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The Relationship of the Impulsivity and Decision-Making Behavior with Social Cognitive Skills in Borderline Personality Disorder

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ABSTRACT

Introduction: In this study, we aimed to examine the relationship between decision-making processes and other cognitive characteristics associated with Borderline Personality Disorder (BPD) in comparison with healthy controls by using the neurocognitive tests.

Method: The sample of the study consists of the patient group diagnosed with BPD (n=27) and the voluntary participants without any psychiatric diagnosis (n=28). Borderline Personality Inventory (BPI) was used for psychiatric evaluation, and Iowa Gambling Test (IGT), Stroop Test, Benton Face Recognition Test, Reading the Mind in the Eyes Test, Dokuz Eylül Theory of Mind Scale (DEToM), WMS-R Digit Span and Logical Memory Subscales were administered for neuropsychological examination.

Results: A significant difference was found between the BPD and the control group in BPI scores (p=0.02). There were no significant differences on the duration of interference and the number of errors in the Stroop Test, but it was observed that the number of spontaneous correction responses differed significantly (p=0.02) between the groups. A significant difference was revealed (p<0.01) in the immediate recall scores of the WMS-R Logical Memory (subtest story A) between the groups. There were also differences in the Iowa Gambling Test between the groups in the response tendency to choose from deck A (p=0.028) in the first half and from deck B (p=0.03) in the second half of the test. Finally, among the total scores of DEToM there was significant difference between the two groups (p<0.01), and this difference was prominent in the second-degree false belief (p=0.024) and empathy (p=0.027) tasks.

Conclusion: As a result of our study, it was concluded that individuals with BPD have minimal difficulty in inhibiting inappropriate response, and this difficulty is related to making disadvantageous choices in decision-making behavior. While BPD group was successful in predicting mental states from external cues in terms of social cognition, however, it was observed that they had difficulty integrating cues within a social pattern and making coherent narratives.

Keywords: Borderline personality disorder, decision making, neuropsychological tests

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INTRODUCTION

Borderline Personality Disorder (BPD) is a chronic personality pattern that originates in young adulthood. Borderline personality disorder is characterized by impulsivity, significant difficulties in interpersonal relationships, extreme sensitivity to abandonment, and inconsistency in affect and self-perception. It has been reported that the prevalence in the population varies between 1.6% and 5.9% (1). The emotional, intellectual and behavioral inconsistencies experienced by the patients diagnosed with BPD can lead to severe emotional fluctuations, extreme judgements, and aggressive behaviors (2). Impulsivity, which is a prominent symptom of BPD, can be defined as the tendency to engage in sudden behaviors without considering the consequences. Impulsive reactions result with responding and taking action to an internal or external stimulus in an instant unplanned manner (3). Therefore, impulsivity is a multidimensional concept that includes inability to use the available information when evaluating the consequences of actions, inability to delay the immediate small reward for a large reward to be obtained later, and not being able to suppress strong motor reactions (4).

Highlights

- **Patients with BPD had minimal difficulty inhibiting inappropriate responses.**
- **BPD group made riskier choices in a decision-making task despite negative feedback.**
- **Patients with BPD were successful in predicting mental states from external cues.**
- **BPD patients have difficulty integrating internal states and external social cues.**
- **This difficulty hinders making a coherent narrative and can be a target in therapy.**

Among the studies regarding information processing in individuals diagnosed with BPD, 83% reported impairment in one or more cognitive areas. It has been shown that these deficits occur in cognitive tasks that are conceptualized as executive functions, and attributed to the dorsolateral prefrontal and orbitofrontal areas (5). The above-mentioned cognitive difficulties are observed mostly in tasks that require response inhibition

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(6). According to the previous studies, the other most common reported cognitive difficulties are observed in decision-making tasks and long-term memory consolidation (consolidation in the learning process) following the response inhibition deficit (7). These tasks may relate with behaviors such as gambling, uncontrolled spending, reckless driving, and risky sexual acts (1); substance abuse, self-harm, suicidal behavior, and eating disorders (8) in BPD. Additionally, weak response inhibition in BPD has been found to be correlated with suicide risk and the number of lifetime suicide attempts (6). Therefore, impairment in executive functions may explain the basic structures of emotion regulation difficulty and impulsivity in BPD.

