

Emotions as Intermediaries for Implicit Memory Retrieval Processing: Evidence Using Word and Picture Stimuli

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Abstract

The significance of emotions are seldom the focus of studies especially those concerning implicit memory. As a result, little is known about the effects of emotions on such memory. In two experiments, perceptual identification test was used to investigate the effects of emotional words and pictures on implicit memory. In Experiment 1, participants viewed lists of positive, negative and neutral words and in Experiment 2, participants saw lists of positive, negative and neutral pictures. Perceptual identification test was conducted after a 30 minute interval. Results showed that participants remembered better on implicit memory when information was with positive valence rather than negative valence: positive pictures and words were remembered more than negative pictures and words. However, the difference in types of information only emerged when the valence was positive. In this case, participants had an advantage for words over pictures only when these were presented with positive emotions, not with negative ones. The findings provide evidence for the significant mediating role of valence on implicit memory retrieval processes.

Keywords: implicit memory, emotional words, emotional pictures, perceptual identification

1. Introduction

Long-term memory has been broken down into two categories, explicit and implicit. Explicit memory is the ability to consciously recall some experience or thought and, implicit memory is an experience that one may not be able to consciously recall yet can be shown to be present. It refers to situations in which memory is affected by prior events but the remembered has no awareness of this influence (Neath 2008). In other words, implicit memory refers to memories of which people are not consciously aware, but which can affect subsequent performance and behavior (Feldman 2008).

Direct tests of memory, such as recognition and recall tasks, are often used to measure explicit memory. On the other hand, indirect tests of memory, such as word stem and perceptual identification test, are used to measure implicit memory (Schacter 1987). In indirect tests, participants are not required to have conscious recollection of the past event. The dissociation of implicit memory and explicit memory has been described as resulting from two distinct anatomical memory systems (Squire 1987; Tulving 1985; Gyurak et al. 2011). This suggestion is derived from findings that an amnesic's implicit memory can be nearly normal while his/her explicit memory is severely impaired (Graf, Squire, & Mandler 1984).

In our daily lives, we experience many events that trigger an emotional response: We receive a compliment, witness a car crash, or watch children playing in a park. One widely accepted framework used to classify these diverse emotional experiences describes emotion in two orthogonal dimensions: Valence is a continuum specifying how negative or positive an event is, whereas arousal refers to the intensity of an event, ranging from very calming to highly exciting or agitating (e.g., Lang, Greenwald, Bradley & Hamm 1993). In general, memory often is better for emotional events than for events lacking emotional relevance. This emotional memory enhancement effect has been demonstrated in a wide range of laboratory studies, using a variety of verbal and nonverbal stimuli (Hamann 2001).

The influence of emotion on cognition is vast and important. From the moment a new born baby opens its eyes,

emotion is already playing a role in shaping the infant's cognition. Studies suggest that an early positive emotional bond with mothers may aid in the development of earliest mental representations (Hofer 1994). Research has also shown that early visual processing of stimuli is improved by signals of emotionality. That is, positive or negative valence (relative to neutral) of a stimulus can change how we process that information. In a study by Sato, Kochiyama, Yoshikawa and Matsumura (2001), event related potentials (ERPs) were used to measure brain activity of participants viewing emotional (happy or fearful) and neutral faces. Statistical analyses of the ERP data revealed that brain regions involved in early visual processing were more activated for emotional relative to neutral faces. If emotionality affects processes as primary as early visual processing, then emotionality may also affect higher order cognitive processes such as memory (e.g., Levine, Lench & Safer 2009).

Considering the significant role of memory in our daily lives, effects of emotional contents have been investigated on explicit memory and implicit memory separately by using different materials, such as emotional words (e.g. Mathews & Barch 2006), pictures (e.g. Kensinger et al. 2007; Tapia, Carretiè, Sierra & Mercado 2008; Yang, Xu, Du, Shi & Fang 2011), and stories (e.g. Frank & Tomaz 2000). Most of the previous studies have investigated the effects of emotional contents on explicit memory, but the effects of emotional contents on implicit memory are still largely unknown.

