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Decision-Making Deficits in Pathological Gambling: The Role of Executive Functions, Explicit Knowledge and Impulsivity in Relation to Decisions Made Under Ambiguity and Risk

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Background: A variety of cognitive and emotional processes influence the decision-making deficits observed in pathological gambling (PG). This study investigated the role of immediate/delayed sensitivity to reward and punishment, executive functions, impulsivity and explicit knowledge in relation to decision-making performance on the original Iowa Gambling Task (IGT-ABCD) and a variant (IGT-EFGH).
Methods: We assessed 131 consecutive patients with a diagnosis of PG by using executive functioning and decision-making tasks, self-report measures of impulsivity and explicit knowledge.
Results: The majority of pathological gamblers (PGs) showed deficits in decision-making, characterized mainly by myopia for the future. Decisions made under risk showed different predictors. Performance on the IGT-ABCD for decisions made under risk was predicted by medium and high levels of explicit knowledge of the task, as well as by scores on the Disorderliness subscale and the degree of Stroop interference. By contrast, IGT-EFGH results were only associated with self-report impulsivity measures.
Conclusions: Decision making in PG involves distinct patterns of deficits, and the predictors differ depending on the reinforcement schedule. Decisions made under risk on the IGT-ABCD are associated with explicit knowledge, executive functions and impulsivity traits related to conscious awareness and control processes. On the IGT-EFGH, however, only impulsivity traits predict decision making. (Am J Addict 2013;22:492–499)

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Despite the negative consequences of addictive behaviors such as gambling, the fact that individuals persist with their behavior illustrates the lack of self-regulation that characterizes these disorders.[1] Self-regulatory and decision-making deficits in addictions typically begin in the more primitive areas of the brain that process reward, and then move to areas related to complex cognitive functions.[2] Cognitive and emotional processes underlying abnormal choice behavior has been widely studied with decision-making tasks. Iowa Gambling Task (IGT-ABCD) has been used to measure impaired decision making related to the ventromedial prefrontal cortex.[3] The IGT-ABCD assesses participants' ability to forgo immediate rewards in order to obtain long-term gains. However, when interpreting IGT results it is necessary to consider the effects of two task-related factors: consequence (reward/punishment) and time to consequence (immediate/delayed).[4] The IGT-EFGH,[5] a modified version of the IGT-ABCD, reverses the order of reward and punishment. By applying both versions of the IGT it is possible to distinguish between different aspects of decision making such as sensitivity to reward and punishment and insensitivity to future consequences (myopia for the future).[6]

Several cognitive and emotional processes influence decision making. Executive dysfunctions related to the dorsolateral prefrontal cortex (DLPFC) cortex, mainly diminished cognitive flexibility[7–10] and response inhibition,[11] have been associated with impairments in decision making. Moreover, in recent years, it has been demonstrated that decision making during the IGT task is more cognitively penetrable[12] and influenced by explicit knowledge (cognitive awareness) than was originally suggested by Bechara et al.[13] Maia and McClelland[14] found that the IGT could be correctly performed through access to conscious explicit knowledge and other authors have reported that both explicit knowledge and somatic markers are involved in decision making.[15] Therefore, executive deficits and explicit knowledge could be related to poorer IGT performance. It should be noted, however, that a recent review[16] examining the associations between IGT performance, executive functions, and intelligence suggested that IGT performance was independent of executive functions and intelligence. One possible explanation for these contradictory findings suggests that the role of executive functions changes during the performance of different blocks of the IGT.[17] The first blocks of choices in the IGT are based on ambiguity and here executive functions are less involved. However, decisions across the last blocks of the task, once the learning phase is complete, are based more on risk-taking, since decision-making results correlate with those of executive tests such as the *Wisconsin Card Sorting Test* (WCST) and the Stroop task during these last blocks.[11,17] Only one recent study[18] has focused on the role of executive functions as predictors of decision making in pathological gamblings (PGs). The authors found that impaired IGT performance was not related to inhibition ability as measured by the Stroop Test and Go/NoGo parameters. These results contrast with other addiction studies that have observed a relationship between decision making on the IGT and, firstly, inhibition ability in alcoholics[11] and, secondly, cognitive flexibility in substance-dependent individuals (SDI).[19]

