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# Decision-making differences between Heroin Polysubstance Abusers and Healthy Control Individuals

Ana Mafalda Luzes Pais Pinto (e-mail: mafaldapinto@hotmail.com)

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**Decision-making differences between heroin polysubstance abusers and control subjects**

Abstract

Drug consume is highly associated with impaired cognitive functions, which may compromise the addict's decision making. To better comprehend this relationship, heroin polysubstance abusers (N=30) and healthy control individuals (N=30) were examined considering the following variables: intelligence, impulsivity and decision making. We used the Iowa Gambling Task and the Balloon Analogue Risk Task as decision making tasks, to evaluate risk taking and risk propensity, respectively, and its correlation. Results demonstrate that opioid dependents have lower performances and more risky behavior than controls on both tasks, although these tasks are only correlated with control individuals, on the later stages of the Iowa Gambling Task.

Key Words: Balloon Analogue Risk Task; Barratt Impulsiveness Scale; Decision-making; Iowa Gambling Task; Impulsivity; Opioid Dependents

**Diferenças na tomada de decisão entre heroinómanos e sujeitos de controlo**

Resumo

O consumo de drogas está fortemente associado a défices nas funções cognitivas, o que pode consequentemente comprometer a capacidade de tomada de decisão dos indivíduos assim afetados. Para compreender melhor esta relação, heroinómanos (N=30) e sujeitos de controlo (N=30) foram avaliados considerando diversas variáveis, tais como a inteligência, a impulsividade e a tomada de decisão. Utilizámos o *Iowa Gambling Task* e o *Balloon Analogue Risk Task*, como tarefas de tomada de decisão, para avaliar a tomada de risco e a tendência para o risco, respectivamente, e a sua correlação. Os resultados obtidos demonstram que os heroinómanos têm *performances* inferiores e mais comportamentos de risco do que os sujeitos de controlo em ambas as tarefas, embora estas tarefas estejam correlacionadas apenas na amostra de controlo, nas últimas fases do *Iowa Gambling Task*.

Palavras-chave: *Balloon Analogue Risk Task*; *Barratt Impulsiveness Scale*; Tomada de Decisão; *Iowa Gambling Task*; Impulsividade; Dependentes de Opiáceos

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# I – Theoretical Framework

## 1.1 Decision Making Models

Decision making is a process of making a choice from a number of hypotheses to reach a desired goal (Eisenfuhr, 2011) that involves the ability to predict and manage outcomes (Osman, 2010). According to Osman (2011), decision making is often a sequential process composed by three components: (1) circumstance sensitivity (net outcome experience); (2) evaluation of the actions taken towards the desired goal; (3) evaluation of future actions based on the outcome achieved to conquer the desired goal.

According to the Rational Model, subjects are considered to make decisions under certainty: they recognize their options, outcomes, decision criteria and they have the ability to make the optimum decision and to implement it (Towler, 2010). This Model is composed by six steps: (1) Recognize and define the problem, the most important step according to Kepner and Tregoe (2005); (2) Generating alternatives; (3) Evaluating alternatives; (4) Choosing an alternative; (5) Implementing the decision and (6) Evaluating decision effectiveness (Schoenfeld, 2011). Nevertheless, individuals can be limited by unconsidered variables, which cause the decision maker to settle for less than the optimal choice, instead of the best decision – bounded rationality (Simon, 1982, 1997, 2009). The Bounded Rationality Model is characterized by the principle of *satisficing*, which involves choosing an option that satisfies minimal requirements of acceptability without analysing all possibilities, that is the usual decision taken by decision makers (Nielsen, 2011). This Model supports that decisions are based on an incomplete comprehension of the true nature of the problem and that decision makers will never be able to generate all possible solutions for consideration (Simon, 1982, 1997, 2009). "Most human decision making, whether individual or organizational, is concerned with the discovery and selection of satisfactory alternatives; only in exceptional cases is it concerned with the discovery and selection of optimal alternatives" (Simon, 1997, p. 140-141).