Decision-making processes are affected by i) interpersonal relationships and the context of events, ii) predicting the outcome and perception of control, iii) benefiting from gains and losses, iv) risk tolerance, v) the amount of information collected before making a decision (9). A person's ability to use these resources in their decision-making process affects how they evaluate their current condition and future situations. Approaches that attempt to model the information processing ability of patients diagnosed with BPD have revealed that tendencies to make attributions based on a single causality, jumping to conclusions, and biased judgment are dominant in their behavioral patterns. These biases are augmented with an increase in the severity of clinical symptoms of BPD (10). Studies using neuropsychological tests have shown that both the increase in the severity of psychiatric symptoms and the increase in impulsivity in BPD results with higher tendency to make risky choices in their decision-making processes; revealing that they could not change their reactions in the expected direction with feedback (11). It is assumed that, especially in reward-based decision-making situations, a bias for short-term instant gratification emerges in BPD, along with a tendency to devalue delayed rewards, they cannot benefit from *delay discounting* (12,13).

One of the most important components of social cognition, *'theory of mind'* is defined as the ability to attribute mental states to oneself and others (14). From a neuroscience perspective; each individual has a set of mechanisms for perceiving and expressing their own internal experiences (15). These mechanisms will then carry representations that enable the individual to accurately understand the minds of others. All of the cognitive processes underlying social interactions, including the processes of perceiving, interpreting, and responding to others' intentions, tendencies, and behaviors have been included in neuroscience in the area of interest of "social cognition" (16). In patients diagnosed with BPD, reasoning deficits such as inadequate review of facts, neglecting alternatives and focusing on only one hypothesis, and overthinking are suggested to be associated with impaired social cognitive skills and mentalization ability (17).

Treatment of BPD is a challenging area in the field of mental health and evidence-based treatments are needed. In this study, we aimed to test the assumptions if the BPD patient group would show any difference as compared with the matched control group; i) in neuropsychological tests requiring simple attentional skills both groups would be at similar levels, but ii) in neuropsychological tests requiring emotion recognition and social cognition skills, and iii) assessing decision-making behavior in risky situations would be less successful. By empirically studying decision-making models through these assumptions, we aim to contribute to the knowledge of understanding cognitive structuring in BPD and to provide guidance for treatment and psychotherapy approaches aimed at improving the quality of daily life of these individuals in the future.

METHODS

Participants

The study sample was gathered from patients who applied to the outpatient clinic of Istanbul University, Istanbul Faculty of Medicine, Department of Psychiatry. The patients who were referred to the Psychotherapy Unit after their psychiatric examination, and healthy controls who do not have any psychiatric diagnosis. Psychotherapy Unit in Psychiatry Department outpatient clinic monitors patients whose primary diagnosis is personality disorder and do not require intensive drug treatment.

The patient and control groups of our study included individuals between the ages of 18 and 50 who were at least primary school graduates (5 years). Among the patients who were being followed in the Psychotherapy Unit and diagnosed with Borderline Personality Disorder according to the DSM-5 diagnostic criteria were informed and invited to the study. Patients who agreed to participate in the study were consecutively included. According to the study inclusion criteria; the patients diagnosed with BPD who did not have any other psychiatric diagnosis at the time of the study and had a score of 15 or above on the Borderline Personality Inventory were included as the patient group. According to the exclusion criteria; patients with a history of psychotic episodes, bipolar disorder and/or comorbid attention deficit hyperactivity disorder were excluded from the study.

Healthy participants of the control group (CG) were reached by using in-hospital bulletin boards. According to the inclusion criteria of the control group, volunteered participants who had not been diagnosed with any psychosis spectrum disorder throughout their lives, who had no psychiatric diagnosis or active use of any psychiatric medication at the time the study was conducted, were included as the healthy control group. Additionally, individuals with neurological (i. e., epilepsy. multiple sclerosis) and/or severe systemic diseases (i. e., neoplastic or autoimmune diseases) that may affect mental functions were not included in the study for both groups.

According to the power analysis performed with the G*Power program, it was seen that the sample size for this study should be n=28 in order for the statistical analysis power to be 0.80. This power value suggests that the study results will reach statistical significance and generalizable results will be obtained.

Application

All applications were performed in a single session lasting approximately 1 hour in a test room where the participant and the researcher (B. K.) were alone, without any external distraction. The scales were administered by the same researcher after obtaining written informed consent from the participants. All procedures performed in this study were carried out in accordance with the ethical standards of the Istanbul University Istanbul Faculty of Medicine Clinical Research Ethics Committee and the 1964 Helsinki declaration (protocol number: 2021–538222).