Impulsivity is another key element in PG. In healthy controls this trait has been associated with an overall deficit in decision making, assessed by the IGT.[20,21] However, other authors have only found an association between low impulsivity and performance across the last blocks of the IGT.[22]

Although behavioral decision-making studies have provided consistent evidence of disadvantageous decision making and less efficient executive functions in PGs, the underlying processes which contribute to the abnormal choice behavior they show on decision-making tasks remains to be elucidated.[23]

The present study aimed to characterize decision-making deficits in PGs and to examine different predictors during two types of decisions: those made under ambiguity and under risk. Based on the available literature the first hypothesis was that the sample of PGs would present decision-making deficits, related mainly to sensitivity to reward and myopia for the future, rather than sensitivity to punishment. Secondly, it was hypothesized that executive functions, self-reported impulsivity and explicit knowledge would not be associated with decisions made under ambiguity. However, they would be involved in decisions made under risk for both versions of the IGT.

METHODS

Participants

Participants were recruited between October 2005 and July 2008. Exclusion criteria at intake were missing values for any diagnostic items, history of psychiatric illness (psychosis, obsessive-compulsive disorder, major depression, manic hypomanic episode or mixed episode, and substance abuse in the last month) and a lifetime history of neurological illness. The final sample consisted of 131 patients consecutively admitted to the Pathological Gambling Unit at Bellvitge University Hospital. All were diagnosed according to *Diagnostic and Statistical Manual of Mental Disorders*, 4th edn, revised text (DSM-IV-TR)[24] criteria for PG, the semi-structured clinical interview being conducted by psychologists with more than 15 years of experience in the diagnosis and treatment of PG. Patients were also assessed with the South Oaks Gambling Screen (SOGS),[25] a 20-item diagnostic questionnaire that discriminates between probable pathological, problematic, and non-problematic gamblers. The Vocabulary subtest of the Wechsler Adult Intelligence Scale, 3rd edn (WAIS-III)[26] was used as a measure of estimated intelligence.[27]

Instruments and Measures

Neurocognitive Measures

Iowa Gambling Task (IGT-ABCD).[3] The task consists in choosing cards from decks marked A, B, C, and D using the mouse. Performance on the task is measured by calculating the number of cards chosen from advantageous decks (C + D) minus the number of cards chosen from disadvantageous decks (A + B) in each block of 20 cards chosen over a total of 100 trials per task. According to the study by Bechara et al.[6] a global task score below 10 is indicative of a deficit on the task.

Iowa Gambling Task: EFGH version (IGT-EFGH).[5] This task reverses the pattern of reinforcement of the IGT-ABCD and evaluates readiness to accept high immediate punishments in order to obtain greater long-term gains, an aspect to do with risk taking. Performance on the task is measured by calculating the number of cards chosen from advantageous decks (E + G) minus the number of cards chosen from disadvantageous decks (F + H) in each block of 20 cards chosen across a total of 100 trials per task. According to the study by Bechara et al.[6] a global task score below 8 indicates a deficit on the task.

Explicit knowledge in relation to the IGT. At the end of the game, participants were asked to describe any strategy they had used, whether they had picked more cards from any particular deck(s), whether they had avoided any particular deck(s), and to explain their reasons for having done so.[28] Level of knowledge was classified as described by Maia and McClelland[14] into three levels of conscious awareness (low, medium, and high).

Wisconsin Card Sorting Test (WCST).[29] The test comprises four stimulus cards and 128 response cards with different shapes, colors, and numbers of figures. Participants must match each response card with one of the stimulus cards placed in front of them in any way they consider justifiable. Each time subjects make a match they are told whether or not it is correct. The categorization criterion changes after ten consecutive correct answers. The number of complete categories, the percentage of perseverative errors and the percentage of non-perseverative errors are all recorded.

