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The Influence of Emotion Valence Words on False Memory in Bilinguals: A Comparison between Native and Non-Native Language

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Abstract: False memory has been widely studied in the field of Cognitive Psychology. This study investigated the impact of emotion valence on the false memory vulnerability of bilinguals in native and non-native languages using the Deese-Roediger-McDermott (DRM) paradigm. Participants were randomly assigned to native and non-native language conditions, presented with both positive and negative emotion valence word lists, and completed recognition tasks. The main effect of language on false memory vulnerability has been found, with a consistently higher false memory rate in the native language regardless of emotion valence. However, the impact of emotional valence on false memory vulnerability was not found. The observed linguistic effect could be attributed to differences in emotion perception between native and non-native languages. This study contributes to the understanding of the potential interaction of language and emotion on the memory process of bilinguals.

Keywords: False Memory; DRM; Emotion Valence; Bilinguals.

1. Introduction

Human memory is not always reliable. False memory has been extensively studied in cognitive psychology. A Deese-Reodiger-McDermott (DRM) paradigm proposed to study false memory by presenting a list of semantically related words that induced subjects to remember a lure word that did not appear in the list (Deese, 1959, Roediger and McDermott, 1995). After studying the word list, participants were asked to recall or recognize the words they had seen. Notably, participants would often report that they remembered seeing the key lure word, which did not appear. It has been proved that people remember things that never happened (Roediger and McDermott, 1995). This finding is crucial for understanding how human memory is processed, and its implications, especially in eyewitness testimony (Kaplan et al., 2015) and traumatic memory (Otgaar et al., 2017).

Emotion has always been a factor that is considered influential to memory. Previous studies showed that negative valence words may lead to higher false memory vulnerability (Brainerd et al., 2008). Moreover, Zhang et al. (2016) indicate there is an interaction between word valence and emotion. Specifically, participants in a negative mood state have a higher false memory rate for negative lure words than for positive and neutral lure words.

However, past research has been conducted in monolingual contexts, and the influence of emotion on false memory vulnerability in bilingual individuals remains understudied. The second language tends to have lower emotional sensitivity for bilingual individuals, especially for negative valence content (Behnke, 2022). Harris et al. (2003) observed stronger physiological responses elicited by taboo words and reprimands in the native language than in non-native language in bilinguals. Therefore, the effect of emotional perception on false memory vulnerability in a non-native language environment should be further explored.

This paper aims to investigate the false memory vulnerability of bilinguals in native and non-native language environments. The study will be conducted with participants who are native Chinese speakers and have English as their second language, comparing how false memory rate differs when exposed to negative and positive valence words in their native and non-native language. We hypothesize that bilingual individuals will exhibit higher false memory rates for negative emotion valence words compared to positive words, particularly in their native language context.

2. Method

2.1. Participants

Ten undergraduate international students (4 males) from the University of Illinois at Urbana-Champaign, over 18 years old, participated in the experiment. Participants were recruited voluntarily on social media. All participants were native Chinese speakers, proficient in English, processed normal or corrected-to-normal vision, and had no history of emotional disorders.

2.2. Materials

To evoke contrasting emotions within the negative and positive word lists, we chose classical emotion-comparable words—"Heaven" and "Hell"—as the key lure words, as referenced in The English Word Database of Emotional Terms (EMOTE) (Grühn, 2016). Next, ten-word lists were created based on the key lure words. For example, the positive condition included words such as "Bliss," "Paradise," "Glory," and "Pleasure," while in the negative condition, “Purgatory," "Devil," and "Pain" are included. The Chinese word lists were obtained through translation. Every word was presented sequentially on the computer screen using Microsoft PowerPoint, displayed for one second in an automatic slideshow format. All stimuli were presented in black font on a white background, ensuring optimal visibility and readability.

2.3. Procedures

Participants were randomly assigned into two groups, one group completed the task in their native language, Chinese in this condition, and the other group tested in their non-native language, English. Participants were presented with both positive and negative emotion valence word lists, each containing 10 words. A counterbalancing approach was used to minimize the potential order effect, two groups of emotion words were presented in different sequences, ensuring that each participant encountered the word lists in a different order; that is, half of the participants learned negative valence words first, and then positive valence words and the other learn in opposite order. Participants were asked to complete a recognition task using a survey right after every list. Each page of the survey displayed only one word, and participants were unable to return to previous pages to alter their responses. The words presented either appeared in the word lists or were lure words that had not been previously encountered. Participants were instructed to make judgments on the words in the form of multiple-choice questions, selecting "old" for words they believed were on the list and "new" for words they had not. There are 10 words contained in the recognition task, with the lure word being the only new word, the remaining nine words are old words from the corresponding studied list.

