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# Emotion Processing in the Survival Paradigm

Destiny Valentine

*University at Albany, State University of New York*, dvalentine@albany.edu

**Emotion Processing in the Survival Paradigm**

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Destiny Valentine

Research Mentor: Allison Wilck, M.A.
Research Advisor: Jeanette Altarriba, Ph.D.
Second Reader: Heather Sheridan, Ph.D.

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**Abstract**

The literature shows that words processed according to their survival relevance typically produce a memory advantage. Similarly, words containing an emotional connotation tend to lead to better memory. The current study examined whether combining both the survival processing effect and the emotion processing advantage would cause an interaction that amplified the effects on memory. Using a modified version of the traditional survival processing paradigm, participants rated emotion words (positive, negative, or neutral) on their relevance to a survival context or home-moving control context. They were later given a surprise recall task for the rated words. The results did not show a survival processing effect regardless of emotional valence. However, there was a significant effect in the amount of intrusions (i.e., false memory) for the conditions that contained negative emotion words. More research is needed to see if emotion words are a boundary condition to the robust survival processing effect.

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## Emotion Processing in the Survival Paradigm

The workings of memory have been studied for decades within the field of psychology. What makes certain words and events more memorable than others? To understand the answer to questions like these, researchers have tested the effects of word type, situational memory, and physiological effects (like emotional arousal) on memory to determine the best mnemonic device.

### The Survival Processing Effect

The survival processing effect is a robust memory phenomenon originally identified by Nairne, Thompson, and Pandeiranda (2007). Throughout their experiments, they found that participants had higher retention rates when processing words in terms of their survival value. The concept relies on the idea that there is an evolutionary framework that allows for an advantage when remembering survival-related information. Humans have evolved to tune memory to focus on information that enhances survival, such as remembering the location of food supplies, how to protect themselves from predators, and how to find a mate (Nairne et al., 2007). By remembering this type of information, our ancestors survived long enough to reproduce and pass along their genetics, including this memory advantage. We can see the effect when we are told to imagine ourselves in conditions similar to ones our ancestors would have been in. Therefore, when Nairne et al. (2007) asked participants to rate words based on their survival relevance in a grassland, they found a higher rate of recall (Experiments 1 & 2) and recognition (Experiment 3) of those words later on, as compared to other established control conditions (self-relevance, pleasantness, and moving relevance). Weinstein, Bugg, and Roediger (2008) concluded that our memory is better when recalling information that evolved from environments our ancestors might have been in (grasslands) as compared to modern day environments (e.g., cities), since our cognitive processes were first formed in such settings.

The survival processing effect has been replicated across a number of variables including with children (Otgaar & Smeets, 2010), visual stimuli (pictures; Otgaar, Smeets, & van Bergen, 2010), intentional learning and rating words on imageability (Nairne, Pandeirada, & Thompson, 2008) and in comparison to modern-day city environments (Weinstein et al., 2008) and vacationing (Nairne et al., 2008). Each study has reported finding superior memory for information encoded from a survival standpoint in comparison to other control conditions.

However, despite studies supporting the survival advantage, there have been others who question the mechanisms causing the effect. Soderstrom and McCabe (2011) tested the idea that ancestral scenarios would have better recall than modern scenarios (e.g., city vs. grasslands). Although Soderstrom and McCabe did find a survival-processing effect in comparison to their pleasantness control, their results showed higher recall for threats that have never been faced before by humans (zombies) over ancestral threats (predators). A possible explanation of the results could be that participants were more familiar with the idea of a zombie, which has been popularized by the media, and were able to create a specific image in their head in comparison to a generalized term, such as predator, as is used in the original Nairne et al. (2007) scenarios. The ability to specifically encode the type of threat allowed for words processed from a survival perspective to be recalled at a high rate. These results questioned whether prioritizing ancestral situations or environments is needed for enhancing memory.  Notably, other studies did find a survival advantage when testing the difference across ancestral environments (grasslands vs. city; Weinstein et al., 2008). However, different designs were used (between- vs. within-subjects), which can lead to the assumption that the results are limited to within-subjects designs.

Regardless, the varying results pose questions about what is causing the survival advantage and whether there may be possible boundary conditions.

Kroneisen and Erdfelder (2011) argued that richness of encoding can explain the survival processing effect. In their experiments, they asked participants to recall words based on specific problems (e.g., surviving without any water) in comparison to Nairne's general surviving in the grassland scenario. Specific scenarios had lower recall rates than the general scenario, despite both involving survival-relevant information. The authors argued that generalized scenarios allow the individual to make multiple associations for each word during encoding, which then increases the amount of retrieval cues for later recall. They concluded that survival relevance is not the main mechanism behind enhanced recall. Instead, generalized survival scenarios invite elaborate and distinctiveness encoding for words, leading to the survival processing effect.

Additionally, studies have noted that although memory is recalled better in these survival situations, it also leads to an increase in false memory (Otgaar & Smeets, 2010). Participants in the survival condition had the highest recall for both correct words and intrusions. Thus, when net accuracy was considered, the survival processing effect disappeared. They concluded that false memory was caused by participants using gist memory traces as opposed to remembering specific instances from the study phase. During recall, participants were activating memory networks for items that were not presented directly but might be related to the target word (Cho, Kazanas, & Altarriba, 2018). This form of processing is known as the Fuzzy Trace Theory (Brainerd & Reyna, 1990). Their results showing an increase in false memory led Otgaar and Smeets to question whether survival processing is an adaptive memory strategy after all.

Studies that have tested or replicated the survival processing effect typically use the original word list provided by Nairne and his colleagues (2007). In three experiments conducted by Butler, Kang, and Roediger (2009), they tested whether changing the words would affect the emergence of the survival processing advantage. Butler et al. first experiment used the original words from Nairne et al. (2007) and was able to replicate the survival processing effect. Experiments 2 and 3 contained words that were rated high in congruency to their chosen scenarios (survival or a bank robbery) and irrelevant words to see if recall was affected by congruency effects. The robbery scenario asked participants to imagine they were leading a heist in a guarded bank. They were told to rate the words on the relevancy to creating a plan, gathering supplies, and finding people to help them complete the heist. Words highly congruent to survival included words such as *shelter, rescue, blanket,* while words highly congruent to a bank robbery included *clerk, vault, mask.* Irrelevant words included words such as *table, spoon, rake*. Participants rated words from each category according to relevance of their randomly assigned condition (survival or robbery) and were later given a recall task. Results indicated that there was higher recall for words that were congruent to their respective scenario. When comparing recall rates for condition-congruent words, there was no survival processing advantage: context congruent words encoded from a survival perspective were recalled at the same rate as words encoded from a robbery perspective. Butler et al. concluded that congruency effects are important to keep in mind when discussing the survival processing advantage. A word's congruence and context have an impact to how they are processed and later remembered.

Although additional studies may be needed to further understand the mechanisms driving the survival processing effect or to identify possible boundaries conditions, the literature has deemed the survival processing effect to be one of the top memory mnemonic devices, overall.

