efpsa
journal of european psychology students

Palma de Figueiredo, R. (2015). Pop-Out Effect of Negative Words in a Word-Grid Task? *Journal of European Psychology Students*, 6(1), 53–61, DOI: http://dx.doi.org/10.5334/jeps.cx

RESEARCH ARTICLE

Pop-Out Effect of Negative Words in a Word-Grid Task?

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The environment is very complex, as there are many different stimuli that evoke attention, and therefore demands different adaptive reactions. Quick responses to upcoming danger are essential for survival. Highly negative stimuli contain alarm signals that cause an attentional shift toward the stimulus.

Past research indicates that high arousal negative words lead to faster reaction times in a Lexical Decision Task. This study tested whether these words can be found faster in a word grid task. Therefore we tested 56 participants who had to find words seen before within a word grid task. Our results show that participants found high arousal negative words faster than high arousal positive or neutral words. This might suggest a pop-out effect for the high arousal negative words within the word grid.

Keywords: high-arousal negative words; emotional words; pop-out effect; Lexical Decision Task; Word-Grid Task; fight or flight; freezing

Introduction

Our surrounding environment is very complex and demands adaptive reactions. This adaptivity is attained by specific systems. Emotions play a big part in this process. They warn us about upcoming danger by evoking the feeling of fear or anger. They also motivate us to certain actions that will help us deal with situations. An example could be the recognition of danger, which will motivate us to run away- “flight” or “fight”, or to stay frozen- “freezing”. This mechanism is also called the fight or flight response (Cannon, 1932; Jansen, Van Nguyen, Karpitskiy, Mettenleiter, & Loewy, 1995). Emotions are a big help to us when it comes to danger and they also help us in social contexts. Emotions play a very big part in adaptive and proper reactions within the social environment.

Also, with the help of emotions we are able to understand and interpret our actions and reactions, and those of people that surround us. Our environment includes numerous stimuli that evoke emotions. These stimuli are not only specific but can also be abstract (LeDoux, 1996). Words and writing are abstract stimuli that will evoke emotion, if they have a specific meaning to a person. However, not every word has the same emotional meaning to all people. For example, the word “Bible” might have a very positive meaning to a biblical Christian person, but will have a neutral or negative meaning to a person who does not share the same religion. Studies were able to show, though, that some words evoke the same emotion in a lot of people (Tausczik & Pennebaker, 2010).

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Emotional Words

Since the environment in which we live is very complex, it therefore demands many adaptive reactions. This adaptive process requires the brain to deal with different demands. The capacity to process stimuli is limited and therefore attentional mechanisms are required to select between relevant and irrelevant objects. Emotional stimuli have been shown to provoke a shift of attention toward the evoking stimulus. This is especially true for negative ones (Bargh, Chaiken, Govender, & Pratto, 1992; Pratto & John, 1991; Riemann & McNally, 1995). Most researchers agree that emotion can at least be divided into two dimensions: The dimension of valence and the dimension of arousal. Valence refers to the pleasantness or unpleasantness of felt emotion, whereas arousal refers to how much an emotion engages us. Due to this, valence ranges from pleasant to unpleasant, and arousal ranges from calm to excited (Lane, Chua, & Dolan, 1999; Lang, Bradley, & Cuthbert, 1998). People most often try to gain an appetitive state, in which case reacting differently to different kinds of stimuli can help us reach that state. For negative stimuli there are two mechanisms at stake. As mentioned above there is the so called flight or fight response as well as the response called freezing. These response tendencies are complementary. Highly arousing negative stimuli are best dealt with by commencing fast responses.

Kensinger and Corkin (2003) were able to show that facts associated with strong emotions are better and more vividly remembered than those without. This emotional memory enhancement effect has been replicated in many ways using pictures, words, sentences, and narrated slide shows. Words are symbolic stimuli that can signal appetitive or potentially threatening situations.

Emotionally loaded words are therefore one of the most used stimuli in emotion research. Many experiments were able to show that the shift of attention results in faster reaction times (RT) for emotionally loaded words but not for neutral words. (Bargh et al., 1992). Kousta, Vinson, and Vigliocco (2009) as well as Yap and Seow (2014) were able to show that emotionally loaded words show faster RT, when presented in a Lexical Decision Task (LDT), than emotionally neutral words. The LDT is a task in which subjects indicate whether a target of letter strings (e.g., circle or hadul) is a word or a nonword.

In contradictory studies Kuchinke et al. (2006) and Larsen, Mercer, Balota, and Strube (2008) were able to show, that emotionally neutral words are found faster than emotionally loaded ones.

Scientists offer several reasons for these differences. Some studies for example differentiated between emotionally neutral words and emotionally loaded words (Yap & Seow, 2014) while others differed between emotionally neutral words and emotionally positive as well as emotionally negative words (Scott, O'Donnell, & Sereno, 2014). Also important to look at is the actual word that is chosen. Words can also be differentiated on dimensions of valence and arousal. Hofmann et. al. (2009) were able to show that high arousal negative words lead to faster reaction times in a LDT. They concluded that this effect might be due to the evolutionary mechanism, mentioned above, called the fight or flight mechanism.

Also there are certain effects of the word frequency. The so called word frequency effect, predicts that words of high frequency in the language are more readily recognized than words of low frequency. This is one of the most robust findings in visual word recognition experiments. Interestingly negative words show a higher word frequency and this goes along with faster RT. Neutral words on the contrary have a low frequency and this might cause the slower RT shown for neutral words (Scott, O'Donnell, Leuthold, & Sereno, 2009). Hofmann, Kuchinke, Tamm, Võ, and Jacobs (2009) were able to show that the word frequency does not have an impact once one controls the dimension of the arousal. Arousal and valence are word features that modulate the frequency (Scott et al., 2009).

