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Original Research Paper

EFFECTS OF AFFECTIVE STATE ON EPISODIC MEMORY RETRIEVAL

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ABSTRACT
The role of emotion in memory recollection has been an arguable issue for a decade. Episodic memory is very triggering in our day to day life and so as our affective states. Present study was conducted to see whether positive, negative and neutral emotional states (affective states) have any effect in recollecting emotion congruent or incongruent episodic memory. Words of positive, negative, or neutral were presented to the participants either in positive, negative, or neutral mood and immediate recall was used in this present experiment. It was hypothesized that congruent mood would enhance better episodic memory recollection than incongruent mood. A total of 36 adult healthy participants were selected for this experiment following an incidental sampling techniques and they were divided into two contrasting groups namely, congruent and incongruent following purely on the basis of chance. Phases of stimulus presentations were counterbalanced. Different images were used to manipulate affective states of the respondents, and different positive (18 words), negative (18 words) and neutral (18 words) words were used as stimulus. Results were analyzed using paired t test. Results revealed that negative mood enhance negative word retrieval ($t = 2.159$, $p < 0.05$) but not positive words. Findings were discussed in the light of current theories of episodic memory recollection.

KEYWORDS
Episodic Memory, Emotion, Congruence, Incongruence, Affective States

EFFECTS OF AFFECTIVE STATE ON EPISODIC MEMORY RETRIEVAL

Mood states consume a lion share of our everyday phenomenon which leaves us ample of opportunities to learn and to retrieve those learning to be a functional creature in the globe. How our experiences, events will be processed, stored and retrieved later is largely determined by our mood states. Our conversations with others are mostly based on emotion and context. For instance, if a reader is asked to read the following sentence and predict the consequence next to it: "Richard came home late from an office party to find his wife waiting

up for him." The reader should predict conflict and misunderstanding between husband and wife if he/she is angry, on the other hand, the reader should predict loving romance and happy exchange if he/she is happy. Although we have not collected the relevant observations, the mood influences seem quite likely, since—in theory—social inferences are selected in much the same way as associations to stimulus words are. Science has interest in this phenomenon dating back at least to 1917 (see Bousfield, 1950, for an early review) where they would like to show that a person's mood at any given time has a strong influence on which aspects of the environment seem most salient, on what is remembered about the past, and on what is encoded about the present episode.

As it is manifested that mood exerts strong influences on different aspects of life, memory scientists made a clear distinction between *mood congruent memory* and *mood dependent memory*. When emotional material is remembered more reliably in moods that match the emotional content of the memories is called as mood congruent memory whereas mood dependence on the other hand, is the facilitation of memory when mood at retrieval is matched to mood at encoding. A study by Weingartner, Miller, and Murphy (1977) demonstrated that patients who switch from mania to normality and vice versa showed a significant relationship between mood state at learning and mood state at recall. They also found that recall of word association get improved when the mood state at recall was similar to the mood state of generated word association. Hence is the emergence of mood dependent memory. The strategy of context-specific encoding and context-specific retrieval paradigm (Tulving & Thomson, 1973) had been the focus of interpreting that finding. If this account is to be taken into consideration then it can be said that, affective states have a capacity of accessibility of pleasant and unpleasant memories. Happy mood left us something pleasant experiences to us and therefore it is found easier to retrieve if same happy mood is induced. Consequently, same mechanism applies to unhappy or unpleasant experience when unhappy mood is induced. This account opens up a new speculation regarding the interaction between affective states at retrieval. The context-specificity notion has been expanded in the light of neuroscience where Erk, Kiefer, Walter and colleagues (2003), showed that the strength of activity associated with the emotional context at encoding correlates with the probability of correct recall. Erk et al., (2003) demonstrate that successful episodic encoding is differentially modulated by emotional context.