**The Emotion Processing Advantage**

Another major mechanism for improving memory is emotion processing (see Bradley & Lang, 2000 for a review). Emotional stimuli have been found to have a processing advantage in various contexts including with the use of facial imagery (Frischen, Eastwood, & Smilek, 2008), phobic or threatening objects (Brosch & Sharma, 2005), and reading words in a sentence (Knickerbocker, Johnson, & Altarriba, 2015).

In comparison to concrete (e.g., chair, computer) and abstract (e.g., justice, love) words, emotion (e.g., happy, distressed) words tend to lead to a memory advantage. Altarriba and Bauer (2004) were among the first in the literature to display such word effects. In their experiment, participants were explicitly told to remember as many words as possible for a later recall test. One type of word list (concrete, emotion, or abstract) was presented auditorily to participants. The difference in recall rates led the authors to conclude that the word types are processed differently. Emotion words were recalled at the highest rate, followed by concrete, then abstract words. As a follow-up, Altarriba and Bauer asked participants to rate the three types of words on concreteness, imageability, and context availability. Concreteness refers to the realness of a word; a word that can be identified through one of the five senses (e.g., 'chair' is concrete because you can touch it). Imageability is the ease of creating an image in your head related to the word (e.g., being able to picture a 'chair' in your mind). Context availability is the ability to think of a context or circumstance where the word can be recalled (e.g., 'chair' is a high frequency word). Regardless of word type, recall was greatest for words that were rated highly in these dimensions. However, emotion words were rated higher on imageability and context availability than abstract words but lower on concreteness. For example, the word *happy* is easy to create an image of and think of a context for when a person might be happy, but it cannot physically be touched, or smelt. Additionally, emotion words were rated lower on all three scales compared to concrete words. Though the ratings may not explain the higher recall of emotion words, it does indicate that emotion words activate different properties than abstract and concrete words, which might affect memory.

An explanation for enhanced memory of emotion words is the dual coding hypothesis. It states that certain types of words are easier to recall because they allow for the word to be coded into both verbal and nonverbal mental representations (Clark & Paivio, 1991). Verbal representations include visual, auditory or articulatory codes that act as symbols for concrete and abstract ideas. Whereas nonverbal representations include images for shapes, sounds, actions, or other nonlinguistic objects (Clark & Paivio, 1991). The idea is that the two types of representations are linked to one another through word associations. The activation of one leads to the activation of the other. Concrete words have both a verbal and nonverbal representation (e.g., "book" can have a verbal code and image to correspond to its shape). Abstract words do not have a nonverbal representation. The dual encoding of concrete words makes them easier to recall. It is suggested that emotion words also contain a nonverbal mental representation, leading to higher rates of recall (Altarriba & Bauer, 2004). Emotion words also tend to have higher amounts of associated words or experiences. When asked to write down meaningfully related words to the target stimuli, emotion words generated a greater number of associations than concrete and abstract words (Altarriba, Bauer, & Benvenuto, 1999). These associations are all activated during recall giving emotion words additional retrieval cues. The dual coding of emotion words creates a processing advantage.

Emotion words also differ from concrete and abstract words because they have a measure of arousal and valence. Arousal is the amount of excitement and energy associated with a given word, while valence is the direction of the emotional association of a word (Knickerbocker et al., 2015). For example, *joy* is rated high in both valence and arousal which would make it a strong positive emotion word. *Horror,* though low on valence, is high in arousal, as is often the case with negative emotion words.

Research has been conducted to examine the effects of the type of emotion words on memory. Kensinger and Corkin (2003) studied the effects of negative emotion words versus neutral words on memory. Negative words differed than neutral words because they were higher in arousal and lower in valence. In Experiment 1, they visually presented the stimuli on a computer while having the participants rate the words on concreteness and abstractness. Participants were told they would receive a recognition test after the ratings. Participants either had to give one of three responses: *remember* (indicating that they vividly remembered seeing the word on the list); *knew (*indicating that the word was familiar and that they believed it had been shown) or *new* (indicating it was not previously presented). Results showed that participants were more likely to rate the negative words as having been vividly remembered as compared to the neutral words. The results were replicated in their follow-up experiment where they tested source memory (font color) on negative and neutral words. Additionally, they tested memory for taboo words (high in both arousal and valence). Recall and recognition was highest for taboo words, followed by negative and neutral words, showing that both valence and arousal play a role in enhancing memory. The authors concluded that individuals have a better detailed memory for negative events than neutral ones due to the enhanced distinctiveness, and attentional bias of negative emotional events.

Furthermore, other studies have tested memory effects of emotion words (both negative and positive) in comparison to neutral words. Tse and Altarriba (2009) had participants conduct a serial recall task of emotion and neutral words. The words were separated by valence (positive, negative, neutral) and concreteness (concrete vs. abstract). Tse and Altarriba's results indicated that the known concreteness effect (concrete words are remembered at higher rates than other word types) did not occur for negative emotion words due to an interaction between concreteness and valence. Adding emotionality (negative valence) to a concrete word limited its ability to be remembered at the rate typical for non-emotion concrete words. One possible explanation is that the words did not possess a *strong* negative valence. Mildly valent cues may cause people to divert their attention away from the target, whereas intense emotional stimuli cause attention to be directed toward the target (Mackintosh & Mathews, 2003). Both concreteness and valence allow for a deeper encoding of a word. However, in this study, the low valence of the word caused attention to be averted, degrading the encoding of the word and its respective recall later. The findings from this research shed light on possible confounds from previous studies that might have ignored the effects of concreteness on emotion stimuli.

An evolutionary stance can be used to understand why emotions (specifically negative emotion) often have a processing advantage. Emotions are categorized into two motivational systems. The defensive system involves threatening context, causing you to think about withdrawal, and escaping an attack. The appetitive system is meant to focus on other contexts that promote survival such as reproduction, nurturance, and ingestion (Bradley, Codispoti, Cuthbert, & Lang, 2001). Activation of each system subsequently produces a physiological response in both humans and animals. When showing participants pictures of unpleasant threatening stimuli such as animal attacks, human attacks, and body mutilations, Bradley et al. found that the pictures elicited large skin conductance responses, evoked high startle reflex potentiation, cardiac deceleration, and were rated the most arousing. The function of the physiological responses is to allow humans to increase attention, social communication, and mobilize for defensive behavior. The prioritization of information involving threatening and survival-related material through our withdrawal-aversive system typically leads to negative stimuli being processed quicker than positive stimuli (Knickerbocker et al., 2015).

Accurate or vivid details of negative events are more likely to be remembered than positive events, especially when the perceived outcome of the event was negative (Kensinger, 2009). Other studies have shown that the type of details remembered for events vary depending on the emotion experienced. Positive emotions tend to enhance peripheral details (those relating to the event but may be irrelevant), while negative emotions enhance central details (main concept; gist) (Talarico, Berntsen, & Rubin, 2009). A possible explanation for these differences is that during negative events, we narrow our focus to what/who is causing the intensity of our emotion. In positive events, we want to enhance our positive experience by focusing on everything around us. Therefore, the type of emotion you are experiencing can affect the type of details you remember.