Another reason for differences between studies could be the usage of different methods. The most popular method for measuring the RT for emotionally neutral, negative, or positive words is the LDT (Hofmann et al., 2009; Kousta et al., 2009; Scott et al., 2014). Other methods of measuring, that were used were, for example: Emotional decision tasks, categorization tasks (De Pascalis, Strippoli, Riccardi, & Vergari, 2004) or tasks in which answers need to be selected (Kakolewski, Crowson, Sewell, & Cromwell, 1999). Imaging methods (e.g functional magnetic resonance imaging) can help by bringing some clarity to the topic and might show whether or not emotionally loaded words show faster RT. Measurements of brain activity, while working on a LDT, were able to show that there are discrepancies between the processing of positive and negative words (Holcomb & Neville, 1990). The part of our brain that is most associated with the processing of emotion is the amygdala. Emotional stimuli activate the amygdala. This will happen even if we are not aware of the stimulus (Morris, Öhman, & Dolan, 1998). The hippocampus plays a main role in the consolidation of emotional stimuli (Cahill & McGaugh, 1998).

As mentioned above, words can be discriminated on dimensions of valence and arousal. When looking at the brain activity while presenting words with a non-varying valence one can see no difference between emotionally loaded (positive and negative words) and emotionally neutral words (Kuchinke et al., 2006). When focusing on the arousal on the other hand, a difference between emotionally loaded and emotionally neutral words can be seen (Nakic, Smith, Busis, Vythilingam, & Blair, 2006). Negative words with a high arousal show a stronger activation of the brain than negative words with a low arousal do. Hofmann et al. (2009) found a significantly higher activation for high arousal negative words than for positive and neutral words. The activation was higher in the left occipito-temporal region, including the left fusiformis and middle temporal gyri. Thus faster RT for high arousal negative words goes along with higher activity in the amygdala and higher activity in the occipito-temporal cortex as well as the left fusiformis (Nakic et al., 2006). The interaction of these regions strengthens the connection between visual perception of words and semantic processes (Hofmann et al., 2009; Price & Devlin, 2003).

The lack of priming effects for high arousal negative words also underlines the importance of arousal especially for negative words. Even without previous negative priming, high arousal negative words can be recognized better (Thomas & LaBar, 2005). For positive words priming does have an effect on the recognition of words, even when the arousal is being controlled (Klauer & Musch, 2003). This points out that positive and negative words are processed differently (Hofmann et al., 2009). Also, the lack of priming suggests that there are no effects of the current mood the person is in, when looking at high arousal words.

Current Study

This study will show whether there is an effect of faster RT for high arousal negative words, even in a complex setting. Former studies most often used an LD, which is also the most used task concerning the field of word study. It is important though to test whether the results stay the same when using different tasks. Only then can it be tested whether the tested effect is robust. The Word-Grid-Task is more complex than the LDT as the participant has to find the word within a number of distractors. The participant also cannot use the usual mechanisms used when reading a word or a text to orient himself, as the words were not necessarily in reading direction and did not begin or end in the first row of the word grid.

The complexity of a task is important because the real word is very complex. Many different stimuli come into the focus of attention and are processed at the same time. If one wants to predict human behaviour, this complexity always needs to be considered. The more different stimuli need to be processed within a task the closer the task comes to the complexity of the real world. Although the

WGT cannot mirror the real world, as there are many more stimuli and variables that need to be taken into consideration, for example the kind of the emotion (fear, anger and so on), it does offer more complexity than the LDT. As mentioned above, it is important not only to look at the valence of a word, but to include the level of arousal. We controlled all words for the dimension of arousal, keeping them all at a high arousal.

First, we presented emotionally neutral and emotionally loaded words; the latter divided into positive and negative words, as well as pseudo-words, in an LD. All emotional words were controlled for the dimension of arousal, all showing a high arousal. Previous research (Hofmann et al., 2009) was able to show that the dimension of arousal only has an effect on RT when looking at high-arousal negative words, but not when looking at high-arousal positive words. Therefore, in the present study only negative words will be called high-arousal negative words. This task will make the participants familiar with the words so that they can find the words faster on the next task.

The second task consists of a grid of letters in which the target word has to be found, called a Word-Grid Task (WGT). We hypothesize that faster RT for high arousal negative word can be found in a setting even as complex as ours, since a person needs to react to a negative emotion quickly in case of danger in a complex environment as well. We therefore predict faster RT for high arousal negative words, compared to neutral and positive words, in our WGT.

Method

Participants

Fifty-six right handed psychology students (12 male, 44 female) of the University of Wuppertal took part in both experiments. The data of five participants were not used in our analysis; the data of three were used to test the experimental software, and data from two other participants were excluded because they were not native German speakers. German word recognition is critical to the validity in this experiment. Therefore we used the data of 51 participants, with ages ranging from 18 to 29 years, with a mean age of 20.6 (SD = 3.2) years for our data analysis. For taking part in the experiments the participants were given course credit for their help and a bar of chocolate.

Materials

The software "Inquisit 3" was used for both experiments. We also used identical computers with a display size of 19" and a display resolution of 1280 × 1024. The average viewing distance was 70 cm and was kept constant during the experiment. The experiment was divided into two separate tasks. The first task was an LDT that was based on Meyer and Schvaneveldt (1971) "Lexical Decision Task". In this task the participant is presented with a mixture of words and pseudo-words (nonsense strings that respect the phonotactic rules of a language). Their task was to indicate whether the presented stimulus is a word or not. The "I" button stood for "Word", the "E" button for "non-Word". The second task was the before mentioned WGT. In each word grid one word had to be found.