Different emotional contents, such as picture (Bush & Geer 2001; Touryan, Marian & Shimamura 2007) and word (Kensinger & Corkin 2003) have been used to examine their effects on memory. However, most of these studies focused on only negative emotional contents, and the effect of positive emotional contents is not known as much as negative ones.

This study is paramount as it contributes into the better understanding of the effect of emotional contents on implicit memory. Kensinger & Schacter (2008) noted that the literature in the area of emotion and implicit memory is comparatively sparse. The results of this study may further clarify the effects of emotional contents on implicit memory specially by using both verbal and non-verbal materials. Bush & Geer (2001) stated that "their study did have weaknesses, by not using positive emotional words". Subsequently, the current study attempted to provide evidence on the effects of different types of emotion (positive and negative) by directly comparing different types of emotion on implicit memory.

In this study perceptual identification was used to measure implicit memory performance. The perceptual identification task was utilized since it is able to tap implicit memory processes and, in comparison with other tasks (e.g. word stem completion), represents a more reliable and uncontaminated measure of implicit memory (MacLeod & McLaughlin 1995).

Evidence supporting the notion that perceptual identification draws upon implicit memory has been provided by studies of amnesic patients. By nature of their disorder, amnesic patients displayed impaired performance relative to controls on tasks which draw on explicit memory, such as recognition and free recall (Haist, Musen, & Squire, 1991; Graf, Squire, & Mandler 1984), but performed as well as controls in implicit memory tasks such as perceptual identification task (Cermak, Talbot, Chandler, & Wolbarst 1985; Haist et al. 1991) and word-stem completion (Graf & Schacter 1985; Graf et al. 1984). In the perceptual identification task, words are presented during a study phase and are subsequently either presented in a degraded form or tachistoscopically (flashed) presented during the test phase. In the test phase, studied words are mixed with a number of baseline words (unstudied or new).

Jacoby (1983) has provided numerous clever demonstrations of implicit retention in normal subjects (Jacoby 1983; Jacoby & Dallas 1981; Jacoby & Witherspoon 1982). In most of Jacoby's experiments, undergraduate subjects were presented with a list of English words during the study phase and later were given one of two types of test. The explicit memory test involved recognition and implicit memory test involved perceptual identification.

In the perceptual identification test, each word was presented for 35 milliseconds. The words were studied in one of three conditions; some subjects considered the meaning of the word, some the rhyme of word, and some the particular letters in the word. Recognition test was used as their explicit memory test; subjects were (explicitly) asked whether they had seen each particular word before or not. The perceptual identification task instructions was simply "what word are we showing you?" with no reference to the words that had been studied. But the ability to identify a word requires memory, although it requires it implicitly, as memory is necessary to do the task, but there is no explicit reference to a particular memory. These studies (e.g., Cermak, Talbot, Chandler, & Wolbarst 1985; Haist et al. 1991; Jacoby 1983; Jacoby & Dallas 1981; Jacoby & Witherspoon 1982) provide strong support for the choice of paradigm adopted in the current study, namely, perceptual identification test.

This task will evaluate implicit memory, particularly when influenced by different emotional information.

Several questions can be addressed relating to the effects of emotional contents on implicit memory, such as, is there any difference between remembering different kinds of stimuli in implicit memory?, and also is there any difference between remembering different types of emotion in implicit memory? Accordingly, we hypothesized that there is a significant difference in remembering between positive, negative, and neutral (baseline) stimuli in implicit memory. Participants would be more likely to remember the positive and negative stimulus (pictures and words) than neutral ones and less likely to remember stimulus presented with positive arousing than those presented with negative arousing. In addition we hypothesized that pictures will be remembered better than words in implicit memory.

The main aim of the current study is to investigate the effects of different types of emotion (positive, negative, neutral (baseline)) and stimulus (word and picture) on implicit memory. We also assessed implicit memory for negative and positive arousing stimulus (word and picture), by showing slides containing different kinds of pictures (negative, positive and neutral) and words having different meanings (negative, positive and neutral) to participants. The present study examined that whether negative and positive emotions can impact participants' abilities to remember words and pictures. In particular, participants studied a series of pictures and words, one third with a negative arousing, one third with positive arousing and rest being neutral. At retrieval, participants were presented with a series of pictures and words, in which some of them were identical to those that participants had studied and some were new.