Encoding of information and memory accessibility varies with different mood states and with different emotional events. That sort of conjecture was experimentally demonstrated by Lloyd & Lishman (1975) using Beck Depression Inventory (Beck, 1967). This study concluded that there is a negative correlation between the ratio of latency for retrieval of unpleasant experiences and the latency for retrieval of pleasant experiences. It revealed that depression accelerate the retrieval of unpleasant memories in comparison to pleasant memories. Teasdale and Fogarty (1979) critically analyzed the reason behind the conclusion drawn by Lloyd & Lishman (1975). They speculated involvement of two factors here. First, unpleasant memory accessibility might be the premorbid characteristics of the respondents and secondly that categorization tendency of the depressed respondents. That is, participants may preferred to categorize the same event as unpleasant when they were depressed but not in the same way when they were not depressed. Their analysis and conclusion put forward another speculation that emotional state or mood might have any effect on memory accessibility and categorization tendency. It is also found in memory literature that participants showed a tendency to retrieve increased number of happy memories in elated mood than in depressed mood, and more unhappy memories in depressed mood than in elated mood (Teasdale, Taylor & Fogarty, 1980; Teasdale & Taylor, 1981). A similar type of study claimed that participants wrote their daily emotional incidents in a dairy and when they were asked to recalled those events, then greater percentage of pleasant experiences were recalled than of unpleasant

experiences when they were recalling those in pleasant mood and converse is true when recalling unpleasant mood (Bower 1980). Similar findings with profound effect had been claimed by Bower (1981) where subjects were asked to recall incidents form their childhood during experimentally induced mood state.

Present experiment is similar to Isen et al.'s (1978) experiment but differs some aspects. Isen et. al. (1978) used verbal materials were positive and negative personality trait words, whereas this study used popular daily words (tri-syllabic) having different valance with different intensity. In a similar line Bower (1981) used abstract nouns or story having positive and negative valance to experimentally manipulate affective state of the participants.

The basic difference between present experiment with Teasdale and Fogarty's experiment (1979) is using different materials. They used a material to induce mood in participant which included reading series of self-referent statements, appropriatein tone and content. Whereas current study used varieties of pictures to induce different moods and it was observed that the pictures were able to manipulate the emotional state or mood of the participant. Their experiment only manipulated depression and no depression mood whereas the present study manipulated positive, negative and neutral mood in encoding materials and recollecting memory. It was recognition not recall through which Smith et al., (2004) found highly arousing negative context is associated with poorer recognition performance than more moderately arousing context (unpublished data). According to Dolan, et al., (2000) amygdala plays a crucial role during the situation where information having a specific valance has to be recalled in a specific mood. But to date no available literature is found to examine the influence of specific mood at retrieval of specific information with specific valance. The effects of induced mood states on the recall of positive and negative verbal material presented within an experimental session have been less consistent. Present approach is to understand what we know that is, emotional background acts to enhance attention during encoding but whether there is any variation in attention during encoding of material having different valance is yet unclear to memory researchers. As a result aim of the present experiment was to investigate the effect of different emotional state in recollecting episodic memory having verbal materials with different valances. It was hypothesized that congruent mood (positive emotional state with positive word, negative emotional state with negative words, or vice-versa) would enhance better episodic memory recollection than incongruent mood (positive emotional state but negative word or vice-versa).

METHOD

Participants

Thirty six young healthy adults (age range 18 to 28 years, mean 23 years) students were recruited as participants. From there 18 were male and 18 were female. None of the participants had consulted any doctor, counselor, psychotherapist or psychiatrist for last 3 months. Some of the participants used spectacles but none of the participants had problem with their vision. All the participants participated in this experiment voluntarily without any payment for participation.

Stimulus materials and list construction

Stimuli (selection of words): For episodic memory 18 positive and 18 negative Bangla (native language) words were chosen through a systematic survey method. The daily *"Prothom Alo"*one of top circulated daily newspapers was selected first. All the tri-syllable both

positive and negative words published from November 2011 to January 2012 were gathered only from the headlines of first and last pages of that newspaper. From those headings 100 most frequently used words were selected. To see whether the words were positive, negative or neutral a survey was executed. In this survey participants were asked to mark the words either as positive or negative or neutral and also mark the intensity of valances on a scale of 0 to 9 where zero (0) means the lowest emotional intensity and nine (9) means maximum emotional intensity of that word. They were also asked to mark whether the words create a mental image or not. Analyzing the data of that survey 18 positive and 18 negative words were selected all of which had a strong image creating ability. They were clustered into two positive words cluster and two negative words clusters. Each cluster consists of 9 words.