However, like other mnemonic devices, the emotion processing advantage does have limitations. Studies have shown that, though emotion may increase true recall and recollection, it also increases the amount of false memory, as well. Specifically, negatively valenced words cause an increase of false memory, while positively valenced words have the opposite effect. In experiments conducted by Brainerd, Stein, Silveira, Rohenkohl, and Reyna (2008), they presented the word stimuli either visually or auditorily and then had participants take a recognition test that included verbatim (was it presented), gist (is it an unpresented word with the same meaning as a presented word), or a verbatim-plus-gist (combination of both statements) questions. Their results showed that negatively valenced words had higher rates of false memory, followed by neutral and lastly positive words. They concluded that false memory was caused by an increase in similarity judgement and a decrease in the use of verbatim processing. Participants accepted the distractor word as being presented because of the word's high semantic relatedness to the target. Additionally, as valence becomes more negative, a person's ability to suppress the acceptance of a false distractor word decreases. This finding is similar to one presented earlier that stated that negative events and words are more likely to be processed using gist traces rather than verbatim ones (Talarico et al., 2009). It should be noted that positively valenced words had the highest rate of verbatim processing which led to the lowest rate of false memory. Emotion words have also been shown to have higher rates of false memory in comparison to concrete and abstract words (Bauer, Olheiser, Altarriba, & Landi, 2009).

**Current Study**

Our current study aims to find a strong mnemonic device by combining both survival processing and emotion stimuli. To our knowledge, no one has yet to use emotion words when studying the survival processing effect. Using Nairne et al.'s (2007) original survival and moving conditions, we switched the study words to either have a positive, negative, or neutral emotionality. We hypothesized that participants would have the highest recall in the survival condition that included negative emotions words. Since the survival condition is a threatening event and has a possible negative outcome, we hypothesized that participants would pay the most attention to detail of the words they rated, in comparison to the moving situation. If so, we would find a survival processing effect despite the emotionality of the words. We also hypothesized an interaction that would lead to a higher rate of recall for negative words. The interaction between survival and negatively valenced words would come from the congruency of negative emotion and a negatively arousing experience (threat of survival).

## Experiment 1

### Methods

**Participants.** One hundred twenty-two students from the University at Albany, State University of New York participated in the experiment in exchange for partial course credit or monetary reward. Five participants were removed from analysis because they either appeared distracted during the tasks or English was not their first language. All of the participants were at least eighteen years old, had normal or corrected-to-normal vision and were fluent in English. A 2 (scenario: survival or moving) x 3 (Word valence: positive, negative, neutral) between-subjects design was used, in which participants were randomly assigned to a condition.

**Materials.** All emotion and neutral (concrete) words were retrieved from Knickerbocker et al. (2015), who found that emotion words had shorter fixation lengths when tracking eye movements in sentence reading. Participants also showed an emotion advantage in recall and reaction time (RT) measurements. Knickerbocker et al. stated the emotion advantage was due to the participants being able to semantically process emotion words quicker than neutral words. The words were selected from the ANEW database and matched on word frequency, length, orthographic neighborhood size, mean naming RT and mean lexical decision task (LDT) RT (Knickerbocker et al.) The stimuli were equated on all aspects except valence. Positive emotion words included words such as *delight* and *joyful,* while negative words included *disappointment,* and *depression.* Neutral words included *patient* and *noisy.*

**Procedure.** Upon arrival, each participant read and signed an informed consent form. Afterwards, they each completed the BDI-II (Beck, Steer, & Brown, 1996) and the STAI (Spielberger, Gorsuch, Lushene, Vagg, & Jacobs, 1983) to get a sense of their overall emotional state at the time of the experiment. The BDI is meant to measure symptoms of depression including changes in behavior and feelings in the past two weeks. The STAI measures symptoms of anxiety at the current moment before beginning the experiment. Higher scores on these surveys indicate severe depressive and anxiety symptoms. Both were administered to record the individual's baseline mood and later on monitor any possible interaction between the participant's current emotional state and their recall of emotion words.

Following the surveys, participants read one of the following instructions taken from Nairne et al. (2007) for their assigned scenario:

**Survival.** In this task, we would like you to imagine that you are stranded in the grasslands of a foreign land, without any basic survival materials. Over the next few months, you'll need to find steady supplies of food and water and protect yourself from predators. We are going to show you a list of words, and we would like you to rate how relevant each of these words would be for you in this survival situation. Some of the words may be relevant and others may not- it's up to you to decide.

**Moving.** In this task, we would like you to imagine that you are planning to move to a new home in a foreign land. Over the next few months, you'll need to locate and purchase a new home and transport your belongings. We are going to show you a list of words, and we would like you to rate how relevant each of these words would be for you in this moving situation. Some of the words may be relevant and others may not- it's up to you to decide.

To ensure their understanding of the instructions, participants were asked to explain the task back to the experimenter. Stimuli were presented for five seconds at the center of the screen. Participants were given a five-point rating scale ranging from 1 (totally irrelevant) to 5 (extremely relevant) and recorded their responses by using the linear keys. A total of 36 words were presented to each participant.

After completion of the rating task, a two-minute distractor task consisting of basic math problems was distributed. Next, they were given a ten-minute free recall task where they were instructed to write down all the words they had rated in the previous task in any order.

A scenario rating task was administered following recall. Participants rated the initial scenario (survival or moving) on a scale of 1 to 5 on emotional arousal, context familiarity, richness of detail, interest, probability of occurrence, imageability of scenario, and distinctiveness. Lastly, each participant completed a demographic questionnaire.

**Results and Discussion**

Three participants were removed for rating all the words the same. Two participants were removed due to language barriers. The final number of participants was 117. Previous research states that differences in attention and memory for emotional stimuli can be affected by depression and anxiety. We tested reaction time and recall between participants scoring above 14 on the BDI and 41 on the STAI and those scoring below, respectively. For depression tendencies there were no differences in response time, $t(115) = .68$, $p = .500$, or recall accuracy, $t(115) = 1.08$ , $p = .280$. For anxiety there were no differences in response time, $t(115) = .55$, $p = .587$, or recall $t(115) = .16$, $p = .876$. Therefore, no participants were excluded due to these measures.

There was no difference in how long it took participants to make the relevancy ratings between emotionality conditions, $F(2,114) = 1.40$, $p = .251$, or scenario conditions $F(1,115) = .12$, $p = .727$. However, there was a difference in the actual relevancy ratings between emotionality conditions, $F(2,114) = 5.23$, $p = .007$. Participants rated the positive words ($M = 3.22$, $SD = .71$) more relevant than the negative words ($M = 2.65$, $SD = .95$), but the neutral words ($M = 2.94$, $SD = .61$) were not rated any different than either positive or negative words.

Looking at ratings between the scenarios, there were no differences in relevancy ratings, $F(1,115) = .01$, $p = .909$.