Materials

Sociodemographic Questionnaire

The sociodemographic questionnaire was prepared by the researchers to determine the sociodemographic characteristics of the participants such as age, gender, educational status and marital status. This form also inquired about the presence of any current disease diagnoses, constantly used medications and other treatments.

Borderline Personality Inventory

Borderline Personality Inventory (BPI) is a self-report inventory (18,19). There are 53 statements in BPI and answered as true or false. Each "true" answer in the inventory is scored as 1; while "false" answer is scored as 0. The total score is calculated with the first 51 items, omitting the last two items (items 52 and 53). The cut-off score of BPI is 15; higher score indicates symptoms that become more severe towards the disease.

A validity and reliability study of the Turkish adaptation of BPI was conducted and the Cronbach's alpha value was reported as 0.84 (18).

Wechsler Memory Scale-Revised

It is a battery that was first created by Wechsler in 1945 for the comprehensive evaluation of memory. The subscales of the revised edition of this comprehensive battery are also valid independently (20). Turkish validation study of these subtests presented the norms according to age and educational level (21,22). Among those, Logical Memory and Digit Span subtests were used in this study and their scores were included in the comparison between groups.

Logical Memory Subscale

The test consists of a story which includes components such as time, place, person and emotions. In order to minimize the learning effect in test-retest evaluations two alternative stories were developed, A and B (23). The test is scored based on story items that the participant can spontaneously recall in immediate and delayed phases after the applicant reads the story. In our study, story A was used with immediate recall assessment. Increasing scores indicate better immediate free recall.

Digit Span Subscale

WMS-R Digit Span Subtest is a frequently used tool to assess attention processes. While forward digit span is considered as a simple attention task; Weintroub (24) and Öktem (25) suggest that the backward digit span measures complex attention skills, and McCarthy and Warrington (26) suggest that it is more effective in evaluating short-term memory.

Dokuz Eylül Theory of Mind Scale (DEToM)

Dokuz Eylül Theory of Mind Scale (DEToM) was developed by Değirmencioğlu (27). It consists of 7 stories and 5 pictures that measure first-degree false belief, second-degree false belief, metaphor comprehension, irony comprehension, faux pas (gaffe recognition, making a blunder) and empathy abilities that covers all components of theory of mind. According to the defined answers of the scale, each correct answer is scored as 1 and each incorrect answer is scored as 0 (zero). Scoring range of the scale is 0–18, and higher scores indicate better abilities (27).

Iowa Gambling Test

The Iowa Gambling Test (IGT) is a computerized version of the gambling task developed by Bechara et al. that aims to evaluate decision-making processes in situations involving uncertainty (28). The test consists of 4 decks of cards labeled from A to D, where each card represents winning or losing money (some choices both winning and losing). The goal is to win as much game money as possible and lose as less game money as possible. The participants can choose from the deck of cards on the screen in any order and frequency they want. After each card selection, a feedback message appears on the screen showing the amount won or lost. Decks A and B give greater rewards but higher penalties, putting the decks at a disadvantage. C and D decks, on the other hand, give smaller rewards and lower penalties. As a result, choices made from these decks become advantageous. The test ends after a total of 100 choices are completed. The normative study of IGT in Türkiye was conducted by İçellioğlu (29).

Stroop Test

The Stroop Test measures the individual's ability to suppress the habitual behavior pattern in the face of changing situations and to continue unusual behavior in line with changing demands or under a disruptive effect (30). It is the frequently used and reliable tool to evaluate response inhibition among executive functions (31,32). The test is based on the task of saying the color names written in colors different from they represent. Stroop interference effect occurs after color naming and word reading tasks are applied. The Stroop interference effect causes a prolonged reaction time compared to automatic response because it requires high level cortical processing skills.

Benton Face Recognition Test

Benton Face Recognition Test was developed specifically to evaluate face recognition ability which is within the scope of perceptual-motor tests (33). The Short Form consists of 27 points and the Long Form consists of 45 points. In this study, evaluation was made through the short form and the test score was calculated using the conversion table. Forty-one points and above are "normal"; the score range of 39–40 is "relatively intact"; the score range of 37–38 is "medium deficient"; a score of 37 and below is considered "severely impaired" (30).

