

Arousal differences in recall and source-monitoring accuracy of witnessed events

Gyanesh Kumar Tiwari*

This study examined the effects of emotional arousal, types of detail and gender differences on the accuracy of recall and source-monitoring of witnessed events in 40 adolescents (20 males and 20 females) aged 16 to 17 + years (Mean = 17 yrs 2 months). Inducement of emotional arousal was done in the subjects by means of two video-clipped events and two corresponding written passages and their accuracy of recall and source-monitoring for central and peripheral details were assessed. Male and female subjects showed significant differences in their levels of emotional arousal, accuracy of recall and source-monitoring. Emotionality inherent in the video-clipped events and corresponding written passages had significant effects on the subjects' accuracy of recall and source-monitoring. Higher recall accuracy occurred in high emotional arousal condition as compared to low emotional arousal condition. In addition, accuracy of recall and source-monitoring of central details showed more prominence than did peripheral details.

Keywords: Eyewitness memory, Recall accuracy, Emotional arousal, Source-monitoring

Exposures to heinous criminal incidents, life-threatening accidents or such unusual events that are not expected frighten and upset the viewers and they often emotionally arouse them. There has been a long debate over the role played by emotional arousal in the qualitative and quantitative expressions of memory. Some researchers advocate the opinion that emotional events tend to be remembered with great clarity and detail (Bohannon, 1988; Christianson, 1992; Christianson & Loftus, 1991; Hulse, Memon & Allan, 2003) while others contend that emotionality affects part of such event that threatens an observer's life (Loftus, 1979). It is argued that emotional arousal shapes memory in two fashions. On one hand it enhances memory of central details or the gist (Cutler, Penrod & Martens, 1987), while on the other it retards memorability of peripheral details or the information that is temporally or spatially removed from the central aspects of an event (Clifford & Hollin, 1981; Loftus & Burns, 1982).

Memory for highly unpleasant or traumatic events has been studied by researchers and clinicians using a variety of methods. One method is to interview witnesses or victims of actual traumatic

events and explore their memories, using case studies (Christianson & Nilson, 1984), field studies (Yuille & Cutshall, 1986), or interviews (Rubin & Kozin, 1984). The other method is to investigate memory for traumatic events in laboratory settings using staged events, or their video-clippings in which subjects are exposed to simulated crimes, accidents and other emotional events and the accuracy of their memories are tested (Heuer & Reisberg, 1990; Loftus & Burns 1982; Tiwari; 2005; Tiwari & Dwivedi, in press).

Source-monitoring refers to the set of processes involved in making attributions about the origins of memories, knowledge and beliefs (Johnson, Hashtroudi & Lindsay, 1993). The ability to remember accurately the source of a memory is an important ingredient in cognitive competence (Cohen & Faulkner, 1989). However, everyday observations confirm that memory for source is imperfect and experiments have shown that people forget whether they had actually done something or only planned to do it (Cohen & Faulkner, 1989). Source-misattribution is one of the factors involved in the errors and distortions that arise in eyewitness testimony (Lindsay & Johnson, 1989; Loftus, 1979). In eyewitness

*Assistant Professor, M. L. K. P. G. College, Balrampur-271201, U. P. (INDIA)
email-gyaneshpsychology@gmail.com

research, the impact of arousal on source-monitoring decisions has been less studied, even though eyewitnesses are often exposed to very arousing situations.

In legal proceedings, eyewitnesses are required to recall accurately the details of the witnessed events and identify their sources. In Indian settings, studies pertaining to eyewitness memory are very limited and the conclusions drawn from American and Western societies cannot and should not be directly applied. Keeping these issues in mind, an experiment has been conducted to highlight the effects of emotional arousal, types of detail and gender on the accuracy of recall and source-monitoring on witnessed events.

Methods and Procedure:

Participants: 40 adolescents aged 16 yrs 6 mo to 17 yrs 6 mo (20 males, $M = 17$ yrs 02 mo and 20 females, $M = 17$ yrs 03 mo) of 12th standard selected randomly served as the subjects in the experiment.

Materials: Two video-clipped events and two passages approximately of three hundred words in length prepared by the researcher corresponding to each video-clip were used as materials. To assess the memory and source-monitoring accuracy of the subjects after a week, two sets of tests were prepared - one for low emotional arousal condition and the other for high emotional arousal condition. In the source-monitoring test, the subjects had to specify whether they "viewed" an item or "read" about it in the passage. Experienced emotional arousal level of the subjects after they had viewed the video-clip and read the concerned passage, was measured by a 9-point scale.