Selection of emotion creating pictures

Emotional state was induced by the use of neutral, positive and negative mood created images. In the neutral images the subject matter was basically inanimate objects which do not directly convey any positive or negative feeling for example pillar of building, pages of a book, textured wall, clothes, lights etc. In the negative images the subject matter was death, violence, screaming people, fear, disable persons, sick people, child labor, accidents etc. And in case of the positive images the subject matter was happy parents with their child, natural beauties, festivals, bride, party etc. To conduct the experiment 60 images (30 neutral, 15 positive and 15 negative) were divided into two clusters: neutral images cluster 1, neutral images cluster 2. In case of all images (neutral, positive and negative) the orientation of the images was horizontal. To measure whether the images were creating the emotional states properly or not we told the subjects to rate their emotional state in a 5 point rating scale. Each image was shown with 4 seconds of duration. All the images were in horizontal formation and there was a balance of using color and black & white images in different phases.

Instruments

Participants were seated at a viewing distance of approximately 65 cm from the screening display. A Compaq Presario CQ43-414TU Notebook PC with 14 inch HD Bright View LED-backlit display (1366 x 768) was used to display the stimuli. Four different Power Point slides were prepared through Microsoft Power Point software to present the stimuli to the participants. Microsoft Power Point software (2010) was used to control stimulus presentation and the time allocation. The recalled words were recorded through a voice recording device (Symphony T35 mobile phone).

Design

Data were collected following a mixed group design. There were two different groups of participants under different arrangements of phases. Each group of participants was exposed to the same images and words but with different arrangements. All the participants faced 4 different phases which were of different combinations of images and words

Procedure

The experiment was conducted in computer lab with controlled condition. The experiment was started signing the inform consent from. Then they were given both verbal and written instructions regarding the experimental phases. To induce a particular mood state participant were showed the mood related images on the computer through our slides for 1 minute. Then the participant was given a 5 point Likert scale (1= lowest intensity and 5= highest intensity)

to indicate the level of their particular mood state. After labeling the mood intensity participants were instructed that they have to retrieve the words they are going to see now. And then s/he was shown words having different valance (positive, negative) for 18 seconds (2 seconds/word) in a slide. They were asked to read them aloud to make sure about encoding of the materials. The arrangement of words in the slide was in oval shape. A blank screen appeared then and subject was asked to recall as many words as he/she can within 18 seconds. The recalled words were recorded on a recording device. Thus the 1st phase was ended. Participants were given one minute break after each phase of the experiment. Rest of the phases (2nd, 3rd, 4th) of the experiment was conducted following same procedure.

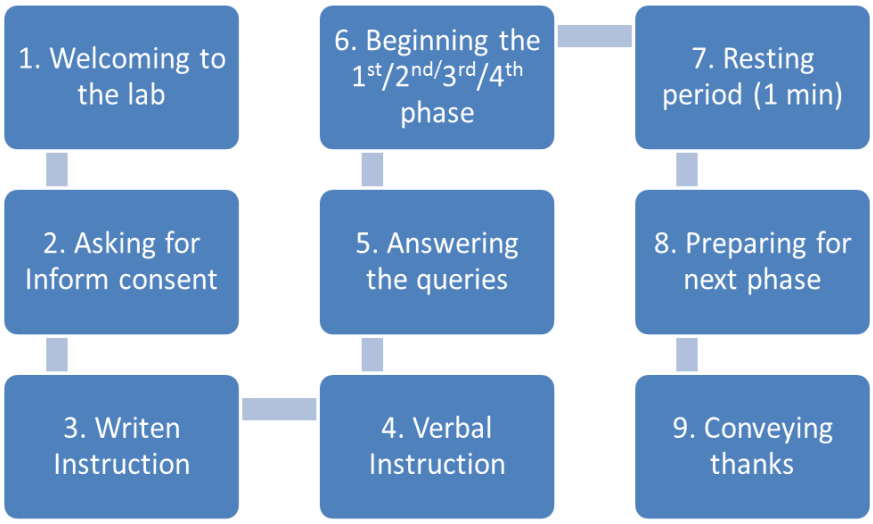

Figure 1. Procedure flow chart

RESULTS

Data were analyzed using paired *t*-test. There is a significant difference between emotional intensity of neutral & positive mood state ($t = 4.76$, $p < .05$) and between neutral & negative mood state ($t = 4.93$, $p < .05$) (see figure 2).

