DOI: 10.14744/DAJPNS.2024.00270
Dusunen Adam J Psychiatr Neurol Sci
2025;38:33-35

LETTER TO THE EDITOR

Comparison of decision-making behaviors and galvanic skin responses in patients with hippocampal sclerosis before and after epilepsy surgery: A case series

Serra Sandor[1], Sakir Delil[2], Selin Yagci Kurtish[3], Taner Tanriverdi[3], Seher Naz Yeni[2]

[1]Istanbul Medeniyet University, Department of Psychology, Istanbul, Turkiye
[2]Istanbul University-Cerrahpasa, Cerrahpasa Faculty of Medicine, Department of Neurology, Istanbul, Turkiye
[3]Istanbul University-Cerrahpasa, Cerrahpasa Faculty of Medicine, Department of Neurosurgery, Istanbul, Turkiye

Dear Editor,

The Somatic Marker Hypothesis (SMH) (1) is a neuropsychological theory that seeks to explain decision-making behavior in ambiguous situations. According to SMH, certain visceral and somatosensory signals, known as somatic markers (SMs), play a pivotal role in influencing decision-making processes. These SMs, generated during emotional experiences, are believed to guide individuals toward making advantageous decisions. A key component of SMH is the involvement of the amygdala, which is essential for generating automatic emotional states related to the potential gains and losses associated with decisions (2). The SMs produced in this process are thought to steer individuals toward choices that result in favorable outcomes.

The Iowa Gambling Test (IGT) (3), was developed to assess decision-making in ambiguous situations and to evaluate the SMH. In this test, participants make 100 choices from four decks of cards. Unbeknownst to them, decks A and B (disadvantageous decks [DDs]) offer immediate rewards but are detrimental in the long term. In contrast, decks C and D (advantageous decks [ADs]) provide smaller immediate monetary rewards but are beneficial in the long run. Healthy individuals have been shown to exhibit larger electrodermal responses before choosing from disadvantageous decks compared to advantageous decks, which correlates with their better performance on the IGT (3). In contrast, patients with amygdala lesions have been observed to demonstrate deficits in developing electrodermal responses before choosing from disadvantageous decks. This indicates a lack of appropriate emotional processing in decision-making (4). Research has shown that patients with mesial temporal lobe epilepsy (MTLE) perform worse on IGT compared to healthy controls (5, 6). In a previous study, we compared the performance of operated and non-operated MTLE patients with that of healthy controls, demonstrating that although operated patients developed SMs, their performance was still inferior to that of controls (7). That study was cross-sectional in design. The current study adopts a within-subject design to compare IGT performance and SM generation in the same group of patients before and after anterior temporal lobectomy (ATL).

Initially, the study included 32 patients who were candidates for ATL at Istanbul University, Cerrahpasa Faculty of Medicine. Inclusion criteria required a diagnosis of epilepsy with typical aura and/or seizures originating from mesial temporal lobe structures.

How to cite this article: Sandor S, Delil S, Yagci Kurtish S, Tanriverdi T, Yeni SN. Comparison of decision-making behaviors and galvanic skin responses in patients with hippocampal sclerosis before and after epilepsy surgery: A case series. Dusunen Adam J Psychiatr Neurol Sci 2025;38:33-35.

Correspondence: Serra Sandor, Istanbul Medeniyet University, Department of Psychology, Istanbul, Turkiye
E-mail: serraicellioglu@gmail.com

Received: September 12, 2024; **Revised:** November 29, 2024; **Accepted:** December 21, 2024

Table 1: Demographic and clinical characteristics, Iowa Gambling Test (IGT) performance, and skin resistance responses of patients