Experimental Design:

The design was a 2 (males and females) $\times$ 2 (low and high emotional arousal conditions) $\times$ 2 (central and peripheral details) mixed factorial with repeated measures on the last two factors. The gender was a between subjects factor, while

the last two factors were within subjects factors.

Procedure: To finalize the procedural details such as types of detail, selection of video-clips and passages, effectiveness and suitability of the items of memory and source-monitoring tests, etc., a pilot study was carried out on 20 subjects.

The final study was conducted in four sessions. As a subject reported in the laboratory his/her biographical details were noted after which the first session started.

Session-1: In session-1, participants were shown a video-clip. After a gap of five minutes subjects read a corresponding written passage. Then they were instructed to fill out a 9-point emotional self-report scale to indicate how emotionally aroused they felt during the period they were watching and reading the video-clip and written passage, respectively.

Session-2: The participants returned back after a week to complete accuracy of recall and source-monitoring tests in this session.

Session-3: The same participants were requested to come back again after 10 days to take part in session-3 of this experiment. In this session, they were presented with the second video-clip and written passage that was meant for low or high emotional arousal. Those who had worked under low emotional arousal condition in session-1 viewed and read the highly emotionally arousing material and vice versa.

Session-4: This session was held after a week of the third Session, participants took relevant tests of recall and source monitoring.

Thus, every participant worked in all four sessions of the experiment in which he/she watched two different video-clips and read two passages, twice completed a 9-point emotional self-report measure, and also responded to two sets of tests of recall and source-monitoring.

Results

Accuracy of Recall

Accuracy of recall and source monitoring were

two dependent measures which were assessed with the help of four sets of tests- two for accuracy of recall and two for source monitoring. Obtained data were converted into percentage to make statistical comparison possible for these results are a part of a detailed study in which two measures of metamemory judgments i.e., judgment of learning and judgment of source were also used and with which these measures were compared.

The results indicated that female subjects evoked higher memory scores ($M = 40.38$, $SD = 16.49$) as compared to male subjects ($M = 31.50$, $S.D. = 13.03$; $F = 20.70$, $df 1, 38$, $p < .001$). Mean percent memory score was higher ($M = 42.00$, $SD = 16.60$) under high arousal in comparison to mean percent memory scores in low arousal condition ($M = 29.88$, $SD = 11.53$; $F = 44.80$, $df 1, 38$, $p < .001$) and mean percent memory score for central

gender for low (b_1) emotional arousal ($F = 8.01$, $df 1.38$, $p < .01$) and high (b_2) emotional arousal ($F = 16.80$, $df 1, 38$, $p < .001$), emotional arousal for (a_1) males ($F = 16.80$, $df 1, 38$, $p < .01$) and for (a_2) females ($F = 28.80$; $df 1, 38$, $p < .001$) indicated that females significantly retained more under both the arousal conditions than did male. Statistically significant simple effects of emotional arousal for males and females show that they emitted higher percent memory scores under high emotional arousal condition than that of low emotional arousal condition.

Statistically significant simple effects of emotional arousal for central (c_1) details ($F = 96.93$ $df 1, 38$, $p < .001$), types of detail (C) for (c_1) low ($F = 8.78$, $df 1, 38$, $p < .01$) and high ($F = 55.59$, $df 1, 38$, $p < .001$) emotional arousal show that the subjects recalled those events more that had central details and were presented with high emotional loadings. Significantly higher percent recall scores were observed for peripheral details as compared to central details under low arousal conditions. Simple effects of gender for central (c_1) details ($F = 22.21$, $df 1, 38$, $p < .001$), and peripheral (c_2) details ($F = 9.42$, $df 1, 38$, $p < .01$) and types of detail (C) for females (a_2) ($F = 11.55$ $df 1, 38$, $p < .01$) made it explicit that females obtained higher mean percent memory scores for central details and peripheral details than that of males.