2. Method

2.1 Experiments 1 and 2

Experiments were designed to study the effects of emotional contents on implicit memory. A mixed-factorial design was used: 1 between-subject factor: 2 stimulus type (picture and word) and 1 within-subject factor: 3 valences (negative, positive and neutral (baseline)). In the experiment 1 picture stimuli and in experiment 2 word stimuli were used. In both experiments participants were assessed by perceptual identification test.

2.2 Participants

The participants were native Malay language speaking young adult included 22 male and 26 female graduates and undergraduates at Universiti Kebangsaan Malaysia ranging in age from 19 to 24 years old. A total 48 participants participated in the experiments. Participants were randomly selected from the entire student population, this approach was adopted in order to reduce the degree of familiarity with memory paradigms sometimes found in subjects recruited from subject pool maintained by the department of psychology. Students were approached in the library at Universiti Kebangsaan Malaysia and asked whether they were willing to participate in a cognitive psychology experiment. Those students willing to participate were then moved to a quiet location and tested or scheduled to be tested later. Participants were randomly assigned to one of the two between-subjects' conditions (experiment 1 or experiment 2). So there were 24 participants in experiment 1 and the rest were in experiment 2.

2.3 Materials

2.3.1 Picture Stimuli

A total of 60 pictures were selected from the standardized International Affective Picture System IAPS (Lang, Bradley, & Cuthbert 2005) on the basis of the normative ratings provided. 20 positive and arousing pictures (mean valence = 7.44; mean arousal = 6.03), 20 negative and arousing pictures (mean valence = 2.16; mean arousal = 6.27), and 20 neutral and non-arousing pictures (mean valence = 5.09; mean arousal = 2.92) were selected. Negative pictures were selected to be low in valence and high in arousal, positive pictures were selected to be high in valence and high in arousal and neutral pictures were selected to be not high or low in valence and not to be aroused (Table 1). All pictures had the same size 640 x 480 pixels and in order to make them all in the same size Adobe Photoshop was used. The pictures were formatted so that, on the screen, they had a height of 16.93cm and a width of 22.58cm.

Table 1. Valence and arousal ratings for picture stimuli used in Experiment 1

Group	Positive (Mean)	Negative (Mean)	Neutral (Mean)
Valence	7.44	2.16	5.09
Arousal	6.03	6.27	2.92

Source: Lang et al. 2005

Table 1 shows the valence and arousal means for positive emotion, negative emotion and neutral conditions for picture stimuli.

2.3.2 Word Stimuli

Word stimuli were selected from the Affective Norms for English Words ANEW (Bradley & Lang 1999) for which normative valence and arousal scores were obtained via responses to the Self-Assessment Manikin (Bradley & Lang 1994).

From the ANEW pool 60 words were selected, these words were then translated and back-translated by native speakers (Malaysian) using Brislin, Lonner & Thorndike's (1973) back translation technique, of the total 60 words, there were 20 positive and arousing words (mean valence = 7.90; mean arousal = 6.35), 20 negative and arousing words (mean valence = 2.26; mean arousal = 6.66), and 20 neutral and non-arousing words (mean valence = 5.03; mean arousal = 3.74) were selected. Negative words were selected to be low in valence and high in arousal, positive words were selected to be high in valence and in arousal and neutral words were selected to be not high or low in valence and not to be aroused. (Table 2)

Table 2. Valence and arousal ratings for word stimuli used in Experiment 2

Group	Positive (Mean)	Negative (Mean)	Neutral (Mean)
Valence	7.90	2.26	5.03
Arousal	6.35	6.66	3.47

Source: Bradley & Lang 1999

Table 2 shows the valence and arousal means for positive emotion, negative emotion and neutral conditions for word stimuli.