Stroop Color and Word Test (SCWT).[30] The SCWT consists of a Word Page (1st list) with the names of colors printed in black ink, a Color Page (2nd list) with letter Xs printed in color, and a Color-Word Page (3rd list) with names of colors printed in an incongruent color. The test yields three scores based on the number of items read on each of the three stimulus sheets in a limited time. It is also possible to calculate an Interference score, which is useful in determining the individual's cognitive flexibility and reaction to cognitive pressures.

Trail making test, Parts A and B (TMT).[31] This is a test of visual conceptual and visuomotor tracking involving motor speed, attention, and the ability to alternate between cognitive categories (set-shifting). It consists of two parts: part A and B. Subjects have to connect circles by drawing lines, alternating between numbers and letters in sequential order, until they reach the circle labeled "end". Scores are the amount of time taken to complete each part. To control for individual differences in motor speed we generated a score based on the time to complete part B minus the time to complete part A.

The Digits Backward Task[32] *of the Wechsler Memory Scale (WMS)*, 3rd edn, requires the examiner to present digits verbally at a rate of one per second. The backward test requires the participant to repeat the digits in reverse order. Performance on the Digits Backward Task measures verbal working memory by requiring internal manipulation of mnemonic representations of verbal information in the absence of external cues.[33] We used the number of digits correctly repeated.

Self-Report Measure of Impulsivity

Novelty-seeking is one of four temperamental dimensions measured by the *Temperament and Character Inventory—Revised* (TCI-R).[34] It reflects several forms of impulsivity, and its internal consistency (Cronbach's α) was .77 in the Spanish adaptation used here.[35] Given our interest in the different aspects of impulsivity, rather than the total score, we focused on the four novelty-seeking subscales: Exploratory Excitability (NS1), Impulsiveness (NS2), Extravagance (NS3), and Disorderliness (NS4).

Procedure

At the time of administration of the neuropsychological tests, participants were not receiving any psychological treatment. To minimize possible learning effects, we administered both versions of the IGT in a counterbalanced order on different days, with a mean inter-session interval of 7 days. The WCST was administered in the first session and the SCWT and TMT were administered in the second session. Patients completed the novelty-seeking test (TCI-R) prior to the neuropsychological assessment.

The study was carried out according to the latest version of the Declaration of Helsinki. Approval was given by the Ethics Committee of our hospital and participants gave written informed consent.

Statistical Analysis

Statistical analyses were performed using SPSS v17. One-way ANOVA for quantitative measures and chi-square tests for categorical outcomes were used to compare socio-demographic and clinical characteristics among participants according to their performance (impairment/non-impairment) on both IGT tasks. Performance on the IGT-ABCD and the IGT-EFGH over the 100 trials (divided into 5 blocks of 20 trials) was then analyzed by means of a 2×5 ANOVA for repeated measures. Finally, linear regression models evaluated the predictors of performance on each IGT task under ambiguity (first two blocks) and under risk (last two blocks).

RESULTS

The mean age of the 131 patients was 37.2 years (SD = 10.8) and most of them were males (117, 89.3%). The mean score on the SOGS was 10.7 (SD = 2.9). Patients had a mean of 10.4 years of education (SD = 2.9), 82.9% of them were employed, 52.9% were married, 32.5% were single, and the remaining 14.6% were separated, divorced, or widowed. The majority of participants (89.5%) were mainly slot-machine gamblers. The mean duration of their gambling problem was 5.8 (SD = 6.0) years. Only 30.6% of patients were taking psychiatric medication.

