



Examining the Relationship Between Positive Emotion and Memory Accuracy

Haofei Song^(✉)

School of Art and Sciences, Rutgers, The State University of New Jersey, New Brunswick 08854, USA
hs900@rutgers.edu

Abstract. There are many discussions about whether emotions affect general learning abilities, especially the memory part. There are several pieces of research have successfully proved that emotional memories contain more accurate details than nonemotional memories do, especially negative emotions. This paper focuses more on whether positive emotion can successfully increase people's memory accuracy on verbal memories. This paper responds to this question by proposing a method of manipulating emotion and testing people's memory accuracy under certain emotions. This paper gives evidence suggesting that positive emotion wouldn't increase people's memory accuracy as we thought. There is only a slight difference in memory accuracy between positively emotionally stimulated people and neutrally emotionally stimulated people, and we can't prove that emotional cues help to increase memory retrieving accuracy.

Keywords: emotion · positive emotion · affect · memory · memory accuracy

1 Introduction

In the last few decades, the relationship between emotion and memory has attracted more and more attention from cognitive psychologists. Accordingly, the quantity of published reports about it has increased rapidly [1].

To clarify the relationship between emotion and memory, it is significant to understand the process that emotion affects memory. People have lots of events that elicit emotions. They celebrate festivals with friends and families, date loved ones, and attend friends' important days, such as weddings and birthdays. They might experience extreme hurt or illness and get to hospitals. These events are usually considered to be remembered vividly and are thought to be unforgettable [2].

There is a common view that emotion is capable to enhance memory. For instance, survivors of traumatic events have "flashbulb" memories. In emotional outburst dominant (usually negative) coded information usually memory in abnormality vivid and accurate ways. This emotion-induced memory enhancement has been shown in experiments and is more likely to occur for negative events than positive ones [3]. While this phenomenon has been studied extensively in affective science, cognitive science, and clinical science, the nature of the effects of these emotions on memory processes is still

subject to considerable debate. There is some debate about, what aspects of memory do emotions improve? Objective indicators of memory, such as accuracy of memory? Or the subjective feelings of memory, such as confidence and vividness?

The memory of events or circumstances in a particular place at a particular time is called episodic memory; we can classify most of the laboratory tasks psychologists have used to study memory over the past century as requiring episodic memory [4]. Episodic memory consists of two components: item memory and source memory [5]. The former refers to forms of memory that provide the basis for memory, and the latter refers to the recall of the context in which facts or information were acquired. The source memory experiment belongs to the recognition memory task used in the study of scene extraction. From the perspective of episodic memory, recognition is supported by two extraction processes, familiarity and recall. According to the dual processing theory, familiarity supports item recognition by providing a general sense of stimulating obsolescence, while recall supports the extraction of contextual information from the study. Thus, from a dual process perspective, the performance of the source memory task necessarily requires recall because the source task involves the participant reporting specific details of the original coding context that were not included in the retrieval cues presented during the test. More importantly for now, recall is thought to support the retrieval of many different types of associations between the elements of a set. For example, source information can refer to encoding details that were extrinsic to the retrieval cue (e.g., the background colour or task performed on the stimulus), or details that were intrinsic (e.g., the colour, font or pitch of a studied stimulus). Recollection therefore supports the retrieval of both extrinsic and intrinsic episodic source information. As we outline below, in the current investigation we specifically manipulate the nature of the source information (i.e., extrinsic vs. intrinsic context) that has to be retrieved.

A number of studies have explored the impact of emotion on item memory, however, with conflicting results. Previous research has shown that emotion can enhance item memory [6], but the results of some other studies have shown that emotion can damage item memory [7]. It is noteworthy that else studies have demonstrated there is no correlation between emotion and item memory [8]. When it comes to the effects of emotions on source memories, the results are also mixed. Although many studies have demonstrated the effect of emotion on source memory, one study found that emotion has no effect on source memory. Even researchers can find that in most studies, emotions have been found to enhance item memory but impair source memory. As one can see from previous findings, many studies have examined the effect of emotion on item and source memory, and the results between the two have not been consistent.

