Effect of Emotional Valence on Working Memory of Psychogenic Non-Epileptic Seizures (PNES) Patients

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Abstract

Background The present study investigated how emotional valence influenced the working memory of patients with psychogenic non-epileptic seizures (PNES) as compared to healthy individuals.

Methods Emotional-N-Back task (E-N-back task) was administered to 15 PNES patients and equal number of healthy individuals. A 2×3 one-way analysis of variance (ANOVA) was used. Correct detection (accuracy) and reaction (RT) time were recorded as behavioral performance measures.

Results The ANOVA result of correct detection (accuracy) measure revealed significant difference in the performance of patients with PNES as compared with healthy individual, $F(2, 48) = 17.08$, $p = 0.001$. However, on the measure of reaction time (RT), both groups performed equally and there was no significant difference, $F(2, 48) = 1.13$, $p = 0.33$. Also the results of present study showed that patients with PNES are quicker in identifying unpleasant picture stimuli, which is evident from their mean comparison: unpleasant ($M = 65.55$, $SD = 15.66$), pleasant ($M = 58.22$, $SD = 20.03$), and neutral ($M = 45.11$, $SD = 23.13$).

Conclusion Conclusively, the finding of the present study shows a significant effect of emotional valence on working memory of patients with PNES on the measure of correct detection (accuracy), but not for second measure, i.e., reaction time this clearly reveals that patients with PNES are poor at emotional–cognitive integration, specifically at working memory level.

Keywords
- PNES
- working memory
- E-N-back task
- valence

Introduction

Emotions play a significant role in facilitation and inhibition of memory including other cognitive processes.[1] In recent years, a few investigations have explored the possibility that how emotions affect patients with psychogenic non-epileptic seizures (PNES), aiming to unravel the underlying mechanism of emotional–cognitive process, because seizures in patients with PNES are functional in nature and are supposed

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to be caused by emotional turmoil.[2] Available evidence show that patients with PNES are more vigilant to emotional stimuli[3] and have more attentional biasness toward negative emotional stimuli (angry faces) in comparison to positive emotional stimuli (happy faces). Thus, indicating that patients with PNES are more vulnerable to negative situation and their cognition are more tuned toward attention-seeking tendency although it operates unknowingly among them.[4,5] However, some studies refuted this argument and found that emotions do not affect the cognition of patients with PNES, especially working memory[6–8] and rejected the cognitive base of attention-seeking tendency of patients with PNES and argued that it is mostly learned or conditioned behavioral phenomenon from a patient's part to gain some environmental benefits.

Further studies have investigated the effect of emotion on memory but these have only explored flashbulb memory and autobiographical memory, and were more focused on healthy individuals, not patients with PNES. It is an established fact that patients with PNES are emotionally more disturbed and have attention-seeking tendency with a faulty emotional–cognitive system with deficits in various cognitive domains such as attention, perception, emotion regulation, and executive functions. However, to date, very less number of studies have focused on the working memory of patients with PNES under combined influences of different emotional valences, i.e., pleasant, unpleasant, and neutral. Citing the paucity of research that how different emotional stimuli influence the working memory of patients with PNES, it is yet to be investigated. Thus, the aim of the present study was to examine the effects of emotional valence on working memory of patients with PNES in comparison with healthy individuals.

Methods

Fifteen patients with PNES and an equal number of matched healthy individuals within the age range of 18 to 25 years ($M = 21.30$, $SD = 1.92$) were selected for the present study. Patients with PNES were recruited from the out-patient department (OPD) of the Department of Neurology, Sir Sunder Hospital, Banaras Hindu University, Varanasi. The healthy control group comprised university students. A 2 (Group: PNES and healthy individuals) × 3 (emotional valence: pleasant, unpleasant, and neutral) factorial design with emotional valence as within subject factor and group as between subject factors was used. Dependent measures included working memory task performance in terms of accuracy (correct detection) and reaction time. Emotional pictures were selected from the International Affective Picture System (IAPS).