Characterizing Decision-Making Results According to Impairments on the IGT Tasks and in Relation to Socio-Demographic and Clinical Characteristics

Data for both tasks were available for 99 patients. Using the previously mentioned cut-off points proposed by Bechara et al.[6] for categorizing impairment on the IGT tasks, 72 patients (72.72%) showed impairment on the IGT-ABCD and 61 (61.61%) on the IGT-EFGH. A total of 45 patients showed impairment on both versions of the IGT (45.45%), 27 (27.27%) were only impaired on the IGT-ABCD, 16 (16.16%) were only impaired on the IGT-EFGH, and 11 (11.11%) showed no impairment. We then compared relevant socio-demographic and clinical characteristics among these four groups of impairment (Table 1). No differences were found for any of the variables considered.

Performance Across IGT Tasks and Blocks

Figure 1 shows the profile of mean IGT scores for both tasks over the five blocks. No significant task $\times$ block interaction was found ($p = .265$). The effect of task (IGT-ABCD vs. IGT-EFGH) was also non-significant ($p = .685$), whereas the effect of block over time was statistically significant ($p = .024$). Although comparisons between blocks revealed that only scores for the first block were lower than for the other four blocks ($p \leq .011$), a linear trend ($p = .012$), and a quadratic trend ($p = .005$) were observed over time.

Predictors of Decisions Made During IGT Tasks Under Ambiguity and Under Risk

Table 2 presents the results of the linear regression models for predicting performance on each of the IGT tasks, both under ambiguity (blocks 1 and 2) and under risk (blocks 4 and 5).

TABLE 1. Socio-demographic and clinical characteristics according to impairments on IGT tasks

	ABCD score < 10 and EFGH score < 8 ($n = 45$)	ABCD score < 10 and EFGH score ≥ 8 ($n = 27$)	ABCD score ≥ 10 and EFGH score < 8 ($n = 16$)	ABCD ≥ 10 and EFGH ≥ 8 ($n = 11$)	Comparison (p-value)
Quantitative measures: *M* (SD)					
Age	37.53 (11.33)	36.35 (11.07)	38.69 (9.70)	37.55 (11.52)	.927
Years of education	10.29 (3.07)	10.59 (2.58)	10.13 (2.28)	11.91 (4.25)	.404
Years of PG problem	5.18 (6.57)	7.88 (4.54)	5.72 (6.76)	6.14 (6.72)	.426
WAIS: vocabulary	34.00 (7.78)	35.85 (8.45)	36.87 (7.82)	37.73 (9.47)	.431
SOGS	10.35 (2.88)	10.73 (3.07)	10.44 (2.19)	10.91 (2.59)	.911
Categorical measures: %					
Sex (male)	91.1	96.3	93.8	90.9	.855
Employed	79.1	80.8	87.5	81.8	.908
Civil status					
Single	34.9	46.2	25.0	18.2	.173
Married	51.2	46.2	43.8	81.8	
Separated	14.0	7.6	31.3	0	
Medication (no)	81.0	75.0	57.1	57.1	.498

IGT = Iowa Gambling Task, PG = pathological gambling, WAIS = Wechsler Adult Intelligence Scale, SOGS = South Oaks Gambling Screen.

Under ambiguity, both models (ie, for the IGT-ABCD and IGT-EFGH) were null ($p = .532$ and $p = .068$, respectively). By contrast, under risk both models were statistically significant ($p = .003$ and $p = .042$, respectively). For the IGT-ABCD task, higher levels of knowledge ($p = .031$ for medium and $p = .002$ for high), lower Stroop interference ($p = .003$) and higher disorderliness scores ($p = .034$) were related to decisions made under risk ($R^2 = .31$). For the IGT-EFGH task, a higher impulsiveness score ($p = .015$) and lower extravagance ($p = .041$) and disorderliness ($p = .031$) scores were related to decisions made under risk ($R^2 = .26$).

