property involves linguistic indexing and control. It states that linguistic and perceptual symbols develop together and become associated with each other. Once simulators for words become linked to simulators for concepts, Barsalou suggests they can be used to control situations, and provide a powerful means of constructing simulations that go beyond an individual's experience.

Based on these properties, Barsalou (1999) states: "*By parsing perception into schematic components and then integrating components across individuals into frames, simulators develop that represent the types of entities and events in experience. The result is a basic conceptual system.*" (p.592) Thus, he inferred, his PSS allows individuals to use combinatorial and recursive mechanisms to construct an unlimited number of complex representations from a finite number of symbols. Using this ability individuals are able to describe and interpret situations, combining concepts productively to form hierarchical structures, and map these structures onto objects in the world.

Other researchers have also attempted to assemble theories of grounded cognition. Glenberg (1997) based his theory on memory. He proposed that memory's main function was to control situated action. In his theory memory patterns reflect bodily actions and are able to mesh with situations during the pursuit of goals. Rubin (2006) expanded on this with his basic systems theory in an attempt to explain what he called 'more complex' memory phenomena that exist outside the laboratory. These include autobiographical memory and oral history which cannot be accounted for by traditional theories of memory cf. Conway, 1992). This theory proposes that a complex memory contains many multi-modal components (e.g., vision, audition, action, space, affect, language, and others) and that retrieving a memory involves the simultaneous simulation of all its multi-modal components.

The grounded-cognition theories thus far put forward are, by their own admission, largely descriptive. This has meant that so far there is a limited amount of empirical evidence to support any one theory. Nevertheless, there is evidence which should encourage proponents of grounded cognition as it supports many of their founding principles. Below, research from the areas of perceptual inference, perception-action coordination, memory, knowledge and conceptual processing, social cognition, and language comprehension is summarised.

In 1995, Goldstone demonstrated participants could build up association between colours and shapes under laboratory conditions. Later, Hansen *et al.* (2006) showed similar effects with objects and their natural colours (e.g., 'banana' and 'yellow'). These demonstrated that states of perceptual systems become stored in memory during perception, and can later produce inferences that go beyond perceived stimuli. Additional evidence comes from Freyd (1987) who reported that people falsely remember the anticipated motion of an object.

Tucker and Ellis (1998) demonstrated grounded cognition in perception-action coordination by presenting participants with a picture of a cup and finding interference on a grasping task. Simply being presented with an object name can produce stimulation in 'grasping' areas. Pulvermüller *et al.* (2006) showed that hearing a word activates articulatory associations. It has also been demonstrated that locating objects in space around the body can be more or less difficult depending on their position. Those lying on the vertical axis are most salient, with front to back next most salient, and left-right least salient (Franklin & Tversky, 1990).

Schacter and Addis (2007) claim that simulations are central to the construction of past and future events in conscious memory. In 2000, Wheeler, Petersen and Buckner presented participants with words either visually or auditorily, and found that at the time of retrieval, only zreas specific to the mode of prior presentation became active. Furthermore, activation was greater for real memories than for false memories.

It is the suggestion of grounded cognition theorists that simulation is the basis for knowledge representation. In support of this claim it has been shown that lesions in a particular modality increase the likelihood of individuals having processing difficulties in categories that rely upon those modalities (e.g., motor and 'tools', visual and 'animals'). Further supporting evidence has been supplied by neuroimaging techniques. Simmons *et al.* (2005) showed that when participants activated the concept of food, their gustatory areas became active.

The effects of grounded cognition on social cognition have long been known. Embodiment effects, for example, are bodily states or effects produced by social cognition (e.g., 'elderly' as a prime results in a slowing of response time; Dijksterhuis & Bargh (2001). Facial expressions (e.g., smiling or frowning) have also been shown to produce associated mental states, and slumping produces negative affect (e.g., Stepper & Strack, 1993). It was suggested by Barsalou (2003) that such effects reflect a pattern-completion inference mechanism that supports situated action in which representations of familiar situations that contain embodiments become established in memory

Most relevant to this thesis is the effect of grounded cognition upon language comprehension. In 2004, Zwaan developed his theory of the 'immersed experiencer' which focussed explicitly on this area. There has previously been a range of evidence to demonstrate the importance of grounded cognition to language comprehension. Zwaan points out that words have been shown to activate brain regions that are close to, or overlap with, brain areas that are active during perception of actions involving words' referents (e.g., Martin & Chao, 2001). Visual representations of object shape and orientation are routinely and immediately activated during word and sentence comprehension (e.g., Dahan & Tanenhaus, 2002). Information that is present in the situation described in a text is more active in the comprehender's mind than information not in the situation (e.g., Glenberg, Meyer & Lindem, 1987). When comprehending language, people's eye and hand movements are consistent with the perception or action of a described situation (e.g., Klatzky, Pellegrino, McCloskey, & Doherty, 1989).

Additional evidence comes from Potter *et al.* (1986) who showed that replacing text with pictures did not disrupt sentence processing, indicating that readers take on perspectives of scenes described in texts. It has also been shown that individuals simulate motion through space as they read text. Richardson *et al.* (2003) found that readers simulate horizontal and vertical paths implied by both concrete and abstract verbs (e.g., push vs. lift, argue vs. respect). Finally, affective simulation has been associated experimentally with language comprehension. Skin conductance has been shown to be higher for both taboo words and reprimands read in participants' first- than later-learned language (Harris *et al.*, 2003). Havas *et al.* (2007) showed that comprehension was better when facial emotion matched sentence emotion, and Barrett (2006) suggested that affective simulation underlies the conceptualisation of emotion that occurs in comprehension and other processes. The work by Zwaan (2004) on perceptual simulation is also relevant here, and provides much of the body of work which supports grounded cognition in language comprehension.

Zwaan (2004) proposes that language provides cues for the reader (or listener) to have an 'immersed experience' and formalises this through the Immersed Experiencer Framework (IEF). This comprises three overlapping stages: the activation stage which deals with comprehension at the word level; the construal phase which deals with comprehension at the clause level; and the integration phase for the discourse level.

There are several assumptions upon which the IEF is based. Zwaan specifies that the linguistic input stream is segregated into discrete units which are sequentially integrated with the contents of working memory. It therefore follows that comprehension is incremental. Zwaan states that information which is current and relevant is stored in an 'active state', thus influencing the incoming information at the integration level. It is in this way that comprehenders are able to engage with language stimuli by having an immersed experience.

The experience that is built up is one based in grounded cognition: for every word processed and integrated, everything related to that word – semantic meaning, perception, motor associations, etc. – is activated. As the comprehender is engaged in the immersed experience, the context in which they find themselves will not only influence their interpretation of events, but the information available to them.

In a narrative, for example, the perspective of the immersed experiencer will be akin to that of the protagonist. Anything visible or relevant to the protagonist, therefore, will be more available to the comprehender, and of more influence in the integration of new information. The perspective of this immersed experience is also affected by the type of language used: distance will be different, for example, when watching a mouse approach a hedge than watching a tractor approach the same hedge. Verbs also affect the experience: if the protagonist 'went', she is moving away, but if she 'goes', she is moving towards. As in real life (Franklin & Tversky, 1990, discussed above), the orientation of the protagonist is important, and objects lying on the protagonists axes (e.g., front-back vs. left-right) will be more or less salient to the immersed experiencer.

There are several further examples of comprehenders having an immersed experience which is based in grounded cognition. Hauk, Johnsrude and Pulvermüller

(2004) used fMRI to show that when reading verbs, pre-motor areas are sometimes active (see also TMS evidence from Buccino *et al*., 2005). Glenberg and Kaschak (2002) had participants read sentences describing the action of moving an object either away from or towards the body. Participants were faster to judge whether such a sentence was meaningful when the action of pressing the response button was congruent with the action in the sentence ('pushing' or 'pulling', e.g., '*he closed the drawer*'). A subsequent experiment in the same paper found similar effects when more abstract terms were used, e.g., the transfer of information ('*I told him the story*').

This demonstrates not only the link between language and grounded cognition, but the fact that not just literal, but more abstract meanings of language can influence our bodily states. Just as Glenberg & Kaschak (2002) found the flow of information, as conveyed through language, impacted on bodily responses, so too can relatively abstract associations of emotion words influence their processing, or at least the response to them under certain conditions. Lakoff and Johnson (1980, 1999) proposed that abstract concepts are grounded metaphorically in embodied and situated knowledge. Extensive linguistic evidence across languages shows that people talk ubiquitously about abstract concepts using concrete metaphors. One such metaphor – which will be addressed more thoroughly in Chapter 3 – associates 'good' with 'up' and 'bad' with 'down' (e.g., *good* souls go *up* to heaven, *sinners* go *down* to hell).

Zwaan's (2004) theory is not only based on grounded cognition, but also on the concept of situation models. The theories mentioned above have attempted to explain our processing of emotion words by dealing with the words themselves as individual, isolated units: elements which share common features but which are unconnected to each other or, for the most part, to the text surrounding them. Zwaan and Radvansky (1998) saw language as a set of processing instructions on how to construct a mental representation of the described situation. They assume that readers construct situational representations (of the state of affairs described in text) in conjunction with text-based representations. Such models are more than collective inferences. Johnson-Laird (1983) described them as amalgamations of inferences and information stated explicitly in the text, and claimed they can incorporate temporal, spatial, causal, motivational, personal and object-related information.

Van Dijk and Kintsch (1983) set out a number of reasons why situation models are essential for our understanding of language. Firstly, they are needed to integrate information across sentences. They explain that new tokens are set up for a character and new information added to that token based on grammatical and world knowledge. In support of this, Hess, Foss and Carol (1995) found that the speed with which the last word of a sentence is named depends on how well it can be integrated with the current situation model. Models also explain similarities in comprehension performance across modalities. Baggett (1979) found support for this when his participants reported similar recall after either viewing a short film or hearing a spoken account. Situation models are also needed to explain translation: e.g., to correctly translate gender pronouns and figures of speech; and to explain how people learn about a domain from multiple documents. Finally, situation models account for effects of domain expertise on comprehension. Schneider and Korkel (1989) conducted a reading study using soccer experts and novices, and found that those with high knowledge had an easier time assembling a situation model than the unfamiliar novices.

One attempt to formalise the construction of situation models is the event-indexing model (Zwaan, Langston & Graesser, 1995). It states that events key to integrated situation models can be indexed on the 5 events of time, space, causation, motivation and protagonist. An event is more easily integrated when it shares more indexes with the existing model. The current goal of the protagonist, for example, is held in short-term working-memory (STWM) until an event occurs by which it is satisfied. 'Foregrounding' is where a retrieval cue is placed in the STWM until something is satisfied (this can over-ride world knowledge).

Zwaan and Radvansky (1998) state two general theoretical issues involved in the construction of situation models: the relationship between linguistic cues and world knowledge, and the multidimensionality of situation models. Gernsbacher (1990) described language as a set of processing instructions on how to construct a situation model. She said that this interacted with world knowledge to focus attention on certain factors. She made the comparison to cinematography where gimmicks such as angles and lighting emphasise certain objects and place certain objects in the foreground, explaining that a variety of linguistic devices are capable of foregrounding information. Some researchers have assumed, when studying multidimensionality, that dimensions are equally weighted. Typically, though, they have been studied in isolation. Spatial information, for example, may be more difficult to integrate and therefore is not processed as deeply as temporal information. This is one question which remains unresolved.

Just as evidence abounds for grounded cognition as the basis for language comprehension, so is there a wealth of support for the information model. A more complete review is provided in Zwaan and Radvansky (1998), but a few key studies are highlighted below.

Glenberg *et al*. (1987) had participants read stories about objects that were spatially associated, but not with the protagonist. They found response latencies to be longer in disassociated than associated conditions even when the distance in text was the same. Morrow *et al*. (1989) had participants memorise a map of a building and object locations before reading a story about a protagonist moving around the said location, together with an occasional object probe. It was found that response time was mediated by distance from protagonist to object. On a similar topic, De Vega (1995) found that people took longer to read text when spatial information was inconsistent, indicating that spatial situational models were constructed during comprehension

Singer *et al*. (1992) reported quicker response times to questions (e.g., does water extinguish fire?) when an inference had previously been made in reading (i.e., after reading that a bucket was poured on fire rather than put beside fire). Myers (1987) explained that moderately related pairs lead to best recall because readers are both enabled and necessitated to generate connecting inferences. Additional support was provided by Duffy, Shinjo and Myres (1990) who found that participants spent less time writing a connecting sentence between 2 moderately related sentences vs. strongly related sentences. Finally, Zwaan, Magliano and Graesser (1995) found that the likelihood of readers regarding a pair of verbs as related increased almost linearly with the number of indexes they shared, based on their index model.

Both grounded cognition and situation models – concepts which are both in their infancy relative to the established and accepted models concerning language comprehension – have the potential to have influence over, and explain, many of the findings presented in this thesis. Grounded cognition theory has particular relevance for Chapter 3 which focuses on the attention capturing properties of emotion words. The remainder of the thesis – particularly some of the latter chapters – will not deal exclusively with the processing of emotion words, but also with ‘spill-over’ effects on subsequent words. This will be examined after both single emotion words and sentences containing several emotion words.

By considering the processing of emotion words – as defined by arousal and valence – in terms of embodied cognition, a number of explanations for thus-far ambiguous phenomena may present themselves. This is something which has not been taken into account, to the author's knowledge, by recent mainstream research into emotion word processing. Of perhaps even more relevance to the majority of the work undertaken here, however, is the burgeoning literature on situation models. These have the potential to explain any effects found on words presented subsequently to emotion words (or emotional phrases or sentences) and will play a key role in interpreting the effects found in the upcoming chapters.

The Current Thesis

Despite the need for more heterogeneity in the research, it seems enough has been shown to warrant a deeper inquiry into what role the two dimensions of arousal and valence play in word processing and its effects. Indeed, because behavioural results reported have been more or less consistent across such a diverse range of methodologies it seems unlikely there is not a genuine effect, and this being so, it would be unwise to abandon such a line of pursuit at this crucial stage.

Of import here, therefore, will be theories concerning the influence of arousal and valence on word processing. To recap, arousal is the extent to which a word is arousing/exciting (or calming), and valence is the degree of positivity or negativity associated with the word. This thesis will not be concerned with synonyms of emotional states, nor subcategories of emotions which share the same valence (e.g., relief and joy: Shah et al., 2004). The effect of arousal and valence will be investigated from a low to a high level, starting with individual word presentation and ERP recording and ending with complete paragraph presentation and the assessment of attitudes. By the end, the role of the emotional content of a word will be more fully understood not only in terms of how that individual word is processed, but also how it, in turn, influences other text in a natural context and how it impacts upon our cognitions and attitudes.

Over the course of this thesis, the manner in which we process emotion words and the impact they have upon us will be investigated. The purpose of the investigation will be to determine not only how the emotional content of a word influences our processing of that word on a basic level, but also to what extent it can influence our processing of subsequent non-emotional text as well as our attitudes and decisions. Thus far, the questions addressed in the literature have been of a low level nature and, as discussed at the beginning of this chapter, have failed to yield wholly decisive results, or provide an adequate explanation for them. It is the aim of this body of work not only to supply an answer to the question of emotion words' effects on processing, but provide plausible, coherent explanations and begin to examine higher level functions which might be affected. This will be addressed by examining blocks of emotional text larger than single words, and also by taking into account the mood of the participant. Additionally, not only will the emotion word (or emotional block of text) be examined, but subsequently presented neutral text will also be studied. In the final experiment of the thesis participants' attitudes will also be measured in addition to behavioural data being recorded.

I will begin by further examining electrophysiological evidence of early processing of emotion words, specifically how they interact with word frequency, a dimension which also manifests very early in the processing stream (Chapter 2).

Next, the attention capturing properties of emotion words will be examined by recording the eye movements of participants as they are cued to attend either to an emotion or neutral word of two simultaneously presented words (Chapter 3).

In the literature outlined above emotion words have always been investigated in isolation. This thesis reports the first ever eye movement study presenting emotion words in the middle of neutral sentences (Chapter 4). It is predicted that the emotion-frequency interaction previously found in LD will be replicated in eye movements.

Of interest here is not just the processing of emotion words, but whether the affect produced by emotional words carries over and impacts subsequent text. To explore this issue, an emotional priming task is first conducted (Chapter 5). This differs from previous experiments because the primes are emotional and the targets neutral, hence any effect uncovered will be the result of the processing spillover from the emotional prime. In all emotional priming experiments to date, to the author's knowledge, the target words have always been emotional.

Next a second eye tracking experiment will be conducted (Chapter 6). This will be similar to the first one, only instead of presenting emotional words in neutral sentences, whole emotional sentences will be presented in the middle of neutral paragraphs. Differences in reading time on the text following the emotional sentence can be interpreted as resulting from the affect of the previous sentence.

The question of mood induction and the effect of the emotional content of text on participants' attitudes and decisions will then be addressed. First, the eye movement experiment presenting emotional words in the context of neutral sentences will be replicated and extended by using a variant of the Velten mood induction task to induce a positive or negative mood in participants (Chapter 7).

The final experiment of the series will also use mood induction but in a more social context (Chapter 8). Participants will be placed in a positive or negative mood, again using the Velten mood induction task, before being shown a number of car reviews and being asked for their opinion on various aspects of the vehicle and whether or not they would recommend it to individuals in different circumstances.

It is hoped that by the end of this research progression a clearer picture will have emerged, not just about how we process emotion words in isolation, but about how we process them in the real-life context of reading, how they interact with frequency, to what extent they capture our attention and are embodied by us as we read them and, perhaps most importantly, how they influence our processing of the surrounding text, and to what extent they can influence our attitudes towards and decisions about specific objects.

Chapter 2

Introduction

Merits of ERP

Electrophysiological studies are expedient in allowing the capture of real-time perceptual and cognitive processes and have been used frequently in the study of emotion word processing and recognition. Several studies have examined different components of the event-related potential (ERP) for emotionality effects (for a review, see Kissler et al., 2006). ERPs are stimulus-locked averages of the electroencephalogram (EEG) across many presentations of stimuli. They provide a continuous millisecond-by-millisecond record of electrical changes related to on-going perceptual and cognitive processing and can index changes related to word recognition in real time. The traditional ERP components are named after their polarity (i.e., positive- or negative-going) and either their ordinal position (first, second, etc.) or their peak latency (e.g., 100, 300 ms). A distinction is often made between early, exogenous components occurring before 200 ms and later, endogenous ones occurring after this time.

Most ERP studies, however, use many repetitions of the experimental materials (e.g., Bernat et al., 2001; Ortigue et al., 2004). Repetition priming has known effects in word recognition including, for example, greater facilitation for LF versus HF words. In an event-related fMRI study, Luo et al. (2003) used a masked repetition priming paradigm with positive, negative, and neutral words in which participants judged whether the target appeared in normal or italics font. They found behavioural repetition priming effects for positive and negative but not neutral words. In terms of fMRI activation, they found greater repetition priming for positive compared to negative words in the left mid-fusiform gyrus. Because word repetition can produce differential effects depending on particular lexical characteristics, results of such studies cannot be easily generalized to conditions in which words are normally identified (without repetition).

Early ERP Findings

Several studies over the years have found early electrophysiological effects for emotion words but, as discussed in Chapter 1, the heterogeneous methodologies do not easily lend themselves to direct comparison and, thus, conclusions drawn from the literature summarised below are tentative.

In 1998, Skrandies found a P1 at around 100 ms using a serial visual presentation, with each word presented for 1 s. Stimuli were polar extremes of the dimensions Evaluation, Activity, and Potency (from Osgood et al.'s 1957 affective-space model) and were repeated 40 times. Participants were told to visualize the word and try to remember it for a subsequent memory task. Ortigue et al. (2004) carried out a forced choice LDT where stimuli, half neutral and half emotional nouns, both pleasant and unpleasant, were presented for 13 ms and found an effect in the P1/N1 window – from 100-140ms. They also reported an advantage of LH processing of emotion words but only after 250 ms.

Kanske and Kotz (2007) presented positive, negative and neutral words which also differed in concreteness in an LDT. Stimuli here were presented unilaterally to either the RVF or LVF. They found larger P2s in the 210-300 ms window for positive vs. neutral words and for right hemifield vs. left hemifield (although the emotion effect disappeared when task was changed to a go/no-go pseudoword/word LDT). The authors also reported an N400 effect and a late-positive component (LPC) effect. They surmised that the former was influenced by greater semantic activation, and the latter by mental imagery activated by concrete words. From differences found in the go/no-go task they also concluded that differences in LPC were due to different mental imagery functions being produced by concrete negative words compared to concrete positive and neutral words.

Herbert et al. (2006) also found a P2 effect from 180-200 ms related to emotion. They presented positive, negative and neutral words for 5 s each and had participants emotionally evaluate and memorise them. They also found a similar effect in the P3a. Larger P2s were found for emotional vs. neutral words. Kissler et al. (2007) conducted a passive viewing task where the stimuli were repeated and found increased negativity for emotion vs. neutral words over the 200-300 ms interval.

Schapkin et al. (2000) performed an EDT where positive, negative and neutral nouns were flashed for 150 ms to either visual field and were repeated 32 times. The earliest effect they found was in the P2 component peaking at around 230 ms with positive stimuli provoking a larger response than negative or neutral ones.

Kostanadov and Azurmanov (1997) found a larger N200 for ‘conflict’ words compared to neutral words when the stimuli were presented subliminally, but no difference until 300 ms post-stimulus onset when presentation was supraliminal. The effects were larger for neutral than for conflict words. Bernat et al. (2001) had participants attend to unpleasant and pleasant mood adjectives both subliminally and supraliminally. They found larger P1 and N1 amplitudes in the LH when subjects attended to unpleasant compared to pleasant words. They also found larger responses to unpleasant words in the later P2, P3a and LPC components. These late effects were bilateral for supraliminal processing, but the P1 and N1 for both subliminal and supraliminal processing, and later effects after subliminal presentation, were found only in the left hemisphere.

It can be seen that within these studies, which vary in the task, stimulus, as well as use of blocking and repetition procedures, some report larger early effects for positive words (Schapkin et al., 2000) and others for negative words (Bernat et al., 2001).

Late ERP Findings

Vanderploeg et al. (1987) used materials drawn from several other studies and found a P2 effect for emotional compared to neutral words. They found a P300 effect for faces but this did not reach statistical significance for words. They noted that these were not as powerful as effects in the same window when using emotional face stimuli, and there were no later effects as with face stimuli. This study is typical of many early experiments in the area which focused on 'emotion' ERP components found in faces rather than components associated with linguistic stimuli. In another study, Pastor et al. (2008) had participants attend to pictures and found significant later differences with emotional words eliciting greater positivity than neutral words in the 400-700 ms window as well as a 'slow wave' from 1-6 s. Such strong effects have rarely been found in such late components, however, when the stimuli are comprised solely of text. Late electrophysiological effects associated with linguistical stimuli are discussed briefly below.

Fischler and Bradley (2006; cited in Kissler, Herbert, Winkler and Junghofer, 2008) consistently found late positivities (300-600 ms post stimulus onset) for both pleasantly and unpleasantly arousing words across a number of studies, but only when the task required semantic processing. In another study, Dillon, Cooper, Grent-'t-

Jong, Woldorff, and LaBar (2006) found a larger late positive potential (LPP) was elicited by emotional than by neutral words from 450-1000 ms. Schapkin et al. (2000) and Herbert et al. (2006) showed late positivities restricted to positive words.

The 200-400 ms window is traditionally thought of as the conscious processing stage (Halgren et al., 1994a, b) and effects here have been found to vary with semantic expectancy, task relevance, and depth of mental judgment. According to Munt et al. (1998), the LPC is generally associated with task demands, possibly semantic reanalysis, and effects due to contextual semantic constraints and stimulus abstractness. This confusion underlines the need for more control in studies and the importance that should be placed on avoiding costly shortcuts such as excessive repetition of stimuli, if interpretable effects are to be found.

It is still unclear, for example, what part arousal and valence play in word processing. Herbert et al. (2006) suggest that arousal influences processing before 300 ms, then valence comes into play. This is called into question by many of the studies mentioned above: Kanske and Kotz (2007) found significant differences in the P2 for positive words vs. neutral words, but no difference between negative and neutral words. At this point it is prudent to summarise the time-course of lexical access.

Lexical Access

The principal purpose of the studies discussed above was to examine the differences in the processing of emotional words (or more often, specific subsets of emotion words as discussed in Chapter 1) compared to the processing of neutral words. In order to accurately interpret prior results, it must first be established what the accepted time-course in word processing is, as well as which electrophysiological phenomena are associated with each stage and each aspect of lexical stimuli.

In their 2006 review, Kissler and her colleagues split word processing into two distinct phases:

- 150-200 ms: specific perceptual features but no meaning-related attributes are extracted (Posner et al., 1999).
- 200+ ms: meaning-related attributes are extracted; specifically in this window they point to the N400 which Kutas and Federmeier (2000) identified as 'the' index of semantic processing.

Sereno, Rayner & Posner (1998) posit an earlier time line of processing. They find that lexicality (judging whether a letter string is a word or a non-word) occurs from 100-132 ms and is represented electrophysiologically by the P1. Word frequency effects occur around 150ms and are represented in the N1. Their earliest frequency effects were found 132 ms post-stimulus in the N1. Spelling-sound regularity effects occur next, between 164 and 196 ms, and shows up in the P2. Frequency effects have also been consistently shown in the P300 component (Hauk & Pulvermüller, 2004; King & Kutas, 1998; Polich & Donchin, 1988; Rugg, 1990).

By focusing on later ERP components researchers can successfully infer downstream effects of the emotional text. Only by looking at the early effects, specifically those that occur before 200 ms post-stimulus, can we begin to address the question of what stage the emotionality of a word begins to influence our processing of it. Specifically, by examining electrophysiological components sensitive to the frequency effect it is possible to use this as an index of lexical access and from there infer at what point emotion (consisting of valence and arousal) comes into play.

Emotion and Frequency

Outwith the work conducted by the current author, there have been two studies which have examined emotion in conjunction with frequency. Nakic et al. (2006) were the first to manipulate both factors in an LDT while measuring fMRI. They used high frequency (HF) and low frequency (LF) words along with three categories of emotional words: neutral, 'high' negative (very unpleasant), and 'low' negative (less unpleasant), with 40 words in each of the 6 conditions. Behaviourally they found the expected frequency effect (RT: HF<LF) as well as an effect of emotion ('high' negative < 'low' negative = neutral). Physiologically they identified brain areas more sensitive to negative than neutral words, principally the amygdala, but provided no temporal analysis.

Two studies to date have used a 2x3 frequency x emotion design investigating HF and LF positive, negative, and neutral words randomly presented in an LDT. Kuchinke et al. (2007) found significant main effects of frequency and emotion in RT as well as the same frequency x emotion interaction. Within HF words: positive < negative = neutral; and within LF words: positive = negative < neutral. The variability in response to negative compared to positive and neutral words in this way may help to explain some of the conflicting results in early literature when frequency was not controlled for. In LF words all emotion words are responded to faster than neutral words, whereas in HF words the negative seems to 'slow up' to the same time as neutral words. This only measured behavioural data, however, not electrophysiological data.

Scott (2005) had previously utilised the same design as Kuchinke et al. and obtained identical behavioural results. ERPs were additionally measured and the N1 (135-190 ms) component was analysed. This component was chosen because, as stated above, it usually shows strong frequency effects. A frequency x emotion interaction was also demonstrated in the N1 waveform data. Follow-up contrasts revealed a significant effect of Frequency for Neutral words, replicating prior studies (e.g., Sereno et al., 1998; 2003), with LF Neutral words eliciting a larger N1 than HF Neutral words. The effect of Frequency was not significant for Positive words [$F<1$], but was significant in the opposite direction for Negative words, with HF Negative words eliciting a larger N1 than LF Negative words. Within LF words, similar to the pattern in the RT data, Neutral words tended to elicit a larger N1 than either Positive or Negative words (which did not differ from each other). Within HF words, Negative words elicited a significantly larger N1 than either Positive or Neutral words. In sum, the N1 frequency effect found in prior studies (which used emotionally neutral words) was replicated with Neutral words. The different pattern of results for Positive and Negative words seems to indicate that the frequency effect is influenced by a word's arousal and valence. The current study expands on this initial analysis, examining the P1, P300 and EPN components. The RT and N1 data are included in the analysis below to provide the reader with a fuller picture of the early effects of emotion word processing, although it should be noted that these have already been published in my Masters thesis (Scott, 2005).

Method

Participants

Twenty-six members of the University of Glasgow community (15 females, 11 males; mean age 21, range: 17-24) were paid £10 for their participation. An additional four participants were run in the experiment, but were not included in the analyses because of poor quality electrophysiological recordings. All participants were native English speakers, had not previously been diagnosed as dyslexic, and were strongly right-handed (mean score 35.6, range: 33-36) as assessed by the 36-point Edinburgh Handedness Inventory (Oldfield, 1971). In addition, all had normal or corrected-to-normal vision and were naïve concerning the purpose of the experiment. In accordance with the guidelines set by the University's ethics committee, written informed consent was obtained prior to experiment participation.

Materials and Design

A 3 (Emotion: Positive, Negative, Neutral) X 2 (Frequency: LF, HF) design was used. Word stimuli varied in terms of arousal, valence, and word frequency. Arousal and valence values were taken from Affective Norms for English Words (ANEW), a database of 1000 words (Bradley & Lang, 1999). Each word in ANEW has associated ratings both for arousal, from 1 (low) to 9 (high), and for valence, from 1 (negative) to 9 (positive). The following criteria for word selection were employed. Arousal values for Positive and Negative words were greater than 6.00, while those for Neutral words were less than 5.45. Valence values were greater than 6.00 for Positive words, less than 4.00 for Negative words, and between those values for Neutral words. Word frequencies were taken from the British National Corpus (BNC), a database comprising 90 million written word tokens (http://www.natcorp.ox.ac.uk/).

A total of 80 sets of word triples (Positive, Negative, and Neutral) were generated with words within each set matched for length and frequency. Forty sets were LF and 40 were HF. All word stimuli are listed in the Appendix and their specifications are listed in Table 2.1.

Table 2.1. Specifications of Word Stimuli

Condition	N	Length	Frequency	Arousal	Valence
Positive					
LF	40	7 (2.2)	8 (5.3)	6.7 (0.6)	7.6 (0.6)
HF	40	6 (2.0)	62 (48.3)	6.6 (0.5)	7.8 (0.5)
Negative					
LF	40	7 (1.7)	8 (5.8)	6.6 (0.6)	2.4 (0.5)
HF	40	6 (1.8)	50 (48.2)	6.7 (0.5)	2.6 (0.7)
Neutral					
LF	40	7 (1.8)	7 (4.8)	4.5 (0.5)	5.2 (0.6)
HF	40	6 (1.6)	66 (62.3)	4.3 (0.4)	5.2 (0.5)

Note. Mean values with standard deviations in parentheses are shown. Units of measurement are as follows: Length in number of letters; Frequency in occurrences per million; Arousal rating range is 1 (low) to 9 (high); and Valence rating range is 1 (negative) to 9 (positive). LF = low frequency and HF = high frequency.

In addition, three sets of 80 pseudowords (orthographically legal pronounceable nonwords, e.g., blimble) were created, with each set length-matched to its corresponding word set. Each participant was presented with all 480 items – 240 words and 240 pseudowords.

Apparatus

Participants were tested in the Psychology Department in an electrically shielded booth with low level ambient light. Experimental Run Time System (ERTS) software was used to control stimulus presentation (cf. Dutta, 1995). Participants were seated at a viewing distance of approximately 65 cm from the monitor, maintained throughout the experiment by means of a chin rest. Stimuli were presented centrally in 20-point Helvetica font on a Sony 15” monitor in white letters on a black background. Approximately three characters subtended 1^o of visual angle. A keypad registered word and non-word responses (right and left index fingers, respectively) with millisecond accuracy. Keys were mounted about 35 cm apart on a board aligned to the body’s midline.

Procedure

Before the experiment, participants were informed about the nature of electrophysiological recording and were given specific task instructions. They were told that half of the stimuli were words and half were nonwords and that they should respond as quickly, but as accurately, as possible. For each trial, the sequence of events was as follows. A central fixation cross was presented for 750 ms followed by a blank interval of 500 ms. A letter string was then presented centrally until response onset. After the response (or if no response occurred within 2 sec of stimulus onset), a variable blank interval of 1.5 sec mean duration (range: 1.25- 2.50 sec) followed. Experimental trials were presented in a different random order for each participant. Participants were first presented with a practice block of 24 trials to become accustomed to the task. Experimental trials were then presented in 10 blocks with short rest periods in between. Each experimental block consisted of 50 trials and lasted approximately 3.5 min. The first two trials of each block were filler items and were not recorded. After each block, participants were given feedback about their performance.

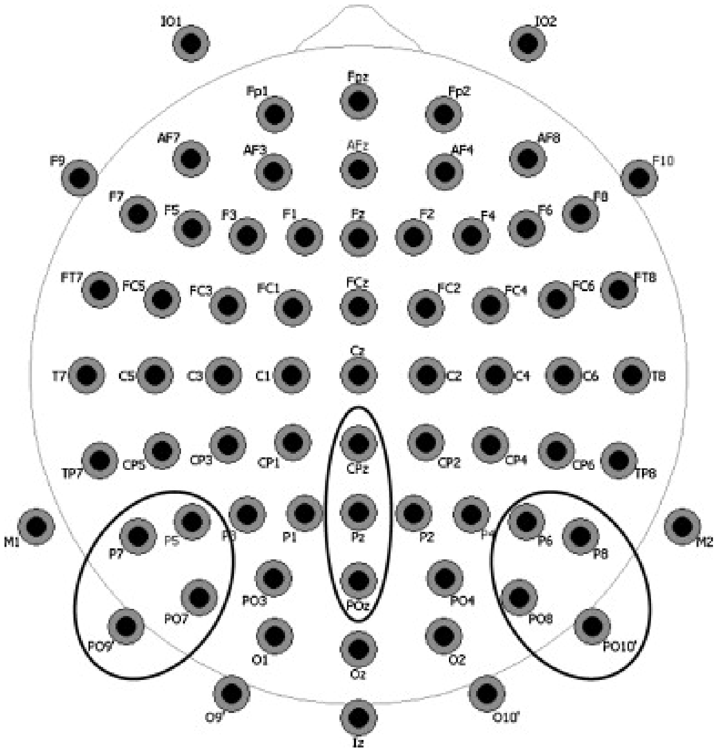
Electrophysiological Recording

A BIOSEMI Active-Two amplifier system was used for continuous recording of electroencephalographic (EEG) activity from 72 Ag/AgCl electrodes (see Figure 4.1): (a) midline electrodes Fpz, AFz, Fz, FCz, Cz, CPz, Pz, POz, Oz, and Iz; (b) left hemisphere electrodes IO1, Fp1, AF3, AF7, F1, F3, F5, F7, F9, FC1, FC3, FC5, FT7, C1, C3, C5, M1, T7, CP1, CP3, CP5, TP7, P1, P3, P5, P7, PO3, PO7, O1, including two nonstandard positions PO9' and O9' (located at 33% and 66% of the M1-Iz distance, respectively); and (c) homologous right hemisphere electrodes. Two additional electrodes (the Common Mode Sense (CMS) active electrode and Driven Right Leg (DRL) passive electrode) were used as reference and ground electrodes, respectively (cf. www.biosemi/faq/cms&drl.htm). EEG and EOG recordings were sampled at 256 Hz. All EEG channels were recalculated off-line to a linked mastoid reference. Trials containing blinks were corrected using a dipole approach (BESA, Version 5.1.8). The analysis epoch started 200 ms prior to stimulus onset and lasted for a total duration of 1.5 sec.

EEG Data Analysis

Trials with non-ocular artifacts (drifts, channel blockings, EEG activity exceeding ±75 μV) and incorrect responses were discarded, resulting in an average data loss of about 30% per participant. After artifact rejection, there remained on average 28 trials of 40 (minimally 20) per participant per condition. The signal at each electrode site was averaged separately for each of the six experimental word conditions, time-locked to word onset, band-pass filtered (0.05-30 Hz, 6 dB/oct), and aligned to a 100-ms pre-stimulus baseline. In line with previous research, specific ERP deflections were examined: the P1 from 80-120 ms; the N1 from 135-180 ms; the Early Posterior Negativity (EPN; e.g., Schupp et al., 2004) from 200-300 ms; and the P300 from 300-450 ms. For time windows occurring before 300 ms (P1, N1, and EPN), mean voltages were computed across four posterior electrodes over right hemisphere (RH) sites (P6, P8, PO8, PO10') and four homologous electrodes over left hemisphere (LH) sites (P5, P7, PO7, PO9') (see Figure 4.1). P300 amplitude (300-450 ms) was measured across three parietal midline electrodes (CPz, Pz, POz). In addition a computerized peak-picking program was used to measure P300 peak latency at Pz (i.e., the time point, from 250-800 ms, when the voltage at Pz was maximally positive).

Figure 2.1. Electrode arrangement. Homologous left and right posterior electrodes are indicated for analysis of average voltage amplitude in the P1, N1, and EPN windows. Midline electrodes are indicated for analysis of average voltage amplitude in the P300 window.



Results

RT Data

Trials in which participants made errors were excluded from the RT data analysis (4.92%). The RT data were subjected to two trimming procedures. Items with RTs less than 250 ms or greater than 1500 ms were excluded from further analysis. For each participant in each condition, items with RTs beyond two standard deviations of that mean were also excluded. These procedures resulted in an average data loss of 4.78%.

A two-way analysis of variance (ANOVA) was performed on the participant data. The main effect of Emotion was significant [$F(2,50)=11.53$, $MSE=3550.501$, $p<.001$]. Follow-up contrasts revealed that responses to Positive words (525 ms) were only marginally faster than those to Negative words (532 ms) [$F(1,50)=3.83$, $MSE=1179.77$, $p=.056$]. [Note, there is no clearly defined convention for what constitutes ‘marginal’ or ‘trend’ effects. In psycholinguistics journals it is common practice to refer to effects within the range of $.05<p<.10$ as ‘marginal’ and those which fall within the range of $10<p<.15$ as ‘non-significant trend’ (e.g., Sereno, Brewer and O’Donnell, 2003). These will be the criteria used throughout this thesis.]

] However, responses to both Positive and Negative words were significantly faster than those to Neutral words (541 ms) [Positive vs. Neutral: $F(1,50)=22.82$, $MSE=7024.812$, $p<.001$; Negative vs. Neutral: $F(1,50)=7.95$, $MSE=2446.922$, $p<.01$]. The main effect of Frequency was highly significant, with faster responses to HF versus LF words (511 vs. 555 ms) [$F(1,25)=86.20$, $MSE=74390.972$, $p<.001$]. The interaction was also significant [$F(2,50)=4.10$, $MSE=974.178$, $p<.05$]. For LF words, both Positive and Negative words (which did not differ from each other) were faster than Neutral words [Positive vs. Negative: $F<1$; Positive vs. Neutral: $F(1,50)=22.29$, *MSE*=5293.214, *p*<.001; and Negative vs. Neutral: *F*(1,50)=18.40, *MSE*=4368.956, *p*<.001]. For HF words, Positive words were faster than both Negative and Neutral words (which did not differ from each other) [Positive vs. Negative: *F*(1,50)=7.40, *MSE*=1757.177, *p*<.01; Positive vs. Neutral: *F*(1,50)=8.82, *MSE*=1757.177, *p*<.01; and Negative vs. Neutral: *F*<1].

The mean ERP voltage amplitude and P300 latency data are presented in Table 2.2. These data are also graphically depicted with standard error bars in Figure 2.2 (P300 peak latency) and Figure 2.3 (P1, N1 EPN, and P300). ERP waveforms from posterior electrodes PO7 (left) and PO8 (right), and from the midline electrode Pz are

Table 2.2. Mean RT (ms), P300 Peak Latency (ms), and Voltage Amplitudes (µV) across ERP Windows for LF and HF Negative, Neutral, and Positive Words

	LF			HF		
	Negative	**Neutral**	**Positive**	**Negative**	**Neutral**	**Positive**
Latency (ms)						
RT	**549**	**567**	**547**	**514**	**516**	**503**
P300 peak	**574**	**570**	**554**	**523**	**534**	**545**
Voltage (µV)						
P1	**1.79**	**1.70**	**1.98**	**1.30**	**1.94**	**1.93**
N1	**–2.06**	**–2.50**	**–2.16**	**–2.61**	**–2.03**	**–2.27**
EPN	**–0.65**	**–0.78**	**–1.07**	**–1.27**	**–0.16**	**–0.81**
P300	**5.95**	**5.32**	**5.85**	**6.94**	**6.47**	**6.61**

Note. LF = low frequency and HF = high frequency. For the P1, N1, and EPN windows, electrode areas comprise posterior sites shown in Figure 1. For the P300 window, midline electrodes were used. The P300 peak latency was calculated from electrode Pz.

shown in Figure 2.4. Scalp topographies of mean ERP amplitudes in each time window are displayed in Figure 2.5. Although the N1 data was analysed previously in Scott (2005), the data are presented alongside the data from the P1, EPN and P300 in order to provide a clearer overall picture of the results.

Figure 2.2. (A) Mean RT (ms) with standard error bars indicated for LF and HF Negative, Neutral, and Positive words. (B) Mean P300 peak latency (ms) from electrode Pz with standard error bars for LF and HF Negative, Neutral, and Positive words.

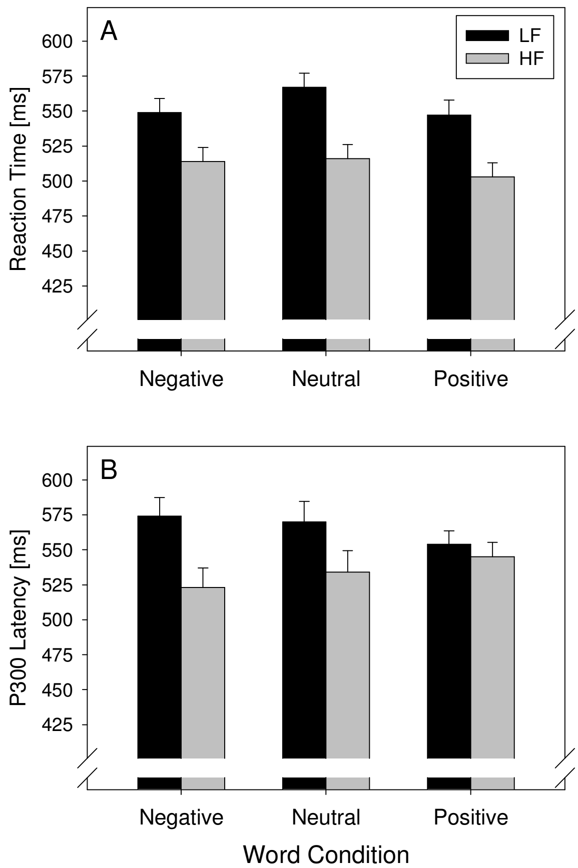


Figure 2.3. Mean voltage amplitude (μV) with standard error bars for LF and HF Negative, Neutral, and Positive words for the following time windows: (A) P1 (80-120 ms); (B) N1 (135-180 ms); (C) EPN (200-300 ms); and (D) P300 (300-450 ms).

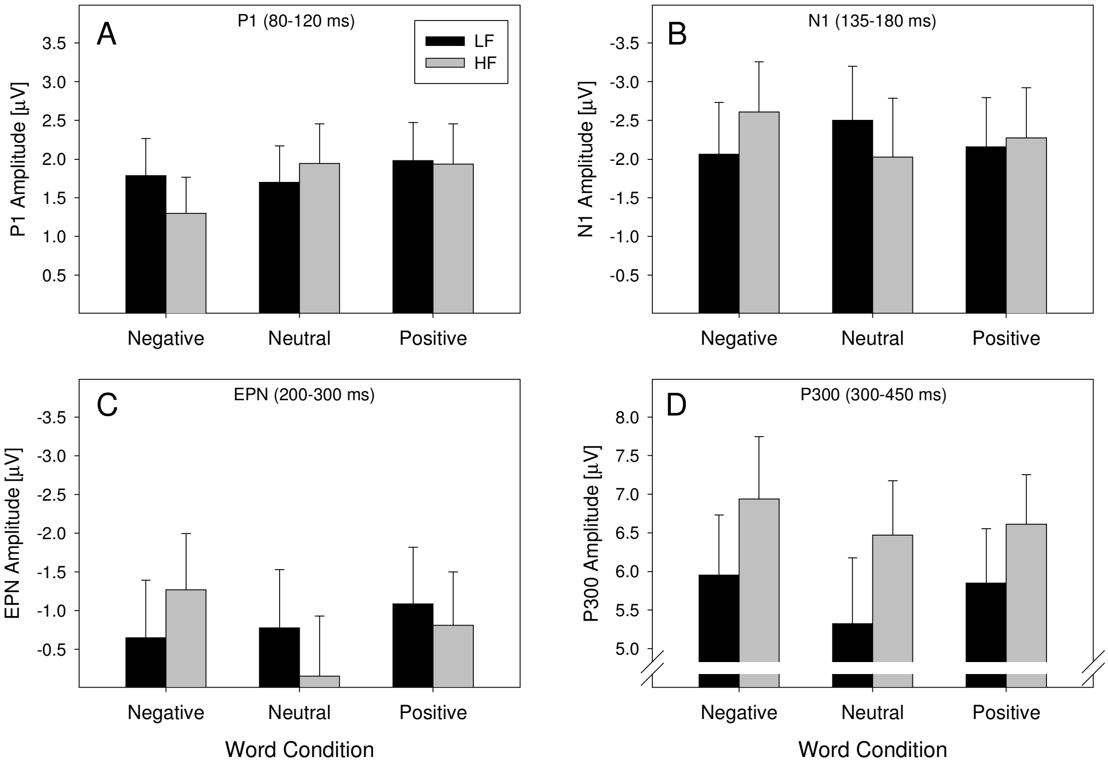


Figure 2.4. ERP waveforms from posterior electrodes PO7 (left) and PO8 (right), and from the midline electrode Pz. Each plot depicts the grand average ERPs to Positive, Neutral, and Negative word conditions for either HF or LF words.

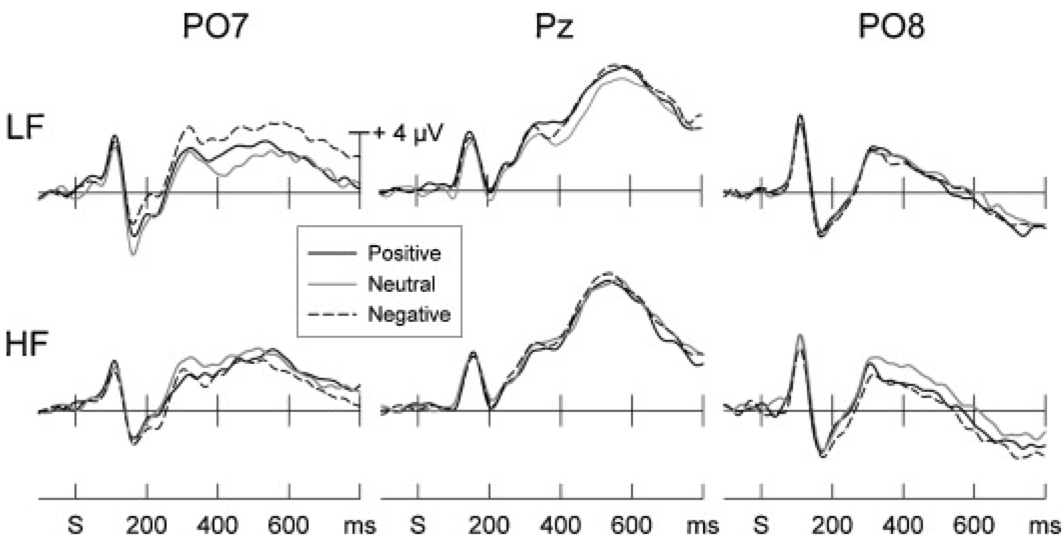
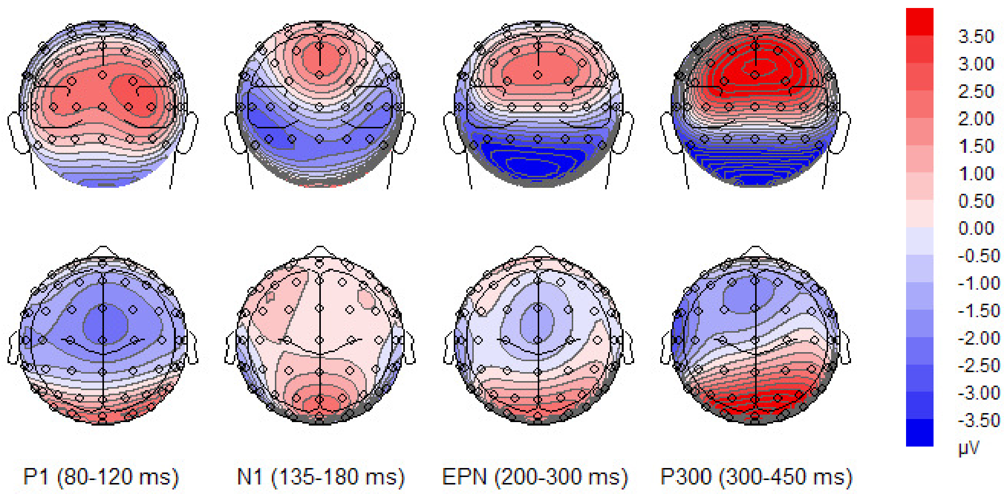


Figure 2.5: Spline-interpolated topographic maps for P1, N1, EPN, and P300 time intervals. Isopotential line spacing is 0.5 µV.



ERP data

A 3 (Emotion: Positive, Negative, Neutral) x 2 (Frequency: LF, HF) x 2 (Hemisphere: RH, LH) repeated measures ANOVA, using the Huynh-Feldt correction, was performed on the average voltage data in the P1 and EPN windows. For the P300 a similar ANOVA was performed but instead of Hemisphere as a factor, Electrode (comprised of three midline electrodes) was used. Finally, the P300 peak latency at a single electrode (Pz) was examined using a two-way ANOVA.

P1 window (80-120 ms). As can be seen in Figure 2.5, mean P1 amplitude was larger over right than left posterior electrodes (2.2 vs. 1.3 μV) [Hemisphere: $F(1,25)=7.86$, $MSE=7.808$, $p<.01$]. The main effect of Emotion was significant [$F(2,50)=4.41$, $MSE=1.058$, $p<.05$] and tended to be modulated by Frequency, as indicated by an Emotion x Frequency interaction [$F(2,50)=2.61$, $MSE=1.368$, $p=.084$]. Further comparisons revealed that P1 amplitude was influenced by Emotion only for HF words [$F(2,50)=5.48$, $MSE=5.219$, $p<.01$], and not for LF words [$F<1$]. As can be seen in Table 2.2 and Figure 3A, P1 amplitude was smaller for HF Negative words (1.30 μV) than either HF Positive (1.93 μV) or HF Neutral (1.94 μV) words [all $Fs(1,25)>6.45$, $MSE=6.532$, $ps<.05$]. Negative LF words tended to elicit a larger P1 than Negative HF words (1.79 vs. 1.30 μV) [$F(1,25)=4.08$, $MSE=6.144$, $p=.054$]; frequency effects, however, were not reliable for either Positive or Neutral words [all $Fs(1,25)<1.48$, $ps>.20$]. No other effects were significant in the analysis of mean P1 amplitude [all $Fs<1$]. Overall, the pattern of effects in the P1 seems to arise mainly from the very early effect of word frequency for Negative words. The established, later N1 frequency effect comes from studies using, notably, emotionally neutral words. Thus, it seems that HF Negative words are processed at an earlier stage.

N1 window (135-180 ms). No main effects were significant, nor were most of the interactions [for Emotion, Frequency, Hemisphere, and Frequency x Hemisphere: all $Fs<1$; Emotion x Hemisphere: $F(2,50)=1.92$, $p>.15$; and Emotion x Frequency x

Hemisphere: $F(2,50)=1.35$, $p>.25$]. Only the Emotion x Frequency interaction was significant [$F(2,50)=7.01$, $MSE=0.975$, $p<.01$]. Follow-up contrasts revealed a significant effect of Frequency for Neutral words, replicating prior studies (e.g., Sereno et al., 1998; 2003), with LF Neutral words eliciting a larger N1 than HF Neutral words (–2.50 vs. –2.03 μV) [$F(1,25)=4.42$, $MSE=5.320$, $p<.05$]. As can be seen in Table 2 and Figure 3B, the effect of Frequency was not significant for Positive words [$F<1$], but was significant in the opposite direction for Negative words, with HF Negative words eliciting a larger N1 than LF Negative words (–2.61 vs. –2.06 μV) [$F(1,25)=9.07$, $MSE=3.419$, $p<.01$]. Within LF words, similar to the pattern in the RT data, Neutral words tended to elicit a larger N1 than either Positive or Negative words (which did not differ from each other) [Positive vs. Negative: $F<1$; Positive vs. Neutral: $F(1,25)=2.70$, $MSE=4.609$, $p=.113$; and Negative vs. Neutral: $F(1,25)=5.89$, $MSE=3.420$, $p<.05$]. Within HF words, Negative words elicited a significantly larger N1 than either Positive or Neutral words (which did not differ from each other) [Positive vs. Negative: $F(1,25)=4.39$, $MSE=2.693$, $p<.05$; Positive vs. Neutral: $F(1,25)=1.97$, $MSE=3.144$, $p>.15$; and Negative vs. Neutral: $F(1,25)=5.72$, $MSE=6.143$, $p<.05$]. In sum, the N1 frequency effect found in prior studies (which used emotionally neutral words) was replicated with Neutral words. The different pattern of results for Positive and Negative words seems to indicate that the frequency effect is influenced by a word's arousal and valence.

EPN window (200-300 ms). The main effect of Emotion was significant [$F(2,50)=5.76$, $MSE=1.414$, p<.01]. Negative and Positive words showed larger EPN amplitudes (–0.96 and –0.94 μV) than Neutral words (–0.47 μV). The Emotion x Frequency interaction was also significant [$F(2,50)=10.75$, $MSE=0.986$, p<.001]. Follow-up contrasts revealed a significant Frequency effect for Neutral words, with LF Neutral words eliciting a larger EPN than HF Neutral words [$F(1,25)=12.11$, $MSE=3.311$, p<.01]. As can be seen in Table 2.2 and Figure 2.3C, the Frequency effect was in the opposite direction for Negative words, with HF Negative words eliciting a larger EPN [$F(1,25)=7.04$, $MSE=5.694$, $p<.05$], and Positive words showed no effect [$F(1,25)=1.31$, $MSE=5.295$, $p>.25$]. Within LF words, Emotion did not reliably influence EPN amplitude [Positive vs. Negative: $F(1,25)=2.48$, $MSE=7.314$, $p=.128$; Positive vs. Neutral: $F(1,25)=1.63$, $MSE=5.448$, $p>.20$; and Negative vs. Neutral: $F<1$]. Within HF words, Negative and Positive words (–1.27 and –0.81 μV) elicited a significantly larger EPN than Neutral words (–0.16 μV), replicating Kissler et al. (2007) whose stimuli, notably, were HF words; additionally, Negative words triggered a larger EPN than Positive words [Positive vs. Negative: $F(1,25)=9.00$, $MSE=2.464$, $p<.01$; Positive vs. Neutral: $F(1,25)=9.14$, $MSE=4.877$, $p<.01$; and Negative vs. Neutral: $F(1,25)=32.63$, $MSE=3.972$, $p<.001$]. No other main effects or interactions were significant [all $Fs<1.41$, $ps>.20$].