Our main analysis focused on a 2 (scenario: moving, survival) x 3 (word type: positive, negative, neutral) fully between-subjects analysis of variance (ANOVA). There was no significant main effect of emotionality, $F(2,111) = .81$, $p = .447$, no main effect of scenario $F(1,111) = .001$, $p = .970$, and no interaction $F(2,111) = .55$, $p = .579$, with regards to recall accuracy between conditions. See Figure 1 for the average rates of recall between conditions.

**Examining intrusions.** Previous literature has indicated that both emotion and survival processing can enhance false memory. Therefore, a Chi-Square analysis was conducted to determine any differences in total number of intrusions between conditions. There was no significant main effect of scenario condition on the total number of intrusions, $\chi^2 (1, N = 117) = .47$, $p > .05$. However, there was a significant main effect of emotionality on the total number of intrusions $\chi^2 (2, N =117) = 10.41$, $p < .05$. Negative emotion words (count = 127) had the highest number of intrusions compared to both positive (count = 100) and neutral (count = 81) words (see Figure 2). Moreover, there was a significant interaction between condition and emotion on the total number of intrusions, $\chi^2 (5, N = 117) = 16.16$, $p < .05$. The negative-moving condition (count = 75) had the highest amount of intrusions in comparison to the other conditions: negative-survival (count = 52), positive-survival (count = 53), positive-moving (count = 47), neutral-survival (count = 43) and neutral-moving (count = 38) (see Figure 3).

The present pattern of results indicates that emotionality does not affect true recall memory. However, negative emotion words do lead to an increase in false memory.

## Experiment 2

To address the overall low recall of Experiment 1, we conducted a follow-up study. The procedure remained the same as in Experiment 1, except we shortened the word list and added in 2 new conditions. We predicted the shortened list would help improve recall rates and result in both a survival processing effect and an emotion processing advantage.

### Methods

Ninety-seven undergraduates at the University at Albany participated in exchange for partial course credit. The same procedure was used from Experiment 1. However, for this experiment the word lists were shortened to 16 words (half the length of Experiment 1 lists) to address the floor effects found in Experiment 1. Although studies that have attempted to replicate the survival processing effect have used 30-36 words overall, they tend to break them into blocked list consisting of 10-16 words at a time (Nairne & Pandeirada, 2010; Nairne et al., 2008; Roer, Bell, & Buchner, 2013; Weinstein et al., 2008). The chosen words were equated again on familiarity, imageability and frequency. Additionally, we added two new conditions with words from the original Nairne et al. (2007) study (survival-Nairne words and moving-Nairne words). Nairne's concrete words included words such as *truck* and *bear.* These conditions were added to allow us to compare recall for emotion words to those traditionally used by Nairne.

### Results and Discussion

Two participants were removed due to a data collection error in the computer software. One participant was removed due to a failure to follow proper instructions on the recall task. One participant was removed due to a language barrier. The final number of participants was 93. To test for any effects of the participants current emotional state (depression and anxiety) on memory, we tested response times and recall between participants who scored above 14 on the

BDI and 41 on the STAI, and those scoring low, respectively. There were no differences in response time, $t(91) = .78$, $p = .436$, or recall accuracy, $t(91) = .352$, $p = .725$ for anxiety. For depression, there was no difference in response time, $t(91) = .41$, $p = .628$. However, there was a significant difference in recall accuracy, $t(91) = 2.22$, $p = .029$. Participants with who scored high (*M* = .53) in depression symptoms recalled more words than those who scored low (*M* = .46). Therefore, we entered BDI score as a co-variate in the main analysis.

There was no difference in the relevancy ratings between scenario conditions, $F(1,92) = 2.63$, $p = .108$. However, there was a difference in how long it took participants to give a rating between scenario conditions, $F(1,92) = 4.59$, $p = .035$. Participants in the survival scenario condition (*M* = 1999 ms, *SD* = 369 ms) took longer to rate the stimuli than those in the moving condition (*M* = 1825 ms, *SD* = 413 ms).

There was a significant difference in the relevancy ratings between emotionality conditions, $F(3,89) = 7.47$, $p < .0005$. On average, positive words (*M* = 3.37, *SD* = .66) were rated as more relevant to both scenarios, than negative (*M* = 2.61, *SD* = .86) and Nairne (*M* = 2.55, *SD* =.53) words. Additionally, there was a significant difference in how long it took participants to give a relevancy rating, $F(3,89) = 3.39$, $p = .022$. Participants took longer to make relevancy ratings for neutral words (*M* = 2067 ms, *SD* = 400 ms) as compared to Nairne words (*M* = 1712 ms, *SD* = 326 ms), positive words (*M* = 1949 ms, *SD* = 387 ms), and negative words (*M* =1923 ms, *SD* = 417 ms).

Our main analysis looked at a 2 (scenario: moving, survival) x 4 (word type: positive, negative, neutral, Nairne) fully between-subjects ANOVA. There was a main effect of word type in regards to recall accuracy, $F(3,84) = 8.12$, $p < .0005$, $\eta_p^2 = .23$. Planned pairwise comparisons indicated that negative words (*M* = .40, *SD* = .11) were recalled at the same rate as positive words ($M$ = .44, $SD$ = .11), and recalled at a lower rate than neutral words ($M$ = .50, $SD$ = .17). Words taken from the original Nairne et al. (2007) study were recalled at a significantly higher rate ($M$ = .58, $SD$ = .12) than the other word types (see Figure 4).

**Examining intrusions.** A Chi-Square analysis was conducted to determine any differences in total number of intrusions between conditions. There was no significant main effect of scenario condition on the total number of intrusions, $\chi^2(1, N = 93) = 1.52$, $p > .05$. There was a significant difference in intrusions between the word types, $\chi^2(3, N = 93) = 54.33$, $p < .05$. Negatively valenced words (count = 66) had the highest number of intrusions, followed by positive (count = 62), neutral (count = 33), and Nairne (count = 7) (see Figure 5). When examining the differences between all the conditions combining word type and scenario, the number of observed intrusions was not equivalent across groups, $\chi^2(7, N = 93) = 59.33$, $p < .05$. The negative-survival condition (count = 38) had the highest intrusions followed by positive-survival (count = 36), negative-moving (count = 28), positive-moving (count = 26), neutral-moving (count = 18), and neutral-survival (count =15). Words derived from Nairne et al. (2007) had the lowest number of intrusions, Nairne-moving (count = 4), and Nairne-survival (count = 3) (see Figure 6).

Experiment 2 replicated the results from Experiment 1. Neither showed a traditional survival processing advantage. Although participants in the survival condition looked at the words longer, it did not produce a benefit in true recall. Rather, higher rates of false recall were observed. Experiment 2 also replicated a high amount of intrusions of negative emotion words overall. Significantly, when looking at both scenario and word type together, negative-survival had both the lowest true recall and the highest amount of false recall. Words obtained from Nairne et al. (2007) had both the highest rate of true recall and lowest rate of false memory.