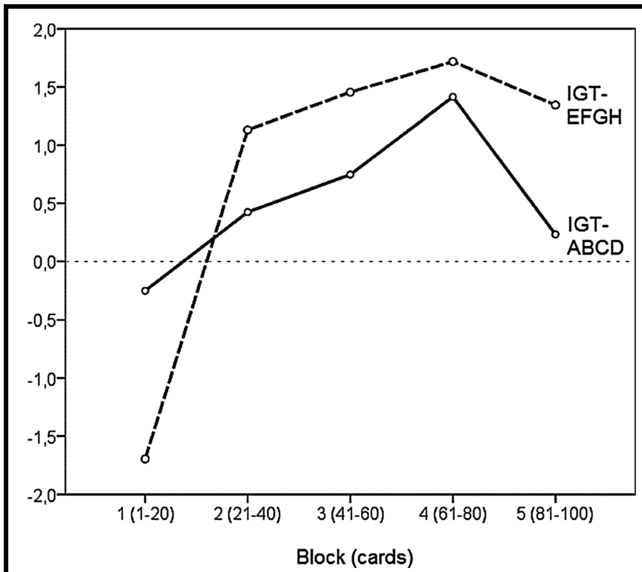

FIGURE 1. Profiles for the mean number of cards chosen from advantageous minus disadvantageous decks according to IGT task and block.

DISCUSSION

This study has characterized decision-making deficits in pathological gamblers (PGs) and examined the relative contribution of several neurocognitive and impulsivity processes to decision making.

Characterizing Decision-Making Deficits According to Impairments on the IGT Tasks

Studies of PGs and healthy controls suggest that PGs show differences in sensitivity to reward and punishment and impaired IGT performance.[36–40] However, it remains unclear what specific combination of abnormal reward, abnormal punishment or abnormal reward and punishment sensitivity characterizes PGs. If the present results are compared with those reported by Bechara et al.[6] with SDI it can be seen that although PGs show more decision-making deficits than do SDI, the profile of the two groups is similar. Especially relevant is the high proportion of PGs who show myopia for the future (deficits on both tasks). Moreover, and as hypothesized, PGs are more likely to show hypersensitivity to reward (only impaired on the IGT-ABCD) than they are hypersensitivity to punishment (only impaired on the IGT-EFGH).

Studies about reward and punishment processing usually conclude that PG is characterized by reward-seeking behavior and/or increased insensitivity to loss.[41] However, an important number of our PGs also showed increased sensitivity to punishment (61.61%). These findings contrast with the

TABLE 2. Predictors of decisions made under ambiguity and under risk on the IGT-ABCD and IGT-EFGH

