A STUDY TO THE ROLE OF THE EMOTIONAL AROUSAL BY NEGATIVE AND POSITIVE STIMULUS IN THE MEMORY AND LEARNING PERFORMANCES OF MEDICAL STUDENTS OF SHAHID BEHESHTI UNIVERSITY OF MEDICAL SCIENCES

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ABSTRACT

Introduction: Recent studies have highlighted the effect of emotional states on cognitive processes. Humans cannot distinguish between different types of emotions, which justify various effects of different emotions on humans. Emotions can lead to loss of function and may have negative effects on daily lives (e.g. test anxiety). Given the cognitive distortion induced by emotional stimuli and environmental events, the present study aimed to compare the effect of arousal induced by positive and negative emotional stimuli on memory and learning function of medical students.Methods and results: This was a semi-experimental study. The sample size was determined as 46. A convenient non-probability sampling was used to select from all students majoring in neurology and psychiatry. The students were randomly divided into two groups. The first group was exposed to positive emotional stimuli and the second group was exposed to negative emotional stimuli. Memory function or involvement was assessed at the first and the last week of internship in the first phase of the study. In the second phase, the students were exposed to emotional stimuli via a monitor. Memory scale and calculation subscale were assessed again. Data collection instruments were demographic questionnaire, Wechsler Memory Scale (WMS), the revised version of the Wechsler Adult Intelligence Scale (WAIS-R), and the International Affective Picture System (IAPS). The findings were compared before and after exposure to emotional stimulus. The paired t-test and Student's t-test were used for statistical analysis. The findings indicated a significant difference in memory function of both groups. Conclusion: A significant difference was also found in scores of the students exposed to pleasant stimuli in both memory and learning function variables. However, a significant difference was found in only memory function in the group of students exposed to unpleasant emotions. The result of the study showed that different types of emotions have various effects on memory function.

Keyword: Arousal; Negative and positive stimulus; Memory and learning performances.

INTRODUCTION

Emotional states are crucial and decisive factors in cognitive and perceptual functions. Many studies have addressed this issue and suggested the effect of excitement and moods on cognitive and perceptual functions. Emotion and mood processing control cognitive functions. The studies have addressed this issue from various perspectives and have suggested the relationship between emotional states and learned and memorized material (5). Excitement intensity, type of excitement, type of emotional arousal, the association caused by hormones, effect and interactions

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caused by physiological function or defects in certain areas of the nervous system, the role of excitement in processing learned information and memory bias, etc. were investigated in the studies. All these cases were used to determine which interventions (especially primary preventive measures) prevent major mental and social disorders.

Excitement refers to a temporary change in intensity of mood. It is generally followed by an increase in the intensity of behavior (1). Excitement has an important role in cognitive representation. It is divided into multiple categories. A typical division is pleasant and unpleasant emotions or positive and negative emotions (2). Emotions are also potential indicators or representations of motives. Emotions are simultaneously represented as physiological changes (e.g. activation of the sympathetic nervous system), change in expressive behavior (facial expressions, postural shifts and gestures), and change in basic cognition (non-objective experience and awareness of circumstances) (3). An unpleasant emotion can be used as a stimuli to arouse the individuals and end the unpleasant feeling (4). Negative emotions are aroused by epinephrine released from the sympathetic nervous system. Epinephrine secretion is elevated during unpleasant emotions and norepinephrine elevations are observed during pleasant emotions. These emotions cause either optimism or depression that affects cognitive processes. Memory dysfunction is associated with cognitive mental disorders. This association was investigated in many experimental and empirical studies. This is because memory can be studied from an empirical perspective while other concepts of cognitive theory cannot be investigated from an empirical perspective. Notably, theorists of clinical psychology have paid attention to facilitating role of emotional factors in cognitive function and dysfunction, especially memory bias (4)

Studies have shown that manipulation and changes in emotions and emotional states make certain predictable changes in cognition, especially in memory (5). Amygdala has a major role in emotional memory. The prefrontal cortex and cerebellum are also involved in emotional memory. These regions are identically involved in emotional memory in both females and males but the site of encoding information in the brain differs between the two genders. Emotions and attention are interweaving processes. Emotions are effective in all phases of memory process via various routes including release of fear hormones, memory storage and involvement of different regions of the brain (memory cycle is the process of retrieving, consolidating, and encoding information). Most studies have shown considerable and significant effects of emotion on memory. Some researchers (e.g. Forgas) have proposed separate and specific processing effects for pleasant (cheerful mood)

and unpleasant emotions (e.g. depressed mood) (7). Learning is an important feature for human being and is under the influence of various factors. It is important to identify these factors in order to facilitate teaching process. These factors have an efficient role in promoting education of children and adolescents. Several theories have been proposed to explain processing effects of emotional states on memory and learning processes. The most important theories are state-dependent learning and mood-congruence theories. Both of these theories confirm the effect of different emotional states on learning and memory function (4). The above theoretical models emphasize priority of processing emotional information a) facilitates learning mood-related materials; b) helps to focus attention on details in harmony with mood; c) improves recollection of information in harmony with mood or material learned in the mood similar to current mood; d) interprets neutral and ambiguous information in harmony with mood (Butler AC) (9).