Participants strongly believe that they can remember details of emotion-alitems/events. However, there is little evidence suggesting better performance (memory) on emotional items than on nonemotional items. One of the concepts to be presented here is emotion cues. Emotion cues are verbal or nonverbal hints to a patients' underlying state, which are often ambiguous. For instance, in research paradigms to assess emotion identification, physicians are presented with an emotion cue and asked to judge whether the patient is angry, sad, happy, etc. Emotion cues are selected by researchers; physicians are made aware the stimuli contain an emotion and do not have to detect when the emotion cues occur. But if some emotional cues can affect individuals' memory ability,

we can use them when we are studying so that we get improved efficiency. There are some experiments done previously studied memories of details in pictures that contain emotional cues. Kensinger [9] demonstrated that participants remember more details when having negative emotional cues. In tasks requiring people to indicate whether they vividly remember an event or simply know that it occurred, negative events tend to be “remembered” more often than positive ones. In his study, negative emotion can lead to fewer reconstructive-memory errors than positive emotion, consistent with evidence that individuals in a negative mood process information in an analytical and detailed fashion, whereas people in a positive mood rely on broader schematic or thematic information and ignore the details. Participants learned about visual objects embedded in the edges of negative or neutral pictures. The results showed that the recognition memory of negative images was better than that of neutral images. However, he failed to demonstrate that positive emotion cues have the same impact on detail-remembering. In this research, the study seeks to give answers to whether emotional cues can improve memory accuracy. This work manipulate participants’ emotions by having them watch a video that causes them happiness or a nonemotional video and then give them tests to measure the impact of that video.

2 Goal and Hypothesis

To fully understand the essential reason for participants’ strong belief in remembering emotional items’ detail, this work assumes that emotional cues can stimulate some part of peoples’ body system and it can temporarily increase people’s ability of encoding information and retrieve memories. Specifically, the goal of this work is to test whether positive emotions have an impact on verbal memory accuracy. The null hypothesis of this study is that there was no difference in retrieving-memory accuracy in verbal memories when participants get positive emotional cues and nonemotional cues. And the alternative hypothesis is that positive emotional cues help to increase the ability to retrieve verbal memories.

3 Methods

3.1 Participants

There are 40 participants in this study. They aged from 17 to 21. All participants were either Undergraduate students in the United States or High School students in China, in which all of them are Chinese.

3.2 Verbal Memory Task

Participants were instructed to learn a list of 42 neutral words at the beginning of the test. All words are selected from a normalized list of words [10]. All words were presented simultaneously for 5 min for participants to learn (see Fig. 1). A video that was supposed to manipulate participants’ emotions was then presented for participants to watch, where the videos were about 10–15min. After watching the given video, participants were given

adapt	affect	auto	basic	altitude
book	break	card	chase	diver
down	duck	excel	except	feet
flash	goat	hard	idol	insure
knee	lamp	main	nature	password
open	well	peek	poet	precede
rapid	read	seal	seat	reserve
sheep	sight	skin	task	tease
nine	jump			

Note. Participants were instructed to remember all of them in 5 minutes.

Fig. 1. 42 Words List [Owner-draw]

Q2

- poet
- affect
- take
- skin
- fast

Note. “fast” and “take” (new) were either semantically or visually related to “rapid” and “task” (old).

Fig. 2. Multiple Choice Questions [Owner-draw]

8 multiple choice questions (5 at a time, 40 in total), some of which were old (20) and some new (20). New words were similar (lure) words that were either semantically or visually related to the old words (see Fig. 2).

3.3 Intervention

Participants viewed an online video after the encoding period of the verbal memory task. We used different videos to manipulate participants’ emotions depending on which group they were in. Experimental group contained a video that can raise the feeling of happiness, which includes a comic dialogue. Control group’s video contained a history content that was not likely to raise any emotion. Both videos are presented in Chinese [11, 12].