Reading the Mind in the Eyes Test (Eyes Test)

Reading the Mind in the Eyes Test consists of non-colored (black and white) photographs of people presented with only the eyes area of their faces. The test was finalized by its developers in 2001 with 36 photographs and 4 options for each photograph (34). The Eyes Test is one of the most frequently used scales to evaluate the emotion recognition ability of theory of mind (35). The test was designed to evaluate the ability to recognize complex, intense emotional states or intentions. Each question contains one correct and three distractor options. The participant is expected to choose from the given options that best expresses the mental presence of the person in the photo. The reliability study of the Turkish adaptation was conduted and this 32-item scale was used in this study (36). The scores of the scale range from 0 to 32. The cut-off score for men is 23.20±3.11; and 25.25±3.11 in women. The number of correct answers is evaluated as better ability in social cognition and theory of mind skills.

Statistical Analysis

The test results were evaluated with the IBM Statistical Package for Social Sciences (SPSS) program version 22.1. Descriptive analysis methods were used to evaluate sociodemographic data and the Shapiro-Wilk test was used to ensure normality of data distribution. According to the distribution characteristics of the data, the test results of the patient and control groups were compared with the non-parametric t-test (Mann-Whitney U test) for independent groups. Spearman Correlation (r_s) analysis method was used to determine the degree of correlation between variables. Variance characteristics were examined by Multivariate Analysis of Variance. Analyses were evaluated at a significance level of $p<0.05$.

RESULTS

Demographic Characteristics

There were no significant differences between the groups in terms of gender (p=0.35), education levels (p=0.20), and age (p=0.36) (Table 1). BPI scores were significantly higher in the BPD group (24.45±6.68) compared to the control group (8.72±3.74, U (53)=232, p=0.023). Although the number of female participants in the BPD group was higher than the control group in our sample, there was no statistically significant difference in the distribution of the gender variable between the patient and control groups ($\chi^2(1)=0.91$; p=0.341).

According to the WMS-R Digit Span Subscale, there was no differentiation between the groups in terms of forward digit span (p=0.12) and backward digit span (p=0.46) scores. However, when the scores for immediate recall from the WMS Logical Memory subtest (Story A) were evaluated, a statistically significant difference was observed between the groups (p=0.002). BPD group did not perform as good as CG at immediate recall phase of the WMS-R Logical Memory subtest, in which verbal material

has semantic integrity within temporal and spatial information and a strong emotional component.

There was no significant difference between the BPD and CG in Stroop Test, in terms of interference duration (p=0.26) and the number of errors in naming the colored words presented with incongruent the color of the ink does not match the name of the color (p=0.84). There was a significant difference in the number of spontaneous response correction during the incongruent colored-words naming task (p=0.016; d=-0.80). There was a tendency for incorrect responses in the BPD patient group but correcting themselves as indicated from a higher number of self-corrected responses compared to the CG.

When Benton Face Recognition Test scores were compared, there was no statistically significant difference between the groups (p=0.84). Also, no significant difference was observed between the two groups regarding emotion recognition abilities assessed with the Eyes Test (p=0.87).

The total score obtained from the Dokuz Eylül Theory of Mind scale (DEToM) indicates a significant difference between the two groups (p=0.004). In its subscales, there was no statistical significance observed in the first and second-degree false belief subscales, metaphor understanding, and faux pas tasks. However, a significant difference was detected in the second-degree false belief (p=0.024; d=0.78) and empathy (p=0.027; d=0.82) tasks.

Table 1. Descriptive statistics of sociodemographic characteristics of the study groups and comparison of neuropsychological test results with the Mann-Whitney U Test