Experimental Task

An Emotional-N-Back task (E-N-back) was used. This task is a modified version of the N-Back task. The task was designed using the SuperLab software (Cedrus, 2012, Version 4.5) and pictures were displayed on 15.6" color monitor of an i3 Intel processor computer with a refresh rate of 60 Hz. On the E-N-Back task, the participants were instructed to detect target pictures with pleasant, unpleasant, and neutral valence, depending upon the block instruction (i.e., 0-back, 1-back, or 2- back) by pressing the space bar. The experimental procedure consisted of a demonstration and practice session of 1 minute and 4 seconds, followed by the main session of 3 minutes and 48 seconds. The display of the task trial started with a fixation (+ sign) for 1000 milliseconds, followed by stimuli for 1250 milliseconds (►**Fig. 1**).

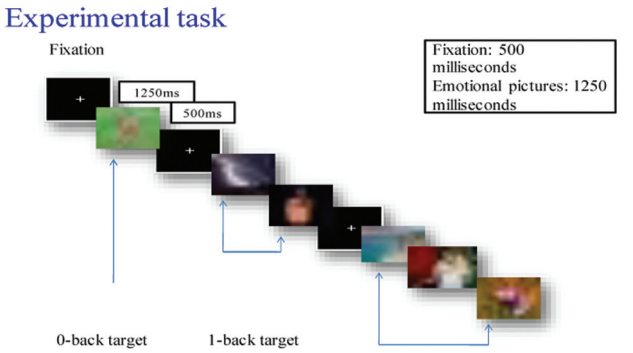

Fig. 1 Flow chart of the experiment task, i.e., 0-back, 1-back, and 2-back task.

Analysis of Data

Mean scores and standard deviations were calculated for all correct detection (accuracy) and reaction time. To examine the effects, the data were subjected to analysis of variance (ANOVA).

Results

Correct Detection (Accuracy)

Mean correct detection scores and *SD*s revealed that better performance of healthy individuals ($M = 62.07$, $SD = 17.04$) on the measure of correct detection in comparison to the performance of patients with PNES ($M = 50.51$, $SD = 23.80$). The main effect of emotional valence on correct detection was observed as statistically significant, F (2, 48) = 17.08, $p = 0.001$, partial eta square = 0.41, which indicates that participants differed in detecting emotional valence pictures. Further, ►**Fig. 2** shows the mean score of correct detection performance of participants for unpleasant emotional valance, which was better ($M = 65.55$, $SD = 15.66$) than pleasant ($M = 58.22$, $SD = 20.03$) and neutral ($M = 45.11$, $SD = 23.13$) valences. It indicates that participants were more emotionally tuned toward unpleasant pictures as compared with pleasant and neutral pictures.

Reaction Time

Performance of patients with PNES on RT (ms) was higher ($M = 703.43$, $SD = 191.90$) in comparison to the performance of their counterpart healthy individuals ($M = 688.22$, $SD = 81.73$); however, it was not a statistically significant. Also, the effect of emotional valence on reaction time (ms) performance of the participants was not found statistically significant, F (2, 48) = 1.13, $p = 0.33$, partial eta squared