However, there are times in life when decision making is not easy. Sometimes decisions are made under risk, when people take action based on an estimation of the probabilities of the consequent outcome (e.g. betting money on a horse race). Other decisions are made under uncertainty, when people have limited knowledge of the possible outcome subsequent to their actions, but can suppose the "best moment" to do it (e.g. selling/buying a property) (Trepel, Fox & Poldrack, 2005). There are also cognitive models that explain risky or ambiguious decisions such as the Expectancy-Valence Model (EV; Busemeyer & Stout, 2002) and the Prospect Valence Learning Model (Ahn, Busemeyer, Wagenmakers, & Stout, 2008; Ahn, Krawitz, Kim, Busemeyer, & Brown, 2011). These cognitive models have been proposed to decompose performance on decision making tasks such as the Iowa

Gambling Task (IGT; Bechara, Damasio, Damasio, & Anderson, 1994), and the Bayesian Sequential Risk-Taking Model (BSR; Wallsten, Pleskac, & Lejuez, 2005) to comprehend the Balloon Analogue Risk Task (BART; Lejuez et al., 2002; Lejuez, Aklin, Zvolensky, & Pedulla, 2003). BSR and EV Models cover the payoff evaluation process, response selection and experienced-based learning, requiring similar cognitive processes (Pleskac et al., 2007).

### 1.2 Decision Making, Iowa Gambling Task and Substance Use Disorder

Some cognitive tasks, such as the IGT and the BART are associated with risky real-world behaviors, such as the illegal use of drugs (Bechara et al., 2001; Lejuez et al., 2002; Verdejo-Garcia, Vilar-Lopez, Perez-Garcia, Podell, & Goldberg, 2006b). Although originally planned to exam people with prefrontal lesions, the IGT has been widely used to measure risk taking or impulsive behaviors in both control and clinical populations (Aklin, Lejuez, Zvolensky, Kahler, & Gwadz, 2005; Bechara, 2003; Lawrence et al., 2006; South, et al., 2008) and so has the BART (South, Dana, White & Crowley, 2011).

The players of the IGT make a series of choices from a set of four computerized 'decks of cards' (A, B, C, D) with the aim of earning as much money as possible. Each deck is associated with a fixed immediate reward for every selection, as well as an occasional penalty which differs in frequency and amount across the decks. Although decks A and B have a higher permanent reward, compared to decks C and D, its selection is disadvantageous because the occasional losses are also higher. The IGT evaluates decision making under uncertainty by considering the subject's choice. A "risky" option involves larger gains, but it also leads to greater penalties, resulting in a long-term net loss. A"safe" option indicates smaller gains, on average, and intermittent small losses, resulting in a long-term net gain (Leeman & Potenza, 2002; Bornovalova et al., 2009). Optimal performance requires diminished choice impulsivity, privileging long-term gain over immediate and larger rewards (Dymond, Cella, Cooper, & Turnbull, 2010), and aspects of reversal learning (Fellows & Farah, 2005), which is the ability to modify the choice of the deck accordingly to the outcomes (Leeman & Potenza, 2002). "As in real-life choices, the individual has to choose between choices that may be risky. Each choice is full of uncertainty because a precise calculation or prediction of the outcome of a given choice is not possible" (Bechara, 2003, p.29).

Decision-making processes may explain why substance abusers often "express a desire to cut down or regulate substance use and may report multiple unsuccessful efforts to decrease or discontinue use" (APA, 2013, p. 483) but can not achieve their goal. The IGT has been used among different substance abusers populations **(**Barry & Petry, 2008; Bechara & Damasio, 2002; Bechara et al., 2001; Rotheram-Fuller, Shoptaw, Berman, & London, 2004; Stout, Busemeyer, Lin, Grant, & Bonson, 2004; Van der Plas, Crone, van den Wildenberg, Tranel, & Bechara, 2009; Verdejo-García, 2006a)

assuming that "gambling behaviors activate reward systems similar to those activated by drugs of abuse and produce some behavioral symptoms that appear comparable to those produced by the substance use disorders" (APA, 2013, p. 481).

There is evidence that opioid abusers present deficit in decision-making capacities on the IGT (Petry, Bickel, & Arnett, 1998; Rotheram-Fuller et al., 1994). Significant differences between performance of heroin polysubstance abusers and healthy participants were found only on IGT Block 5 (Verdejo-García, Perales, & Pérez-García, 2007). The authors also indicated that both cocaine and heroin polysubstance abusers performed poorly on decision-making when compared to controls. Polysubstance users were more prone to hold to response after being rewarded, but showed choice strategies similar to controls when penalized (Verdejo-García et al., 2010).