The type of emotional arousal has selective effect on memory given the role of emotions in learning and memory function based on the above-mentioned material and literature as well as neurotransmitter involvement and physiological association of these variables claimed that a given task with a sets of shocks can boost or tamper arousal depending on personal response to the task. Referred to two basic principles in the emotional theory; a) the greater the arousal, the more intense the excitement, b) the capability of distinguishing between different excitements allows representation of excitements through a variety of physiological excitations or apparent actions. Researchers decided on studying the effect of emotional arousal in depressed and healthy individuals based on clinical and theoretical data to determine similar or different effects of emotional arousal in the two groups. Academics proceeded to determine learning and memory capacity of these individuals as well as immediate and long-term effects of different emotional stimuli on memory and learning. The results of these studies can help to promote formal education (different levels of education) and upbringing of children and adolescents, reduce test anxiety and control its negative effects, offer solutions to authorities, and prevent learning problems, memory dysfunction, and mental disorders (e.g. anxiety and fear of memory dysfunction), and many other cases.(12)(13)(14)

MATERIAL AND METHOD

This was a semi-experimental study on the effect of arousal induced by positive and negative emotional stimuli on learning and memory function in medical students of Shahid Beheshti University of Medical Sciences in 2018. The pre-implementation study was approved by the University's Ethics Committee. The participants were selected from interns in neurology and psychiatry wards. Forty interns were selected. Inclusion criteria were consent of the participants and internship in the above wards. Exclusion criteria were incomplete questionnaires and stimulation processes, tired of participation in the project, dissatisfaction with the project. The participants were randomly divided into two groups. Demographic questionnaires, the Wechsler memory scale and calculation subscale were distributed among the participants. . The sample size was determined as 46 given available articles and literature. Data were analyzed by version 22, SPSS software and parametric tests were used for normal data and nonparametric tests were used for abnormal data. The meaning has described with P-value less than 0.05.

RESULT

Table 1 shows mean scores of the participants exposed to positive emotional stimuli. Studied variables were compared before and after exposure to the stimuli using the paired t-test. A significant difference was found in memory and learning function of the participants. An increase was observed in function of both variables after exposure to the stimuli (3% and $P<0.01$). Learning and memory function was also compared in the group exposed to unpleasant stimuli using the paired t-test (Table 2). A significant difference was found in memory function of this group ($P < 0.01$) but no difference was found in learning function. Table 3 shows mean scores of change in memory and learning function in both groups. Student's t-test results also showed that changes in memory function significantly differed in both groups. More changes were found in memory function in the group exposed to positive emotional stimuli ($P < 0.05$) but there was no significant difference in learning function of both groups. Table 4 shows mean scores of the participants exposed to pleasant stimulus. The scores were compared using the paired t-test before and after exposure. The results indicated a significant difference between the participants in subscales of rational memory, recollection of numbers, visual memory, and associative learning ($P < 0.01$). However, no significant difference was found between the two groups in subscales of general information, orientation and memory control. Table 5 shows comparison of scores of the

participants exposed to unpleasant stimuli in the subscales of memory scale using the paired t-test. The results showed a significant difference between the scores of participants in subscale of visual memory (P<0.01) but no difference was found between the two groups in other subscales.

Table 1 - Mean and standard deviation of memory and learning function of participants before and after exposure to positive emotional stimuli

Indicator &variable	*stage*	*number*	*X*	*SD*	*t*	*p-value*
Memorial function	Before	23	72.09	4.09	2.71	0.01
	After	23	74.65	4.55		
learning	Before	23	12.26	1.42	0.29	N.S
	After	23	12.13	1.58		

Table 2 - Mean and standard deviation of memory and learning function of participants before and after exposure to negative emotional stimuli

Indicator &variable	*stage*	*number*	*X*	*SD*	*t*	*p-value*
Memorial function	Before	23	70.08	4.82	5.96	0.01
	After	23	76.08	4.09		
learning	Before	23	11.73	1.89	-2.37	0.03
	After	23	11.91	1.16		

Table 3 - Mean of change in memory and learning function of students based on type of excitement

Indicator &variable	*stage*	*number*	*d*	*SD*	*t*	*p-value*
Memorial function	Before	23	6.15	5.48	2.11	0.04
	After	23	3.35	5.48		
learning	Before	23	0.52	1.28	0.63	N.S
	After	23	0.722	1.29		

Table 4 - Comparison of mean scores of the participants in the pleasant group before and after exposure