The first task. This first task was undertaken by all participants to make them comfortable with the words that were used in the second task as well. Due to some test runs we decided that the familiarisation was important. Participants that undertook the second task without the pre-activation of the words on the first task took longer to find any words within the word grid paradigm. Due to this their concentration and motivation was lower. This in turn manifested in more mistakes, especially towards the end of the task. A second test run showed better reaction times in the word grid task after having seen the words once. Further test runs were able to show that the reaction times increased even more when each word was shown twice. There was no further increase when showing the words three times. Also, participants that had seen the words beforehand reported more motivation and showed lower mistake rates. Therefore we constructed the lexical decision task as a familiarisation process

The first task contained 24 emotional words, 25 neutral words, as well as 45 pseudo-words. All words were German nouns consisting of four to eight letters and were drawn from the Berlin Affective Word List Reloaded (BAWL-R) (Võ et al., 2009). The BAWL–R is a list of over 2,900 German words taken from the CELEX database (Baayen, Piepenbrock, & van Rijn, 1993). In this list all words are controlled for valence, arousal and word frequency. All words used in this experiment had a high arousal.

The pseudo-words were orthographically legal and pronounceable. The pseudo-words were created either by changing one letter or as new composite of legal German syllables. The words and pseudo-words were matched on mean number of letters and syllables. All words presented in the LDT were in a randomized order. Every word was presented twice. The 24 emotional words were divided into 12 high arousal negative words and 12 high arousal positive words. With both the positive and the negative words we kept the arousal on a constant level, meaning that we used high arousal negative words (e.g., Bastard) and high arousal positive words (e.g., Erotik, meaning eroticism). Since the control of the dimension of arousal does not show any effect for the processing of positive words, in the following we will refer to the high arousal positive words, as positive words.

The second task. The second task was a WGT. In this task, the participants had to find a word within a grid of distractor letters (as can be seen in **Figure 1**). Every word presented in the second task had been shown to the participants before in the first task. This ensured a faster and more accurate processing of the words in the second task. Since every word, that is neutral words, positive words and high arousal negative words, was presented twice in the first task it is not likely that the first task had an effect other than the intended impact of faster and more accurate processing.

The second task contained the same 24 emotional words (12 positive words and 12 high arousal negative words) as well as 25 of the neutral words from the first task. Each word was presented in a word grid with distractor letters and had to be found by the participants (see **Figure 1**). Each word grid contained only one word. The word could

Figure 1: An example of the Word-Grid as presented to the participants in the second task. In the experiment the word had not been highlighted and had to be found within the set of distractors.

either be neutral, positive, or high arousal negative. The word grids (size 14.5 cm × 12.5 cm with 72 letters in an eight × nine grid; black letters on white background, as can be seen in **Figure 1**) were compounded using a web-based program called "Suchsel" (Schmalz, 2011). Every word could only be found horizontally, diagonal or vertically. A word would never begin or end in a border area of the word grid. This placement ruled out any effect that word position might have on RT. This is, if a word was shown beginning in the left border line and being horizontal, it is possible that the participants would react faster, not because of the emotional meaning of the word but because it's in the standard German reading direction and place. We also controlled the number of horizontal, diagonal and vertical words, meaning that there were as many neutral words written horizontally, diagonally and vertically as were positive or high arousal negative words.

Procedure

All experiments took place in laboratory rooms within the university of Wuppertal. This way, environmental factors such as light and temperature could be controlled. The experiment was also only undertaken by participants during the early evening, to ensure that the time of the day could not interfere with the results of the experiments.

The participants were informed of the procedure of the following tasks and about the anonymity of their data. They were told they could withdraw from the study at any time, if needed. After they were informed they gave written consent. The experiment was started, with a standardised oral instruction, explaining that the following experiment consisted of two tasks. Thereafter the first task was started. The examiner stayed in the room until the participants had read and understood the standardised instruction of the first task. Also, the examiner orally underlined the importance to be fast and accurate on this task. The examiner then left the room and the participants worked on the first task.

After the participant finished the first task the examiner started the second task and again waited until the participants had read and understood the standardised instruction of the second task. The examiner stayed until all questions of the participants had been answered and then gave the oral hint that every word in this task had already been presented in the first task. The examiner then left the room and the participants worked alone on the second task.

Procedure of the first task. As the first task begins the participants see a display with written instructions, which informs the participant of what he or she has to do in the first task. After the instruction a test trial follows (three neutral, three pseudo-words). Each trial begins with a white fixation cross in the middle of a black display. After the cross disappeared the word stimulus appears for 700 ms. After the word vanishes from the display, the participant has to press the "I" key for "word" and the "E" key for "non word". After pressing the key the next trial begins. The measurement of the reaction time begins with the appearance of the word stimulus and ends with pressing the key. Mistakes the participants make are also measured.

Procedure of the second task. The second task also begins with written instructions shown on the start display. The instruction explains the second task to the participant. After the instruction a test trial begins. After the test trial the actual experiment begins. Each trial begins with a word grid (position 50, 50; size 50%/50%), containing the neutral, positive or high arousal negative word. All items were presented in a randomized order. It is the participant's job to find the word. To confirm he or she found the word the participant has to press the space key. The measurement of reaction time starts with the appearance of the word grid and stops when the participant hits the space key. After hitting the space key a new display appears. This display shows a text window, in which the participant is supposed to enter the word he or she has found. That way we could make sure that the right word had been found.

Data analyses

For data analyses we used data from the second task only. The first task was presented only to ensure a better processing of the words in the second task. Data analyses contained error rates in percentages (for better comparison) and RT. An alpha level of .05 was used for all statistical tests. Outliers of more than standard deviations from the means were removed. RT for mistakes was also excluded.