3.4 Procedure

The test was a virtual test where participants were asked to complete it at home. To make sure all participants were energetic, participants were asked to do the test during daytime. Participants were randomly assigned to either experimental group (positive) or control group (neutral). Words list and multiple choice questions were the same in two groups, while given videos were either a video that was demonstrated with positive emotion or video that was demonstrated with neutral emotion. The independent variable in the study was the type of videos (positive or neutral) that participants watched between encoding and recognition phases of the verbal memory task. The dependent variable in the study was the memory accuracy participants have on the verbal memory task.

3.5 Measure

Memory performance (memory accuracy) were measured by calculating how many old words participants could successfully recognize divided by 20, which is the number of total correct answers (from old words). The overall testing time each participant had to decide whether they were following the instructions of this work or not were also measured. All data showing not following the instructions of experimenters would be deleted.

4 Results

19 experimental group samples and 21 control group samples were received at first. In order to use all valid data, 10 of them were deleted because their overall testing time was below 20 min (which is the least time participants needed to complete all parts of it, including watching videos and remembering words). Samples then had been left with 30 samples including 13 from the experimental group and 17 from the control group, 11 women and 19 men. The memory accuracy of each participant was calculated by having their overall correct answers number divided by 20. So that the accuracies were between 0 to 1.

To start with, means and standard deviations of each group were calculated to exclude any outliers (see Fig. 3), and there were no outliers excluded. Bar Graph was made to visualize mean data comparison of two groups (see Fig. 4).

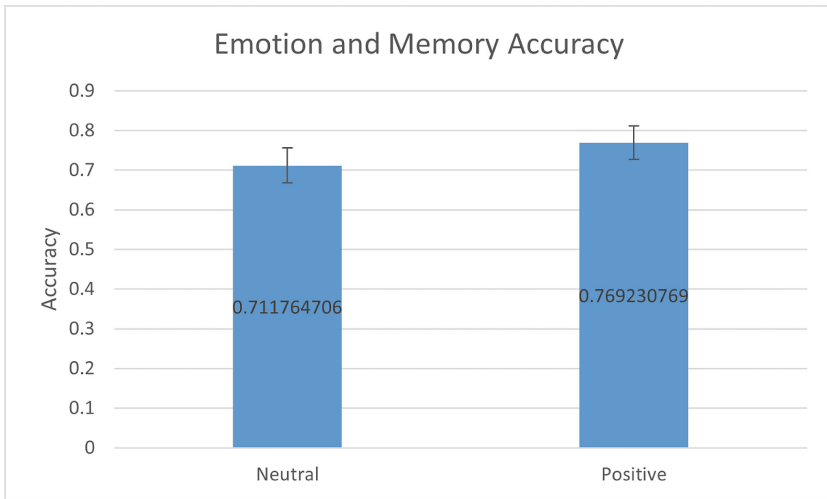
R-code was used to calculate two groups' mean difference. Normality test was used at first to make sure whether two groups' data were normal distribution. If it was not normally distributed, other methods would be used to analyze the data. Shapiro-Wilk Normality test was applied to the analysis. The P values were 0.4548 for the control group and 0.6547 for the experimental group respectively (see Fig. 5). Therefore, I failed to reject the null hypothesis, indicating that the. Memory accuracy of both positive and neural groups can be considered to conform to the normal distribution.

Then, unpaired t-test was used to verify whether there is a significant difference between two groups' means. The P-value of the unpaired t-test was 0.3656 (degree of freedom was 28), which is far greater than 0.05 (see Fig. 6). This indicated that this research failed to reject the null hypothesis (which is that there is no or slight impact of emotional cues on verbal memory accuracy), and that there is no obvious difference in the accuracy between the neutral group and the positive group.

Group	Neutral Emotion	Positive Emotion
Mean	0.71	0.77
SD	0.18	0.15
Error	0.04383	0.04257

Note. Mean, Standard Deviation and Error were calculated on Excel.

Fig. 3. Basic Data [Owner-draw]



Note. Bar Graph depicting the mean-accuracy difference between neutral and positive groups. Error bars are $\pm .043835$ (left) and $\pm .042569$ (right).