## General Discussion

The two experiments we conducted examined the effects of emotion words on memory within the survival processing paradigm. Experiment 1 failed to replicate both a survival processing effect and an emotion processing advantage during recall. Despite participants rating positive words as more relevant, they did not recall them at a significantly different rate than neutral or negative words. This finding does not support the idea that a congruency effect for stimuli-scenario relevancy is behind the survival processing advantage (Butler et al., 2009).

Overall, recall was lower than expected for all conditions in Experiment 1. A possible explanation could be that the stimuli list was too long. Nairne et al., (2007) originally used 32 words, while the Experiment 1 listed contained 36 words. Another possibility for the lack of a survival processing advantage is that emotions are universal to everyday life and events. We experience emotion in every context, and therefore encoding emotion words from a survival context is not prioritized. Individuals might be just as likely to remember words like *joy*, *upset*, and *nervous* in both a survival and moving context because it can be applied to both. However, this does not explain the lack of an emotion processing advantage in comparison to neutral words.

Experiment 1 had an increase in false memory for negative emotion words. Previous literature stated that negative emotions are more likely to be recalled using gist traces (Talarico et al., 2009). According to the Fuzzy Trace Theory (Brainerd & Reyna, 1990), gist traces are when people encode and remember information using patterns, senses, and overarching concepts known as *'gist'*. Thus, they are likely to falsely remember words with similar meanings. The intrusions recorded within our study supported this concept. An example of a common semantically related intrusion was *scared* when the target word was *afraid.* It could be that the high semantic relatedness combined with a negative valence caused participants to falsely remember seeing the intrusion words (Brainerd et al., 2008). To address these possible explanations for the low recall accuracy in Experiment 1, the stimuli lists used in Experiment 2 were halved in length.

Experiment 2 included both a shorter stimuli list to improve recall rates and new conditions including Nairne's original words as an additional concrete word comparison. Nonetheless, Experiment 2 failed to replicate the survival processing advantage, despite response times indicating that participants in the survival condition viewed the words longer. The results from both experiments suggest that emotion words act as a boundary condition within the survival processing paradigm. Although, it should be noted that, due to time constraints for the current project, more data needs to be collected to increase the sample size in Experiment 2.

There was a significant difference in the recall rates of Nairne's concrete words in comparison to emotion words. This finding supports the concreteness effect (Schwanenflugel, Harnishfeger, & Stowe, 1988), which states that concrete words are better remembered than emotion words, despite studies supporting the opposite (Altarriba & Bauer, 2004). A possible explanation for the high rate of true recall of concrete words could be that it is more beneficial to remember the distinction between nouns rather than emotion words. An individual would need to remember nouns like *car* and *bear* since they might be physically used or present in a given situation, whereas remembering the distinction between whether you were feeling *joy* or *delighted* is less important since they encompass the same overall feeling of positivity. Creating this distinction in their memory also accounts for the significantly lower false memory of concrete words. However, it should be noted that our neutral word category also contained concrete words and failed to produce a concreteness effect in Experiment 1. Additionally, they had a lower rate of true recall and higher rate of false memory compared to Nairne's words, despite both being concrete words. Other researchers (Butler et al., 2009) have also tried switching the stimuli to other concrete words and also failed to produce a survival processing effect. These results pose the questions as to what makes Nairne's original concrete words more memorable than emotion and other concrete words.

Nairne et al.'s (2007) word stimuli were not originally matched on emotionality, and thus his results call into question whether survival processing increases arousal and later retention. Nairne and his colleagues obtained emotionality ratings for their words and noted a null effect of emotionality on the survival advantage in both recall and recognition. The current study specifically manipulated emotionality through valence (positive and negative) to determine which word type would affect survival processing. Our results supported their analysis: emotionality did not produce a survival processing advantage. These findings suggest that valence does not mediate the survival advantage.

Future studies can focus on manipulating the arousal of the emotional stimuli. Previous studies have shown that taboo words (high in both arousal and valence) are better remembered than negative words that are low in arousal (Kensinger & Corkin, 2003). It could have been that our emotion words were low in arousal and that is why we failed to see an emotion processing advantage. Alternatively, a change in population might also produce different results. Our study's participants were college students, whereas the survival processing effect has been shown to produce effects in children at 8 and 11 years old (Otgaar & Smeets, 2010). It is possible that children might process emotions differently than adults and will demonstrate a different pattern of results (Herba, Landau, Russell, Ecker & Phillips, 2006). Possible follow-up studies could also include a change in memory measurements. Perhaps, recognition tests would induce a survival processing effect or emotion advantage as shown in previous studies (Cho et al., 2018; Kensinger & Corkin, 2003; Nairne et al., 2007). A change in stimuli to emotion-laden words would also be interesting to observe. Emotion-laden words are words that express or elicit emotions without directly referring to the emotion (Pavlenko, 2008). The word *death* might elicit emotions that make someone sad, while words like *friend* tends to make people feel happy. Emotion-laden words can often be considered either concrete or abstract since they refer to objects or concepts, which could possibly change the pattern of results we observed. Lastly, using a within-subjects design with block list word ratings might also produce different results. Studies have shown that the survival processing effect can sometimes show up in within-subject but not between-subjects designs (Soderstorm & McCabe, 2011).

Across two experiments that manipulated emotional valence in the survival processing paradigm, it was found that emotion words failed to produce an emotion processing advantage in comparison to neutral concrete words. It also failed to produce the survival processing effect, which has been replicated in previous literature. Notably, emotion words did lead to a significant increase in false memory. The present pattern of results indicates that valence does not mediate the survival processing effect. More research should be conducted to see if emotion words are a boundary constraint on the robust survival processing effect.