According to Verdejo-García et al. (2007), the IGT taxes a specific form of impulsivity, defined as the lack of ability to make decisions in accordance with long-term rewards rather than short-term rewards Some authors defend that impulsivity is an important individual characteristic for understanding the determinants of disadvantageous risky choice in the IGT (Upton, Bishara, Ahn, & Stout, 2011). However, other authors claim that "stability of impulsive behavior measured by a single IGT test using 100 cards may not be acceptable in the absence of sufficient practice" (Xu, Korczykowski, Zhu, & Rao, 2013, p. 483), indicating the sample's low mean of age as a possible reason for this conclusion, given the fact that impulsivity decreases with age, as adolescents become adults (Steinberg et al., 2008).

### 1.3 Impulsivity, Balloon Analogue Risk Task and Substance Use Disorder

Impulsivity and novelty seeking are individual temperaments that relate to the propensity to develop a Substance Use Disorder (SUD, American Psychiatric Association (APA), 2013). Impulsivity is a multifactorial construct, composed of several independent factors that can be assessed with different measures (Evenden, 1999). Impulsivity has been defined as a predisposition toward rapid, unexpected responses to internal or external stimuli with reduced concern to negative consequences (Brewer & Potenza, 2008; Moeller, Barratt, Dougherty, Schmitz, & Swann, 2001). Impulsivity is also associated with a persistent substance use, regardless of harm consciousness - the core component of addiction according to O'Brien, Volkow and Li (2006). Impulsivity is considered to mediate risk (Ersche, Turton, Pradhan, Bullmore, & Robbins, 2010), or even to be a longitudinal predictor (Hicks, DiRago, Iacono, & McGue, 2010) of SUDs, being characterized by low levels of self-control (Stein & Hollander, 1995).

Recently, impulsivity has been divided into distinct components, covering response and choice forms (Dalley, Everitt, & Robbins, 2011; Potenza & de Wit, 2010; Winstanley, Theobald, Dalley, & Robbins, 2004), such as the incapacity to suppress a learned or reinforced response as measured by go/no-go tasks. Other form of impulsivity is related to the

inability to delay gratification when confronted with conflictive choices that are immediately rewarded, but are also followed by delayed punishment (Verdejo-García et al., 2007).

Bechara (2004) explains different mechanisms of impulsivity control: (1) - Motor Impulsiveness (poor ability to suppress or withhold a prepotent response that is non-affective, traditionally evaluated by Go/no Go tasks, or affective, e.g. stealing); (2) - Attentional Impulsiveness (inability to inhibit a recurrent thought held in working memory, e.g., will to consume drugs by drug addicts, this mechanism can be measured by the Wisconsin Card Sorting Task); (3) - Emotional Impulsiveness (strong desire and urge to seek reward, accompanied by a poorer capacity to control that urge and delay gratification, which is highly related to decision-making).

Tversky and Kahneman (1981) suggest that decision-making is determined by potential losses, caused by the "loss aversion" (Kahneman & Tversky, 1979) rather than gains or the ratio of the two. It is important to remark that these effects "are large and systematic, although by no means universal" (Tversky & Kahneman, 1981, p. 457). However, other authors defend that impulsivity implies a reckless action chasing a reward (Patterson & Newman, 1993).

The BART is a cognitive paradigm for measuring risk taking propensity (Lejuez et al., 2002, 2003a, 2003b). In this task, participants sequentially inflate virtual balloons that either grow larger or explode, knowing that some balloons could pop after just one pump and others could not pop until they fill the whole screen. Behavioral performance on the BART has been shown to correlate with risk-taking and impulsive behaviors including alcohol and drug use, cigarette smoking, gambling, theft, aggression, psychopathy and unprotected sexual intercourse (Aklin et al, 2005; Bornovalova et al., 2005; Hopko et al., 2006; Hunt, Hopko, Bare, Lejuez, & Robinson, 2005; Lejuez et al., 2003a; Lejuez et al., 2003b; Lejuez et al., 2002; Lejuez, Simmons, Aklin, et al., 2004). Risk taking on the BART also was significantly associated with measures assessing sensation seeking, disinhibition, and impulsivity (Aklin et al., 2005; Lejuez et al., 2002, 2003b). Overall, the BART is considered useful in assessing "real-world" risk taking behaviors beyond the predictive validity of measures of sensation seeking or impulsivity (Lejuez et al., 2003b).