Reaction Times. For RT we conducted repeated measures ANOVA, again with word valence (neutral, positive and negative) as within subject factor. The reaction times used were the reaction times of correct identifications. We conducted a paired samples t-test to confirm a significant effect for each pair of words we used. Neutral words were compared to positive words, negative words were compared to neutral words and positive words were compared to negative ones.

Error rates. For the analyses of the error rate we transformed the absolute error rate into percentage error rates, for better comparison. Error rates from each participant were submitted to repeated measures ANOVA, with word type (neutral, positive and negative) as within-subject factor. To confirm significant effects for each pair of words we used a paired samples t-test, with the pair's positive-negative, positive-neutral, and negative-neutral.

Results

Reaction Times

The average reaction time for neutral words was 32367 ms (*SD* = 8956), for positive words 35752 ms (*SD* = 13706) and for high arousal negative words 30678 ms (*SD* = 10461), as can be seen in **Figure 2**. The repeated measures ANVOA indicated a significant main effect, $F(2, 50) = 3.81$, $p = .029$, $\eta_p^2 = 0.135$ for emotional valence. A paired samples t-test used to assess that participants found high arousal negative words faster than positive words yielded significant results, $t(50) = 2.76$, $p = .008$. High arousal negative words are found faster than neutral words, $t(50) = 2.02$, $p = .048$. There is no significant difference between positive and neutral words when looking at RT, $t(50) = –1.27$, $p = .207$.

Error rates

Average error rates for positive words were 36 %, for neutral words 15 % and for high arousal negative words 48 %, as can be seen in **Figure 3**. The repeated measures ANOVA indicated a significant main effect of word type, $F(2, 50) = 144.8$ $p < .001$, $\eta_p^2 = 0.855$. The subsequent paired examples t-test we used to confirm our ANOVA and to confirm the significance between every pair revealed a significant difference between positive and neutral words, $t(50) = 9.76$, $p < .001$, positive and high arousal negative words, $t(50) = –6.04$, $p < .001$, as well as between high arousal negative words and neutral words, $t(50) = 14.81$, $p < .001$. High arousal negative words show a higher mistake rate than neutral and positive words do. Participants made the fewest mistakes when seeing neutral words

Discussion

Findings from this study suggest that high arousal negative words are found faster even in a complex setting such as a WGT. The new paradigm we created (WGT) is more complex than the former used LDT and therefore depicts the complexity of the real world better.

In the first part of our experiment the participants were confronted with a LDT, in which each word was presented twice. The first part of our experiment was there to ensure faster and more accurate processing in the second part of the experiment, the WGT. In the word grid the participants had to find a target word that was neutral, positive or high arousal negative. Our results show that negative high arousal words are found faster than positive words. This shows that even in a complex setting faster lexical processing happens when looking at negative high arousal words. Interestingly, when looking at the error rate one can see that the participants also made significantly more mistakes when seeing word grids with high arousal negative words, compared to both positive and neutral words.

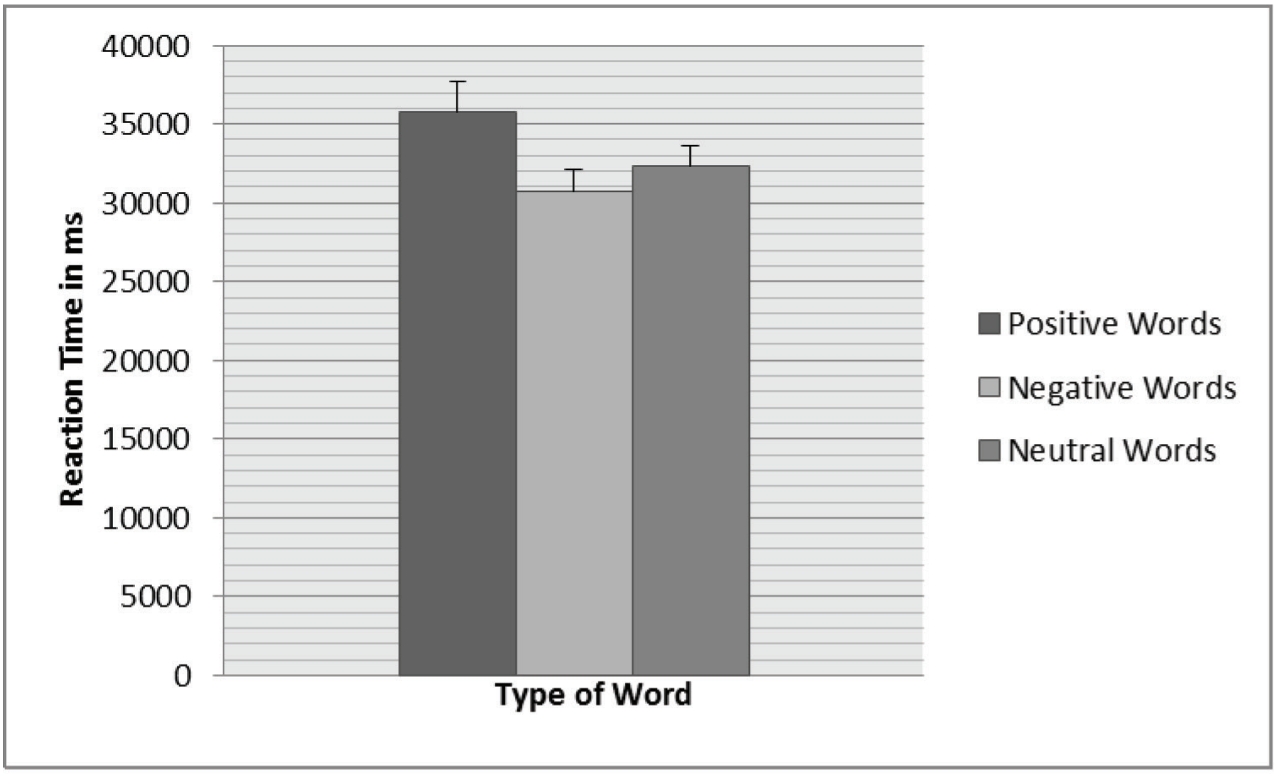

Figure 2: Mean RTs for neutral, positive, and high-arousal negative words. Error bars represent 1 *SE*.