2.4 Experiment 1

2.4.1 Procedure

The experiment was conducted on a Laptop using the Microsoft PowerPoint 2007; Participants were seated comfortably in a chair in front of the stimulus presentation monitor. Laptop was placed at approximately 30cm distance and all participants were presented with the same pictures.

The experimental session consisted of three phases: Study, Break and Test phase. The duration of each study phase was 2 minutes 30 seconds, followed by a 30 minute rest interval before the test phase. There was a practice session before each of Study and Test phases. These practice trials gave the experimenter a chance to make sure that each participant understood the nature of the task.

2.4.2 Study Phase

Practice phase was conducted to familiarize the participants with the experimental procedure; the practice phase consisted 4 pictures. These pictures were presented on the monitor, to ensure that participants understood the procedures.

Once the practice phase had been successfully completed, the study phase began. In the study phase of the experiment, the participants saw a list of 30 pictures (10 positive emotional, 10 negative emotional, and 10 neutral pictures). The participants were instructed to look carefully and not to miss any picture. The duration of presentation for each picture was 4 s with a blank screen for 1 s in between the pictures. The order of list of the pictures was randomized, so that no several negative, positive or neutral pictures could be presented subsequently in order to limit habituation.

2.4.3 Test Phase

Following the study phase, there was a delay (Break) of 30 minutes. After Break time the practice phase were performed to help participants understand the test procedure. In the practice phase the experimenter told participants that they would see pictures flashed on the screen for a brief period of time, Adobe Flash software was used to manipulate the time. Participants were told that their task was simply to describe the picture that they saw if they were able to identify it in the window. Following the practice phase and after making sure that participants understood the procedure the test phase was performed.

A pilot study was conducted to find the best stimulus presentation time in the perceptual identification test. For the first time trial pictures were presented for 50 ms for participants, results were checked to see if the

participants can correctly identified 75% or greater of the pictures shown, so the show duration of the pictures in the study was decreased by 10 ms for the next trial, so if the participants correctly identified less than 75% of the pictures displayed, the duration of the pictures remained same as the previous trial time. The result of the pilot study showed that the best show time for each picture was 40 ms.

The test phase was as follow, test started with the experimenter showing the participants the list of pictures, which was consisted of 30 (non-studied) distracters pictures (10 positive, 10 negative, and 10 neutral pictures) and 30 previous studied pictures (10 positive, 10 negative, and 10 neutral pictures). Previously studied and distracter pictures were randomly distributed through a presentation sequence of 60 total pictures, using the same equipment as in the study task.

The test trials consisted of the following sequence of events: a sign appeared in the center of the computer screen for 1000 ms, the test picture replaced the sign and remained on the screen for 40 ms, and then a backward mask which was a mixture of different colors was immediately replaced the picture and remained on the screen for 2000 ms (Figure 1).

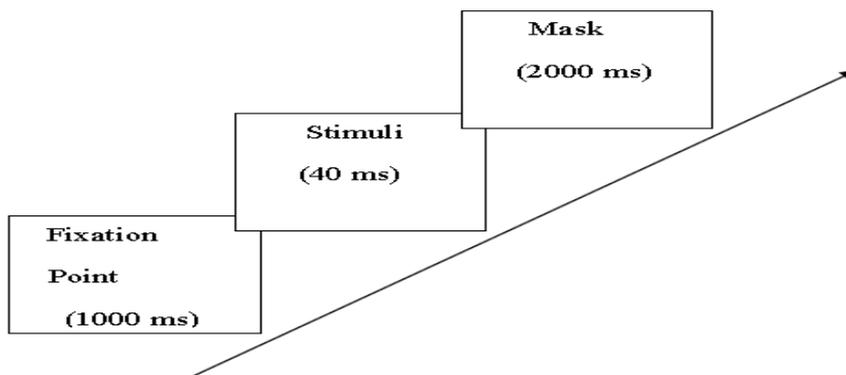


Figure 1. Sequence of each trial in the stimuli perceptual identification task

2.5 Experiment 2

2.5.1 Procedure

Experiment 2 was identical to experiment 1, except that in this experiment word was used as the stimuli.