3. Results

3.1. False Memory for Lure Words

Table 1 shows the mean proportion and standard errors for the false memory of lure words, meaning the participant incorrectly recognized the lure words as old words. In the Chinese condition, the average false memory rate for positive valence words is 1.0, while for negative valence words, it is 0.8. In the English condition, the average false memory rate for both positive and negative valence words is 0.0 and 0.2, respectively. The standard error of false memory rates for positive valence words is 0.0 in the Chinese condition, and 0.2 for negative valence words. In the English condition, the standard errors for both positive and negative valence words are 0.0 and 0.2, respectively.

Table 1. Mean False Memory Rate by Language and Word Valence

Language	Word Valence	Mean False Memory Rate	Standard Error (SE)
Chinese	**Positive**	**1.0**	**0.0**
Chinese	**Negative**	**0.8**	**0.2**
English	**Positive**	**0.0**	**0.0**
English	**Negative**	**0.2**	**0.2**

Figure 1 shows the average percentage of participants who made false alarms for lure words in different language situations. A 2×2 mixed-design ANOVA was conducted to analyze the effect of word valence and language on false memory. Results showed a significant main effect of Language, indicating that participants have higher false memory rates when learning word lists in their native language than in non-native language, $F(1,8) = 32$, $p < 0.001$. However, there was no significant main effect of emotion valence, $F(1,8) = 0$, $p = 1.000$, suggesting that participants create the same level of false memories regardless of the emotion valence of words. Finally, there was no significant language-by-valence interaction, $F(1,8) = 2$, $p = 0.195$, such that differences in false memory rates across languages are unaffected by the emotion valence of words. In sum, the results suggest a significant main effect of language on the rate of false memories, participants learning in their native language environment increased the occurrence of false memories, regardless of the emotional stimulus.

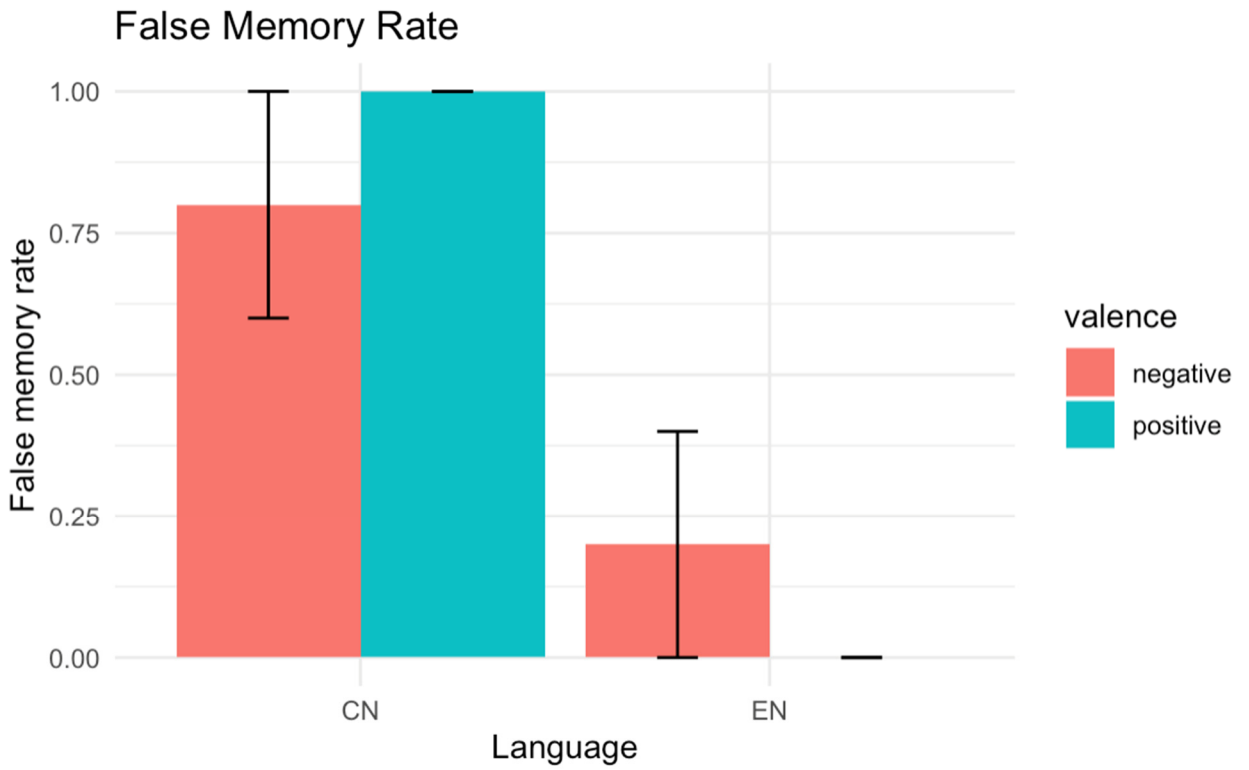

Figure 1. The graph shows a comparison of false memory rates, differentiated by the word emotion valence (negative or positive), between Chinese (CN) and English (EN) language groups. The false memory rate represents the frequency the participants create false alarms for the lure words in the recognition task