Although the BART was originally used to evaluate risk propensity in young adults (aged from 18 to 25), it is now widely used among older adults (Fernie, Cole, Goudie, & Field, 2010; Moallem & Ray, 2012; Papachristou, Nederkoorn, Havermans, Horst, & Jansen, 2012; Reed, Levin, & Evans, 2012). An analysis of the effects of age on the BART is yet to be studied. [1]

Heroin polysubstance users have shown lower rates of delayed rewards compared to alcohol users and controls, and lack of forethought and

[1] There is also a version of the BART to assess adolescent risk behaviors (BART-Y; Lejuez et al., 2007). This one has also demonstrated a significant relation with multiple risk behaviors such as substance use, delinquency and impulsivity. There are other two derivations: GBART and LBART that differ on the number of balloons (20) and require participants to deal with money earned differently.

future orientation on decision making related tests, reflecting impulsivity traits (Kirby & Petry, 2004; Kirby, Petry, & Bickel, 1999; Madden, Bickel, & Jacobs, 1999; Mintzer & Stitzer, 2002; Petry et al., 1998; Rotheram-Fuller et al., 2004).

Nevertheless, evidence of response inhibition impairment in abstinent opioid abusers still requires more evaluations to corroborate the hypotheses identified so far or to formulate new ones (Verdejo-García at al., 2007), since there are few studies that confirm impaired inhibitory control in abstinent opioid abusers, showing that they have compromised their planning and reflection impulsivity skills (Lee & Pau, 2002; Pau, Lee, & Chan, 2002).

### 1.4. The Iowa Gambling Task and the Balloon Analogue Risk Task

The risk taking measures from the IGT and the BART, Proportion Advantageous and Pumps without Explosion, respectively, were not significantly correlated with one another (substance users made riskier decisions on the IGT, but they did not do so on the BART) (Bishara et al., 2009). However, regard to losses on the IGT was related to reliance that the balloon would pop, and consequently money would be lost, on the BART. As stated by the authors, this relationship suggests that both tasks may evaluate loss sensitivity in decision making. The consistency parameters were also related, proposing that both tasks may evaluate the randomness of choices in decision making.

At the behavioral level, IGT deck selections and BART pumps did not correlate in some studies (Aklin et al., 2005; Bishara et al., 2009; Lejuez et al., 2003a). According to Xu et al. (2013), a significant correlation between the BART and the IGT is only found on the second and third test sessions. The authors indicated that individual differences in impulsive behaviors as measured by the BART are more stable and reproducible than those measured by the IGT, because of the lower reliability of the IGT in the first two of the three sessions. Other authors also suggested that risk taking in the early stages of the IGT need to be considered separately (Brand, Recknor, Grabenhorst, & Bechara, 2007; Upton et al., 2011), which may be explained by the little explicit knowledge players have at the beginning of the task. In the earlier stages of the IGT, risk taking is not a deliberate act; it reveals a failure to recognize risk. However, as the task advances, players are expected to differentiate the risky options from the advantageous. When this recognition of the advantageous decks is absent, it is due to the failure to develop explicit knowledge of the risky IGT alternatives, which is consistent with past studies showing that impulsive individuals perform poorly in decision tasks that require a learning process (Franken, van Strien, Nijs, & Muris, 2008).

The BART results have tended to be more strongly related to drug use in adolescents and undergraduate students than the IGT results (Aklin et al., 2005; Bishara et al., 2009; Lejuez et al., 2003a). Despite the studies that examined the IGT have found it to be sensitive to heavy drug use among

adults (Bechara & Damasio, 2002), it is not clear if the sensivity of the IGT would be compared to the BART's sensitivity for this population (Bishara et al., 2009).

## II – Objectives

The main objectives of this study are to compare heroin polysubstance abusers (HPA) and healthy control individuals (HCI) in several areas such as decision making, impulsivity, intelligence and psychopathologic symptoms. We also examined the role of impulsivity as a mediator to the decision making tasks results, the possible cognitive decline caused by heroin and other substances, and the conceivable correlations between intelligence, years of abusive consume of drugs and performances at the decision making tasks. Furthermore, we intend to clarify the correlation between the IGT and the BART, two measures that are currently marked by controversial conclusions.