Fig. 4. Groups Means Comparison [Owner-draw]

5 Discussion

The experiment was designed to test whether positive emotions have an impact on verbal memory accuracy. The results of the work indicated that there is no or slight impact of emotional cues on verbal memory accuracy, and that there is no obvious difference in the accuracy between the neutral group and the positive group. The view of this work supported that positive emotion had no or only slight help on increasing people's memory accuracy, consistent with some previous observations.

According to Fredrickson, positive emotions expand the range of attention, cognition, action, and the range of perception, thought, and action currently in the mind, thus counteracting the damaging effects of greater semantic relevance [13]. Based on such speculation, we expect that positive emotions have no effect on cognition. As well, from the perspective of Sharot and Yonelinas, only when the background information related

<pre>shapiro.test(ct\$acc) ## ## Shapiro-Wilk normality test ## ## data: ct\$acc ## W = 0.94989, p-value = 0.4548</pre>	<pre>shapiro.test(ex\$acc) ## ## Shapiro-Wilk normality test ## ## data: ex\$acc ## W = 0.95367, p-value = 0.6547</pre>
--	--

Note. The first line refers to the R-code, and the rest of them are the results of the R-code. The left side is the control (neutral) group, while the right side is the experimental (positive) group.

Fig. 5. Shapiro-Wilk Normality Test In R-Code [Owner-draw]

```
res <- t.test(ex$acc, ct$acc, var.equal = TRUE)
res

##
## Two Sample t-test
##
## data: ex$acc and ct$acc
## t = 0.91968, df = 28, p-value = 0.3656
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
## -0.07052841 0.18546054
## sample estimates:
## mean of x mean of y
## 0.7692308 0.7117647
```

Note. P- Value of unpaired test is 0.3656

Fig. 6. Unpaired T-Test In R-Code [Owner-draw]

to emotional stimuli provides individuals with some adaptive value, or is very important to predict the future events, emotions can enhance the source memory [14]. In this study, stimulus of the verbal memory task which may not have enough adaptive value or not have enough importance to predict the future events, resulted in the non-significant impact. The vast majority of research on emotional memory is completely focused on the comparison on the performance of the negative and neutral information, while this work has focused on comparing the performance of the positive and neutral information. This theoretical basis of the work is consistent with the generality of a recent discovery by Schmidt et al., in which emotional valence and arousal interact in the context of item recognition performance [15]. The high-arousal positive titer images were thought to have better recognition and were attributed to more self-referential coding of the

positive stimulus by the participants. And the current findings reaffirm the importance of including a range of emotional stimuli in future studies. The data also suggest a new theoretical prediction: positive emotional valence information is more easily unified than negative emotional information, resulting in the dissociative effects of negative and positive valence on memory.

There may also be such a theoretical explanation for the lack of significant promotion effect of positive emotions on memory accuracy shown by the implementation results of this study. Since memory consolidation takes time [16]. The longer the retention interval, the longer the time devoted to memory consolidation, and correspondingly, the longer the positive emotions act on memory consolidation. It is likely that an enhanced effect of positive affect will manifest itself as the holding interval is prolonged. The retention intervals in this study were much shorter, unlike previous studies that used longer retention intervals, such as 1 week. Therefore, it is reasonable to show that positive emotions have slight or no influence in this study.

6 Conclusion

The study assumes that there are some reasons for people to believe that they can remember emotion-included scenarios, and the study gives an alternative hypothesis stating that positive emotions can increase people's memory accuracy. This experiment manipulated participants' emotion by having them watch videos that include emotional cues (either containing positive emotion cues or non emotion cues). Memory accuracy was measured by having participants do a words-remembering test. The final analysis showed that there wasn't a strong difference in memory accuracy between people with positive emotion and people with neutral emotion, indicating that positive emotion had no or only slight help on increasing people's memory accuracy. Issues with repetitive video. In the experimental group, some participants reported that they have watched that video before, and they might not want to laugh again for the same joke. This indicated that some participants in the experimental group did not have positive emotions as the work expected.