3.2. Hit Rate for Studied Words

Table 2. Mean Hit Rate by Language and Word Valence

Language	Word Valence	Mean Hit Rate	Standard Error (SE)
Chinese	**Positive**	**0.72**	**0.07348469**
Chinese	**Negative**	**0.76**	**0.02000000**
English	**Positive**	**0.72**	**0.07348469**
English	**Negative**	**0.88**	**0.03741657**

Table 2 shows the mean proportion and standard errors for correct recognition rate, meaning the participant correctly recognized the studied words as old words. In the Chinese condition, the average hit rate for positive valence words is 0.72, while for negative valence words, it is 0.76. In the English condition, the average hit rate for both positive and negative valence words is 0.78 and 0.88, respectively. The standard error of hit rates for positive valence words is 0.07348469 in the Chinese condition and 0.08717798 for negative valence words. In the English condition, the standard errors for both positive and negative valence words are 0.04898979 and 0.02000000, respectively.

Figure 2 shows the average percentage of participants who correctly recognize studied words in different language situations, referred to as the hit rate, reflecting the participants' memory accuracy. A 2×2 mixed-design ANOVA was conducted to analyze the effect of word valence and language on recognition hit rate. Results showed there was no significant main effect of Language, $F(1,8) = 4.05$, $p = 0.079$, and the main effect of emotion valence, $F(1,8) = 0.831$, $p = 0.389$. In addition, the language-by-valence interaction was also not significant for the recognition hit rate based on the result, $F(1,8) = 0.153$, $p = 0.706$. In sum, the accuracy of memory in the recognition task is not influenced by language and emotion valence.