		Case 1	Case 2	Case 3	Case 4	Case 5	Case 6
	Age	33	36	26	29	31	48
	Age at surgery	28	31	21	23	26	43
	Education (years)	12	5	13	11	5	8
	Gender (M/F)	F	M	M	M	F	M
	Age of onset	10	7	10	12	4	7
	Lesion lateralization	Left	Left	Right	Right	Right	Left
	Duration of epilepsy	18	24	11	11	22	36
Total IGT Net Scores	Pre-op	4	-12	12	-10	-2	0
	Post-op	6*	0*	18*	-2*	7*	-4
pSRRs	Pre-op	2.19	2.18	2.19	2.19	2.18	2.22
	Post-op	2.21*	2.19*	2.20*	2.19	2.20*	2.25*
aSRRs (Decks A and B)	Pre-op	2.09	2.08	2.07	2.09	2.32	2.14
	Post-op	2.14*	2.30*	2.17*	2.23*	2.10	2.11
aSRRs (Decks C and D)	Pre-op	2.09	2.08	2.07	2.09	2.11	2.14
	Post-op	2.09	2.26	2.09	2.09	2.22	2.09
dSRRs	Pre-op	0.00	0.00	0.00	0.00	0.21	0.00
	Post-op	0.05*	0.04*	0.08*	0.14*	0.11	0.02*

Pre-op: Preoperative; Post-op: Postoperative; Total IGT Net Scores: Difference between the total number of advantageous and disadvantageous deck selections in the Iowa Gambling Test (IGT); pSRRs: Mean magnitudes of punishment skin resistance responses; aSRRs: Mean magnitudes of anticipatory skin resistance responses; dSRRs: Difference between mean magnitudes of skin resistance responses before disadvantageous and advantageous decks. *Indicates an increase in value postoperatively.

Exclusion criteria included mental disabilities, behavioral disorders, illiteracy, and extra-temporal involvement. Demographic data, neuropsychological test results, routine electroencephalography (EEG) findings, and magnetic resonance imaging (MRI) scans were collected for each patient. Additionally, pre- and post-operative ictal video-EEG recordings were obtained. Post-surgery, follow-up testing was initiated in 2020. However, due to the Coronavirus Disease 2019 (COVID-19) pandemic, many patients, who lived in different cities and were seizure-free, were unable to participate. Ultimately, only six patients agreed to participate in 2022. Pre-operative evaluations were conducted in 2015, and surgeries were performed in 2016.

To evaluate decision-making, the Turkish version of the IGT was administered, during which patients made selections from DDs and ADs (6). Net scores were calculated for 100 total card choices and across five consecutive blocks. Electrodermal activity was recorded as skin resistance responses (SRRs) using the DERMAN system (TEKNOFIL Research, Inc.) (7). Two types of SRRs were analyzed: punishment SRRs (pSRRs), occurring after choosing from a deck followed by an overall monetary loss, and anticipatory SRR (aSRRs), occurring before the subsequent choice after a prior loss.

The results showed that five of the six patients demonstrated an increase in their total IGT scores post-operatively, while one patient exhibited a slight decrease. When comparing aSRRs before selecting from DDs and ADs, it was found that only one patient generated higher responses before DDs pre-operatively (Table 1). This patient was the oldest, had the longest duration of epilepsy, and underwent surgery at the latest age among the group. These factors may have contributed to a distinct pattern of cognitive impairment. However, this interpretation remains speculative and requires further research for confirmation.

Post-operatively, five of the six patients displayed higher aSRRs before choosing from DDs. Overall, all electrodermal responses increased (Fig. 1), suggesting that emotional responsiveness, particularly in the amygdala, might improve after ATL. Although imaging studies have provided contradictory findings, some suggest that ATL can alter amygdala reactivity, potentially underlying improved decision-making behavior in these patients (8–10). These findings underscore the critical role of mesial temporal lobe structures, particularly the amygdala, in decision-making under ambiguous conditions. Furthermore, they emphasize the importance of comprehensive pre-

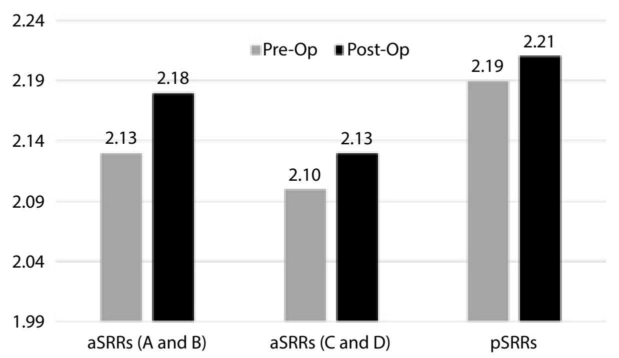

Figure 1. Mean magnitudes of different skin resistance responses (SRRs) before and after anterior temporal lobectomy (ATL).