P300 window (300-450 ms). To capture the P300's centroparietal topography (see Figure 2.5), a 3 (Emotion: Positive, Negative, Neutral) x 2 (Frequency: LF, HF) x 3 (Electrode: CPz, Pz, POz) ANOVA was performed on the average voltage data. There was a main effect of Electrode, with Pz (7.20 μV) having greater amplitude than CPz and POz (5.24 and 6.13 μV) [$F(2,50)=4.50$, $MSE=33.224$, $p<.05$]. As can be seen in Table 4.2 and Figure 4.3D, there was a main effect of Frequency, with LF words eliciting a smaller P300 than HF words (5.71 vs. 6.68 μV) [$F(1,25)=10.93$, $MSE=10.011$ $p<.01$]. This replicates prior research (e.g., Polich & Donchin, 1988). No other effects were significant [all $Fs<1.58$, $ps>.20$].

P300 peak latency. The P300 peak latency from electrode Pz was analyzed by a two-way ANOVA. Similar to the P300 pattern of results, there was only a main effect of

Frequency, indicating an earlier peak for HF versus LF words (534 vs. 566 ms) [$F(1,25)=9.00$, $MSE=1797.631$, $p<.01$]. This effect also replicates Polich and Donchin's (1988) findings. No other effects were significant [all Fs<2.13, ps>.14].

Discussion

The purpose of the current experiment was to investigate the early time course of emotion word processing. Positive, negative, and neutral words were presented randomly in an LDT while brain electrophysiological responses were recorded. Unlike most prior studies, there was no use of masking, priming, mood induction, lateralized presentation, blocking, or repetition of stimuli. Such manipulations make results difficult to generalize as they may produce second order effects or induce strategic processing. Critically, word frequency was manipulated in order to better determine the onset of lexical-semantic processing, and employed a 3 (Emotion: Positive, Negative, Neutral) × 2 (Frequency: LF, HF) design.

In previous analyses (Scott, 2005), the reaction time data and N1 component of the ERP were analysed. Scott (2005) was initially interested in the N1 (135–180 ms) because this is when lexical effects (e.g., word frequency, contextual predictability) have been reliably demonstrated (e.g., Hauk and Pulvermüller, 2004; Sereno et al., 1998; and Sereno et al., 1998; 2003). Behaviourally, Scott found significant Emotion and Frequency effects as well as an interaction. For LF words, both Positive and Negative words were responded to faster than Neutral words; for HF words, Positive words were responded to faster than Negative and Neutral words. It is somewhat difficult to evaluate these findings with respect to the prior literature. A precise time course of lexical processing is difficult to infer from such data; one cannot simply align cognitive components of the LDT with corresponding components of the ERP. Nevertheless, the presence of an interaction in RT indicates that Frequency and Emotion influence at least one common processing stage. By examining the electrophysiological record, the temporal dynamics of the component processes of word recognition can be more effectively established.

In the N1 window Scott (2005) had expected to find an N1 (135–180 ms) effect of word frequency. The N1, however, only showed a significant Emotion × Frequency interaction. For LF words, Neutral words generated higher amplitudes; for HF words, Negative words generated higher amplitudes. Neutral words exhibited the established frequency effect, with LF words eliciting a larger N1 than HF words. This replicates the findings of past studies which, notably, have used LF and HF emotionally neutral words (e.g., Sereno et al., 1998; Sereno et al., 2003). Positive words, however, showed no frequency effect, and Negative words showed a frequency effect in the opposite direction, with HF words eliciting a larger N1 than LF words. Nevertheless, the presence of an interaction suggests that frequency is modulated by arousal and valence.

In the current experiment, the time course of processing was tracked by examining the pattern of effects across consecutive temporal windows. Taken together, these results reveal a transitory account of emotion word processing. The P1 (80–120 ms) window allowed a determination of whether there was prior evidence of such effects, in particular, those related to stimulus arousal and valence. The EPN (200–300 ms) was then examined, a window in which Kissler et al. (2007) reported an initial differentiation between high arousal (positive and negative) and neutral words. Finally, the P300 (300–450 ms) time window was examined, because previous electrophysiological studies of word recognition have reported word frequency effects in this late time range (e.g., Hauk & Pulvermüller, 2004; King & Kutas, 1998; Polich & Donchin, 1988; Rugg, 1990).

The analysis of the earlier P1 (80–120 ms) revealed that the only experimental condition affecting P1 amplitude was the HF Negative word condition which elicited a smaller P1 than the other conditions. Hauk and Pulvermüller (2004) demonstrated P1 sensitivity to word length. Although LF Negative words were one character longer on average than HF Negative words in our study, this LF-HF length disparity was identical for Positive and Neutral words (see Table 4.1) where no such effect occurred. Thus, the P1 amplitude seemed to be selectively modulated by the combined features of high frequency, high arousal, and negative valence (i.e., HF Negative words). Finally, post-N1 time windows were examined. In the EPN (200–300 ms), the N1 pattern of frequency effects for Neutral, Positive, and Negative words was maintained. In addition, while no significant differences emerged among LF words, for HF words, both Negative and Positive words generated a larger EPN than Neutral words. This last finding replicates Kissler et al. (2007) whose stimuli comprised HF words. The final P300 (300–450 ms) window only exhibited significant effects of frequency, with LF words eliciting a smaller P300 than HF words. Although this replicates the frequency effects of Polich and Donchin (1988), other ERP studies have reported N400 word frequency effects in sentence and word list paradigms, with LF words eliciting larger amplitudes than HF words (see Kutas et al., 2006). These apparently opposite effects both accurately describe the same waveform pattern (i.e., LF words elicit a smaller positive-going P300 or a larger negative-going N400 than HF words). On the basis of the current results, it is not possible to characterize these late word frequency effects as either P300 or N400 effects. Given that the N400, rather than P300, is sensitive to variations in language materials, it seems more plausible to assume that LF words elicited a larger N400 rather than a smaller P300. An N400 which overlays a more substantial P300 component could also account for the P300 latency shift, with longer latencies to LF than HF words. Regardless of the precise nomenclature of these later ERP components, it is clear that later stages of lexical processing appear to behave differently than earlier ones in that effects of emotion have become attenuated.

In the following, a framework is described that allows us to interpret the current findings. The interpretations rely on two assumptions. First, it is suggested that words that are highly salient are easier to process. It is not disputed, for example, that HF words are easier to process than LF words because they are more familiar. This notion of salience is then extended to arousal. High arousal words have stronger lexical representations and are more salient than low arousal (neutral) words because of their emotionality. This should speed recognition. However, unlike word frequency, arousal can have environmental consequences. Arousal that is positive or negative in valence will lead to vastly different outcomes. In addition, arousal that is HF vs. LF may lead to consequences which have more or less environmental significance, respectively.

The second assumption is that some version of a "perceptual defense" mechanism operates on incoming stimuli. The idea of perceptual defense is not new; McGinnies (1949) developed it from Freud and Rogers' notion of unconscious denial. McGinnies presented taboo and control words tachistoscopically and found that taboo words required longer exposures for correct identification. He suggested that perceptual defense insulated the observer from (negative) emotion-provoking properties of stimuli. Although there have been several criticisms of this study, including accounts of why the results were artifactual (e.g., taboo words had lower word frequencies; participants consciously withheld taboo word responses because of social convention), the idea itself remains viable and has been resurrected in various forms. For example, Pratto and John's (1991) Automatic Negligence Function proposes that negative words require more cognitive resources and are processed longer than positive ones. Similarly, Taylor's (1991) Mobilization-Minimization hypothesis states that if a stimulus is negative, there are strong, rapid physiological and cognitive responses in the initial processing of that stimulus – the mobilization stage. In the subsequent minimization stage, additional physiological and cognitive responses are employed to diminish the impact of the negative stimulus.

The current rendering of perceptual defense is that high arousal stimuli, in particular negatively valenced ones, are recognized more quickly and initiate an internal response because of their environmental significance. This internal response is manifest in the neural substrate as increased processing and can be interpreted either as enhancement or disruption. When an emotional stimulus is encountered, levels of high arousal are associated with that stimulus which is internally registered (consciously or not). In extreme cases, this awareness may occur pre-attentively. This internal registration will occur more quickly for high arousal stimuli that are more frequent. The valence of the arousal also plays a role, with a bias to process negative stimuli more rapidly than positive stimuli because they engender unpleasant consequences.

The overall pattern of results supports the proposal that frequency, arousal, and valence all contribute to the immediate processing of words. It remains less clear, however, precisely how these factors interact over different stages of processing. For example, HF Negative words are the most salient because of their frequency, arousal, and valence profile. The combination of these features seems to result in a processing head start: HF Negative words produced lower amplitudes than any other condition in the P1. According to these suppositions, early activation of high arousal that is both negative in valence and highly frequent in occurrence, however, will trigger an internal response which shows up as enhancement or disruption in the N1 window. With Positive words, the advantage that a moderate level of salience confers is seemingly offset by an equally moderate level of enhancement/disruption caused by the automatic internal response to high arousal stimuli. These opposing effects serve to mask the early frequency effect. With Neutral words, unaccompanied by any effects of emotion, N1 frequency effects clearly emerge. The subsequent EPN shows increased amplitude for HF Negative and Positive words vs. HF Neutral words which could be interpreted either as continued disruption from high levels of arousal or, as suggested by Kissler et al. (2007), enhancement of processing emotion vs. neutral words (their stimuli were HF words). By the P300/N400, emotion effects have become attenuated and all that remains is the behaviorally more robust frequency effect. The P300 peak latency shows the same pattern.

An alternative explanation of the early P1–N1 pattern of effects is one that relies instead on attentional mechanisms (see, e.g., Mangun and Hillyard, 1991, 1995) which are selectively responsive to HF arousal. Such an effect could be expressed electrophysiologically as a negative-going wave having an earlier onset and larger amplitude for HF Negative compared to HF Positive words. As a result, for HF Negative words, the amplitude of the P1 is reduced and the N1 greatly enhanced. For HF Positive words, because the attentional effect occurs later and to a lesser degree, only the amplitude of the N1 is enhanced, thereby counteracting the standard frequency effect. Whatever the explanation, the results clearly demonstrate an early effect of arousal that is modulated by word frequency. This suggests that the differential activation to at least a subset of high arousal words must engage brain mechanisms that are operative during early visual processing. Accumulating evidence in visual object processing has demonstrated that semantic analysis is more rapid than has been traditionally assumed (e.g., Thorpe et al., 1996) and that top-down feedback can begin to affect processing in sensory areas after 80 ms post-stimulus (e.g., Foxe and Simpson, 2002).

In sum, this experiment shows that the emotional tone of a word modulates its early lexical processing. Past N1 effects of lexical processing, as indexed by the presence of word frequency effects, were replicated. These effects were extended by demonstrating that such effects were modulated by the emotional characteristics of the word stimuli. Effects of emotion specifically for HF Negative words occurred as early as the P1. While emotion modulated early processing, in general its effect was more transient than word frequency. HF emotion and neutral words were differentiated in the post-N1, EPN. However, by the P300/N400, only effects of frequency were evident.

The experiment, however, has certain limitations. While the ERP methodology provides a rich temporal record of events, the precise neural mechanisms involved are less accessible. For example, it has often been suggested that the amygdala plays a role, having reciprocal connections to visual cortical areas. However, the timing of such activation (~800 ms post-stimulus; Naccache et al., 2005) is estimated to occur well after lexical access. There is a need to explore temporally more plausible determinants of emotional effects on word recognition. A second concern is that the presentation of words in isolation using a specialized task involves the recruitment and application of strategies not found in normal reading. Visual word recognition typically occurs during normal reading, where individual word meanings are activated and integrated on-line into a developing discourse context. This concern is addressed is subsequent chapters when emotion word processing in normal reading is investigated by examining participants' eye movements.

Chapter 3

Introduction

The results presented in chapter two set emotion word processing in a new light. We now know that the emotionality of a word interacts with its frequency and influences processing in early stages, reflected in ERP differences in the P1 and N1 components. Following on from reports of an emotion x frequency interaction in the N1 (135-190m post stimulus onset) reported in Scott (2005), data presented in Chapter 2 detail effects in the P1 window (80-120 ms). This follows previous reports of emotional effects in the P1 (Skrandies, 1998; around 100ms) and in the P2 (e.g., Kanske & Kotz, 2007, in the 210-300 ms window; Schapkin et al., 2000, peaking around 230 ms).

These findings underline the importance of being able to investigate word processing by capturing effects in real time. Only by employing such appraisals will we be able to more accurately determine the order in which different factors influence the processing of emotional words, and the levels at which they interact. For this, eye movements are ideal as they capture the moment-to-moment processing of text as reflected in the pattern of eye movements. Eye tracking is a well established tool in the investigation of a wide array of linguistic questions (for a review, see Rayner, 1998). Roelofs (2007) states (p. 233): "Whereas before . . . the eyes used to be poetically called a window to the soul, Wundt (1897) took gazes to be a window to the operation of the attention system."

It is because of eye-tracking, for example, that we know that low-level variables such as word length strongly influence both where readers fixate next and the amount of time a reader fixates on a word (Rayner et al., 1996; Kliegl et al., 1982). Through the employment of eye-tracking methodologies, including gaze-contingent paradigms, Rayner and his colleagues were able to conclusively prove that frequency influences word processing at a (previously doubted) early stage, and to begin to construct a time line relating lexical properties and their order of processing (e.g., Reichle & Rayner, 2002; Sereno & Rayner, 2003; Sereno et al., 1998). The principle advantage of eye-tracking over behavioural methodologies is that the participant can read words under normal conditions, without having to press response buttons or name words under time pressure (Underwood & Bat, 1996).

To date, it is mostly emotive scenes, pictures, and faces which have been investigated using eye movements, usually in relation to attention. The area of attention and the issues involved with attention and the placement of emotional objects in different positions of visual space will be briefly examined below. Relevant work concerning the recording of eye-movement measures towards emotional pictorial stimuli will then be discussed and the issue of how such techniques can be modified to examine emotional word processing addressed.

Attention

One question of interest for investigators involved in the study of eye movements, towards both textual and pictorial stimuli, is how we discriminate between everything that illuminates our retinas and what appears in our visual fields. What makes us select information for further processing whilst ignoring other information? The processes of reading and word recognition are fundamentally connected to the phenomenon of attention.

Dual theories of attention (Barrett, Tugade, & Engle, 2004) differentiate between the two sub-categories of voluntary (or ‘endogenous’ or ‘overt’) attention and reflexive (or ‘exogenous’ or ‘covert’) attention. Endogenous orienting refers to the ability of the individual to consciously control attention; exogenous orienting is when a sensory event associated with a stimulus captures our attention automatically.

Attention can be defined as the cognitive brain mechanism which enables one to process relevant inputs, thoughts, or behaviours whilst ignoring irrelevant ones (Gazzaniga et al., 2002). It is considered to be a covert mechanism since humans and primates can attend to space without overt adjustments of external sensory structures (e.g., one can direct visual attention without moving the eyes). The present assumption is that visual covert attention is a mechanism for quickly scanning the visual field for interesting locations. This shift in covert attention is linked to eye movement circuitry that creates a subsequent saccade to that location (Wright & Ward, 2008).

Findlay and Gilchrist (2003) successfully used eye-tracking techniques to demonstrate the tight coupling of covert and overt attentional shifts. They showed that covert attentional shifts are closely followed by overt shifts. The eye-tracking methodology has also been used to address a host of other issues related to vision and attention as overt, behavioural manifestations of the allocation of attention (i.e., eye movements) can be observed and the functioning of the attentional system can be probed in real time. This allows issues such as the distinction between initial orienting and subsequent engagement of attention to be investigated.

The role of attention has been investigated with respect to pictorial stimuli, but its role in the attentional properties of different categories of text in different spatial positions, is still largely unexplored. Relevant studies which have used both pictures and words will be discussed shortly, but first the relationship between spatial position and affect (Lakoff & Johnson, 1980), which is central to much of the key literature, is described.

Spatial Position and Affect: Pictorial Stimuli

Although associations between affect and spatial positions are prevalent in mainstream culture, there has been little research examining this relationship in reading. In everyday life, objects that are spatially up or high are often considered to be 'good'; objects that are spatially down or low are, conversely, considered to be 'bad'. In the Bible, for example, the virtuous go *up* to Heaven, while the sinners go *down* to Hell. Popular slang is also replete with these associations: consider drug users who 'get high' after smoking a joint but 'come down' when the ecstasy of the drug diminishes.

Although few experimental studies have corroborated the association between affect and spatial markedness, some evidence does exist to suggest the link is not entirely metaphorical conjecture, but is rooted in the way in which we organise our thoughts about the world around us. An early study by Wapner et al. (1957) found that participants who just received an 'A' on an exam displayed an upward bias in a vertical bisection task. However, students who just received an 'F' exhibited a downward bias in the same task. In related work, Fisher (1964) found that participants experiencing a great deal of sadness had a downward bias when tracing the path of an autokinetic cue relative to those experiencing less sadness. A later study by Stepper & Strack (1993) had participants adopt either an upright posture or a slumped down posture while performing a task. The participants reported feeling more pride if they were successful when an upright rather than slumped position had been maintained.

One explanation of why affect is related to physical representation (e.g., vertical position) is based on Jean Piaget's developmental theory. According to this view, human cognition matures through means of moment-to-moment reactions to sensorimotor experiences. As children age, they begin to develop more complex representations of their environment, eventually achieving abstract thought processes. These later, more advanced operations are, however, still based upon the early sensorimotor representations.

For example, eating sweet foods leads to a pleasant taste (sensory experience) and positive affect (abstract state). In adulthood, this pairing of sensory and abstract representations may give rise to a physical metaphor (e.g., a sweet person is a pleasant person) which exerts subtle influence on representations and evaluation. Lakoff and Johnson (1999) build on this notion by contending that abstract thought is not just aided by physical metaphors, but is instead based on them. They argue that metaphors allow people to think conceptually because they link abstract concepts such as affect to tangible sensory experiences.

There is certainly laboratory-based evidence to suggest that humans automatically correlate affect and spatial position. Crawford and Cacioppo (2002) reasoned that the combination of spatial and affective information is essential for many approach and avoidance behaviours, and thus for survival. Positive stimuli may signal opportunity while negative stimuli may signal danger. As it is more important to detect danger (as it's easier to recover from a missed opportunity than a failed escape), Crawford and Cacioppo hypothesised that responses to negative stimuli would be stronger than responses to positive stimuli. Over two experiments they presented pictures to participants and had participants 'guess' where on the screen that picture was going to appear. Each participant saw pictures either in the range negative-neutral or in the range positive-neutral, and with affect correlated to either right or left spatial position to a strength of either r=0.3 or r=0.8. In the first experiment, pictures were not controlled for arousal but in experiment 2 they were, and arousal was slightly stronger for the positive items than for the 6 negative ones (arousal ratings of 7 vs. 6). Participants first viewed a training block in which distributions of valence to spatial position were manipulated and then the experimental block which contained 16 novel items. As predicted, participants who saw pictures with left-side affect in the negative-neutral range better predicted the position in which the stimuli would appear than participants who viewed the positive-neutral pictures. This shows that even in a short space of time participants can infer correlations between affect and spatial position (although they did so subconsciously, all participants reported that they were guessing randomly).

Crawford, Margolies, Drake and Murphy (2006) carried out 3 experiments to further support the notion that affect and spatial position are linked. They presented participants with affective pictures at various positions on the screen. It was shown that when participants were asked to recall the presentation location of these images they showed an upwards bias for pictures of a positive valence, and a downwards bias for pictures of a negative valence. These bias were present when participants had to recall the pictures' positions immediately (experiment 1) and after a delay (experiment 2). In the third experiment the same biases were shown when participants were asked to recall yearbook pictures of individuals with positive or negative behavioural descriptors.

In the context of the current investigation this is encouraging. If participants build up an accurate correlation between spatial position and affect within the confines of an experiment (and over a very short period of time), then it does not seem unlikely that they could have built up a positive-negative correlation with top-bottom spatial position tied to the associations, defined above, to which they have been exposed throughout their lives. Given the findings of Crawford and Cacciopo, however, it is possible that this association between affect and spatial position will not be uniform over the vertical axis, with 'bottom=bad' possible carrying more weight than 'top=good'.

As has already been discussed in previous chapters, the top-bottom (vertical) spatial dimension is a relatively important one. In Zwaan's (2004) portrayal of the 'immersed experiencer' he points to Franklin and Tversky's finding that this dimension, while not as salient for language comprehenders as the 'front-back' dimension, is nevertheless more salient than 'right-left'. If accurate, it would make this dimension, and by association any values associated with this (such as affect), particularly important and easily accessible.

Further evidence of the importance of the vertical dimension comes from a paper by Huttenlocher, Hedges, Corrigan, and Crawford (2004) which showed that humans automatically organise visual space using vertical and horizontal axes. In a series of experiments asking participants to reproduce dots at their original locations within a circle, it was shown that individuals used these axes to divide the circle into quadrants, and that biases in response usually involved shifting into the centre of these 'quadrants', even when diagonal were explicitly shown. Given the importance of axes – in particular the vertical axis – in human spatial organisation, and its salience in the 'immersed experiencer' model (Zwaan, 2004), it is of great interest to establish the extent to which affect is mapped onto this dimension, and the role it plays in capturing attention.

If the theories of grounded cognition discussed in the introductory chapter are correct (e.g., Barsalou's (1999) theory of perceptual symbol systems), then this adds new weight to the arguments presented above. Rather than merely an association of 'up' being attached to positive words, and 'down' to negative words, embodied cognition would claim that these spatial positions are attached to the words in the relevant brain areas, and activated when the words are read. When a positive word is read, therefore, not only is the spatial position 'up' activated, but the reaction of the motor system to look in that direction is also activated, as are other associations with the top (vs. the bottom) position in space. This gives the individual an urge to look up rather than down, then, and should facilitate the reading of positive words when presented in a top spatial position (or bottom words in a bottom spatial position)

Researchers asking questions regarding the conceptual organisation of thought have made full use of both behavioural and eye-tracking methodologies by scrutinizing the interaction of a stimulus' affect and spatial location. While early studies provided invaluable insights through methods such as the dot-probe technique and visual search paradigm, more recent eye-tracking investigations have paved the way for the current analysis of affective text presented in different spatial locations.

Posner and Cohen (1984) carried out a study to investigate attentional influence on spatial bias and demonstrated that RTs to orient to target locations can be faster when automatic rather than conscious attention is invoked. Participants were presented with three boxes in discrete positions on the screen and were asked to press a button when they detected a target in one of the boxes. At a brief interval before the onset of the target, a flash of light would also appear in one of the locations with the purpose of attracting attention to that location. On some trials the flashing light would be in the same box as the target and on others it would not. As such, the light was completely uninformative with regards to the later position of the target. This method cued exogenous attention as participants did not consciously decide whether or not to attend to the box with the flashing light.

It was found that when the cue preceded the target by up to 150 ms, participants were significantly faster at detecting the target at that location. At longer delays of 300 ms and above, the opposite was found – participants were slower at detecting a target in the same location as the cue. The explanation for these results assumes that attention initially shifts to the cued location but, if the target does not appear imminently, it quickly shifts to another location. This slowing of RT is known as inhibition of return (IOR), where the recently attended location becomes inhibited over time such that responses to stimuli occurring there are slowed (Ward, 2006).

The occurrence of IOR provides many implications for researchers in cognitive psychology. In exogenous cuing tasks, if there is too long of a delay before onset of the target this may impede participants' performance, particularly in spatial position studies which are discussed next – since spatial position is partly related to IOR (Tipper et al., 1991). Indeed, of the studies reviewed in Chapter 1, several (e.g., Kakolewski, Crowson, Sewell, & Cromwell, 1999; Fox, Russo, Bowles & Dutton, 2001; Schutzwohl & Borgstedt, 2005) employed target detection at various spatial positions after varying SOAs. Although such questions have never been explicitly asked about textual stimuli, the same principle could apply to words. If one of the cues presented in such a task (e.g., an emotional or neutral word changing into bold font) were to capture attention in the same manner as the flashing light in Posner and Cohen's (1984) experiment, the IOR phenomenon could influence results in ways not considered by researchers focused on other issues, such as the effects of unilateral presentation.

Eye Tracking and Attention

It is only recently that researchers have begun to utilize eye-tracking to investigate the dual issues of attention and affect. To date the issue of spatial position has not been addressed but already many questions regarding the nature and control of attention relating to affective pictorial stimuli have been resolved. Based on this past research, two recent studies by Hyönä, Nummenmaa and Calvo have emerged, both of which stem from Calvo and Lang's (2004) research. Calvo and Lang presented pairs of emotional scenes to participants and asked them to decide if they were different or similar in valence. It was found that emotional pictures were fixated more immediately, and for longer, within the first 500 ms.

This technique was repeated by Nummenmaa, Hyönä, and Calvo (2006), but was better controlled. They used 16 positive, 16 negative and 16 neutral pictures repeated twice over two experiments. Experiment 1 was a replication of Calvo and Lang (2004), while in Experiment 2, participants were asked *either* to direct their gaze to the emotional picture *or* to the neutral picture and keep fixated there. Pictures were presented in opposite corners of the screen for 3000 ms. Their scenes were taken from Lang, Bradley, and Cuthbert's (2005) IAPS (International Affective Picture System) database and were controlled for valence and arousal. They also controlled for physical characteristics of the stimulus (such as density) and used more sophisticated tracking techniques than had been employed in Calvo and Lang.

The results from Experiment 1 were similar to their predecessors' findings. They showed that the first fixation was more likely to be on an emotional than a neutral picture, and that first pass and gaze duration measures also showed a greater frequency of subsequent fixations on emotional than on neutral pictures. There was no difference found in these measures between emotionally pleasant vs. unpleasant stimuli.

In Experiment 2, participants demonstrated a strong orienting bias towards emotional pictures (again, equally to pleasant and unpleasant) even when they had been specifically instructed to avoid them. Despite this there was some evidence that a certain degree of control was possible – the probability of making a first fixation on emotional targets was lower in the attend-to-neutral condition.

There *was* a bias towards emotional pictures in early attentional engagement. The proportion of gaze duration for emotional pictures (relative to neutral pictures) in attend-to-emotional condition was greater than for neutral pictures (relative to emotional pictures) in the attend-to-neutral condition. In latter stages of attentional engagement there was an equally strong systematic bias towards emotional pictures in the attend-to-emotion condition and towards neutral pictures in the attend-to-neutral condition. The task manipulation, therefore, was most effective in later processing stages.

The conclusion drawn was that emotional pictures, be they pleasant or unpleasant, capture overt visual attention. From these results it would appear that voluntary avoidance control, an endogenous sub-category of attention, only becomes possible with additional time. This can be seen as there was a greater probability of fixating first on an emotional than a neutral picture, even when participants were explicitly instructed not to do so. The fact that the instructions to attend-to-neutral were not as effective as attend-to-emotional (as measured by gaze duration) also implicates early attention engagement.

The author, however, point to two pieces of evidence which demonstrate that endogenous attention does exert some influence. First, the mean latency recorded for the initial fixation on a picture (460-490 ms) was significantly longer than the mean latency of a typically observed reflexive saccade (150-175 ms; Rayner, 1998). Second, the probability of a first fixation on an emotion picture was reduced in the attend-to-neutral condition, implying that some degree of control and inhibition is possible.

Calvo, Nummenmaa, and Hyönä (2007) presented to participants 128 photographs – 64 neutral, 32 positive, 32 negative – all depicting people in emotional states. The experiment employed a 2 [prime presentation (single vs. dual), between subjects] x 3[valence of probe (positive, negative, control)] x 2 [prime-probe relationship (identical, not identical)] x 2 [visual field (left, right)] design. Each participant saw each prime presented twice in the RVF and twice in the LVF. The prime picture scenes (one emotive, one neutral) were presented peripherally 5.2^{o} of visual angle away for 450 ms, then a mask was presented for 500 ms, and finally a probe for recognition (identical or related) was shown.

Results showed an interaction of prime type (single vs. dual) and scene valence. Participants showed poorer identification of neutral scenes in the dual prime condition due to stimulus competition. The hit rate was higher for emotional than neutral scenes in dual prime condition and there was evidence of impairment in sensitivity in dual prime for control but not emotional pictures. The authors suggest this to be indicative of reduced attentional resources devoted to control pictures in the presence of emotional pictures. The fact that there was no effect in the single prime condition rules out an alternative explanation, such as the effect being due to greater distinctiveness or less complexity, etc., of one of the sets of stimuli. This is an explanation which has been posited in the past based on results from other paradigms such as the dot-probe and visual search tasks (e.g., Mogg et al., 2004).

Overall, participants showed an advantage for processing emotional over neutral information even when there was no competition for resources. Emotional stimuli were also shown to engage attention more even when presentation was task-irrelevant. Calvo and his colleagues point to two possible explanations to explain this: selective orienting and encoding efficiency. Both of these were explored in this study and evidence for both was obtained.

Emotional scenes were more likely to be fixated first. This suggests something about these scenes must be perceived covertly (pictures were controlled for luminance, colour, etc., factors which are usually associated with such salience advantages) and so this points towards a selective orienting mechanism. On the other hand, shorter fixations were shown on emotional scenes and shorter times were required to accurately identify emotional scenes covertly. Also, there were more of these shorter fixations on emotional scenes suggesting they were scanned more quickly. This provides support for a processing efficiency mechanism.

These studies demonstrate the power of eye tracking to answer questions that other techniques are only able to pose. By recording participants' moment-to-moment fixations and saccades, a precise time-line is built up without uncertainty about eye position that accompanies attention research that does not use an eye-tracker. In these three studies, it was confirmed that any emotional pictorial stimuli, positive or negative, captured attention, and delineated the extent to and conditions under which exogenous attentional shifts could be inhibited. Following such striking results it seems natural to apply some of the techniques described above to the processing of affective text, its spatial position and attention-grabbing properties. A few recent papers dealing with the issue of affective text and spatial position are discussed below. Some questions that remain unanswered are identified and the current study is then described.

Spatial Position and Affect: Text

The relationship between vertical position and affect was examined by Meier and Robinson (2004) in two studies. The first of these studies was conducted to determine if affective judgments are facilitated when they are congruent with metaphors related to vertical position. Participants evaluated 100 words as either positive or negative and the position of the words was randomly assigned to either the top or bottom of the screen, so that valence and position were orthogonal. In a second study, they then sought to show that affective judgments activate areas of visual space using a sequential priming paradigm, this time without the manipulation of vertical position.

Results from the first experiment showed a congruence effect: positive words were evaluated faster when they appeared in the top position, and evaluations of negative words were faster when they appeared on the bottom. They extended these results in the second study by showing that evaluations bias spatial attention in a metaphor-consistent direction (e.g., “good” activates “up”). The results of this investigation provide strong evidence of an automatic association between affect and vertical position. The authors’ reasoning behind study two was that, if affective judgment is based on physical metaphor, making such a judgment should activate areas of visual space. Their results offer confirmation of this hypothesis suggesting that, when making evaluations, people automatically assume objects that are high in visual space are good, whereas objects that are low are bad.

In a similar study, Schnall and Clore (2004) investigated the consequence of spatial and conceptual congruence on evaluations. Specifically, they examined the effect of a match of two different conceptual relations with their corresponding spatial relation. The spatial dimension was verticality (up vs. down) and the two conceptual dimensions were valence (good vs. bad) and concreteness (concrete vs. abstract). The stimulus word, which consisted of either a good or bad word that was either abstract or concrete, was placed on the top or the bottom of a page on which participants evaluated the word. They found that abstract good things were rated better when they were presented on top of the page but, perhaps more surprisingly, concrete bad words were also rated as better when presented on the bottom of the page.

The finding regarding negative words appears to be partially contradictory to Meier and Robinson (2004). It would seem logical that placement on the bottom of the screen would add to the negativity of negative words, but this is apparently not the case. The authors explain this counterintuitive finding by arguing that conceptual relations are inherently connected to spatial relations. They propose that people are more familiar with spatially represented concepts and, subsequently, this familiarity leads to a more pleasant experience – for negative words as well as positive words. Even though a negative stimulus is always negative, we derive some comfort from seeing it in its proper place. We would rather see a demon down in hell, for example, than up in heaven.

There seems to be strong initial evidence that there is a real coupling of affect and spatial position, and that it exists not just for pictorial stimuli but for text also. This is not to say that affective words will capture attention in the same way as emotional scenes, however. If, as hypothesised in Chapter 1, our seeming preference for affective stimuli does come from some evolutionary survival mechanism, then such a mechanism would surely be more fine-tuned to scenes and faces than to words.

The fact that positive words seem to ‘belong’ in a high space and negative words in a low space complicates matters further.

The Current Experiment

This experiment sought to replicate and extend Nummenmaa et al.’s (2006) study by using affective and neutral words rather than pictures, and presenting the stimuli simply above or below the fixation point rather than in opposite corners of the screen. We have seen a clear association between affect and spatial location (up vs. down) which suggests words of different valence are processed differently, often contingent on verticality. On the basis of this evidence, the aim of this study was to examine eye movements in reading of affective words (positive, negative, and neutral) at different vertical positions (top or bottom).

No study has investigated the processing of affective words and verticality using eye movements, but instead behavioural paradigms have been employed. Specifically, it is hypothesized that positive words will be recognised faster when they are on the top, whereas negative words will be recognised faster when they are at the bottom. It is also expected that high-frequency words will be recognised faster than low-frequency words independent from valence.

Method

Participants

Sixteen participants (7 male, 9 female) took part in the experiment. All were right-handed native English speaking volunteers who did not suffer from dyslexia. The majority of the participants were around undergraduate age (mean = 22; range: 19-24). All had normal or corrected-to-normal vision and were naïve as to the purpose of the experiment. They were recruited through advertisements placed around the university campus. In accordance with the guidelines set by the University's ethics committee, written informed consent was obtained prior to experimental participation.

Apparatus

Participants' eye movements were tracked using a SR Research Desktop Mount EyeLink 2K eyetracker. This had a spatial resolution of 0.01 degrees and eye position was sampled at 1000 Hz using pupil/corneal reflection tracking. Text (black letters on a white background, in a 20 point non-proportional font) was presented on a Dell P1130 19" flat screen CRT monitor with an 800 x 600 resolution. The monitor was run at 170 Hz (5.88 ms per screen refresh). Participants were positioned at a viewing distance of approximately 72 cm, and 3 characters of text subtended 1 degree of visual angle. The position of the chin rest meant that participants' eyes were not horizontally aligned with the central fixation cross, but were always slightly higher. Although viewing was binocular, eye movements from the right eye were recorded.

Design

A 2 (Word Frequency: HF, LF) x 2 (Word Position: top, bottom) x 6 (Target-Mate Condition: C-N, C-P, N-C, N-P, P-C, P-N) within-subjects design was employed. Target-Mate condition names refer to the emotionality of each, with positive (P), negative (N), or neutral control (C) words. The dependent measure was participants' RT to an exogenous cueing task.

Stimuli

The stimuli used were the same sets of words triples employed in Chapter 2. The sets of words were comprised in the following twelve conditions: HF words (C-N; C-P; N-C; N-P; P-C P-N) and LF words (C-N; C-P; N-C; N-P; P-C; P-N) where each of the listed conditions were displayed twice: once with the target on the top, and once with the target on the bottom. Each word was therefore presented eight times: twice as a target in the top position, twice as a target in the bottom position, twice as a distracter in the top position and twice as a distracter in the bottom position.

Stimuli were presented over 960 experimental trials, split by 10 blocks with 96 trials per block (within LF words: 160 trials each for PN, CN, and CP pairings (for PN, for example, 80 trials when N is on top, 40 of which N is the target, and 80 trials when P is on top, 40 of which P is the target; and the same for HF words). Each trial began with a fixation circle appearing at the centre of the screen. When the eye-tracker program determined that the participant was directly fixating on this circle, the upper and lower words appeared. After a delay of 334 ms, one of the words changed from normal into bold font. This was the attentional cue for the participants. If the participant successfully moved their eyes to the target (i.e., the word in bold), the central fixation circle reappeared, and the next trial would begin. If the participant looked in the wrong direction (at the other word, or somewhere else on the screen), the two words remained on the screen, either until the target was fixated or until 4000 ms elapsed, whichever came first. Each block of trials was preceded and succeeded by a calibration procedure for which the subject was required to saccade to nine small crosses that were sequentially presented in a square array of positions separated by 6° horizontally and vertically.

Procedure

Participants were taken to a designated room in the Glasgow University Psychology Department. They were shown an instruction sheet and asked to read and sign the consent form. They were first presented with written instructions for the eye-tracking task before being instructed again verbally and any questions they had were answered. They were asked to place their head in a head rest and this was adjusted until the participant confirmed they were comfortable. They were told a 9-point calibration would occur first, which would consist of 9 points appearing randomly on the screen and this would be repeated to validate the initial calibration. Participants were instructed that a central fixation point would appear after this and they should look at this point, after which a word would appear above and below this point. They were told one of these words will turn from normal into bold font. They were asked to keep their eyes on the fixation cross until the bold onset, and then to look at the bold word as quickly as possible. Participants were also informed they could have a break at the end of every block.

Results

The target region comprised the target word (that had changed into bold font) and the region of space immediately surrounding it. Three independent measures of eye movement behaviour were used: saccadic latency to the target, percentage of saccade errors, and percentage of saccade anticipations. Saccadic latency to the target was measured from the onset of the bold change. In line with previous research (e.g., Walker et al., 2000), upper and lower latency cutoffs of 666 ms and 66 ms, respectively, were used. Only correct trials were included for the saccadic latency measure. For percentage of saccade errors, only trials in which the first saccade from the central fixation was to the non-target were included (the mate; i.e., the word in normal font). For percentage of saccade anticipations, only trials when the first saccade from the central fixation was to the (eventual) target were included, but when these saccades were made before the target changed into bold font. The relative percentage of data included in each measure was as follows: 48% for saccadic latency, 19% for percent error, and 11% for percent anticipations, which translates to approximately 461, 182, and 106 data points per participant per condition, respectively. The remaining 22% of data were unusable because the first saccade was to another screen location or there was a track loss or blink during the target event.

A 3-way within-participants analysis of variance (ANOVA) – with the factors of Position (Top, Bottom), Frequency (HF, LF), and Target-Mate Condition (C-N, C-P, N-C, N-P, P-C, P-N) – was performed on saccade latency, percentage of errors made and percentage of trials anticipated. The participant means across all measures are reported in Table 3.1.

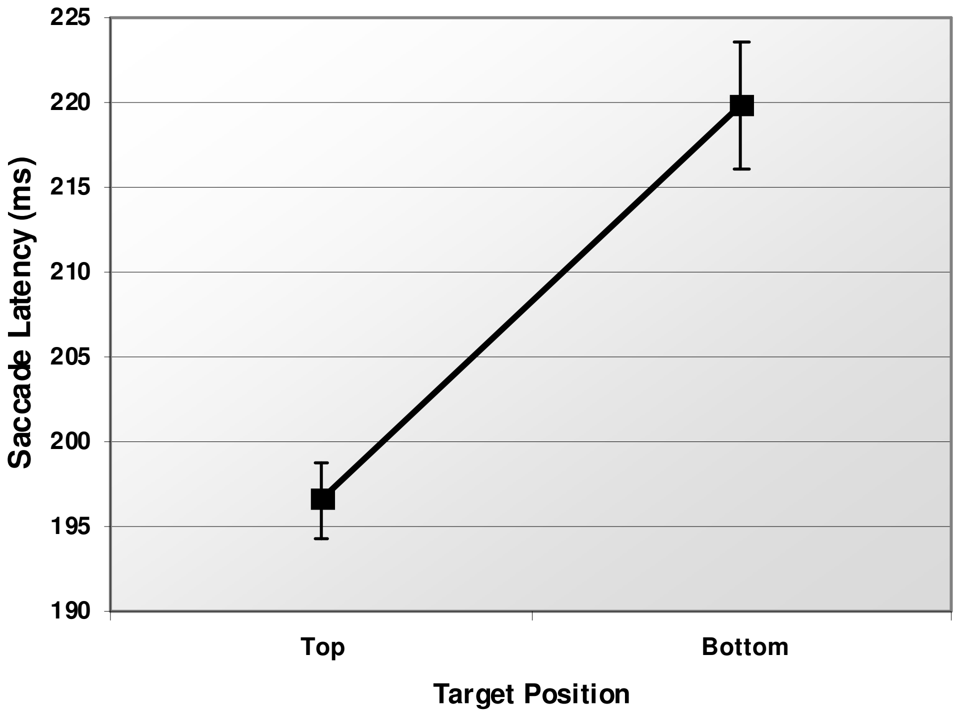
Saccade Latency

Saccade latency is the time taken from the target changing into bold font to the commencement of the saccade. There were main effects of target position [$F(1,15)=7.907$, $MSE=51819.162$, $p<.05$] and a marginal effect of target-mate condition [$F(5,75)=1.98$, $MSE=51819.162$, $p=.091$], however, no effect of word frequency was found [$p=0.94$]. As specified in the previous chapter, a marginal effect has a significance value of $.05<p<.10$, and a non-significant trent effect has a significance value of $.10<p<.15$, as per convention. There were no significant interactions [all Fs<1]. Mean latencies to target words in the top position (197ms) were significantly faster than those to target words in the bottom position (220ms) as illustrated in Figure 3.1. There was no difference in latency times to LF compared to HF words.

Table 3.1. Mean saccade latencies (in Milliseconds), Percentage of errors and percentage of anticipations across Position, Frequency and Target-mate condition.

Measure	**Saccade Latency (ms)**	**Percentage Errors (%)**	**Percentage Anticipation (%)**
Position			
Top	196.5	8.5	15.4
Bottom	219.8	30.2	6.9
Frequency			
HF	208.3	19.0	11.1
LF	208.0	19.6	11.2
Target-Mate			
C-N	202.4	19.3	11.3
C-P	208.6	20.8	10.1
N-C	209.1	18.2	10.3
N-P	205.8	20.3	11.2
P-C	206.4	20.5	11.3
P-N	216.6	16.9	12.8

Figure 3.1. Means across Target position (Top versus Bottom)



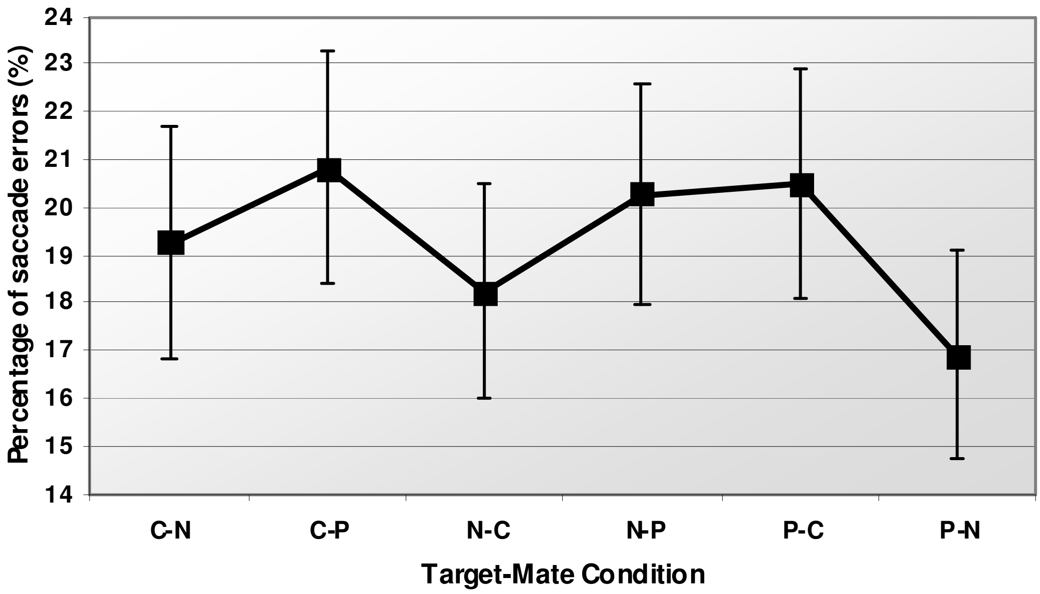
As the main effect for Target-Mate was marginally significant, follow-up Scheffé contrasts were performed in order to further investigate any pattern which might be present. The 15 post-hoc contrasts revealed a number of significant and marginal effects between conditions. There was a statistically marginal effect for the C-P versus P-N comparison [$F(1,15)=2.791$, $MSE=2067.486$, $p=.099$]. There were significant effects for three other comparisons: C-N versus P-N [$F(1,15)=8.728$, $MSE=6464.84$, $p<.01$]; N-P versus P-N [$F(1,15)=5.10$, $MSE=3777.652$, $p<0.05$]; and P-C versus P-N [$F(1,15)=4.537$, $MSE=3360.668$, $p<.05$]. It seems that all these differences arose from the fact that the slowest saccadic latencies were in the P-N condition. In this condition, both the target and non-target were high arousal words and the participant was cued to look to the positive and not the negative word.

Percentage of saccade errors

Percentage of saccade errors comprises trials where the first saccade from the central fixation circle was to the non-target word. There was a main effect of target position [Target position: $F(1,15)=38.962$, $MSE=45012.516$, $p<.001$] and of target-mate condition [$F(5,75)=4.906$, $MSE=146.344$, $p<.001$] but no effect of frequency [$F<1$]. There were no significant interactions [all Fs<1]. Mean percentage of errors to targets in the bottom position (30%) were significantly greater than those to targets in the top position (9%).

The main effect of Target-Mate was found to be significant and the 15 post-hoc Scheffé contrasts detailed a number of significant effects, as well as effects which were marginal to trend, between conditions. There was an effect to non-significant trent for the C-N versus C-P comparison [$F(1,15)=2.619$, $MSE=78.125$, $p=.110$]. There were significant effects for seven other comparisons: C-N versus P-N [$F(1,15)=5.893$, $MSE=175.781$, $p<.05$]; C-P versus N-C [$F(1,15)=7.13$, $MSE=212.695$, $p<.01$]; C-P versus P-N [$F(1,15)=16.369$, $MSE=488.281$ $p<.001$]; N-C versus N-P [$F(1,15)=4.426$, $MSE=132.031$, $p<.05$]; N-C versus P-C [$F(1,15)=5.318$, $MSE=158.643$ $p<.05$]; N-P versus P-N [$F(1,15)=12.106$, $MSE=361.133$ $p<.001$]; and P-C versus P-N [$F(1,15)=13.555$, $MSE=404.346$, $p<.001$]. It is worth noting the P-N condition appears to be implicated in four of seven of these significant effects since the P-N condition included the lowest proportion of errors (17%) suggesting a speed-accuracy trade-off may be active (see Figure 3.2).

Figure 3.2. Means across Target-mate conditions (CN; C-P; N-C; N-P; P-C; P-N).



Percentage of saccade anticipations

Percentage of saccade anticipations measures the proportion of trials when the first saccade from the central fixation was to the target, but was made before the word changed into bold font and, hence, was an anticipation. Main effects of target position [$F(1,15)=17.707$, $MSE=7004.167$ $p<.001$] and target-mate condition [$F(5,75)=2.564$, $MSE=57.721$, $p<.05$] were reported, though an effect of word frequency was not found [$F<1$]. There were no significant interactions [all *F*s<1]. Means across target position show twice as many anticipations to the target word when the target word was on the top than on the bottom (15% versus 7%, respectively).

The pattern of means revealed a significant effect of Target-Mate condition, and post-hoc Scheffé contrasts reported three marginal effects and two statistically significant effects between conditions. There was a statistically marginal effect for the C-N versus P-N comparison [$F(1,15)=3.299$, $MSE=74.268$, $p=.073$]; the N-P versus P-N comparison [$F(1,15)=3.47$, $MSE=78.125$, $p=.066$]; and the P-C versus P-N comparison [$F(1,15)=3.299$, $MSE=74.268$ $p=.073$]. Two significant comparisons were found between C-P versus P-N [$F(1,15)=10.326$, $MSE=232.471$, $p<.01$]; and N-C versus P-N [$F(1,15)=8.608$, $MSE=193.799$, $p<.01$]. In general, it seemed that there were more anticipations to the positive target in the P-N condition than any other target in the other conditions.

Discussion

This study sought to determine whether words with emotional content capture our attention, and whether their position in visual space might facilitate or inhibit any inherent attention-capturing properties. Eye-movements were monitored while participants were cued to view high-frequency and low-frequency words of positive, negative and neutral valence in high and low spatial positions. Words in the top spatial position were shown to be viewed quicker than words on the bottom. Saccadic latencies in the P-N condition (a positive target word versus a negative non-target word) were shown to be longer than in any other condition, albeit only marginally. It was also in this P-N target-mate condition that participants committed the least number of errors, as would be expected in a speed-accuracy trade-off.

That the P-N target-mate condition is heavily involved in the majority of these effects (albeit some are only marginally significant) is some demonstration that, at least to some extent, this particular pairing of word-type is different from the other conditions. The most obvious explanation for these findings is that the P-N condition is the most salient of all the pairs of stimuli presented. This possibility, along with other possible explanations and a discussion of the limitations of the experiment, will be dealt with after the main finding of saccadic latency on target position is discussed.

Targets in the top position were fixated on faster than targets in the bottom position. This effect is independent of target-mate. As there is therefore no implication of spatial position and affect influencing this result, an alternative explanation must be found. An obvious conclusion is that participants have some inherent preference for fixating 'up' than for fixating 'down'. This is supported by the fact that there were also more anticipations to targets in the top position compared to the bottom position.

As noted in the methods section, participants' eyes were not aligned to be directly in line with the central fixation cross. Due to the location of the chin rest the positioning of all the participants was such that their eye-line was above the central fixation cross, and was often in the majority of cases was also above the word presented in the top position. It could simply be the case that, from this vantage point, it was more comfortable, or easier, for participants to fixate on the top word which was closer to their horizontal line of vision than to fixate further downwards to the word in the bottom position. Such physical factors could easily override the salience of any particular word type, or the metaphorical mapping of affect onto spatial position, and the only way to discount such an explanation would be to repeat the experiment and employ more rigorous controls as regards the position of participants relative to stimuli.

If the positioning of participants was not a confound, however, there is another explanation which accounts for the findings. In 2005 Chan and Bergen carried out a series of 3 experiments with native readers of English (who read from left-to-right, top-to-bottom), (mainland) Chinese native speakers (who read left-to-right like English, but was historically read right-to-left) and Taiwanese native speakers (who read right-to-left) to investigate the interaction with writing systems as a component of how literate humans gain and convey information. Experiment 1 showed that, in a recollection task, English and Chinese speakers remembered more objects that had been presented in the top-left quadrant, but Taiwanese speakers remembered more objects presented in the top-right quadrant. In experiment 2 participants were shown 10 pairs of pictures and asked to compose a sentence starting with the object they saw first. For English and Chinese speakers the object on the left was typically the subject, whereas for Taiwanese speakers it was the object on the right. In the final experiment participants had to arrange 'in order' pictures of the same object in various stages of growth (e.g., a sapling, a tree, a stump). Left-to-right was the only order used by English-reading participants, and was the most common order used by Chinese. Each order equally likely to be used by Taiwanese participants

Results from other paradigms have previously shown similar results as regards left-right and right-left reading: Italian speakers place the agent (which came first in a story) to the left of the patient and Arabic speakers do the opposite; French speakers place small numbers towards the left and large numbers towards the rights whereas Iranian speakers do not (Dehaene *et al*., 1993's SNARC effect). The results from Chan and Bergen (2005) were the first to demonstrate that, as well as left-right (in the case of English readers), information is also thought of from top-to-bottom. This innate preference to begin observing/examining information starting at the top-left, as one would do when reading or scanning a page of text, could explain the results of the current study, especially as the stimuli used here was text and so that particular strategy would be especially salient.

Other than an attraction to the stimulus in the top position, the other noticeable result from the current experiment concerned the P-N target-mate condition (where the target was a positive word and the mate – or distracter – a negative word). When this particular target-mate condition was presented to participants, they were slower to fixate on the target once it had turned bold (the effect of saccadic latency on target-mate was marginal), they had a smaller percentage of saccadic errors than several other target-mate pairings, and there were, in general, more anticipations to the target when the target was positive and the distracter was negative than in any other condition.

As discussed at length in the introduction, high spatial positions are thought of as good, and low ones as bad. This transcends the notion of linguistic markedness (Trask, 1999). At a basic level, an unmarked word is usual or dominant, characterized as a basic or default form (e.g., male forms in English are unmarked, whereas female forms are marked: lion*ess*, act*ress*). What of vertical space in this world of covert linguistic prejudice? Emotionally, the ‘down’ spatial position is marked: down is negative. Schnall & Clore (2004) found a facilitation effect – positive words are rated as even more positive when they are in an upward position. It has also been reported that individuals find graphs easier to understand when an increase in quantity is represented by an increase (rather than decrease) of slope. This corresponds to the ‘more is up’ spatial metaphor, subsequently leading to what is ‘more’ being invariably judged to be better or more desirable.

Further evidence for this metaphor can be seen time and again throughout the literature. Separate research has shown that participants simulate motion through space as they read texts. Meier and Robinson (2006) investigated whether the vertical metaphor would be valuable in understanding negative affect as manifested in neurotic and depressive symptoms. They found attention was oriented downwards among individuals high in neurotic or depressive symptoms, providing evidence for an association between affect and metaphor – that spatial position is marked as either ‘good’ or ‘bad’. It seems, then, that when we ‘feel down’, we actually orient ourselves downwards and gaze lower than when we are ‘feeling high’. It is possible that such an effect was absent in the current study due to task demands.

Meier and Robinson (2004) found a congruence effect for emotional words and spatial position. Positive words were evaluated faster when they were in the top rather than the bottom position, whereas evaluations of negative words were faster when they were on the bottom. The current results differ as no interaction between target position and target-mate (positive, negative or neutral) was found. Whereas Meier and Robinson (2004) had participants emotionally evaluate the stimuli with which they were presented, the current experiment involved the low-level task of simply attending to whichever one of the stimuli turned bold. This meant that there was no need for the participants to read the words presented, and as they were instructed to focus on the fixation cross until the onset of bold text it could be argued that they were able to extract only limited meaning from the words, emotional or otherwise. Whereas in the studies by Calvo, Hyona and colleagues (discussed in the introduction), an association between affect and spatial position was successfully demonstrated. It has already been noted in this thesis that the emotional content of pictorial stimuli is generally more salient and easily accessible than that of text. It is possible that, while the emotional content of pictures do include some attention capturing properties, for the same level of feeling to be elicited from text, the task must require some higher-level interaction, such as evaluation, rather than simply attending to a lower-level perceptual property of the stimulus.