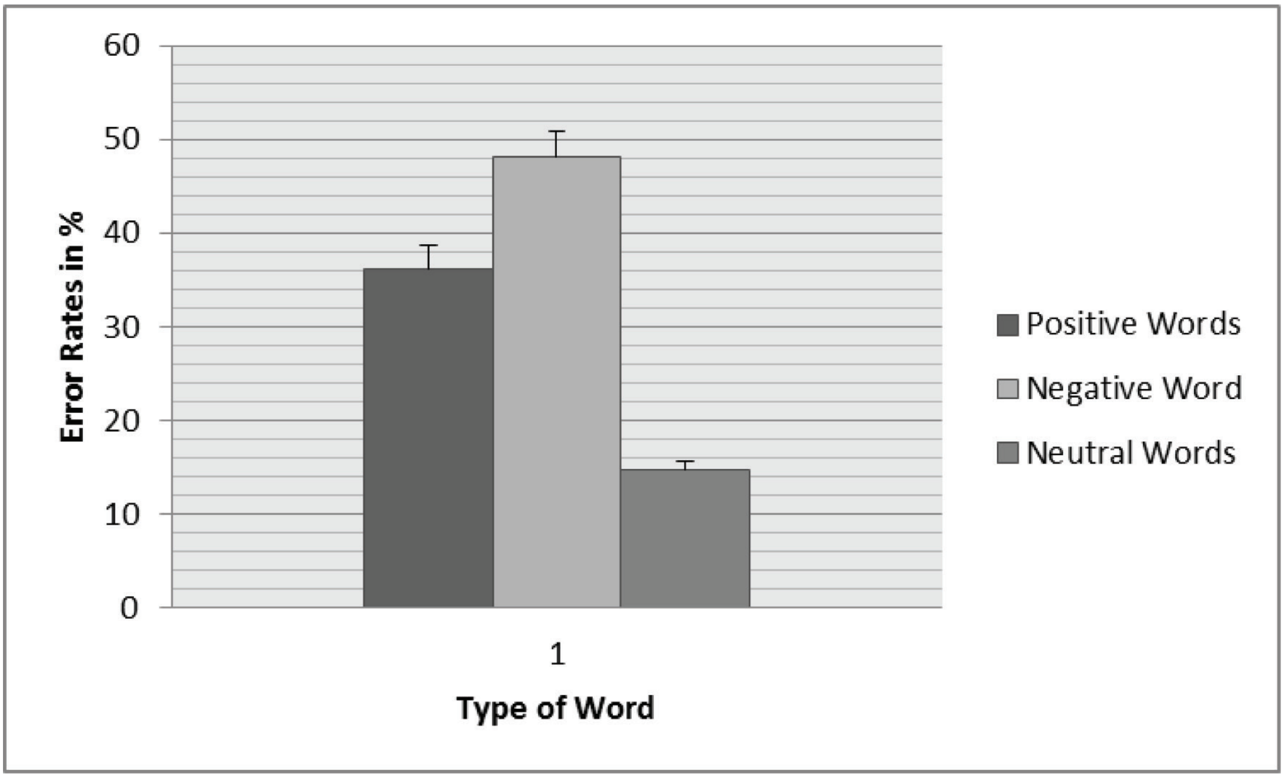

Figure 3: Error rate in percent for neutral, positive, and high-arousal negative words. Error bars represent 1 *SE*.

Negative emotions play an important role in our evolutionary past. They warn us about upcoming danger and provoke lifesaving reactions (Lang et al., 1998). When a human detects a negative emotion he or she might be in a situation where he or she has to react fast in order to protect him- or herself (Taylor, 1991). Therefore it is only logical to predict faster RT for negative emotions than for positive emotions or in cases where there is no emotion evoked at all. This phenomenon can be transferred to word stimuli (Altarriba, Bauer, & Benvenuto, 1999). Words are symbols representing objects in our environment and we use semantic connections between words and real world objects.

Different physiological, affective, cognitive, and behavioural activational patterns are evoked through emotional stimuli, including, in the case of our experiment, both negative high arousal words and positive words (Heller, 1993). These activational patterns meet the requirements of the stimulus. For example, if a human sees a negative stimulus he will react with short term mobilization and with long term minimization (Taylor, 1991). Cannon (1932) described the fight or flight reaction as a reaction, of humans and other animals, to upcoming danger or to negative situations, where the body reacts according to a specific pattern of intensive physiological changes. Levinthal (1990) further described that in the fight or flight reaction the body is activated very fast by the sympathetic nervous system as well as the endocrine system when confronted by danger. Following this reaction of the body, the parasympathetic nervous system activates itself, which makes the arousal become less strong in a short amount of time. This causes blood pressure, heartrate, the rate of catabolism and also breathing, to become slower. Usually the body quickly switches back to its normal functional state.

Hagenaars, Oitzl, and Roelofs, (2014) also described another very important mechanism called freezing. The freezing system is associated with a typical physiological response. When a stimulus is perceived as threatening neural circuits get activated to adapt to the demand of the stimulus. The nervous system is the most well-known, closely followed by the glucocorticoid stress system. In freezing, the two opposing parts of the autonomic nervous system, the sympathetic and the parasympathetic system, become activated. Depending on the nature of the stimulus one of the systems reacts. The sympathetic system is expressed by an increase of the arousal and physical symptoms that support the freezing response, being for example hyper-responsiveness or a short term decrease of the body temperature (Fendt & Fanselow, 1999).