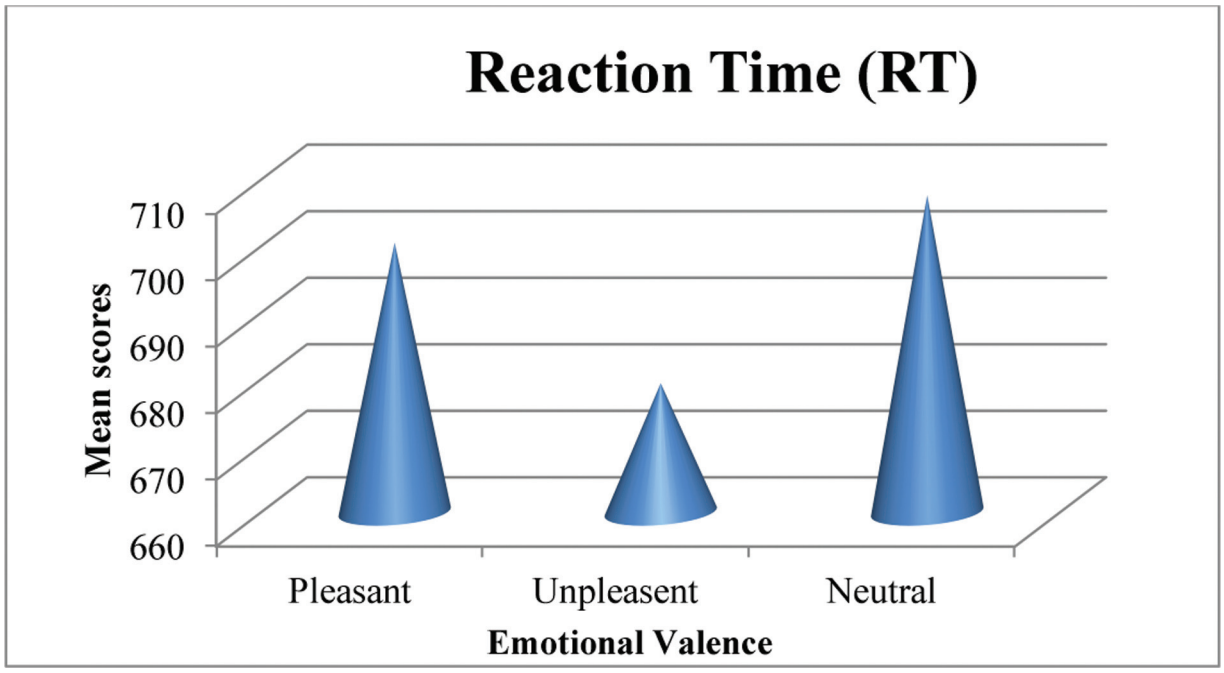

Fig. 2 Mean correct detection performance as a function of emotional valence.