Variables	BPD Group (n=27)	Control Group (n=28)	Significance (p value)	Cohen effect size coefficient (d)
Gender (%)				
Female	16(59.2)	13(46.4)	0.34	
Male	11(40.8)	15(53.6)		
	Mean ± SD	**Mean ± SD**	**p**	
Age	31.00±8.54	30.37±9.49	0.36	
Education (year)	13.64±2.77	15.29±2.44	0.20	
BPI	24.45±6.68	8.72±3.74	0.023*	
	Median (IQR)	**Median (IQR)**	**p**	**d**
Digit Span Forward	6 (2)	6.5 (2.75)	0.12	0.52
Digit Span Backward	5 (3)	4 (1)	0.46	-0.25
WMS Logical Memory-A	11 (6)	17 (6)	<0.01*	1.01
Stroop Test				
Time of Interference	35 (6)	29.5 (17.5)	0.26	-0.29
Errors	0 (1.5)	0.5 (1)	0.84	0.03
Corrections	2 (2.5)	0 (0)	0.02*	-0.80
BFRT	47 (5.5)	47 (5)	0.84	0.01
Eyes Test	22 (4.5)	23 (3.75)	0.87	-0.06
Iowa Gambling Test				
(C+D)-(A+B)	18.5 (8.5)	21.3 (12.5)	0.44	0.21
A Deck	18 (7)	22 (8)	0.06	0.73
First half	11 (3.5)	12 (2)	0.03*	0.75
Second half	8 (6)	9.5 (7)	0.07	0.61
B Deck	32 (10)	28 (7.75)	0.05	-0.58
First half	16 (5.5)	14 (4.75)	0.11	-0.58
Second half	17 (6)	14 (4.75)	0.03*	-0.40
C Deck	22 (13)	21 (8.75)	0.63	0.28
First half	12 (3.5)	11 (5)	0.87	0.17
Second half	11 (10)	11 (3.75)	0.92	0.68
D Deck	22 (7.5)	24 (7.5)	0.51	-0.02
First half	12 (4.5)	12 (2)	0.75	0.14
Second half	11 (7)	13 (6.5)	0.49	0.10
DEToM	12 (3.5)	15 (3)	<0.01*	0.97
1st degree ToM	3 (1.5)	3 (1.75)	0.29	0.28
2nd degree ToM	1 (1)	2 (0.75)	0.02*	0.78
Grasping the irony	2 (2)	2.5 (1)	0.36	0.47
Understanding the metaphor	2 (1)	2 (1)	0.57	0.25
Empathy	4 (1.5)	5 (1)	0.03*	0.82
Faux pas	1 (1)	1 (0)	0.26	0.37

*p<0.05 significance level.
BFRT: Benton Face Recognitin Test; BPD: Borderline Personality Disorder; IQR: Interquartile Range.; ToM: Theory of Mind; WMS: Wechsler Memory Scale; DEToM: Dokuz Eylül Theory of Mind.

Table 2. Correlation analysis results of Stroop Test and Iowa Gambling Test results according to groups

	BPD Group (n=27)						Control Group (n=28)					
	Stroop Test						Stroop Test					
	Interference Time		Error		Spontaneous Correction		Interference Time		Error		Spontaneous Correction	
Iowa Gambling Test	r^s	p	r^s	p	r^s	p	r^s	p	r^s	p	r^s	p
(C+D)-(A+B)	-0.52	0.02*	-0.64	<0.01*	-0.03	0.22	-0.31	0.17	-0.04	0.85	0.14	0.57
A Deck	-0.12	0.64	-0.23	0.35	-0.05	0.84	0.19	0.4	0.12	0.59	-0.07	0.75
First half	-0.06	0.81	-0.3	-0.22	-0.02	0.93	0.22	0.34	0.09	0.69	-0.86	0.72
Second half	-0.14	0.57	-0.14	0.58	-0.06	0.79	0.15	0.54	0.11	0.64	-0.08	0.72
B Deck	0.55	0.02*	0.72	<0.01*	0.31	0.22	0.24	0.28	-0.02	0.91	-0.05	0.81
First half	0.18	0.47	0.4	0.09	0.36	0.14	0.21	0.36	-0.05	0.84	-0.03	0.88
Second half	0.66	<0.01*	0.71	<0.01*	0.12	0.64	0.26	0.26	-0.007	0.97	-0.09	0.71
C Deck	-0.67	0.79	-0.39	0.1	0.18	0.46	-0.02	0.94	0.03	0.91	0.16	0.49
First half	0.12	0.64	-0.23	0.35	-0.03	0.91	0.05	0.85	0.08	0.74	0.04	0.87
Second half	-0.2	0.42	-0.45	0.06	0.28	0.26	-0.09	0.71	0.04	0.87	-0.01	0.96
D Deck	-0.39	0.1	-0.26	0.28	-0.38	0.11	-0.31	0.17	-0.08	0.73	0.06	0.77
First half	-0.29	0.25	0.23	0.37	-0.46	0.05	-0.45	0.05	-0.1	0.67	0.06	0.78
Second half	-0.4	0.09	-0.25	0.33	-0.26	0.29	-0.36	0.12	-0.13	0.59	0.03	0.89

*p<0.05 significance level.
BPD: Borderline Personality Disorder; r^s: Spearman Correlation Coefficient.