aSRRs (A and B): Mean magnitudes of anticipatory skin resistance responses before selecting from Decks A and B; aSRRs (C and D): Mean magnitudes of anticipatory skin resistance responses before selecting from Decks C and D; pSRRs: Magnitudes of punishment-related skin resistance responses; Pre-Op: Preoperative measurements; Post-Op: Postoperative measurements.

and post-operative neuropsychological assessments in patients with MTLE. This study explored decision-making behavior of patients with MTLE in ambiguous situations through the framework of the SMH. However, this type of decision-making is intricately linked to other cognitive functions, particularly executive functions. Accordingly, it is essential to explore the relationship between patients' performance on the IGT and their executive functioning. However, this limitation, combined with the highly restricted sample size, significantly impacts the generalizability of the findings. Although the study did not include a control group, the results offer valuable insights into the potential effects of ATL on decision-making and emotional reactivity. The findings suggest that neuroplastic changes may occur following surgical intervention, enabling the brain to compensate for impaired functions. Despite the limitations, including the small sample size and absence of a control group, the study contributes to our understanding of the relationship between emotional processing, decision-making, and surgical outcomes in patients with MTLE.

In conclusion, this study highlights the role of the amygdala in decision-making behavior in MTLE patients and suggests that ATL may lead to improvements in decision-making performance. Future research with larger sample sizes and control groups is necessary to further validate these findings and explore their implications for clinical practice.

Ethical Approval: The Istanbul University-Cerrahpasa, Cerrahpasa Faculty of Medicine Clinical Research Ethics Committee granted approval for this study (date: 17.10.2014, number: 19451483/604.01-5548).

Conflict of Interest: The authors declare that they have no conflict of interest.

Informed Consent: Informed consent was obtained from all participants.

Use of AI for Writing Assistance: Not declared.

Financial Disclosure: This study supported by the Scientific Research Projects Coordination Unit of Istanbul University (project number: 44547).

Peer-review: Externally peer-reviewed.

REFERENCES

1. Damasio AR. Descartes' Error: Emotion Reason, and the Human Brain. New York: Avon Books, 1994.
2. Bechara A, Damasio H, Damasio AR, Lee GP. Different contributions of the human amygdala and ventromedial prefrontal cortex to decision-making. J Neurosci 1999; 19:5473-5481. [CrossRef]
3. Damasio AR. The somatic marker hypothesis and the possible functions of the prefrontal cortex. Philos Trans R Soc Lond B Biol Sci 1996; 351:1413-1420. [CrossRef]
4. Bechara A, Damasio H, Damasio AR. Role of the amygdala in decision-making. Ann N Y Acad Sci 2003; 985:356-369. [CrossRef]
5. Bernasconi N, Bernasconi A, Caramanos Z, Antel SB, Andermann F, Arnold DL. Mesial temporal damage in temporal lobe epilepsy: a volumetric MRI study of the hippocampus, amygdala and parahippocampal region. Brain 2003; 126:462-469. [CrossRef]
6. Bonatti E, Kuchukhidze G, Zamarian L, Trinka E, Bodner T, Benke T, et al. Decision making in ambiguous and risky situations after unilateral temporal lobe epilepsy surgery. Epilepsy Behav 2009; 14:665-673. [CrossRef]
7. Sandor S, Delil S, Yagci S, Korkmaz B, Yeni SN. Improved decision-making and psychophysiological responses in mesial temporal lobe epilepsy after anterior temporal lobectomy. Epileptic Disord 2018; 20:517-524. [CrossRef]
8. Vilà-Balló A, De la Cruz-Puebla M, López-Barroso D, Miró J, Sala-Padró J, Cucurell D, et al. Reward-based decision-making in mesial temporal lobe epilepsy patients with unilateral hippocampal sclerosis pre- and post-surgery. NeuroImage Clin 2022; 36:103251. [CrossRef]
9. Bonelli SB, Powell R, Yogarajah M, Thompson PJ, Symms MR, Koepp MJ, et al. Preoperative amygdala fMRI in temporal lobe epilepsy. Epilepsia 2009; 50:217-227. [CrossRef]
10. Shaw P, Lawrence E, Bramham J, Brierley B, Radbourne C, David AS. A prospective study of the effects of anterior temporal lobectomy on emotion recognition and theory of mind. Neuropsychologia 2007; 45:2783-2790. [CrossRef]