## III – Method

### 3.1 Participants

Thirty HPA and thirty HCI participated in this study voluntarily. There were no significant differences in education, age and sex between the two groups (Table 1). The sample of the control subjects were recruited based on opioid dependent characteristics: level of education, age and sex (Table 2). Therefore, most of these participants were recruited in industrial/comercial companies, but since there were opioid dependents that attended college, we also decided to request the participation of college undergraduates. The HPA were recruited as inpatients for a closed-regimen detoxification program at the Coimbra Detoxification Unit of the Institute on Drugs and Drug Addiction. Participants with presence of cognitive impairment; diagnosis of Axis I or II according to the DSM-IV-TR (2000), excepting SUDs; HIV/AIDS infection and intelligence estimate lower than 70 (DSM-IV-TR, 2000) were excluded. The criteria were confirmed by laboratory findings, medical and psychological assessment. After acute opioid withdrawal symptoms (Kleber, 2007), assessment was conducted between abstinence days 5 and 6 on heroin and buprenorphine dependent subjects, and between days 8 and 9 on methadone dependent subjects. Opioid-dependent individuals were medicated according to the current therapeutic administration protocol in this institution (Table 3).

All involved companies, institutions and subjects provided their consent to conduct this study.

**Table 1**
*Descriptive statistics, Levene's test and Pearson's chi-square test for sociodemographic variables*

| | HPA ($N$ = 30) | HCI ($N$ = 30) | | | |
|---|---|---|---|---|---|
| | *M (SD / SEM) Min-Max* | *M (SD / SEM) Min-Max* | *F* | $\chi^2$ | *p* |
| Age [a] | 37.30 (6.83 / 1.25) 17-50 | 37.63 (9.18 / 1.68) 18-51 | 2.786 | - | 1 |
| Education [a] | 9.97 (2.86 / 0.52) 6-16 | 10.00 (2.80 / 0.51) 6-17 | .045 | - | .834 |
| Sex (**%** male) | 93.3% | 83.3% | - | 1.456 | .228 |

*Note.* [a] In years.

**Table 2**

*Descriptive statistics for sociodemographic characteristics of the two samples (N = 60)*

| | HPA ($N$=30) | HCI ($N$=30) |
|---|---|---|
| | *n* (%) | *n* (%) |
| Sex | | |
| Masculine | 28 (93.3%) | 25 (83.3%) |
| Feminine | 2 (6.7%) | 5 (16.7%) |
| Marital Status | | |
| Single | 15 (50%) | 11 (36.7%) |
| Married | 3 (10%) | 15 (50%) |
| Civil Union | 5 (16.7%) | 1 (3.3%) |
| Divorced | 6 (20%) | 3 (6.7%) |
| Separated | 1 (3.3%) | - |
| Widow | - | 1 (3.3%) |
| Schooling | | |
| Primary School | - | - |
| Middle School ($5^{th}$, $6^{th}$ grades) | 5 (16.7%) | 6 (20%) |
| Middle School ($7^{th}$, $8^{th}$, $9^{th}$ grades) | 15 (53.6%) | 13 (43.3%) |
| High School (Junior year) | 1 (3.3%) | 2 (6.7%) |
| High School (Senior year) | 4 (13.3%) | 5 (16.7%) |
| University Attendance | 5 (16.7%) | 4 (13.3%) |
| Employment | | |
| Regular employee | 7 (23.3%) | 21 (70%) |
| Occasional employee | 3 (10%) | 1 (3.3%) |
| Unemployed for less than a year | 7 (23.3%) | - |
| Unemployed for a year or more | 10 (33.3%) | 4 (13.3%) |
| Student / Vocational Training | 2 (6.7%) | 4 (13.3%) |
| Retired | 1 (3.3%) | - |

**Table 3**
*Self-reported substance use history and medication of HPA (N=30)*

| | HPA ($N$ = 30) |
|---|---|
| | *M (SD / SEM)* |
| Age at onset of alcohol use | 17.18 (6.13 / 1.49) |
| Age at onset of cannabis use | 14.57 (2.33 / 0.49) |
| Age at onset of cocaine use | 19.27 (3.51 / 0.46) |
| Age at onset of heroin use | 18.43 (3.81 / 0.70) |
| Years of heroin use [a] | 18.87 (6.49 / 1.18) |
| | *n* (%) |
| Principal Drug | |
| Alcohol | 2 (6.9%) |
| Cocaine | 1 (3.4%) |
| Opioid: Heroin | 25 (86.2%) |
| Opioid: Methadone | 1 (3.4%) |
| Substance use in the last 30 days **%** | |
| Alcohol | 6 (20.6%) |
| Cannabis | 13 (44.7%) |
| Cocaine | 11 (37.9%) |
| Opioid: Heroin | 17 (56.7%) |
| Opioid: Methadone | 2 (6.7%) |
| Current opioid agonist[c] **%** | |
| Methadone | 10 (33.3%) |
| Buprenorphine | 4 (13.3%) |
| Opioid agonist (dose range, mg/day)[b] % | |
| Methadone | |
| [0, 25] | 2 (6.7%) |
| ]25, 50] | 7 (23.3%) |
| ]75, 100] | 1 (3.3%) |
| Buprenorphine | |
| [0, 2] | 1 (3.3%) |
| ]2, 4] | 1 (3.3%) |
| ]6, 8] | 2 (6.7%) |