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## Appendix

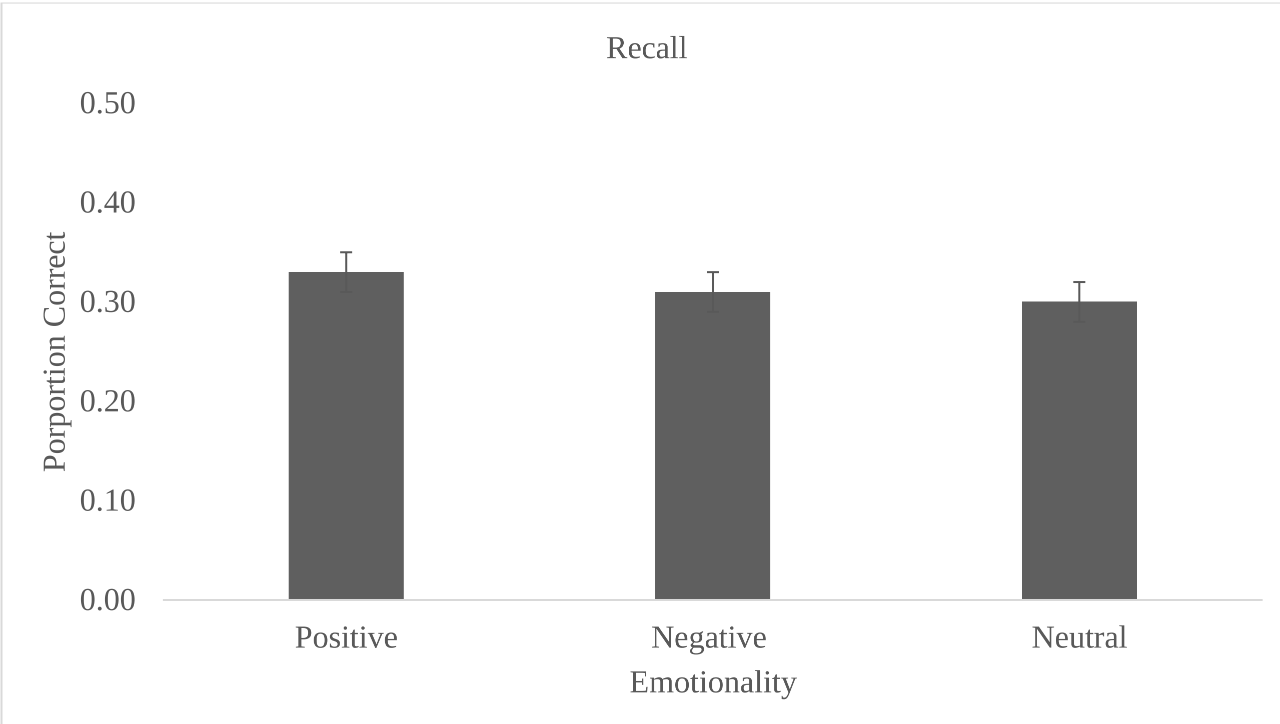


**Figure 1.** The chart shows the overall rate of recall in Experiment 1 by word type. The error bars represent the standard deviation.

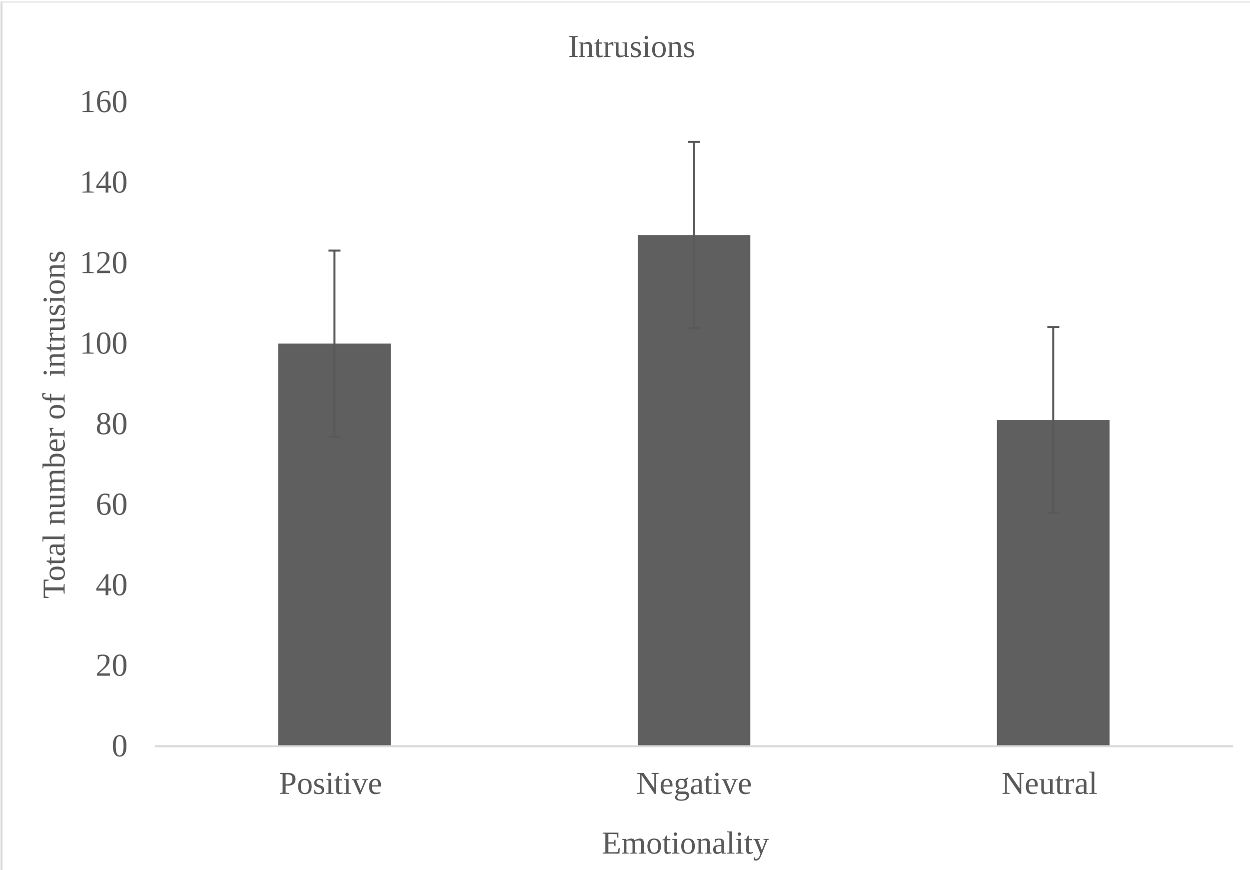


**Figure 2.** The graph shows the number of intrusions (false memory) in Experiment 1 by word type. The error bars represent the standard deviation.