So if the effects of spatial position and affect are not causing the findings, what makes the P-N target-mate condition so special? There must be something particularly salient about this combination of stimuli for the observed results to have been produced. Specifically, the fact that it is the positive word that is the target has to be of import for all of the findings to be accounted for, as this is the only thing which distinguishes the P-N target-mate condition from the N-P condition.

At this juncture we can only speculate about what it is that makes the P-N condition (specifically, the positive target when presented alongside its negative mate) salient. It could be that the combined high arousal of both words makes the combination salient In addition, the attention of the participant is more strongly attracted to the positive word rather than its negative counterpart (at least in the very early perceptual stages under discussion here) because of a perceptual defense mechanism. Alternatively, it might be the case that the marked difference between the valences of the two words in the P-N condition accentuates their positivity and negativity respectively and draws the attention of the participant to the more attractive of the two options.

A theoretical framework into which the present findings seem to fit is the notion of inhibition of return (IOR). Touched upon in the introduction, this phenomenon was first described by Posner and Cohen (1984) who reported that, immediately following an event at a peripheral location (a cue), there is a facilitation for the processing of other stimuli at that location. It is proposed that this results from an exogenous shift in attention to the peripheral location, thus inhibiting a return of attention to the central space (Klein, 2000). It has been demonstrated that if the cue precedes the target by 150 ms then performance is enhanced, however if the cue precedes the target by 300 ms then performance is inhibited.

In the current circumstance, in the P-N condition, participants' attention was oriented towards the positive word (as shown by the significantly high number of anticipations). In these cases, the saccade is made before the target word becomes bold – the eye movement cannot be inhibited and they move (early) to the word. Attention is captured by the positive word which, here, is somehow more salient because of its presentation in conjunction with a negative word, and participants are compelled to look at it. Since participants' initially attend to the positive word, then, they may be inhibited from returning their gaze to this fixation location, and are, hence, eventually slower to orient toward the target. This is discernible through increased saccadic latencies in the P-N condition. The fact that the Stimulus Onset Asynchrony (SOA) in the current experiment was 300 ms makes it potentially vulnerable to IOR as suggested by Posner and Cohen (1984).

Lupianez et al. (1997) showed that IOR occurred later in more difficult tasks than simple tasks. Particularly, IOR begins earlier when the task is mere target identification (rather than, for example, discrimination). The present study employed a simple target identification task, raising the possibility that IOR actually occurred earlier than 300 ms. This view of earlier IOR is strengthened since Lupianez et al. also report that IOR begins earlier when saccadic responses (as was the requirement here) rather than manual responses are made.

It would seem, then, that one explanation into which these results can fit is IOR. This also explains the finding that there were fewer % errors in the P-N condition: if participants were inhibited from returning to the positive target they had more time in which to reach the correct decision as to which word to fixate on, and were therefore more accurate in their responses, a classic speed-accuracy trade-off. The SOA here, though, is right on the uppermost threshold of the phenomenon's influence. Even though this explanation is plausible given the uncomplicated task demands, no certain conclusions are able to be drawn. In order to resolve the issue of IOR, the study would need to be replicated, but with a shorter SOA, perhaps 150 ms.

This lengthy SOA is just one of a number of methodological features which it seemed prudent to employ at the time of this experiment's conception. With the benefit of hindsight, however, such features may have unintentionally affected the pattern of results. As mentioned earlier in the discussion participants' eye position was not aligned with the central fixation cross, but was invariably above it. In order to exclude this as a reason for participants' preference for fixating on words in the top position, it should be ensured in the future that the level of participants' eyes are aligned with the central fixation cross.

A limitation of the materials employed in this study was the absence of C-C, N-N, and P-P conditions. Forty words were used in each target-mate condition, and each word was repeated eight times (four times as the target and four times as the distracter, twice each in the top and bottom positions). It was thought that to either cut down further on the number of stimuli in each of these conditions (to make way for more conditions), or to repeat the stimuli even more times, would have compromised the integrity of the experiment, as would loosening the criteria of what constituted a 'positive' or 'negative' word. It was the purpose at the outset of this experiment to examine the attention capturing properties of different categories of stimuli, e.g., would positive words be more likely to capture attention than the negative word presented along with it. In hindsight, it may have been useful to include conditions comparing the same category of stimuli in the top vs. the bottom condition. In this way it may have been shown that, for example, a positive word in the top position was fixated on faster than a positive word in the bottom position when the distracter was also positive, thus providing evidence for an association between affect and spatial position.

In terms of the two factor theory of emotion (e.g., Osgood et al., 1957) it is unclear from these results how valence and arousal could be independently said to facilitate or inhibit attentional capture. In this case, spatial position seems to exert more of an influence than either of these factors, with words in the top position yielding shorter response latencies regardless of their emotional category. It could be said, then, that while the effects of arousal and valence impact upon the processing of a word very early on in reading (as shown by the interaction with frequency and affect in the P1 in Chapter 2) neither of these factors, alone or combined, are powerful enough, at least in the context of the current paradigm, to coerce a shift of attention from the central fixation cross to the word in question (as would be seen in saccadic latency or percentage of anticipations). While valence and arousal play an important and thus far under-investigated role in reading words, then, at least in these circumstances, their influence seems negligible compared to the impact of the word's position in visual space.

It would appear that the lower limit of the influence of the emotionality of a word can be determined. While a word's emotionality influences its processing, it does not seem to strongly influence its attentional capture, except when combined with its position in visual space in certain circumstances. But that is not to say that the methods employed in this chapter can not be applied to more fruitful ends. In the next chapter, eye-tracking methodology is again applied, this time measuring eye-movements while participants read sentences containing emotional words.

Chapter 4

Introduction

Without exception all the studies thus far conducted into the analysis of emotion words share the methodological feature of presenting and measuring the target in isolation. Some have involved priming, but when the emotive target is presented it is alone on the screen (at the very most, as was the case in Chapter 3, presented together with a distracter). No studies to date (as far as I am aware) have examined the processing of emotion words in the context of normal reading. Quite apart from some of the methodological issues that concern many of these studies (e.g., target repetition), they all therefore suffer from a potential lack of ecological validity. While no doubt providing insight into the processing mechanisms related to distinct facets of specific words, the results are not necessarily generalisable to reading in every day life. Words typically occur within a text and are read for comprehension; outside the laboratory, words seldom appear alone unless accompanied by tasks such as lexical decision or categorization. At this stage, therefore, it would be pertinent to corroborate the findings of the accumulated research on isolated words with evidence from the reading of words in their natural habitat – sentences. To do so, eye-movement methodologies will again be applied. Although introduced in the previous chapter, eye-movements specifically in reading will be discussed and the eye-tracking strategies used to record them will be introduced. The merits of the eye-tracking procedure – from what they have taught us thus far to what they can undoubtedly add to the present area of research – will then be discussed and the current experiment, the monitoring of eye fixations as participants' read sentences containing emotion words, introduced.

Eye Movements & Eye Tracking Measures

When reading, individuals gather information by focusing on the text for short periods of time using a combination of fixations (pauses) and saccades (eye movements). In English reading, fixations generally last around 200-250 ms and are typically separated by saccades of around 7-9 letter spaces in length. Although some information is gained through parafoveal viewing (the debate on how much, and what consequences this has, is contentious and will not be addressed here), the purpose of the saccade is to bring new information into the foveal region to allow its processing (Rayner & Bertera, 1979).

In normal text, words may be fixated more than once, or sometimes skipped altogether. Function words are more likely to be skipped than content words (approximately 85% of the latter are fixated compared to only 35% of the former) (Carpenter & Just, 1983). Short words (2-3 letters) are only fixated about a quarter of the time whereas if a word is long (8 letters or more), it is almost invariably fixated, often more than once. It has been shown that, for words of 6 letters or less in length, high frequency words were more likely to be skipped than low frequency words (O'Regan, 1979; Rayner et al., 1996). It should also be noted that 10-15% of saccades during reading are regressive, either to earlier points in the word (indicating problems in the processing of that word) or to previous words or lines (indicating that the reader had difficulty understanding the text and is seeking clarification).

We know all this because studies in which participants' eye-movements have been measured allowing us to examine how individuals read – which letter or word they fixate on, how long they look for, to which words they regress and when – in intimate detail (see Rayner, 1998). Measuring eye movements during normal reading has become, over the past three decades or so, an established technique, and an invaluable tool, in capturing the on-line cognitive and linguistic processes associated with lexical processing (Rayner, 1998; Sereno & Rayner, 2003). As eye-movements capture moment-to-moment data, using this method can provide temporal information that is more accurate than a haemodynamic neuroimaging scan (only without the localization information). As it is a direct measure of reading, what can be inferred is more accurate information than would be gained by presenting sentences word-by-word while measuring, for example, ERPs. Eye-tracking allows the analyst to see for how long a subject fixates on a word and under what conditions a word is skipped or regressed to, all in real time. Another asset of eye-movement data is that readers engage in the task at their own pace. Tinker (1939) showed no difference in reading and comprehension measures between readers with their head fixed on an eye-tracker in the laboratory, and those reading in an easy chair.

Several measures of eye movements can be used to analyze different aspects of the reading pattern depending on what the investigator is interested in. A summary of four of these measures – first fixation duration (FFD); gaze duration (GD); single fixation duration (SFD) and total fixation time (TT) – is given below and why they are relevant to the current investigation is summarised.

Standard eye movement measures for target word processing include FFD and GD. FFD is the average duration of the first fixation on a word, whether it is a single fixation or one of two or more consecutive fixations on that word. GD is the average sum of all consecutive fixations on a word before the reader moves to another word. The SFD measure (Rayner, Sereno, & Raney, 1996; Sereno, 1992) has been used more recently in eye movement data analysis and designates those cases when the target was fixated exactly once. That is, SFD represents the proportion of trials in which FFD and GD are identical. A final measure is TT which incorporates GD plus any fixations returning to the target. Crucially, for inclusion in TT, there must be at least one intervening fixation between when the eyes fixate (or skip) the target and when they return to it. For this reason, TT can functionally be considered both a target and spillover measure, because later-occurring, returning fixations are added to first-pass durations.

There is debate and disagreement over which of these measures best summarises the record of eye movements and therefore gives us the clearest insight into the underlying cognitive processes. When a single word is the unit of analysis, as is the case here, then the most appropriate measure to use is not clear cut. FFD would, of course, be the most apt if readers always made one (and only one) fixation on a word, but unfortunately this is not the case. FFD is often reported, but we must be aware that this is not entirely representative of the all target words as some will have been skipped and others fixated multiple times. GD, representing the sum of all fixations on a word prior to a saccade to another word, is therefore also commonly employed so as to include data excluded when calculating FFD (i.e., the 2^{nd}, 3^{rd}, etc. fixations on a word; Rayner, 1998).

Inhoff (1984) argued that FFD and GD in fact measured different cognitive processes. He showed both measures to be affected by word frequency, but only GD by the predictability of the word in context, and concluded that while FFD is a reflection of lexical access, GD also measures text integration processes. Rayner and Pollatsek (1987) counter-argued, as other studies failed to support Inhoff's claims, that that FFD is affected by very fast cognitive operations and GD by slower ones. In this study these two measures, as well as SFD and TT, will be reported and vigilance will be taken to remain aware that these measures may be affected by different manners of cognitive processes.

The Merits and Success of Eye-Tracking Methodologies

Recent research on eye movements during reading has undergone a paradigm shift and a resurgence – instead of being viewed as a simple observable behaviour that is unrelated to reading, many researchers now use eye-movement data as a sensitive tool, indicative of the processes involved in reading. Variations in eye fixations reflect variations in the difficulty of the word being inspected and thus eye movement and fixation measures can be considered as providing a direct indication of the current difficulty of processing. It is now well-established that differences in properties of words influence a number of factors associated with eye movements, such as how long they are fixated, and from this we can deduce the underlying cognitive processes involved in reading.

If words are controlled for length and there remains variation in fixation time across different categories of word, it can be reasonably assumed that other properties of the fixated word modulate fixation time. One variable that strongly influences fixation time on a word in such a way is word frequency. It has been shown across many studies and measures (e.g., FFD, GD, SFD) that readers look longer at LF words than HF words (e.g., Altarriba, Kroll, Scholl & Rayner, 1996). Additionally, contextual constraint, semantic relatedness, and lexical and phonological ambiguity all modulate fixation times on words, and could all be argued to influence lexical access. Eye-movements, then, measure the moment-to-moment attention of a reader as they move through the text, constantly manifesting difficulties and facilities in reading relating to complex strategies we have only begun to understand. By continuing to examine these intimate measures we can steadily build on what the past 30 years has taught us and reveal the exact influence of factors, such as emotion, upon reading.

So how do the data collected from behavioural techniques like the lexical decision task compare to the accumulated wealth of eye movement data? The answer, perhaps surprisingly, is fairly well. Despite Everatt and Underwood (1994) finding only minor correlation between eye fixation times and lexical decision times, the results of Schilling, Rayner, & Chumbley (1998) were more positive. They compared naming and LDTs for words presented in isolation to fixation times on the same word inserted in neutral sentence contexts, and found correlations between the measures. Moreover, the size of frequency effect was fairly equivalent for naming and GD (but smaller for FFD and SFD). The size of the frequency effect was also found to be exaggerated in LDT compared to fixation times. It is with some confidence, then, that the current study is initiated with the hope of generalizing the findings from emotion words in LDTs to a reading context.

The Current Study

The focus of this study was to determine whether the emotionality of a word affects early lexical processes. The evidence gained thus far from behavioural and electrophysiological studies, presented in previous chapters, suggests that this is indeed the case. However, evidence from reading such words in proper text – in normal, more real-life conditions – would add weight to the argument. As stated previously, lexical access itself can be indexed by the presence of word frequency effects (Balota, 1990; Sereno & Rayner, 2003). A word frequency effect represents the difference in responses to commonly used high frequency (HF) words and low frequency (LF) words that occur much less often. Reliable electrophysiological word frequency effects have been reported early in the N1 (~130-190 ms), with LF words eliciting a greater amplitude than HF words (Sereno et al., 1998, 2003; Scott et al., 2009). As in the previous experiments, frequency has been controlled in addition to the valence and arousal of the target words.

The hope was to establish the early processing of emotion words within the context of normal reading. HF and LF positive, negative, and neutral words were embedded as targets in single-line sentences. Participants' eye movements were recorded as they read, and their fixation times on target words were analyzed. Word frequency effects have been reliably demonstrated in numerous eye movement studies (see, e.g., Sereno & Rayner, 2000). Moreover, these fixation time effects have been linked to the electrophysiology of the N1. The presence of an emotion by frequency interaction in fixation time would confirm Scott et al.'s early time course of emotion processing, but in a normal reading situation.

Method

Participants

Forty-eight members of the University of Glasgow community (23 males and 25 females; mean age 21.5) were paid £6 for their participation. All were native English speakers, had normal uncorrected vision and did not suffer from dyslexia.

Apparatus

Participants' eye movements were monitored via a Fourward Technologies Dual Purkinje Eyetracker (Gen V), which has a resolution of 10 min of arc. The signal from the eyetracker was sampled every millisecond by a 386 computer. Sentences were displayed on a ViewSonic 17GS CRT in a non-proportional font and were limited to the central 60 characters of an 80-character line. Participants were seated

86 cm from the monitor, and 4 characters subtended 1° of visual angle. Although viewing was binocular, eye movements were recorded from the right eye.

Materials and design

A 3 (Emotion: Positive, Negative, Neutral) x 2 (Frequency: LF, HF) design was used. Arousal and valence values were acquired from the Affective Norms for English Words (ANEW), a database of 1000 words (Bradley & Lang, 1999). Arousal values ranged from 6-9 for Positive and Negative words, and from 1-5.5 for Neutral words. Valence values ranged from 6-9 for Positive, 1-4 for Negative, and 4-6 for Neutral words. Word frequencies were acquired from the British National Corpus (http://www.natcorp.ox.ac.uk/). The specifications of the target stimuli are summarised in Table 4.1 below (as mean values with standard deviations in parentheses).

Table 4.1: Length, Frequency, Arousal and Valence ratings for target words

Condition	N	Length	Frequency	Arousal	Valence
Positive HF	15	7 (1.9)	5 (3.1)	6.9 (0.6)	7.7 (0.6)
LF	15	6 (1.2)	71 (61.2)	6.6 (0.5)	7.8 (0.7)
Negative HF	15	7 (1.8)	8 (5.1)	6.7 (0.6)	2.3 (0.5)
LF	15	6 (1.4)	53 (32.7)	6.7 (0.5)	2.5 (0.6)
Neutral HF	15	7 (1.8)	5 (4.4)	4.1 (0.7)	5.4 (0.4)
LF	15	6 (1.2)	87 (70.3)	3.9 (0.6)	5.2 (0.5)

There were 30 sets of word triples (Positive, Negative, and Neutral), with words within each set matched for length and frequency. Fifteen sets were LF and 15 were

HF. Target word specifications are listed in Table 1. A set of three neutral sentence frames corresponded to each set of three targets, such that each target word could appear in any of the three possible sentence frames. An example of a set of three sentences and their interchangeable targets (in bold) is shown below and all sentences and targets are displayed in the appendix.

1. Phoebe discussed the **kiss** at great length with her friends. [positive]
2. Michelle dreamt about the **news** every night for weeks. [neutral]
3. Tom delivered the **bomb** with great care and attention. [negative]

Three participant groups read three versions of the materials, differing on the target (Positive, Negative, or Neutral) used in each sentence. A total of 90 items across six conditions (Emotion x Frequency) yielded 15 items per participant per condition.

Procedure

A bite bar (to minimize head movements) was first prepared for each participant. Participants were instructed to read each sentence on the monitor while their eye movements were recorded. They were told that yes-no comprehension questions followed half of the sentences to ensure they were paying attention.

The experiment involved initial calibration of the eyetracking system, reading 6 practice sentences, recalibration, and reading the 90 experimental sentences. A calibration display appeared before every trial and involved a series of 5 calibration points extending over the maximal horizontal range in which sentences were presented. During this display, the calculated position of the eye was visible, allowing the experimenter to check the accuracy of the calibration and recalibrate if necessary.

Each trial began with the calibration display. When participants were fixating the left-most calibration point (corresponding to the first character of text), a sentence was presented. After reading each sentence, participants fixated on a small box below and to the right of the last word and pressed a key to clear the screen. The calibration screen reappeared either immediately or, on half the trials, after they had answered a yes-no question by pressing corresponding response keys. Participants had no difficulty in answering the questions correctly (mean=95%).

Results

The target region comprised of the space before the target word and the target word itself. The upper and lower cutoff values for individual fixations were 750 and 100 ms, respectively; data were excluded if the first-pass fixation on the target was outside these cutoffs. Data were additionally excluded if there was a track loss or blink on the target, or if a first-pass fixation on the target was either the first or last fixation of the sentence. Overall, 6% of the data were excluded for these reasons.

In reading, most content words are typically fixated once; sometimes they are refixated or skipped. In this study, the probabilities for single fixation, immediate refixation, and skipping of the target before (and after) data exclusion were .71 (.75), .13 (.14), and .10 (.11), respectively. The standard eye-movement measures of first fixation duration (FFD), single fixation duration (SFD), gaze duration (GD) are considered here. SFD represents the proportion of trials in which FFD and GD are identical and, in this study, accounts for the majority of data (75%). A final measure is total fixation time (TT) which incorporates GD plus any fixations returning to the target. In this experiment, returning fixations occurred on 18% of trials. Participant means fixation durations (ms) for LF and HF Positive, Negative, and Neutral words are presented in Table 4.2.

Table 4.2: Eye-tracking means for target words across measures

	LF			HF		
	Pos	Neg	Con	Pos	Neg	Con
FFD	277	272	285	263	278	276
SFD	286	282	297	269	286	280
GD	312	305	335	284	302	296
TT	377	363	398	331	352	346

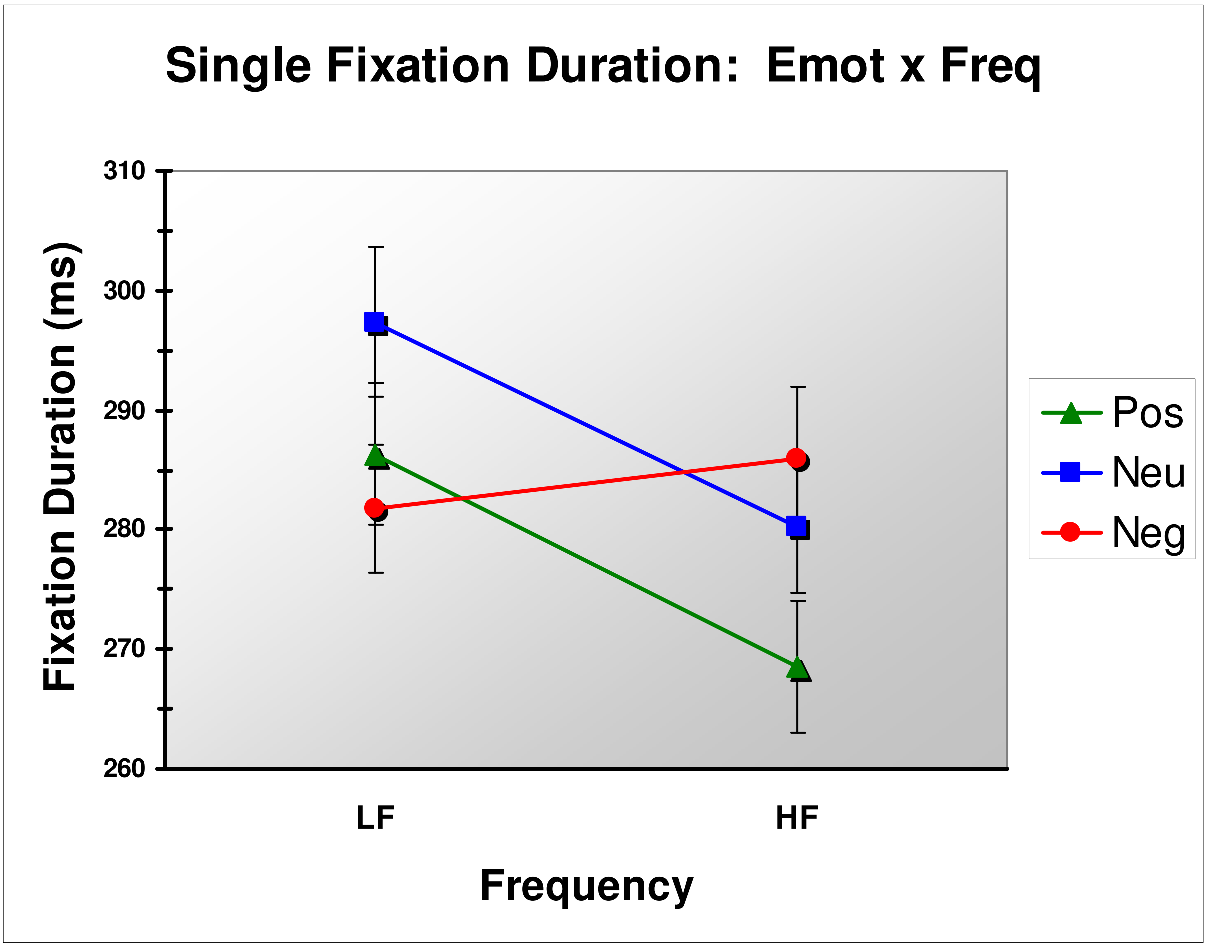
For each measure, a two-way analysis of variance (ANOVA) was performed both by participants (F_1) and by items (F_2). As 75% of target fixations were single fixations, we will focus on the SFD measure, although the results for all measures are presented. In general, the immediate target measures of FFD and GD produced highly similar patterns of results. The later TT measure often produced a similar but weaker version of results. For SFD, there were significant effects of Emotion and Frequency, as well as an Emotion x Frequency interaction (by participants and items). The SFD means (with standard error bars) are graphically depicted in Figure 4.1. ANOVA results for all measures, both by participants (F_1) and by items (F_2), are presented in Table 4.3.

Table 4.3: Simple main effect, and interactions for eye-tracking measures FFD, SFD, GD, and TT

		df	*F*	*MSE*	*p*
Emotion					
FFD	F_1	2, 94	7.65	352	<.001
	F_2	2, 28	4.60	185	<.05
SFD	F_1	2, 94	8.53	364	<.001
	F_2	2, 28	6.07	155	<.01
GD	F_1	2, 94	12.44	607	<.001
	F_2	2, 28	3.80	463	<.05
TT	F_1	2, 94	4.47	1905	<.05
	F_2	2, 28	2.42	1212	=.107
Frequency					
FFD	F_1	1, 47	4.39	528	<.05
	F_2	1, 14	2.15	360	>.15
SFD	F_1	1, 47	16.49	458	<.001
	F_2	1, 14	5.54	519	<.05
GD	F_1	1, 47	38.10	1046	<.001
	F_2	1, 14	6.54	1680	<.05
TT	F_1	1, 47	49.19	1888	<.001
	F_2	1, 14	9.08	2871	<.01
Emotion x Frequency					
FFD	F_1	2, 94	7.81	367	<.001

	F_2	2, 28	5.62	257	<.01
SFD	F_1	2, 94	8.19	459	<.001
	F_2	2, 28	3.70	333	<.05
DG	F_1	2, 94	12.25	659	<.001
	F_2	2, 28	4.40	564	<.05
TT	F_1	2, 94	6084	1799	<.01
	F_2	2, 28	2.50	1457	=.100

Figure 4.1. Single Fixation Duration (Emotion x Frequency)



Follow-up contrasts for the interaction compared differences between emotion words at each level of frequency (see Table 4.4) as well as frequency differences for each type of emotion word (see Table 4.5). In SFD, for LF words (Positive=286, Negative=281, and Neutral=297 ms), comparisons between emotion words revealed no Positive-Negative difference, an effect (significant by participants, non-significant trent by items) for Positive-Neutral, and a significant difference for Negative-Neutral. For HF words (Positive=269, Negative=286, and Neutral=280 ms), a different pattern emerged, with contrasts showing a significant difference for Positive-Negative, an effect (significant by participants, marginal by items) for Positive-Neutral, and no Negative-Neutral difference. The frequency contrasts for each type of emotion word in SFD demonstrated significant effects for Positive (LF=286 and HF=269 ms) and Neutral (LF=297 and HF=280 ms) words, but no effect for Negative words (LF=282 and HF=286 ms). The only difference in this pattern of effects across the other measures is that in FFD, there was a weak reverse frequency effect (marginal by participants, non-significant trent by items) for Negative words (LF=272 and HF=278 ms).

Table 4.4: Main Effects for HF and LF words by Participants (F_1) and by Items (F_2) on Target Measures

			Positive-Negative		**Positive-Neutral**		**Negative-Neutral**	
			F	***p***	***F***	***p***	***F***	***p***
LF	**FFD**	F_1	**2.01**	**>.15**	**4.06**	**<.05**	**11.78**	**<.001**
		F_2	**2.00**	**>.15**	**1.75**	**>.15**	**7.50**	**<.05**
	SFD	F_1	**1.10**	**>.25**	**6.32**	**<.05**	**12.69**	**<.001**

		F_2	<1	*ns*	2.45	=.129	6.20	<.05
	GD	F_1	1.63	>.20	19.03	<.001	31.80	<.001
		F_2	1.05	>.30	4.37	<.05	9.68	<.01
	TT	F_1	2.62	=.109	6.05	<.05	16.63	<.001
		F_2	1.58	>.20	1.42	>.20	5.99	<.05
HF	FFD	F_1	15.73	<.001	11.60	<.01	<1	*ns*
		F_2	9.58	<.01	5.33	<.05	<1	*ns*
	SFD	F_1	15.89	<.001	7.14	<.01	1.73	>.15
		F_2	6.35	<.05	3.23	=.083	<1	*ns*
	GD	F_1	12.06	<.001	5.21	<.05	1.41	>.20
		F_2	4.87	<.05	1.92	<.15	<1	*ns*
	TT	F_1	6.01	<.05	2.73	=.102	<1	*ns*
		F_2	2.52	=.124	2.01	<.15	<1	*ns*

Table 4.5: Follow-Up Frequency Contrasts by Participants (F_1)

and by Items (F_2) on Target Measures

		Positive		Negative		Neutral	
		LF vs. HF		LF vs. HF		LF vs. HF	
		F	*p*	*F*	*p*	*F*	*p*
FFD	F_1	13.76	<.001	2.80	=.098	5.38	<.05
	F_2	8.03	<.01	2.81	=.105	3.41	=.075
SFD	F_1	16.58	<.001	<1	*ns*	15.32	<.001
	F_2	8.52	<.01	<1	*ns*	7.23	<.05
GD	F_1	28.96	<.001	<1	*ns*	55.67	<.001

	***F*₂**	11.50	<.01	<1	*ns*	16.76	<.001
TT	***F*₁**	27.41	<.001	1.36	>.20	36.50	<.001
	***F*₂**	12.01	<.01	<1	*ns*	10.49	<.01

Spillover effects are only partially captured by the TT measure as it also (mainly) reflects first-pass processing. We thus examined the next forward-going fixation, and the next region comprising of the word following the target. However, no significant differences were obtained [all F_1s<1.15, all *p*s>.30; all F_2s<1.65, all *p*s>.20].

Discussion

The current experiment investigated the immediate effects of reading emotion words within natural contexts. Participants read sentences containing Positive, Negative, and Neutral words. Critically, target word frequency (HF, LF) was additionally manipulated to more precisely determine the temporal locus of emotional processing. Fixation time analyses demonstrated not only significant effects of Emotion and Frequency, but also an overriding interaction, suggesting that lexical access (as indexed by word frequency) is modulated by arousal and valence. Follow-up contrasts revealed that, for LF words, emotionality confers a processing benefit, with shorter fixation times on Positive and Negative compared to Neutral words. For HF words, however, only Positive words demonstrate a processing advantage. HF Negative words seem to attract additional cognitive resources, a notion confirmed by the pattern of frequency effects which are present for Positive and Neutral words, but lacking for Negative words. This matches the effect found previously when HF and LF emotion words were presented in isolation in a lexical decision task.

The theoretical implications from these findings concern the role of attention in word recognition. HF words are considered easier to process than LF words because of their more robust lexical status. We suggest that high arousal words (Positive or Negative) are more salient than low arousal (Neutral) words. While it is not the case that they draw attention when presented outside the fovea – as was demonstrated in the previous chapter – their inherent emotional properties may make them more immediately accessible when they are focused upon, in this case during natural reading. Such a supposition, that saliency somehow increases with emotionality, is not in conflict with the theories discussed in the introductory chapter, including two-factor theories (e.g., Osgood et al., 1957) which take valence and arousal as the defining measures of emotional text.

By definition, arousal, unlike frequency, generates an internal response. In addition, arousal that is positive or negative in valence results in different consequences. Moreover, arousal representing HF or LF concepts may have more or less environmental significance, respectively. It therefore seems credible that attentional mechanisms are selectively responsive to HF negative arousal: an initial processing advantage is offset by the recruitment of additional resources needed to evaluate such words.

The precise neural substrates underpinning this bias are less transparent. Recent fMRI studies have demonstrated amygdala involvement in processing emotion words (Hamann & Mao, 2002; Lewis et al., 2007; Nakic et al., 2006; Strange et al., 2000; Tabert et al., 2001). Although fMRI studies have identified specific neural loci related to processing emotion words, they cannot in general capture the moment-to-moment temporal course of such activity. While it is outwith the remit of this thesis to address such issues in any great detail, it should be noted that such studies are occurring in parallel with work, such as the current experiment, more focused on the temporal aspects of language processing. Hopefully the two areas will continue to progress, to draw from each other, and learn more about the processes and structures which underpin reading.

Despite the amount of research on affective word processing, a clear picture is only beginning to emerge regarding when and how emotion-specific lexical mechanisms operate. It is important to recognize the limitations of emotion word studies in which words are presented in isolation. Visual word recognition typically occurs during normal reading, where individual word meanings are activated and integrated on-line into a developing discourse context. Establishing reliable emotion word effects in early reading measures provides positive evidence for the central role of emotion in language processing.

This does not add anything in terms of elaboration to any of the proposed theoretical explanations for such results, such as the ANF or the Mobilization-Minimization hypothesis, *per se*. The same is known now about processing time of emotional words as was before the experiment was conducted. What these findings do provide is further confidence not only that the pattern of results found in behavioural tasks is real, but that they occur in normal reading rather than just under prescribed conditions in the laboratory. The application of such theories, therefore, we now know exists not just under restricted conditions, but in daily reading. This gives the research more impetus and confirms that the implications of future studies have great potential. From here researchers can move forwards with confidence to pinpoint the mechanisms fundamental to the processing of emotional words in reading.

A more disappointing result was the failure to find any spillover effects in any fixations or regions following the target word. This implies that any effect that emotional text has on the processing of subsequent words was either not generated by a single emotional target, or was not strong enough to be measured by the current methodology. This does not mean that any such effect does not exist, or even that it is inconsequential if it occurs within normal reading. Rather, perhaps only target words of extremely high arousal or valence generate such an effect, or perhaps there needs to be a slower build-up of emotion – more than a single word, no matter how strong, can produce. Alternatively, it may be the case that there is an effect, but that it does not manifest itself through changes in the timing or pattern of participants' eye movements. The following two chapters pursue the existence of such an emotive effect on subsequent text through priming (Chapter 5) and reading (Chapter 6) paradigms, measuring reaction times and eye-movements, respectively.

Chapter 5

Introduction

Semantic Priming and Frequency

Semantic priming is the phenomenon of a word activating other words which are semantically related to it, thus making them more accessible. For example, if one heard the word ‘cat’, other semantically related words such as *dog*, *mouse*, or *Garfield* will be activated. Other words such as *cup*, *sugar*, and *Snoopy* will not (McDonald et al., 2005). The idea that a word activates other words with similar semantic properties is called the spreading activation model (Collins & Loftus, 1975; Klauer & Musch, 2003). When one word aides in the processing of another word, this is called facilitation (Kreher et al., 2006). When a prime actively hinders the processing of another word this is called inhibition (Rösler et al., 2001). There have been several alternatives to the spreading activation explanation proposed. Perhaps the best known is the response conflict mechanism which stresses inhibition of non-congruent primes as the main cause of effects. Becker (1979) devised the verification model which assumes that the quality of the stimulus affects the rate of feature extraction by the feature analyser and that the verification process is unaffected by stimulus quality. This was based on previous findings that the magnitude of semantic priming in LDT is larger for LF than HF words (indicating that these affect the same stage of processing, Becker, 1979) and that semantic priming was also larger for degraded vs. intact stimuli (Meyer, Schvaneveldt, & Ruddy, 1975). This has been followed by other attempts to incorporate all findings influencing semantic priming into a single model. The most notable of these have been Borowsky and Besner (1993) and Stolz and Neely (1995) logogen-based multistage activation model. A comprehensive and universally agreed upon explanation accounting for findings of diverse variable such as frequency, context, stimulus quality, repetition priming, and others which fall outwith the range of the current study, has yet to be found.

Priming has often been studied using LDTs but rarely has the phenomenon been studied in relation to frequency. Hines (1993) showed LF words are facilitated more than HF words by semantically-related primes. This is thought to be because there is more scope to decrease the processing time of LF than HF words, as HF words are already very accessible and are therefore naturally processed quickly. Two seminal papers have sought to examine the interaction between context and frequency in priming. Even though these were both published prior to 1980 they have been a major influence behind much of the research produced since that time.

The first was Schuberth and Eimas (1977) who manipulated the context leading up to a target word rather then using a single word as a prime. Although today this would come under the heading of context rather than priming effects the study is still worthy of note as it was the first to investigate the impact of both frequency and semantic relatedness on a target word. Participants classified letter strings as words or non-words when presented as targets in incomplete sentences (e.g., 'The dog chewed the _______'). Each sentence was presented four times, twice with words and twice with non-words. The words were either HF or LF, and either semantically related or unrelated to the sentence fragment. Non-words were either legal or illegal. Each sentence was presented for 1500 ms, and each target for 3000 ms, and the participants responded 'yes' for word or 'no' for non-word. The results showed additive effects of frequency and context, but not an interaction. RTs were faster for all HF words than for LF words and illegal PWs; RTs for all related words were faster than for unrelated words and legal and illegal PWs.

Becker (1979) attempted to improve on his predecessors' methodology. He used word pairs; the target was primed by a single word rather than a whole context, and he did not repeat any of the stimuli as this has a greater facilitating effect in LDTs for LF than HF words. Becker's study used 48 HF and 48 LF targets in word pairs. Context words (primes) were presented for 750 ms followed by an ISI of 300 ms, then the target until response. A frequency-context interaction was found for both the RT and error data, with the difference between related and unrelated words less for HF than LF words.

In both of the studies, the SOA was over 1000 ms (Schuberth & Eimas' was 1500 ms, Becker's was 1050 ms,). It has been established that this is more than sufficient time for conscious processes to play a part in processing. To ensure that only automatic processes are involved, the SOA would need to be 250 ms or less (Neely, 1991). Indeed, the eye movement and ERP findings reported in previous chapters suggests that processing is already underway within 200 ms of a word being fixated. One final observation concerns the object of the manipulation in both studies. It was the target, not the prime, which was varied in terms of frequency and context. It is less clear what the effect of manipulating lexical properties of the prime would have on a target.

Emotional Priming

Fazio et al. (1986) first documented affectively congruent priming with words, and it has since been replicated with a host of other stimuli including pictures, faces and smells. In emotional priming, words from a particular emotional category facilitate responses to other (semantically related or unrelated) words from the same category. No study carried out to date, to the knowledge of the author, has investigated the effect of an emotional prime on a neutral target. Past research has only been concerned with the emotionality of the target stimulus. There have been a few cross-modal studies which have demonstrated that emotional words can be used to prime other, perhaps more salient, expressions of emotion such as faces and pictures.

The most common explanation for this finding is the spreading activation model. That is, a positive word will prime other members of the ‘positive’ category. A localist model of spreading activation would be implausible as the ‘positive’ category would be too large for every member to activate every other member to a sufficient degree to facilitate processing. Instead what has been proposed by some is a more distributed model of representation. Such models (e.g., Mason, 1995) explain priming as the result of overlap between the representational patterns of the prime and target. On this view, if a subset of nodes represent valence, this could provide an explanation of affective priming effects. Other explanations include the response conflict (De Houwer, Hermans, Rothermund, & Wentura, 2002; Klauer, 1998) and the judgment tendency mechanism, also known as the affective matching principle (Klauer & Musch, 2003; Wentura, 2000). These propose that participants consider the prime and target as a pair, and that congruent stimuli elicit a tendency towards an affirmative response, producing a faster RT. The semantic models mentioned above (e.g., Becker, 1979; Borowsky & Besner, 1993; Stolz & Neely, 1995) do not consider affective priming. One other model was proposed by Klauer and Stern (1992) and involved judgmental tendency mechanisms. This proposes a 3-component process when the prime-target pairing takes the form noun-adjective: (1) affective components of prime and target activated; (2) compatibility of the affective components compared; and (3) relevant information recalled to form an adequate answer on the basis of the a priori hypothesis and the available information. As not all the prime-target pairings here are noun-adjective, however, this theory is not wholly relevant to the current research.

In the following, research in linguistic affective priming will be reviewed and their implications for models will be analysed. Carroll and Young (2005) performed several cross-modal priming experiments involving emotional pictures, faces, words, and non-verbal sounds. They used words from a previous rating study from the categories happy, sad, fear, disgust and anger (4 of each). These categories represent some of the universal emotional facial expressions. It was shown that words priming faces and faces priming words produced facilitation for congruent stimuli. When targets were facial expressions, word primes resulted in faster RTs for related vs. neutral and related vs. unrelated stimuli, which did not differ from each other. When emotional words were the targets, they were primed by non-verbal sounds (e.g., 'beeps'), with related words responded to faster than neutral words, which in turn were responded to faster than unrelated words.

Lundquist et al. (2006) used a technique known as semantic satiation – participants repeated a category word out loud 3 to 30 times, thus decreasing the accessibility of its meaning. Following this, a word of the same or different emotional category was presented. This technique had already been shown to slow word associations (Black, 2001), judgments of category membership and identity recognition (Lewis & Ellis, 2000). The hypothesis was that this would also inhibit judgments of facial expressions of emotions. Participants' responses to facial emotions slowed when they were told to be accurate, and diminished the number of correct responses when they were told to be as fast as possible. The categories of emotion words used again corresponded to the universal facial expressions of emotion (happy, sad, fear, disgust. anger, surprise), and they were repeated.

Much of the work in this area has centered not on emotion words as defined by the 2-dimensional valence and arousal model, but in terms of the universal facial expressions of emotion to enable cross-modal priming. For this reason, investigations have explored the different sub-categories of emotions of the same valence. In Carroll and Young's (2005) fourth experiment, they investigated whether emotion recognition was dimensional or categorical by using only the negative categories of fear, sadness and disgust. They found that stimuli in the same sub-category led to shorter reaction times than both neutral and unrelated words. At least in this cross-modal situation, priming was not only due to valence.

There have been a few studies which have examined affective priming solely in language. Bargh et al. (1996) and Hermans et al. (1994) showed that valenced target words were pronounced faster after an affectively related prime, demonstrating that stimulus evaluation occurred automatically (rather than being a goal-dependent and therefore conditional on the nature of the task) and facilitated encoding of same-valenced stimuli. In Hermans et al., although participants were instructed to ignore the primes, the same effect was obtained. This cannot be explained by the response conflict model (as one could on Stroop-type trials), as there is conflict on each trial. There have been, however, several failures to replicate these effects, including De Houwer et al. (1998) who used ED, and Klauer and Musch's (1998) study in German (they also failed to find effects in bilinguals, but their procedure differed from that of Bargh et al.).

Spruyt et al. (2004) replicated Bargh et al.'s second experiment, with the addition of meaningless strings of consonants (e.g., BBBB) and also instructed participants to ignore the primes. They presented 16 nouns, 4 each from the categories strong positive, weak positive, weak negative, strong negative, plus 10 positive and negative adjectives. The ISI was 200 ms and targets were presented for 2000 ms. The only significant difference was that positive words were pronounced faster than negative words, a result which does not fully support Bargh et al.'s results. Spruyt (2002) *did* find some effects, but only when primes were pictures rather than words. Another possible explanation could be that responses were faster than in Bargh et al.'s study – perhaps too fast for effects to manifest themselves.

In 2005 Chen et al controlled both affect and frequency in an effort to test the response conflict model as well as whether accessibility (which increases as a function of frequency and recency of use) and evaluative extremity of the target might 'overwhelm' the influence of the prime. They hypothesised that low-accessibility targets produce greater competition in a response-competition framework than high-accessibility targets. They suggest that a high-accessibility (and incongruent) target may result in faster response to the target. They suggest that the rapid change between the contrasting valences of prime and target will enable participants to make fast and accurate judgments about the valence of the target. In this explanation, accessibility seems to mean the same as word frequency.

In this study, the authors used 12 positive and 12 negative primes (as well as letter string primes), and the targets were 18 HF and 18 LF positive and negative words controlled for length. Each target appeared once in an EDT, with primes presented for 100 ms and an SOA of 300 ms. Responses were faster after positive primes and after HF targets. Also there was a 3-way interaction (prime valence x. target valence x. frequency). A congruency effect was found for all HF incongruent prime-target pairs, and a reverse congruency effect for all LF incongruent prime-target pairs. The authors point out that only by paying attention to the frequency of the target did this result emerge. Paying attention to the frequency of the prime would have shown only an affective congruency effect. Two additional interactions showed that for LF targets there was no effect of valence, but for HF targets negative words were responded to faster than positive words. LF targets were also slower when the prime was negative, whereas HF targets were slowed when the prime was positive.

Wentura (2000) carried out three primed lexical decision experiments in an attempt to test the judgment tendency model. The first of these used a Latin-square design with negative, positive, and neutral words, and non-words, and measured reaction time. Priming stimuli were 40 positive, 40 negative, and 40 neutral nouns, and 40 pseudonouns. Words were controlled for length and arranged so that semantic relatedness would not be a factor. Primes were presented for 200 ms, followed by a 100 ms inter-stimulus interval (ISI), then the target was presented until a response key was pressed. Significant effects of prime-target relation were found, supporting the hypothesis of affective priming in the LD task.

In the second experiment, each prime was presented twice – once followed by a word, and once by a non-word. The procedure was the same as in the previous experiment, and the stimuli used were also the same, although they were increased in size to a total of 96 word and 96 non-word targets. The instructions emphasized which category the subjects had to respond 'YES' to more than the previous experiment. Materials used here were the same as those in Experiment 1 but were increased in size to contain 24 negative and 24 positive items in each set. The only significant effect was that responses in the *word* = *yes* condition were faster than those in the *word* = *no* condition. These results are also compatible with the judgment tendency model of affective-cognitive links. This theory states that, with a statement of the form '(noun) is (adjective)', a three-component process will take place. The affective components of the noun and the adjective are compared, the compatibility of the components are compared, and then, in a controlled process, relevant information is recalled to form an adequate answer on the basis of an *a priori* hypothesis. These results do not, however, support the spreading activation account, that is, the mere presentation of highly valenced objects or words automatically increases the accessibility of the corresponding affective evaluation, whereby activation from one node to in the lexicon spreads to neighbouring nodes, lowering their recognition thresholds (Collins & Loftus, 1975).

In the third experiment, the design was the same as in Experiment 2 except that the materials of affectively congruent and incongruent prime-target pairs were completely replaced with (affectively neutral) associatively related and unrelated pairs; also, for half the related materials, the associate of a given stimulus served as the target (symmetrical priming), while for the other half it was the prime (backward priming). Associated pairs were responded to significantly faster than unassociated pairs. These results also tend to support the Judgment Tendency model.

Finally, Storbeck and Robinson (2004) conducted a series of priming studies with both picture and word stimuli. With both an LDT and an evaluative task, semantic but not affective priming was found. In the following experiment, they found that the same stimuli can produce affective priming, but only when words come from a single semantic category. According to the authors, the results indicate that semantic but not affective priming is mediated by spreading activation. They also suggest that, because semantic encoding seems to be more obligatory than affective encoding (to the extent that it is manifested in priming), it occurs first. They further state in their discussion that both affect (Bargh, 1997) and semantic meaning (Dehaene et al., 2001) can be elicited by subliminal stimuli. As has already been demonstrated in the current thesis, affect influences processing at least as early as lexical access. Thus, both affective and semantic encoding seem to occur early in processing. In the studies carried out up until now, semantic coding carries with it the obligatory activation of related semantic categories, while the same does not appear to be the case for affective encoding. The next step, therefore, is to focus on the emotionality of the prime, rather than the target, and to determine whether the prime's valence and arousal can influence the processing of a subsequent neutral word.

The Current Study

What follows are two experiments which were run simultaneously and aimed to consolidate and build upon the literature summarised above. The same participants took part in both experiments, with half being run in Experiment 1A then experiment 1B, and the other half 1B then 1A. Experiment 1A replicated in part the semantic priming effect in an LDT. Primes were HF and LF semantically related and unrelated words. Semantic priming should be evident in comparing related and unrelated conditions. In addition, the results should demonstrate whether prime frequency interacts with semantic relatedness. Of particular interest, however, are the unrelated conditions. Because HF words are more salient, it is expected that an unrelated HF prime will produce more interference than an unrelated LF prime in processing the subsequent target. Experiment 1B used identical methodology to Experiment 1A, but examined how the affective qualities of a prime influence the following target. All prime-target relationships were semantically unrelated. Primes were HF and LF positive and negative words and targets were (unrelated) emotionally neutral words. Thus, unlike the studies mentioned above, the prime and target were not of similar valence. Similar to Experiment 1A, it was expected that HF affect would be more disruptive to the downstream processing of a neutral target, particularly if this affect was negative.

Experiment 1 A

Methods

Participants

Thirty-six participants (12 male, 24 female) took part in this experiment. All were native English speaking volunteers who did not suffer from dyslexia. The majority of the subjects were around typical undergraduate age (mean = 22; range: 19-35). All had normal or corrected-to-normal vision and were naïve as to the purpose of the experiment. They were recruited through advertisements placed around the university campus. In accordance with the guidelines set by the University's ethics committee, written informed consent was obtained prior to experimental participation.

Apparatus

Participants were tested using PsyScope experiment version 1.2.5 on an Apple Mac computer and made responses on a PsyScope button box. A Hansol 21"monitor with a 1024 x 768 resolution and 100 Hz refresh rate was used to present the stimuli to the participants. Courier size 24 font was used, and the stimuli were black letters presented on a white background. The screen was positioned approximately 25" from the participants' heads, with approximately 2.95 characters subtending 1 degree of visual angle.

Materials and Design

A 2 (Semantic Relatedness: related (SR), unrelated (SU)) x 2 (Prime Frequency: HF, LF) within-subjects design was used. Twenty-four target words were paired with 24 length-matched orthographically legal pseudoword targets (average length=4.79 characters) None of the pseudowords resembled words related to the prime to avoid indirect semantic priming (e.g., Deacon et al., 2004). These target pairs were then matched with 4 possible prime words which varied in their semantic relatedness and frequency to make 4 priming conditions: LH-related; HF-related; LF-unrelated; HF-unrelated.

Each participant was presented with 96 prime-target pairs: 24 word targets and 24 pseudowords targets from this experiment, and 48 targets from Experiment 2. Of the 48 prime-target sets presented from the current experiment there were 6 from each experimental condition.

Targets and primes were chosen from lists of semantically related words in Moss and Olden (1996), Hirsh and Tree (2001), Francis and Kucera (1982) and Overschelde et al. (2004). The latter was an updated version of the Battig and Montague (1969) category norms. Word frequencies were obtained from the BNC (www.natcorp.ox.ac.uk). The average length of words was 4.92 characters for related primes and 4.83 characters for unrelated primes. The average frequency of target words was 49.34 per million. The average frequencies of primes were: HF-related = 152.43; HF-unrelated = 119.72; LF-related = 7.15; LF-unrelated = 7.69. A set of 10 practice stimuli were also constructed, but these did not overlap with the list of experimental stimuli described above. Examples of the stimuli are shown in Table 5.1.

Procedure

Participants were taken to a designated room in the Glasgow University Psychology Department. They were shown an instruction sheet and asked to read and sign the consent form. The procedure was then verbally explained again and participants were

Table 5.1: Example prime-target pairs for HF and LF related and unrelated primes and neutral targets

Word/PW	Reelatedness	Freq	Prime-Target Example
Word	Related	HF	mother – relative
		LF	anatomy – biology
	Unrelated	HF	present – shelter
		LF	beetle – clergy
PW	Related	HF	science – junidge
		LF	nephew – andesker
	Unrelated	HF	higher – durate
		LF	ketchup – stamdar

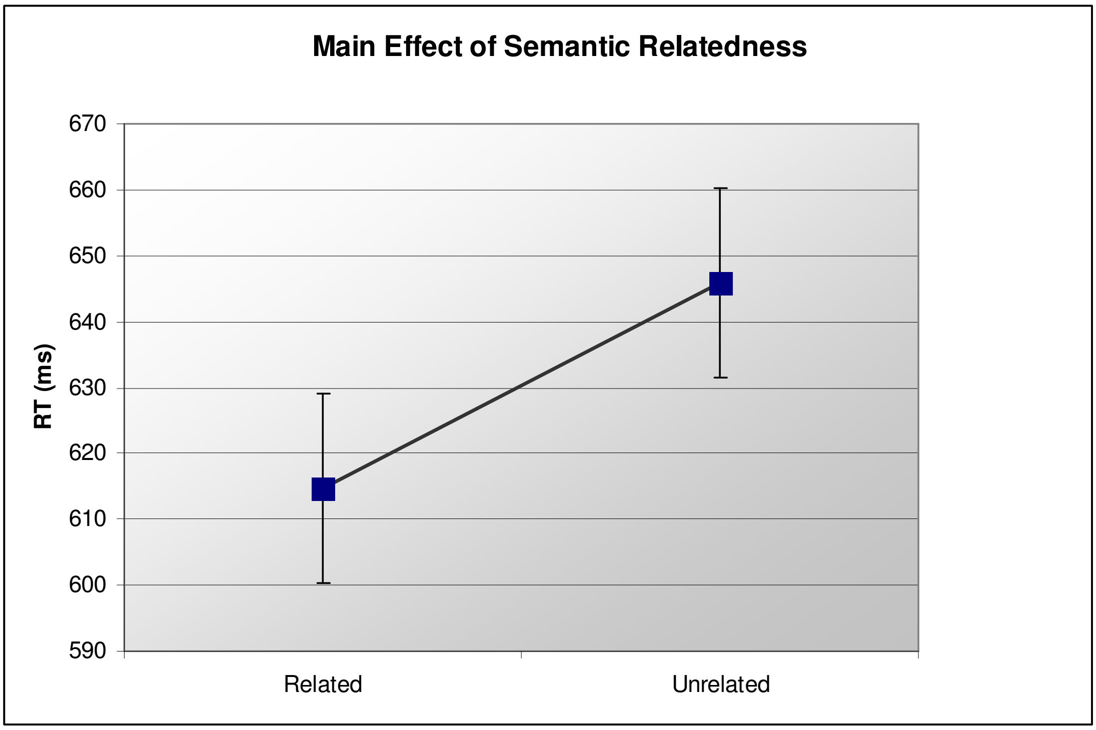
briefed on how to use the button box (right, green button for word; left, red button for non-word). Participants were told that correct responses and accuracy was of importance, but that if errors occurred it was not important, however if it reoccurred the participant should slow down in the response to avoid constant mistakes. After the instructions, a practice block of trials was run. The experimental trials were presented in a random order of words and non- words. The experiment lasted approximately 10 minutes. The events for each trial were as follows. A blank screen was presented for 1000 ms, followed by a fixation cross for 200 ms. There was another blank screen for 500 ms then the Prime for 135 ms, immediately followed by the Target that remained on the screen until the participant responded.

Results

Semantic Relatedness and Frequency Effects

Trials in which participants made errors were excluded from the RT data analysis. The RT data were subjected to two trimming procedures. Items with RTs less than 250 ms or greater than 1500 ms were excluded from further analysis. For each participant in each condition, items with RTs beyond two standard deviations of that mean were also excluded. Two-way analyses of variance (ANOVAs) were performed on the reaction time data for words and non-word targets. For words, the main effect of semantic relatedness was significant [$F(1,35)=9.86$, $MSE=34696.202$, $p<.005$] with related targets being responded to faster than unrelated targets (see Figure 5.1). There was no significant effect of prime frequency or any interaction between the two [both Fs<1]. For non-words, there were no significant main effects or interactions [all Fs<1].