*Note*.[a]Time elapsed since the first use of opioid; [b]Subjects under opioid agonist treatment.

### 3.2. Instruments

*Sociodemographic and Clinical Questionnaire*. Sociodemographic characteristics (age, educational years, marital and employment status – Appendix A); clinical background (psychiatric/neurologic disorder, consume of alcohol) and criminal record were self-reported prior of the evaluation.

*Brief Symptom Inventory* (BSI; Derogatis, 1982/1993; Portuguese version of Canavarro, 1999). The BSI is a 53-item, self-report symptom inventory, in which participants rate the extent to which they have been bothered (0= "not at all" to 4="extremely") in the past week by various

symptoms. The Portuguese version of the BSI (Canavarro, 1999; Derogatis, 1982/1993) was used to evaluate psychopathologic symptoms, particularly nine primary dimensions (Somatization; Obsessive-compulsive; Interpersonal Sensivity; Depression; Anxiety; Hostility; Phobic Anxiety; Paranoid Ideation and Psychoticism) plus three global indeces (Global Severity Index (GSI), Positive Symptom Distress Index (PSDI) and Positive Symptom Global (PSG).

*Montreal Cognitive Assessment* (MoCA; Nasreddine et al., 2005; Portuguese version of Freitas, Simões, Martins, Vilar, & Santana, 2010; Simões et al., 2008). In order to assess cognitive functioning, we used the Portuguese version of the MoCA. It is a 30–item inventory and it was designed for mild cognitive dysfunction. It evaluates different cognitive domains: executive functions; visuoconstructional skills; memory; language; attention and concentration; abstract thinking; calculating; spatial and temporal orientations.

*Iowa Gambling Task* (IGT; Bechara, Damasio, Damasio, & Anderson, 1994). As a decision-making task we used the IGT adapted to euros and translated to European Portuguese (Areias, Paixão, & Figueira, 2008). In this task the subject is unaware of the probabilities of wins and losses of each deck. The player starts the task with 2000€ and is advised to proceed cautiously by distinguishing the advantageos decks from the unadvantageous ones.

*Vocabulary and Block Design* (Wechsler Adult Intelligence Scale III, WAIS-III; Wechsler, 2008). Two subtests from the Portuguese Version of the WAIS-III, Vocabulary and Block Design, were applied to obtain intelligence estimation, according to the *Deviation Quotient* formula (Tellegen & Briggs, 1967).

*Balloon Analogue Risk Task* (BART; Lejuez et al., 2002, 2003b). The BART was used to measure risk-taking propensity in its original format, however the instructions were given in Portuguese, given that an adaptation and validation to the Portuguese population is yet to be done. The subject earned 0.10€ *per* pump and it was not informed about what determined the balloon explosion. In fact, the computer allowed a maximum of 1 to 128 pumps before explosion.

*Barratt Impulsiveness Scale –11* (BIS-11; Patton, Stanford, & Barratt, 1995; Portuguese version of Romeiro, Almeida, & Horta, 2005). As impulsivity measure we used the BIS-11 that decomposes Impulsivity into three higher order factors composed each of them by two first order factors: Attentional Impulsivity (attention + cognitive instability); Motor Impulsivity (motor + perseverance) and Non-planning Impulsivity (cognitive complexity + self-control). The authors define these conceptions as attention: "focusing on a task at hand"; cognitive instability: "thought insertions and racing thoughts"; motor: "acting on the spur of the moment"; perseverance: "a consistent life style" cognitive complexity: "enjoying challenging mental tasks" and self-control: "planning and thinking carefully". The BIS-11 revealed that substance dependent individuals have higher total scores than controls (Allen, Moeller, Rhoades, & Cherek, 1998; Costa et al., 2012;

Patton et al., 1995), although there are also contradictory results (Lejoyeux, Feuche, Loi, Solomon, & Ades, 1998). BIS-11 was significantly correlated with severity of heroin and cocaine use as measured by self-reported substance use history (Moeller, Doughtery, & Barratt, 2001; Roncero et al., 2011). This self-report questionnaire measures the propensity to consider the consequences of their actions before any action takes place (Miller, Joseph, & Tudway, 2004).