IGT task	IGT-ABCD						IGT-EFGH					
Criterion	Ambiguity (blocks 1 and 2)			Risk (blocks 4 and 5)			Ambiguity (blocks 1 and 2)			Risk (blocks 4 and 5)		
Predictors	*B* (CI 95%)	β	*p*	*B* (CI 95%)	β	*p*	*B* (CI 95%)	β	*p*	*B* (CI 95%)	β	*p*
IGT knowledge: medium[a]	−1.20 (−7.56; 5.16)	−.04	.708	8.03 (.77; 15.29)	.22	.031	3.48 (−3.42; 10.39)	.12	.318	4.48 (−4.90; 13.86)	.11	.344
IGT knowledge: high[a]	1.77 (−3.68; 7.22)	.07	.520	10.09 (3.87; 16.31)	.33	.002	11.90 (5.94; 17.85)	.46	.000	5.77 (−2.32; 13.86)	.16	.160
WCST: categories	−1.52 (−4.41; 1.37)	−.27	.298	−.29 (−3.58; 3.01)	−.04	.863	.92 (−2.23; 4.08)	.15	.562	2.04 (−2.25; 6.33)	.24	.346
WCST: % persev. errors	−.19 (−.53; .16)	−.22	.289	.03 (−.36; .43)	.03	.871	.11 (−.27; .50)	.12	.556	.43 (−.10; .95)	.33	.107
WCST: % non-persev. errors	−.31 (−.71; .10)	−.26	.141	−.08 (−.55; .39)	−.05	.733	.38 (−.05; .82)	.30	.083	.03 (−.56; .62)	.02	.913
SCWT: interference	−.22 (−.44; .00)	−.22	.050	−.39 (−.65; −.14)	−.31	.003	.12 (−.13; .37)	.11	.334	.02 (−.32; .35)	.01	.919
TMT: B − A	.02 (−.02; .07)	.11	.329	−.03 (−.08; .02)	−.13	.211	.02 (−.03; .07)	.08	.494	.05 (−.02; .12)	.16	.154
WMS: digits forward	.34 (−1.03; 1.70)	.07	.623	.71 (−.85; 2.27)	.11	.365	.25 (−1.23; 1.73)	.04	.736	1.14 (−.87; 3.15)	.15	.263
WMS: digits backward	−.55 (−1.97; .87)	−.11	.443	.89 (−.74; 2.51)	.14	.280	1.60 (.02; 3.18)	.29	.047	.16 (−1.99; 2.30)	.02	.886
NS1: excitability	.11 (−.34; .56)	.05	.624	−.09 (−.60; .42)	−.03	.726	.18 (−.31; .67)	.08	.472	.60 (−.07; 1.26)	.19	.081
NS2: impulsiveness	−.18 (−.67; .31)	−.09	.470	.37 (−.19; .93)	.14	.196	−.02 (−.54; .51)	−.01	.947	.89 (.18; 1.60)	.30	.015
NS3: extravagance	.01 (−.42; .44)	.01	.963	−.28 (−.77; .21)	−.13	.253	−.27 (−.76; .22)	−.14	.280	−.70 (−1.36; −.03)	−.27	.041
NS4: disorderliness	.09 (−.45; .63)	.04	.749	.67 (.05; 1.29)	.23	.034	−.18 (−.77; .41)	−.07	.538	−.89 (−1.69; −.08)	−.26	.031
Model goodness-of-fit												
F (*p*-value)	.92 (.532)			2.72 (.003)			1.75 (.068)			1.92 (.042)		
R^2	.131			.307			.243			.260		

[a]Reference category: low.; IGT = Iowa Gambling Task, WCST = Wisconsin Card Sorting Test, SCWT = Stroop Color and Word Test, TMT = Trail Making Test, WMS = Wechsler Memory Scale, NS = novelty-seeking.

lowered sensitivity to punishment found in the study by Goudriaan et al.[39] This discrepancy could be explained by differences in the preferred type of gambling, as our sample was composed mostly of slot-machine gamblers. When Goudriaan et al.[39] differentiated their subjects according to the type of gambling preference they found that slot-machine gamblers showed increased sensitivity to punishment compared with casino gamblers. Reuter et al.[42] compared fMRI BOLD responses associated with reward and punishment in 12 PGs with a preference for slot-machine gambling and 12 matched healthy men using a guessing paradigm. Compared to controls PGs showed less activity in the ventral striatal and ventromedial prefrontal cortex when receiving monetary rewards. The authors conclude that this reduced regional brain activity could be the result of lower sensitivity to reward or higher sensitivity to punishment. According to our results, an important number of PGs with a preference for slot machines show not only high sensitivity to reward but also a higher sensitivity to punishment, as we found no significant differences between the performance of PGs on the IGT-ABCD and IGT-EFGH tasks across the blocks (Fig. 1).

Predictors of Decisions Made Under Ambiguity and Under Risk on the IGT-ABCD and IGT-EFGH Tasks

The analysis of the proposed predictors confirmed our hypothesis. On the IGT-ABCD, and in line with other studies,[11,17,18,38] decisions made under ambiguity were not influenced by executive functions, or by the level of explicit knowledge or impulsivity. The same results were obtained for the IGT-EFGH.