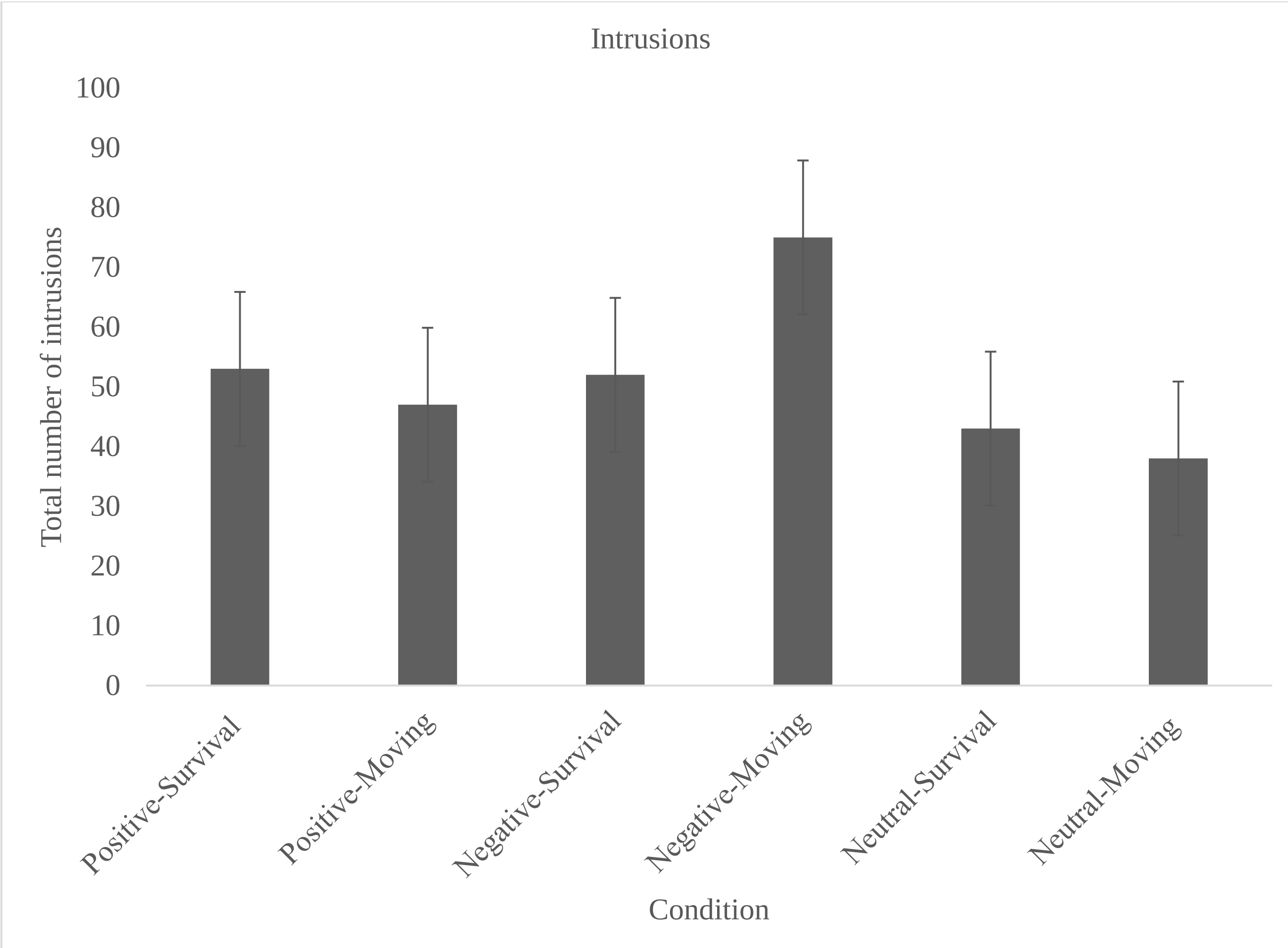


**Figure 3.** This graph shows the number of intrusions per condition and word type. The error bars represent the standard deviation.

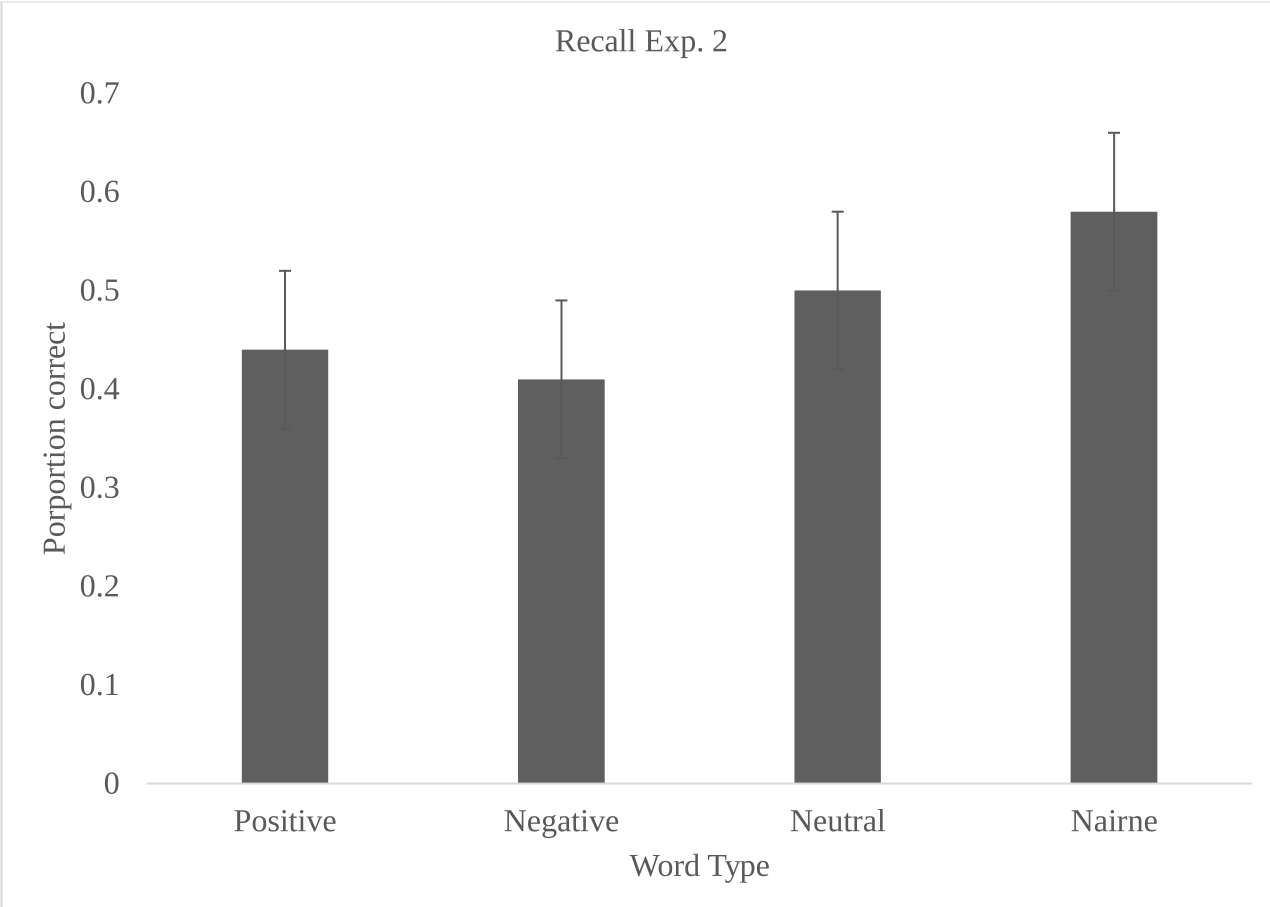


**Figure 4.** This graph shows the overall recall rates for Experiment 2. The error bars represent the standard deviation.