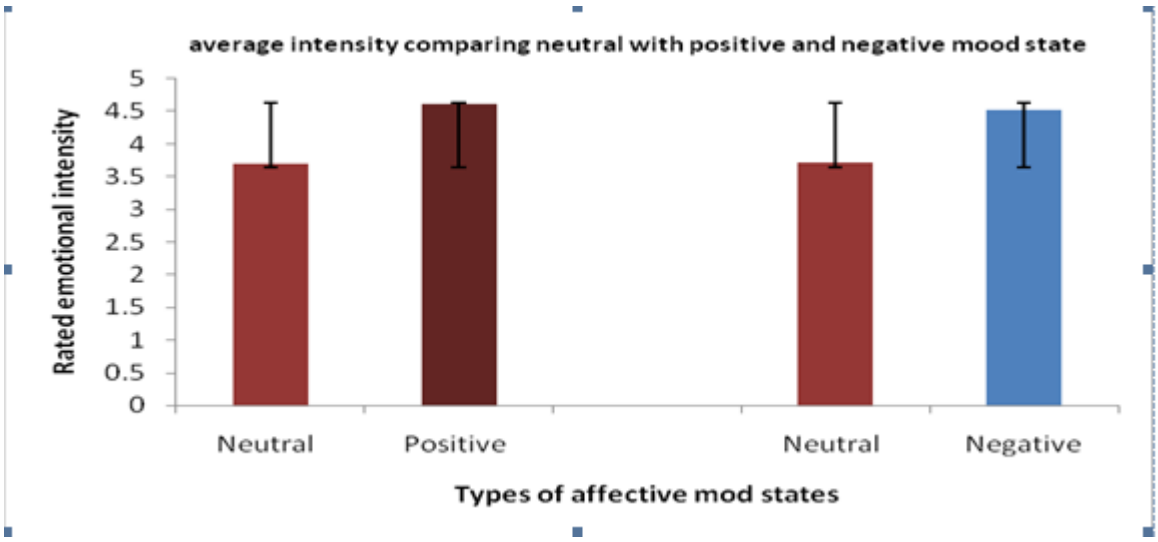

Figure 2. A pair wise comparison of the rated emotional intensity of the pictures between neutral and positive; neutral and negative mood states

ANOVA conducted on percentage of recall shows a significant difference among the three affective state condition [$F(1, 35) = 1.136$; $p < .05$]. Later post-hoc comparison showed that for positive words, no significant difference was observed between neutral and positive mood states ($t = 0.84$, $p > .05$). On the other hand in case of negative word recall a significant difference was found between neutral and negative mood ($t = 2.60$, $p < .01$) (see figure 3).

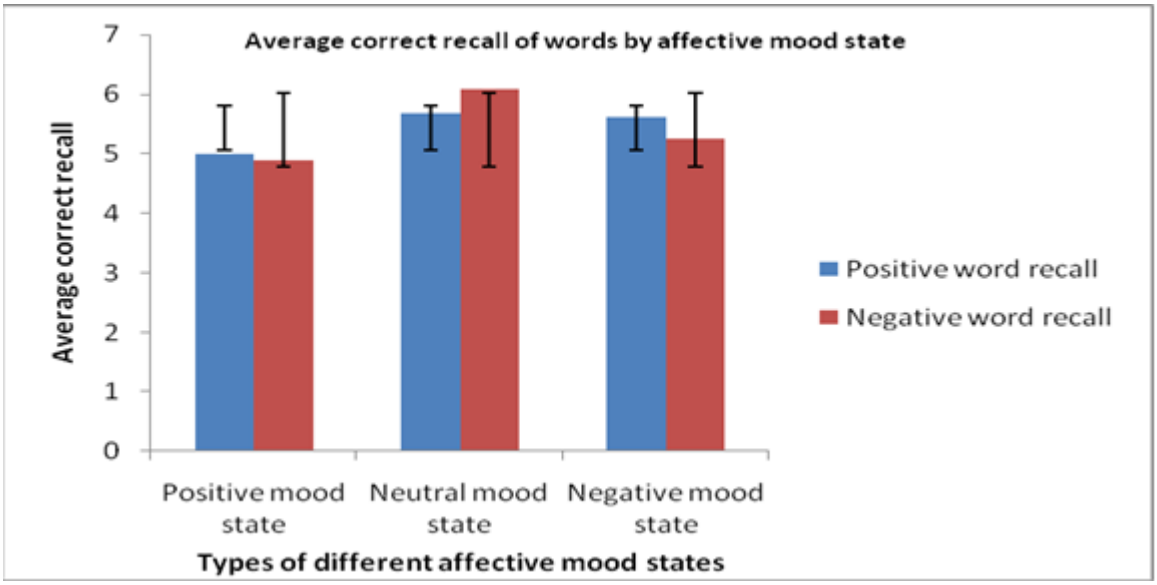

Figure 3. A comparative graphical presentation of the recall of words having different valance in different affective mood states

DISCUSSION

The aim of this present study was to see whether emotional states (affective states) have any effect on recollecting emotion congruent or incongruent episodic memory.It was hypothesized that congruent mood would produce better recall than incongruent mood. Present study employed a new procedure to induce affective state in participants and result claims that the procedure was successful doing that mood change in participants. Result also showed that both the positive and negative mood change was highly significant in comparison to neutral mood (see figure 2).