### 3.3. Research Procedures

All subjects were volunteers and signed an informed consent form in order to participate in the study (Appendix A). The instruments were applied in the following order: Sociodemographic Questionnaire (Appendix B); BSI (Appendix C); MoCA (Appendix D); IGT (Appendix E); WAIS-III subtests (Appendix F & Appendix G); BART (Appendix H) and BIS (Appendix I), usually the break was made after the IGT. Previously, they were informed about the procedure and confidentiality terms. All subjects were tested individually in two sessions on the same day, during 60 to 120 minutes total, depending mostly on their performance, with a 15 minute break, minimum. Both sessions occurred in a private office inside the company or institution, where alcohol consume was controlled, guaranting environmental conditions for the assessment. In this study participants were not rewarded neither received the amounts earned on the decision making tasks.

### 3.4. Statistical Procedures

In data analysis, we used the descriptive and analytical statistics. Regarding the first, we determined absolute and relative frequencies, measures of central tendency and measures of variability or dispersion, in addition to measures of skewness and kurtosis, according to the characteristics of the study variables. With regard to statistical inference, we used the non-parametric statistics.

The use of parametric tests requires the simultaneous fulfillment of two conditions: a normal distribution among quantitative variables and homogeneity of population variances in order to compare two or more samples. Thus, to study the variables' distribution normality was performed using the Kolmogorov-Smirnov test and to test the homogeneity of variances we used the Levene's test. These tests have shown that the distribution is not normal ($p < .05$), but homogeneous ($p > .05$). So, we used the non-parametric statistics, more specifically the following tests: Mann-Whitney U test, for comparison of mean ranks of quantitative variables between two independent groups; Spearman's rank correlation coefficient, a measure of linear association, was used to study quantitative variables. The correlation indicates that the intensity of one tends to be accompanied to the intensity of the other, in the same direction or in reverse. Therefore the values oscillate between -1 and +1. Specifically, we use Mann-Whitney test for verify differences between groups in all instruments applied, we also considered

correlations to examine the relationship between several variables, including the IGT, the BART and the BIS.

Decision-making behavior on the IGT was measured by the number of selections made from advantageous decks minus the number of selections from disadvantageous decks ((C+D)-(A+B)) and also examined by Blocks. We also analysed the prevalence of a final successful balance (≥2000) in both groups and compared self-reported deck preference to actual deck selections on the IGT. We also considered the formula ((B+D)-(C+A)), meaning decks with low punishments (B and D) *minus* decks with high punishments (C and A), to compare both groups, which is another way to evaluate IGT performance by blocks and overall.

We examined adjusted average of pumps (positively associated with risk taking) as the main dependent variable for the BART.[2] But also Total of Pumps, Total of Explosions (positively associated with risk taking), and Total of Money (negatively associated with risk taking), all dependent variables for the BART according to Lejuez et al. (2002, 2003a, 2003b, 2007).

The presentation of results is made with the use of tables and graphs, which present the most relevant data. The description and analysis of the data sought to obey the order of data collection.

All the statistical calculations were processed through the IBM-SPSS 22.0 program.

[2] "These adjusted values, defined as the average number of pumps excluding balloons that exploded (i.e., the average number of pumps on each balloon prior to money collection), were preferable because the number of pumps was necessarily constrained on balloons that exploded, thereby limiting between subjects variability in the absolute averages" (Lejuez et al., 2002, p. 78).

## IV – Results

HPA present significant higher levels of all psychopathological symptoms and indexes relatively to HCI (Table 3).