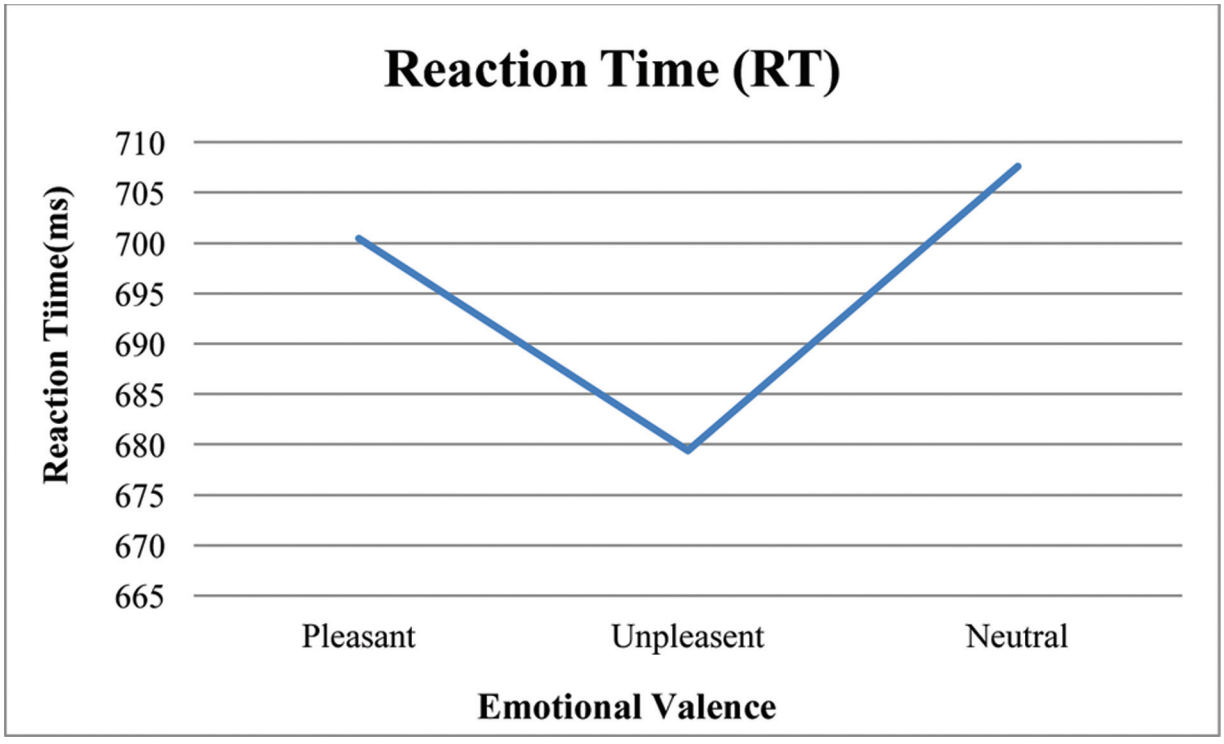

Fig. 3 Mean reaction time performance as a function of emotional valence.

= 0.04. ►**Fig. 3** shows that participants performance under neutral ($M = 707.62$, $SD = 190.78$) pleasant ($M = 700.49$, $SD = 120.06$) and unpleasant ($M = 679.36$, $SD = 122.18$) emotional valence conditions. Though the figure depicts that participants were quicker in responding to unpleasant pictures, which shows that they detected more readily unpleasant pictures as compared with pleasant and neutral pictures. In addition, the figure depicts that participants responded quickly to pleasant pictures in comparison to neutral pictures, which indicates that emotional-laden pictures are more quickly processed in cognition.

Discussion

The findings of the present study revealed that patients with PNES ($M = 50.51$, $SD = 23.80$) differed significantly F (2,

48) = 17.08, $p = 0.001$) from healthy individuals ($M = 62.07$, $SD = 17.04$) on the measure of correct detection, which shows that the patients with PNES were not able to hit the target as healthy individuals did during various cognitive load conditions, indicating less cognitive integration function in working memory. The present finding is consistent with that of previous studies by Li et al and Roberts et al[9,10], where patients with PNES differed significantly from healthy individuals on correct detection of working. Further, the present study revealed that unpleasant emotional stimuli were quickly identified by patients with PNES, which indicates that patients were more vigilant and pre-attentive to unpleasant emotional stimuli in comparison with healthy individuals.[11–13] This further provides support to the widely accepted notion that at affective level, patients with PNES are poor and lack proper channelization of negative stimuli at the working memory level.

Further, the performance of patients with PNES on measure of RT was found not-significant $F(2, 48) = 1.13$, $p = 0.33$, which revealed that both groups performed equally and took almost similar time in responding to emotional pictures. This clearly shows that perception and identification by patients with PNES are good but at the level of response disposition (behavioral manifestation) they are having trouble, which is consistent with the findings of Bakvis, Spinhoven, Putman, Zitman, and Roelofs,[14,15] where a no-significant difference was found between patients with PNES and healthy individuals on the measure of RT on the emotional n-back task.

Conclusively, the present study revealed that the working memory of patients with PNES was poor, which is evident from the results obtained on correct detection (accuracy) and RT measures, thus indicating that patient with PNES experience more difficulty in integrating information at the cognitive level, especially in working memory. The second finding of the present study is that patients with PNES responded more quickly to unpleasant pictures, which indicates that patients with PNES were quicker to identify unpleasant picture stimuli, which provides strength to the widely accepted concept that patients with PNES are more attuned and vulnerable toward negative situations.

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Conflict of Interest
None declared.

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