3. Results

A two-factor ANOVA was conducted on participants' correct responses. The factors involved were stimulus type (word, picture) as between-subject factor and emotions (positive, negative, neutral (baseline)) as within-subject factor. (Table 3)

Table 3. Summary of ANOVA results

	F	df	P-value
Valence	13.511	2	.000*
Stimuli	0.342	1	.562
Valence * Stimuli	15.755	2	.000*

*P < 0.05

Table 3 presents the ANOVA results for emotion and stimulus types.

Results from the ANOVA showed that valence was the only factor that reached significance (F (2, 92) = 13.511, p < 0.001), stimulus type did not (F (1, 46) = 0.342, p = 0.562). Post-hoc test done on the valence factor showed that the significant difference was between positive and negative valences (t (47) =4.090, p<0.001, Mean=8.56 for positive valence, Mean=7.69 for negative valence). There was also a significant difference between negative and neutral valences (t (47) =3.836, p<0.001, Mean=7.69, Mean=8.67; negative, neutral, respectively) where negative valence was less remembered than neutral condition. However, there was no difference between positive and neutral valences (t(47)=0.433,p=0.667, Mean=8.56, Mean=8.67; positive, neutral, respectively). (Table 4)

Table 4. Summary of T-test results show the interaction between different valences (positive, negative, and neutral (baseline)) considering both stimulus (picture and word)

	t	df	P-value
Positive-Negative	4.090	47	.000*
Positive-Neutral	0.433	47	.667
Negative-Neutral	3.836	47	.000*

*P < 0.05

Table 4 shows the interactions of the variables.

In addition, there was a significant interaction between valence and stimulus type ($F(2, 92) = 15.75, p < 0.001$). Further analyses conducted by using t-tests revealed that the mean value for positive words (Mean = 9.00), was higher than that of positive pictures (Mean = 8.13), ($t(46) = 3.225, p < 0.01$); positive words were remembered significantly better than positive pictures. However, negative words were not significantly better remembered than negative pictures ($t(46) = 2.005, p = 0.051$), mean value for negative word (Mean = 8.00), was just slightly higher than negative picture's mean (Mean = 7.38). As for the baseline conditions, neutral pictures were remembered significantly better than neutral words ($t(46) = -5.043, p < 0.001$), mean value for neutral pictures (Mean = 9.29), was higher than neutral picture's mean (Mean = 8.04). (Table 5).

Table 5. Summary of T-test results, considering different types of valence (positive, negative, and neutral (baseline)) and stimulus types (picture and word)

	t	df	P-value
Positive	3.225	46	.002*
Negative	2.005	46	0.051
Neutral	-5.043	46	0.000*

*P < 0.05

Table 5 presents the t-test results for emotion by stimulus type.

Table 6. Summary of the T-test results show the interaction between different valences (positive, negative, and neutral (baseline)) in Experiment 1 (picture stimuli)

	t	df	P-value
Positive-Negative	2.304	23	.031*
Positive-Neutral	-5.243	23	.000*
Negative-Neutral	-6.137	23	.000*

*P < 0.05

Table 6 are the results for interactions of the variables in experiment 1.

Table 7. Summary of the T-test results show the interaction between different valences (positive, negative, and neutral (baseline)) in Experiment 2 (word stimuli)

	t	df	P-value
Positive-Negative	3.542	23	.002*
Positive-Neutral	3.218	23	.004*
Negative-Neutral	0.137	23	.892

*P < 0.05

Table 7 are the results for interactions of the variables in experiment 2.

4. Discussion

The results from this study showed that positive emotional contents were better remembered than negative emotional ones. This is true regardless of the type of information to be remembered: in this case, positive emotional content superiority effect existed for both words and pictures. The present results are consistent with some of the previous studies which have also found the advantage of positive emotion over negative one. (D'Argembeau, Comblain, & van der Linden, 2005; White, 2002; Jay, Caldwell-Harris, & King, 2008). There are some evidences supporting this effect, an fMRI study showed that positive words induced greater activation than negative words (Fossati, Hevenor, Graham, Grady, Keightley, Craik, & Mayberg, 2003) and it has been found that positive words evoke orienting responses in people whereas both negative and neutral words do not. A possible interpretation for this effect would be to postulate that people's neutral or normal state tends to be more toward the positive than to the negative. In other words, the superior performance for positive emotions can be accounted by the fact that positive emotions trigger the active application of knowledge structures to cognitive processes, which supports successful performance (e.g. Ashby, Isen, & Turken 1999; Fiedler 1991).