Considering the state-dependent learning paradigm, at least four test conditions for learning and recalling phases were created. Two of these were related to congruence and two others were concerning incongruent. In congruence condition storage and retrieval was done in the same state, as for example, participant stored the information in a particular state and recalled information in that particular state. On the other hand, in incongruent condition, storage and retrieval was done in opposite state, for instance, learning in one state and recall in another state. Present study has been derived from this concept. Mood state and stimulus valance had been manipulated simultaneously. Four conditions were applied to participants in the present experiment. Firstly, participants were induced in a positive mood and then some positive words were encoded. Secondly, participants were induced in positive mood and some negative words were encoded. Thirdly, participants were induced in negative mood and some positive words were encoded. Finally, participants were induced in negative mood and some negative words stimuli were encoded. In all the phases' immediate recall was taken.

Findings emerged from this study shows that different affective states have marked significant effects on recollecting episodic memory. Events stored in our memory,

specifically episodic in nature, are retrieved in a state-specific manner and the differences found are related to strategies in that particular affective state. Different affective states provide different contexts for production of associative pattern in different states. The significant effect of mood state on recall of negative words in the present experiment is more similar to Teasdale & Russell (1983) but in contrast with the results obtained by Isen *et al*. (1978). It may be because the negative mood induced by the mood induction procedure in the present experiment was possibly more intense than that induced by losing a computer game in the study of Isen *et al*. (1978). Emotional intensity hypothesis by Dutta & Kanungo (1967, 1975) is appropriate to explain the findings here. According to this hypothesis, the mood-congruity effect comes from the influence of emotional intensity on memory. The idea is that a mood's intensity would wane when they read material of the opposite quality. Thus, happy subjects would come down from their euphoria somewhat when they read about a funeral or unjust suffering, whereas these topics would intensify sad subjects' feelings.

Result of this present study is also contrasted with those of the investigators reported by Bower et al. (1978) which failed to find an effect of mood on memory recall for previously presented positive and negative verbal material. Findings of the present study are consistent with the results of studies demonstrating an effect of recall mood on retrieval of memories of life experiences (Teasdale & Fogarty. 1979; Teasdale, Taylor & Fogarty, 1980; Bower, 1981; Teasdale & Taylor, 1981).

Results of the present study in case of congruity state the positive mood did not facilitate to recall more positive words. But in case of recalling the negative words the negative mood highly facilitated the recalling. That means recalling negative words in negative mood was significant and which proved the congruity of same emotional state and episodic memory recalling. Findings of this present study can be explained by selective reminding hypothesis. According to this hypothesis, when one is sad, a sad incident in a story is more likely than a happy incident to remind, but and vice versa was not found when one is happy. It can also work as another reminding of another same kind of event memory. This occurs perhaps because the old memory allows one to elaborate on the input event or to infuse it with greater emotion. Present finding is similarly in line with Bower & Gilligan, 1979).

Human memory has been modelled in terms of an associative network of semantic concepts and schemata that are used to describe events. They are connected by different nodes and activation of nodes can be either by same kind of stimulation or by prior association of thoughts. Activation of an emotion node also spreads activation throughout the memory structures towhich it is connected, creating sub-threshold excitation at those event nodes. Thus, the sad person becomes conscious of thinking about, and will recall some sad event. This recall constitutes reactivation of a sad memory and sends feedback excitation to the sadness node, which will maintain activation of that emotion and thus influence later memories retrieved.

Finally it can be concluded that present experiment intended to verify those speculations through experimentally manipulated emotional states and categorized stimuli.The findings presented here suggest that the manner in which life events are scanned, coded, and stored in memory may be determined not only by drug state but also partly by mood state. Such mood-state specificity appears to provide a context in which memory store is scanned, events are retrieved. So it can be said that mood states serves partly as a cue for memory accessing of other items where as disparate mood states partially block that access in the stored items.

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