Decision-making in adult unipolar depressed patients and healthy subjects: significant differences in Net Score and in non-traditional alternative measures*

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Abstract

Alterations in executive functioning are frequent in depressive patients. One clinical characteristic of depression is difficulty and slowness in decision-making. This study aimed to compare the performance of a group of 30 non-psychotic unipolar depressed to 30 healthy controls in a version of the Iowa Gambling Task (IGT) from the Psychology Experiment Building Language (PEBL). Significant differences between depressed patients and healthy controls in traditional Net Score measures as well as in various alternative metrics were verified.

Keywords: Unipolar depression; Iowa Gambling Task (IGT); Decision-making; Normative data

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1. Introduction

Iowa Gambling Task (IGT) (Bechara, Damasio, Damasio & Anderson, 1994) was developed with the purpose of simulating real-life judgment alterations, allowing to assess the emotions associated with decision-making in patients suffering damage to the orbitofrontal cortex (OFC). During the task, subjects perform a series of 100 selections from a group of four decks of cards (A, B, C and D), resulting the selection in a fixed monetary reward and, occasionally, in monetary losses. Yielding fixed rewards of 100$ for each choice, decks A and B are classified by Bechara et al. (1994) as "disadvantageous" because, in the long run, punishments surpass rewards; on the contrary, decks C and D, despite yielding rewards of half of that amount (50$ for each choice), are "advantageous" in the long run once rewards exceed punishments.

This study used a IGT version from the Psychology Experiment Building Language (PEBL) (Mueller, 2013), a free access battery, following the application indications of Areias, Paixão and Figueira (2013). The classical 100 trials were performed, complying with changes of original instructions (Bechara, Damasio, Damasio & Lee, 1999), embedded in the application. According to Bechara (2000), in initial studies, subjects tended to think they could never win the game because they had the impression that reward and punishment schedules were generated by the computer. In the current study, subjects were therefore informed that there were decks better than others and that cards were in a predefined order (and then not likely to be changed by the computer).

Decision-making corresponds to the cognitive processes involved in reaching a decision, allowing the adoption of a flexible behavior aimed toward a goal or the completion of a task in a dynamic environment. Impairments in decision-making are a main characteristic of many psychiatric pathologies, such as affective disorders, being difficulty and slowness in decision-making a clinical feature of depression (Clark & Robbins, 2009), and therefore, in IGT, depressed subjects are usually outperformed by controls (Cella, Dymond & Cooper, 2010). However, some authors suggest that alterations in decision making are only typical of mania (bipolar disorder) (Murphy et al., 2001; Chamberlain & Sahakian, 2006) and that lower results in depression are due to psychomotor alterations, entailing a prolonged deliberation time, rather than impairment in decision-making (Clark & Robbins, 2009).

Regarding performance assessment, in addition to a conventional calculation (CD-AB Trials 1-100), we replicated other alternative measures (Gansler, Jerram, Vannorsdall & Schretlen, 2011), particularly D-A, as well as two measures which exclude the first trials (CD-AB Trials 21-100; CD-AB

Trials 41-100) in which choices are made without an explicit knowledge of reward and punishment contingencies (Areias et al., 2013).

The purpose of this study was to compare the performance of a clinical sample of non-psychotic unipolar depressed subjects to adult healthy controls in a free version of IGT. Another objective was to provide initial normative data in order to allow its application in clinical contexts and future research. According to the literature, we hypothesized that depressed subjects would perform more poorly in IGT compared to healthy controls.