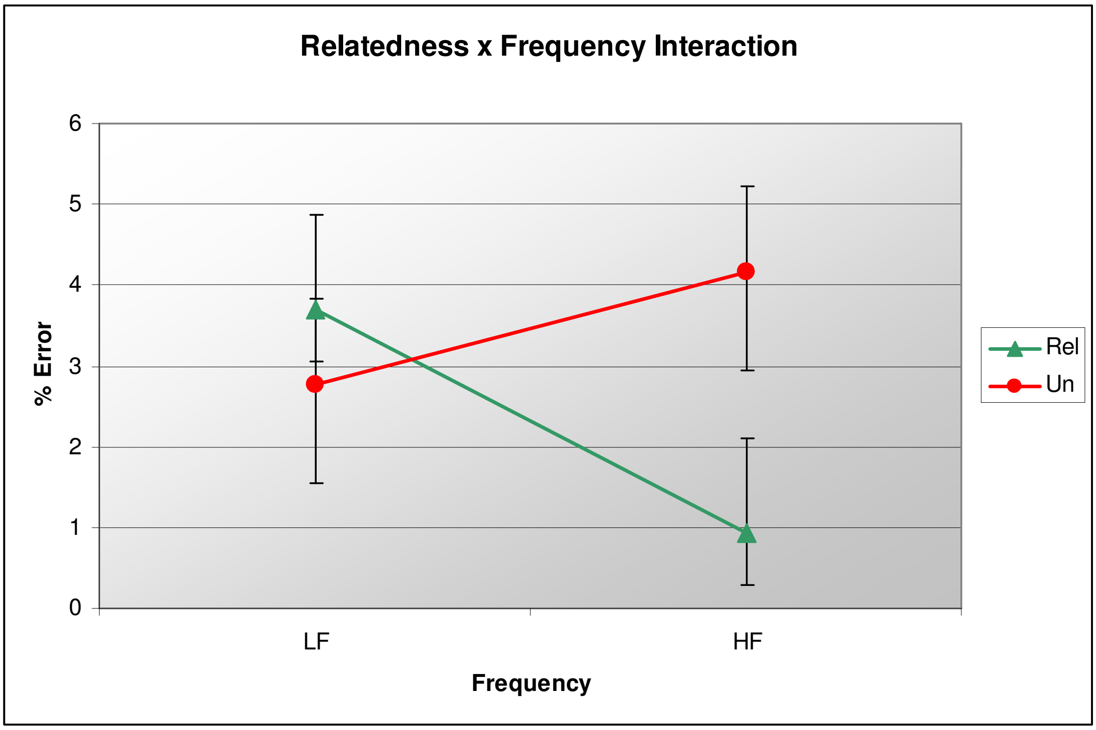
Figure 5.1: Main Effect of Semantic Relatedness



ANOVAs were also carried out on the %error data for words and non-words. For words, there were no significant main effects, but the semantic relatedness x frequency interaction was marginally significant [$F(1,35)=9.86$, $MSE=156.313$, $p<.06$] and is shown in Figure 5.2. Follow-up Scheffé contrasts with no corrections for multiple comparisons revealed that within HF words semantically related words were responded to significantly more accurately than semantically unrelated words [$F(1,35)=4.592$, $MSE=156.313$, $p<.05$], but within targets following LF primes there was no difference in % error between related and unrelated words [$F<1$]. Within unrelated, words there was no difference between words following HF and LF primes [$F<1$], and within related words, targets following HF primes were responded to marginally more accurately than targets following LF primes [$F(1,35)=3.373$, $MSE=156.313$, $p<.08$].

For % errors in non-word targets, there was no main effect of semantic relatedness [$F<1$], but there was an effect of frequency [$F(1,35)=4.888$, $MSE=434.028$, $p<.05$], with non-word targets following HF primes being responded to more accurately than those following LF primes. The relatedness x frequency interaction was not significant.

Figure 5.2.: Semantic Relatedness x Frequency Interaction



Discussion

As expected, a significant effect of semantic relatedness was found. The presence of this reliable effect demonstrates that the materials used here are suitable for producing priming effects. This is encouraging as the stimuli presented in experiment 1B conform to many of the same constraints. In this experiment it is hoped that a priming effect will be shown on neutral target words when the prime is either positive or negative, something which has never before been investigated.

Experiment 1 B

Methods

Participants

The same 36 participants who took part in Experiment 1 also took part in this experiment.

Apparatus

The apparatus used here was identical to that used in Experiment 1.

Materials and Design

A 2 (Prime Emotion: positive, negative) x 2 (Prime Frequency: HF, LF) within-subjects design was used. The stimuli used for the emotional primes conformed to the same valence and arousal standards as the stimuli used in the previous chapter, and targets were all neutral words from the same list (matched for length and frequency). There were 6 words in each group: LF negative; HF negative; LF positive; HF positive. Examples of the stimuli are shown in Table 5.2.

Procedure

The procedure here was identical to that in Experiment 1.

Table 5.2: example prime-target pairs for HF and LF positive and negative primes and neutral targets

Word/PW	Relatedness	Freq	Prime-Target Example
Word	Positive	HF	exercise – windmill
		LF	reunion – hydrant
	Negative	HF	trouble – method
		LF	outrage – utensil
PW	Positive	HF	Power – factam
		LF	Elated – berrow
	Negative	HF	Victim – looster
		LF	Venom –caborial

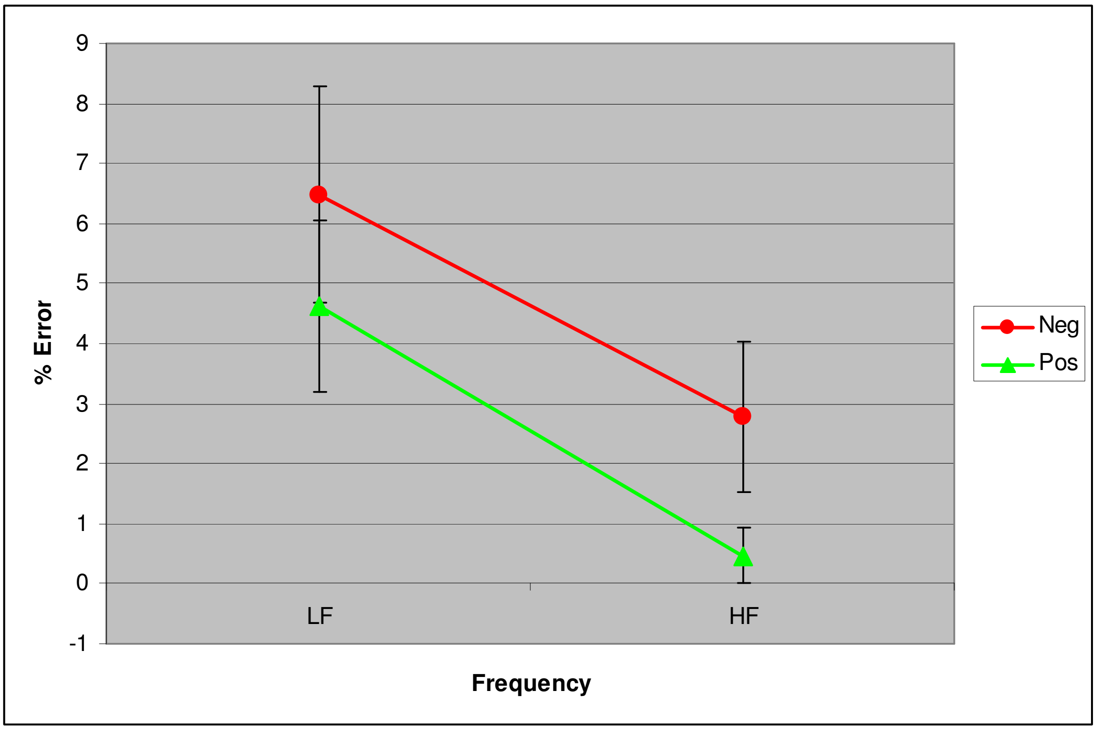
Results

Emotion and Frequency Effects

Two-way analyses of variance (ANOVAs) were performed on the RT data for words and non-word targets. For both word and non-word targets, there were no main effects of valence or frequency of prime, and no significant interaction between the two [all Fs<1].

ANOVAs were also carried out on the % error data for words and non-words. For words, there were significant main effects for both frequency [$F(1,35)=4.2$, $MSE=156.25$, $p<.05$], with targets following HF primes being responded to more accurately than targets following LF primes, and emotion [$F(1,35)=8.523$, *MSE*=557.59, *p*<.05], with targets following positive primes being responded to more accurately than targets following negative primes. These main effects are shown in figure 5.3 The interaction was not significant.

Figure 5.3. Graph of Main Effects of Frequency and Emotion on % Error



For % errors in non-word targets, there were no significant main effects or interactions [all *F*s<1].

General Discussion

In Experiment 1 A, the expected results of semantic priming were shown: semantically related targets were responded to significantly faster than unrelated targets. More surprisingly, a marginal interaction in % errors was found between frequency and semantic relatedness. While no difference was shown within LF words, within HF words semantically related targets were responded to more accurately than unrelated targets. In contrast to the initial prediction, HF primes seemed to facilitate (in terms of reduced number of errors) both word and nonword decisions.

The goal of the second experiment was to investigate how word valence affects the decision process in a lexical decision task. Previous studies have shown that words having a particularly strong valence in either direction (i.e., negative or positive) are responded to faster or are more likely to be remembered than neutral words (Buchanan et al., 2006; Kensinger & Corkin 2004; Maratos et al., 2000; Olafson and Ferraro, 2001). It was expected that some differences would be found in the current study between positive and negative primes, but due to the inconsistent nature of the literature available it was unclear what these effects might be.

There were no differences found in participants' RTs to targets following positive words compared to negative words. This was the primary measure we investigated because, as explored previously, RTs were the measure of interest in the majority of studies in the literature which employed LDTs or EDTs. However, unlike prior studies, in the current study, only the prime had an emotional value; all of the targets were neutral. Specifically, we were looking at whether a positive or negative word might influence a subsequent neutral word. The null RT effects seem to implicate that there is no immediate facilitation or inhibition following the presentation of an emotion word.

% error rates on targets following positive vs. negative primes were also examined. For the % error data, there were significant main effects of emotion, with higher accuracy to targets following positive than negative primes, as well as frequency, with higher accuracy to targets following HF than LF words.

A significant finding from both Experiments was that more errors occurred after participants were presented with targets following LF than HF primes. This effect was present within both negative and positive stimuli in the second experiment, and within semantically related stimuli in the first experiment. By definition, LF words require more cognitive effort to access. One explanation might be that recognition is guided by familiarity. The differential amount of cognitive effort required to access HF vs. LF primes could affect performance on the subsequent target word – non-word judgment. Just as more cognitive resources are required to process negative than positive words, more cognitive resources are required to process LF than HF words. Both situations result in higher error rates on the target.

Of principle interest at the moment are the results concerning the positive and negative primes in Experiment 2. Zajonc (1980) proposed that, at a very early stage, stimuli are classified as "good' or "bad". It might be the case that participants made this classification of the positive and negative primes. They therefore processed this positive prime quickly and had more cognitive resources available to accurately make a lexical decision judgment on the target than when the prime was negative.

A similar explanation was suggested by Kakolewski et al. (1999) who found that non-depressed (i.e., healthy, normal) individuals were more likely to quickly process positively valenced stimuli. This was based on the theory of unrealistic optimism (Beck, 1967, 1976) which stated that healthy individuals have an overly optimistic view of the world and are therefore more likely to notice and respond to positive stimuli in the environment. Because of this naturally occurring positive stance, healthy participants are likely to notice the positive primes more quickly than the negative ones, process them quicker, and thus be free to move onto the task of making a judgment about the target much quicker with the result of making fewer errors in judgment. Moreover, because of this optimism, the positive prime may have captured their attention more than the negative prime, and so they are devoting more cognitive resources to making a judgment about a target following a positive prime, and hence make fewer errors.

Alternatively, it could be argued that when the target follows a negative word an increase in the numbers of errors are made. Just as the explanation above relied on the assumption that we are more likely to seek out, attend to, and approach positive stimuli, other theories are based around the notion that we avoid negative stimuli, possibly in an effort to protect ourselves from them. The perceptual defense theory proposed by McGuinnies (1949) and developed by Pratto and John (1991) and Taylor (1991) proposes that the negative primes presented in this experiment attracted more cognitive resources than the positive primes which resulted in fewer resources being available for making the word – non-word judgment on the target, and hence there were higher error rates.

This latter argument is especially persuasive when taking into consideration recent studies which have employed neuroimaging techniques such as those discussed in Chapter 1. Robinson et al. (2004) expanded on the theories of McGuinness (1949) and Pratto and John (1991) and suggested that negative stimuli which are also highly arousing (the exact definition of negative words in this experiment) symbolize a danger and trigger an alarm system that prepares the fight-or-flight response. If such stimuli were presented, it seems likely that the ability to focus on non- threatening stimuli would decrease, thereby decreasing the ability to perform on the task at hand. Support for this can be found in Maratos et al. (2000) which measured brain potentials for negative and neutral stimuli and found that a significantly higher chance for false alarms with negative words.

These experiments, however, have certain limitations. There were 48 prime-target pairings and this allowed for only 6 items per participant per condition. This may not be enough to allow any effects to manifest themselves. Effects may exist, but would need to be tested using a much larger bank of stimulus. Unfortunately, this may be difficult to accomplish given the relatively small number of words in databases such as ANEW and the strict control criteria imposed on words of each emotional type (positive, negative, and neutral).

Also, no pre-experiment rating study of the stimuli was conducted to ensure equally strong semantic relatedness across items. Although Becker (1979) had claimed that this was an important issue, he did not find a significant effect of strength of relatedness in his own study. Our stimuli were simply assessed for relatedness among a small group of experimenters. This could have resulted in one condition having a higher number of strongly related items than others.

Another possible limitation is the nature of the prime-target relations themselves. It may have been prudent to have included conditions where the prime was a non-word or a no prime condition or, in the case of experiment 1B, neutral primes. It was thought unnecessary to include a no-prime condition as the removal of the prime altogether would have reduced this to a simple LDT. As the stimuli used conformed to the same standards (and in many cases overlapped with) the stimuli presented in Chapter 2 it was assumed that the RT results would have been replicated. Due to the limited number of stimuli available, as well as the strict controls discussed to be adhered to, a no-prime condition was thought, in this case, to be an unnecessary luxury.

Similar thinking was behind the decision not to include a neutral-prime condition. As the eye movement results from chapter 4 conformed to the same pattern as the LDT results from chapter 2, and every one of them were collected when the target emotion word appeared after several neutral words, it was concluded that any previously presented neutral word would have little impact on reading time of, or in this case RT for, the emotional target. One possible drawback resulting from the omission of such a control condition, however, was the inability to determine, taking the current experiment in isolation, whether there was better accuracy for target words following positive primes, worse accuracy for target words following negative primes, or both.

In sum, despite the marginal interaction in the % error data, any effect produced by the affective prime seems quite limited and does not influence RT. One way forward would be to create a larger affective context than a single word prime in order to produce a measurable effect on subsequent neutral text. In the next chapter, eye movements are measured while the target region is preceded (primed) not by a single word but by a whole sentence.

Chapter 6

Introduction

It has been demonstrated in the preceding chapters that a difference exists between how we process words with high emotional content, be they positive or negative, and how we process neutral words. Work on single emotion words in neutral sentences showed that a word's arousal and valence was reflected in participants' eye fixation times on those words. The demonstration of an interaction between emotion and frequency illustrated just how early in word processing emotional content comes into play. This immediacy of processing was corroborated by the early electrophysiological differences found in Chapter 2, which presented single emotion words in isolation. Positive and negative words produced significantly distinct patterns in both the P1 (80-120 ms) and N1 (135-190 ms) components of the ERP.

Other ERP studies have concerned themselves with later components elicited by emotional stimuli and have reliably demonstrated longer lasting effects. Using affective pictures, Pastor et al. (2008) replicated previous research when they reported late potentials relating to emotive pictures and images. Participants attended to positive, negative and neutral scenes while ERPs were recorded. They reported finding an LPP (late positive potential) on centro-parietal electrodes as well as a larger positive slow wave which continued between 1 and 6 seconds after stimulus offset. This later potential was interpreted by the authors as extended processing of motivationally relevant cues.

Effects have also been found when text has been used as the stimulus. Two of these studies, one by Dillon, Cooper, Grent-'t-Jong, Woldorff, and LaBar (2006) and the other by Pastor et al. (2008) were mentioned briefly in Chapter 2 but shall be expanded on now. Dillon et al. (2006) had exposed participants to positive, negative and neutral words (half of the latter set belonging to the category of 'school-related') mostly taken from Bradley and Lang (1999) and all controlled for frequency, semantic similarity and immovability. ERPs were recorded while participants read each word and then rated it for arousal. It was found that emotion words elicited a late positive potential (LPP) between 450 and 700 ms post-stimulus located on midline and right hemisphere frontal electrodes. This was interpreted as an increase in attentional resources indicating sustained attentional processing.

Significant post-lexical effects of emotion have also been found in this thesis using the current stimulus set of emotional words. In Chapter 2, a P300 effect was found in the 300-450 ms window. Although not in the range described above, this is nevertheless evidence that downstream effects can be elicited using the stimuli utilized thus far. However, the electrophysiological studies mentioned use single stimuli presented in isolation. Such longer-lasting effects can perhaps be better examined within a more ecologically valid context of participants reading short, coherent passages of text. In Chapter 4, a region comprising the two words immediately following the target (emotion) word was analysed. It was hoped that some difference would be manifest as a result of an emotional spillover effect, but no significant differences were found.

In Chapter 5, there was also an attempt to examine the influence of emotional words on subsequent neutral text using priming. Although differences were found with percent error scores, with both positive and HF words being responded to most accurately, there was no difference in RT to neutral words whether they followed a negative or a positive prime. The absence of any spillover effects can be explained in a number of ways. First, it may be the case that the influence of emotion in a word is so small that it is insufficient to impact on subsequent text. Alternatively the categories of emotion considered thus far may be too broad. Negative words as a whole may not have an effect on following neutral words, for example, but a subset of negative words, such as ‘fear’ or ‘guilt’ words, may. If this is the case, then possible resolution lies outwith the realm of this thesis which, as explained in Chapter 1, concerns itself only with the broad categories of positive and negative emotions. It may be the case, however, that isolated emotion words do not produce a strong enough effect to influence subsequent processing, but groups of similarly-valenced emotion words might lead to a build up of affect which can be measured downstream.

As well as providing an opportunity to discover such spillover effects of emotion, this may lead researchers to deal with more true-to-life bodies of text. In advertising, for example, one solitary positive word or idea will not be used to sell an item or a brand, but the advertisement will look to paint a picture, as it were, using a collection of positive words and phrases. Similarly in health campaigns, it is not enough to say that smoking is bad or unhealthy or unsociable; one must point out in great detail the grotesqueness of a festering malignancy, or the pain and heartache of a family watching a parent slowly wither away.

In picture research – which encompasses most of the research to date dealing with the processing of emotional stimuli – one positive component does not make a positive image. A woman holding a flower in a bare room, for example, is not a positive image. If she is smiling though, and the sun is shining through a window, and there are children and a loving husband and a family dog and more flowers on a vase on the window sill and perhaps an empty cot implying the impending arrival of another baby, *that* would be a positive image.

With this in mind, the current experiment will take a similar form to the eye movement study presented in Chapter 4. Emotionally positive (Pos), negative (Neg), and neutral (Neu) sentences (constructed from positive, negative, and neutral words, respectively) will be presented as the second sentence within a three-sentence narrative, with sentences 1 and 3 within this narrative being neutral. The materials are constructed so that each of the three emotional sentences (Pos, Neg, or Neu) can plausibly appear as the second sentence in any of the three corresponding passages (A, B, or C). Three participant groups will be used to read the three possible versions of each material set.

In this way the longer-lasting effects produced by emotion words can be examined within the more ecologically valid context of participants reading short, coherent passages of text. These texts will contain not emotion words presented in isolation, as has been the case throughout the literature up to this point, but several positive, negative or neutral words working together to form a picture or idea in the reader's mind and possibly colour their processing of subsequent words.

As the first sentences of each triplet will be neutral and of an equivalent length, there are not expected to be any differences in processing time across emotion condition (Pos, Neg, Neu) in this sentence. For the second sentence, Negative sentences should take longer to read than either Positive or Neutral ones (which should not differ from each other). This would be consistent with the pattern of behavioural results from Chapter 2, and eye movement results from Chapter 4, taking into account that stimuli here are not divided into high and low frequency categories. Final sentences preceded by high-arousal (Neg and Pos) second sentences should be easier to process than those preceded by Neu second sentences. Such a pattern of results would support an attention-based account of emotion processing. That is, the degree of stimulus arousal (high or low) and direction of valence (positive or negative) differentially trigger attentional mechanisms. High arousal will lead to more sustained processing in general, but more so for negatively than positively valenced materials (negative environmental outcomes are more threatening). This initial disruption (slowing), however, paradoxically leads to facilitation in downstream processing. Although it is well-known that the strength of a memory trace may be enhanced for emotional events (e.g., Adolphs & Damasio, 2001; Blaney, 1986; but cf. repressed memories), the temporal dynamics of encoding have not been specified as they unfold in real time in an on-line reading situation.

Method

Participants

Thirty-four members of the University of Glasgow community (13 males and 21 females; mean age 20.8) were paid £6 for their participation. All were native English speakers, had normal uncorrected vision and did not suffer from dyslexia.

Apparatus

The same apparatus used in chapter 4 was used here.

Materials and design

A 3 factor within-subject design was used where participants read sentences of different emotional content (Positive, Negative, Neutral) in neutral paragraph contexts. The emotionality of the target sentences were ensured by the presence in each of positive, negative and neutral words (all of which conformed to the same ratings standards used in previous chapters) from the Affective Norms for English Words (ANEW), a database of 1000 words (Bradley & Lang, 1999).

There were 24 sets of sentence triples with the total number of characters in each set matched for length. A set of three neutral paragraph frames (one sentence before the target and one after) corresponded to each set of three targets, such that each target could appear in any of the three possible paragraph frames. An example of a set of three paragraphs and their interchangeable targets (in bold) is shown below and all paragraphs and targets sentences are displayed in the appendix.

1. Thousands of fans waited in the stadium to see the band's farewell concert. **The wonderful music filled the air and the delighted applause reached a crescendo.** All the journalists reported the event in the press the next day.

[Positive]

2. The Mexican mariachi performers warmed up as the tourists sat sipping beer. **Suddenly gunfire erupted and many of the screaming spectators were shot and killed.** Such occurrences were not uncommon in that part of the world.

[Negative]

3. The stage crew were watchful as the performers entered the arena. **They wore their familiar moustaches, black leather jackets and wide brimmed hats.** The stewards tried to form a barrier between the stage and the crowd.

[Neutal]

Three participant groups read three versions of the materials, differing on the target sentences (Positive, Negative, or Neutral) used in each paragraph. A total of 72 items across three conditions yielded 24 items per participant per condition.

Procedure

A bite bar (to minimize head movements) was first prepared for each participant. Participants were instructed to read each sentence on the monitor while their eye movements were recorded. They were told that yes-no comprehension questions followed half of the sentences to ensure they were paying attention.

The experiment involved initial calibration of the eyetracking system, reading 3 practice paragraphs, recalibration, and reading the 72 experimental passages. A calibration display appeared before every trial and involved a series of 11 calibration points extending over the maximal horizontal and vertical range in which sentences were presented. During this display, the calculated position of the eye was visible, allowing the experimenter to check the accuracy of the calibration and recalibrate if necessary.

Each trial began with the calibration display. When participants were fixating the left-most upper calibration point (corresponding to the first character of text), a passage was presented. After reading each passage, participants fixated on a small box below and to the right of the last word and pressed a key to clear the screen. The calibration screen reappeared either immediately or, on half the trials, after they had answered a yes-no question by pressing corresponding response keys. Participants had no difficulty in answering the questions correctly (mean=95%).

Results

A 3-way (positive, negative, control) within-subjects ANOVA was performed on first pass (FP) and TT reading times (in milliseconds per character) by participants and by items for each of the three sentences. First pass was used as the principal measure here, as the target region was a whole sentence rather than a single word (as in

Chapter 4). First pass represents the sum of the fixations from the first time the sentence is fixated until the reader's eyes leave the region to the right. As expected, for the first (neutral) sentence there were no significant difference [all *Fs*<1]. The ANOVAs for sentence 2 (the target sentence: positive, negative or neutral) and sentence 3 (neutral), where processing spillover effects of emotion would manifest, are considered below.

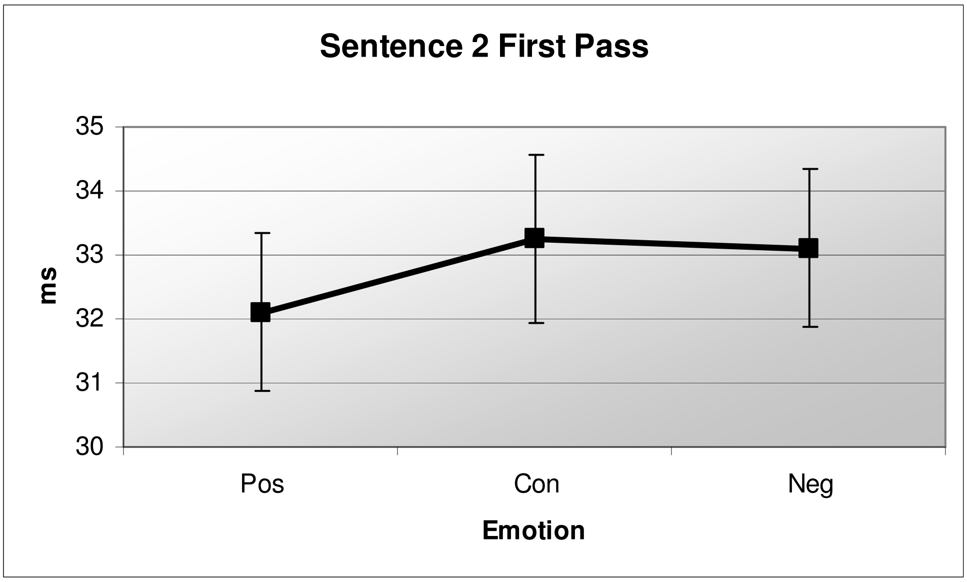
Sentence 2

The main effect of emotion in the FP measure was significant by subjects and significant to non-significant trent level by participants [$F_1(2,33)=3.873$, $MSE=154.803$, $p<0.05$; $F_2(2,71)=2.087$, $MSE=25.638$, $p<0.15$] and is shown in Figure 6.1. The TT measure was only significant to non-significant trent by subjects and was not significant by participants [$F_1(2,33)=2.315$, $MSE=9.928$, $p=0.107$; $F_2(2,71)=1.217$, $MSE=20.549$, $p=0.299$]. Follow-up contrasts on the FP data revealed that positive sentences were read significantly faster than both negative sentences [$F_1(2,33)=5.004$, $MSE=16.98$, $p<0.05$; $F_2(2,71)=3.485$, $MSE=42.815$, $p<0.07$] and control sentences [$F_1(2,33)=6.517$, $MSE=22.116$, $p<0.05$; $F_2(2,71)=2.729$, $MSE=33.534$, $p<0.11$] (although these differences were only marginal or non-significant trent by items). There was no difference between negative and control sentences [all *Fs*<1].

Sentence 3

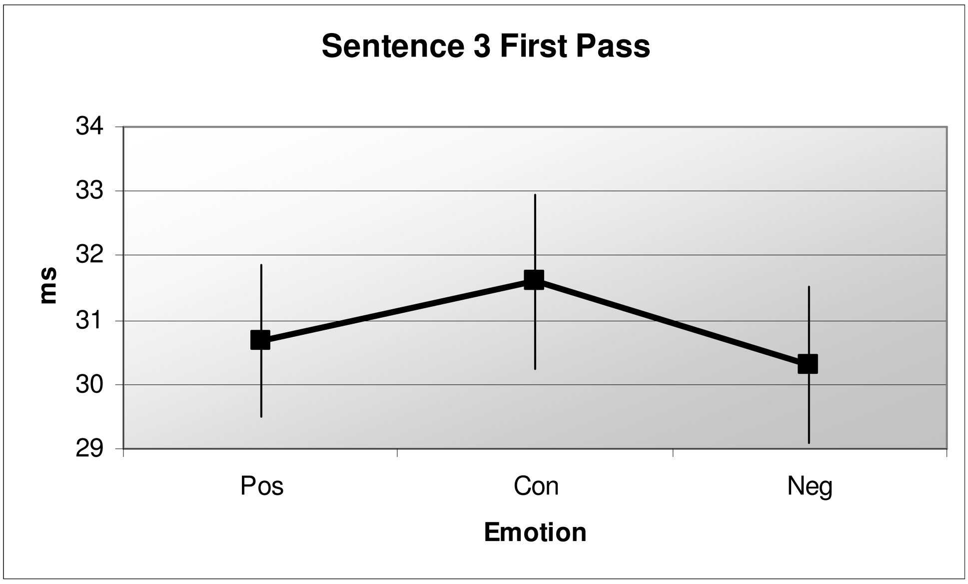
For FP reading times, the main effect of emotion was significant by subjects and marginal by items [$F_1(2,33)=3.932$, $MSE=4761.147$, $p<0.05$; $F_2(2,71)=2.898$, $MSE=25.993$, $p<0.06$] and is shown in Figure 6.2. Follow-up contrasts revealed that there was no significant differences between the FP reading times for positive and negative sentences [all *Fs*<1]. Control sentences, however, were read marginally slower than positive sentences [$F_1(2,33)=3.891$, $MSE=14.563$, $p<0.06$; $F_2(2,71)=2.031$, $MSE=18.219$, $p<0.16$], and significantly slower than negative sentences [$F_1(2,32)=7.382$, $MSE=28.188$, $p<0.05$; $F_2(2,71)=5.726$, $MSE=51.361$, $p<0.05$].

Figure 6.1: First pass reading times for sentence 2



The TT data also showed a significant effect of emotion by subjects, and an effect to non-significant trent by items [$F_1(2,33)=41.397$, $MSE=20.698$, $p<0.05$; $F_2(2,71)=2.317$, $MSE=29.41$, $p<0.11$]. Follow-up contrasts revealed the same basic pattern as in the FP data: text following negative sentences were read fastest, being fixated on for marginally less time than text following positive sentences [$F_1(2,33)=3.419$, $MSE=14.343$, $p=0.69$; $F_2(2,71)=2.307$, $MSE=29.277$, $p<0.14$], and significantly less time than text following neutral sentences [$F_1(2,33)=9.759$, $MSE=40.936$, $p<0.005$; $F_2(2,71)=4.329$, $MSE=54.945$, $p<0.05$]. There was no difference between reading time of text following positive vs. neutral sentences [all $Fs<1$].

Figure 6.2: First Pass Reading Times for Sentence 3



Discussion

As expected, there was no difference between reading times of the first neutral sentences, demonstrating the equivalency of the items. The difference in reading times in sentence 2 was consistent with reading times of previous emotional stimuli, taking into account that emotional words here were not segregated into HF and LF items (although they were generally controlled for frequency). Positive sentences (containing positive words) were read quicker than negative sentences (containing negative words) and neutral sentences.

The principal region of interest in this experiment was sentence 3, which was always neutral. This would be the expected locus of possible spillover effects from the emotional second sentence, and could demonstrate that emotional textual stimuli influences the processing of subsequent text, whether or not that text is emotional in content. Sentences preceded by neutral sentences were read significantly slower than sentences preceded by negative, and marginally slower than sentences preceded by positive, sentences. There was no difference in reading times between neutral sentences following positive or negative sentences.

This demonstrates, for the first time, the influence of emotional text upon the processing of subsequent non-emotional stimuli. The results – that emotional text seemingly facilitates the processing of a following neutral sentence (albeit the effect is only marginal for the positive sentence) – are supportive of an attention-based account of emotion processing, signaling that arousal and valence differently trigger attentional mechanisms. The fact that all emotional text (as defined by the 2-factor theory) is high in arousal results in more sustained processing. That negative environmental outcomes are more serious than positive ones in terms of evolution, they threaten us more and therefore should result in a greater processing advantage than positive ones.

This is consistent with the results of previous experiments, both in this thesis and from the wider literature. Previous attempts to find such spillover effects as were demonstrated here did not typically meet with much success when textual stimuli were employed. These failures may have occurred for a number of reasons. First, as has been stated, pictures are typically more salient than words and contain more information; therefore, it is possible to convey more emotional information through a picture than through a word (as has been the basis of many previous experiments) or even a sentence. It was thought that perhaps it was not possible to influence the processing of subsequent text by means of emotional words alone for this reason.

Another shortcoming in previous attempts to demonstrate spillover effects was the methodology employed. Typically, studies have participants engage in tasks specific to the psychology laboratory, presenting words in isolation in, for example, a priming study (such as in Chapter 5 of this thesis). The current experiment is the first to tackle the issue using the more ecologically valid investigative tool of eye-tracking in normal reading. These results demonstrate, therefore, that not only do spillover effects occur, but they do so in normal reading.

The manifestation of this effect in eye-movements is confirmation of previous electrophysiological evidence mentioned in the introduction. In Chapter 2, electrophysiological effects following emotional stimuli were found in the 300-450 ms window. Previously, Pastor et al. (2008) reported finding a large positive slow wave up to 6 seconds after stimulus onset.

This is consistent with the theory posited throughout this thesis – that a negative stimulus initially results in a slowing of responses due to increased cortical activation, but then has the paradoxical effect of facilitating downstream processing. In the current context, this is demonstrated by the finding that sentences following negative words are read faster than those following neutral words, the first time such effects have been shown in normal reading.

Of course, as argued in Chapter 1, it is important to consider top-down explanations in addition to bottom-up ones. Much has been made so far in this discussion about the fact that the effects found in sentences 2 and 3 occurred in the context of natural reading. While this gives the findings greater ecological validity than the reviewed studies in which emotion words (and subsequently presented words) were presented in isolation, it also opens the door to explanations based on top-down processes.

Situation models, such as Zwaan's (2004) immersed experiencer framework (IEF), describe language as a set of cues, or instructions, with which the comprehender – in this case the reader – can build up an accurate representation of the events, situations, and protagonists described. The words in the text, when read and processed, activate different, relevant areas of the brain (e.g., motor cortex for movements) as described in the grounded cognition literature (e.g., Barsalou, 2008). In this way the reader not only understands what is being described in the text by processing the semantics of each individual word, but becomes immersed himself as he constructs a model of the situation being described.

Several versions of situation models have been proposed in the literature, with Zwaan's (2004) IEF being the one focused on in Chapter 1. As all these models are similar in what they propose, Zwaan's model will be used to describe possible top-down processes relevant to the current findings.

This model distinguishes 3 components of the comprehension process – the activation, construal and integration stages. In the first phase the word activates a functional web so that the referent can be experienced. The consideration afforded this in the literature thus far concerns speculation into such factors as semantics and the perspective and shape of objects, but not emotions. It may be assumed that, just as a verb such as 'reach' would activate related areas in the motor cortex, and 'eagle' would activate images in the visual cortex, so an emotion laden word would elicit an emotional reaction in the relevant area (possibly the amygdala, as discussed in Chapter 1). This is the assumption that has been worked from already, but it is the latter two phases of the IEF which suggest alternative explanations for the current findings.

In the second stage these functional webs are integrated with the mental simulation of a specific event in the mind of the comprehender. Again, there has not been much research devoted to the role of emotion in this stage of processing. Of more interest has been the temporal and spatial regions involved, the perspective of the protagonist, any focal entity, and the relationship between them. It may be supposed, in the context of the current experiment, that the influence of emotion words at this stage can account for any effects in the emotional sentence. This stage is all about the integration of information into the immediate context (*immediate* time; *immediate* space) so it would be safe to assume that it deals with related components in relatively short sentences such as those presented here.

It is impossible to discern, however, whether the shorter reading time demonstrated for positive sentences is the result of the positive words being read faster (as is assumed due largely to previous findings, as explained above) or with the induced 'positiveness' facilitating the integration of each word's functional web to the immediate context. It is an assumption of the Zwaan model that comprehension is incremental. This is logical as words are read sequentially so, although Zwaan also states that specific words can have a retroactive as well as a proactive influence on the situation model, it is reasonable to assume that by the end of the second sentence a general 'positive', 'negative' or 'neutral' situation model has been built up.

The final stage, integration, is the only one in which the role of emotion has been mentioned in the literature, although this has been limited to the 'reaction' of the experiencer due to an observation they may have made in their 'immersed experience'. It is in this stage that the immediate context built up in the construal stage is integrated into the larger context of the immersed experience, and the experiencer is able to react appropriately. The two factors Zwaan claims most influence integration is relevant human experience, and the amount of overlap in the evolving mental integration. Of the materials utilized here there is sometimes, although not always, explicit referral in the third sentence to the state of affairs in the second sentence ("the event" and "such"). As a result it is unclear whether any effect observed is really a spill-over effect (as reasoned at the start of this discussion), or in fact a phenomenon related to the integration stage of situation models.

Van Dijk and Kintsch (1983) suggested that situation models are needed to integrate information across sentences, while Hess, Foss and Carol (1995) found that the speed with which the last word of a sentence is named depends on how well it can be integrated with the current situation model. In this experiment *all* third sentences were read after all positive, negative, and neutral second sentences, so ease of integration should have been constant across condition. In any case, if one sentence directly follows another it may be natural to assume that they are related. If this is the case – and assuming the sentences are compatible – the information in the new sentence will be automatically integrated into the existing situation model regardless of any explicit referral to a previous sentence.

It could be the case, though, that emotion is an important but overlooked factor in integration. The reading of the second sentence could have developed a 'positive' or 'negative' situation model into which subsequent information had to be integrated, which may be easier or harder depending on the emotion involved. Having completely unrelated sentences, which contain no explicit referral to anything mentioned in sentences one or two, as third sentences would test the claim that there is a spill-over effect in contrast to the multiple interpretations of the effect found with related sentences. Of course, this would perhaps diminish the ecological validity of the study as semantics and situations are not often isolated from sentence to sentence. Such a manipulation would, however, be helpful in more specifically determining the nature of any emotion-laden spill-over effect, and that it is such an effect, rather than a consequence of a situation model that is causing differences in reading times in sentence three.

It may not be emotion itself that has a noteworthy impact on situation models, but the arousal that all emotion words (as they are defined here) elicit. This is plausible since the reading times of neutral sentences following both negative and positive sentences were reduced (albeit the positive one only marginally). Plausibly, the arousal content of the emotion words presented could cause not a specifically emotional situation model to be formed, but an 'urgent' one which encouraged more rapid integration than usual. Alternatively, the situation model may have remained constant, and the arousal elicited by the emotion words, while not impacting on the IEF itself, could have caused readers to integrate words faster into the simulation.

Before any conclusions regarding situation models and emotional integration are drawn, however, more research needs to be carried out. The integration level is said to be influenced by information which is current and relevant and is stored in an 'active state', which may be reasonably assumed to be everything which has been read in the preceding sentence (or sentences). Situation models are, however, said to be amalgamations of information stated *explicitly* in the text and their inferences, and it is claimed that they can incorporate at least temporal, spatial, causal, motivational, and personal and object-related information. Here, once again, emotion is not mentioned. It is reasonable to assume that the 'negative' or 'positive' aspect comes from the inferences and real world knowledge, or experience, of the reader, as the emotion words used elicit rather than describe emotion. As such, it will be difficult to discern whether any effects of emotion are directly due to so-called spill-over from single, or multiple, emotion words in the text, or whether these influence the situation model of the reader and thus influence the integration of subsequent text.

Whatever the reason, this is the first study to demonstrate that reading emotional text can impact upon the reading time of subsequently presented neutral text. If the current results are reliable, showing that emotional text influences the processing of subsequent neutral sentences, several possible follow-up studies suggest themselves. In the current experiment only the emotional content of the word, not its frequency, was manipulated. It would be of interest to see if either HF or LF words were more able to influence subsequent text. Adding frequency as an independent variable and still maintain the strict levels of control employed in the current study would possibly require a greater source of emotional words than is currently available in the ANEW database.

Another limitation of the current results is that the spillover effect was only demonstrated on subsequent neutral text. It is possible that the effect would be accentuated, or perhaps disappear altogether, if sentence 3 were emotionally positive or negative. This could be the topic of a future study.

Another consideration does not involve the post-emotion region, but in developing a procedure that enhances emotional states. That is, if the mere reading of emotion words and multi-word descriptions of emotional situations can influence our perception of subsequent text, then stronger manipulations of emotion itself would likely produce greater effects.

The final two experiments in this thesis will consider the impact of mood induction both in word processing measured by eye-tracking (Chapter 7) and in consumer psychology (Chapter 8). If the emotional value of one sentence is capable of affecting the processing of a neutral sentence, then by utilizing established mood-induction techniques it should be possible to examine the effect of mood on reading time of text that conforms to the manipulations suggested above (i.e., frequency and emotion). It will also be possible to examine what impact mood has on the reading of emotional words in text designed to convey a message. In the final experiment of the thesis this will be accomplished by placing positive and negative words in passages designed to convey either a positive or a negative message about a product, and then assessing participants’ attitudes to that product.

Chapter 7

Introduction

The chapters presented thus far have focused on two questions. The first concerned how the emotional content of a word affects its processing. This has been addressed using behavioural, electrophysiological and eye movement paradigms and has produced consistent results. We have shown that arousal and valence both play a part in the processing of emotional words, demonstrated by reaction and fixation time, and that there is an early interaction with word frequency. We have also shown that HF negative words are associated with a larger N1, denoting the need for higher cognitive effort to process such words.

The second question queried the possible impact of emotion words, presented either individually or as a group, on subsequent, neutral text. Attempts to answer this second question were met with varying degrees of success. Single emotional words presented in neutral sentences reveal no downstream effects on reading measures. When emotion words are used as primes, there were no differences in RTs to neutral targets, although differences in accuracy were shown. However, when groups of emotive words, either positive or negative, were presented together to form emotive sentences, there was a processing advantage (as demonstrated by faster reading times) in subsequent neutral text.

In the investigations up to this point, the concern has been with the emotional state of the stimuli presented, not of the participant to whom it was presented. One issue not yet addressed is the role played by the mood or mindset of the participant. If the participant is already happy, for example, would she respond to a positive emotional word or sentence differently than a participant in a negative mood, or one having a more neutral disposition? The issue of mood will first be discussed. Then, the topics of mood and mood induction in language studies, particularly those dealing with emotional language, will be examined in more detail.

Mood

Mood has long been accepted as one of the principal factors in determining our outlook on the world, and our perception of everything we encounter. Unrealistic optimism (e.g., Harris, 1996; Klein, 1996), for example, is the name given to the phenomenon in which a healthy individual's outlook on life and their evaluation of their chances of success are seen as more positive and optimistic than is actually the case. Weinstein (1980) demonstrated that we as healthy individuals all rate our chances of achieving success – e.g., owning our own house or living past the age of 80 – as being above average, while our chances of suffering misfortune – e.g., becoming homeless or unemployed – are perceived to be less than average. This has also been shown for health risks such as the chances of developing prostate cancer in men (Clarke, Lovegrove, Williams, & Macpherson, 2000).

Depressed subjects, on the other hand, have a more negative (albeit more realistic) view of their world and their potential positions therein. Those in a depressed state have also exhibited other symptoms such as being less sensitive to light than healthy individuals (Friberg, Bremer, & Dickinsen, 2008) and taking longer to process emotional facial expressions (Gollan, Pane , McCloskey, & Coccaro, 2008) as well as displaying changes in attention and executive functions (Chepenik, Cornew, & Farah, 2007). In contrast to healthy participants, depressed (and previously depressed) participants have also been shown to respond faster to negative words than to positive words (Van Strien & Luipen, 1999). Whereas this is now accepted not to be the norm, it must be noted that no study to date has manipulated both the frequency and emotional content of word stimuli with a clinical population.

Depression is what may be described as an extreme form of trait affect or underlying disposition. Even within the healthy population, different people may tend towards being more optimistic or more pessimistic as part of one component of their personality. It is also the case, though, that our mood is constantly varying and can change very quickly based on minimal provocation, as has been demonstrated throughout the field of social psychology. For example, Isen and Levin (1972) put people in a good mood by leaving a coin for them to find. They found that these happy people were more likely to help a stranger who had dropped their books.

It has been shown that our mood at a given point in time impacts upon our perception of the world around us in two ways. First, mood also underpins cognitive processing style. Individuals in a positive mood, possibly because they assume things are going well and there are no imminent problems or dangers, will be more likely to use top-down, heuristic-based processing to interpret their environment or to form opinions and make judgments (e.g., Isen, 1987). Those in a negative frame of mind, however, possibly seeking the cause of their troubles, will take a more analytical, detail-oriented approach and be more likely to engage in bottom-up processing (e.g., Schwarz, 1990). Second, mood determines what we are able to recall from memory (e.g., Lewis, Critchley, Smith, & Dolan, 2005) and what we notice in our environment. Individuals are more likely to notice, attend to, and remember information, events and stimuli congruent with their current affective state (Haenze & Hesse, 1993).

Mood Induction

Given the extensive effect of mood, it is no surprise that it is still considered a major factor and is manipulated in experiments in many areas, including health (Annesi & Whitaker, 2008), memory (Kanayama, Sato, & Ohira, 2008), face perception (Forgas & East, 2008), and industrial psychology (Forgas, Dunn, & Granland, 2008). When investigating mood and its impact on behaviour or processing, one can either measure mood in the participant or induce it artificially. When conducting field or observational experiments, particularly those of a social psychological nature, it is often possible to induce a positive or a negative mood surreptitiously, such as by the careful placement of capital. When a laboratory is the setting for the investigation, however, there have emerged several methods which have been repeatedly shown to be effective in achieving the desired state in the participant.

Ruys & Stapel (2008) summarised that recollecting memories, listening to music, reading reports of events, watching film clips, receiving feedback and imagining life events have all been successfully used to induce positive and negative moods (Fiedler, 2001; Forgas, 1992; Isen, 1987; Schwarz, 1990). They suggested that it is the evaluative tone of the induction procedure which is important rather than the specific content activated (indeed, they indicate that any descriptive information may in fact counteract the evaluative tone) and went on to show that mood induction is possible even if it is done subliminally. This evidence implies that mood induction is fairly straight forward, having been successfully accomplished using a number of distinct procedures for a variety of experimental tasks.

Mood Induction in Language Studies

Mood induction has been used to investigate the processing of emotional language for many years. Niedenthal and Setterlund (1994) wrote:

> *"Emotions should increase the efficiency of perception of emotion – congruent stimuli in the visual field, individuals should be able to detect, identify or classify emotion congruent words faster or more accurately than other words." (p.402)*

Halberstadt, Neidenthal, and Kushner (1995) induced either a happy or a sad mood in participants by having them listen to 8 minutes of classical music. Participants then had to listen to words and then write them down. Upon hearing homophones where one meaning was negative and the other neutral (e.g., die-dye), sad participants were more likely to produce the sad spelling. This was not true for happy subjects who were just as likely to select either interpretation.

Olafson and Ferraro (2001) replicated these results. They used an LDT and demonstrated that a facilitation to affectively congruent stimuli generalised to other tasks. Ferraro, King, Ronning, Pekarski, and Risan (2003) primed young and older participants using 8 minutes of happy or sad music and then asked them to perform an LDT comprising of 25 happy, 25 sad and 50 pseudowords. They too found a mood x stimulus type interaction, where happy participants were fastest to respond to happy words and sad participants to sad words.

Benkeboom and Semin (2006) demonstrated that mood not only influences language processing but also its production, and does so across task and mood induction technique. Over a series of four studies they had participants describe either an autobiographical life event or a scene from a film after having been induced to a positive or negative mood. Mood was induced either through watching a series of film clips or by recalling a positive or a negative life event. It was shown that participants in a positive mood used predominantly abstract linguistic expressions while those in a negative mood produced more concrete descriptions, in keeping with the more detail-oriented processing style associated with negative mood as described above.

It must be noted, though, that inducing mood does not always have the expected effect. Bisson and Sears (2007) placed half of their participants into negative mood by using a multi-modal induction procedure involving video, music, story writing, and instructions before having them carry out the following experiment. 'Primes' were ambiguous sentences which could have been interpreted as having a negative, positive or neutral meaning. These were presented and then followed at ISIs of 0, 1000 or 2000 ms by a target word which was negative-related, positive-related, neutral-related or unrelated to the prime. For example, if the prime sentence was '*Jane was stunned by her final exam mark*' the three related primes could be *distress* (negative), *success* (positive) and *grades* (neutral). Each subject saw a total of 20 of each category of target in an LDT. Although a semantic priming effect was found, no advantage was shown for negatively related targets within the negative affect group, meaning there was an absence of the expected interpretation bias. One effect of interest is that participants whose mood was induced to be negative showed a slower RT than participants whose mood was not manipulated.

Rossell and Nobre (2004) also had difficulty obtaining results from negative mood induction. They based their study on reports that induction of both positive and negative mood has been shown to facilitate semantic priming across a number of studies with a range of SOAs from 200-1500 ms (e.g., Haenze & Hesse, 1993; Matthews, Pitcaithly, & Mann 1995). They report that mood induction has been shown to facilitate RT to single words in LDT tasks involving words of the same 'categorical' affective valence (e.g., 'happy' but not 'love' words are primed by a happy induction; Challis & Krane, 1998). They suggest from this evidence that the mechanism responsible is a weaker form of semantic relatedness. In their study they induced the discrete moods of 'neutral', 'happy', 'fearful' and 'sad'. They found reliable semantic priming affects for happy and neutral prime-targets but not for the others. They instead reported no priming facilitation for the fearful group and a slowing of RT for the sad group.

As has been stated earlier, this thesis is not dealing with discrete emotions but rather with the general categories of positive and negative affect. Rossell and Nobre (2004) did find the expected facilitation when positive and neutral mood was primed; it was only in the negative subcategories of fearfulness and sadness that their predictions were not upheld. It is possible that some other mechanism was at work and, had a general 'negative' category been induced, then facilitation would have occurred as was the case in the similar study conducted by Olafson and Ferraro (2001).

Bisson and Sears's (2007) failure to find a facilitation effect for their negative affect group is more difficult to explain. They themselves suggest the possibility that the mood induction procedure did not work properly (although evidence such as the slowing of participants' RTs seems to indicate that it did). Perhaps the most likely explanation is that there was not enough negative content in their prime sentences (given that they could also have been interpreted as being neutral or positive in meaning) to influence the target word, or to be assimilated by the schema activated by the mood induction procedure. It may be the case that similar materials utilized in a different task would have produced more consistent results.

The Current Study

This study aims to examine the impact of mood on the processing of emotional text more closely than has been attempted in the literature to date. In Chapter 4 of this thesis, as summarised above, a relationship was established between the emotionality and frequency of a word as recorded by various eye tracking measures. The result was evidence that the effects previously visible through behavioural measures such as reaction times on LDTs and EDTs were shown to be present when participants were reading in a normal context.

In this study, the same measures and stimuli employed in Chapter 4 will be used, with the addition of a mood induction procedure preceding the experiment and mood appraisal questionnaires following it. The goal is to examine whether the mood congruence effect occurs in natural reading through measurement of fixations on positive, negative and neutral words in neutral sentences. It will also explore the role of frequency on the processing of an emotional word of a particular valence by a participant of a similar or disparate affective state. A variation on the Velten mood induction technique, explained in detail below, will be employed to place participants into a positive, negative or neutral mood prior to reading the sentences.

It is expected that those participants primed to be in a neutral mood will replicate the pattern of effects demonstrated in Chapter 4. It is also expected that a congruency effect will manifest – i.e., participants in a positive mood will read positive words quickest while participants in a negative mood will read negative words quickest. Different interactions are expected between frequency and word type within the different induction conditions as participant mood should modulate responses to different sets of words.

Methodology

Participants

Thirty-six participants (27 female, 9 male) took part in this experiment. All were right-handed native English speaking volunteers who did not suffer from dyslexia. The majority of the subjects were around undergraduate age (mean = 22; range: 18-49). All had normal or corrected-to-normal vision and were naïve as to the purpose of the experiment. They were recruited through advertisements placed around the university campus. In accordance with the guidelines set by the University's ethics committee, written informed consent was obtained prior to experimental participation.

Apparatus

Participants' eye movements were tracked using a SR Research Desktop Mount EyeLink 2K eyetracker. This had a spatial resolution of 0.01 degrees and eye position was sampled at 1000 Hz using pupil/corneal reflection tracking. Text (black letters on a white background, in a 20 point non-proportional font) was presented on a Dell P1130 19" flat screen CRT monitor with an 800 x 600 resolution. This was run at 170 Hz (5.88 ms per screen refresh). Participants were positioned at a viewing distance of approximately 72 cm, 3 characters of text subtended 1 degree of visual angle. Although viewing was binocular, eye movements from the right eye were recorded.

Materials and Design

A 3 (Mood Induction: positive, negative, neutral) x 3 (Emotion: positive, negative, neutral) x 2 (Frequency: HF, LF) mixed design was used, with emotion and frequency being within-subjects factors. There were 18 participants in each mood condition.

The stimuli shown to the participants during the reading task were identical to those used in Chapter 4.

Mood Induction

Participants were randomly assigned to one of two mood groups – positive or negative- - or to a control condition where mood was not induced. Participants' mood was induced using either ten positive or ten negative Velten Mood Induction Statements (Jennings, McGinnis, Lovejoy, & Stirling, 2000) to which participants responded by recalling autobiographical events where they felt the same way as described by each statement. In the control condition, participants were required to read 10 statements of neutral valence from the Velten Mood Induction Statements. Some of the Velten statements used were adapted to eliminate American idioms.

Mood Assessment

After completing the experiment, participants filled out two mood assessment scales in order to assess their current mood. The Geriatric Depression Scale (GDS; Yesavage et al., 1983) is composed of items to which participants respond 'no' or 'yes'. The Positive and Negative Affect Schedule (PANAS; Watson, Clark, & Tellegen, 1988) consists of 10 positive affect words and 10 negative affect words. Participants were asked to indicate how they felt at the present moment by rating each item on a 5 point Likert scale, where 1 indicated ‘very slightly or not at all’ and 5 indicated ‘extremely’.

Procedure

Participants were taken to a designated room in the Glasgow University Psychology Department. They were shown an instruction sheet and asked to read and sign the consent form. The instruction sheet informed them the study concerned mood and would be split into 3 parts. In Part 1 they would either be placed into a positive or negative mood by being asked to recall a series of autobiographical events, or have to attend to a series of neutral statements. Part 2 was a distracter task where they would be required to read a series of sentences on the eye-tracking machine. In Part 3 they would have to answer questionnaires which would measure how their mood had been affected by the distracter task. They then completed the modified Velten mood induction task for the group they had been placed in, completed the reading task and filled in the GDS and PANAS questionnaires. They were fully debriefed as to the true purpose of the experiment once all the questionnaires had been filled in. The whole process lasted approximately 45 minutes.

Results

The same target regions and cut-off criteria that were used in Chapter 4 were also employed here. The standard eye-movement measures of first fixation duration (FFD), single fixation duration (SFD), gaze duration (GD) are considered here. SFD represents the proportion of trials in which FFD and GD are identical and, in this study, accounts for the majority of data (73%). A final measure is total fixation time

(TT) which incorporates GD plus any fixations returning to the target. In this experiment, returning fixations occurred on 15% of trials. 1.

For each measure, a two-way analysis of variance (ANOVA) was performed both by participants (F_1) and by items (F_2). In general, the FFD, SFD, and TT measures all reported similar results, with significant main effects for frequency (marginal for FFD) and emotion, as well as an Emotion x Frequency interaction (also marginal for FFD). Mood induction was significant by items, but never by participants [all Fs<1]. Participant means fixation durations (ms) for LF and HF Positive, Negative, and Neutral words are presented in Table 7.