The physiological arousal occurs in negative as well as positive situations. Levinthal (1990) proposed that the implications of negative arousal are greater than of positive arousal. This leads us to the idea that arousal is more likely to be interpreted negatively than positively (Taylor, 1991). The mobilization leads to faster RT when confronted with a negative stimulus in recall tasks and should therefore lead to faster RT when confronted with negative word stimuli, as they are symbols for emotionally negative objects (Tausczik & Pennebaker, 2010). Our results do support this idea and also align with former studies, especially those of Hofmann et al. (2009). Although our experimental methodology differed from Hofmann et al. (2009), who used an anagram task, our results are the same. This indicates a robust effect.

This study offers a new aspect in the contentious field of emotional word research. Since former studies showed discrepancies on the result of this topic (Kousta et al., 2009; Kuchinke et al., 2006; Larsen et al., 2008; Yap & Seow, 2014), we concentrated on the dimension of arousal when choosing the words for our experiment. In some former studies researchers did not differentiate between dimensions of valence and arousal (Kuchinke et al., 2006; Larsen et al., 2008), which is a possible reason for different experimental outcomes.

The most popular task used in the emotional word research is the LDT (Hofmann et al., 2009; Kousta et al., 2009). Our results are interesting because we did not use an LDT, but a more complex one, in which the participant has to find the target word surrounded by distractor letters. The LDT at the beginning of our experiment was only there to improve the overall processing in the second task and therefore to reduce motivational deficits and higher mistake rates. Since the before-seen word stimuli were still active in short term memory (Baddeley, 1992), the participants were able to react faster in the second task. The LDT therefore only functioned as help for better processing on the actual task.

The WGT format ensures that the participant does not only have a given number of letters that have to be ordered to form a word (as is true for the anagram task used in Hofmann et al., 2009), but they have to find the word within a number of distractors (as can be seen in **Figure 1**). Also, no effects of word position can affect the outcome since no word was shown in the border areas of the word grid. These processes underline the complexity of our new paradigm. Our results show that humans are more sensitive to high arousal negative words then they are to neutral or for positive ones. This points out that humans are able to react to dangerous stimuli fast, even when they are within a complex environmental setting. The evolutionary mechanism therefore seems to be working for symbols like word stimuli as well.

The interpretation of data showed that the error rates were significantly higher for high arousal negative words than they were for positive and for neutral words, although the former showed faster RT when they were found. This can be explained by looking at our working memory. Emotional arousal can have an effect on the performance of working memory, leading to less accuracy when processing stimuli (Kensinger & Corkin, 2003). The processing of emotionally loaded stimuli has a beneficial impact on the transmission of the stimulus material from working memory to long term memory. This leads to reflective effects on the accuracy and therefore limits the overall ability to perform well. Solving a task becomes more error prone (Kensinger & Corkin, 2003).

Fox, Russo, Bowles, and Dutton (2001), explain that negative stimuli do not actually demand more attentional capacity than positive or neutral stimuli, but attention has to be engaged for a longer time, since it can be life threatening to dismiss a negative stimulus or emotion too early. As our working memory can only hold so many stimuli at the same time, a longer engagement for negative stimuli can lead to fewer available resources for other stimuli. This in turn may lead to the dismissal of some stimuli. This process can be responsible for our result; that the participants made as many mistakes as they did. This could explain why there are more mistakes for high arousal negative words. It is important though to examine this in a further study to clarify the process behind this phenomenon.

Data analysis shows longer RT for positive words than for high arousal negative words. This finding could also be explained with the unique nature of our WGT paradigm. High arousal negative words could show a pop-out effect. The pop-out effect has been widely discussed in the visual search paradigm. In visual search the participant sees a display that contains a target stimulus and some distractor stimuli. If drawing the line to our WGT, the actual word can be seen as the target stimulus, while the letters that surround the word can be seen as distractor stimuli. The participant then has to find the target stimulus or has to make the decision that there is no target stimulus to be found. After the target stimulus was found or the decision was made that there is no target stimulus within the search display, the reaction time is being measured. This procedure is similar to our experiment, where the participant has to push the space key when he or she finds the target word, which measures the time it took him or her to find the word. In our experiment there were no word grids without target stimulus.

In experiments concerning the visual search paradigm, the reaction time is now compared to the display size, meaning the number of distractors shown on the search display (Treisman & Gelade, 1980). Through this comparison different reaction time search functions can be shown. Based on the findings of many visual search experiments, Treisman and Gelade, (1980) suggested the difference of two separate search modes; the parallel search and the serial search. If the search function does not change with the size of the search display one can assume that the items within the search display are scanned simultaneously, that is, parallel. If the search function, on the other hand, shows a linear function we assume that the items are scanned gradually, that is, serial. For the parallel search the target stimuli seem to pop out of the display and can be seen almost immediately after looking at the search display. This phenomenon describes the pop-out effect. Treisman and Gelade (1980) deduced, when looking at the search function of the parallel search paradigm, that the finding of the target had to rely on preattentional search processes.

High arousal negative words could show a pop-out effect within the WGT, which then would lead to faster RT. It is possible that when looking at the word grid containing a high arousal negative word, the word evokes emotion before having consciously been seen. It then drives the attention toward the word, which will lead the participant to find the word. Since there is no reason for us to be especially aware of positive word stimuli (Lang et al., 1998), it is not surprising that this effect can only been seen for high arousal negative words. For high arousal negative words there is a reason for higher alert, and this explains why there is a faster RT for high arousal negative words.