Table 3. Correlation analysis results of BPI scores with neuropsychological tests in the BPD group

	BPD Group (n=27) Borderline Personality Inventory scores	
Neuropsychological Tests	r_s	p
Digit Span Forward	-0.25	0.20
Digit Span Backward	-0.38	0.049*
Stroop Test		
Time of Interference	0.11	0.57
Errors	0.24	0.22
Corrections	0.28	0.15
Benton Face Recognition Test	0.11	0.57
Eyes Test	-0.33	0.09
WMS Logical Memory	-0.32	0.10
DEToM		
Total Score	-0.36	0.14
1st degree ToM	0.04	0.87
2nd degree ToM	-0.02	0.92
Grasping the irony	-0.42	0.90
Understanding the metaphor	0.06	0.80
Empathy	-0.22	0.40
Faux-pas	-0.46	0.06
Iowa Gambling Test		
A deck	0.22	0.38
B deck	-0.39	0.11
C deck	0.24	0.35
D deck	-0.40	0.09

*p<0.05 significance level.
BPD: Borderline Personality Disorder; DEToM: Dokuz Eylül Theory of Mind; ToM: Theory of Mind; WMS: Wechsler Memory Scale.

In the IGT, the two groups were compared separately for each of the four decks in the test. There was a trend level difference for selection from decks A and B in both the BPD group and the control group (p=0.058 and p=0.051, respectively). There were no differences in deck C (p=0.63) or deck D (p=0.51) (Table 1). The choice pattern was evaluated based on the differences in choices between the first and last halves of the 100 cards. The variance characteristics indicated that the trend level difference in deck A was caused by the BPD-diagnosed group preferring it significantly over the control group during the first half of the test (F (1.52)=5.34; p=0.027; partial η^2=0.13). BPD diagnosed patients' choices in the second half of the test explained the difference observed in deck B (F (1.52)=3.543; p=0.07; partial η^2=0.09). Furthermore, net score of choosing from advantageous decks (C+D)-(A+B) were negatively correlated with the Stroop Test interference duration and number of errors. (Table 2).

The relationship between BPI scores and neuropsychological test scores in the BPD group was examined using Spearman correlation coefficient (Table 3). According to this, analysis as the BPI scores increased, there was a decrease in the digit span backwards (r_s=-0.382; p=0.049). Also, there was a trend level negative correlation between faux pas subscale in DEToM and BPI scores (r_s=-0.046; p=0.06).

DISCUSSION

In this study, neuropsychological tests were used to examine the decision-making behaviors of individuals diagnosed with BPD in comparison with a healthy control group matched in terms of gender and education levels. Accordingly, in comparison with CG, BPD group showed an increase in the number of spontaneous corrections in the response inhibition task, which can be considered as impulsivity. In addition, it was observed that the BPD group did risky choices from disadvantageous deck in decision-making task though they were given negative feedback, and made more incorrect attributions in social cognition tasks such as empathy and second-order false belief.

In terms of the focused (simple) and complex attention abilities, which were evaluated by digit span, the patients diagnosed with BPD did not show difference from healthy controls in our study. Regarding our study hypothesis, neuropsychological test performances requiring attention abilities would be at similar levels between the patient group diagnosed with BPD and healthy controls was confirmed. This finding of ours also showed that the patients diagnosed with BPD did not have any attentional deficit that would effect other cognitive tests. However, as the WMS logical memory subscale, a verbal material (i. e., a story) that has semantic integrity with its time, place and emotional content is presented, the patients with BPD cannot recall as successful as healthy individuals. Studies in the literature consider this test as a measurement of verbal memory and suggest that it indicates difficulty in memory in patients diagnosed with BPD whose results were consistent with our study (37,38). In studies where the logical memory subscale showed no difference with healthy controls, an index score for verbal memory was calculated, not a raw test score (39). Therefore, we concluded that the difficulties of the patients diagnosed with BPD in the task of recalling a verbal material with episodic components may not be a memory disorder but a disruption of a complex attention process.