2. Methods

2.1. Participants

Both studied samples, experimental and control groups, were comprised of 30 subjects each. The experimental (patients') group was composed by 22 women and 8 men, with a mean age of 42.20 years old (*SD* = 13.49), a mean of 8.50 (*SD* = 3.57) years of education and an age range of 17-67 years old. The participants from this group were recruited in the city of Faro (Portugal), more precisely from the Department of Psychiatry and Mental Health of Hospital Center of Algarve (a state owned entity). With analogous characteristics, healthy controls comprised 20 women and 10 men, with a mean age of 41.43 years old (*SD* = 15.18), a mean of 10.03 (*SD* = 3.59) years of education and an age range of 17-67 years old. Patients and controls did not differ significantly regarding gender (χ^2 = .317, *df* = 1, *p* = .573), age (*t* = .207, *df* = 58, *p* = .837, *d* = .053), and education (*t* = -1.655, *df* = 58, *p* = .099, *d* = -.427).

All participants were Caucasians and Portuguese speakers.

2.2. Measures

The computerized IGT (Mueller, 2013), a free software from PEBL Test Battery (Mueller & Piper, 2014), similar to the commercial version of IGT from Psychological Assessment Resources (PAR), and a valid measure of decision-making (Parkhurst, Gelety, Greenhalgh & Birkett, 2014), was performed.

The same computer running Microsoft Windows 8.1 was used with all subjects, with a touch screen in order to minimize the difficulties of older subjects in using a mouse or a keyboard.

2.3. Procedures

Each participant completed a health and demographic questionnaire and depression diagnoses were confirmed through the Mini International Neuropsychiatric Interview (MINI) (Sheehan et al., 1997) and the Brief Symptom Inventory (BSI) (Canavarro, 2007). Exclusion criteria were current or prior history of bipolar disorders, schizophrenia, major psychosis, substance abuse, dementia and neurologic disease, including head injury involving loss of consciousness. To discard malingering, Rey 15-Item Memory Test (15-IMT) was used (Simões et al., 2010).

This study was approved by the Hospital Center of Algarve Ethics Committee, in conformity with the Helsinki declaration. After being provided with all the information about the study, all participants signed an informed consent statement.

All analyzes were conducted using the Statistical Package for the Social Sciences (SPSS), version 20.0. The level of significance was set at $p < .05$.

3. Results

Differences between total scores for depressed subjects and healthy controls in general performance (Net total score $t = -3.852$, $df = 58$, $p = .001$, $d = -.994$) and most alternative metrics (CD-AB Trials 1-40) ($t = -.2.873$, $df = 100$, $p = .005$, $d = -.569$); (CD-AB Trials 41-100) ($t = -.2.873$, $df = 100$, $p = .005$, $d = -.569$); (CD-AB Trials 21-100) ($t = -.2.873$, $df = 100$, $p = .005$, $d = -.569$); (C-B Trials 1-100) ($t = -.2.873$, $df = 100$, $p = .005$, $d = -.569$); (D-A Trials 1-40) ($t = -.2.873$, $df = 100$, $p = .005$, $d = -.569$); (D-A Trials 1-100) ($t = -.2.873$, $df = 100$, $p = .005$, $d = -.569$) were found (*Table 1*).

In terms of the influence of demographic variables, a one-way analysis of variance (ANOVA) only showed significant differences regarding age groups in healthy subjects ($F[2, 27] = 9.97$, $p = .001$, $\eta_p^2 = .425$), with a shared variance of 33% in performance time ($R^2 = .339$, $F[1, 28] = 14.372$, $p = .001$).

Table 1. Descriptive statistics (n = 60)