Table 7.1: Means for LF and HF words of each emotional category by all measures

	LF			HF		
	Pos	Neg	Con	Pos	Neg	Con
FFD	209	205	212	200	207	211
SFD	216	210	217	202	210	214
GD	253	250	265	222	240	242
TT	329	303	329	280	301	314

GD also produced these significant effects, as well as a 3-way Emotion x Frequency x Mood Induction interaction. The 2x2 (emotion x frequency) interaction apparent to some degree in the majority of measures will be examined in all measures before focusing on the 3-way interaction in the GD results, as the principal concern of this experiment is to find an effect of mood induction. ANOVA results for all measures both by participants (F_1) and by items (F_2), are presented in Table 7.2.

Table 7.2: ANOVA results for all measures both by participants (F_1) and by items (F_2)

Induction		*df*	*F*	*MSE*	*P*
FFD	F_1	2,51	1.438	4835.398	0.2469
	F_2	2,132	7.871	10985.516	<0.005
SFD	F_1	2,51	0.885	3614.481	0.419
	F_2	2,132	5.769	12305.278	<0.05
GD	F_1	2,51	0.996	7612.133	0.3766
	F_2	2,132	3.144	14537.723	<0.05
TT	F_1	2,51	1.554	41286.176	0.2231
	F_2	2,132	6.051	86967.248	<0.005
Emotion					
FFD	F_1	2,51	4.512	1484.843	<0.05
	F_2	2,132	4.236	4374.312	<0.05
SFD	F_1	2,51	2.931	1307.176	0.0579
	F_2	2,132	2.742	4436.737	0.0663
GD	F_1	2,51	7.448	6618.003	<0.01
	F_2	2,132	8.302	19858.868	<0.001
TT	F_1	2,51	6.478	11974.704	<0.01
	F_2	2,132	5.404	36076.737	<0.05
Frequency					
FFD	F_1	1,51	1.51	501.262	0.2248
	F_2	1,132	1.775	2351.111	0.1851
SFD	F_1	1,51	5.807	2455.753	<0.05

	F_2	1,132	3.264	7046.075	0.0731
GD	F_1	1,51	28.401	36842.670	<0.001
	F_2	1,132	31.198	103067.616	<0.001
TT	F_1	1,51	11.87	40401.0	<0.01
	F_2	1,132	1.062	102999.946	<0.05
Emotion x Frequency					
FFD	F_1	2,102	3.075	893.448	0.0505
	F_2	2,264	3.07	2132.137	0.0502
SFD	F_1	2,102	3.472	1437.522	<0.05
	F_2	2,264	3.678	3504.616	<0.05
GD	F_1	2,102	4.432	2769.873	<0.05
	F_2	2,264	2.575	5657.231	0.0781
TT	F_1	2,102	8.179	15415.815	<0.001
	F_2	2,264	5.828	36946.372	<0.05
Emotion x Frequency x Induction					
FFD	F_1	4,102	1.215	353.137	0.3090
	F_2	4,264	<1	598.352	*ns*
SFD	F_1	4,102	1.086	449.781	0.3649
	F_2	4,264	<1	618.835	*ns*
GD	F_1	4,102	3.616	2259.948	<0.01
	F_2	4,264	2.491	5315.005	<0.05

TT	***F_1***	4,102	<1	112.329	*ns*
	F_2	4,264	<1	678.475	*ns*

Emotion x Frequency Interaction

Follow-up contrasts for the Emotion x Frequency interactions were also carried out for each eye-movement measure and differences were compared between emotion words at each level of frequency (see Table 7.3) as well as frequency differences for each type of emotion word (see Table 7.4). For these comparisons, SFD data will be focused on as it accounts for the majority of the data. The SFD data showed a similar pattern to the other three measures, and will allow for comparison with the data from Chapter 4.

Table 7.3: Emotion x Frequency interactions for each eye-movement measure and differences between emotion words at each level of frequency

			Positive-Negative		**Positive-Neutral**		**Negative-Neutral**	
			F	***p***	***F***	***p***	***F***	***p***
LF	**FFD**	***F_1***	**1.26**	***ns***	**<1**	***ns***	**4.36**	**<.05**
		F_2	**1.403**	***ns***	**<1**	***ns***	**4.662**	**<.05**
	SFD	***F_1***	**2.53**	**0.1152**	**<1**	***ns***	**3.98**	**<.05**
		F_2	**1.976**	**0.161**	**<1**	***ns***	**2.842**	**0.093**
	GD	***F_1***	**<1**	***ns***	**5.94**	**<.05**	**9.39**	**<.01**
		F_2	**<1**	***ns***	**5.27**	**<.05**	**7.641**	**<.01**
	TT	***F_1***	**9.4**	**<0.01**	**<1**	***ns***	**9.48**	**<.01**
		F_2	**7.108**	**<.05**	**<1**	***ns***	**7.631**	**<.05**

HF	**FFD**	F_1	**5.20**	**<.05**	**11.55**	**<.01**	**1.25**	*ns*
		F_2	**4.234**	**<.05**	**14.011**	**<.001**	**2.834**	**0.0935**
	SFD	F_1	**4.25**	**<.05**	**8.29**	**<.01**	**<1**	*ns*
		F_2	**3.435**	**0.065**	**13.405**	**<.001**	**3.269**	**0.0718**
	GD	F_1	**12.59**	**<.001**	**16.49**	**<.05**	**<1**	*ns*
		F_2	**7.449**	**<.01**	**13.397**	**<.001**	**<1**	*ns*
	TT	F_1	**6.11**	**<.05**	**16.2**	**<0.001**	**2.414**	**0.12**
		F_2	**3.802**	**0.0523**	**13.182**	**0.001**	**2.825**	**0.094**

Table 7.4: Follow-Up Frequency Contrasts by Participants (F_1) and by Items (F_2) on Target Measures

		Positive		Negative		Neutral	
		LF vs. HF		LF vs. HF		LF vs. HF	
		F	***p***	***F***	***p***	***F***	***p***
FFD	F_1	**7.31**	**<.001**	**<1**	*ns*	**<1**	*ns*
	F_2	**9.404**	**<.01**	**<1**	*ns*	**<1**	*ns*
SFD	F_1	**11.89**	**<.001**	**<1**	*ns*	**<1**	*ns*
	F_2	**14.315**	**<.001**	**<1**	*ns*	**<1**	*ns*
GD	F_1	**40.53**	**<.001**	**4.8**	**<0.05**	**22.49**	**<.001**
	F_2	**29.979**	**<.001**	**5.187**	**<.05**	**16.898**	**<.001**
TT	F_1	**34.29**	**<.001**	**<1**	*ns*	**3.4**	**0.0681**
	F_2	**25.442**	**<.001**	**<1**	*ns*	**2.279**	**0.1323**

For LF words (Positive=216, Negative=210, and Neutral=217 ms), comparisons between emotion words revealed negative were read significantly faster than control and marginally faster than neutral, while there was no difference between positive and neutral. For HF words (Positive=202, Negative=210, and Neutral=214 ms), a different pattern emerged, with contrasts showing Positive words were read significantly faster than both negative and neutral, which did not differ from each other.

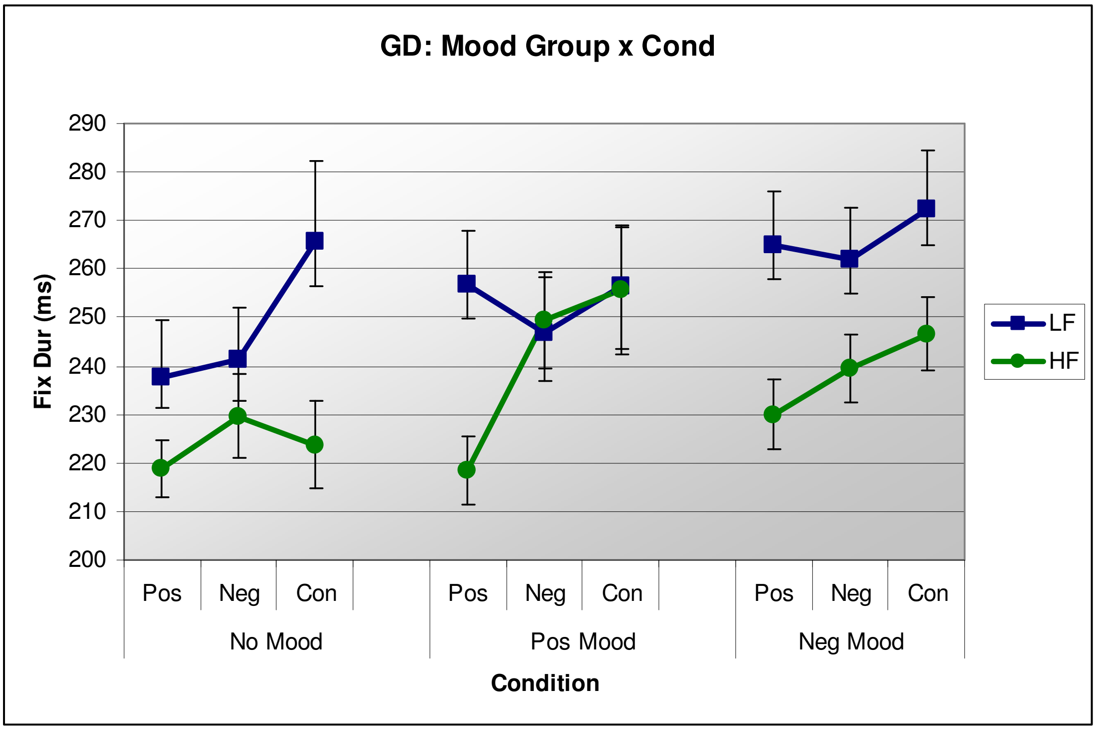
The frequency contrasts for each type of emotion word in SFD demonstrated significant effects for Positive words (LF=216 and HF=202 ms), but no effect for Negative words (LF=210 and HF=210 ms) or neutral words (LF=217 and HF=214 ms). The only difference in this pattern of effects across the other measures is as follows:

- The marginal effect between LF pos vs. LF neg was non-significant in FFD and GD but significant in TT
- There was a marginal effect for HF neg (301) vs. HF neu (314) in the TT measure
- The frequency contrast within negative words was significant in GD (LF=250 and HF=240 ms), and within neutral words was significant in GD (LF=265 and HF=242 ms) and marginal in TT (LF=303 and HF=301 ms).

Emotion x Frequency x Mood Induction Interaction in the GD Measure

The GD means (with standard error bars) are graphically depicted in Figure 7.1.

Figure 7.1: Gaze Duration Measure of Mood Group x Frequency x Word Type Interaction



Follow-up contrasts for the 3-way interaction were carried out. Emotion x Frequency comparisons were carried out for each of the 3 mood induction groups (positive, negative, neutral). These compared differences between emotion words at each level of frequency (see Table 7.5) as well as frequency differences for each type of emotion word (see Table 7.6).

Table 7.5: Follow-Up Frequency Contrasts by Participants (F_1) and by Items (F_2) on Word Type

			Positive-Negative		**Positive-Neutral**		**Negative-Neutral**	
Mood			***F***	***p***	***F***	***p***	***F***	***p***
Control	LF	F_1	**<1**	***ns***	**14.2**	**<0.001**	**10.45**	**<0.01**

		F_2	**<1**	***ns***	**5.938**	**<0.05**	**5.499**	**<0.05**
	HF	F_1	**2.07**	**1.598**	**<1**	***ns***	**<1**	***ns***
		F_2	**1.188**	***ns***	**<1**	***ns***	**<1**	***ns***
Positive	LF	F_1	**1.19**	**0.2837**	**<1**	***ns***	**1.147**	**0.2917**
		F_2	**<1**	***ns***	**<1**	***ns***	**<1**	***ns***
	HF	F_1	**11.614**	**<0.001**	**16.774**	**<0.001**	**<1**	***ns***
		F_2	**9.581**	**<0.05**	**15.183**	**<0.001**	**<1**	***ns***
Negative	LF	F_1	**<1**	***ns***	**<1**	***ns***	**1.54**	**0.2232**
		F_2	**<1**	**1.431**	**<1**	***ns***	**2.033**	**0.1574**
	HF	F_1	**1.271**	**0.2675**	**3.925**	**0.0557**	**<1**	***ns***
		F_2	**<1**	***ns***	**4.58**	**<0.05**	**2.602**	**0.11.3**

Table 7.6: Follow-Up Frequency Contrasts by Participants (F_1) and by Items (F_2) on Frequency

		Positive		Negative		Neutral	
		LF vs. HF		LF vs. HF		LF vs. HF	
Mood		***F***	***p***	***F***	***p***	***F***	***p***
Control	F_1	**6.15**	**<.05**	**2.49**	**0.1236**	**31.531**	**<0.001**
	F_2	**4.052**	**<.05**	**1.029**	**0.3131**	**15.446**	**<0.001**
Positive	F_1	**17.64**	**<.001**	**<1**	***ns***	**<1**	***ns***
	F_2	**15.219**	**<0.001**	**<1**	***ns***	**<1**	***ns***
Negative	F_1	**17.67**	**<.001**	**7.299**	**<0.05**	**9.54**	**<.001**
	F_2	**14.407**	**<0.001**	**9.19**	**<0.01**	**8.09**	**<0.01**

No-mood-induction (control) condition: For LF words (Positive=237, Negative=241, and Neutral=266 ms), comparisons between emotion words revealed that positive and negative words were both read significantly faster than control words, but they did not differ significantly from each other. For HF words (Positive=2219, Negative=230, and Neutral=224 ms), positive words were read marginally faster than negative words but there was no difference between positive and neutral, or negative and neutral words.

The frequency contrasts for each type of emotion word in SFD demonstrated the expected frequency effect (HF<LF) for positive and neutral words, but the difference between HF negative and LF negative words was only significant to non-significant trent.

Positive mood induction condition: For LF words (Positive=257, Negative=247, and Neutral=257 ms), there were no significant differences between means. For HF words (Positive=218, Negative=250, and Neutral=256 ms), positive words were read significantly faster than both negative and control words, which did not differ from each other.

The frequency contrasts for each type of emotion word in SFD demonstrated the expected frequency effect (HF<LF) for positive words, but no effect for negative or neutral words.

Negative mood induction condition: For LF words (Positive=265, Negative=262, and Neutral=272 ms) there were no significant differences. For HF words (Positive=230, Negative=239, and Neutral=247 ms), positive words were read marginally faster than neutral words, but other than that there were no significant differences.

The frequency contrasts for each type of emotion word in SFD demonstrated the expected frequency effect (HF<LF) for positive, negative and neutral words.

Discussion

A 3-way ANOVA was carried out on FFD, SFD, GD and TT measures of eye movements. There was an emotion x frequency interaction which was significant across all measures (marginal in FFD by subjects and by items, and in GD by items). Follow-up contrasts showed that within LF words negative words were read fastest, while within HF words positive words were read fastest. For SFD, positive HF words were fixated on for less time than positive LF words, but there was no frequency effect found within negative or neutral words.

The most interesting result was the 3-way interaction between emotion, frequency and mood induction that emerged in the GD measure. It might be the case that it manifests in this instance because, as discussed in Chapter 4, Inhoff (1984) posits that GD is more likely than shorter measures such as FFD or SFD to exhibit effects of higher cognitive processes such as predictability. If the mood of the participant facilitates assimilation of similar-mood emotional words, this could account for these findings. If this is the case, however, it is unclear why the interaction is not also present in the TT measure. Whatever the reason, it seems clear that the mood of the participant did influence the processing of both emotional and neutral words in reading.

In the no-mood-induction group, the only frequency effect is within control words. Within LF words, positive and negative words were fixated on for less time than neutral words, and there were no significant differences within HF words. In the positive mood induction group, the only significant frequency effect was within positive words. There were no significant differences within LF words, and within HF words positive words were fixated for less time than negative or control words. In the negative mood induction group, there were significant frequency effects for positive, negative and neutral words. There were no significant differences within LF words, and within HF words the only significant effect (marginal by subjects) was that positive words were fixated for less time than neutral words.

The no-mood-induction control condition was expected to replicate the results of the experiment in Chapter 4 (the same experiment as it contained no mood induction). This was not the case. There was the expected pattern within the LF words, but there was no difference between the fixation times of HF words. It appears that the fixation times on positive words have 'slowed' in this instance, having previously been fixated for relatively less time than negative or neutral words.

The most likely explanation for this unexpected discrepancy is the presence of a floor effect. This could be explained by the fact that the two experiments were conducted on different eye-tracking machines and, critically, different text-presentation systems. The Chapter 4 study was run using a Fourward Technologies Dual Purkinje Eyetracker (Gen V) eye-tracker, while the current study utilized the SR Research Desktop Mount EyeLink 2K eyetracker. Both eyetrackers have high spatial and temporal resolution. However, the quality of the display with the Dual Purkinje eyetracker was fairly degraded (cyan pixels of light on a black background). Text presented on the EyeLink was of high quality with black letters on a white background, similar to text in a book.

Evidence supporting the difference in stimulus quality comes from the average fixation times in the two experiments. The average fixation time in the control condition in this experiment was for SFD/LF = 214.3, SFD/HF = 208.7, and for GD/LF = 256, GD/HF = 234.7. In Chapter 4 the corresponding fixation times were 288.3, 278.3, 317.3, and 294, respectively. This represents an average difference of around 40ms for LF and 60ms for HF words in the GD measure. A floor effect is quite plausible: e.g., fixation times on HF positive words cannot get any faster. Indeed, the pattern produced by the current data appears similar to the interaction produced in Chapter 4 with the exception of HF positive words (which were not faster than HF negative or HF neutral words as was expected). It is possible that the 220 ms mark is the minimum threshold for such fixations.

Assuming, then, that the pattern manifest in the no- mood-induction condition reflects the same basic patterns of word processing demonstrated in Chapter 4, what is happening in the other two mood-induction conditions? In the positive mood induction condition, there was only a significant frequency effect within positive words, not within negative or neutral words. There were no significant differences within LF words, and within HF words positive words were fixated on for less time than negative and neutral words, which did not differ from each other.

In the negative mood induction condition there was a significant frequency effect within each of the emotion word conditions. As in the positive-mood-induction group, there were no significant differences within LF words. The only difference within HF words was that positive words were fixated on for marginally less time than control words.

These results were not expected. It had been speculated that there may have been a congruency effect within each mood-induction group, whereby either positive or negative words were read faster, and therefore fixated on for less time. While this was the case with HF words in the positive mood induction group, it was not replicated in the LF words, and in the negative mood group, positive words were actually read *faster* than negative words, even though this difference did not reach a significant level.

It might be the case that positive and negative mood are two discrete systems, each of which modulate either the negativity or positivity in words in distinct ways. For both the positive and negative mood groups, there was no difference in GD times between any of the LF words. This could indicate that any differences in word processing brought on by mood were limited to HF words. The expected congruency effect is found in the positive mood group but not in the negative mood group, where the only differences were marginal. This may be because negative mood makes individuals more analytical (by adopting a less heuristic-based approach than positive individuals; Schwarz, 1990). Such individuals may take more care in reading, resulting in no one type of word gaining a clear processing advantage.

An alternative interpretation might be that the inclusion of mood induction in this paradigm diminishes the overall effects. In the positive mood condition, although there is no difference between LF words, HF words conform to the same pattern as was seen for HF words in Chapter 4. It may be the case that arousal causes a general slowing of processing times. There is then a congruence effect for positive-mood participants who read positive words faster than negative or neutral words. The same is not the case for negative mood participants who are more analytical in their reading, and who only exhibit frequency effects within each category of emotion word, while not showing any clear-cut differences between the types of words themselves.

The final principle in issue with the current experiment relates to the mood induction technique employed. The Velten technique was chosen to induce the mood of participants as it has a history of being effective. Indeed, the 3-way interaction between mood induction, emotion and frequency that manifested in the GD measure shows that it was successful here, at least to some degree. It could be the case, of course, that the particular modification of the Velten mood induction paradigm employed in this study was, for some reason, more effective at priming one general emotional state than the other. This is unlikely, however, as the negative group rated themselves lower, and the positive group higher, on the PANAS and MAS questionnaires completed at the end of the study.

Were the study to be repeated, one way of ensuring that the desired mood was induced in participants (or that it was induced more strongly than resulted from application of the Velten technique) would be to approach the problem from the perspective of grounded cognition. A technique which does precisely this was first used by Strack, Martin and Stepher (1988) and was recently implemented by Havas, Glenberg and Rinck (2007). This method relies on the notion that, just as feelings and cognitions cans illicit responses in the motor cortex, so too can movements bring about changes in feeling and mood. In order to achieve different moods, participants are required to hold a pencil in the mouth either using only their teeth, or only their lips. When only the teeth are used, a smile is produced and a happy mood elicited; when only the lips are used a pout is produced and a negative mood elicited. This has been shown, incidentally, to produce stronger effects than were observed in participants who were forced to smile or frown.

Havas, Glenberg and Rinck's (2007) employed this technique and found an interaction with sentence valence when the tasks involved both valence and sensibility judgments. There was also an emotion-sentence compatibility found which was interpreted using a simulation account. They concluded that emotional systems contribute to language comprehension much as they do to social interaction.

Interestingly, one failure of this technique was its inability to produce any effects in a primed LDT other than the expected prime-target congruency. This might indicate that the emotional simulation only affects comprehension processes beyond initial lexical access, and implies that it may be of roughly the same strength as that produced by traditional mood induction techniques.

In this study participants were required to read for comprehension. This not only made ecological validity extremely high, but eliminated any strategy or demand characteristics which might be associated with a more complex, less natural, paradigm.

While the Havas, Glenberg and Rinck (2007) paper aptly demonstrates the effectiveness of this emotional simulation technique – if not its strength compared to traditional mood induction methods – there is a reason that it was not utilised in the current experiment. The moods simulated by having participants hold a pencil in their mouths are specific to 'happy' and 'sad' moods, not to generalised 'positive' or 'negative' moods. The positive mood is induced by having the participant smile. This is indicative of happiness, but not of surprise, another 'positive emotion, as identified by studies of facial expressions. The negative mood is simulated by having the participants frown as this, as mentioned above, produces stronger results than having them frown. A pout, however, is not representative of a range of negative emotions. It could be argued that it can denote anger or sadness but certainly not fear or disgust.

For this reason, to have used such a technique in the current study would have been to contravene what was set out in Chapter 1 – to deal only with positive, negative and neutral – not specific – emotions. Having said this, emotion simulation techniques could prove very useful in the future when the research on emotive text is expanded to include discrete emotions, as is proposed in other chapters.

Assuming that the current results do, as suggested, indicate a difference in the modulation of negativity between individuals in positive and negative moods, there are a number of logical steps which could now be taken to enhance knowledge in this area. As the most reliable and interesting effects in the present study showed up in the GD measure – one which includes later fixations on a word – it might be of interest to repeat the eye-tracking study conducted in Chapter 6 with the inclusion of mood induction. It would be likely that a similar, and perhaps clearer, pattern of results would appear in a situation where the target region comprised of a sentence rather than a word, and which contained several, rather than just one, emotional stimulus.

An alternative option, and the one which will be pursued in the following chapter, is to assess the impact of participants' mood on higher levels of cognitive functions than the processing of words or sentences. We have seen in this chapter the impact of mood on the processing of single words, possibly due to some modulation of negativity. It has also been demonstrated in previous chapters how the processing of chunks of text containing a number of positive or negative words, and a positive or negative theme, can affect the processing of subsequent neutral stimuli. If something as automatic as reading a word can be influenced by emotion, then it is possible that emotional text can influence higher cognitive functions, such as the formation of attitudes. In the final experiment of the thesis, presented in Chapter 8, this will be put to the test by having participants read either positive or negative reviews of a product, in this case a car. These reviews will contain either negative or positive words and the participants will be primed to either a positive, negative, or neutral mood.

Chapter 8

Introduction

In this final study I will examine the use of emotional language in blocks of text specifically designed to convey information about a particular product. The previous chapters have exposed differences in the processing of emotional words across many tasks. The next logical step is to look at how such processing differences may affect the higher-level behaviour of an individual. It has been established that the emotionality of a word affects processing very early on – so that it interacts with frequency in RT tasks, ERPs and a number of eye movement measures. In addition, emotional language has been shown to impact upon subsequently presented stimuli under certain circumstances.

Such effects are well-established when it comes to pictorial stimuli, but even taking into account the inconsistencies in attempts to find similar results with linguistic stimuli, enough has been discerned to suggest the potential for such an effect, and certainly there is sufficient evidence to warrant a deeper investigation of the issue. When using single words as stimuli spillover effects have not been found. In the current thesis alone, this was true of eye-movements in Chapter 4 and RTs in Chapter 5's priming study. When a collection of words of similar valence are presented together, however, faster ms-by-character first-pass reading times were found on neutral sentences following both positive and negative sentences than following neutral sentences. This is clear evidence that while individual emotional words might not impact upon the processing of subsequent neutral stimuli, when several emotion words are used together their influence can be more far-reaching.

Additionally, electrophysiological evidence adds weight to the argument that the emotional effects of a word influence cognition long after the word has been read.

In Chapter 2 – a study investigating the earliest, most low-level aspects of emotion word processing – enhanced electrophysiological components were found in the two post-N1 time windows analysed, the Early Posterior Negativity (200-300 ms) and P300 (300-450 ms). Using intracranial fMRI recording Naccache et al. (2005) showed amygdala activity during subliminal presentation of emotion words starting from 800 ms post-stimulus.

In the case of pictures, emotionally valenced stimuli have shown a larger positive slow wave persisting up to 6 seconds after stimulus offset (Pastor et al., 2008; Dillon et al., 2006). It is possible that the on-going access of emotion words in our reading of text produces immediate and sustained effects both on attention and evaluative processing. Such an effect, produced by an accumulation of emotional words, could impact far beyond eye-movement and RT measures to higher level functions.

This study will begin to investigate the effect of emotional language on participants' attitudes and decision making. Several decades of research on health warnings and product advertising has demonstrated that the use of positive and negative information in a persuasive message influences behaviours and attitudes. This has taken the form of an interest in fear-based appeals, the construction of two-sided messages, and in framing a message in terms of either loss or gain (e.g., Rucker, Petty, & Briñol, 2008; Shehryar & Hunt, 2005). A related issue has been the role of the reader's affect or mood in message processing (e.g., Briñol, Petty, & Barden, 2007). There exists a gap, however, between our understanding of the immediate, lexical processing of valenced words and the behavioural and attitudinal consequences of higher-level processing of a valenced message. The construction and framing of messages will be discussed before the role of mood in message processing is examined.

Fear Based Appraisals

There has been discussion throughout this thesis of researchers using stimuli from discrete rather than general emotional categories. One discrete emotion that has been used more than any other when trying to influence the behaviour of individuals is fear. This has predominantly been used to try and limit undesirable social behaviours such as smoking, taking drugs and, most recently and graphically, drink driving. It has long been argued by researchers that differences in the levels of fear result in changes in how persuasive a communication is (e.g., Keller & Block, 1996). Increasingly, it has been called into question whether fear level alone is sufficient to determine behavioural outcome. Some studies that employed a high fear arousing communication have reported an increase in risky behaviours in participants, the opposite of the expected and desired, outcome (e.g., Witte, 1994).

Shehryar and Hunt (2005) employed terror management theory (TMT; Greenberg, Pyszczynski, & Solomon, 1986) to examine the consequences associated with a fearful message to try and understand maladaptive responses such as increases in risky behaviour. TMT posits that, when an individual's mortality is brought under threat by a message, a terror management procedure is started whereby one's 'worldviews' – essentially beliefs deigned to increase self-esteem through positive group associations – are activated to act as anxiety buffers. When these are activated (i.e., when a message threatens one's life), it is argued, maladaptive responses can occur. Shehryar and Hunt found that when participants' pre-commitment to said behaviours were high, they only conformed to the message if the fear-consequences were non-fatal (e.g., harm or embarrassment). Those with low pre-commitment were influenced by the message in all conditions.

While this work offers an insight into the way we deal with mortal fear when making decisions and planning behaviour, none of the automobile reviews presented in the current experiment focus on the mortality of the driver. Also, while some of the messages presented will be negative in tone, none are designed to make the reader specifically fearful. What is more pertinent to consider in the current situation is the presence of both positive and negative information in the one message, and how this conflict affects participant interpretation.

Two-Sided Messages

Rucker, Petty, and Brińol's (2008) research stems from work dating back to the 1950s (e.g., Hoovland, Janis, & Kelly, 1953) about the advantages of using one- vs. two-sided messages in consumer psychology. The questions addressed in such papers considered whether it was more beneficial to present only positive information about a product, or whether the inclusion of *some* negative information facilitated the consideration of opposing views, or at least the impression of it, and was therefore more persuasive. It has been found that when only one type of argument (i.e., positive or negative) is presented, participants often assume there are opposing attributes of which they are not aware (Priester, Petty, & Park, 2007). In such cases, it may be better to present two-sided messages, as then participants will be more likely to dismiss arguments opposing the theme of the message as trivial and assume they have most of the opposing information at hand.

Rucker et al (2008) focused more on the framing of the message, investigating whether framing the message as being two-sided, regardless of its actual content, may elicit the same effects. They conducted a series of experiments, varying the frame, both inside and outside the message, from being one-sided to two-sided. They found that messages where the inclusion of negative attributes was more salient in the frame led to higher attitude certainty. They also showed that attitudes formed after exposure to a two-sided frame were more predictive of behavioural intentions than those formed after exposure to a one-sided frame.

What is of concern in the current experiment is not the presence of both negative and positive information in the same message, but how this information is presented. When reading the automobile reviews, participants will see a message which is either wholly positive or wholly negative. The way in which the information is presented, however, may be via positive or negative words. While not conveying any information, these words might have some unexpected effect if their valence contradicts the general theme of the message. The valence qualities of words and the valence quality of the overall message should interact to affect both cognitive processing and attitude formation.

Goal Orientation

As well as message type, there has been a recent emphasis placed on the goal orientation of the participant in the cognitive response to a stimulus. This has come in the wake of the argument by Higgins (1998) of his regulatory focus theory of motivation. This theory states that, when faced with making a judgment, the outcome will be based primarily on whether the participant is promotion- or prevention-focused. Promotion-focused individuals think about situations mainly in terms of maximising their gains, while prevention-focused ones are more concerned with minimising their losses. In the scenario used by Higgins himself, a mouse with promotion focus will concentrate on getting the cheese; a mouse with prevention focus will concentrate on avoiding the cat.

Regulatory focus has been shown to affect the behaviour of individuals across a number of conditions. Freitas and Higgins (2002) showed that promotion focus leads to earlier onset of goal pursuit. Thompson et al. (1998) showed that promotion-focused individuals were more likely to develop illusions of control in situations where they had none.

In terms of attitudes and decisions, there have been many effects demonstrated as a result of regulatory focus. Shah et al. (2004) showed that those in a promotion focus were more likely to sit closer to an in-group member than those in prevention focus. Dholakia et al. (2006) demonstrated over a series of studies that participants with promotion focus experience greater desire for temptations than those in prevention focus, but are also more able to exert self-control over these desires. Pham and Avnet (2004) showed that subjects primed with a prevention goal pay attention to the content of a persuasive message. Conversely, those with a promotion goal pay attention to the affect elicited.

Both promotion and prevention focus have been linked to specific categories of emotion based on how one feels when a particular goal is achieved or not. When in promotion focus, if a goal is achieved (the investment paying off) one feels joy, while if the goal is not achieved (not investing and therefore not gaining money, or indeed investing and losing it) one feels dejection. Conversely if one is in a prevention state and the goal is achieved (not losing money and therefore maintaining a standard of living) one would feel relief, whereas if one was unsuccessful in achieving the goal (losing the money) the emotion felt would be anxiousness. Of particular interest is the fact that when an individual is in a promotion focused state he is more attuned to 'joyful' and 'dejection' words, whereas when he is in a prevention focus he is more attuned to 'relief' and 'anxiousness' words. This is demonstrated using the concept of 'regulatory fit', the idea that individuals in a particular focus are more attuned to emotions which fall within the realms of that focus. Shah and Higgins (2001) showed that individuals with a strong prevention focus are especially efficient at emotionally appraising attitude objects along the quiescence-agitation dimension, and those with promotion focus along the cheerfulness-dejection dimension. In a modified LDT, participants rated several positive and negative objects and assessed how relaxed and happy the positive ones made them feel, and how depressed and anxious the negative ones made them feel. As expected, promotion focus was linked to cheerfulness and dejection while prevention focus was linked to relaxation and agitation.

More evidence for the concept of regulatory fit, and therefore the association of these specific four emotions with promotion and prevention focus, comes from the Shah (2004) study. Students were asked how they felt about others from the same or rival universities. Students' prevention focus was uniquely related to relaxation- and agitation-related emotions, and promotion focus to cheerfulness- and dejection-related emotions. Brazy, Shah, and Devine (2005) found effects consistent with these emotional pairs when measuring prejudice.

Brockner and Higgins (2001) attempted to define these four categories of emotion associated with regulatory focus theory in terms of arousal and valence. They stated that high promotion focus and high regulatory effectiveness give rise to cheerfulness (positive valence, high arousal); high promotion focus and low regulatory effectiveness elicits dejection (negative valence, low arousal); high prevention focus and high regulatory effectiveness induces quiescence (positive valence, low arousal); high prevention focus and low regulatory effectiveness produces agitation (negative valence, high arousal). While this model is intriguing, there has been no follow-up and so it remains empirically unexplored.

Higgins' theory of regulatory focus followed on from, and provided an alternative for, Tellegen's (1985) theory of emotion. This states that individuals fall into one of two subcategories – where individuals are either more likely to be affected by positive affect (PA) or by negative effect (NA). This concept has links to Beck's theory of depression and theory of illusory optimism and emphasises the effective susceptibility rather than goal of the participant. While goal-orientated approach has gathered momentum in recent years, and has demonstrated its worth by generating consistent and compelling results, such an approach is not at odds with theories concerned more traditionally with the general affective state of the participant. Certainly, general affective state has been consistently investigated, as described in previous chapters, not only as conditions for stimulus selection, but also via mood manipulation. The areas of attitude formation and decision making are no different, and the effect of participant mood on such higher cognitive processes is considered below.

Mood and Cognition

As stated in Chapter 7, it has been repeatedly demonstrated that mood impacts upon behaviour. It has been shown specifically that the mood of an individual can affect their attitudes and also their decision making.

Winkielman et al. (2007) recently summarised, in a review of affective influence on cognitions, that participants in positive moods are more likely to view ambiguous stimuli positively (Niedenthal, 1990), act more confidently and cooperatively (Forgas, 2006) and be more optimistic in risk-taking (Johnson &

Tversky, 1983). They also stated, however, that this was oversimplifying the issue, as participants in distinct emotional states of the same valence have been shown to display differing behaviours in a task. Niedenthal and Setterlund (1994), for example, found that participants primed to a happy mood were faster to respond to happiness-related words on an LDT, but not positive words in general. Lerner and Keltner (2001) induced fear, anger or happiness and found that fearful participants were more pessimistic and risk-averse than both angry and happy participants, who did not differ.

In another example of discrete emotion priming, Zemack-Rugar et al. (2007) subliminally primed sadness and guilt and demonstrated that guilty participants showed lower indulgence than sad participants, and were also more likely to agree to carry out a very boring task for the benefit of a charity.

Here, as always, we are more concerned with studies which induce general 'positive' or 'negative' states rather than more specific ones. Despite Winkielman and his colleagues' reservations about the 'simplicity' of dealing with general mood states, there is a wealth of evidence to suggest that such general states have a profound impact on the thoughts and actions of individuals both across a number of tasks and situations, and mood induction techniques. This evidence not only reveals a genuine effect of general affective states on behaviour, but invites investigation of the issue utilizing stimuli with emotional language, something which is conspicuously lacking in the literature thus far.

Evidence presented in the previous chapter (e.g., Isen & Levin, 1972) tells us that people in happier moods will be more likely to engage in altruistic behaviour. It has also been suggested in recent reviews that happy individuals are more likely to cooperate in group situations (e.g., Baron, 1993; Forgas, 1998). Some studies cited do show that negative mood decreases cooperation, but others do not, and the overall picture is further complicated by a number of complex methodologies.

Forgas and Moylan (1987) interviewed people on their way out of the cinema about various topics. They spoke to individuals who had been to see film performances classified as predominantly happy, sad, or aggressive in affective tone, and questioned them about political judgments, expectations about the future, judgments of responsibility and guilt, and quality-of-life judgments. It was found that individuals in a happy compared to a sad or aggressive state made judgments which were more positive, lenient or optimistic. This shows a distinction between those interviewees in a positive mood and those in negative moods.

There is an abundance of evidence to suggest that, in some circumstances, discrete emotions may influence specific behaviours very differently (such as guilt versus sadness when deciding whether or not to suffer for the sake of charity). It is also clear that for other behaviours, and under other (perhaps more general) circumstances, a positive versus a negative mood is enough to distinguish between different thoughts or courses of action.

It is controversial why people in different moods behave in certain ways in different situations. One of the most intuitive and earliest theories was that those in positive moods are less concerned with engaging in behaviours which may lead to mood deterioration, while those in negative moods are more focused on activities which will improve their temper. Raghunathan and Trope (2002) provided support for this hypothesis by showing that those in positive moods are less concerned with the mood deteriorating consequences of accepting risk. Leith and Baumeister (1996) showed that negative moods often lead to poor long-term decisions if the decision in question leads to short-term gain.

It might be the case that an individual's mood determines their processing style with positive and negative individuals perceiving and analysing their worlds in radically different ways. It is thought that positive people adopt a heuristic-based, top-down strategy while negative people are more analytical (Bless et al., 1996). Hertel and Fiedler (1994) showed the decisions of people in a positive mood are more variable than those in negative moods. They interpreted this as illustrating that positive individuals devote fewer resources to planning.

It has also been shown that, when others are present, individuals in a positive mood often conform to the consensus heuristic and mimic the actions of the other individuals who are present (Allison & Kerr, 1994). This behaviour has been shown to occur even if it does not result in the best outcome for the individual in question. Hertel, Neuhof, Theuer, and Kerr (2000) had participants play a chicken dilemma game – a task similar to the prisoner dilemma game, but the loss is greater when the second player chooses the selfish rather than the cooperative option. Players in positive moods were found to imitate other players in a heuristic fashion whereas negative players studied the game analytically to reach the optimal choice.

The literature has attempted to explain the phenomenon of positive mood leading to positive evaluations in different ways. According to associative networking models, people who experience positive emotions selectively retrieve mood-congruent information from memory and use this to make more optimistic judgments. The affective-congruency model (Fazio et al., 1986) can also be used to explain such findings in some cases. If there is positive information contained within the stimuli to be evaluated then those in a positive mood may afford this more weight than any negative information given and, therefore, form an eventual evaluation biased to the positive.

The affect-as-information model (e.g., Clore & Sttorbeck, 2005) proposes that individuals will use their feelings as a heuristic shortcut to judgment. While this can lead to misattribution, and does not occur under all circumstances, it has been used to explain findings that cannot be accounted for by congruency effects alone. Affect-congruency effects are often eliminated when participants are given an alternative explanation for the presence of their feelings, thus undermining their diagnostic value for judgment without presumably reducing semantic accessibility. Schwarz and Clore (1983) showed that the affectively congruent influence of good vs. bad weather on life satisfaction judgments is eliminated when participants are subtly reminded of the surrounding weather conditions.

The Current Study

The goal of this experiment is to identify the factors which influence consumer choice in written advertisements. Several variables will be orthogonally manipulated. First, at the level of the underlying message, each product (e.g., automobiles) will be presented as a better or worse product. Second, in communicating this message, several positive or negative emotion words will be used. The third factor that is manipulated is the mood of the participant.

Four car reviews, based on existing ones from car magazines and the internet, will be constructed. The overall length of each car advertisement will be fairly substantial (on the order of 150 to 300 words), with care taken to ensure equality between ads in terms of length, content, and number of emotion words used. Participant mood will be manipulated by administering a subset of the Velten Mood Induction Statements as was the case in the previous chapter. Participants will then read each car advertisement in turn and respond to two questionnaires about each car before reading the next advertisement.

This is the first study to address the issue of how the language used to present a message can influence how the message itself is interpreted. While the nature of the materials used and the number of controlled words in the available databases dictate that the stimuli employed here are not as well controlled as those used in the other experiments presented in this thesis, the following results are predicted. In terms of the mood manipulation, it is expected that results are consistent with past research demonstrating that mood can modulate information processing across various domains (e.g., Storbeck & Clore, 2007; Winkielman, Knutson, Paulus, & Trujillo, 2007). In general, results of mood induction experiments show evidence of affective congruency (e.g., participants in a positive mood are more likely to attend to positive stimuli) and affect-as-information (e.g., participants in a positive mood are more likely to evaluate a given product as being better).

In terms of the text manipulations – Message (positive, negative) x Word (positive, negative) – it is expected that there will be differences across conditions in participants' attitudes as reflected in the semantic differential and product recommendation questionnaires. Specifically, I expect that the presence of emotion words that are inconsistent with the underlying message will modulate participants' attitudes accordingly. Such a result would be both novel and significant within the consumer information processing literature. It would demonstrate the interaction of valence at word and message level to influence attitudes and serve as a foundation on which to base more specific and hopefully better controlled studies in the future.

Methodology

Participants

Forty-eight participants (15 male, 33 female) took part in this experiment. All were right-handed native English speaking volunteers who did not suffer from dyslexia, and were paid with either £4 or a course credit for their participation. The majority of the participants were around typical undergraduate age (mean = 21; range: 18-45). All had normal or corrected-to-normal vision and were naïve as to the purpose of the experiment. They were recruited through advertisements placed around the university campus. In accordance with the guidelines set by the University's ethics committee, written informed consent was obtained prior to experimental participation.

Apparatus

Participants were tested using PsyScope experiment version 1.2.5 on an Apple Mac computer and made responses on a PsyScope button box. A Hansol 21" monitor with a 1024 x 768 resolution and 100 Hz refresh rate was used to present the stimuli. The font Times New Roman of size 26 was used, and the stimuli were black letters presented on a white background. The screen was positioned approximately 25 inches from the participants' heads, with approximately 2.95 characters subtending 1 degree of visual angle.

Materials and Design

A 3 (Mood Prime: positive, negative, neutral) x 2 (Review Message: positive, negative) x 2 (Review Language: positive negative) mixed design was used, with review-message and review–language being within-subjects factors. Total reading time for the three paragraphs of each review was measured, as was participants' attitudes towards each car plus their mood at the end of the experiment. They were placed in either a happy or a sad mood based on a modified version of the Velten mood-priming task. Some of the statements had been modified to make them more relevant to British rather than American participants and to update the terminology so it would relate better to participants of undergraduate age.

Paragraphs were reviews of cars three paragraphs long. The first paragraph dealt with the performance, speed, and handling of the car. The second paragraph discussed its comfort and size, and the third its safety and efficiency. There were four reviews in total, one with a positive message described using positive words (e.g., *ensures supreme confidence when cornering*), one with a positive message described using negative words (e.g., *the monstrous boot is capable of greedily devouring a set of golf clubs*), one with a negative message described using positive words (e.g., *offering the poise and grace of a rollercoaster cart*), and one with a negative message described using negative words (e.g., *the worst bumps can be felt as bone-shaking shudders*). The length of each paragraph and the number of positive or negative words contained in each is summarised in the table below.

<u>Table 8.1</u>: Summary of Each Car Review

passage		Pos M, Pos W	Pos M, Neg W	Neg M, Pos W	Neg M, Neg W
P1	lines	8	8	8	8
	words	99	110	114	99
	characters	617	608	675	625
	emot wrds	19	19	18	19
P2	lines	4	4	5	5
	words	50	47	68	55

	characters	321	278	389	372
	emot wrds	9	10	9	12
P3	lines	5	5	5	4
	words	56	62	52	49
	characters	355	337	334	312
	emot wrds	11	10	12	8
Total	lines	17	17	18	17
	words	205	219	234	203
	characters	1293	1223	1398	1309
	emot wrds	39	39	39	39

Procedure

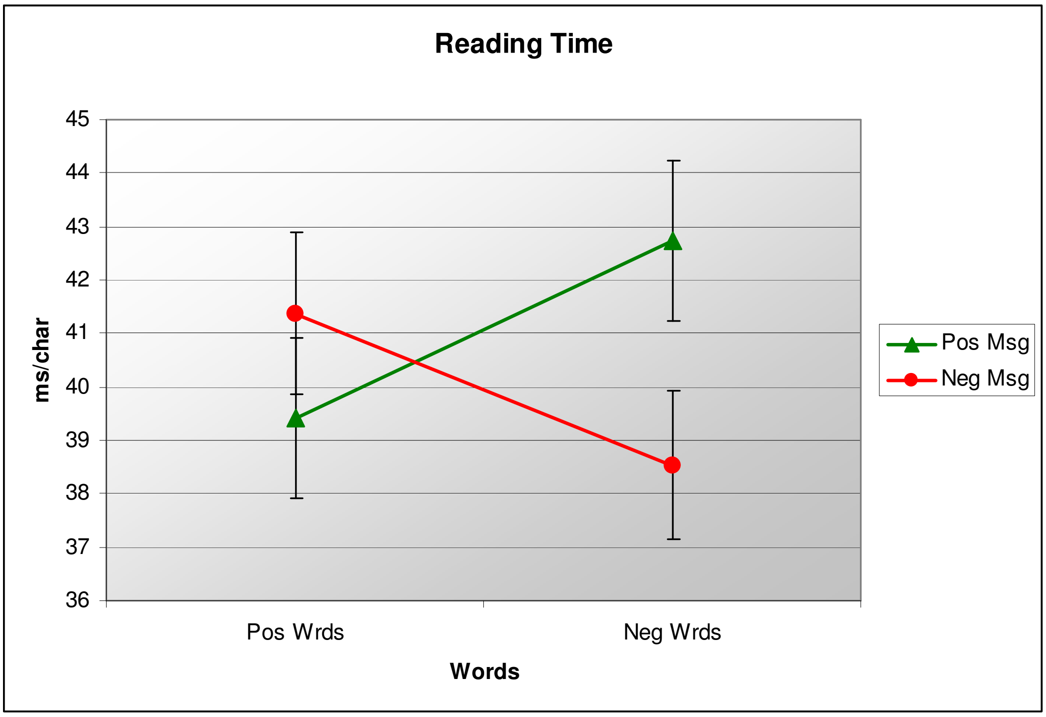
Participants were taken to a designated room in the Glasgow University Psychology Department. They were shown an instruction sheet and asked to read and sign the consent form. The instruction sheet informed them the study they were about to take part in concerned mood and would be split into 3 parts. In Part 1, they would either be placed into a positive or negative mood by being asked to recall a series of autobiographical events, or have to attend to a series of neutral statements. Part 2 was a distracter task where they would be asked to read reviews of cars taken from a popular car website and offer their opinion. In Part 3, they would have to answer questionnaires which would measure how their mood had been affected by the distracter task. They then completed the modified Velten mood induction task for whichever group they had been placed in. After reading each review, participants were asked to rate the car on a series of nine 7-point semantic differentials (e.g., serious-fun; wasteful-efficient). They were then asked on a similar 7-point scale to what extent they would recommend the car to two characters – the first being a single mother looking to protect her children and get good value; the second a marketing executive looking to impress his peers with a status symbol. At the end of the experiment, mood was measured using PANAS (Positive-Affect Negative-Affect Scale) and the GDS (Geriatric Depression Scale). They were fully debriefed as to the true purpose of the experiment once all the questionnaires had been filled in.

Results

Reading Time

A 3 (Mood: Positive, Negative, Neutral) X 2 (Message: Positive, Negative) X 2 (Words: Positive, Negative) analysis of variance (ANOVA) was performed on ms-per-character reading times by participants. There were no significant main effects [all Fs<1]. There was a significant interaction of Message x Words [$F(1,45)=23.74$, $MSE=455$, $p<0.0005$]. Follow-up Scheffé contrasts were performed with no corrections for multiple comparisons and it was found that when the reviews had a positive message, the ones with positive words were read significantly faster than the ones with negative words [$F(1,45)=4.829$, $MSE=92.63$, $p<0.05$]. When the reviews had a negative message, those with negative words were read significantly faster than those with positive words [$F(1,45)=22$, $MSE=422.44$, $p<0.0005$]. When positive words were used, reviews with a positive message were read significantly faster than words with a negative message [$F(1,45)=13.75$, $MSE=263.78$, $p<0.005$], and when negative words were used , reviews with a negative message were read significantly faster [$F(1,45)=10.13$, $MSE=194.23$, $p<0.005$]. The 3-way interaction between mood induction, message and words was not significant [$F(1,45)=1.76$, $MSE=33.67$, $p<0.1$]

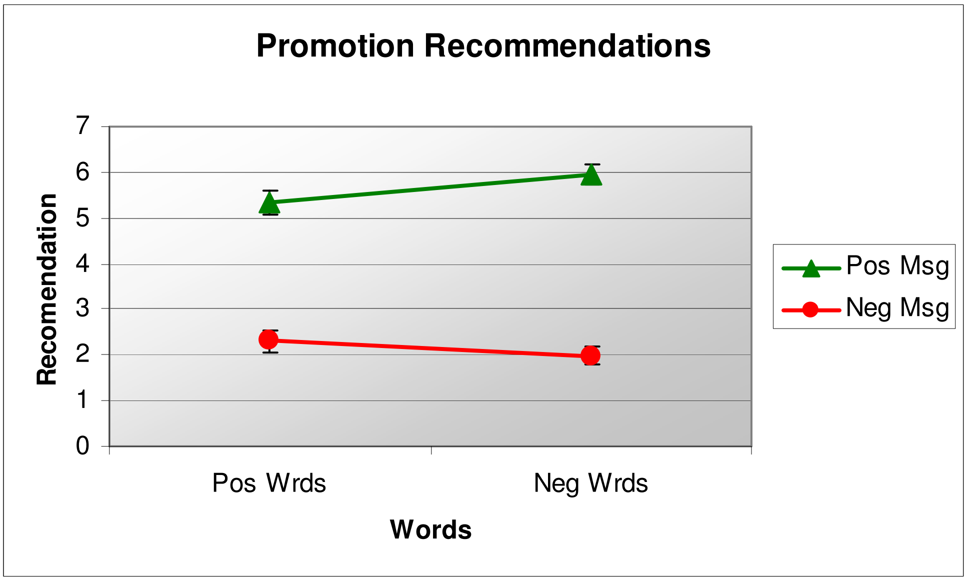
Figure 8.1: ms-per-char reading time message x word interaction



Recommendations

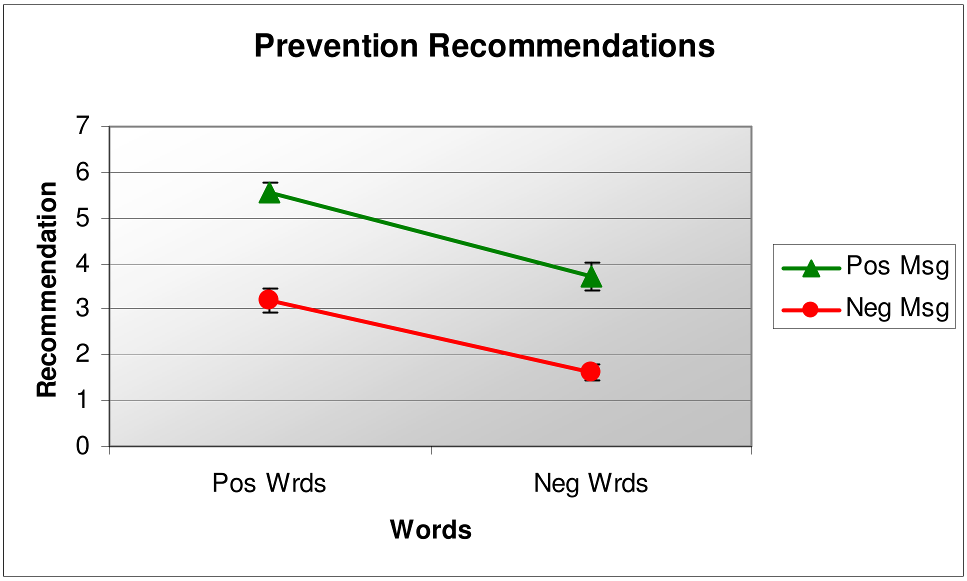
Participants were asked to rate how highly they would recommend each vehicle in regard to two specific subjects, Jane and Greg. Jane was a single mother with little money and concerned for the safety of her children, hence prevention-focused, while Greg was a flashy marketing executive concerned with style and status, thus promotion- focused. Two 3 (Mood: Positive, Negative, Neutral) X 2 (Message: Positive, Negative) X 2 (Words: Positive, Negative) ANOVAs, one for promotion focus and one for prevention focus, were carried out to examine the effects of mood induction and review type.

Figure 8.2: Promotion Recommendation Message x Word Interaction



For promotion focus, the only significant main effect was of message [*F*(1,45)= 252.536, MSE=588, p<0.001], with positive messages being recommended higher than negative messages. There was no effect of words or mood. There was also a significant interaction of message x words [*F*(1,45)= 4.912, MSE=11.021, p<0.05]. Follow-up contrasts revealed that the Ford Kiss (+ message, + words) was significantly different from both the Fiat Casino (- message, + words) [p<0.001] and the Nissan Storm (- message, - words) [*F*(1,45)= 97.609, MSE=219.01, p<0.001, *F*(1,45)= 120.339, MSE=270.01, p<0.001 respectively], as was the Daewoo Scorpion (+ message, - words) [*F*(1,45)= 142.177, MSE=319.01, p<0.001, *F*(1,45)=169.364, MSE=380.01, p<0.001 respectively]. Within negative messages, there was no difference between the Casino (- message, + words) and the Storm (- message, - words) [**p>.2**]. Within positive messages, the Scorpion (+ message, - words) was recommended significantly higher than the Kiss (+ message, + words) [*F*(1,45)= 4.178, MSE=9.375, p<0.05].