To show whether the suggestion of the pop out effect for high arousal negative words, within the WGT, is correct, a follow up experiment should be made, in which the size of the word grid and therefore the number of distractor letters is varied. If the high arousal negative words are still found faster even with a bigger size word grid, the pop-out effect does exist in this new paradigm. Also, in a further study not only high-arousal negative words should be taken into account, but also low-arousal negative words. This would clarify whether the effects are due to the arousal of the word or if there might be other processes that have to be taken into account. The meaning of the dimensions of valence and arousal for emotional word research could be underlined by that. If negative words with only a controlled valence instead of also a controlled arousal show a slower RT, the idea that arousal is more relevant than valence in the processing of emotional words (Nakic et al., 2006) can be supported.

We do not expect the participant affective state to interfere with the results of our experiment, as Hofmann et al. (2009) as well as Thomas and LaBar (2005) were able to show that there are no priming effects for high arousal words. To make sure that there is no effect, the participants' current mood should be taken into account. This study is important for future research because it underlines the importance of the dimension of arousal for emotional word research. It also shows that when the arousal is controlled, faster RT for negative words can be seen. Since the environment in which we have to act every day is very complex it is immensely important to test how humans react in situations in which many different stimuli are presented to them at the same time. For this reason it is important to test whether existing paradigms also work in complex settings.

Acknowledgements

I would like to thank Markus J. Hofmann and the class of experimental psychology of the university of Wuppertal for helping and supporting me in writing this paper.

References

Altarriba, J., Bauer, L. M., & **Benvenuto, C.** (1999). Concreteness, context availability, and imageability ratings and word associations for abstract, concrete, and emotion words. *Behavior Research Methods, Instruments & Computers*, *31*(4), 578–602. DOI: http://dx.doi.org/10.3758/BF03200738

Baayen, R. H., Piepenbrock, R., & **van Rijn, H.** (1993). The CELEX lexical database [CD-ROM]. Philadelphia: University of Pennsylvania, Linguistic Data Consortium.

Baddeley, A. D. (1992). Working memory: The interface between memory and cognition. *Journal of Cognitive Neuroscience*, *4*(3), 281–288. DOI: http://dx.doi.org/10.1162/jocn.1992.4.3.281

Bargh, J. A., Chaiken, S., Govender, R., & **Pratto, F.** (1992). The generality of the automatic attitude activation effect. *Journal of Personality And Social Psychology*, *62*(6), 893–912. DOI: http://dx.doi.org/10.1037/0022-3514.62.6.893

Cahill, L., & **McGaugh, J. L.** (1998). Mechanisms of emotional arousal and lasting declarative memory. *Trends in Neurosciences*, *21*(7), 294–299. DOI: http://dx.doi.org/10.1016/S0166-2236(97)01214-9

Cannon, W. B. (1932). *The wisdom of the body*. New York, NY: W W Norton & Co.

De Pascalis, V., Strippoli, E., Riccardi, P., & **Vergari, F.** (2004). Personality, event-related potential (ERP) and heart rate (HR) in emotional word processing. *Personality and Individual Differences*, *36*(4), 873–891. DOI: http://dx.doi.org/10.1016/S0191-8869(03)00159-4

Fendt, M., & **Fanselow, M.S.** (1999). The neuroanatomical and neurochemical basis of conditioned fear. Neurosci. Biobehav. Rev. 23, 743–760

Fox, E., Russo, R., Bowles, R., & **Dutton, K.** (2001). Do threatening stimuli draw or hold visual attention in subclinical anxiety? *Journal of Experimental Psychology: General*, *130*(4), 681–700. DOI: http://dx.doi.org/10.1037/0096-3445.130.4.681

Hagenaars, M. A., Oitzl, M., & **Roelofs, K.** (2014). Updating freeze: aligning animal and human research. *Neuroscience & Biobehavioral Reviews*, *47*, 165–176.

Heller, W. (1993). Neuropsychological mechanisms of individual differences in emotion, personality, and arousal. *Neuropsychology*, *7*(4), 476–489. DOI: http://dx.doi.org/10.1037/0894-4105.7.4.476

Hofmann, M. J., Kuchinke, L., Tamm, S., Võ, M. H., & **Jacobs, A. M.** (2009). Affective processing within 1/10th of a second: High arousal is necessary for early facilitative processing of negative but not positive words. *Cognitive, Affective & Behavioral Neuroscience*, *9*(4), 389–397. DOI: http://dx.doi.org/10.3758/9.4.389

Holcomb, P. J., & **Neville, H. J.** (1990). Auditory and visual semantic priming in lexical decision: A comparison using event-related brain potentials. *Language and Cognitive Processes*, *5*(4), 281–312. DOI: http://dx.doi.org/10.1080/01690969008407065

Jansen, A. S., Van Nguyen, X., Karpitskiy, V., Mettenleiter, T. C., & **Loewy, A. D.** (1995). Central command neurons of the sympathetic nervous system: Basis of the fight-or-flight response. *Science*, *270*(5236), 644–646.

Kakolewski, K. E., Crowson Jr., J. J., Sewell, K. W., & **Cromwell, R. L.** (1999). Laterality, word valence, and visual attention: A comparison of depressed and non-depressed individuals. *International Journal of Psychophysiology*, *34*(3), 283–292. DOI: http://dx.doi.org/10.1016/S0167-8760(99)00085-9

Kensinger, E. A., & **Corkin, S.** (2003). Memory enhancement for emotional words: Are emotional words more vividly remembered than neutral words? *Memory & Cognition*, *31*(8), 1169–1180. DOI: http://dx.doi.org/10.3758/BF03195800

Klauer, K., & **Musch, J.** (2003). Affective priming: Findings and theories. In J. Musch, & K. Klauer (Eds.), *The psychology of evaluation: Affective processes in cognition and emotion*. (pp.7–49). Mahwah, NJ: Lawrence Erlbaum Associates Publishers.