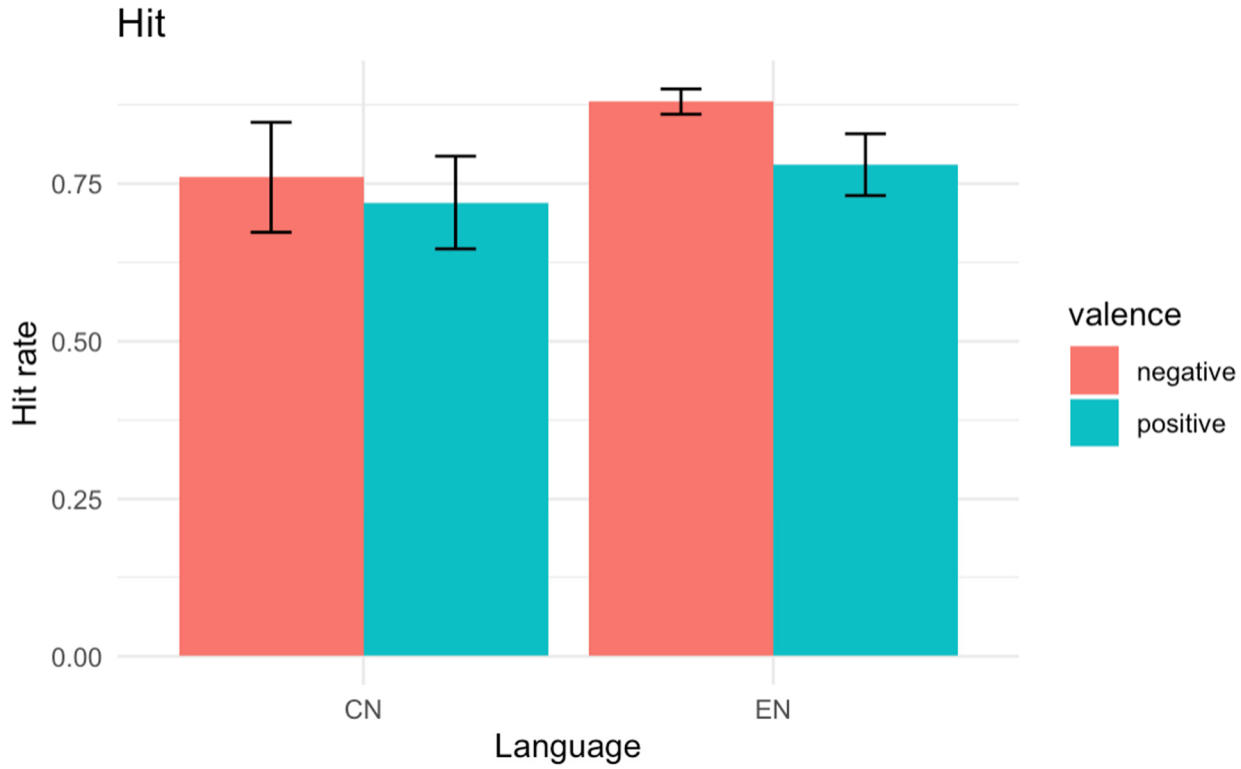

Figure 2. The graph shows a comparison of hit rates, differentiated by the word emotion valence (negative or positive), between Chinese (CN) and English (EN) language groups. The hit rate represents the proportion of correct recognition of the studied words

4. Discussion

The results show that language has a significant impact on the vulnerability of false memories. Participants performed a consistently higher rate of misrecognition of key lure words in their native language than non-native language, regardless of receiving positive or negative emotion valence words. Besides, this study examined memory accuracy by analyzing the hit rate of the recognition task, observing that memory accuracy was not affected by language or emotion valence.

Based on previous research on the perception abilities of bilinguals towards emotional stimulus, it was found that they tend to have stronger emotional perception in their native language (Behnke, 2022). Therefore, it is more likely for bilinguals to be affected by emotional words and generate false memories in their native language compared to non-native language. In addition, the morphological differences between English and Chinese may also be one of the factors that influence the results. For instance, in English, there is a noticeable difference between the lure word "Hell" and the studied word "Purgatory" in initial letters and word length, which would be easy to differentiate. However, in Chinese, the lure word "地狱 (Hell)" and the studied word "炼狱 (Purgatory)" contain the same character, "狱". This higher level of similarity may lead participants to be easily confused, therefore resulting in false memory. Moreover, the proficiency of bilinguals in their non-native language could be another potential influencing factor. Given the disparity in proficiency between native and non-native languages, the processing speed of word meanings may vary, resulting in bilinguals being less influenced by the word meanings and therefore failing to prime the lure words.

Finally, several limitations must be considered when discussing results, which may have had an impact on

experimental outcomes:

1. Insufficient sample size. Due to the limited scope and time constraints of the project, only ten samples were collected for this study. This may be a significant factor contributing to the non-significant results, while also impairing its stability and reliability.

2. The smaller number of words. In the typical DRM paradigm, a word list usually contains around 15 words. However, lexical availability is limited given the selection of comparative words with special meanings of “Hell” and “Heaven”. After filtering out several duplicate and obscure words, only ten relevant words were retained for the experiment. Similarly, it was hard to find new words for the recognition task with similar word lengths and emotional stimuli. Therefore, lure words were included as the only new words. The limited number of words may have caused lower task difficulty, resulting in a ceiling effect where the test accuracy remains at a high level.

3. Order effect. The potential order effect on the learning stage and recognition task failed to be ruled out. Despite the randomization, the word sequence could only be presented in the same order across groups. The accuracy of participants’ memory might be interfered consequently.

Future research could refine the limitations above and further manipulate bilinguals’ proficiency levels in their second language. This would allow for an examination of whether the main effect of language persists and provide insights into the perceptual differences in emotion by comparing false memory rates across different emotion valence word lists.

5. Conclusion

In conclusion, this study investigated the impact of emotion valence on false memory vulnerability among bilinguals in both native and non-native languages using the DRM paradigm. The results indicate a significant effect of language on false memory rate, whereas emotion does not. These findings contribute to our understanding of how language and emotion valence influence the memory processes of bilinguals. However, further research is needed to explore the underlying reasons for the influence of language, providing valuable insights into the complexity of human memory.

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Appendix

English conditions

Positive Valence Word list: Halo, Angle, Bliss, Cherub, Kindness, Glory, Warm, Soul, Paradise, Pleasure.

Negative Valence Word list: Fire, Suffer, Abyss, Purgatory, Inferno, Devil, Sinners, Torture, Pain, Death.

Chinese conditions

Positive Valence Word list: 光环, 天使, 极乐, 守护神, 仁慈, 赞颂, 温暖, 灵魂, 天国, 愉悦。

Negative Valence Word list: 火焰, 折磨, 深渊, 炼狱, 地府, 恶魔, 罪人, 酷刑, 痛苦, 死神。