Table 1 : Means and Standard Deviations (in parentheses) for Recall and Source monitoring Scores by Gender (Male or Female) and Arousal Level (High or Low)

Gender	Arousal Level	Types of Detail	Recall	Source Discrimination
Male	Low	Central	22.00 (9.52)	56.50 (17.73)
		Peripheral	30.50 (8.26)	31.50 (9.89)
Male	High	Central	45.00 (3.57)	30.50 (16.05)
		Peripheral	28.50 (8.13)	34.00 (14.29)
Female	Low	Central	30.00 (12.57)	50.50 (23.28)
		Peripheral	37.00 (10.81)	49.00 (21.25)
Female	High	Central	58.50 (14.97)	33.50 (13.87)
		Peripheral	36.00 (11.88)	31.50 (13.09)

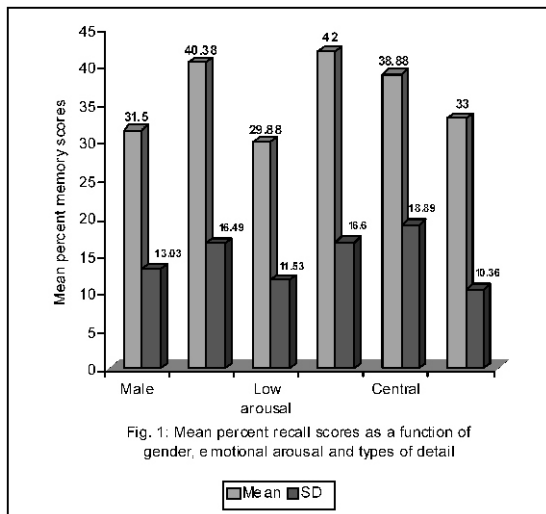


Fig. 1: Mean percent recall scores as a function of gender, emotional arousal and types of detail

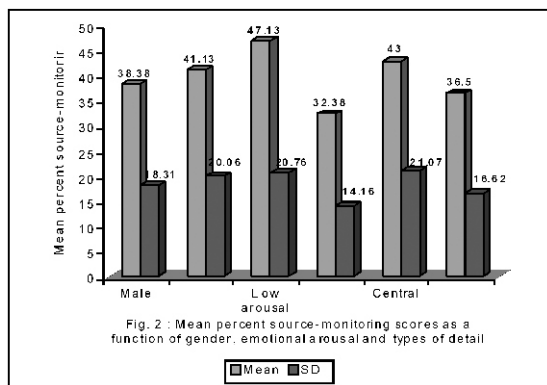
details ($M = 38.88$, $SD = 18.89$) was higher than that of peripheral details ($M = 33.00$, $SD = 10.36$; $F = 13.27$, $df 1, 38$, $p < .001$) (Figure 1).

These data were further analyzed by using simple effect analysis of variance. The analyses showed a complex and intriguing relationships among the variables. Statistically significant simple effect of

Source-monitoring

Treatment level-wise analyses of percent source-monitoring scores brings to the fore the female subjects evoked higher percent source-monitoring scores ($M=41.13$, $SD=20.06$) as compared to male subjects ($M=38.38$, $SD=18.31$). Source-monitoring mean percent score was higher under low arousal ($M=47.13$, $SD=20.76$) in comparison to high arousal condition ($M=32.38$, $SD=14.16$; $F=33.58$, $df\ 1, 38$, $p<.001$). Likewise mean percent source-monitoring score for central details ($M=43.00$, $SD=21.07$) was higher than that of peripheral details ($M=36.50$, $SD=16.62$; $F=5.73$, $df\ 1, 38$, $p<.05$) (Figure 2).

Statistically significant simple effects of levels of emotional arousal for males (a_1) ($F=11.44$, $df\ 1, 38$, $p<.01$) and females (B for a_2) ($F=22.64$, $df\ 1, 38$, $p<.001$) make it explicit that males and females did not differ significantly in their percent source-monitoring scores under low and high emotional arousal conditions, whereas both males



and females showed significantly higher percent source-monitoring scores under low arousal than under high arousal conditions.

Statistically significant simple effects of emotional arousal for central ($F=37.35$, $df\ 1, 38$, $p<.01$) and peripheral details ($F=4.34$, $df\ 1, 38$, $p<.05$) and types of detail for low ($F=14.59$, $df\ 1, 38$, $p<.001$) arousal make it apparent that subjects

emitted significantly higher percent source-monitoring scores for both central and peripheral details under low than they did under high emotional arousal condition. Similarly, significantly higher percent source-monitoring scores were observed for central than for peripheral details under low emotional arousal condition. Statistically significant simple effect of types of detail for males ($F=8.60$, $df\ 1, 38$, $p<.01$) makes it clear that males elicited significantly higher percent source-monitoring scores for central details than for peripheral details, while no significant difference was shown by female subjects in their percent source-monitoring scores of central or peripheral ones.