Not following the instructions of experimenters. In this test, 10 subjects' data were deleted due to test-time being too short. Since this test was done online, it was hard to have all participants follow the instructions of experimenters. They might not follow the instructions for reasons. Male and Female proportions were not equal. There were only 17.6% women in the experimental group, while there were 61.5% women in the control group. There might be a gender difference that the study did not control. Since the conclusion is that positive emotions have little improvement in memory accuracy, there might be some other reasons for people to believe that emotion-related memories can be remembered more vividly than non-emotion-related memories. Future research could focus on some hormones in the body elicited by emotional cues, which could have an effect on people's memory accuracy. Or they can focus on some aspects like that people think emotional events are important to be remembered for some reasons or that people feel warm in an event and they are grateful for others.

References

1. Uttl, B., Ohta, N., & Siegenthaler, A. L. (2006). *Memory and emotion*. Blackwell Publishing: Victoria. pp. 2–3.
2. Ochsner, K. N. (2000). Are affective events richly recollected or simply familiar? the experience and process of recognizing feelings past. *Journal of Experimental Psychology: General*, 129(2), 242–261.
3. Finn, B., Roediger, H. L., & Rosenzweig, E. (2012). Reconsolidation from negative emotional pictures: Is successful retrieval required? *Memory & Cognition*, 40, 1031–1045.
4. Tulving, E. (1972). Episodic and semantic memory. In E. Tulving & W. Donaldson (Eds.), *Organization of memory* (pp. 381–403). New York: Academic Press.
5. Slotnick, S. D., Moo, L. R., Segal, J. B., & Hart, J. Jr., (2003). Distinct prefrontal cortex activity associated with item memory and source memory for visual shapes. *Cognitive Brain Research*, 17, 75–82.
6. Shigemune, Y., Abe, N., Suzuki, M., Ueno, A., Mori, E., Tashiro, M., et al. (2010). Effects of emotion and reward motivation on neural correlates of episodic memory encoding: A PET study. *Neuroscience Research*, 67, 72–79.
7. Corson, Y., & Verrier, N. (2007). Emotions and false memories: Valence or arousal? *Psychological Science*, 18, 208–211.
8. Dougal, S., & Rotello, C. M. (2007). “Remembering” emotional words is based on response bias, not recollection. *Psychonomic Bulletin & Review*, 14(3), 423–429.
9. Kensinger, E. A. (2007). Negative emotion enhances memory accuracy. *Current Directions in Psychological Science*, 16(4), 213–218.
10. Toglia MP & Battig WF (1978) *Handbook of semantic word norms* (Lawrence Erlbaum).
11. Positive Video: (2022). bilibili. Retrieved September 22, 2022, from https://www.bilibili.com/video/BV1nU4y127Xh?spm_id_from=333.337.search-card.all.click&vd_source=30cdd2050576bfe5a3b6ee36ab6ed418
12. Neutral Video: (2021). bilibili. Retrieved September 22, 2022, from https://www.bilibili.com/video/BV1hK4y1o7uG?spm_id_from=333.337.search-card.all.click&vd_source=ab6fac300e8c79826da7754bffe38484
13. Fredrickson, B. L. (2001). The role of positive emotions in positive psychology: The broaden-and-build theory of positive emotions. *American Psychologists*, 56, 218–226.
14. Sharot, T., & Yonelinas, A. P. (2008). Differential time-dependent effects of emotion on recollective experience and memory for contextual information. *Cognition*, 106, 538–547.
15. Schmidt, K., Patnaik, P., & Kensinger, E. A. (2011). Emotion’s influence on memory for spatial and temporal context. *Cognition & Emotion*, 25, 229–243.
16. McGaugh, J. L. (2000). Memory: A century of consolidation. *Science*, 14, 248–251.

Open Access This chapter is licensed under the terms of the Creative Commons Attribution-NonCommercial 4.0 International License (<http://creativecommons.org/licenses/by-nc/4.0/>), which permits any noncommercial use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license and indicate if changes were made.

The images or other third party material in this chapter are included in the chapter's Creative Commons license, unless indicated otherwise in a credit line to the material. If material is not included in the chapter's Creative Commons license and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder.