	Depression [a]		Healthy [b]				
	Mean	*SD*	*Mean*	*SD*	*t*	*p*	*d*
Performance (CD-AB)							
Net 1 (Trials 1-20)	-2.33	3.71	-.20	5,23	-1.820	.074	-.469
Net 2 (Trials 21-40)	2.13	4.26	5.86	5.55	-2.919	.005	-.753
Net 3 (Trials 41-60)	3.96	5.43	8.60	6.32	-3.042	.004	-.787
Net 4 (Trials 61-80)	3.53	7.45	7.93	8.71	-2.101	.040	-.542
Net 5 (Trials 81-100)	3.66	7.53	9.93	7.60	-3.206	.002	-.828
Net total score	11.03	20.71	31.80	21.04	-3.852	.000	-.994
Alternative Metrics							
CD-AB (Trials 1-40)	.20	5,68	5.66	7.82	-3.321	.002	-.798
CD-AB (Trials 41-100)	11.16	17.20	26.46	18.08	-3.358	.001	-.867
CD-AB (Trials 21-100)	13.30	19.44	32.33	21.06	-3.636	.001	-.938
C-B (Trials 1-100)	-4.30	16.96	9.63	17.46	-3.134	.003	-.809
D-A (Trials 1-40)	2.36	3.49	4.86	3.52	-2.759	.008	-.713
D-A (Trials 41-100)	12.80	8.87	17.36	13.24	-1.569	.122	-.404
D-A (Trials 1-100)	14.96	8.93	22.23	14.52	-2.334	.023	-.603
Frequency							
Deck A	14.70	2.89	11.70	4.31	3.163	.003	.817
Deck B	29.80	10.43	22.36	8.19	3.068	.003	.793
Deck C	25.50	8.41	32.00	12.66	-2.342	.023	-.604
Deck D	29.66	8.13	33.93	12.71	-1.548	.127	-.400
Time	358.8	92.6	341.0	103.0	0.702	.486	.181

Note: [a] n = 30, [b] n = 30.

4. Discussion

As in Cella, Dymond, and Cooper's (2010) study, and in contrast to the results obtained by Smoski et al. (2008), there were differences concerning total results between depressed subjects and healthy controls. It was not possible to corroborate that alterations in decision-making are specific features of bipolar disorders (Murphy et al., 2001) because, in the current study, depressed patients were outperformed by controls even in alternative measures, particularly CD-AB Trials 21-100 and CD-AB Trials 41-100, that exclude the first trials which may be related to a higher difficulty or slowness in adapting to the rules of the game (Areias et al., 2013).

Concerning aging effects, older subjects (over 50 years old) took more time to perform the test, these results may be related to cognitive decline and motor functioning loss. The age effect is not recorded in the test performance, since there is no consensus on the existence of performance differences on the decision-making process between old and young (Wiesiolek, Foss & Diniz, 2014).

5. Conclusion

This study's results reinforce the hypothesis that impairment in decision-making is not only specific to the maniacal state of bipolar patients, being also a main feature of affective disorders (Roiser, Rubinsztein & Sahakian, 2009), which has been corroborated by studies based on functional neuroimaging that have shown differences in neural responses to feedback during decision-making between depressed patients and healthy controls (Steele, Kumar & Ebmeier, 2007), revealing the unipolar depressive patients a hypersensitivity to negative feedback, with disrupted top-down control by the prefrontal cortex of the amygdala (Tavares et al., 2008).

The main contribution of this study was to present initial normative data for this test (*Table 2*), hoping to help clinicians with future applications of IGT, once it represents a crucial tool to assess decision-making in depressive patients, as well as in subjects who do not suffer from any mental disorder. The main limitation was the sample size, regarding both patients' group and health controls, which prevented us from validating more clearly normative data for IGT. Future research attempting to compare a wider samples is therefore recommended.

Table 2. Percentile of healthy and depressed subjects

Net Score							
Percentile	Depression [a]			Healthy [b]			Time [c]
	(1-100)	(21-100)	(41-100)	(1-100)	(21-100)	(41-100)	
5	-29.25	-28.95	-22.95	-.90	.20	0	525.0
10	-15.60	-8.00	-13.20	6.40	6.60	4.20	498.7
25	-6.00	-2.50	-1.00	17.00	16.00	12.00	405.2
50	14.00	15.00	12.00	27.00	26.00	23.00	346.9
75	20.50	22.50	20.00	44.00	52.00	40.50	278.3
90	40.60	42.40	41.80	67.80	67.20	60.00	233.9
95	52.50	52.50	46.00	73.80	73.80	60.00	199.0

Note: [a] n = 30, [b] n = 30, [c] n = 60.

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