Discussion

Emotional arousal

Results of the study extend the theory that emotionality inherent in a witnessed event shapes its processing and retention. The results have demonstrated an enhancement in accuracy of recall obtained after a week under a high level of arousal. It appears that the necessary facilitating effect of low arousal dissipates after a week. However, the high level of emotional arousal presumably creates an optimal level of arousal in the subjects who therefore show improved memory performance. These results can be explained in terms of several theories related to emotion and cognition interface.

This contention, however, does not hold true for source-monitoring where retrospective decision-making was involved. Every aspect of decision-making involves a series of hypothesis testing that presumably provides some sort of a fillip to one's level of arousal. The results suggested that for a higher cognitive phenomenon like decision-making which was used as source-monitoring in the study, excessive level of arousal resulted in impairment in source-monitoring. Low level of arousal, on the other hand, with the support received from concomitant aspects of decision-making facilitated source-monitoring accuracy.

Gold (1987) has argued that arousal may directly

and specifically facilitate coding. To this end, a number of studies have also indicated that emotionality of an event is an excellent predictor of recall (Heuer & Reisberg, 1990) as it increases subjective rehearsal of the encoded information as well as more attention (capacity resources) to deploy, thereby in accuracy of recall. It has been demonstrated in the studies that scenes depicting injury or threat, as opposed to mundane items or activities, are selectively perceived (Schupp, Junghofer, Weike, & Hamm, 2004) and better remembered when presented even very briefly (Christianson, Loftus, Hoffman, & Loftus, 1991). Along with selective perceptual and attentional processing, emotional arousal elicits consciously controlled conceptual processing regarding the cause of arousal. Christianson (1992) speculated that effortful elaboration after an arousing experience, called by Christianson as poststimulus elaboration, may involve a deeper level of processing than that generated by a neutral experience (Craik & Lockhart, 1972). Relative to affectively neutral memories, emotional memories tend to be long-lasting vivid and detailed (LeDoux, 2000).

The significant main effect of emotional arousal for source-monitoring accuracy posited that subjects serving under low emotional arousal condition more correctly sourced the details of witnessed events as compared to those who underwent high emotional arousal condition. It is speculated that heightened emotional arousal makes hindrance in the way of sourcing an event. Dutton and Carroll's (2001) study offers support to the present study who found that medium levels of emotional arousal improved both recall and source-monitoring for peripheral details, whereas high levels of arousal impaired source-monitoring. Thus, it is concluded that increased emotionality interferes with sourcing details of witnessed events.

Types of Detail

The findings of the study showed that effects of emotional arousal were strongly mediated by

types of detail contained in the witnessed events and shaped recall accuracy and source monitoring. The significant main effect of types of detail demonstrated that central details were recalled more accurately as compared to that of peripheral details. Support for such findings comes from many studies (Adolphus, Denburg, & Travel, 2001; Brown, 2003; Dutton & Carroll, 2001). The findings of the study show that recall of central details had an edge over those of peripheral details and support Easterbrook's (1959) cue-utilization hypothesis in terms of which increasing arousal might have led to a narrowing of attention and a reduction in the number of cues utilized. High emotional arousal, on the other hand, might be accounted for enhanced recall of central details as compared to peripheral details.

The significant main effect of types of detail for source-monitoring accuracy as well as significant interaction between emotional arousal x types of detail showed that subjects more accurately sourced central details as compared to peripheral details. These results are in consonance with the accuracy of recall in which central details were well retained as compared to peripheral details.

Gender

The effects of gender on two dependent measures were found mixed; females exhibited higher accuracy of recall as compared to their male counterparts. Nevertheless, they were almost similar in source-monitoring. These differences are explainable with regard to specification of socialization, role expectations, differential exposure to such stimuli, emotional makeup and role demands of males and females in traditional Indian social set up.

A meta-analysis by Shapiro and Penrod (1986) has indicated that females might be slightly more likely to make more accurate identification than males. This may be due to the fact that males and females take an interest in different aspects of scene and thereby remember source that differ in details (Powers, Andriks, & Loftus, 1979).

Distinctive cognitive abilities (Maccoby & Jacklin, 1974), different emotional make up (Tiwari, 2005; Tiwari & Dwivedi, in press), gender role demands, differential skill, gender roles (Sanik, 1981), task familiarity and task experience (Dixon & Hertzog, 1988) are some of the chief factors which are supposed to play roles in gender differences in eyewitness performance.

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