Figure 8.3: Prevention Recommendation Main Effects of Message and Word

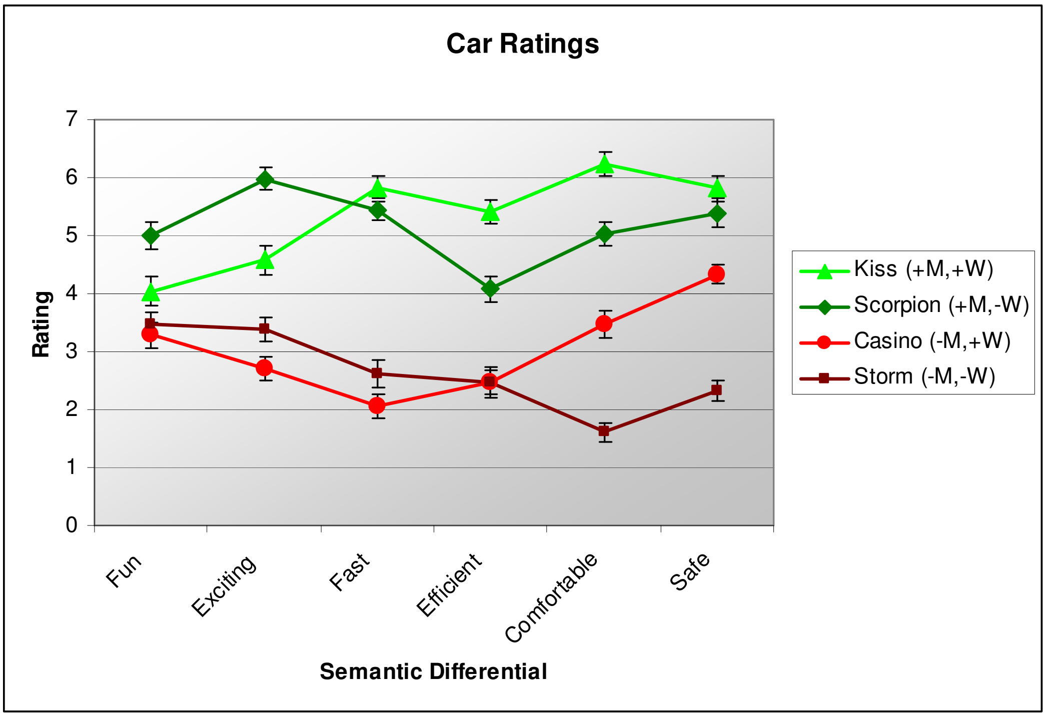


For prevention focus, there were significant main effects of message [$F(1,45)= 70.139$, MSE=238.521, $p<0.001$], with positive messages being recommended higher than negative messages, and words [$F(1,45)= 48.201$, MSE=140.083, $p<0.001$], with messages containing positive words recommended higher than messages containing negative words. There were no significant interactions.

Questionnaire Data:

After reading each review, participants were asked to rate the vehicle on a series of 6 semantic differentials. Results were recorded on a 7-point Likert scale and a 3 (Mood: Positive, Negative, Neutral) X 2 (Message: Positive, Negative) X 2 (Words: Positive, Negative) ANOVA was performed on each. For each, there was a significant effect of review type [all $ps<0.001$] while there were no significant effects of mood induction.

Figure 8.4: Semantic Differential Ratings for all Message Types



Differential No.	Pos. Semantic	Neg. Semantic
1	Fun	Serious
2	Exciting	Calm
3	Fast	Slow
4	Efficient	Wasteful
5	Comfortable	Uncomfortable
6	Safe	Dangerous

Table 8.2: p-values for comparisons between review types for each semantic differential (review 1: message type, word type; review 2: message type, word type)

Diff.	+ +, - +	+ +, + -	+ +, - -	- +, + -	- +, - -	+ -, - -

1	*p*<0.01	*p*<0.001	*p*<0.05	*p*<0.001	NS	*p*<0.001
2	*p*<0.001	*p*<0.001	*p*<0.001	*p*<0.001	*p*<0.06	*p*<0.001
3	*p*<0.001	*p*<0.05	*p*<0.001	*p*<0.001	*p*<0.05	*p*<0.001
4	*p*<0.001	*p*<0.001	*p*<0.001	*p*<0.001	NS	*p*<0.001
5	*p*<0.001	*p*<0.001	*p*<0.001	*p*<0.001	*p*<0.001	*p*<0.001
6	*p*<0.001	*NS*	*p*<0.001	*p*<0.001	*p*<0.001	*p*<0.001

The six semantic differentials used can be split into 3 promotion-focused word pairs (serious-fun, calm-exciting, slow-fast) and 3 prevention-focused word pairs (wasteful-efficient, uncomfortable-comfortable, dangerous-safe). For each differential, both positive message reviews were always rated significantly higher than both negative message reviews. Each semantic differential is considered individually below.

Serious-Fun:

Kiss (+,+) was rated significantly higher than Casino (-,+) and Storm (-,-) [$F(1,45)=8.634$, MSE=13.5, $p<0.01$ and $F(1,45)=4.857$, MSE=7.594, $p<0.05$ respectively], as was Scorpion (+,-) [$F(1,45)=44.797$, MSE=70.042, $p<0.001$ and $F(1,45)=35.503$, MSE=55.510, $p<0.001$, respectively]. Within the positive message reviews, Scorpion (+,-) was rated higher than Kiss (+,+) [$F(1,45)=14.097$, MSE=22.024, $p<0.001$]. Within the negative message reviews, there was no difference between the ratings for Casino (+,-) and Storm (-,-) [$p>0.4$].

Calm-Exciting:

Kiss (+,+) was rated significantly higher than Casino (-,+) and Storm (-,-) [$F(1,45)=30.447$, MSE=84.375, $p<0.001$ and $F(1,45)=12.645$, MSE=35.042, $p<0.001$

respectively], as was Scorpion (+,-) [$F(1,45)=92.654$, MSE=256.76, $p<0.001$ and $F(1,45)=58.733$, MSE=162.76, $p<0.001$, respectively]. Within the positive message reviews, Scorpion (+,-) was rated higher than Kiss (+,+) [$F(1,45)=16.874$, MSE=46.76, $p<0.001$]. Within the negative message reviews, Storm (-,-) was rated marginally higher than Casino (-,+) [$F(1,45)=3.849$, MSE=10.667, $p=0.056$].

Slow-Fast:

Kiss (+,+) was rated significantly higher than Casino (-,+) and Storm (-,-) [$F(1,45)=182.479$, MSE=341.260, $p<0.001$ and $F(1,45)=132.098$, MSE=247.042, $p<0.001$ respectively], as was Scorpion (+,-) [$F(1,45)=245.637$, MSE=459.375, $p<0.001$ and $F(1,45)=186.534$, MSE=348.844, $p<0.001$, respectively]. Within the positive message reviews, Kiss (+,+) was rated higher than Scorpion (+,-) [$F(1,45)=4.684$, MSE=8.76, $p<0.05$]. Within the negative message reviews, Storm (-,-) was higher than Casino (-,+) [$F(1,45)=4.061$, MSE=7.594, $p<0.05$].

Wasteful-Efficient:

Kiss (+,+) was rated significantly higher than Casino (-,+) and Storm (-,-) [$F(1,45)=111.441$, MSE=207.094, $p<0.001$ and $F(1,45)=201.441$, MSE=207.094, $p<0.001$ respectively], as was Scorpion (+,-) [$F(1,45)=33.234$, MSE=61.76, $p<0.001$, $p<0.001$ and $F(1,45)=33.234$, MSE=61.76, $p<0.001$, respectively]. Within the positive message reviews, Kiss (+,+) was rated higher than Scorpion (+,-) [$F(1,45)=22.96$, MSE=42.667, $p<0.05$]. Within the negative message reviews, there was no difference between the ratings for Casino (+,-) and Storm (-,-) [$p=1$].

Uncomfortable-Comfortable:

Kiss (+,+) was rated significantly higher than Casino (-,+) and Storm (-,-) [$F(1,45)=151.645$, MSE=181.5, $p<0.001$ and $F(1,45)=428.930$, MSE=513.375, $p<0.001$ respectively], as was Scorpion (+,-) [$F(1,45)=236.945$, MSE=283.594, $p<0.001$ and $F(1,45)=48.956$, MSE=58.594, $p<0.001$, respectively]. Within the positive message reviews, Kiss (+,+) was rated higher than Scorpion (+,-) [$F(1,45)=28.277$, MSE=33.844, $p<0.001$]. Within the negative message reviews, Casino (-,+) was rated higher than Storm (-,-) [$F(1,45)=70.496$, MSE=84.375, $p<0.001$].

Dangerous-Safe:

Kiss (+,+) was rated significantly higher than Casino (-,+) and Storm (-,-) [$F(1,45)=30.75$, MSE=52.51, $p<0.001$ and $F(1,45)=170.124$, MSE=290.510, $p<0.001$ respectively], as was Scorpion (+,-) [$F(1,45)=15.866$, MSE=27.094, $p<0.001$ and $F(1,45)=131.816$, MSE=225.094, $p<0.001$, respectively]. Within the positive message reviews, there was no difference between the ratings of Kiss (+,+) and

Scorpion (+,-) [p=0.125]. Within the negative message reviews, Casino (-,+) was rated higher than Storm (-,-) [$F(1,45)=56.218$, MSE=96.0, $p<0.001$].

Discussion

While providing an intriguing glimpse of the role positive and negative language may play in persuasive messages – and in the provision of information through text in general – the nature of the current study prohibits definitive conclusions from being drawn. Although the reviews used as stimuli were controlled for the number of emotional words they contained, as well as overall passage length, the length and frequency of the emotional words in each were not matched across categories. This decision was made in part because of the limited number of pre-rated positive, and partly to ensure the reviews were realistic and read as naturally as possible. Another limitation caused by the scarcity of available emotional words was the limited number of stimuli presented: there was only one review of each type (positive message, positive words; positive message, negative words; negative message, positive words; negative message, negative words). Despite this, the results are intriguing – and not wholly expected – and so tentative explanations may be proposed.

It was expected that a mood congruency effect in the ms-per-character measure of reading time would be found, illustrating that participants in a positive mood read positive language fastest, and participants in a negative mood read negative language fastest. This was not the case. There was no effect of mood induction and the only significant effect was the interaction between message and word type. For the message x word interaction, there was a within-message congruency effect – positive messages were read faster when they contained positive rather than negative words, and negative were read faster when they contained negative rather than positive words.

This indicates, first of all, that mood did not influence reading time of these messages. Previously, mood has been shown to affect the processing times of single words in neutral sentences (Chapter 7). In that study, positive and negative mood differentially affected the processing times of HF words of different emotionality. From these results, however, it would appear that, as far as reading time of whole passages are concerned, it is irrelevant whether participants are in a positive, negative or neutral mood as this has no bearing on how quickly they read different messages (i.e., positive or negative). It must be noted, though, that both LF and HF words were used in the car reviews in the current study. Alternatively, of course, the drawbacks of the specific form of mood induction used here – as discussed in the previous chapter – also apply here. It may be beneficial to repeat the study using a range of different mood induction techniques. If the reason for an absence of effect of mood induction was due to a deficiency in the Velten technique, then at the very least the results here provide a baseline of responses of 'neutral mood' participants from which to work in the future.

The second implication of the results is that the type of language used in a message *does* impact on how it is read. The message is read faster if the words used are of the same underlying emotional type as the tone of the message, so negative messages are read faster when they contain negative rather than positive words, for example. This may simply be because the discrepancies in input require additional cognitive resources to be integrated. Are these effects manifested at a word level response or to a slower message integration process? It is impossible to tell from reading times alone. In addition to reading times, message-word inconsistencies could affect the impact of the message and, therefore, the attitudes about the product (in this case the car), or aspects of the product, formed by the participant.

An attempt was made in this study to try to connect the two-factor theory of emotion, which has been central throughout this thesis, to Higgins's theory of regulatory focus. This was done by having participants indicate how strongly they would recommend each car to two individuals, one obviously promotion-focused (a high-flying marketing executive concerned with wealth, image and status) and the other prevention-focused (a single mother struggling with money and concerned for the well-being of her children). Although some attempt has been made by Brockner and Higgins (2001) to map their theory onto the more widely acknowledged two-factor model of emotional language, this is the first study, to my knowledge, to perform manipulations on mood and stimuli and then investigate *post hoc* the effect of focus.

According to this mapping, the four distinct emotions associated with either success or failure while in either promotion or prevention focused could be described in terms of valence and arousal. Cheerfulness was positive valence, high arousal; dejection was negative valence and low arousal; quiescence was positive valence low arousal; and anxiety was negative valence, high arousal. As explained in the opening chapter, the nature of the lexical stimuli available at the moment constrains the use of low-arousal words of extremely high or low valence within the target set, so all emotional words used, positive and negative, are high arousal. As such, this makes it impossible to attempt to map the results onto Brockner and Higgins's model. It may be the case, however, that message type and word type influence arousal and valence to different degrees. Alternatively, using language which is inconsistent with the tone of the message could have the effect of diluting the possible influence of valence *or* arousal. The increased reading times in such incongruous conditions have already been suggested to be a reflection of extra processing which is carried out to accommodate the incongruous language into the schema of the message. This processing may cause the arousal or valence elicited by such a message to become less extreme.

Overall no effect of mood was found in the recommendation measures, but participants varied in how strongly they would recommend each car to the prevention- or promotion-focused individuals based on message and word type.

For the promotion focus recommendations, there was a word x message interaction. Positive messages were recommended higher than negative messages. With respect to words, positive messages containing negative words were recommended higher than those containing positive words. For prevention focus recommendations, there were no significant interactions but a main effect of message, with positive messages being recommended higher than negative messages, and of words, with messages containing positive words were recommended higher than messages containing negative words.

While for promotion focused individuals negative messages were viewed as equally bad when they contained both negative and positive words, prevention focused individuals recommended the negative product significantly more when it contained positive than negative words.

Participants recommended the car featured in the review with the positive message more to promotion-focused individuals when it contained negative words, but more to prevention-focused individuals, as with the negative message, when it contained positive words. It would seem, then, that not only can emotional words as defined by the two-factor theory influence the effect of focus, but that when considering promotion focus, emotion words play a more complex role than they do in prevention focus. In this experiment participants were not induced into either a promotion or a prevention focus, but asked to assume this role-taking perspective *post hoc*, after they had seen the product reviews. This means that an effect of focus, such as it is, was not on-line but occurred retrospectively. Taking this into account, the findings were as follows:

Prevention Focus	**Promotion Focus**
Positive message, positive wrds	Positive message, negative wrds
▼	▼
Positive message, negative wrds	Positive message, positive wrds
▼	▼
Negative message, positive wrds	Negative message, positive wrds
▼	‖
Negative message, negative wrds	Negative message, negative wrds

As stated before, it impossible at this stage to conclusively account for these findings with one theory, but there are several mechanisms which could give rise to such a pattern of results. One explanation is that when adopting a prevention stance, participants respond to the raw negativity of either the word or message. This results in an additive effect – the more 'negative information' contained in the product review, be it in the message or in the words, the more negatively that product is rated and therefore the less they would recommend it.

Conversely, individuals in a promotion stance do not take the negative words at 'face value'. For promotion-focused individuals, products with negative messages were recommended equally lowly – the content of the message was the overriding factor. For positive messages, however, messages containing negative words were recommended higher than those containing positive words. This shows the ability of participants in a promotion stance to modulate the negative words if they are contained in a positive message.

It appears from this data that promotion focused individuals are better able to look beyond the most obvious 'emotional' meaning of a word and integrate it better into context. For a prevention focused person 'wicked' will always mean wicked; for a promotion focused person it could mean 'exciting'.

Alternatively, when processing the reviews, the participants may not have read the words within the message as being predominantly 'positive' or 'negative' but rather as being ironic or non-ironic. The issue of irony in the literature has been the focus of debate between two opposing camps: the Graded Salience Hypothesis (Giora, 1997) versus the Processing Equivalence Hypothesis (Gibbs, 1994). The Processing Equivalence Hypothesis states that ironic and literal meanings of words may be processed by distinct, equivalent processes. This predicts that processing time for each should be equal for each alternative of a word's meaning, providing it is congruent or incongruent with the context. The Graded Salience Hypothesis states that the literal meaning of a word must be accessed in all circumstances, and then the ironic meaning activated thereafter if the context so dictates. This predicts that ironic meaning will always take longer to process as literal meaning must be processed first.

Currently, the weight of evidence rests in favour of Giora who has produced, over a series of experiments, a pattern of results in keeping with her predictions which cannot be explained by the Processing Equivalence Hypothesis. One example is a study by Giora and Fein (1999) where participants were presented with either literal or ironic target sentences following initial context sentences that biased either the literal or ironic meanings. In the ironic context there was no significant difference in response time between compatible and incompatible responses (ironic and literal targets), but there was in the literal context. These results were as predicted and support the Graded Salience Hypothesis, showing that ironic interpretation involves processing the literal meaning, and revealing that ironic and literal interpretations do not involve equivalent processes.

This seems to tie in with the self-paced reading time results of the current experiment. Of the materials employed here, congruent message-word reviews (positive message, positive word; negative message, negative word) could be viewed as being literal in meaning, while incongruent reviews (positive message, negative word; negative message positive word) could be viewed as being ironic or non-literal in meaning. The Graded Salience Hypotheses predicts that the congruent reviews would be read faster than the incongruent reviews; as for the latter their literal meaning would need to be activated before the ironic meaning. This is what was found.

It is less clear what role irony could be playing in attitude formation. It could be the case that ironic, non-literal language is more appealing to individuals in a promotion focus, while those in a prevention focus prefer straightforward literal language. If this were the case, however, within the negative messages, those continuing negative words should have been rated higher by prevention-focused individuals, and those containing positive words should have been rated higher with promotion-focused individuals, neither of which was the case.

Of course, it is ambiguous whether or not the stimuli here (specifically, the emotion words used which are incongruous with message type) fall under the category of 'irony' at all. In some cases the meanings of the incongruent emotion words are clearly literal (e.g., a *sedate* top speed; *thunder* through town centers). The argument could be made that such words are ambiguous (e.g., thunder: the main meaning is the noun which has negative valence and is rated as such in databases such as Bradley & Lang, 1998; the alternative meaning is the verb which may or may not have a negative valence in its own right). This is another reason why more specific studies need to be carried out to more thoroughly investigate findings which, due to the limitations of the current experiment, are open to multiple interpretations here.

While irony can be ruled out as an explanation for at least some of the incongruous words used – particularly in the positive message, negative word review – negation cannot. In their 2005 paper, Giora and Fein explored the difference between irony and negation. They found that negation (e.g., 'he is not very bright') was still recognised as irony, albeit a weaker form than true irony (e.g., 'he is very bright' said of an idiot). They explain that a negative marker serves to moderate a statement rather than imply its opposite, so negative ironies differ from affirmative ones quantitatively but not qualitatively.

Negation was used primarily in this experiment in the negative message, positive word review (e.g., *handling is neither superb nor exciting*). It could be the case, therefore, that irony was a factor not of the incongruous conditions in general but that a mitigated form of irony – namely negation – was a factor of only the negative message, positive word condition. To further investigate this issue conclusively, the experiment would need to be repeated with an additional 4 reviews presented and irony added as an additional variable.

It would be premature to rule out any theory at the current time. It could be the case, for example, that the ironic status of stimuli affects their reading time while their emotional content has more of an influence on attitude formation. What is clear is that better controlled studies need to build on the current findings, particularly when the final results are taken into account.

In the current experiment each review was rated on 6 semantic differentials: boring-fun; slow-fast; calm-exciting; wasteful-efficient; comfortable-uncomfortable; and dangerous-safe. This was done to assess the impact of mood, message type and word type on participants' perceptions of different specific aspects of the products in question. Results between differentials varied considerably. Within each differential, both positive messages (Kiss and Scorpion) were rated as significantly higher (i.e., more towards the 'positive' than 'negative' adjective, more towards 'comfortable' than 'uncomfortable', for example) than both negative messages (Casino and Storm). Within the positive and negative messages, however, the results were more complicated.

The 6 differentials seem to sort themselves out into two sets of three, the positive adjectives from the first set seemingly more promotion- focused (i.e., more focused on maximising gains: fun, exciting, fast) and the positive adjectives from the second set more prevention-focused (i.e., more focused on minimising losses: efficient, comfortable, safe).

This distinction showed up clearly in the recommendations for the cars featured in reviews with negative messages. In these three 'promotion-focused' adjectives, there was no significant difference between the ratings for Storm (-,-) and Casino (-,+) for 'fun', but Storm was rated significantly more positively for 'fast' and marginally more positively for 'exciting'. In the three 'prevention-focused' adjectives, they were rated equally for 'efficient', and for 'comfortable' and 'safe', Casino (-,+) was rated more positively than Storm (-,-).

In the recommendations for the cars featured in reviews with negative messages, the same pattern emerges. For the 'promotion-focus' adjectives, Scorpion (+,-) is rated more positively than Kiss (+,+) for 'fun' and 'exciting', but Kiss is rated higher for 'fast'. Within the three 'prevention-focused' differentials, Kiss is rated higher for 'efficient' and 'comfortable' while there is no difference in their ratings for 'safe'.

This is similar to the pattern of results produced by the recommendations for the promotion and prevention focused individuals. Within the 'prevention' differentials, there seems to be an approximately additive effect of message type and word type, while within the 'promotion' differentials, there is less distinction between the negative messages, and positive messages with negative words are generally rated higher than positive messages with positive words.

It could be the case, then, that the same factors that influence the recommendations of the cars to the promotion- and prevention-focused individuals are also having an effect on the participants' attitudes towards specific aspects of the car. This occurs, it must be remembered, independent of the mood of the participant. It is still unclear what mechanisms are behind these processes (i.e., the emotionality of the word, the ironic content of the word, a combination of the two, or something completely different), but these results emphasise the need to expand upon the current experiment.

It would be useful to repeat the study with participants being induced into a promotion or a prevention focus before reading the reviews to see if focus has an effect where general mood did not (or even attempting to prime discrete emotions). This would perhaps amplify the effects shown in the recommendation ratings and could also influence participants' attitudes towards the differentials, for example, by accentuating the effects of the associated semantics (i.e., promotion-focused individuals would show greater effects for the 'fun', 'exciting', and 'fast' differentials). There could also perhaps be an attempt made to re-write the reviews using words of the discrete emotions 'cheerfulness', 'dejection', 'quiescence', and 'anxiety', but, as mentioned above, there are a lack of well-controlled emotional words with low levels of arousal. It is also unclear at this stage whether all words in a particular quadrant of the arousal-valence graph could be agreed to fall under the banners ascribed them by Higgins in his attempt to map regulatory focus onto the two-factor theory. To my knowledge, there has thus far been no formal attempt to verify this.

As stated in the introduction to this chapter, a growing number of researchers hold the opinion that it is not the emotional state of the individual as much as their goal or focus that determines how they interpret stimuli. The results of the current experiment seem to support this view, but also suggest that a large role remains for the two-factor theory of emotional language (if it is indeed the case that this is having an influence on participants' attitudes, and they are not being affected by irony alone). The next logical step is to repeat the current experiment but, instead of priming individuals to be in a positive or negative mood, induce them to promotion or prevention focus. This would allow the impact of focus to be assessed when participants are exposed *a priori* and indicate to a much more conclusive degree what effect positive and negative words, as defined by the two-factor theory, play in Higgins' model. The use of words conforming to Higgins' classifications of cheerfulness, dejection, quiescence, and anxiety could also be used in messages shown to participants, but only after a sufficiently large database had been compiled to allow emotion words of low arousal to be properly controlled. Also, as mentioned previously, it would be interesting to compare responses to incongruent messages (i.e., positive message, negative word; and negative message positive word) when both are specifically designed to contain either a great deal of irony or no irony at all.

Chapter 9

The remit of this thesis was to explore what influence the emotionality of words have on their processing, and to clarify the mechanisms causing these differences to arise. While no questions were answered unequivocally, the series of experiments presented over the preceding seven chapters has advanced knowledge in the field of emotion word processing. Through thorough control of materials, and careful application of appropriate paradigms, once ambiguous patterns of results have been clarified to provide an insight into this area of psycholinguistics.

The questions we are in a position to ask now are more advanced and specific than those posed at the beginning of the current thesis and that is due in no small part to the interplay of results reported in the preceding chapters. These will now be addressed in stages: first reviewing early stages of emotion word processing, then spill-over effects and finally the impact of emotion words on higher levels of processing and the impact of mood induction. The limitations of this thesis will then be considered before the current position is reflected upon and the direction of future research identified.

Chapters 2, 3, and 4 focused on the emotion words themselves in a LDT while ERPs were recorded, and attentional and reading tasks while eye movements were recorded. It is these three chapters which clarified the ambiguity described in the introductory chapter and set the foundation for the subsequent experiments. Chapter 3 investigated the attention-capturing properties of emotional textual stimuli. This drew on original research by Nummenmaa and Hyönä, replicating their original eye-tracking procedure but employing words rather than pictures as stimuli.

Two words were presented simultaneously, one above and one below a central fixation cross. Participants were instructed to look at whichever word turned bold. It was expected that HF words would be recognised faster than LF words, and that positive words would be identified faster when they were in the top position, and negative words faster when they were in the bottom position. Instead, saccade latencies were found to be significantly longer when any target was presented in the top position, and marginally longer when the target was positive and the distracter negative. Participants also made the least number of errors in this condition, leading to the conclusion that the P-N target-mate condition was the most salient of all the pairs of stimuli presented.

Another proposed explanation was that participants have some inherent preference for fixating 'up' than for fixating 'down', deriving from Chan and Bergen's (2005) work with writing systems as a component of how literate humans gain and convey information. This is supported by the fact that there were also more anticipations to targets in the top position compared to the bottom position. There were also methodological issues concerned with this experiment, however.

Participants' eyes were not aligned to be directly horizontal to the central fixation cross, but were always slightly above it, which confounded results. Also, the SOA was 300ms, right at the uppermost threshold of the influence of inhibition of return, meaning no clear conclusions could be drawn.

Chapters 2 and 4 examined the influence of arousal, valence and frequency on the processing of a word. The LDT in Chapter 2 and the reading task in Chapter 4 both produced the same pattern of results. The findings from Chapter 4 were especially significant as this was the first experiment to examine emotional words in a realistic, on-line reading situation by recording eye-movements. In this experiment positive, negative and neutral words were presented in neutral sentences. In both the eye-movement measures and RTs in the LDT there was an emotion x frequency interaction. While the normal frequency effect (HF<LF) was present in positive and neutral words it was absent in negative words. Within LF words positive and negative were both responded to fastest; within HF words, only positive was fastest.

These results should be interpreted in the context of the electrophysiological findings reported in Chapter 2. Emotion manifests in the ERP output very early, interacting with frequency in the P1 window (80-120 ms) and the N1 window (135-180 ms). Negative HF words elicited smaller amplitudes than the other conditions in P1. Within LF words in N1 neutral words had higher amplitudes, while within HF words it was negative words which produced the highest amplitude. The established N1 frequency effect (LF>HF) was shown for neutral words, but it was absent in positive words and reversed in negative words.

The most likely explanation for these results was said to be a version of perceptual defense such as the Mobilisation-Minimisation hypothesis, or the Automatic Negligence Function. Such theories claim that our attention is initially grabbed by more salient negative stimuli. Because the emotional content of such stimuli may be harmful or disturbing to us psychologically, it is then suppressed and the result is longer reaction times and higher cognitive activity associated with negative stimuli. The role of frequency is, at this stage, less clear cut. Within LF words both positive and negative words are responded to faster than neutral words, and both positive and negative words produce a smaller N1 amplitude than neutral words. Within HF words only positive words were responded to fastest and negative words showed a reduced P1 amplitude but a larger N1 amplitude.

It could be the case that high arousal (present in both positive and negative words) facilitates the processing of LF words by means of some sort of short-cut system to recognition. Such a system could be associated with less cognitive activity in the N1 window due to the implementation of such a mechanism. HF words are, generally, recognised more quickly than LF words, so perhaps there is not time for such a shortcut mechanism to activate when we are exposed to such easily accessible stimuli. In this case negative words are immediately recognised quicker than positive or neutral words, but in order to protect ourselves from any detrimental effects associated with their negative valence their meaning is suppressed. This manifests behaviourally through increased RT and fixation times, and electrophysiologically as larger N1 amplitudes.

Other researchers continue to investigate the special place negative stimuli hold in our processing system, although there are still not many who investigate the issue while concurrently manipulating frequency. Estes and Verges (2008) point out that a consequence of humans' preferential response to negative stimuli, this automatic vigilance for negative valence, is that negative words tend to produce slower responses than positive or neutral words in cognitive tasks. They reject propositions by other researchers that this is because exposure to negative stimuli elicits a general suppression of motor activity (e.g., Algom et al., 2004). Such claims have compared this response to the 'freezing' reflex shown by animals under threat. Estes and Verges showed that a slowing of response to negative stimuli only occurs on tasks where valence is irrelevant for responding. They carried out both LDTs and EDTs using 20 positive and 20 negative (but no neutral) words. Stimuli were controlled for length and frequency and rated by participants for valence and arousal.

It was found that while negative words produced slower responses than positive words on lexical judgments, they produced faster reaction times on valence judgments. This demonstrates that negative stimuli – at least in word form – do not cause general motor suppression. Rather, they elicit selective responding, with tasks for which valence is response-relevant producing faster RTs. The authors explain this effect by proposing that when valence is of relevance to the task then the fact that the negativity preferential engagement of attention facilitates the response. If valence (the negativity) is unrelated to the task, however, RT is inhibited as the negativity causes delayed disengagement of the valence before the task at hand can be considered.

Chapter 2 also reported a significant frequency x emotion interaction in the EPN from 200 ms – 300 ms. In this window there were no significant differences between emotional categories of LF words, but within HF words both positive and negative produced a larger amplitude than neutral. This, combined with reports from the literature of late effects of emotional stimuli , some lasting for up to 6 s after stimulus onset (e.g., Pastor et al., 2008; Dillon et al., 2006), prompted speculation that some of the affect elicited by the emotional stimuli might ‘spill over’ and impact of the processing of subsequently presented neutral text.

Chapters 5 and 6 looked beyond the emotional stimuli themselves to subsequent neutral text. The aim here was to see, through the measurement of behavioural data in a priming task and the recording of eye movement in a reading study, whether a consequence of emotional processing was some impact on the processing of subsequent stimuli. The priming study succeeded in replicating a semantic priming effect but failed to show any facilitation or inhibition in the recognition of neutral targets when they had been primed by either positive or negative words. Indeed, the only effects here were main effects of word type and frequency for percent error. Fewer errors were made for words following HF than LF primes, and following positive than negative primes.

It seems plausible that emotional text can influence the processing of subsequent neutral text. The results of Chapters 4 and 5 indicate that this does not happen with single emotion words, but the results from Chapter 6 demonstrate that it can occur when emotional phrases within a connected text are presented. When several emotion words come together to 'paint a picture' they impact on the reading times of subsequent neutral sentences, even when there is no measurable difference in the reading times of the emotional sentences themselves.

Chapter 6 followed the same template as the sentence and word triples of chapter 4, but presented positive, negative or neutral sentences in the middle of neutral paragraphs. Because the blocks of text were so large, frequency was not controlled for. It was found that for the emotional target sentence, positive sentences were read faster than negative or neutral. For the following sentence – the location of any spill-over effect – those following negative sentences were read significantly faster than neutral words, and positive words were read marginally faster than neutral words. This is in keeping with the findings of Estes and Verges (2008) – valence was not relevant to the task so the facilitation enjoyed by the positive words for the reading of the positive sentence was not evident for the negative sentence. While sentences following the positive sentence, though, were read only marginally faster than those following neutral, the sentences following the negative sentences were read significantly faster.

One explanation for this is that the heightened arousal caused by the reading of the negative sentence facilitated the reading of the following text, without the slowing effects of negative emotional content. An alternative account is based instead on situation models. It is possible that the observed 'spill-over' effect was not caused by the additive influence of the emotion words presented, but by the impact of these words on the situation model built up by the reader. Although the line of enquiry in this study did not allow the distinction to be made between which stage of any situation model (e.g., Zwaan's (2004) immersed experiencer framework) would have been impacted upon, informed speculations were made. It is possible that reading a sentence containing several emotion words – and depicting emotionally charged events – would have led to the formation of an overall 'positive' or 'negative' situation model. This could then have affected the integration of subsequent information into the model. Alternatively, the presence of emotion words could have built up a positive or negative mood, or merely a heightened arousal, in participants, which could also have affected the integration of new information into a situation model.

The final two experiments in the thesis examined whether mood induction modulates emotion word processing. Chapter 7 was a replication of the reading study from chapter 4 where participants were primed using a modified Velten mood induction procedure to a positive, negative or neutral mood. A mood induction x word type x word frequency interaction showed up on the GD measure of eye-movements. The neutral mood condition produced a replication of the Chapter 4 results, taking into account a floor effect caused by the visual clarity of the display. In the positive mood condition only positive HF words were fixated for less time. Within the negative mood condition there was a frequency effect within positive, negative and neutral words, and positive HF words were fixated on for marginally less time than neutral HF words.

Chapter 8 investigated the use of emotion words in a persuasive message. After being induced to a positive, negative or neutral mood, participants saw reviews of four different products which varied in terms of the message type (positive vs.

negative) and the words used to convey that message (positive vs. negative). Participants were asked to rate each product on a series of semantic differentials as well as recommending them to two individuals, one of whom was 'promotion focused' and the other 'prevention focused' as defined by Higgins's (1998) theory of regulatory focus. There was no effect of mood. Both within recommendation to individuals, and for adjectives identified *post hoc* as being more 'promotion' or 'prevention' focused, promotion appeared to have a more complex influence than prevention in the modulation of negativity. For prevention ratings participants seemed to take negativity at face value, leading to additive main effects of word and message. For promotion ratings there was usually no difference between negative message regardless of the language used, while positive messages containing negative words were rated the highest.

This calls into question the wisdom of this thesis' stance of employing only words rated as 'positive and 'negative' based solely on ratings of arousal and valence. Higgins's promotion and prevention notions are associated with the distinct emotions of joy, dejection, relief and anxiety, and it is clear that motivational state, as defined by Higgins could play a large part in the processing of emotional words and the impact of these words on higher cognitive functions, such as the formation of attitudes. Throughout the literature, though, arousal and valence have shown consistent effects.

Gianotti et al. (2008) summarise that ERP studies have consistently shown an 'arousal effect' – a larger late positive ERP wave following highly arousing stimuli developing around 300-400 ms and lasting for several hundred ms (Codispoti, Ferrari, & Bradley, 2006; Delplanque et al., 2006; Dolcos & Cabeza, 2002; and Keil et al., 2002). This has been linked to motivational attention in models which propose motivationally significant stimuli are selectively processed because they naturally engage attentional resources (Bradley, 2000; Lang, Bradley. & Cuthbert, 1997). In two ERP studies (Junghöfer et al., 2001; Schupp et al., 2004) where a short exposure to the stimuli was used (120-300 ms) differences were shown as early as 100-200 ms post stimulus onset.

They also report a 'valence effect' shown as early as 100 ms post stimulus onset (Esslen et al. 2004, Keil et al, 2002, Ortigue et al, 2004, Skrandies, 1998; Skrandies & Chiu, 2003). They tell of 3 studies which reported valence and arousal effects. Dolcos & Cabeza (2002) reported both effects occurring between 500-800 ms post stimulus, and additional arousal effects up to 1200ms. Kiel et al (2002) found valence effects between 120 and 150 ms, arousal effects in LPC from 300ms to 900ms. Finally, Delplanque et al (2006) used an oddball paradigm and focused attention on the P3a (333-384 ms) and P3b (439-630 ms). They found valence effects in both and arousal effects in the P3b.

Gianotti et al. point out, though, that not only did these three studies use pre-defined components in analysis, they did not control for valence when looking for an arousal effect. In their study, Gianotti and her colleagues used high arousing positive (11), low arousing positive (9), high arousing negative (8) and low arousing negative(12) pictures and words as stimuli (as well as carrying out a number of similar experiments in the series involving pictures as stimuli). Twenty neutral words were also shown but were not included in the analysis. Words were presented for 450 ms followed by an ISI of 1550 ms. The 60 words were used repeatedly as stimuli in 6 runs in pseudo-random sequences. Participants were asked to attend to the stimuli. Occasionally a question mark would appear, and when it did they had to repeat the previous word aloud.

The results showed that the different dimensions of arousal and valence were characterised by several distinct 'microstates' produced by differently active neural populations, leading to the conclusion that the processing of valence and arousal involve different neural assemblies (supporting the statement in the introduction that the amygdala processes arousal and the prefrontal cortex valence, e.g., Anderson et al., 2003; Kesinger & Schacter, 2006. Extraction of valance information started at around 100–118 ms in the word experiment and 142 ms in the picture experiment – words information at 226 for words and 302 for pictures. The results also showed a 'common step' – the last microstate of valence extraction was identical to the first microstate of arousal extraction. It must be noted, though, that stimuli were presented repeatedly in this experiment. In Chapter 1 this was pointed out a major criticism of many previous works on emotional word processing. While still not exemplary practice, Gionotti et al.'s study is included as it is the only study other than Robinson et al.'s (2004), to my knowledge, to employ a 2x2 design investigating high and low levels of both valence and arousal.

Robinson et al. (2004) also reported a valence x arousal interaction. They built on speculation by Watson et al (1999) and Lang (1995) that arousal and valence are not truly independent, but that negative arousal activates the avoidance system, and positive arousal the approach system. There have, however, been claims that arousal and valence independently effect experience (Russell & Barrett, 1999), physiology (Lang et al., 1993) and brain activity (Heller & Nitschke, 1998). The conclusions were that we have two pre-attentive orientations: novel and intense stimuli are avoided (Neumann, Forster & Strack, 2003); familiar and mild stimuli trigger an approach orientation (Zajonc, 2001).

Robinson et al. said these must be integrated before a conscious response can be made. They carried out 7 studies where participants had to rate pictures and words on emotionality. Words were taken from Bradley and Lang (1999) and controlled for frequency. Participants had to identify and then emotionally evaluate each of the words. There was a cross-over valence x arousal interaction – negative high arousal words and positive low arousal words were responded to faster. But results showed that negative high and low arousal and positive high arousal all generated responses around 900 ms (all above 880 ms), while positive low arousal generated responses below 820 ms.

It is worth noting that the high arousal negative and low arousal positive words, reported by Robinson (2004) to be responded to fastest, correspond to the specific emotional states of 'anxiousness' and 'relief', at least according to Brockner & Higgins (2001). These of course are the emotions associated with prevention focus in Higgins's theory. If this is the case, it implies that 'prevention focused' words are responded to faster than 'promotion focused' words.

If this is the case, in most of the experiments contained in this thesis it was not 'positive' and 'negative' words which were being investigated, but high arousal high valence 'joy' words, and high arousal low valence 'anxious' words. As neither studies by Robinson et al. (2004) nor Giatonni et al. (2008) manipulated frequency, a direct comparison with the majority of this thesis is not appropriate. In Chapter 6, however, frequency was not manipulated and for target regions (the emotional second sentences in the paragraph study) positive stimuli were read faster than negative or neutral stimuli. This is not consistent with the predictions of Gianotti as the task was not valence-relevant. Their predictions are in keeping, however, with the findings from Chapter 8 where prevention recommendations and semantic differentials were rated purely on the basis of raw negativity while promotion focused items seemed to have modulated stimulus negativity more effectively, something which would surely take time.

These results indicate that valence and arousal are independent. They must be replicated to confirm the findings, although at this stage they are intriguing. The main problem in investigating such results is, as was mentioned in the first chapter, the lack of availability of well-controlled stimuli. As most highly arousing words (the vast majority in corpora such as ANEW) are also at the extremes of valence, just as those low in arousal tend to be of medium valence, finding words which fall into the positive high arousal 'joy' and negative low arousal 'dejection' categories proves difficult. Evidence of this is the repetition of a small number of stimuli in the above experiments. If this area is to be investigated further then a new, much larger battery of emotional words needs to be compiled, or separate ratings must be carried out from study to study to enable a large, well controlled set of words to be presented without repetition. It may be the case that because valence and arousal are correlated, as explained in Chapter 1, there are simply not enough low arousal positive and negative words to allow well-controlled studies of the sort contained in this thesis to be carried out.

The consideration given to the results has, up to this point, focused exclusively on bottom-up explanations. It has already been noted elsewhere in this thesis that there are equally valid top-down accounts, particularly for the 'spill-over' effects described in the later chapters. Although the investigation of emotional sentences and phrases naturally follows on from the preceding work on single emotion words, it should not be taken for granted that the same systems are involved.

Situation models such as Zwaan's (2004) immersed experiencer framework describe comprehenders, or experiencers, developing an interactive model into which they become immersed. This is built up using cues in language and is based in grounded cognition. Although, as previously explained, there has been very little consideration thus far of the role of emotion in either grounded cognition or situation models, there is no reason to assume that the principles applied to this factor should be any different to the mechanisms posited to act on other word features.

Just as the image associated with a word, for example, is stored in the visual cortex, so the emotional connotations of a word will likely be stored in emotional areas of the brain. Although definitive agreement has yet to be reached on this issue, such areas are thought to include the amygdala, as discussed in Chapter 1. Thus, when an emotion word (e.g., *kiss* – positive, or *bomb* - negative) is read, the emotional areas associated with the word (e.g., positive feelings such as love, lust, excitement; negative feelings such as panic, anxiety, fear) are activated, and the experiencer, or reader, will then experience (at least to some degree) the same emotions as if the object described by the word were experienced in real life.

Such activation would explain the arousal reported to be experienced by participants when reading emotion words, and can also be assimilated with the findings from Chapters 1, 4 and 7 where targets were single emotion words. Also consistent with these notions of embodied cognition is the perceptual defense theory proposed throughout the thesis.

It must be remembered, though, that virtually no work has been conducted into the role played by emotions in situation models, so the proposals put forward here are merely conjecture. It is not known, firstly, if (as outlined in Chapter 1, appears to be the case for emotion words presented in isolation) 'positive' and 'negative' emotions impact on situation models (which appears to be the case for emotion words presented in isolation, as outlined in Chapter 1), or if it would be of greater use to focus on discrete emotions. There is also no evidence to show that arousal and valence – the two factors by which positive and negative words have been defined throughout this thesis – work together in situation models. It is assumed in this discussion that they do, as appears to be the case with single emotion words, but there is, as yet, no evidence to back up this supposition.

The mechanisms thought to be concerned with the processing of single emotion words correspond to those used in the first stage of Zwaan's (2004) immersed experiencer framework: the activation stage. Recall that this is when information about a newly encountered word becomes active. Of more relevance to the spill-over effects discussed in this thesis are the second and third stages of Zwaan's model: the construal and integration stages. These describe the process in which each word being integrated with the local and wider context of the situation, respectively.

It is difficult to make any definite conclusions about the role of emotion in this part of the process. One reason is that Zwaan defines these stages as being non-sequential. This, together with the lack of previous research into emotion in situation models, means there is no basis for conjecture, and no other findings to look to, when attempting to map emotion onto this theory. Zwaan, himself, describes the theory as unfinished, with plenty of areas yet to be explored. While emotion is one of these areas, and will no doubt be the basis of many interesting studies in the future, it is impossible to draw any meaningful conclusions from studies such as the ones presented here which were not designed to investigate such models.

It is thought that with the reading of several emotional words an emotional 'picture' – in this thesis either positive or negative – is built up. This could lead to the situation model itself becoming positive or negative. This is a novel suggestion, and further investigation is required to corroborate it, but there is a possibility that an 'emotionally charged' situation model may facilitate the integration of subsequent information. In the case of a positive model this may be because individuals are being less analytical with new information being absorbed. For negative models it may be the case that individuals are aware of the urgency of the situation and thus employ measures to process and understand any new information available to them as rapidly as possible. This, in terms of evolution, would increase their chances of avoiding or dealing with any imminent danger, and therefore their chances of survival.

As outlined in Chapter 1, the remit of this thesis was to define responses to emotional words and to propose credible explanations for the processes behind such phenomena. The first part of this has been a success – not only have behavioural results identified an interaction between the emotion and frequency of a word, but these have been corroborated by ERP and eye-tracking evidence, and emotion words have also been shown, under the correct circumstances, to influence the processing of subsequent neutral text and even higher cognitive functions. However, there are still many outstanding questions regarding the second part. It may be the case, of course, that both bottom-up and top-down influences affect the processing of emotion words. As outlined earlier in the chapter, and throughout the thesis, there are possible bottom-up explanations for the reported effects. But there is no reason to assume that these explanations, and the ones above concerning situation models, are mutually exclusive. It is a prerequisite for situation models that a word must be processed and understood before it is integrated first into the local context of the phrase or sentence, and then into the larger context of the situation. The bottom-up considerations already discussed apply to this first stage. It is here that semantic information concerning the word is accessed, and networks of neurons spanning several regions of the brain – described by Pulvermüller as 'functional webs' – are activated, and, presumably, emotional content first asserts itself.

The suggestion thus far has been that as emotion words are integrated into the situation model, they make the model itself 'positive' or 'negative' and that in this way – or possibly by heightening participants' arousal – subsequent words are integrated faster, regardless of their emotive content. This is not to say, however, that if the situation model is an emotional one, the other characteristics of a word cease to play any part in its integration.

The results reported in the preceding chapters allow us to do little more than speculate about any potentially complex interplay between the top-down influences of the situation models and the bottom-up impact of the individual words. There is no way to distinguish, for example, between the different phases of integration into the situation model using the current paradigms. Even if there was, the majority of situation models in the literature (e.g., Zwaan, 2004) are relatively new and only vaguely defined. This would make the discovery of any concrete effects, and related conclusions, difficult, even if an experiment were specifically set out to investigate such mechanisms.

The role that emotion plays in situation models – whether it be the mood of the comprehender or the emotional content of language – is one which has received little attention in the literature. Investigators thus far have been more concerned with semantic integration and the 'experience' or 'perspective' of the comprehender as they move through a narrative. While there are still many outstanding questions regarding the role of emotion in a word's integration to situation models, it must be remembered that the current work has achieved its objectives. By demonstrating consistent results across a range of methodologies a clear picture has emerged of the influence of a word's emotional content on its processing. This has not only allowed a more thorough consideration of bottom-up explanations, but has provided a basis for a new set of inquiries – those regarding top-down mechanisms and the integration of emotion words into situation models – to be considered.

One possible limitation of this thesis as a whole is its self-imposed restriction of considering stimuli which only conform to the 'positive' and 'negative' emotional categories as defined by the two-factor theory. While widely agreed to be a reliable definition of emotional words, if this definition is not wholly accurate then it throws the results into question. Although there is always an argument to employ specific emotions (e.g., guilt, anger, fear, etc. rather than simply 'negative') there has been no real reason thus far to doubt that the general categories of 'positive' and 'negative' should be defined using valence and arousal. Gianotti et al (2008) state that "*multivariate studies have consistently shown that the principal; variance in the categorisation of emotional stimuli is accounted for two predominant dimensions, arousal and valence* (e.g., Mehrabian & Russel, 1974; Osgood, Suci & Tannenbaum, 1957)" (p.143).

Fontaine et al. (2007), however, claim that the two-factor theory is flawed. They say that "*four dimensions are needed to satisfactorily represent similarities and differences in the meaning of emotion words*." (p. 1050) They used a verb-related questionnaire – GRID; 22 emotional terms and 144 emotional features (31 refer to appraisals, 18 to bodily experiences, 9 to facial expressions, 12 to vocal expressions, 5 to gestural expressions, 40 to action tendencies, 22 to subjective feelings, and 4 to regulation). These were derived from "diverse emotion theories and literature".

Participants were given 4 of the 24 emotions and asked to rate all 144 features on a 9 point scale. There was found to be no difference in the results between English, French and Dutch.

They carried out principal component analysis and found that four variables accounted for a total of 75.4% of the variance. 'evaluation – pleasantness' accounted for 35.3%; 'potency – control' accounted for 22.8%; 'activation – arousal' accounted for 11.4%; and 'unpredictability' accounted for 6.0%. One drawback to the study (pointed out by the authors) was that it was mainly a student sample which was used. Some words, e.g., 'love', are known to be associated with lower arousal levels in older populations.

Further research needs to be carried out before the established two-factor theory is abandoned in favour of this new model (or one of its competitors). If the results reported in this study are robust, and 'evaluation-pleasantness' can be taken to be equivalent to 'valence' this means that the two dimensions used to define emotional words in the two-factor model account for only 46.7% of the variance. However, the dimensions of 'potency-control' and 'unpredictability' have not, to my knowledge, been investigated in any study other than that of Fontaine and his colleagues.

One of the principal strengths of this thesis was the methodologies employed. This is the first time that eye-tracking has been used to investigate the processing of emotional words. The employment of this paradigm enabled previous findings from LDTs to be confirmed in real time with an on-line reading task. This thesis was also the first to employ Nummenmaa and Hyönä's vertical choice paradigm with emotional text rather than emotional pictures. In addition, this is the first time that the interaction with word type and message type has been investigated (see Chapter 8), or an empirical attempt been made to reconcile the two-factor theory of emotion with the goal-driven theory of regulatory focus.

The use of the Velten mood induction paradigm may have modulated the results of the final two experiments. Bisson and Sears (2007), in their experiment described in Chapter 7, successfully employed a multi-modal induction procedure, presented prime sentences orally and utilized an LDT. Primes were ambiguous and could have positive, negative or neutral interpretations. Lawson and McLeod (1999) failed to produce priming results in a similar experiment. They used a Velten induction procedure, had participants perform a pronunciation task, presented the stimuli via text and used prime sentences which could only have negative or neutral meanings.

This is not the only criticism leveled against the Velten mood induction procedure. Clark (1983) reported that 30%-50% of participants were not affected by the Velten induction procedure. This would initially not appear to be the case in Chapters 7 and 8 of the current thesis, as participants in the 'negative' group scored lower than the other two mood groups on the MAS and PANAS scales, while the 'positive' group scored higher. Kenealy (1986), though, described Velten as being "inconsistent and equivocal", saying that although participants often reported changes of feeling they often showed no differences in behaviour. There is no way of knowing whether or not this was the case here, although it could explain why there was no effect of mood in Chapter 8. Also, if the Velten technique was perhaps not as powerful as first thought, it could explain why, in Chapter 7, there was only an effect of mood in the gaze duration measure.

An observation mentioned in the Chapter 7 discussion (equally applicable to Chapter 8) was that, although the Velten technique is generally agreed to be a valid method of mood induction, emotional simulation may have been a more effective way to induce positive and negative feelings in the participants. A technique such as that used by Havas, Glenberg and Rinck (2007) – where participants were required to hold a pencil in their mouths using only their teeth to produce a smile or only their lips to produce a pout, thus triggering the related emotion – may be considered for future study into such phenomena.

In conclusion, the effect of emotionality has been successfully indexed with regard to frequency in word processing. It has also been demonstrated that, when presented together, negative and positive emotional text can impact upon the processing of subsequent neutral text, and also impact upon the formation of attitudes and perhaps other higher cognitive processes. The big question now is which direction to head in next? One option would be to investigate many discrete emotions such as guilt, anger and fear, while another would be to continue to attempt to unite theories of emotion with theories of motivation such as the application of joy, dejection, relief and anxiety to Higgins's theory of regulatory focus. Now that the early processing effects of positive and negative stimuli have been better established there could also be study conducted into the impact of such words on higher level cognitive processes other than attitudes.

For the majority of these options to become reality one resource needed is a larger bank of available stimuli in order to adequately control stimuli and continue to effectively employ them without repetition in original paradigms. This is especially true if research is to continue into the relationship between arousal and valence by employing groups of 'low arousal' positive and negative words. Perhaps if this can be successfully achieved then the role of the ‘general’ positive and negative emotional categories in relation to discrete emotions will become clearer and the role played by emotion in motivation and goal attainment will be illuminated. That can only mean the advancement of knowledge and the generation of more pioneering research.

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Appendix A: Stimuli from Chapter 2 Experiment
Low- and high-frequency (LF, HF) positive, negative, and neutral words.