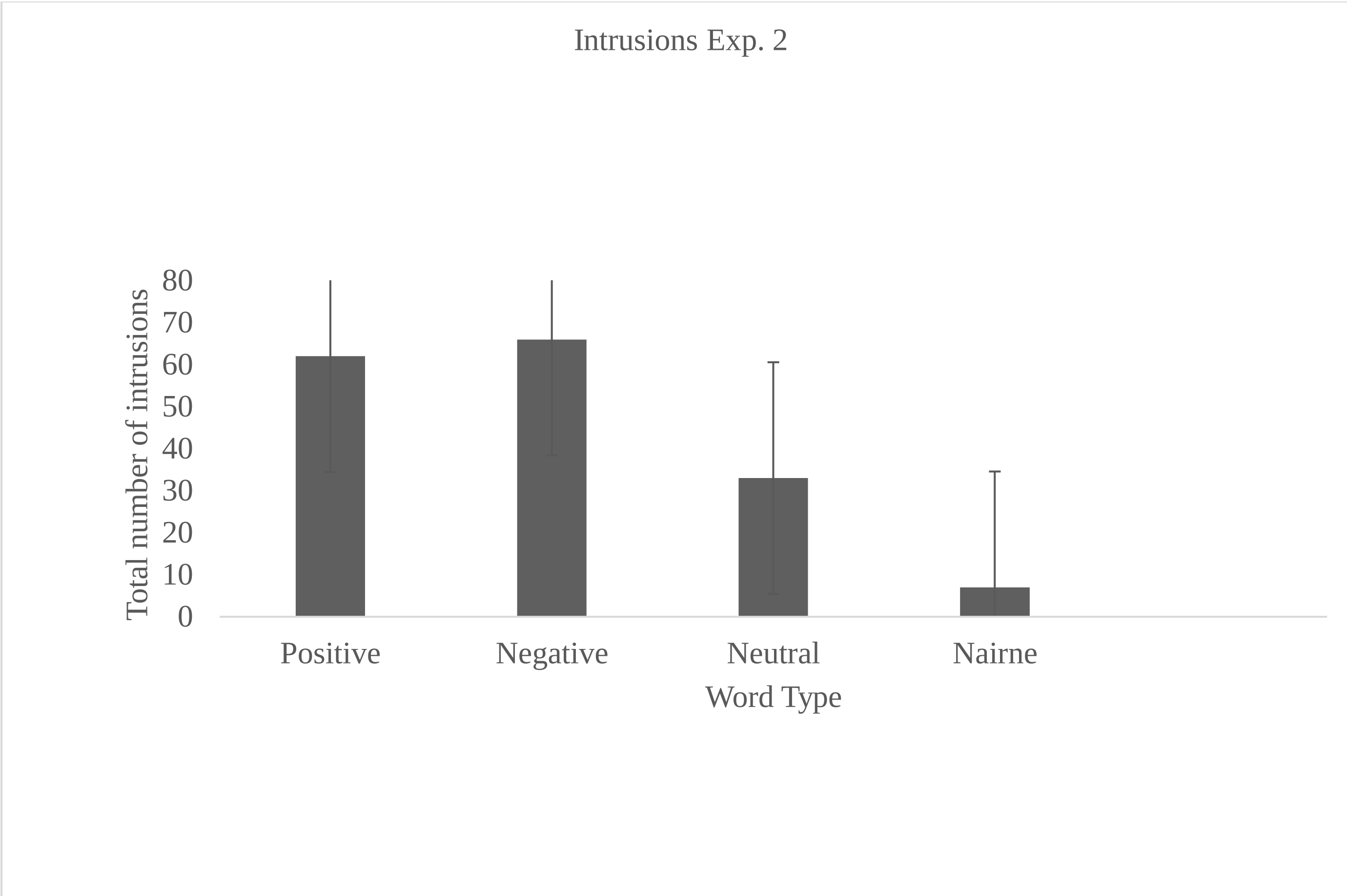


**Figure 5.** This graph shows the total number of intrusions by word type. The error bars represent the standard deviation.

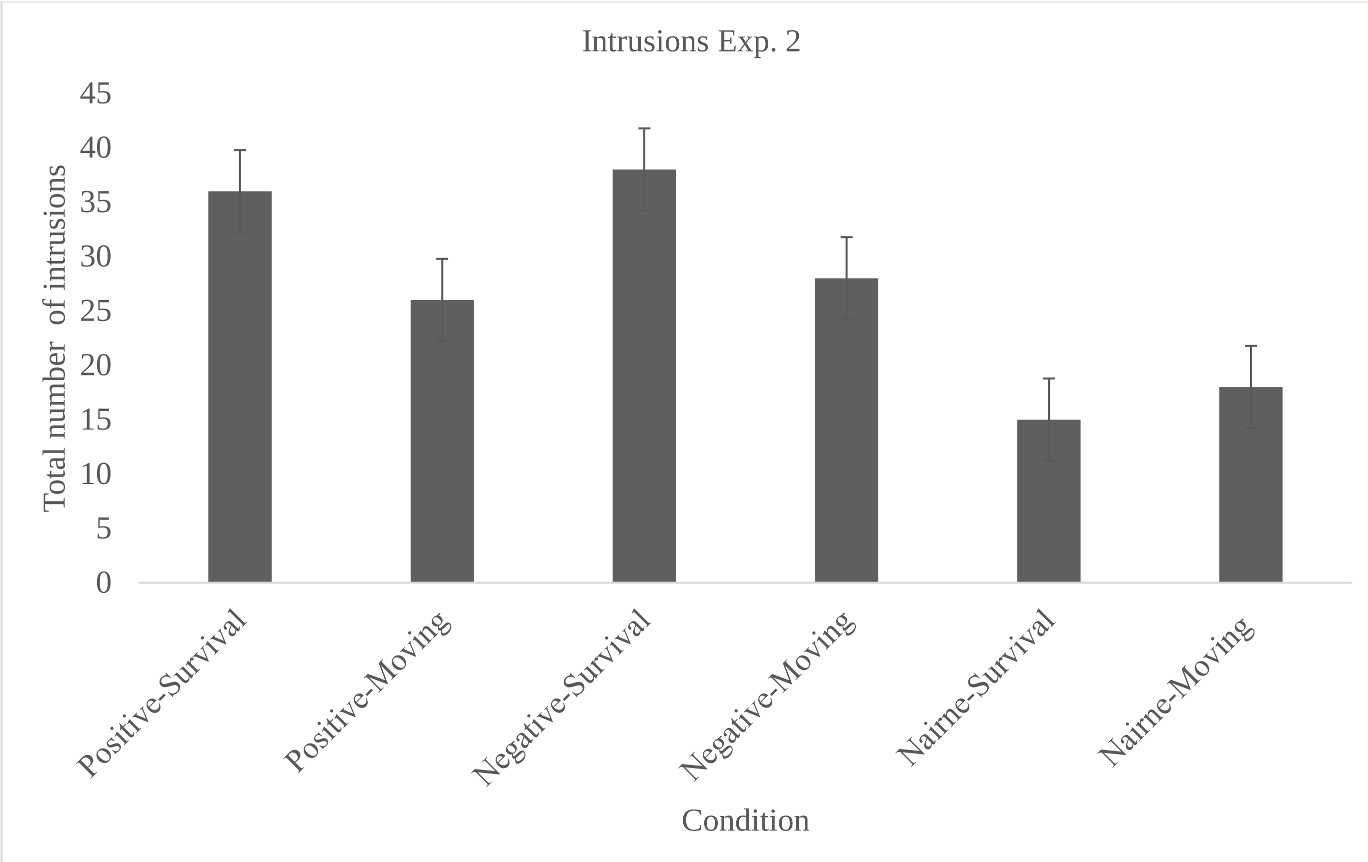


**Figure 6.** This graph shows the total number of intrusions per condition and word type. The error bars represent the standard deviation.