Mental flexibility is a high-level attentional function. Within the mental flexibility the person can inhibit the habitual response under a disruptive influence (also called as resistance to interference). Mental flexibility is often evaluated through regulating the motor response by suppressing the dominant and therefore habitual behavioral tendency and shifting attention and behavior. The last section of Stroop Test presents with interfering effect on sustained attention, thus requires inhibiting the habituated response and shifting the attention. During this task 'spontaneous correction' indicates that the subject realizes their responses are incorrect and without any external instruction, subject makes correction right after their initial response. An increase in the spontaneous correction score in Stroop Test indicates the difficulty in impulse control. The fact that the interference duration and number of errors of the BPD group were at the same level as the CG. The increase in spontaneous correction responses may suggest that impulse control of BPD group is not completely impaired, but they have difficulties. The dominant effect of impulsivity on decision-making processes manifests itself in reacting without collecting all the evidence, a lack of inhibition of inappropriate actions. a tendency to make risky decisions, and a preference for immediate small rewards over delayed large rewards. Previous studies shown that when decision-making process ends with a probable reward, individuals with BPD cannot correctly attribute the value of the delayed reward and acts in a behavior to obtain instant gratification (12,40).

Individuals diagnosed with BPD may exhibit two dominant behaviors in terms of decision-making processes: 'risk avoidance' or 'risk approach', depending on their fluctuating moods. The most frequently used experimental paradigm to evaluate risk approach or risk avoidance behavior with neuropsychological tests is based on gambling tasks. The IGT used in our study is a testing protocol in which the participant is asked to choose cards from four decks, where two decks are advantageous and produce a profit, while the other two are disadvantageous and produce a loss. Typically, as trials progress healthy individuals realize the disadvantageous decks (decks A and B) through feedbacks, and they shift their choices to advantageous decks (decks C and D) (41). There are studies showing that although patients diagnosed with BPD distinguish the decks in IGT according to their advantageousness, they cannot change their behavior towards winning (42,43). In our study, BPD patients showed a decrease in their pattern of choosing from the disadvantageous A deck in the second half of the test. However, in this second half of the test, it was observed that participants turned to the disadvantageous B deck, which also had high gains with high total losses similar as A deck, rather than making their choices from the advantageous C and D decks. The fact that patients group tended to turn to the B deck in the second half of IGT suggests that they followed the feedback and could actually change their behavior by shifting their choices from the A deck. Consistent with our study, previous studies in which the cognitive features of BPD were examined with detailed neuropsychological tests, as the impulsivity was evaluated considering the reaction times (44) no differences was observed as compared to healthy control groups. In reward-based decision-making situations, the patients cannot sufficiently benefit from delay discount and kept making high-risk disadvantageous choices (45–47). In our study, the correlational relationship between the number of choices made from the disadvantageous deck of the IGT in the BPD group and the Stroop Test parameters (interference duration and number of errors), which are indicators of impulsive tendencies, was evaluated in accordance with the findings of the literature.

The results of the studies examining decision-making processes through functional neuroanatomical components appear to focus mainly on the orbitofrontal cortex (OFC) and ventromedial prefrontal cortex (vmPFC). Of these, two types of deficits were suggested to affect decision-making in patients with orbitofrontal cortex lesions. Firstly, patients may fail to change their judgment toward a particular stimulus, even though the outcome is negative. Secondly, patients are impaired at tasks requiring empathy or other theory of mind, fail to process and recognize the emotions of others, and show impaired judgment in social contexts. Such limitations in social learning and emotional identification often lead to clinical syndromes such as disinhibition, impulsivity, increased risk-taking behavior, and the inability to change one's behavior despite negative social consequences (48). In patients with vmPFC damage, decision-

making processes manifest with increased risk-taking behavior. It has been shown that individuals with vmPFC damage have an increased tendency to choose cards from disadvantageous decks during IGT (41). Another study with 11 patients with chronic frontal lobe injuries showed that patients with focal left-sided OFC and vmPFC lesions exhibited more risk-taking behavior (rather than impulsivity) in a gambling task compared to patients with bilateral frontal injuries and patients without frontal injuries (49). These findings support the relationship between deficient decision-making processes reflected in behavior and social cognitive difficulties in patients diagnosed with BPD.

The ability to recognize internal state from external cues is the cognitive basis of social functioning, it promotes empathy, trust and social adaptation behaviors (50). The ability to accurately infer the mental state of others from external cues such as facial emotional expressions is important for guiding one's own behavior and regulating one's own emotional state in a social context. In many studies, patients diagnosed with BPD performed less successfully than healthy individuals in facial emotion recognition (51). In particular, it has been reported that they have an anger bias about others' emotions (52) or interpret neutral facial expressions more negatively (53,54). Among the few studies that investigate the ability of individuals diagnosed with BPD to benefit from external cues regarding the mental states of others using the Eyes Test; reporting no difference between healthy control groups and groups diagnosed with BPD (55–57). The findings of our study are consistent with studies that concluded that the ability to recognize facial emotions and even attribute the intentions of others is normal in patients with BPD.