LF			HF		
Positive	Negative	Neutral	Positive	Negative	Neutral
nude	demon	hawk	fun	mad	odd
lust	shark	cane	joy	gun	iron
sexy	rude	muddy	car	war	book
fame	rage	truck	win	fire	army
alert	toxic	lump	joke	rape	tool
champ	venom	swamp	gift	evil	bowl
thrill	slap	boxer	sex	fight	wine
cheer	snake	trunk	cash	pain	rock
glory	devil	alien	kiss	crash	hide
flirt	annoy	rattle	brave	hate	stiff
dazzle	detest	limber	plane	bomb	clock
casino	tumour	mystic	song	anger	rough
riches	betray	salute	happy	angry	cold
erotic	sinful	clumsy	heart	fear	hotel
dancer	insult	vanity	talent	burn	bench
aroused	scared	spray	quick	abuse	coast
dollar	killer	invest	lucky	victim	paint
elated	leprosy	icebox	couple	afraid	watch
miracle	poison	insect	rescue	horror	fabric
admired	hatred	hammer	engaged	tense	excuse
orgasm	pervert	ketchup	pretty	bloody	yellow
terrific	wicked	coarse	loved	guilty	patient
intimate	destroy	custom	travel	cancer	manner
reunion	intruder	trumpet	leader	trouble	glass
ecstasy	outrage	radiator	passion	panic	journal
treasure	torture	highway	desire	surgery	writer
sunlight	hostile	whistle	holiday	danger	detail
festive	disloyal	repentant	inspired	tragedy	gender
graduate	terrified	privacy	memories	assault	shadow
fireworks	assassin	scissors	progress	stress	teacher
adventure	ambulance	nursery	success	pressure	market
athletics	slaughter	pamphlet	laughter	confused	avenue
affection	nightmare	nonsense	birthday	divorce	medicine
valentine	humiliate	appliance	romantic	violent	contents
intercourse	jealousy	sheltered	exercise	accident	village
infatuation	cockroach	sceptical	promotion	disaster	passage
astonished	distressed	sentiment	surprised	rejected	context
triumphant	unfaithful	nonchalant	beautiful	nervous	material
millionaire	hurricane	thermometer	confident	suspicious	reserved
rollercoaster	suffocate	lighthouse	excitement	controlling	concentrate

Appendix B: Stimuli from Chapter 3 Experiment

trial	top	bottom	bold	delay	Freq	Item	Tgt_Bold	Mate_norm	Tg
1	fun	odd	TOP	300	HF	1	Pos	Con	T
2	car	book	TOP	300	HF	2	Pos	Con	T
3	joy	iron	TOP	300	HF	3	Pos	Con	T
4	win	army	TOP	300	HF	4	Pos	Con	T
5	gift	bowl	TOP	300	HF	5	Pos	Con	T
6	cash	rock	TOP	300	HF	6	Pos	Con	T
7	joke	tool	TOP	300	HF	7	Pos	Con	T
8	sex	wine	TOP	300	HF	8	Pos	Con	T
9	kiss	hide	TOP	300	HF	9	Pos	Con	T
10	plane	clock	TOP	300	HF	10	Pos	Con	T
11	happy	cold	TOP	300	HF	11	Pos	Con	T
12	heart	hotel	TOP	300	HF	12	Pos	Con	T
13	song	rough	TOP	300	HF	13	Pos	Con	T
14	brave	stiff	TOP	300	HF	14	Pos	Con	T
15	talent	bench	TOP	300	HF	15	Pos	Con	T
16	quick	coast	TOP	300	HF	16	Pos	Con	T
17	lucky	paint	TOP	300	HF	17	Pos	Con	T
18	couple	watch	TOP	300	HF	18	Pos	Con	T
19	engaged	excuse	TOP	300	HF	19	Pos	Con	T
20	rescue	fabric	TOP	300	HF	20	Pos	Con	T
21	leader	glass	TOP	300	HF	21	Pos	Con	T
22	travel	manner	TOP	300	HF	22	Pos	Con	T
23	loved	patient	TOP	300	HF	23	Pos	Con	T
24	pretty	yellow	TOP	300	HF	24	Pos	Con	T
25	holiday	detail	TOP	300	HF	25	Pos	Con	T
26	passion	journal	TOP	300	HF	26	Pos	Con	T
27	desire	writer	TOP	300	HF	27	Pos	Con	T
28	inspired	gender	TOP	300	HF	28	Pos	Con	T
29	success	market	TOP	300	HF	29	Pos	Con	T
30	memories	shadow	TOP	300	HF	30	Pos	Con	T
31	progress	teacher	TOP	300	HF	31	Pos	Con	T
32	laughter	avenue	TOP	300	HF	32	Pos	Con	T
33	romantic	contents	TOP	300	HF	33	Pos	Con	T
34	birthday	medicine	TOP	300	HF	34	Pos	Con	T
35	exercise	village	TOP	300	HF	35	Pos	Con	T
36	surpised	context	TOP	300	HF	36	Pos	Con	T
37	beautiful	material	TOP	300	HF	37	Pos	Con	T
38	promotion	passage	TOP	300	HF	38	Pos	Con	T
39	confident	reserved	TOP	300	HF	39	Pos	Con	T
40	excitement	concentrate	TOP	300	HF	40	Pos	Con	T
41	fun	odd	BOTTOM	300	HF	1	Con	Pos	B
42	car	book	BOTTOM	300	HF	2	Con	Pos	B
43	joy	iron	BOTTOM	300	HF	3	Con	Pos	B
44	win	army	BOTTOM	300	HF	4	Con	Pos	B
45	gift	bowl	BOTTOM	300	HF	5	Con	Pos	B
46	cash	rock	BOTTOM	300	HF	6	Con	Pos	B
47	joke	tool	BOTTOM	300	HF	7	Con	Pos	B
48	sex	wine	BOTTOM	300	HF	8	Con	Pos	B
49	kiss	hide	BOTTOM	300	HF	9	Con	Pos	B
50	plane	clock	BOTTOM	300	HF	10	Con	Pos	B
51	happy	cold	BOTTOM	300	HF	11	Con	Pos	B

52	heart	hotel	BOTTOM	300	HF	12	Con	Pos	B
53	song	rough	BOTTOM	300	HF	13	Con	Pos	B
54	brave	stiff	BOTTOM	300	HF	14	Con	Pos	B
55	talent	bench	BOTTOM	300	HF	15	Con	Pos	B
56	quick	coast	BOTTOM	300	HF	16	Con	Pos	B
57	lucky	paint	BOTTOM	300	HF	17	Con	Pos	B
58	couple	watch	BOTTOM	300	HF	18	Con	Pos	B
59	engaged	excuse	BOTTOM	300	HF	19	Con	Pos	B
60	rescue	fabric	BOTTOM	300	HF	20	Con	Pos	B
61	leader	glass	BOTTOM	300	HF	21	Con	Pos	B
62	travel	manner	BOTTOM	300	HF	22	Con	Pos	B
63	loved	patient	BOTTOM	300	HF	23	Con	Pos	B
64	pretty	yellow	BOTTOM	300	HF	24	Con	Pos	B
65	holiday	detail	BOTTOM	300	HF	25	Con	Pos	B
66	passion	journal	BOTTOM	300	HF	26	Con	Pos	B
67	desire	writer	BOTTOM	300	HF	27	Con	Pos	B
68	inspired	gender	BOTTOM	300	HF	28	Con	Pos	B
69	success	market	BOTTOM	300	HF	29	Con	Pos	B
70	memories	shadow	BOTTOM	300	HF	30	Con	Pos	B
71	progress	teacher	BOTTOM	300	HF	31	Con	Pos	B
72	laughter	avenue	BOTTOM	300	HF	32	Con	Pos	B
73	romantic	contents	BOTTOM	300	HF	33	Con	Pos	B
74	birthday	medicine	BOTTOM	300	HF	34	Con	Pos	B
75	exercise	village	BOTTOM	300	HF	35	Con	Pos	B
76	surpised	context	BOTTOM	300	HF	36	Con	Pos	B
77	beautiful	material	BOTTOM	300	HF	37	Con	Pos	B
78	promotion	passage	BOTTOM	300	HF	38	Con	Pos	B
79	confident	reserved	BOTTOM	300	HF	39	Con	Pos	B
80	excitement	concentrate	BOTTOM	300	HF	40	Con	Pos	B
81	odd	fun	TOP	300	HF	1	Con	Pos	T
82	book	car	TOP	300	HF	2	Con	Pos	T
83	iron	joy	TOP	300	HF	3	Con	Pos	T
84	army	win	TOP	300	HF	4	Con	Pos	T
85	bowl	gift	TOP	300	HF	5	Con	Pos	T
86	rock	cash	TOP	300	HF	6	Con	Pos	T
87	tool	joke	TOP	300	HF	7	Con	Pos	T
88	wine	sex	TOP	300	HF	8	Con	Pos	T
89	hide	kiss	TOP	300	HF	9	Con	Pos	T
90	clock	plane	TOP	300	HF	10	Con	Pos	T
91	cold	happy	TOP	300	HF	11	Con	Pos	T
92	hotel	heart	TOP	300	HF	12	Con	Pos	T
93	rough	song	TOP	300	HF	13	Con	Pos	T
94	stiff	brave	TOP	300	HF	14	Con	Pos	T
95	bench	talent	TOP	300	HF	15	Con	Pos	T
96	coast	quick	TOP	300	HF	16	Con	Pos	T
97	paint	lucky	TOP	300	HF	17	Con	Pos	T
98	watch	couple	TOP	300	HF	18	Con	Pos	T
99	excuse	engaged	TOP	300	HF	19	Con	Pos	T
100	fabric	rescue	TOP	300	HF	20	Con	Pos	T
101	glass	leader	TOP	300	HF	21	Con	Pos	T
102	manner	travel	TOP	300	HF	22	Con	Pos	T
103	patient	loved	TOP	300	HF	23	Con	Pos	T
104	yellow	pretty	TOP	300	HF	24	Con	Pos	T
105	detail	holiday	TOP	300	HF	25	Con	Pos	T

106	journal	passion	TOP	300	HF	26	Con	Pos	T
107	writer	desire	TOP	300	HF	27	Con	Pos	T
108	gender	inspired	TOP	300	HF	28	Con	Pos	T
109	market	success	TOP	300	HF	29	Con	Pos	T
110	shadow	memories	TOP	300	HF	30	Con	Pos	T
111	teacher	progress	TOP	300	HF	31	Con	Pos	T
112	avenue	laughter	TOP	300	HF	32	Con	Pos	T
113	contents	romantic	TOP	300	HF	33	Con	Pos	T
114	medicine	birthday	TOP	300	HF	34	Con	Pos	T
115	village	exercise	TOP	300	HF	35	Con	Pos	T
116	context	surpised	TOP	300	HF	36	Con	Pos	T
117	material	beautiful	TOP	300	HF	37	Con	Pos	T
118	passage	promotion	TOP	300	HF	38	Con	Pos	T
119	reserved	confident	TOP	300	HF	39	Con	Pos	T
120	concentrate	excitement	TOP	300	HF	40	Con	Pos	T
121	fun	odd	BOTTOM	300	HF	1	Pos	Con	B
122	car	book	BOTTOM	300	HF	2	Pos	Con	B
123	joy	iron	BOTTOM	300	HF	3	Pos	Con	B
124	win	army	BOTTOM	300	HF	4	Pos	Con	B
125	gift	bowl	BOTTOM	300	HF	5	Pos	Con	B
126	cash	rock	BOTTOM	300	HF	6	Pos	Con	B
127	joke	tool	BOTTOM	300	HF	7	Pos	Con	B
128	sex	wine	BOTTOM	300	HF	8	Pos	Con	B
129	kiss	hide	BOTTOM	300	HF	9	Pos	Con	B
130	plane	clock	BOTTOM	300	HF	10	Pos	Con	B
131	happy	cold	BOTTOM	300	HF	11	Pos	Con	B
132	heart	hotel	BOTTOM	300	HF	12	Pos	Con	B
133	song	rough	BOTTOM	300	HF	13	Pos	Con	B
134	brave	stiff	BOTTOM	300	HF	14	Pos	Con	B
135	talent	bench	BOTTOM	300	HF	15	Pos	Con	B
136	quick	coast	BOTTOM	300	HF	16	Pos	Con	B
137	lucky	paint	BOTTOM	300	HF	17	Pos	Con	B
138	couple	watch	BOTTOM	300	HF	18	Pos	Con	B
139	engaged	excuse	BOTTOM	300	HF	19	Pos	Con	B
140	rescue	fabric	BOTTOM	300	HF	20	Pos	Con	B
141	leader	glass	BOTTOM	300	HF	21	Pos	Con	B
142	travel	manner	BOTTOM	300	HF	22	Pos	Con	B
143	loved	patient	BOTTOM	300	HF	23	Pos	Con	B
144	pretty	yellow	BOTTOM	300	HF	24	Pos	Con	B
145	holiday	detail	BOTTOM	300	HF	25	Pos	Con	B
146	passion	journal	BOTTOM	300	HF	26	Pos	Con	B
147	desire	writer	BOTTOM	300	HF	27	Pos	Con	B
148	inspired	gender	BOTTOM	300	HF	28	Pos	Con	B
149	success	market	BOTTOM	300	HF	29	Pos	Con	B
150	memories	shadow	BOTTOM	300	HF	30	Pos	Con	B
151	progress	teacher	BOTTOM	300	HF	31	Pos	Con	B
152	laughter	avenue	BOTTOM	300	HF	32	Pos	Con	B
153	romantic	contents	BOTTOM	300	HF	33	Pos	Con	B
154	birthday	medicine	BOTTOM	300	HF	34	Pos	Con	B
155	exercise	village	BOTTOM	300	HF	35	Pos	Con	B
156	surpised	context	BOTTOM	300	HF	36	Pos	Con	B
157	beautiful	material	BOTTOM	300	HF	37	Pos	Con	B
158	promotion	passage	BOTTOM	300	HF	38	Pos	Con	B
159	confident	reserved	BOTTOM	300	HF	39	Pos	Con	B

160	excitement	concentrate	BOTTOM	300	HF	40	Pos	Con	B
161	mad	odd	TOP	300	HF	1	Neg	Con	T
162	war	book	TOP	300	HF	2	Neg	Con	T
163	gun	iron	TOP	300	HF	3	Neg	Con	T
164	fire	army	TOP	300	HF	4	Neg	Con	T
165	evil	bowl	TOP	300	HF	5	Neg	Con	T
166	pain	rock	TOP	300	HF	6	Neg	Con	T
167	rape	tool	TOP	300	HF	7	Neg	Con	T
168	fight	wine	TOP	300	HF	8	Neg	Con	T
169	crash	hide	TOP	300	HF	9	Neg	Con	T
170	bomb	clock	TOP	300	HF	10	Neg	Con	T
171	angry	cold	TOP	300	HF	11	Neg	Con	T
172	fear	hotel	TOP	300	HF	12	Neg	Con	T
173	anger	rough	TOP	300	HF	13	Neg	Con	T
174	hate	stiff	TOP	300	HF	14	Neg	Con	T
175	burn	bench	TOP	300	HF	15	Neg	Con	T
176	abuse	coast	TOP	300	HF	16	Neg	Con	T
177	victim	paint	TOP	300	HF	17	Neg	Con	T
178	afraid	watch	TOP	300	HF	18	Neg	Con	T
179	tense	excuse	TOP	300	HF	19	Neg	Con	T
180	horror	fabric	TOP	300	HF	20	Neg	Con	T
181	trouble	glass	TOP	300	HF	21	Neg	Con	T
182	cancer	manner	TOP	300	HF	22	Neg	Con	T
183	guilty	patient	TOP	300	HF	23	Neg	Con	T
184	bloody	yellow	TOP	300	HF	24	Neg	Con	T
185	danger	detail	TOP	300	HF	25	Neg	Con	T
186	panic	journal	TOP	300	HF	26	Neg	Con	T
187	sugery	writer	TOP	300	HF	27	Neg	Con	T
188	tragedy	gender	TOP	300	HF	28	Neg	Con	T
189	pressure	market	TOP	300	HF	29	Neg	Con	T
190	assault	shadow	TOP	300	HF	30	Neg	Con	T
191	stress	teacher	TOP	300	HF	31	Neg	Con	T
192	confused	avenue	TOP	300	HF	32	Neg	Con	T
193	violent	contents	TOP	300	HF	33	Neg	Con	T
194	divorce	medicine	TOP	300	HF	34	Neg	Con	T
195	accident	village	TOP	300	HF	35	Neg	Con	T
196	rejected	context	TOP	300	HF	36	Neg	Con	T
197	nervous	material	TOP	300	HF	37	Neg	Con	T
198	disaster	passage	TOP	300	HF	38	Neg	Con	T
199	suspicious	reserved	TOP	300	HF	39	Neg	Con	T
200	controlling	concentrate	TOP	300	HF	40	Neg	Con	T
201	mad	odd	BOTTOM	300	HF	1	Con	Neg	B
202	war	book	BOTTOM	300	HF	2	Con	Neg	B
203	gun	iron	BOTTOM	300	HF	3	Con	Neg	B
204	fire	army	BOTTOM	300	HF	4	Con	Neg	B
205	evil	bowl	BOTTOM	300	HF	5	Con	Neg	B
206	pain	rock	BOTTOM	300	HF	6	Con	Neg	B
207	rape	tool	BOTTOM	300	HF	7	Con	Neg	B
208	fight	wine	BOTTOM	300	HF	8	Con	Neg	B
209	crash	hide	BOTTOM	300	HF	9	Con	Neg	B
210	bomb	clock	BOTTOM	300	HF	10	Con	Neg	B
211	angry	cold	BOTTOM	300	HF	11	Con	Neg	B
212	fear	hotel	BOTTOM	300	HF	12	Con	Neg	B
213	anger	rough	BOTTOM	300	HF	13	Con	Neg	B

214	hate	stiff	BOTTOM	300	HF	14	Con	Neg	B
215	burn	bench	BOTTOM	300	HF	15	Con	Neg	B
216	abuse	coast	BOTTOM	300	HF	16	Con	Neg	B
217	victim	paint	BOTTOM	300	HF	17	Con	Neg	B
218	afraid	watch	BOTTOM	300	HF	18	Con	Neg	B
219	tense	excuse	BOTTOM	300	HF	19	Con	Neg	B
220	horror	fabric	BOTTOM	300	HF	20	Con	Neg	B
221	trouble	glass	BOTTOM	300	HF	21	Con	Neg	B
222	cancer	manner	BOTTOM	300	HF	22	Con	Neg	B
223	guilty	patient	BOTTOM	300	HF	23	Con	Neg	B
224	bloody	yellow	BOTTOM	300	HF	24	Con	Neg	B
225	danger	detail	BOTTOM	300	HF	25	Con	Neg	B
226	panic	journal	BOTTOM	300	HF	26	Con	Neg	B
227	sugery	writer	BOTTOM	300	HF	27	Con	Neg	B
228	tragedy	gender	BOTTOM	300	HF	28	Con	Neg	B
229	pressure	market	BOTTOM	300	HF	29	Con	Neg	B
230	assault	shadow	BOTTOM	300	HF	30	Con	Neg	B
231	stress	teacher	BOTTOM	300	HF	31	Con	Neg	B
232	confused	avenue	BOTTOM	300	HF	32	Con	Neg	B
233	violent	contents	BOTTOM	300	HF	33	Con	Neg	B
234	divorce	medicine	BOTTOM	300	HF	34	Con	Neg	B
235	accident	village	BOTTOM	300	HF	35	Con	Neg	B
236	rejected	context	BOTTOM	300	HF	36	Con	Neg	B
237	nervous	material	BOTTOM	300	HF	37	Con	Neg	B
238	disaster	passage	BOTTOM	300	HF	38	Con	Neg	B
239	suspicious	reserved	BOTTOM	300	HF	39	Con	Neg	B
240	controlling	concentrate	BOTTOM	300	HF	40	Con	Neg	B
241	odd	mad	TOP	300	HF	1	Con	Neg	T
242	book	war	TOP	300	HF	2	Con	Neg	T
243	iron	gun	TOP	300	HF	3	Con	Neg	T
244	army	fire	TOP	300	HF	4	Con	Neg	T
245	bowl	evil	TOP	300	HF	5	Con	Neg	T
246	rock	pain	TOP	300	HF	6	Con	Neg	T
247	tool	rape	TOP	300	HF	7	Con	Neg	T
248	wine	fight	TOP	300	HF	8	Con	Neg	T
249	hide	crash	TOP	300	HF	9	Con	Neg	T
250	clock	bomb	TOP	300	HF	10	Con	Neg	T
251	cold	angry	TOP	300	HF	11	Con	Neg	T
252	hotel	fear	TOP	300	HF	12	Con	Neg	T
253	rough	anger	TOP	300	HF	13	Con	Neg	T
254	stiff	hate	TOP	300	HF	14	Con	Neg	T
255	bench	burn	TOP	300	HF	15	Con	Neg	T
256	coast	abuse	TOP	300	HF	16	Con	Neg	T
257	paint	victim	TOP	300	HF	17	Con	Neg	T
258	watch	afraid	TOP	300	HF	18	Con	Neg	T
259	excuse	tense	TOP	300	HF	19	Con	Neg	T
260	fabric	horror	TOP	300	HF	20	Con	Neg	T
261	glass	trouble	TOP	300	HF	21	Con	Neg	T
262	manner	cancer	TOP	300	HF	22	Con	Neg	T
263	patient	guilty	TOP	300	HF	23	Con	Neg	T
264	yellow	bloody	TOP	300	HF	24	Con	Neg	T
265	detail	danger	TOP	300	HF	25	Con	Neg	T
266	journal	panic	TOP	300	HF	26	Con	Neg	T
267	writer	sugery	TOP	300	HF	27	Con	Neg	T

268	gender	tragedy	TOP	300	HF	28	Con	Neg	T
269	market	pressure	TOP	300	HF	29	Con	Neg	T
270	shadow	assault	TOP	300	HF	30	Con	Neg	T
271	teacher	stress	TOP	300	HF	31	Con	Neg	T
272	avenue	confused	TOP	300	HF	32	Con	Neg	T
273	contents	violent	TOP	300	HF	33	Con	Neg	T
274	medicine	divorce	TOP	300	HF	34	Con	Neg	T
275	village	accident	TOP	300	HF	35	Con	Neg	T
276	context	rejected	TOP	300	HF	36	Con	Neg	T
277	material	nervous	TOP	300	HF	37	Con	Neg	T
278	passage	disaster	TOP	300	HF	38	Con	Neg	T
279	reserved	suspicious	TOP	300	HF	39	Con	Neg	T
280	concentrate	controlling	TOP	300	HF	40	Con	Neg	T
281	odd	mad	BOTTOM	300	HF	1	Neg	Con	B
282	book	war	BOTTOM	300	HF	2	Neg	Con	B
283	iron	gun	BOTTOM	300	HF	3	Neg	Con	B
284	army	fire	BOTTOM	300	HF	4	Neg	Con	B
285	bowl	evil	BOTTOM	300	HF	5	Neg	Con	B
286	rock	pain	BOTTOM	300	HF	6	Neg	Con	B
287	tool	rape	BOTTOM	300	HF	7	Neg	Con	B
288	wine	fight	BOTTOM	300	HF	8	Neg	Con	B
289	hide	crash	BOTTOM	300	HF	9	Neg	Con	B
290	clock	bomb	BOTTOM	300	HF	10	Neg	Con	B
291	cold	angry	BOTTOM	300	HF	11	Neg	Con	B
292	hotel	fear	BOTTOM	300	HF	12	Neg	Con	B
293	rough	anger	BOTTOM	300	HF	13	Neg	Con	B
294	stiff	hate	BOTTOM	300	HF	14	Neg	Con	B
295	bench	burn	BOTTOM	300	HF	15	Neg	Con	B
296	coast	abuse	BOTTOM	300	HF	16	Neg	Con	B
297	paint	victim	BOTTOM	300	HF	17	Neg	Con	B
298	watch	afraid	BOTTOM	300	HF	18	Neg	Con	B
299	excuse	tense	BOTTOM	300	HF	19	Neg	Con	B
300	fabric	horror	BOTTOM	300	HF	20	Neg	Con	B
301	glass	trouble	BOTTOM	300	HF	21	Neg	Con	B
302	manner	cancer	BOTTOM	300	HF	22	Neg	Con	B
303	patient	guilty	BOTTOM	300	HF	23	Neg	Con	B
304	yellow	bloody	BOTTOM	300	HF	24	Neg	Con	B
305	detail	danger	BOTTOM	300	HF	25	Neg	Con	B
306	journal	panic	BOTTOM	300	HF	26	Neg	Con	B
307	writer	sugery	BOTTOM	300	HF	27	Neg	Con	B
308	gender	tragedy	BOTTOM	300	HF	28	Neg	Con	B
309	market	pressure	BOTTOM	300	HF	29	Neg	Con	B
310	shadow	assault	BOTTOM	300	HF	30	Neg	Con	B
311	teacher	stress	BOTTOM	300	HF	31	Neg	Con	B
312	avenue	confused	BOTTOM	300	HF	32	Neg	Con	B
313	contents	violent	BOTTOM	300	HF	33	Neg	Con	B
314	medicine	divorce	BOTTOM	300	HF	34	Neg	Con	B
315	village	accident	BOTTOM	300	HF	35	Neg	Con	B
316	context	rejected	BOTTOM	300	HF	36	Neg	Con	B
317	material	nervous	BOTTOM	300	HF	37	Neg	Con	B
318	passage	disaster	BOTTOM	300	HF	38	Neg	Con	B
319	reserved	suspicious	BOTTOM	300	HF	39	Neg	Con	B
320	concentrate	controlling	BOTTOM	300	HF	40	Neg	Con	B
321	fun	mad	TOP	300	HF	1	Pos	Neg	T

322	car	war	TOP	300	HF	2	Pos	Neg	T
323	joy	gun	TOP	300	HF	3	Pos	Neg	T
324	win	fire	TOP	300	HF	4	Pos	Neg	T
325	gift	evil	TOP	300	HF	5	Pos	Neg	T
326	cash	pain	TOP	300	HF	6	Pos	Neg	T
327	joke	rape	TOP	300	HF	7	Pos	Neg	T
328	sex	fight	TOP	300	HF	8	Pos	Neg	T
329	kiss	crash	TOP	300	HF	9	Pos	Neg	T
330	plane	bomb	TOP	300	HF	10	Pos	Neg	T
331	happy	angry	TOP	300	HF	11	Pos	Neg	T
332	heart	fear	TOP	300	HF	12	Pos	Neg	T
333	song	anger	TOP	300	HF	13	Pos	Neg	T
334	brave	hate	TOP	300	HF	14	Pos	Neg	T
335	talent	burn	TOP	300	HF	15	Pos	Neg	T
336	quick	abuse	TOP	300	HF	16	Pos	Neg	T
337	lucky	victim	TOP	300	HF	17	Pos	Neg	T
338	couple	afraid	TOP	300	HF	18	Pos	Neg	T
339	engaged	tense	TOP	300	HF	19	Pos	Neg	T
340	rescue	horror	TOP	300	HF	20	Pos	Neg	T
341	leader	trouble	TOP	300	HF	21	Pos	Neg	T
342	travel	cancer	TOP	300	HF	22	Pos	Neg	T
343	loved	guilty	TOP	300	HF	23	Pos	Neg	T
344	pretty	bloody	TOP	300	HF	24	Pos	Neg	T
345	holiday	danger	TOP	300	HF	25	Pos	Neg	T
346	passion	panic	TOP	300	HF	26	Pos	Neg	T
347	desire	sugery	TOP	300	HF	27	Pos	Neg	T
348	inspired	tragedy	TOP	300	HF	28	Pos	Neg	T
349	success	pressure	TOP	300	HF	29	Pos	Neg	T
350	memories	assault	TOP	300	HF	30	Pos	Neg	T
351	progress	stress	TOP	300	HF	31	Pos	Neg	T
352	laughter	confused	TOP	300	HF	32	Pos	Neg	T
353	romantic	violent	TOP	300	HF	33	Pos	Neg	T
354	birthday	divorce	TOP	300	HF	34	Pos	Neg	T
355	exercise	accident	TOP	300	HF	35	Pos	Neg	T
356	surpised	rejected	TOP	300	HF	36	Pos	Neg	T
357	beautiful	nervous	TOP	300	HF	37	Pos	Neg	T
358	promotion	disaster	TOP	300	HF	38	Pos	Neg	T
359	confident	suspicious	TOP	300	HF	39	Pos	Neg	T
360	excitement	controlling	TOP	300	HF	40	Pos	Neg	T
361	fun	mad	BOTTOM	300	HF	1	Neg	Pos	B
362	car	war	BOTTOM	300	HF	2	Neg	Pos	B
363	joy	gun	BOTTOM	300	HF	3	Neg	Pos	B
364	win	fire	BOTTOM	300	HF	4	Neg	Pos	B
365	gift	evil	BOTTOM	300	HF	5	Neg	Pos	B
366	cash	pain	BOTTOM	300	HF	6	Neg	Pos	B
367	joke	rape	BOTTOM	300	HF	7	Neg	Pos	B
368	sex	fight	BOTTOM	300	HF	8	Neg	Pos	B
369	kiss	crash	BOTTOM	300	HF	9	Neg	Pos	B
370	plane	bomb	BOTTOM	300	HF	10	Neg	Pos	B
371	happy	angry	BOTTOM	300	HF	11	Neg	Pos	B
372	heart	fear	BOTTOM	300	HF	12	Neg	Pos	B
373	song	anger	BOTTOM	300	HF	13	Neg	Pos	B
374	brave	hate	BOTTOM	300	HF	14	Neg	Pos	B
375	talent	burn	BOTTOM	300	HF	15	Neg	Pos	B

376	quick	abuse	BOTTOM	300	HF	16	Neg	Pos	B
377	lucky	victim	BOTTOM	300	HF	17	Neg	Pos	B
378	couple	afraid	BOTTOM	300	HF	18	Neg	Pos	B
379	engaged	tense	BOTTOM	300	HF	19	Neg	Pos	B
380	rescue	horror	BOTTOM	300	HF	20	Neg	Pos	B
381	leader	trouble	BOTTOM	300	HF	21	Neg	Pos	B
382	travel	cancer	BOTTOM	300	HF	22	Neg	Pos	B
383	loved	guilty	BOTTOM	300	HF	23	Neg	Pos	B
384	pretty	bloody	BOTTOM	300	HF	24	Neg	Pos	B
385	holiday	danger	BOTTOM	300	HF	25	Neg	Pos	B
386	passion	panic	BOTTOM	300	HF	26	Neg	Pos	B
387	desire	sugery	BOTTOM	300	HF	27	Neg	Pos	B
388	inspired	tragedy	BOTTOM	300	HF	28	Neg	Pos	B
389	success	pressure	BOTTOM	300	HF	29	Neg	Pos	B
390	memories	assault	BOTTOM	300	HF	30	Neg	Pos	B
391	progress	stress	BOTTOM	300	HF	31	Neg	Pos	B
392	laughter	confused	BOTTOM	300	HF	32	Neg	Pos	B
393	romantic	violent	BOTTOM	300	HF	33	Neg	Pos	B
394	birthday	divorce	BOTTOM	300	HF	34	Neg	Pos	B
395	exercise	accident	BOTTOM	300	HF	35	Neg	Pos	B
396	surpised	rejected	BOTTOM	300	HF	36	Neg	Pos	B
397	beautiful	nervous	BOTTOM	300	HF	37	Neg	Pos	B
398	promotion	disaster	BOTTOM	300	HF	38	Neg	Pos	B
399	confident	suspicious	BOTTOM	300	HF	39	Neg	Pos	B
400	excitement	controlling	BOTTOM	300	HF	40	Neg	Pos	B
401	mad	fun	TOP	300	HF	1	Neg	Pos	T
402	war	car	TOP	300	HF	2	Neg	Pos	T
403	gun	joy	TOP	300	HF	3	Neg	Pos	T
404	fire	win	TOP	300	HF	4	Neg	Pos	T
405	evil	gift	TOP	300	HF	5	Neg	Pos	T
406	pain	cash	TOP	300	HF	6	Neg	Pos	T
407	rape	joke	TOP	300	HF	7	Neg	Pos	T
408	fight	sex	TOP	300	HF	8	Neg	Pos	T
409	crash	kiss	TOP	300	HF	9	Neg	Pos	T
410	bomb	plane	TOP	300	HF	10	Neg	Pos	T
411	angry	happy	TOP	300	HF	11	Neg	Pos	T
412	fear	heart	TOP	300	HF	12	Neg	Pos	T
413	anger	song	TOP	300	HF	13	Neg	Pos	T
414	hate	brave	TOP	300	HF	14	Neg	Pos	T
415	burn	talent	TOP	300	HF	15	Neg	Pos	T
416	abuse	quick	TOP	300	HF	16	Neg	Pos	T
417	victim	lucky	TOP	300	HF	17	Neg	Pos	T
418	afraid	couple	TOP	300	HF	18	Neg	Pos	T
419	tense	engaged	TOP	300	HF	19	Neg	Pos	T
420	horror	rescue	TOP	300	HF	20	Neg	Pos	T
421	trouble	leader	TOP	300	HF	21	Neg	Pos	T
422	cancer	travel	TOP	300	HF	22	Neg	Pos	T
423	guilty	loved	TOP	300	HF	23	Neg	Pos	T
424	bloody	pretty	TOP	300	HF	24	Neg	Pos	T
425	danger	holiday	TOP	300	HF	25	Neg	Pos	T
426	panic	passion	TOP	300	HF	26	Neg	Pos	T
427	sugery	desire	TOP	300	HF	27	Neg	Pos	T
428	tragedy	inspired	TOP	300	HF	28	Neg	Pos	T
429	pressure	success	TOP	300	HF	29	Neg	Pos	T

430	assault	memories	TOP	300	HF	30	Neg	Pos	T
431	stress	progress	TOP	300	HF	31	Neg	Pos	T
432	confused	laughter	TOP	300	HF	32	Neg	Pos	T
433	violent	romantic	TOP	300	HF	33	Neg	Pos	T
434	divorce	birthday	TOP	300	HF	34	Neg	Pos	T
435	accident	exercise	TOP	300	HF	35	Neg	Pos	T
436	rejected	surpised	TOP	300	HF	36	Neg	Pos	T
437	nervous	beautiful	TOP	300	HF	37	Neg	Pos	T
438	disaster	promotion	TOP	300	HF	38	Neg	Pos	T
439	suspicious	confident	TOP	300	HF	39	Neg	Pos	T
440	controlling	excitement	TOP	300	HF	40	Neg	Pos	T
441	mad	fun	BOTTOM	300	HF	1	Pos	Neg	B
442	war	car	BOTTOM	300	HF	2	Pos	Neg	B
443	gun	joy	BOTTOM	300	HF	3	Pos	Neg	B
444	fire	win	BOTTOM	300	HF	4	Pos	Neg	B
445	evil	gift	BOTTOM	300	HF	5	Pos	Neg	B
446	pain	cash	BOTTOM	300	HF	6	Pos	Neg	B
447	rape	joke	BOTTOM	300	HF	7	Pos	Neg	B
448	fight	sex	BOTTOM	300	HF	8	Pos	Neg	B
449	crash	kiss	BOTTOM	300	HF	9	Pos	Neg	B
450	bomb	plane	BOTTOM	300	HF	10	Pos	Neg	B
451	angry	happy	BOTTOM	300	HF	11	Pos	Neg	B
452	fear	heart	BOTTOM	300	HF	12	Pos	Neg	B
453	anger	song	BOTTOM	300	HF	13	Pos	Neg	B
454	hate	brave	BOTTOM	300	HF	14	Pos	Neg	B
455	burn	talent	BOTTOM	300	HF	15	Pos	Neg	B
456	abuse	quick	BOTTOM	300	HF	16	Pos	Neg	B
457	victim	lucky	BOTTOM	300	HF	17	Pos	Neg	B
458	afraid	couple	BOTTOM	300	HF	18	Pos	Neg	B
459	tense	engaged	BOTTOM	300	HF	19	Pos	Neg	B
460	horror	rescue	BOTTOM	300	HF	20	Pos	Neg	B
461	trouble	leader	BOTTOM	300	HF	21	Pos	Neg	B
462	cancer	travel	BOTTOM	300	HF	22	Pos	Neg	B
463	guilty	loved	BOTTOM	300	HF	23	Pos	Neg	B
464	bloody	pretty	BOTTOM	300	HF	24	Pos	Neg	B
465	danger	holiday	BOTTOM	300	HF	25	Pos	Neg	B
466	panic	passion	BOTTOM	300	HF	26	Pos	Neg	B
467	sugery	desire	BOTTOM	300	HF	27	Pos	Neg	B
468	tragedy	inspired	BOTTOM	300	HF	28	Pos	Neg	B
469	pressure	success	BOTTOM	300	HF	29	Pos	Neg	B
470	assault	memories	BOTTOM	300	HF	30	Pos	Neg	B
471	stress	progress	BOTTOM	300	HF	31	Pos	Neg	B
472	confused	laughter	BOTTOM	300	HF	32	Pos	Neg	B
473	violent	romantic	BOTTOM	300	HF	33	Pos	Neg	B
474	divorce	birthday	BOTTOM	300	HF	34	Pos	Neg	B
475	accident	exercise	BOTTOM	300	HF	35	Pos	Neg	B
476	rejected	surpised	BOTTOM	300	HF	36	Pos	Neg	B
477	nervous	beautiful	BOTTOM	300	HF	37	Pos	Neg	B
478	disaster	promotion	BOTTOM	300	HF	38	Pos	Neg	B
479	suspicious	confident	BOTTOM	300	HF	39	Pos	Neg	B
480	controlling	excitement	BOTTOM	300	HF	40	Pos	Neg	B
481	lust	cane	TOP	300	LF	41	Pos	Con	T
482	nude	hawk	TOP	300	LF	42	Pos	Con	T
483	sexy	muddy	TOP	300	LF	43	Pos	Con	T

484	fame	truck	TOP	300	LF	44	Pos	Con	T
485	alert	lump	TOP	300	LF	45	Pos	Con	T
486	glory	alien	TOP	300	LF	46	Pos	Con	T
487	thrill	boxer	TOP	300	LF	47	Pos	Con	T
488	champ	swamp	TOP	300	LF	48	Pos	Con	T
489	cheer	trunk	TOP	300	LF	49	Pos	Con	T
490	flirt	rattle	TOP	300	LF	50	Pos	Con	T
491	erotic	clumsy	TOP	300	LF	51	Pos	Con	T
492	dollar	invest	TOP	300	LF	52	Pos	Con	T
493	dazzle	limber	TOP	300	LF	53	Pos	Con	T
494	casino	mystic	TOP	300	LF	54	Pos	Con	T
495	riches	salute	TOP	300	LF	55	Pos	Con	T
496	aroused	spray	TOP	300	LF	56	Pos	Con	T
497	dancer	vanity	TOP	300	LF	57	Pos	Con	T
498	admired	hammer	TOP	300	LF	58	Pos	Con	T
499	elated	icebox	TOP	300	LF	59	Pos	Con	T
500	miracle	insect	TOP	300	LF	60	Pos	Con	T
501	terrific	coarse	TOP	300	LF	61	Pos	Con	T
502	orgasm	ketchup	TOP	300	LF	62	Pos	Con	T
503	intimate	custom	TOP	300	LF	63	Pos	Con	T
504	treasure	highway	TOP	300	LF	64	Pos	Con	T
505	ecstacy	radiator	TOP	300	LF	65	Pos	Con	T
506	reunion	trumpet	TOP	300	LF	66	Pos	Con	T
507	sunlight	whistle	TOP	300	LF	67	Pos	Con	T
508	graduate	privacy	TOP	300	LF	68	Pos	Con	T
509	festive	repentant	TOP	300	LF	69	Pos	Con	T
510	adventure	nursery	TOP	300	LF	70	Pos	Con	T
511	fireworks	scissors	TOP	300	LF	71	Pos	Con	T
512	affection	nonsense	TOP	300	LF	72	Pos	Con	T
513	athletics	pamphlet	TOP	300	LF	73	Pos	Con	T
514	valentine	appliance	TOP	300	LF	74	Pos	Con	T
515	intercourse	sheltered	TOP	300	LF	75	Pos	Con	T
516	infatuation	sceptical	TOP	300	LF	76	Pos	Con	T
517	astonished	sentiment	TOP	300	LF	77	Pos	Con	T
518	triumphant	nonchalant	TOP	300	LF	78	Pos	Con	T
519	millionaire	thermometer	TOP	300	LF	79	Pos	Con	T
520	rollercoaster	lighthouse	TOP	300	LF	80	Pos	Con	T
521	cane	lust	BOTTOM	300	LF	41	Con	Pos	B
522	hawk	nude	BOTTOM	300	LF	42	Con	Pos	B
523	muddy	sexy	BOTTOM	300	LF	43	Con	Pos	B
524	truck	fame	BOTTOM	300	LF	44	Con	Pos	B
525	lump	alert	BOTTOM	300	LF	45	Con	Pos	B
526	alien	glory	BOTTOM	300	LF	46	Con	Pos	B
527	boxer	thrill	BOTTOM	300	LF	47	Con	Pos	B
528	swamp	champ	BOTTOM	300	LF	48	Con	Pos	B
529	trunk	cheer	BOTTOM	300	LF	49	Con	Pos	B
530	rattle	flirt	BOTTOM	300	LF	50	Con	Pos	B
531	clumsy	erotic	BOTTOM	300	LF	51	Con	Pos	B
532	invest	dollar	BOTTOM	300	LF	52	Con	Pos	B
533	limber	dazzle	BOTTOM	300	LF	53	Con	Pos	B
534	mystic	casino	BOTTOM	300	LF	54	Con	Pos	B
535	salute	riches	BOTTOM	300	LF	55	Con	Pos	B
536	spray	aroused	BOTTOM	300	LF	56	Con	Pos	B
537	vanity	dancer	BOTTOM	300	LF	57	Con	Pos	B

538	hammer	admired	BOTTOM	300	LF	58	Con	Pos	B
539	icebox	elated	BOTTOM	300	LF	59	Con	Pos	B
540	insect	miracle	BOTTOM	300	LF	60	Con	Pos	B
541	coarse	terrific	BOTTOM	300	LF	61	Con	Pos	B
542	ketchup	orgasm	BOTTOM	300	LF	62	Con	Pos	B
543	custom	intimate	BOTTOM	300	LF	63	Con	Pos	B
544	highway	treasure	BOTTOM	300	LF	64	Con	Pos	B
545	radiator	ecstacy	BOTTOM	300	LF	65	Con	Pos	B
546	trumpet	reunion	BOTTOM	300	LF	66	Con	Pos	B
547	whistle	sunlight	BOTTOM	300	LF	67	Con	Pos	B
548	privacy	graduate	BOTTOM	300	LF	68	Con	Pos	B
549	repentant	festive	BOTTOM	300	LF	69	Con	Pos	B
550	nursery	adventure	BOTTOM	300	LF	70	Con	Pos	B
551	scissors	fireworks	BOTTOM	300	LF	71	Con	Pos	B
552	nonsense	affection	BOTTOM	300	LF	72	Con	Pos	B
553	pamphlet	athletics	BOTTOM	300	LF	73	Con	Pos	B
554	appliance	valentine	BOTTOM	300	LF	74	Con	Pos	B
555	sheltered	intercourse	BOTTOM	300	LF	75	Con	Pos	B
556	sceptical	infatuation	BOTTOM	300	LF	76	Con	Pos	B
557	sentiment	astonished	BOTTOM	300	LF	77	Con	Pos	B
558	nonchalant	triumphant	BOTTOM	300	LF	78	Con	Pos	B
559	thermometer	millionaire	BOTTOM	300	LF	79	Con	Pos	B
560	lighthouse	rollercoaster	BOTTOM	300	LF	80	Con	Pos	B
561	cane	lust	TOP	300	LF	41	Con	Pos	T
562	hawk	nude	TOP	300	LF	42	Con	Pos	T
563	muddy	sexy	TOP	300	LF	43	Con	Pos	T
564	truck	fame	TOP	300	LF	44	Con	Pos	T
565	lump	alert	TOP	300	LF	45	Con	Pos	T
566	alien	glory	TOP	300	LF	46	Con	Pos	T
567	boxer	thrill	TOP	300	LF	47	Con	Pos	T
568	swamp	champ	TOP	300	LF	48	Con	Pos	T
569	trunk	cheer	TOP	300	LF	49	Con	Pos	T
570	rattle	flirt	TOP	300	LF	50	Con	Pos	T
571	clumsy	erotic	TOP	300	LF	51	Con	Pos	T
572	invest	dollar	TOP	300	LF	52	Con	Pos	T
573	limber	dazzle	TOP	300	LF	53	Con	Pos	T
574	mystic	casino	TOP	300	LF	54	Con	Pos	T
575	salute	riches	TOP	300	LF	55	Con	Pos	T
576	spray	aroused	TOP	300	LF	56	Con	Pos	T
577	vanity	dancer	TOP	300	LF	57	Con	Pos	T
578	hammer	admired	TOP	300	LF	58	Con	Pos	T
579	icebox	elated	TOP	300	LF	59	Con	Pos	T
580	insect	miracle	TOP	300	LF	60	Con	Pos	T
581	coarse	terrific	TOP	300	LF	61	Con	Pos	T
582	ketchup	orgasm	TOP	300	LF	62	Con	Pos	T
583	custom	intimate	TOP	300	LF	63	Con	Pos	T
584	highway	treasure	TOP	300	LF	64	Con	Pos	T
585	radiator	ecstacy	TOP	300	LF	65	Con	Pos	T
586	trumpet	reunion	TOP	300	LF	66	Con	Pos	T
587	whistle	sunlight	TOP	300	LF	67	Con	Pos	T
588	privacy	graduate	TOP	300	LF	68	Con	Pos	T
589	repentant	festive	TOP	300	LF	69	Con	Pos	T
590	nursery	adventure	TOP	300	LF	70	Con	Pos	T
591	scissors	fireworks	TOP	300	LF	71	Con	Pos	T

592	nonsense	affection	TOP	300	LF	72	Con	Pos	T
593	pamphlet	athletics	TOP	300	LF	73	Con	Pos	T
594	appliance	valentine	TOP	300	LF	74	Con	Pos	T
595	sheltered	intercourse	TOP	300	LF	75	Con	Pos	T
596	sceptical	infatuation	TOP	300	LF	76	Con	Pos	T
597	sentiment	astonished	TOP	300	LF	77	Con	Pos	T
598	nonchalant	triumphant	TOP	300	LF	78	Con	Pos	T
599	thermometer	millionaire	TOP	300	LF	79	Con	Pos	T
600	lighthouse	rollercoaster	TOP	300	LF	80	Con	Pos	T
601	lust	cane	BOTTOM	300	LF	41	Pos	Con	B
602	nude	hawk	BOTTOM	300	LF	42	Pos	Con	B
603	sexy	muddy	BOTTOM	300	LF	43	Pos	Con	B
604	fame	truck	BOTTOM	300	LF	44	Pos	Con	B
605	alert	lump	BOTTOM	300	LF	45	Pos	Con	B
606	glory	alien	BOTTOM	300	LF	46	Pos	Con	B
607	thrill	boxer	BOTTOM	300	LF	47	Pos	Con	B
608	champ	swamp	BOTTOM	300	LF	48	Pos	Con	B
609	cheer	trunk	BOTTOM	300	LF	49	Pos	Con	B
610	flirt	rattle	BOTTOM	300	LF	50	Pos	Con	B
611	erotic	clumsy	BOTTOM	300	LF	51	Pos	Con	B
612	dollar	invest	BOTTOM	300	LF	52	Pos	Con	B
613	dazzle	limber	BOTTOM	300	LF	53	Pos	Con	B
614	casino	mystic	BOTTOM	300	LF	54	Pos	Con	B
615	riches	salute	BOTTOM	300	LF	55	Pos	Con	B
616	aroused	spray	BOTTOM	300	LF	56	Pos	Con	B
617	dancer	vanity	BOTTOM	300	LF	57	Pos	Con	B
618	admired	hammer	BOTTOM	300	LF	58	Pos	Con	B
619	elated	icebox	BOTTOM	300	LF	59	Pos	Con	B
620	miracle	insect	BOTTOM	300	LF	60	Pos	Con	B
621	terrific	coarse	BOTTOM	300	LF	61	Pos	Con	B
622	orgasm	ketchup	BOTTOM	300	LF	62	Pos	Con	B
623	intimate	custom	BOTTOM	300	LF	63	Pos	Con	B
624	treasure	highway	BOTTOM	300	LF	64	Pos	Con	B
625	ecstacy	radiator	BOTTOM	300	LF	65	Pos	Con	B
626	reunion	trumpet	BOTTOM	300	LF	66	Pos	Con	B
627	sunlight	whistle	BOTTOM	300	LF	67	Pos	Con	B
628	graduate	privacy	BOTTOM	300	LF	68	Pos	Con	B
629	festive	repentant	BOTTOM	300	LF	69	Pos	Con	B
630	adventure	nursery	BOTTOM	300	LF	70	Pos	Con	B
631	fireworks	scissors	BOTTOM	300	LF	71	Pos	Con	B
632	affection	nonsense	BOTTOM	300	LF	72	Pos	Con	B
633	athletics	pamphlet	BOTTOM	300	LF	73	Pos	Con	B
634	valentine	appliance	BOTTOM	300	LF	74	Pos	Con	B
635	intercourse	sheltered	BOTTOM	300	LF	75	Pos	Con	B
636	infatuation	sceptical	BOTTOM	300	LF	76	Pos	Con	B
637	astonished	sentiment	BOTTOM	300	LF	77	Pos	Con	B
638	triumphant	nonchalant	BOTTOM	300	LF	78	Pos	Con	B
639	millionaire	thermometer	BOTTOM	300	LF	79	Pos	Con	B
640	rollercoaster	lighthouse	BOTTOM	300	LF	80	Pos	Con	B
641	shark	cane	TOP	300	LF	41	Neg	Con	T
642	demon	hawk	TOP	300	LF	42	Neg	Con	T
643	rude	muddy	TOP	300	LF	43	Neg	Con	T
644	rage	truck	TOP	300	LF	44	Neg	Con	T
645	toxic	lump	TOP	300	LF	45	Neg	Con	T

646	devil	alien	TOP	300	LF	46	Neg	Con	T
647	slap	boxer	TOP	300	LF	47	Neg	Con	T
648	venom	swamp	TOP	300	LF	48	Neg	Con	T
649	snake	trunk	TOP	300	LF	49	Neg	Con	T
650	annoy	rattle	TOP	300	LF	50	Neg	Con	T
651	sinful	clumsy	TOP	300	LF	51	Neg	Con	T
652	killer	invest	TOP	300	LF	52	Neg	Con	T
653	detest	limber	TOP	300	LF	53	Neg	Con	T
654	tumour	mystic	TOP	300	LF	54	Neg	Con	T
655	betray	salute	TOP	300	LF	55	Neg	Con	T
656	scared	spray	TOP	300	LF	56	Neg	Con	T
657	insult	vanity	TOP	300	LF	57	Neg	Con	T
658	hatred	hammer	TOP	300	LF	58	Neg	Con	T
659	leprosy	icebox	TOP	300	LF	59	Neg	Con	T
660	poison	insect	TOP	300	LF	60	Neg	Con	T
661	wicked	coarse	TOP	300	LF	61	Neg	Con	T
662	pervert	ketchup	TOP	300	LF	62	Neg	Con	T
663	destroy	custom	TOP	300	LF	63	Neg	Con	T
664	torture	highway	TOP	300	LF	64	Neg	Con	T
665	outrage	radiator	TOP	300	LF	65	Neg	Con	T
666	intruder	trumpet	TOP	300	LF	66	Neg	Con	T
667	hostile	whistle	TOP	300	LF	67	Neg	Con	T
668	terrified	privacy	TOP	300	LF	68	Neg	Con	T
669	disloyal	repentant	TOP	300	LF	69	Neg	Con	T
670	ambulance	nursery	TOP	300	LF	70	Neg	Con	T
671	assassin	scissors	TOP	300	LF	71	Neg	Con	T
672	nightmare	nonsense	TOP	300	LF	72	Neg	Con	T
673	slaughter	pamphlet	TOP	300	LF	73	Neg	Con	T
674	humiliate	appliance	TOP	300	LF	74	Neg	Con	T
675	jealousy	sheltered	TOP	300	LF	75	Neg	Con	T
676	cockroach	sceptical	TOP	300	LF	76	Neg	Con	T
677	distressed	sentiment	TOP	300	LF	77	Neg	Con	T
678	unfaithful	nonchalant	TOP	300	LF	78	Neg	Con	T
679	hurricane	thermometer	TOP	300	LF	79	Neg	Con	T
680	suffocate	lighthouse	TOP	300	LF	80	Neg	Con	T
681	cane	shark	BOTTOM	300	LF	41	Con	Neg	B
682	hawk	demon	BOTTOM	300	LF	42	Con	Neg	B
683	muddy	rude	BOTTOM	300	LF	43	Con	Neg	B
684	truck	rage	BOTTOM	300	LF	44	Con	Neg	B
685	lump	toxic	BOTTOM	300	LF	45	Con	Neg	B
686	alien	devil	BOTTOM	300	LF	46	Con	Neg	B
687	boxer	slap	BOTTOM	300	LF	47	Con	Neg	B
688	swamp	venom	BOTTOM	300	LF	48	Con	Neg	B
689	trunk	snake	BOTTOM	300	LF	49	Con	Neg	B
690	rattle	annoy	BOTTOM	300	LF	50	Con	Neg	B
691	clumsy	sinful	BOTTOM	300	LF	51	Con	Neg	B
692	invest	killer	BOTTOM	300	LF	52	Con	Neg	B
693	limber	detest	BOTTOM	300	LF	53	Con	Neg	B
694	mystic	tumour	BOTTOM	300	LF	54	Con	Neg	B
695	salute	betray	BOTTOM	300	LF	55	Con	Neg	B
696	spray	scared	BOTTOM	300	LF	56	Con	Neg	B
697	vanity	insult	BOTTOM	300	LF	57	Con	Neg	B
698	hammer	hatred	BOTTOM	300	LF	58	Con	Neg	B
699	icebox	leprosy	BOTTOM	300	LF	59	Con	Neg	B

700	insect	poison	BOTTOM	300	LF	60	Con	Neg	B
701	coarse	wicked	BOTTOM	300	LF	61	Con	Neg	B
702	ketchup	pervert	BOTTOM	300	LF	62	Con	Neg	B
703	custom	destroy	BOTTOM	300	LF	63	Con	Neg	B
704	highway	torture	BOTTOM	300	LF	64	Con	Neg	B
705	radiator	outrage	BOTTOM	300	LF	65	Con	Neg	B
706	trumpet	intruder	BOTTOM	300	LF	66	Con	Neg	B
707	whistle	hostile	BOTTOM	300	LF	67	Con	Neg	B
708	privacy	terrified	BOTTOM	300	LF	68	Con	Neg	B
709	repentant	disloyal	BOTTOM	300	LF	69	Con	Neg	B
710	nursery	ambulance	BOTTOM	300	LF	70	Con	Neg	B
711	scissors	assassin	BOTTOM	300	LF	71	Con	Neg	B
712	nonsense	nightmare	BOTTOM	300	LF	72	Con	Neg	B
713	pamphlet	slaughter	BOTTOM	300	LF	73	Con	Neg	B
714	appliance	humiliate	BOTTOM	300	LF	74	Con	Neg	B
715	sheltered	jealousy	BOTTOM	300	LF	75	Con	Neg	B
716	sceptical	cockroach	BOTTOM	300	LF	76	Con	Neg	B
717	sentiment	distressed	BOTTOM	300	LF	77	Con	Neg	B
718	nonchalant	unfaithful	BOTTOM	300	LF	78	Con	Neg	B
719	thermometer	hurricane	BOTTOM	300	LF	79	Con	Neg	B
720	lighthouse	suffocate	BOTTOM	300	LF	80	Con	Neg	B
721	cane	shark	TOP	300	LF	41	Con	Neg	T
722	hawk	demon	TOP	300	LF	42	Con	Neg	T
723	muddy	rude	TOP	300	LF	43	Con	Neg	T
724	truck	rage	TOP	300	LF	44	Con	Neg	T
725	lump	toxic	TOP	300	LF	45	Con	Neg	T
726	alien	devil	TOP	300	LF	46	Con	Neg	T
727	boxer	slap	TOP	300	LF	47	Con	Neg	T
728	swamp	venom	TOP	300	LF	48	Con	Neg	T
729	trunk	snake	TOP	300	LF	49	Con	Neg	T
730	rattle	annoy	TOP	300	LF	50	Con	Neg	T
731	clumsy	sinful	TOP	300	LF	51	Con	Neg	T
732	invest	killer	TOP	300	LF	52	Con	Neg	T
733	limber	detest	TOP	300	LF	53	Con	Neg	T
734	mystic	tumour	TOP	300	LF	54	Con	Neg	T
735	salute	betray	TOP	300	LF	55	Con	Neg	T
736	spray	scared	TOP	300	LF	56	Con	Neg	T
737	vanity	insult	TOP	300	LF	57	Con	Neg	T
738	hammer	hatred	TOP	300	LF	58	Con	Neg	T
739	icebox	leprosy	TOP	300	LF	59	Con	Neg	T
740	insect	poison	TOP	300	LF	60	Con	Neg	T
741	coarse	wicked	TOP	300	LF	61	Con	Neg	T
742	ketchup	pervert	TOP	300	LF	62	Con	Neg	T
743	custom	destroy	TOP	300	LF	63	Con	Neg	T
744	highway	torture	TOP	300	LF	64	Con	Neg	T
745	radiator	outrage	TOP	300	LF	65	Con	Neg	T
746	trumpet	intruder	TOP	300	LF	66	Con	Neg	T
747	whistle	hostile	TOP	300	LF	67	Con	Neg	T
748	privacy	terrified	TOP	300	LF	68	Con	Neg	T
749	repentant	disloyal	TOP	300	LF	69	Con	Neg	T
750	nursery	ambulance	TOP	300	LF	70	Con	Neg	T
751	scissors	assassin	TOP	300	LF	71	Con	Neg	T
752	nonsense	nightmare	TOP	300	LF	72	Con	Neg	T
753	pamphlet	slaughter	TOP	300	LF	73	Con	Neg	T