Another explanation for the superior positive emotion effect is that positive stimuli signal reward and elicit an approach tendency, whereas negative stimuli signal punishment and are associated with avoidance (Kiefer, Schuch, Schenck & Fiedler 2007). This explains why people seemed to suppress thus lead to poor performance in remembering negative materials. Indeed, the current study found that negative emotional contents were significantly less remembered even when compared to the baseline condition.

More interestingly, the current study has found that different information types (stimulus type) gave different results on implicit memory depending on the type of valence they contained. It seemed that here, participants had an advantage for words over pictures especially when these were presented with positive emotions. There was no word superiority effect for negative emotions. This seems to contradict with previous studies. Some previous studies have shown that it was pictures that were remembered better than words, not the other way around (Paivio & Csapo 1973; Madigan 1983; Weldon & Roediger 1987). Paivio (1975) claimed that picture stimuli held an advantage over words because they are dually encoded. While words are merely encoded verbally, pictures elicit both a verbal code and an image code because participants are more likely to generate a label for pictures than to image words. Having two types of codes connected to the pictures allows a greater chance of retrieval during a memory task. The current results, however, contradict Paivio's claim. Here, the advantage of dual encoding for pictures seemed to disappear when positive valence was introduced to the stimuli. In fact, the positive emotion favored word stimuli. Note that such effect prevails on implicit memory (the type of memory investigated in the current study). In reference to implicit memory, previous studies such as Weldon and Coyote (1996) and Weldon and Roediger (1987) also did not find any advantage for pictures over words in implicit memory tests. Any superiority effects of pictures over words could only be found in explicit memory tests (e.g., Madigan, 1983; Weldon & Coyote, 1996). Weldon and Roediger (1987) had students study pictures and words and then different groups were given either an explicit memory test or an implicit memory test. As is often found, pictures were better remembered than words in explicit memory test (the picture superiority effect). However, similar to the current results, words produced better results than did pictures on the implicit memory test. These dissociations may implicate different memory systems that subserve distinct memorial functions (Roediger, 1990), especially when different valence is mediating the systems. Hence, it can be suggested that emotions indeed mediated advantageously the processing of retrieval when the information requires verbal coding or processing (i.e. words) (Paivio 1975). We also propose that the positive intermediating effect of emotions occurred only for implicit memory retrieval.

5. Conclusion and Implication

In conclusion, this study has supported other studies on emotion that have shown the superiority effect of positive emotional content on memory. The current study has gone further to prove that the positive emotion advantage can also be found in implicit memory tasks. Furthermore, this study has shown that words can be better remembered than pictures when tested on implicit memory. Nevertheless, the word superiority effect existed only for positive emotions but not negative ones. One possible implication or claim for this is that valence (positive and/or negative) has some kind of a intermediating effect in retrieving information from memory. Here, it is found that positive emotion indeed mediated favorably the retrieval system when memory is accessed implicitly, in particular the system that is related to word processes. As, Kensinger & Schacter (2008) noted that the literature in the area of emotion and implicit memory is comparatively sparse. This is due to the difficulty in designing and conducting implicit memory tests comparing to the explicit memory. Yet, this study managed to come up with a design to tap on implicit memory. Subsequently, it not only contributed into the better understanding of the effect of emotional contents on implicit memory, it has also shown evidence of a

breakthrough on the subject matter. The significance of emotional contents, especially, positive and negative emotions can also have practical benefits in different aspects of life. For example, findings from this study are able to benefit those in advertising business. Insights from this study can direct advertisers in making their advertisements more effective leading to higher purchase of their products.

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