Indicator &variable	stage	number	x	SD	t	p-value
general knowledge	Before	23	5.96	0.21	-1	N.S
	After	23	6	0.01		
navigation	Before	23	4.87	0.34	0.37	N.S
	After	23	4.83	0.39		
Control of memory	Before	23	6.96	1.77	-1.9	N.S
	After	23	7.78	1.24		
Logical memory	Before	23	11.74	3	-3.51	0.02
	After	23	14.04	2.68		
Digitization of digits	Before	23	11.13	1.79	-2.8	0.01
	After	23	12.09	1.7		
Visual memory	Before	23	10.09	1.59	-3.06	0.01
	After	23	11.09	1.62		
Associate learning	Before	23	19.35	1.28	-4.74	0.01
	After	23	20.35	0.46		

Table 5 - Comparison of mean scores of the participants in the unpleasant group before and after exposure

Indicator &variable	stage	number	x	SD	t	p-value
general knowledge	Before	23	5.87	0.34	-1.45	N.S
	After	23	5.97	0.21		
navigation	Before	23	5.00	0.00	1.81	N.S
	After	23	4.87	0.34		
Control of memory	Before	23	7.43	2.13	-1.52	N.S
	After	23	8.04	1.33		
Logical memory	Before	23	12.11	3.39	-1.31	N.S
	After	23	13.22	3.77		
Digitization of digits	Before	23	12.00	1.38	1.7	N.S
	After	23	11.48	1.62		
Visual memory	Before	23	10.13	1.91	-3.1	0.01
	After	23	11.04	1.58		
Associate learning	Before	23	19.54	1.00	-1.9	N.S
	After	23	20.04	0.86		

DISCUSSION AND CONCLUSION

The results of the study showed that average age of the participants was 23.76±1.63. The number of females was more than males. The participants were compared in the studied variables by gender. The results showed no significant difference between male and female participants in the studied variables. Li M (6) and Joormann J (8) theorized model of memory association network and emphasized the role of dominant emotion and information processing. Activation of an emotion triggers activation of all associated memory structures. Priority of processing emotional information a) facilitates learning mood-related materials, b) helps to focus attention on details in harmony with mood, c) improves recollection of information in harmony with mood as well as learned material in the mood similar to the current mood, d) interprets neutral and vague information in harmony with mood. A significant difference was found in memory function of the participants exposed to positive (pleasant) stimuli. Therefore, positive stimuli improves memory

function. The same finding was found in case of learning function and emotional stimuli made significant changes in learning function. The effect of mood processing on memory was confirmed in the studies on induction of cheerful and depressed moods by Sun Q (16).Findings of the present study are consistent with the results of the study by Baker et al (20). Maksimainen J (10) showed that emotional processing of stimuli help to recognize and recollect emotions rather than emotional cognition. Memory and learning function of the participants exposed to unpleasant stimulus was also compared before and after exposure to stimuli. The results indicated lower scores in both variables after the exposure but the difference was only significant in memory function. Grol M (11) believed that emotional states and stimuli interpret neutral and vague information in harmony with mood. This was confirmed in the present study. This finding was also consistent with the results the studies on memory function by Sun Q (16) Mean changes in memory and learning function of the two groups were analyzed. A significant difference was found in memory function of both groups. The participants exposed to positive emotional stimuli experienced more changes in memory function than the group exposed to negative stimuli. These results are consistent with state-dependent learning and mood congruence theories. State-dependent learning theory claims that people recollect the material learned in a mood similar to the current mood (Meyer MAA) (15) Mood congruence theory depends on the similarity between mood and nature of learned and recollected materials. Bruke Found an association between emotional load of learned material and the mood that recollect learned materials. Recollection of memories in harmony with mood is much easier (20). Bisby J (17) believed that negative emotional arousal restricts attention. They also claimed that positive emotions develop and improve memory. bruke Found out that arousal can boost all aspect of memory but restrict attention (20). Findings of this study were consistent with Ingour's theory, which suggested that memory bias can lead to memory dysfunction during information retrieval. Cognitive activation theory claims that negative cognitive schemas not only allow abstraction, selective attention and encoding of negative information but also retrieval of negative information since this kind of information is consciously memorized through the above schemas. From the cognitive perspective, activation of negative cognitive structures in memory also triggers memory bias both in encoding and retrieval processes. Mean scores of the two groups were compared separately at both phases of the study. There was no significant difference in studied variables in both phases. These results were not consistent with the results of the studies by Bisby J (17) .In contrary to literature, learning is an effective factor in this process. The two

groups were compared in subscales of memory function and no significant difference was found between the participants at both phases. Both groups were compared separately in the subscales of memory function before and after exposure. The results showed significant difference in the group exposed to unpleasant stimuli in subscales of visual memory and associative learning at both phases, which showed that the difference in negative emotions roots from more complex scales and the effect of learning can be neglected. These results were consistent with the results of the studies by Wang B (18) and Okada G (19) and Bisby J (17) and Sun Q (16) the results of this study confirm the theories that proposed the effect of emotional arousal on memory function as well as studies in this field. But there was no consistency in learning function between the results of this study and other studies. The results of this study were not consistent with the results of the studies carried out in other countries in both studied variable. The scale used to measure learning (in learning function), the effect of learning and cognitive abilities (in learning and memory function) were the reasons for these confounding results.

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