Predictors of Decisions Made Under Risk on the IGT-ABCD

As hypothesized, the differences between predictors for each IGT task appear in relation to decisions made under risk. On the IGT-ABCD, decisions made by PGs under risk were predicted positively by the level (medium or high) of explicit knowledge, negatively by the degree of interference control and positively by the Disorderliness subscale of the TCI-R. Some authors[11,18] have suggested that PG and other addictions are characterized by deficits in decisions made under risk because they have not acquired explicit knowledge regarding the task. However, to the best of our knowledge this is the first study to confirm that this lack of learning or conscious awareness can influence the results of decision making. Regarding our neurocognitive results, a previous study found that interference control in PGs was highly correlated with another decision-making task in a risk situation.[38] By contrast, Kertzman et al.[18] report that impaired IGT performance in PGs with different gambling problems was not related to inhibition ability, as measured by the Stroop Test and Go/NoGo parameters. However, in a more detailed analysis these authors found that these parameters did show a significant association with casino slot-machine players, this being consistent with the present findings.

The self-report measure of the Disorderliness subscale (ie, strict regimentation, organization, rigidity, and over-control) predicted positive outcomes on the IGT-ABCD. Other studies about decision making and PG have also found that low disorderliness predicts dropout from cognitive-behavioral psychological treatment.[43] Moreover, high disorderliness scores are related to antisocial traits, and some studies[44] have observed that antisocial personality was associated with better IGT-ABCD performance. In conclusion, control and learning processes (inhibition of prepotent response and explicit knowledge), and self-reported personality trait (disorderliness) converge to predict better decisions under risk during the IGT-ABCD in PGs.

Predictors of Decisions Made Under Risk in the IGT-EFGH

IGT-EFGH performance of PGs was only predicted by self-reported impulsivity measures (TCI-R): positively by impulsiveness and excitability (trend) and negatively by extravagance and disorderliness. The inverse role of the Disorderliness subscale in predicting performance on both the IGT-ABCD (high disorderliness) and the IGT-EFGH (low disorderliness) shows the importance of interpreting personality traits by using the concept of functional vs. dysfunctional impulsivity.[45,46] In PGs, managing and avoiding immediate large rewards in order to obtain greater gains in the future is associated with disorderliness (ie, over control), probably because it compensates an impulsive behavior towards reward, which is more prominent and penalized in the immediate-reward reinforcement schedule of the IGT-ABCD. On the IGT-EFGH, however, managing and coping with large immediate punishments in order to obtain better outcomes in the future seems to be related to disorderliness in the inverse way. Too much rigidity or strict regimentation could impede the flexibility and future goal-reward orientation that is needed on the IGT-EFGH. In line with other studies, these results show how performance in different domains of executive functioning and decision making can be influenced by reward values or the reinforcement schedule.[19,47] Recent study[43] reported similar results, finding that low disorderliness, high exploratory excitability and poor IGT-EFGH scores predicted dropout from cognitive-behavioral treatment in PGs. Our results could shed some light about the current debate on predictors of therapy outcome among PGs.[48,49] It seems that both predictors could explain some of the variance in risky decisions made on the IGT-ABCD, whereas on the IGT-EFGH only self-report measures of impulsivity have predictive value.

Limitations

Our sample mostly comprised slot-machine gamblers who were seeking treatment for this problem, and who were free of major psychiatric disorders and without substance use during the last month. This could affect the generalizability of our results. The lack of a healthy control group prevents any conclusions from being drawn as to whether these deficits are specific to PGs.

CONCLUSIONS

In summary, decision making in PGs is characterized by broad, different and complex patterns of deficits in reward/punishment and immediate/delayed reinforcements. The majority of PGs had a decision-making deficit, and almost half of them showed myopia for the future. The neurocognitive and self-report impulsivity processes studied were only associated with this abnormal choice behavior in relation to decisions made under risk. Decisions made under ambiguity were not influenced by these predictors. Overall, these results highlight the need for specific interventions in the form of learning strategies designed to help individuals cope with diminished inhibition and disadvantageous decision-making strategies.[48] In PGs, this approach should be focused on the role of impulsivity in their functional adaptation, including techniques to identify the impulse before acting and to help them consider consequences and to reflect on solutions.[43]

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