In our study, there were several tasks that caused differentiations in response behavior and statistically significant differences in some of the ToM tests of the two groups. The first one was DEToM's story tasks that measure second-degree false belief. While first-degree false belief describes a person's ability to make inferences about another person's belief; second-degree false belief is the ability to infer what a second person thinks about a thought of a third person (58). It is also expressed as belief about belief (59). First-degree false belief task requires relatively simple theory of mind skill. It suggests that patients diagnosed with BPD are successful at the level of healthy controls in first-degree false belief tasks, but patients could not make appropriate attributions in tasks that require higher-level abstraction and thinking about the thought. At this point, the findings of our study are consistent with the view that individuals diagnosed with BPD can function at the level of healthy controls in defining internal states (60). In addition, we also found it consistent with the perspectives (61,62) claiming that the patients with BPD are unable to integrate internal states with external clues in a context-appropriate manner and to correctly distinguish between fantasy and reality and make harmonious narrations in the face of changing situations and changing representations within social relations. In our study, during the DEToM application, the stories were also given to the participants in print. With this administration method, an attempt was made to prevent the possible negative impact of probable difficulty in working memory on ToM assessment by ensuring that all participants followed the stories before answering. Therefore, the possibility that the BPD group's failure to perform at the level of healthy controls in short term memory that may have a negative impact on this task of the DEToM was controlled.

Among the hypotheses of our study, our hypothesis that the performance of patients with BPD in neuropsychological tests requiring emotion recognition and social cognition skills regarding their social cognitive functions is lower than that of healthy controls was supported by our study findings. While DEToM was developed, the ability to put oneself in someone else's shoes mentally and emotionally (63) was accepted as a component of the theory of mind and 5 tasks were added to measure empathy ability (27). In our study, it was observed that the patient group diagnosed with BPD could not make accurate attributions in empathy tasks at the level of healthy controls. In experimental setups in which social relationships were presented virtually, patients diagnosed with BPD were found to be fairer in perceiving others and more successful in capturing the emotional cues of unfair attributions (60). This high-level theory of mind skill actually emerges as a result of excessive mentalization and causes them to more easily attribute fairness to others and injustice to themselves (62). It was also concluded that the as social perspective coordination of patients with BPD decreases, the difficulty in distinguishing and integrating their own perspectives with the perspectives of others increases (64) and this may also have a negative effect on their empathy ability. There are studies in the literature reporting that the most sensitive theory of mind task to BPD is faux pas (57). However, according to our study results, patients with BPD showed no difference as compared to healthy controls in this task of DEToM.

There are studies reporting a relationship between symptom severity and impairment in cognitive functions in BPD (11). Although we expected a similar relationship between our study hypotheses, a correlation was observed between BPI scale scores and neuropsychological test results only with complex attention skills. It can be concluded as the symptom severity of the patient group increases their complex attention capacities decline.

Our study has some limitations. First of all, due to the small sample size we could not perform multivariate analysis. Moreover, people who did not have additional psychiatric diagnoses and only patients who were followed up in the Psychotherapy Unit were included in our study. Considering that BPD without additional psychiatric diagnosis may have a milder course, our findings should not be generalized to patients with BPD. On the other hand, examining the relationship between decision making and impulsivity tendency in BPD is a strength of our study.

As a result, our study revealed that individuals diagnosed with BPD had minimal difficulty in inhibiting the inappropriate response, and this difficulty was associated with making disadvantageous choices in decision-making behavior. Although individuals with BPD are successful in predicting mental states from external cues, they have difficulty in integrating cues and making coherent narratives within a social pattern. Our findings suggest that psychotherapy for individuals diagnosed with BPD should focus on integrating social cues and coherent perception of context. However, in addition to the quantitative limitation of the sample group, it is thought that more adequate interpretations can be achieved when the measurement materials are diversified and supported by dynamic measurements (such as skin conductance response and functional neuroimaging).

Ethics Committee Approval: All procedures performed in this study were carried out in accordance with the ethical standards of the Istanbul University Istanbul Faculty of Medicine Clinical Research Ethics Committee and the 1964 Helsinki declaration (protocol number: 2021–538222).

Informed Consent: The scales were administered by the same researcher after obtaining written informed consent from the participants.

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