754	appliance	humiliate	TOP	300	LF	74	Con	Neg	T
755	sheltered	jealousy	TOP	300	LF	75	Con	Neg	T
756	sceptical	cockroach	TOP	300	LF	76	Con	Neg	T
757	sentiment	distressed	TOP	300	LF	77	Con	Neg	T
758	nonchalant	unfaithful	TOP	300	LF	78	Con	Neg	T
759	thermometer	hurricane	TOP	300	LF	79	Con	Neg	T
760	lighthouse	suffocate	TOP	300	LF	80	Con	Neg	T
761	shark	cane	BOTTOM	300	LF	41	Neg	Con	B
762	demon	hawk	BOTTOM	300	LF	42	Neg	Con	B
763	rude	muddy	BOTTOM	300	LF	43	Neg	Con	B
764	rage	truck	BOTTOM	300	LF	44	Neg	Con	B
765	toxic	lump	BOTTOM	300	LF	45	Neg	Con	B
766	devil	alien	BOTTOM	300	LF	46	Neg	Con	B
767	slap	boxer	BOTTOM	300	LF	47	Neg	Con	B
768	venom	swamp	BOTTOM	300	LF	48	Neg	Con	B
769	snake	trunk	BOTTOM	300	LF	49	Neg	Con	B
770	annoy	rattle	BOTTOM	300	LF	50	Neg	Con	B
771	sinful	clumsy	BOTTOM	300	LF	51	Neg	Con	B
772	killer	invest	BOTTOM	300	LF	52	Neg	Con	B
773	detest	limber	BOTTOM	300	LF	53	Neg	Con	B
774	tumour	mystic	BOTTOM	300	LF	54	Neg	Con	B
775	betray	salute	BOTTOM	300	LF	55	Neg	Con	B
776	scared	spray	BOTTOM	300	LF	56	Neg	Con	B
777	insult	vanity	BOTTOM	300	LF	57	Neg	Con	B
778	hatred	hammer	BOTTOM	300	LF	58	Neg	Con	B
779	leprosy	icebox	BOTTOM	300	LF	59	Neg	Con	B
780	poison	insect	BOTTOM	300	LF	60	Neg	Con	B
781	wicked	coarse	BOTTOM	300	LF	61	Neg	Con	B
782	pervert	ketchup	BOTTOM	300	LF	62	Neg	Con	B
783	destroy	custom	BOTTOM	300	LF	63	Neg	Con	B
784	torture	highway	BOTTOM	300	LF	64	Neg	Con	B
785	outrage	radiator	BOTTOM	300	LF	65	Neg	Con	B
786	intruder	trumpet	BOTTOM	300	LF	66	Neg	Con	B
787	hostile	whistle	BOTTOM	300	LF	67	Neg	Con	B
788	terrified	privacy	BOTTOM	300	LF	68	Neg	Con	B
789	disloyal	repentant	BOTTOM	300	LF	69	Neg	Con	B
790	ambulance	nursery	BOTTOM	300	LF	70	Neg	Con	B
791	assassin	scissors	BOTTOM	300	LF	71	Neg	Con	B
792	nightmare	nonsense	BOTTOM	300	LF	72	Neg	Con	B
793	slaughter	pamphlet	BOTTOM	300	LF	73	Neg	Con	B
794	humiliate	appliance	BOTTOM	300	LF	74	Neg	Con	B
795	jealousy	sheltered	BOTTOM	300	LF	75	Neg	Con	B
796	cockroach	sceptical	BOTTOM	300	LF	76	Neg	Con	B
797	distressed	sentiment	BOTTOM	300	LF	77	Neg	Con	B
798	unfaithful	nonchalant	BOTTOM	300	LF	78	Neg	Con	B
799	hurricane	thermometer	BOTTOM	300	LF	79	Neg	Con	B
800	suffocate	lighthouse	BOTTOM	300	LF	80	Neg	Con	B
801	lust	shark	TOP	300	LF	41	Pos	Neg	T
802	nude	demon	TOP	300	LF	42	Pos	Neg	T
803	sexy	rude	TOP	300	LF	43	Pos	Neg	T
804	fame	rage	TOP	300	LF	44	Pos	Neg	T
805	alert	toxic	TOP	300	LF	45	Pos	Neg	T
806	glory	devil	TOP	300	LF	46	Pos	Neg	T
807	thrill	slap	TOP	300	LF	47	Pos	Neg	T

808	champ	venom	TOP	300	LF	48	Pos	Neg	T
809	cheer	snake	TOP	300	LF	49	Pos	Neg	T
810	flirt	annoy	TOP	300	LF	50	Pos	Neg	T
811	erotic	sinful	TOP	300	LF	51	Pos	Neg	T
812	dollar	killer	TOP	300	LF	52	Pos	Neg	T
813	dazzle	detest	TOP	300	LF	53	Pos	Neg	T
814	casino	tumour	TOP	300	LF	54	Pos	Neg	T
815	riches	betray	TOP	300	LF	55	Pos	Neg	T
816	aroused	scared	TOP	300	LF	56	Pos	Neg	T
817	dancer	insult	TOP	300	LF	57	Pos	Neg	T
818	admired	hatred	TOP	300	LF	58	Pos	Neg	T
819	elated	leprosy	TOP	300	LF	59	Pos	Neg	T
820	miracle	poison	TOP	300	LF	60	Pos	Neg	T
821	terrific	wicked	TOP	300	LF	61	Pos	Neg	T
822	orgasm	pervert	TOP	300	LF	62	Pos	Neg	T
823	intimate	destroy	TOP	300	LF	63	Pos	Neg	T
824	treasure	torture	TOP	300	LF	64	Pos	Neg	T
825	ecstacy	outrage	TOP	300	LF	65	Pos	Neg	T
826	reunion	intruder	TOP	300	LF	66	Pos	Neg	T
827	sunlight	hostile	TOP	300	LF	67	Pos	Neg	T
828	graduate	terrified	TOP	300	LF	68	Pos	Neg	T
829	festive	disloyal	TOP	300	LF	69	Pos	Neg	T
830	adventure	ambulance	TOP	300	LF	70	Pos	Neg	T
831	fireworks	assassin	TOP	300	LF	71	Pos	Neg	T
832	affection	nightmare	TOP	300	LF	72	Pos	Neg	T
833	athletics	slaughter	TOP	300	LF	73	Pos	Neg	T
834	valentine	humiliate	TOP	300	LF	74	Pos	Neg	T
835	intercourse	jealousy	TOP	300	LF	75	Pos	Neg	T
836	infatuation	cockroach	TOP	300	LF	76	Pos	Neg	T
837	astonished	distressed	TOP	300	LF	77	Pos	Neg	T
838	triumphant	unfaithful	TOP	300	LF	78	Pos	Neg	T
839	millionaire	hurricane	TOP	300	LF	79	Pos	Neg	T
840	rollercoaster	suffocate	TOP	300	LF	80	Pos	Neg	T
841	shark	lust	BOTTOM	300	LF	41	Neg	Pos	B
842	demon	nude	BOTTOM	300	LF	42	Neg	Pos	B
843	rude	sexy	BOTTOM	300	LF	43	Neg	Pos	B
844	rage	fame	BOTTOM	300	LF	44	Neg	Pos	B
845	toxic	alert	BOTTOM	300	LF	45	Neg	Pos	B
846	devil	glory	BOTTOM	300	LF	46	Neg	Pos	B
847	slap	thrill	BOTTOM	300	LF	47	Neg	Pos	B
848	venom	champ	BOTTOM	300	LF	48	Neg	Pos	B
849	snake	cheer	BOTTOM	300	LF	49	Neg	Pos	B
850	annoy	flirt	BOTTOM	300	LF	50	Neg	Pos	B
851	sinful	erotic	BOTTOM	300	LF	51	Neg	Pos	B
852	killer	dollar	BOTTOM	300	LF	52	Neg	Pos	B
853	detest	dazzle	BOTTOM	300	LF	53	Neg	Pos	B
854	tumour	casino	BOTTOM	300	LF	54	Neg	Pos	B
855	betray	riches	BOTTOM	300	LF	55	Neg	Pos	B
856	scared	aroused	BOTTOM	300	LF	56	Neg	Pos	B
857	insult	dancer	BOTTOM	300	LF	57	Neg	Pos	B
858	hatred	admired	BOTTOM	300	LF	58	Neg	Pos	B
859	leprosy	elated	BOTTOM	300	LF	59	Neg	Pos	B
860	poison	miracle	BOTTOM	300	LF	60	Neg	Pos	B
861	wicked	terrific	BOTTOM	300	LF	61	Neg	Pos	B

862	pervert	orgasm	BOTTOM	300	LF	62	Neg	Pos	B
863	destroy	intimate	BOTTOM	300	LF	63	Neg	Pos	B
864	torture	treasure	BOTTOM	300	LF	64	Neg	Pos	B
865	outrage	ecstacy	BOTTOM	300	LF	65	Neg	Pos	B
866	intruder	reunion	BOTTOM	300	LF	66	Neg	Pos	B
867	hostile	sunlight	BOTTOM	300	LF	67	Neg	Pos	B
868	terrified	graduate	BOTTOM	300	LF	68	Neg	Pos	B
869	disloyal	festive	BOTTOM	300	LF	69	Neg	Pos	B
870	ambulance	adventure	BOTTOM	300	LF	70	Neg	Pos	B
871	assassin	fireworks	BOTTOM	300	LF	71	Neg	Pos	B
872	nightmare	affection	BOTTOM	300	LF	72	Neg	Pos	B
873	slaughter	athletics	BOTTOM	300	LF	73	Neg	Pos	B
874	humiliate	valentine	BOTTOM	300	LF	74	Neg	Pos	B
875	jealousy	intercourse	BOTTOM	300	LF	75	Neg	Pos	B
876	cockroach	infatuation	BOTTOM	300	LF	76	Neg	Pos	B
877	distressed	astonished	BOTTOM	300	LF	77	Neg	Pos	B
878	unfaithful	triumphant	BOTTOM	300	LF	78	Neg	Pos	B
879	hurricane	millionaire	BOTTOM	300	LF	79	Neg	Pos	B
880	suffocate	rollercoaster	BOTTOM	300	LF	80	Neg	Pos	B
881	shark	lust	TOP	300	LF	41	Neg	Pos	T
882	demon	nude	TOP	300	LF	42	Neg	Pos	T
883	rude	sexy	TOP	300	LF	43	Neg	Pos	T
884	rage	fame	TOP	300	LF	44	Neg	Pos	T
885	toxic	alert	TOP	300	LF	45	Neg	Pos	T
886	devil	glory	TOP	300	LF	46	Neg	Pos	T
887	slap	thrill	TOP	300	LF	47	Neg	Pos	T
888	venom	champ	TOP	300	LF	48	Neg	Pos	T
889	snake	cheer	TOP	300	LF	49	Neg	Pos	T
890	annoy	flirt	TOP	300	LF	50	Neg	Pos	T
891	sinful	erotic	TOP	300	LF	51	Neg	Pos	T
892	killer	dollar	TOP	300	LF	52	Neg	Pos	T
893	detest	dazzle	TOP	300	LF	53	Neg	Pos	T
894	tumour	casino	TOP	300	LF	54	Neg	Pos	T
895	betray	riches	TOP	300	LF	55	Neg	Pos	T
896	scared	aroused	TOP	300	LF	56	Neg	Pos	T
897	insult	dancer	TOP	300	LF	57	Neg	Pos	T
898	hatred	admired	TOP	300	LF	58	Neg	Pos	T
899	leprosy	elated	TOP	300	LF	59	Neg	Pos	T
900	poison	miracle	TOP	300	LF	60	Neg	Pos	T
901	wicked	terrific	TOP	300	LF	61	Neg	Pos	T
902	pervert	orgasm	TOP	300	LF	62	Neg	Pos	T
903	destroy	intimate	TOP	300	LF	63	Neg	Pos	T
904	torture	treasure	TOP	300	LF	64	Neg	Pos	T
905	outrage	ecstacy	TOP	300	LF	65	Neg	Pos	T
906	intruder	reunion	TOP	300	LF	66	Neg	Pos	T
907	hostile	sunlight	TOP	300	LF	67	Neg	Pos	T
908	terrified	graduate	TOP	300	LF	68	Neg	Pos	T
909	disloyal	festive	TOP	300	LF	69	Neg	Pos	T
910	ambulance	adventure	TOP	300	LF	70	Neg	Pos	T
911	assassin	fireworks	TOP	300	LF	71	Neg	Pos	T
912	nightmare	affection	TOP	300	LF	72	Neg	Pos	T
913	slaughter	athletics	TOP	300	LF	73	Neg	Pos	T
914	humiliate	valentine	TOP	300	LF	74	Neg	Pos	T
915	jealousy	intercourse	TOP	300	LF	75	Neg	Pos	T

916	cockroach	infatuation	TOP	300	LF	76	Neg	Pos	T
917	distressed	astonished	TOP	300	LF	77	Neg	Pos	T
918	unfaithful	triumphant	TOP	300	LF	78	Neg	Pos	T
919	hurricane	millionaire	TOP	300	LF	79	Neg	Pos	T
920	suffocate	rollercoaster	TOP	300	LF	80	Neg	Pos	T
921	lust	shark	BOTTOM	300	LF	41	Pos	Neg	B
922	nude	demon	BOTTOM	300	LF	42	Pos	Neg	B
923	sexy	rude	BOTTOM	300	LF	43	Pos	Neg	B
924	fame	rage	BOTTOM	300	LF	44	Pos	Neg	B
925	alert	toxic	BOTTOM	300	LF	45	Pos	Neg	B
926	glory	devil	BOTTOM	300	LF	46	Pos	Neg	B
927	thrill	slap	BOTTOM	300	LF	47	Pos	Neg	B
928	champ	venom	BOTTOM	300	LF	48	Pos	Neg	B
929	cheer	snake	BOTTOM	300	LF	49	Pos	Neg	B
930	flirt	annoy	BOTTOM	300	LF	50	Pos	Neg	B
931	erotic	sinful	BOTTOM	300	LF	51	Pos	Neg	B
932	dollar	killer	BOTTOM	300	LF	52	Pos	Neg	B
933	dazzle	detest	BOTTOM	300	LF	53	Pos	Neg	B
934	casino	tumour	BOTTOM	300	LF	54	Pos	Neg	B
935	riches	betray	BOTTOM	300	LF	55	Pos	Neg	B
936	aroused	scared	BOTTOM	300	LF	56	Pos	Neg	B
937	dancer	insult	BOTTOM	300	LF	57	Pos	Neg	B
938	admired	hatred	BOTTOM	300	LF	58	Pos	Neg	B
939	elated	leprosy	BOTTOM	300	LF	59	Pos	Neg	B
940	miracle	poison	BOTTOM	300	LF	60	Pos	Neg	B
941	terrific	wicked	BOTTOM	300	LF	61	Pos	Neg	B
942	orgasm	pervert	BOTTOM	300	LF	62	Pos	Neg	B
943	intimate	destroy	BOTTOM	300	LF	63	Pos	Neg	B
944	treasure	torture	BOTTOM	300	LF	64	Pos	Neg	B
945	ecstacy	outrage	BOTTOM	300	LF	65	Pos	Neg	B
946	reunion	intruder	BOTTOM	300	LF	66	Pos	Neg	B
947	sunlight	hostile	BOTTOM	300	LF	67	Pos	Neg	B
948	graduate	terrified	BOTTOM	300	LF	68	Pos	Neg	B
949	festive	disloyal	BOTTOM	300	LF	69	Pos	Neg	B
950	adventure	ambulance	BOTTOM	300	LF	70	Pos	Neg	B
951	fireworks	assassin	BOTTOM	300	LF	71	Pos	Neg	B
952	affection	nightmare	BOTTOM	300	LF	72	Pos	Neg	B
953	athletics	slaughter	BOTTOM	300	LF	73	Pos	Neg	B
954	valentine	humiliate	BOTTOM	300	LF	74	Pos	Neg	B
955	intercourse	jealousy	BOTTOM	300	LF	75	Pos	Neg	B
956	infatuation	cockroach	BOTTOM	300	LF	76	Pos	Neg	B
957	astonished	distressed	BOTTOM	300	LF	77	Pos	Neg	B
958	triumphant	unfaithful	BOTTOM	300	LF	78	Pos	Neg	B
959	millionaire	hurricane	BOTTOM	300	LF	79	Pos	Neg	B
960	rollercoaster	suffocate	BOTTOM	300	LF	80	Pos	Neg	B

Appendix C: Stimuli from Chapter 4 Experiment

Low Frequency Words and Sentences:

Sentences	Negative	Neutral	Positive
Dave kept staring the _____ performer on the stage. Her movements were _____ and made Ryan feel uncomfortable. Ed thought that Bea was _____ and that night she proved it.	sinful	limber	erotic
The rugby star had been _____ throughout his career. The journalist wrote about the _____ lawyer yesterday. She didn't care for the _____ football player.	unfaithful	nonchalant	triumphant
Looking carefully, you can see the _____ behind the trees. Located on a hill, the _____ could be seen for miles. Everyone in the _____ was beginning to feel ill.	asylum	motel	casino
The lowly private thought he would _____ the major general. Traditionally recruits would _____ their superior officers. Diego knew he could only _____ some members of his company.	annoy	salute	cheer
The documentary on the _____ was very interesting. Lisa read about the _____ in her animal book. A sturdy creature, the _____ can survive in many habitats.	spider	camel	puppy
The young boy felt _____ about being in the school play. Amanda was totally _____ about public speaking. The referee was _____ as he ran onto the pitch.	terrified	energised	impartial
Iain returned from the meeting _____ and tired. Anna appeared _____ after the incident. We saw that Richard was _____ by our behaviour.	humiliated	unaffected	astonished
The relatives thought Jane was _____ for a girl of her age. Jason knew he was _____ and he didn't want to change. Heather felt very _____ after having a few drinks.	rude	aloof	sexy
Hannah could only think about the _____ as she lay awake. The appearance of the _____ alarmed the investigator. Andrew read about the _____ in his magazine.	tumour	violin	riches
Agent Ross would have to _____ Mary during his assignment. She speculated Dylan might _____ her at the party. Fred knew he could never _____ her in a crowd.	betray	detect	dazzle
The sailor wanted to _____ the passing jet-skier. The young fishermen tried to _____ the Greenpeace boat. The crowd wanted to _____ the champion with drinks.	drown	spray	thrill
The man who carried out the _____ had a long beard. Rumours of the _____ spread from village to village. The recipient of the _____ was a young refugee.	torture	errand	miracle
The woman looked _____ around the room one more time. Eileen paced _____ as she awaited the results. As the others gazed _____ into the office, Hazel waited.	nervously	silently	excitedly
The court heard how the _____ had been treated. The student wanted to dress as a _____ for Halloween. Judith thought that Phil could be _____ when he grew up.	killer	golfer	dancer

The teenagers were _____ during their return journey. Nigel was frequently _____ because he drank too much. The tramp often became _____ due to slight distractions.	hostile	drowsy	aroused

High Frequency Words and Sentences:

	Negative	**Neutral**	**Positive**
The reporter described David's _____ in great detail. She spoke of a mysterious _____ that would soon follow. Their inevitable _____ was the central theme of the story.	tragedy	outcome	passion
Janet and Sheena were lectured by the _____ professor. Jane thought that the _____ actor was quite attractive. The student was _____ in her response to the question.	violent	modest	helpful
The careless man dropped the _____ on the floor. Oliver forgot to bring Kevin's _____ to the table. The vagrant had found the _____ in the dumpster.	knife	bowl	sweet
The counsellor was quick to notice _____ in many children. The coach nurtured _____ in some of the younger players. There had been evidence of Robin's _____ since childhood.	stress	habits	talent
King Kong ate the _____ as the crowd ran for safety. Jim liked to look at the _____ when he went to the museum. Daniel knew that the _____ was hidden in the woods.	weapon	engine	plane
They were discussing the young _____ over dinner. The first _____ was the oldest of them all. The article described each _____ as tall and thin.	victim	writer	winner
The confetti landed on the _____ child in the brown jumper. She wore glasses and was described as _____ by most people. Steam rose as the _____ woman disembarked from the train.	angry	plain	lucky
Linda listened to the _____ through the wall. When Nicole heard the _____ she thought of her childhood. As Lucy thought about the _____, Scott poured her a drink.	abuse	rain	song
As the jury watched, the _____ defendant began to cry. The detective kept the _____ girl waiting for over an hour. After talking to the _____ clerk, he saw her point of view.	guilty	quiet	pretty
Phoebe discussed the _____ at great length with her friends. Michelle dreamt about the _____ every night for weeks. Tom delivered the _____ with great care and attention.	bomb	news	kiss
The cat watched the _____ hurry down the street. There was silence as the _____ walked into the theatre. The shop was closing as the _____ rushed to the checkout.	criminal	teacher	friends
Stories of the group's _____ travelled quickly. The origin of their _____ was not well understood. We discovered that Dr. Falkin's _____ was a hoax.	trouble	machine	success

As Kyle anticipated the _____, his heart began racing.	accident	meeting	holiday
After the _____ everyone looked for someone to blame.			
In the end, the _____ wasn’t as bad as people had feared.			
Nobody realised the impact that the _____ would cause.	fire	book	cash
The journalist reported the _____ at the general’s estate.			
Reginald still dreamt about the _____ months later.			
Stuart thought that the _____ would pass quickly.	fear	month	love
Gillian felt like her _____ of fame would last forever.			
Luke considered his _____ of solitude very seriously.			

Appendix D: Stimuli from Chapter 5 Experiment 1

No	NW	Target Word	Freq	Length	# Syll
1	andesker	relative	52	8	3
2	junidge	biology	11	7	4
3	stamdar	shelter	16	7	2
4	durate	clergy	15	6	2
5	famper	purple	13	6	2
6	heach	chair	77	5	1
7	uttle	drink	76	5	1
8	stred	organ	14	5	2
9	bleth	coins	15	5	1
10	faner	ocean	21	5	2
11	trest	crime	76	5	1
12	derin	canal	24	5	2
13	preed	cloth	20	5	1
14	nisk	beer	35	4	1
15	gast	feet	147	4	1
16	stip	exam	6	4	2
17	hist	carp	5	4	1
18	flib	cows	12	4	1
19	garm	tail	28	4	1
20	sote	face	373	4	1
21	hant	bark	6	4	1
22	gorn	shoe	11	4	1
23	blen	sore	8	4	1
24	wid	cup	123	3	1
			49.34	4.88	1.50

Related LF

	Word	Freq	Length	Syll
1	mother	270	6	2
2	science	113	7	2
3	nuclear	88	7	2
4	bishop	50	6	2
5	colour	117	6	2
6	table	207	5	2
7	water	358	5	2
8	heart	146	5	1
9	money	342	5	2
10	river	101	5	2
11	drugs	56	5	1
12	boats	20	5	1
13	sheet	41	5	1
14	wine	66	4	1
15	hand	366	4	1
16	test	143	4	1
17	fish	113	4	1
18	milk	47	4	1
19	head	400	4	1

20	eyes	323	4	1
21	tree	66	4	1
22	foot	74	4	1
23	pain	77	4	1
24	tea	76	3	1
		152.43	4.79	1.38

Related HF

	Word	Freq	Length	Syll
1	mother	270	6	2
2	science	113	7	2
3	nuclear	88	7	2
4	bishop	50	6	2
5	colour	117	6	2
6	table	207	5	2
7	water	358	5	2
8	heart	146	5	1
9	money	342	5	2
10	river	101	5	2
11	drugs	56	5	1
12	boats	20	5	1
13	sheet	41	5	1
14	wine	66	4	1
15	hand	366	4	1
16	test	143	4	1
17	fish	113	4	1
18	milk	47	4	1
19	head	400	4	1
20	eyes	323	4	1
21	tree	66	4	1
22	foot	74	4	1
23	pain	77	4	1
24	tea	76	3	1
		152.43	4.79	1.38

Unrelated LF

	Word	Freq	Length	Syll
1	cucumber	2	8	3
2	tabasco	0	7	3
3	ketchup	1	7	2
4	beetle	3	6	2
5	cashew	0	6	2
6	theft	8	5	1
7	screw	7	5	1
8	peach	7	5	1
9	yacht	11	5	1
10	stamp	14	5	1
11	paste	5	5	1
12	lemon	12	5	2
13	beans	13	5	1

14	swan	11	4	1
15	mint	7	4	1
16	nest	15	4	1
17	beak	3	4	1
18	skip	5	4	1
19	weed	5	4	1
20	leaf	16	4	1
21	cyst	0	4	1
22	mask	14	4	1
23	frog	5	4	1
24	fox	20	3	1
		7.69	4.88	1.33

Unrelated HF

	Word	Freq	Length	Syll
1	military	125	8	4
2	clothes	75	7	1
3	present	234	7	2
4	higher	173	6	2
5	father	250	6	2
6	mouth	99	5	1
7	break	93	5	1
8	dress	53	5	1
9	music	158	5	2
10	games	65	5	1
11	plant	87	5	1
12	spend	71	5	1
13	match	100	5	1
14	suit	52	4	1
15	hair	148	4	1
16	neck	59	4	1
17	door	252	4	1
18	gold	82	4	1
19	star	70	4	1
20	city	242	4	2
21	food	198	4	1
22	acid	51	4	2
23	file	61	4	1
24	dog	75	3	1
		119.72	4.88	1.38

Appendix E: Stimuli from Chapter 5 Experiment 2

No	NW	Target Word	Length	Freq	# Syll	Valence	Arousal
1	pummit	office	6	266	2	5.24	4.08
2	turelling	appliance	9	2	3	5.1	4.05
3	caborial	bathroom	8	24	2	5.55	3.88
4	Natch	ankle	5	10	2	5.27	4.16
5	wumple	theory	6	142	2	5.3	4.62
6	horrow	window	6	107	2	5.91	3.97
7	Flad	hawk	4	4	1	5.88	4.39
8	Lurt	vest	4	3	1	5.25	3.95
9	Tarth	hotel	5	123	2	6	4.8
10	treamful	radiator	8	5	4	4.67	4.02
11	factam	salute	6	4	2	5.92	5.31
12	Darret	method	6	98	2	5.56	3.85
13	bequette	windmill	8	2	2	5.6	3.74
14	plaction	medicine	8	29	3	5.67	4.4
15	sachid	poetry	6	32	3	5.86	4
16	Hosh	knot	4	7	1	4.64	4.07
17	Striff	hammer	6	12	2	4.88	4.58
18	blimble	bandage	7	2	2	4.54	3.9
19	berrow	errand	6	2	2	4.58	3.85
20	glivest	utensil	7	0	3	5.14	3.57
21	Pobe	part	4	519	1	5.11	3.82
22	Shace	paint	5	35	1	5.62	4.1
23	bestented	hairdryer	9	1	3	4.84	3.71
24	looster	hydrant	7	0	2	5.02	3.71
			6.25	59.54	2.08	5.30	4.11

Positive LF

No	Word	Length	Freq	# Syll	Valence	Arousal
1	Flirt	5	1	1	7.52	6.91
2	Valentine	9	3	3	8.11	6.06
3	Reunion	7	4	3	6.48	6.34
4	Champ	5	2	1	7.18	6
5	Erotic	6	5	3	7.43	7.24
6	Orgasm	6	2	3	8.32	8.1
7	Lust	4	5	1	7.12	6.88
8	Fame	4	13	1	7.93	6.55
9	Nude	4	4	1	6.82	6.41
10	Sunlight	8	14	2	7.76	6.1
11	Alert	5	14	2	6.2	6.85
12	Dollar	6	22	2	7.47	6.07
13	Inspired	8	22	3	7.15	6.02
14	Treasure	8	10	2	8.27	6.75
15	Elated	6	2	3	7.45	6.21

16	Joke	4	22	1	8.1	6.74
17	Cheer	5	8	1	8.1	6.12
18	Casino	6	2	3	6.81	6.51
19	Brave	5	19	1	7.15	6.15
20	Talent	6	23	2	7.56	6.27
21	Kiss	4	27	1	8.26	7.32
22	Glory	5	17	2	7.55	6.02
23	Fireworks	9	4	2	7.55	6.67
24	Festive	7	4	2	7.3	6.58
	avg	5.92	10.38	1.92	7.48	6.54

Positive HF

No	Word	Length	Freq	# Syll	Valence	Arousal
1	Heart	5	146	1	7.39	6.34
2	Beautiful	9	88	3	7.6	6.17
3	Exercise	8	90	3	7.13	6.84
4	power	5	341	2	6.54	6.67
5	Desire	6	59	3	7.69	7.35
6	Victory	7	61	3	8.32	6.63
7	Gift	4	31	1	7.77	6.14
8	Love	4	232	1	8.72	6.44
9	Cash	4	90	1	8.37	7.37
10	Success	7	144	2	8.29	6.11
11	Happy	5	110	2	8.21	6.22
12	Pretty	6	72	2	7.75	6.03
13	Holiday	7	75	3	7.55	6.59
14	Progress	8	88	2	7.73	6.02
15	Travel	6	76	2	7.1	6.21
16	Song	4	40	1	7.1	6.07
17	Travel	6	76	2	7.1	6.21
18	Profit	6	62	2	7.63	6.68
19	Quick	5	54	1	6.64	6.57
20	Happy	6	110	2	8.21	6.49
21	Sex	3	87	1	8.05	7.36
22	Lucky	5	39	2	8.17	6.53
23	Confident	9	34	3	7.98	6.22
24	Leader	6	99	2	7.63	6.27
		5.88	96.00	1.96	7.69	6.48

Negative LF

No	Word	Length	Freq	# Syll	Valence	Arousal
1	Tumour	6	0	2	2.36	6.51
2	Cockroach	9	1	2	2.81	6.11
3	Outrage	7	7	2	3.52	6.83
4	Bees	4	8	1	3.2	6.51
5	Vandal	6	1	2	2.71	6.4
6	Rabies	6	1	2	1.77	6.1

7	Rape	4	22	1	1.25	6.81
8	Rude	4	9	1	2.5	6.31
9	Thief	5	8	1	2.13	6.89
10	Jealousy	8	8	3	2.51	6.36
11	Demon	5	3	2	2.11	6.76
12	Brutal	6	8	2	2.8	6.6
13	Crucify	7	0	3	2.23	6.47
14	Intruder	8	3	3	2.77	6.86
15	Venom	5	3	2	2.68	6.08
16	Slap	4	5	1	2.95	6.46
17	Scream	6	11	1	3.88	7.04
18	Fearful	7	8	2	2.25	6.33
19	Sinful	6	2	2	2.93	6.29
20	Pervert	7	1	2	2.79	6.26
21	burn	4	17	1	2.73	6.22
22	Rage	4	14	1	2.14	8.17
23	Hurricane	9	5	3	3.34	6.83
24	Betray	6	4	2	1.68	7.24
		5.96	6.21	1.83	2.59	6.60

Negative HF

No	Word	Length	Freq	# Syll	Valence	Arousal
1	Bloody	6	41	2	2.9	6.41
2	Pressure	8	125	2	3.38	6.07
3	Trouble	7	87	2	3.03	6.85
4	Fire	4	139	1	3.22	7.17
5	Anger	5	40	2	2.34	7.63
6	Cancer	6	45	2	1.5	6.42
7	Fear	4	97	1	2.76	6.96
8	Pain	4	77	1	2.13	6.5
9	Fight	5	71	1	3.76	7.15
10	Accident	8	66	3	2.05	6.26
11	Afraid	6	60	2	2	6.67
12	Guilty	6	44	2	2.63	6.04
13	Terrible	8	42	3	1.93	6.27
14	Rejected	8	43	3	1.5	6.37
15	Victim	6	42	2	2.18	6.06
16	War	3	290	1	2.08	7.49
17	Stress	6	51	1	2.09	7.45
18	Danger	6	63	2	2.95	7.32
19	Abuse	5	36	2	1.8	6.83
20	Nervous	7	33	2	3.29	6.59
21	gun	3	36	1	3.47	7.02
22	Bomb	4	32	1	2.1	7.15
23	Disaster	8	30	3	1.73	6.33
24	Surgery	7	28	3	2.86	6.35
		5.83	67.42	1.88	2.49	6.72

Appendix F: Stimuli from Chapter 6 Experiment

The target stimuli within each set of three paragraphs always come in the order Positive (green)-Negative (red)-Neutral (blue). The target sentences are in bold.

Stimulus 1:
The little boy was running down the hill. **He was playing with the puppy he got for Christmas.** His mother came to pick him up.

Gordon was in the woods behind his house. **He fell, cutting himself badly and breaking his leg.** It was hours before he returned home.

The accountant was taking a long stroll. **He was wearing a blue sweatshirt, jeans and trainers.** There was no one else for miles around.

Stimulus 2:
The inspector was listening closely to the tape recording through large earphones. **The singing of the choir sounded like angels to him.** He tried to identify any noises in the background which might provide clues.

Frank sat silently in the back row of the cathedral and tried to remain unseen. **The wails of the mourners echoed in the large crypt.** He planned to stay in the shadows beside the large pillar.

Antonio Gonzalez stared out at his large congregation from behind the marble lectern. **The hair he was sitting on was wooden and painted green.** The priest would eventually have to stand and deliver his sermon.

Stimulus 3:
Yvonne stood with a group of her classmates and looked into the enclosure. **The mother panda kissed her baby and put an arm comfortingly around its shoulder.** The children watched open-mouthed in fascination.

The wildlife documentary last night was watched by a record number of viewers. **The python squeezed a squealing rat to death before greedily devouring it whole.** People will always be captivated by the behaviour of exotic creatures.

Helen stayed as still and quite as she could and started taking pictures. **The chameleon sat on the branch and changed colour to match its surroundings.** These shots could make the cover of National Geographic.

Stimulus 4:
Thousands of fans waited in the stadium to see the band's farewell concert. **The wonderful music filled the air and the delighted applause reached a crescendo.** All the journalists reported the event in the press the next day.

The Mexican mariachi performers warmed up as the tourists sat sipping beer. **Suddenly gunfire erupted and many of the screaming spectators were shot and killed.** Such occurrences were not uncommon in that part of the world

The stage crew were watchful as the performers entered the arena. **They wore their familiar moustaches, black leather jackets and wide brimmed hats.** The stewards tried to form a barrier between the stage and the crowd.

Stimulus 5:
Alan sat across the small table from Kirsty. **He smiled kindly at her, told her that he loved her, and gave her a ring.** Just then a waitress came over and showed them the wine list.

Joshua and Isobel knelt alone in the temple. **He told her that he was having an affair and that the relationship was over.** The silence in the large hall lasted for a very long time.

William leaned over the table towards Jill. **He was wearing a pink shirt and a pinstripe suit which was a size too big.** Some of the people in the crowded restaurant started staring.

Stimulus 6:
Ellen waited patiently as two men walked up the drive towards her. **She discovered that she had won millions of pounds in the lottery.** This was news that she had not been expecting.

Sophie opened the official looking envelope and read the letter inside. **She found out that her husband had been killed in the war overseas.** She just sat there and did not react to the news.

The lawyer summoned Mary into his office and got right down to business. **She learned that she had inherited a rubber tree from a distant Aunt.** Because Mary remained silent, the lawyer repeated what he had said.

Stimulus 7:
Rosalyn waited to hear the results of her check-up. **Apparently she was in perfect health and would live for many years to come.** She knew her husband, who was waiting outside to collect her, would want to know.

Lara filled in the questionnaire in the fashion magazine. **Apparently she was morbidly obese and had a high risk of developing cancer.** Her friends had told her that these types of tests were not the most reliable.

Clare was being lectured by her brother who was a medic. **She found out that there were no particular concerns regarding her health.** Sometimes her brother seemed to forget that he was not yet fully qualified.

Stimulus 8:
The class listened intently to their lecture in Eastern European Studies. **The Czech car had been the fastest of its era and had won many races around the world.** It was a topic which engaged the students' interest.

The old Russian sat by the boy's bed-side telling tales of his exploits. **The Soviet war had been grizzly, and prisoners had been tortured and mutilated.** The child listened, but was too young to understand such things.

Thomas loved history and was reading a book he had found in the library. **There were many stories about the British ambassador to Kazakhstan.** Sometimes he wished he could have lived in a distant, bygone age.

Stimulus 9:
Moonlight illuminated the low bridge over the shallow stream. **The young romantic couple gazed lovingly into each other's eyes and then embraced.** The distant gurgling of a waterfall upstream could be clearly heard.

Sand stretched away on either side as far as the eye could see. **A vagrant, doubled over and bleeding from a wound in his gut, fell to his knees.** A group of ladies took no notice and hurried off up the promenade.

The trees here weren't as dense as they were deeper in the forest. **A sparrow landed nearby and began drinking from a small puddle on the ground.** The only creatures watching were the squirrels and birds in the branches above.

Stimulus 10:
Mrs. Pertwee watched the children practice their roles for the school play. **The fairies sang and laughed as they danced hand-in-hand with the bunny rabbits.** She thought they looked very convincing.

Caroline sat with her head in her hands watching the program on TV. **The evil monsters snarled and growled as they circled around, searching for fresh prey.** Why were good films never shown on bank holidays?

The author closed her eyes and tried to imagine the scene in her mind. **The sailors studied the compass and map and began to plot a course for the island.** She grabbed a pen and began scribbling away.

Stimulus 11
listening to the noises outside. **They tenderly stroked one another's faces and smiled in contentment.** A sudden cool breeze activated the wind chimes through the open window.

The couple sat on plastic stools on opposite sides of a table in the small room. **They were terrified about the escaped killer from the nearby prison.** The single light from outside cast shadows across the floor.

Rosie and James stayed close to one another during their first night in the cabin. **The overhead ceiling fan was broken and the room was humid.** The lights of a passing truck swept their room with amber.

Stimulus 12:
Ellen stared at the painting above the fireplace. **A casino stood proudly on the crest of a hill, with shining lights that beckoned patrons to the show.** She liked the colours but would not have chosen the work for her own house.

Dustin considered the photograph he'd been sent. **A casino stood proudly on the crest of the hill, with shining lights that beckoned patrons to the show.** He couldn't believe his
brother had stayed there for the past 2 years.

Norma drove towards her latest place of work. **The motel sat on the side of the freeway, a low building that sprawled over the dusty terrain.** Although it hadn't been her first choice, she needed a change of career.

Stimulus 13:
George was mesmerised by the performance in front of him. **The dancer winked suggestively as she teased the folds of her skirt across a smooth, olive coloured thigh.** Other members of the audience were also watching open-mouthed.

Dr. Jones sat and watched the ceremony with the elders. **The warrior, painted in blood and adorned with human teeth and bones, snarled as he brandished his sword.** He didn't fully understand the custom, but observed with interest.

Carlos held his breath as the ancient ritual unfolded. **The old man with the white beard chanted in a low monotone as he slowly beat the large camel-skin drum** He dared not make a sound lest he be discovered by the natives.

Stimulus 14:
The former rugby player walked to the podium and prepared to make his speech. **He had been a champion and a gentleman, winning trophies and respect throughout a glittering career.** The room fell silent and all eyes focused expectantly on him.

Mary's husband changed the channel to watch the documentary on the Chelsea player. **He was notorious for having a cruel and barbaric streak, bordering on sadistic, and had ended many careers.** She felt it lacked the feeling and drama of Coronation Street.

The journalist sat in the coffee shop waiting for the former boxer to arrive. **He had had an uneventful career, eventually retiring from the sport to work in his father's fish factory.** It was the man's exploits in later life that would be discussed.

Stimulus 15:
The king summoned his subject to come and stand before him. **The elated treasurer smiled and opened a chest to reveal gold, silver and jewels.** The monarch sat back, arched his eyebrows and steepled his fingers.

The plantation owner wore a white suit and matching large hat. **The slave, malnourished and scarred from horrific beatings, recoiled in fear.** Everyone listened to the man's strong Southern drawl when he spoke.

The lawyer entered the room where his client waited for him. **The servant was dressed in a red gown and carried a small musical instrument.** The two had never met before but soon understood each other.

Stimulus 16:
The bungalow in the suburbs had a white picket fence and a well manicured lawn. **The happy friends sang a song together as they skipped through the door.** Once inside, no sounds could be heard.

The large sandstone grammar school basked in the twilight of early evening. **The intruder checked he was alone before picking the lock and entering.** There was nobody else inside at this hour.

A light flashed on automatically when there was movement outside the shop. **The teacher parked her car and entered the building through the front door.** After a few seconds the bulb went out.

Stimulus 17:
The hall was busy and Angus had been there for a while. **He was feeling attractive and self-confident when noticed a pretty girl smiling at him.** He lifted himself off his seat and headed towards the bathroom.

Donald wasn't sure what had been in his fruit punch. **He was in an awful mood, no one was talking to him, and he thought that he might vomit.** He didn't usually feel like this and wasn't sure how to react.

After one cocktail, Douglas had begun to feel strange. **He was tired, struggling to keep his eyes open and propping himself up against a table.** He got out his mobile to call his brother and ask for a lift.

Stimulus 18:

Jodie read the detailed article as she sat in the crowded waiting room. **The cash had been discovered in a treasure chest by a young couple on holiday.** People wrote about all sorts of things these days.

The journalist read the report about the most recent piece of evidence. **The tumour was black and grizzly and had been festering in the liver of the addict.** She put the file in the top drawer of her desk.

There was only one thing Catherine could think about as she lay awake. **The violin had been carved from cedar wood in Austria in the nineteenth century.** She wouldn't be able to get to sleep for hours.

Stimulus 19:
Gemma was outside the examiner's office. **She bounced excitedly with great anticipation.** Soon the old man would come out and talk to her.

Naomi knew the postman would arrive soon. **She fidgeted nervously as she awaited the results.** She would soon know the outcome of years of hard work.

Beth listened to the names on the radio. **She was sitting quietly in a small, Lincoln green room.** The DJ seemed to be speaking as slowly as he could.

Stimulus 20:
The panel of executives summoned the next interviewee to sit before them. **She was quite beautiful and smiled a lot, making everyone want to like her.** Each of the employers took shorthand notes on their laptops.

Jenny and Susan were asked to show the new girl around the school. **She was aggressive and hostile and they immediately took a disliking to her.** They took her to the cafeteria, the gym, and the music department.

The secretaries looked up from their desks as their new boss entered. **She was very quiet and modest and had shoulder-length light brown hair.** The old man she was replacing had retired to go fishing in Alaska.

Stimulus 21:
Ethan was eager to open the package his pen pal had sent. **The cake was covered in chocolate and smelled sweet.** The note said that it was a token of Tibetan culture.

Jamie stared inside the window of the shop on the corner. **The knife had a long, rusty blade with a jagged edge.** He passed it everyday on his way to school.

Joanne was surprised when the boy offered her the gift. **The bowl was hand-crafted and painted in red and blue.** She knew the locals didn't have much money to spare.

Stimulus 22:

The politician approached the man he had read about. **The athlete had won gold medals in several Olympic events.** He handed him a certificate and shook him by the hand.

Michael read the story in the Guardian that Saturday. **The victim had endured the horrors of a Korean POW camp.** He was sure the man had gone to school with his father.

The speaker was introduced to the assembled guests. **The author was in his 60s and had published several books.** He would talk about his many experiences over the years.

Stimulus 23:
Alison watched the feature on Richard and Judy. **The holiday had been the best of their lives.** She often tuned in when she got home from work.

Karen listened to the people talk on the radio. **The tragic accident left many dead and wounded.** They spoke with a hybrid Indian-Scottish accent.

Paddy sat in his armchair and reminisced. **Nothing much had happened during the broadcast.** He took a long drink and closed his eyes.

Stimulus 24:
Although the building was small, it housed several people. **The children laughed in a field nearby, chasing butterflies around the flowers.** There were plans for a second building to be constructed in the area.

The new city mayor went to see the facility for himself. **The stench was terrible, emanating from rotting waste and human excrement.** When he got home that night, he talked to his wife about his visit.

They had chosen to live in a commune away from all cities. **The residents discussed various issues and summarised their opinions.** The adults would meet that night to consider what actions to take.

Appendix G: Negative Velten Mood Induction

In this questionnaire you will be presented with 10 statements. Think about each statement and how it relates to you. Then write down an episode from your life which you think best exemplifies the statement. Two examples have been provided to give you a better idea of the type of responses we are looking for.

Statement: I don't think things are ever going to get better.

Episode: *I felt like this when I found out that I had failed an exam at university last year*

Statement: I wish I could be myself, but nobody likes me when I am.

Episode: *I often feel like this when I meet new people*

= =

Statement 1: Why should I try when I can't make a difference anyway.

Episode:

____
____
____

Statement 2: When I talk no one really listens.

Episode:

____
____
____

Statement 3: Sometimes I feel so guilty that I can't sleep.

Episode:

____
____
____

Statement 4: Sometimes I feel really guilty about the way I've treated my parents.

Episode:

Statement 5: There is no hope.

Episode:

Statement 6: I feel I am being suffocated by the weight of my past mistakes.

Episode:

Statement 7: Nobody understands me or even tries to.

Episode:

Statement 8: I feel worthless.

Episode:

Statement 9: I feel cheated by life.

Episode:

Statement 10: Even when I give my best effort, it just doesn't seem to be good enough.

Episode:

Appendix H: Positive Velten Mood Induction

In this questionnaire you will be presented with 10 statements. Think about each statement and how it relates to you. Then write down an episode from your life which you think best exemplifies the statement. Two examples have been provided to give you a better idea of the type of responses we are looking for.

Statement: When it comes down to it, I'm a good person.

Episode: *I once abseiled off of a tall building for charity even though I am scared of heights*

Statement: I'm going to have it all!.

Episode: *I went to my friend's party and had a great time and also got an A in my test the next morning*

= =

Statement 1: The world is full of opportunity and I'm trying to take advantage of it.

Episode:

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____

Statement 2: My parents brag about me to their friends.

Episode:

____

____

Statement 3: I've got some really good friends.

Episode:

____

____

Statement 4: Most people like me.

Episode:

____
____
____

Statement 5: I can't remember when I felt so good.

Episode:

____
____
____

Statement 6: It's great to be alive.

Episode:

____
____
____

Statement 7: I feel energized.

Episode:

____
____
____

Statement 8: I know if I try I can make things turn out fine.

Episode:

____
____
____

Statement 9: I can make things happen.

Episode:

____
____
____

Statement 10: I feel creative.

Episode:

Appendix I: Neutral Velten Mood Induction

On the page below, 10 statements are presented. Read each statement to yourself. Please let the experimenter know when you have finished.

= =

Statement 1: The movie theatre was located in the city centre.

Statement 2: The Canary Islands are off the coast of Africa.

Statement 3: Cardiff is in Wales.

Statement 4: Some think that electricity is the safest form of power.

Statement 5: She walked over to the shop and knocked on the door.

Statement 6: Rome is the capital of Italy.

Statement 7: Many buildings in Aberdeen made of granite.

Statement 8: It snows in Aviemore.

Statement 9: Elephants carried the supplies.

Statement 10: Diamonds can cut glass.

Appendix J: Mood Assessment Scale (MAS)

Please <u>circle</u> the response (YES or NO) that <u>best</u> answers each question.

1. Are you basically satisfied with your life? YES / NO
2. Have you dropped many of your activities and interests? YES / NO
3. Do you feel that your life is empty? YES / NO
4. Do you often get bored? YES / NO
5. Are you hopeful about the future? YES / NO
6. Are you bothered by thoughts you cannot get out of your head? YES / NO
7. Are you in good spirits most of the time? YES / NO
8. Are you afraid that something bad will happen to you? YES / NO
9. Do you feel happy most of the time? YES / NO
10. Do you often feel helpless? YES / NO
11. Do you often get restless and fidgety? YES / NO
12. Do you prefer to stay at home, rather than going out and doing new things? YES / NO
13. Do you frequently worry about the future? YES / NO
14. Do you feel you have more problems with memory than most people? YES / NO
15. Do you think it's wonderful to be alive now? YES / NO
16. Do you often feel downhearted and blue? YES / NO
17. Do you feel pretty worthless the way you are now? YES / NO
18. Do you worry a lot about the past? YES / NO
19. Do you find life very exciting? YES / NO
20. Is it hard for you to get started on new projects? YES / NO
21. Do you feel full of energy? YES / NO
22. Do you feel that your situation is hopeless? YES / NO
23. Do you think that most people are better off than you are? YES / NO
24. Do you frequently get upset over things? YES / NO
25. Do you frequently feel like crying? YES / NO

26. Do you have trouble concentrating? YES / NO

27. Do you enjoy getting up in the morning? YES / NO

28. Do you prefer to avoid social gatherings? YES / NO

29. Is it easy for you to make decisions? YES / NO

30. Is your mind as clear as it used to be? YES / NO

Appendix K: Positive Affect Negative Affect Scale (PANAS)

The following questionnaire consists of 20 words that describe different feelings and emotions. Read each item. Then circle the appropriate number that corresponds to your response on the following scale:

(1) = Very slightly or not at all	**(2) = A little**	**(3) = Moderately**	**(4) = Quite a bit**	**(5) = Extremely**

Finally, it is important that you indicate to what extent you feel this way JUST NOW.

* * * * *

	Very slightly or not at all	A little	Moderately	Quite a bit	Extremely
1. Interested	1	2	3	4	5
2. Distressed	1	2	3	4	5
3. Excited	1	2	3	4	5
4. Upset	1	2	3	4	5
5. Strong	1	2	3	4	5
6. Guilty	1	2	3	4	5
7. Scared	1	2	3	4	5
8. Hostile	1	2	3	4	5
9. Enthusiastic	1	2	3	4	5
10. Proud	1	2	3	4	5
11. Irritable	1	2	3	4	5
12. Alert	1	2	3	4	5
13. Ashamed	1	2	3	4	5
14. Inspired	1	2	3	4	5
15. Nervous	1	2	3	4	5
16. Determined	1	2	3	4	5
17. Attentive	1	2	3	4	5
18. Jittery	1	2	3	4	5
19. Active	1	2	3	4	5
20. Afraid	1	2	3	4	5

Appendix L: Stimuli from Chapter 8 Experiment

Positive message, positive words

The Ford Kiss is a relatively new addition to the £12,000-15,000 hatchback class and at first glance measures up very favourably to its established peers. The 1.5 litre 6 valve engine packs in a monumental 140bhp, sprints from 0 to 60 in just 5 seconds and delivers an astonishing top speed of 158mph. While this machine's awesome pace is most evidently on display on motorways and A-roads, it is complimented by pristine handling and phenomenal grip which ensures supreme confidence when cornering hard at any speed. This combination of power and finesse ensures sparkling performance in all driving environments.

This classy vehicle also comes lavishly equipped with an extensive range of features designed to make the interior as luxurious as possible. Immaculately upholstered and surprisingly supportive seats make it clear that comfort has priority, while there is abundant useable room inside the cabin, as well as a large boot.

In addition to the quality feel there are practical applications too. The Kiss is very economical to run and service, making it great value. Finally a generous range of impressive safety features such as state-of-the-art alarms, immobiliser, and smart-key entry system ensure that you sleep soundly in your bed knowing that your car is protecting itself.

Negative message, positive words

The newly released Fiat Casino is a compact hatchback in a comparable style to the popular Renault Clio. Like its French cousin it has a 1.2 litre engine and three doors, but that's where the similarity ends. With a sedate top speed of 105mph, and the ability to stroll from 0 to 60 in a colossal ten seconds, all you will be able to do is sit back, relax and watch as you are overtaken by better, more advanced cars, and perhaps also a child on a bicycle. Handling is neither superb nor exciting, with the expected nimbleness absent, and new suspension offering the poise and grace of rollercoaster cart.

The Casino is far too serene for a sports or muscle car, but we suspect it is rather too extravagantly complicated to appeal to sensible housewives either. While an amazing array of dazzling techno-gadgets are at your fingertips you would need an advanced degree to enjoy them.

At a standard £14,500 this car is not easy on the wallet, and liberal fuel consumption means you will soon have to part with more of your cash at the pumps. Add to this the less than first-class performance and an interior which looks comfortable and classy but is made of polyester and you would do well to invest your money elsewhere.

Positive message, negative words

The 3-door Daewoo Scorpion possesses blistering pace for such a hefty car with an intimidating top speed of 160mph, and the basic model's 1.5 litre, 6 valve engine delivering a screeching 155bhp. When setting off this car will emit a scream to chill the spine as it climbs to 60mph in only 8 seconds. While cruising the growl of the engine is not too loud, but provides an ever-present reminder of the wild beast lurking under the bonnet. There's more to this machine than its ferocious speed, with razor-sharp handling allowing you to attack the tightest corners with venom, and affording you the confidence to thunder through town centres and snake along twisty B-roads.

This car punches above its weight in the twelve to fifteen thousand pound small hatchback class. It is lighting fast, bulkier and less pricey than the majority of its rivals. As well as its stirring performance, the interior is cavernous and the monstrous boot capable of greedily devouring a set of golf clubs. All this will keep you calm during the daily hustle and grind of the city.

The Scorpion employs a number of passive safety features to prevent nasty accidents and injuries. These include airbags, front and side crumple zones, and skeletal front pillars to reduce blind spots. As well as the expected alarm system the vehicle comes equipped with dead-locks which should help to discourage thieves and vandals.

Negative message, negative words

The three door Nissan Storm has a 1.4 litre engine which delivers a top speed of 122mph. Unfortunately it offers only 105bhp meaning that acceleration is sluggish and you will inevitably be left plodding along, seething with jealousy as less inferior cars leave you trailing in their wake. And it's not just the performance which spoils this car. Control is awkward, particularly at high speeds, and a tortured clanking under the bonnet betrays sloppy engineering which threatens to turn into more critical problems sooner rather than later. The all round ride and handling leave you feeling dissatisfied and unfulfilled.

The Storm is marketed as being compact, but the interior is cramped and brick-like suspension means the worst bumps can be felt as bone-shaking shudders. There is little storage room, with a miniscule glove-compartment and shallow boot limiting load-carrying ability. Also absent is sufficient headroom, with a low roofline reducing comfort and hampering rear visibility.

Other strange omissions include many of the safety features which tempted buyers of the previous model, leaving this particular vehicle vulnerable to thieves. Combine this with a thirsty engine and disappointing performance and what you have is a costly vehicle which compares poorly to other cars in its class.

Appendix M: Semantic Differential Questionnaire from Chapter 8 Experiment

Please circle the number which best describes your feelings about the **Ford Kiss/Fiat Casino/Daewoo Scorpion/Nissan Storm**:

Desirable	1	2	3	4	5	6	7	Undesirable
Serious	1	2	3	4	5	6	7	Fun
Slow	1	2	3	4	5	6	7	Fast
Powerful	1	2	3	4	5	6	7	Weak
Safe	1	2	3	4	5	6	7	Dangerous
Exposed	1	2	3	4	5	6	7	Protected
Efficient	1	2	3	4	5	6	7	Wasteful
Sparkling	1	2	3	4	5	6	7	Dull
Calm	1	2	3	4	5	6	7	Exciting
Sedate	1	2	3	4	5	6	7	Energetic
Comfortable	1	2	3	4	5	6	7	Uncomfortable

Appendix N: 'Promotion' and 'Prevention' Recommendations Questionnaire from Chapter 8 Experiment

Jane is a single mother of two who lives on the South Side of Glasgow. She is a fairly cautious individual who is always worrying about the safety of her two children and about how much money she has in the bank. She has decided to buy a new car in order to commute to her work and to drop her children off at school.

Please use the scale below to indicate to what extend you would recommend the the **Ford Kiss/Fiat Casino/Daewoo Scorpion/Nissan Storm** to Jane

Wouldn't recommend 1 2 3 4 5 6 7 Highly recommend

Grieg has just graduated with top honours and started a new job for an up-and-coming advertising agency in London. He likes to go out and socialise a lot and is enjoying spending his large salary on life's luxuries. Image and status are very important to him as he wants to be seen as successful and wealthy.

Please use the scale below to indicate to what extend you would recommend the **Ford Kiss/Fiat Casino/Daewoo Scorpion/Nissan Storm** to Grieg

Wouldn't recommend 1 2 3 4 5 6 7 Highly recommend