Kousta, S., Vinson, D. P., & **Vigliocco, G.** (2009). Emotion words, regardless of polarity, have a processing advantage over neutral words. *Cognition*, *112*(3), 473–481. DOI: http://dx.doi.org/10.1016/j.cognition.2009.06.007

Kuchinke, L., Jacobs, A. M., Võ, M. H., Conrad, M., Grubich, C., & **Herrmann, M.** (2006). Modulation of prefrontal cortex activation by emotional words in recognition memory. *Neuroreport: For Rapid Communication of Neuroscience Research*, *17*(10), 1037–1041. DOI: http://dx.doi.org/10.1097/01.wnr.0000221838.27879.fe

Lane, R. D., Chua, P. M., & **Dolan, R. J.** (1999). Common effects of emotional valence, arousal and attention on neural activation during visual processing of pictures. *Neuropsychologia*, *37*(9), 989–997. DOI: http://dx.doi.org/10.1016/S0028-3932(99)00017-2

Lang, P. J., Bradley, M. M., & **Cuthbert, B. N.** (1998). Emotion, motivation, and anxiety: Brain mechanisms and psychophysiology. *Biological Psychiatry*, *44*(12), 1248–1263. DOI: http://dx.doi.org/10.1016/S0006-3223(98)00275-3

Larsen, R. J., Mercer, K. A., Balota, D. A., & **Strube, M. J.** (2008). Not all negative words slow down lexical decision and naming speed: Importance of word arousal. *Emotion*, *8*(4), 445–452. DOI: http://dx.doi.org/10.1037/1528-3542.8.4.445

LeDoux, J. E. (1996). *The emotional brain: The mysterious underpinnings of emotional life*. New York, NY: Simon & Schuster.

Levinthal, C. F. (1990). *Introduction to physiological psychology (3rd ed.)*. Englewood Cliffs, NJ: Prentice-Hall, Inc.

Meyer, D. E., & **Schvaneveldt, R. W.** (1971). Facilitation in recognizing pairs of words: Evidence of a dependence between retrieval operations. *Journal of Experimental Psychology*, *90*(2), 227–234. DOI: http://dx.doi.org/10.1037/h0031564

Morris, J. S., Öhman, A. A., & **Dolan, R. J.** (1998). Conscious and unconscious emotional learning in the human amygdala. *Nature*, *393*(6684), 467–470. DOI: http://dx.doi.org/10.1038/30976

Nakic, M., Smith, B. W., Busis, S., Vythilingam, M., & **Blair, R. J. R.** (2006). The impact of affect and frequency on lexical decision: the role of the amygdala and inferior frontal cortex. *Neuroimage*, *31*(4), 1752–1761.

Pratto, F., & **John, O. P.** (1991). Automatic vigilance: The attention-grabbing power of negative social information. *Journal of Personality and Social Psychology*, *61*(3), 380–391. DOI: http://dx.doi.org/10.1037/0022-3514.61.3.380

Price, C. J., & **Devlin, J. T.** (2003). The myth of the visual word form area. *Neuroimage*, *19*(3), 473–481.

Riemann, B. C., & **McNally, R. J.** (1995). Cognitive processing of personally relevant information. *Cognition and Emotion*, *9*(4), 325–340. DOI: http://dx.doi.org/10.1080/02699939508408970

Schmalz, M. (2011). Suchsel [Computer software]. Retrieved on 12.10.2013 from http://www.suchsel.de.vu/

Scott, G. G., O'Donnell, P. J., Leuthold, H., & **Sereno, S. C.** (2009). Early emotion word processing: Evidence from event-related potentials. *Biological Psychology*, *80*(1), 95–104. DOI: http://dx.doi.org/10.1016/j.biopsycho.2008.03.010

Scott, G. G., O'Donnell, P. J., & **Sereno, S. C.** (2014). Emotion words and categories: Evidence from lexical decision. *Cognitive Processing*, *15*(2), 209–215. DOI: http://dx.doi.org/10.1007/s10339-013-0589-6

Tausczik, Y. R., & **Pennebaker, J. W.** (2010). The psychological meaning of words: LIWC and computerized text analysis methods. *Journal of Language and Social Psychology*, *29*(1), 24–54. DOI: http://dx.doi.org/10.1177/0261927X09351676

Taylor, S. E. (1991). Asymmetrical effects of positive and negative events: The mobilization-minimization hypothesis. *Psychological Bulletin*, *110*(1), 67–85. DOI: http://dx.doi.org/10.1037/0033-2909.110.1.67

Thomas, L. A., & **LaBar, K. S.** (2005). Emotional arousal enhances word repetition priming. *Cognition and Emotion*, *19*(7), 1027–1047. DOI: http://dx.doi.org/10.1080/02699930500172440

Treisman, A. M., & **Gelade, G.** (1980). A feature-integration theory of attention. *Cognitive Psychology*, *12*(1), 97–136.

Võ, M. H., Conrad, M., Kuchinke, L., Urton, K., Hofmann, M. J., & **Jacobs, A. M.** (2009). The Berlin Affective Word List Reloaded (BAWL–R). *Behavior Research Methods*, *41*(2), 534–538. DOI: http://dx.doi.org/10.3758/BRM.41.2.534

Yap, M. J., & **Seow, C.** (2014). The influence of emotion on lexical processing: Insights from RT distributional analysis. *Psychonomic Bulletin & Review*, *21*(2), 526–533. DOI: http://dx.doi.org/10.3758/s13423-013-0525-x

How to cite this article: Palma de Figueiredo, R. (2015). Pop-Out Effect of Negative Words in a Word-Grid Task? *Journal of European Psychology Students,* 6(1), 53–61, DOI: http://dx.doi.org/10.5334/jeps.cx

Published: 14 July 2015

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