**Table 3**

*Mann-Whitney U-test results for the BSI in both groups*

| | HPA (*N*=30) | HCI (*N=30*) | | |
|---|---|---|---|---|
| | Mean Rank | Mean Rank | MW | *p* |
| Dimensions | | | | |
| Somatization | 39.27 | 19.17 | 110.00 | .000*** |
| Obsessive-compulsive | 36.21 | 21.82 | 189.50 | .001** |
| Interpersonal Sensivity | 37.79 | 20.45 | 148.50 | .000*** |
| Depression | 39.38 | 19.07 | 107.00 | .000*** |
| Anxiety | 39.56 | 18.92 | 102.50 | .000*** |
| Hostility | 37.79 | 20.94 | 148.50 | .000*** |
| Phobic Anxiety | 36.29 | 21.75 | 187.50 | .000*** |
| Paranoid Ideation | 36.38 | 21.67 | 185.00 | .001** |
| Psychoticism | 38.58 | 19.77 | 128.00 | .000*** |
| Indexes | | | | |
| GSI[a] | 39.83 | 18.68 | 95.50 | .000*** |
| PSDI[B] | 39.10 | 19.32 | 114.50 | .000*** |
| PSG[c] | 39.50 | 18.97 | 104.00 | .000*** |

*Note* .[a] Global Severity Index; [b] Positive Symptom Distress Index; [c] Positive Symptom Global; ** p < .01; *** p < .0001, two-tailed.

HPA differ significantly from HCI on IQ estimate (Table 4), calculation, delay-recall and spatial orientation and MoCA total score (Table 5), these results may point out a faster cognitive decline or impairment on executive functions on HPA, given that Education is a homogeneous variable between groups (p > .05).

**Table 4**

*Mann-Whitney test for intelligence estimate according to the groups*

| | HPA (*N*=30) | HCI (*N*=30) | | |
|---|---|---|---|---|
| | | | MW | *p* |
| WAIS-III: Vocabulary | 27.12 | 31.88 | 351.50 | .283 |
| WAIS-III: Block Design | 23.52 | 36.71 | 240.50 | .003* |
| Intelligence Quotient[a] | 23.34 | 35.66 | 242.00 | .005* |

*Note.* [a]Calculated by deviation quotient (Tellegen & Briggs, 1967*)*; *p < .05, two-tailed.

**Table 5**

*MoCA's Mann-Whitney test according to the group*

| | HPA (*N*=30) | HCI (*N*=30) | | |
|---|---|---|---|---|
| | Mean Rank | Mean Rank | MW | *p* |
| Visuospatial/Executive | | | | |
| Trail Making Test | 32.45 | 27.63 | 364.00 | .111 |
| Copy of the Cube | 29.90 | 30.10 | 432.00 | .948 |
| Clock Drawing | 31.00 | 29.03 | 406.00 | .529 |
| Naming | 29.93 | 30.07 | 433.00 | .945 |
| Attention | | | | |
| Digit Span | | | | |
| Forward | 29.86 | 30.13 | 431.00 | .937 |
| Backward | 29.43 | 30.55 | 418.50 | .655 |
| Concentration and Calculation | | | | |
| Letter A Tapping | 29.98 | 30.02 | 434.50 | .981 |
| Serial 7 subtractions | 25.84 | 34.02 | 314.50 | .046* |
| Language | | | | |
| Sentence Repetition | 28.88 | 31.08 | 402.50 | .480 |
| Letter P fluency | 29.34 | 30.63 | 416.00 | .713 |
| Abstraction | 30.17 | 29.83 | 430.00 | .934 |
| Delayed Recall | 24.64 | 35.18 | 279.50 | .017* |
| Orientation | | | | |
| Temporal | 29.48 | 30.50 | 420.00 | .309 |
| Spatial | 26.38 | 33.50 | 330.00 | .005** |
| MoCA (total score) | 24.84 | 34.98 | 285.50 | .023* |

*Note.**p < .05; **p < .01, two-tailed.

Opioid dependents not only report higher total scores of impulsivity compared to controls, as previously comproved (Allen et al., 1998; Costa et al., 2012; Patton et al., 1995), they also significantly differ from the firsts on the main dimensions of BIS-11 (Table 6). With the exception of the BSI, differences revealed in the BIS-11 were the most significant between both groups. According to the Portuguese version of the BIS-11(Romeiro et al., 2005), the Impulsivity mean score for Portuguese population is 67.3 and we only found 2 control individuals who scored above *versus* 12 individuals in HPA group.

**Table 6**

*BIS's Mann Whitney test according to the group*

| | HPA (*N*=30) | HCI (*N*=30) | | |
|---|---|---|---|---|
| | | | MW | *p* |
| Attentional | 34.45 | 20.67 | 155.00 | .001** |
| Attention | 32.50 | 22.10 | 198.00 | .014* |
| Cognitive Instability | 34.00 | 21.00 | 165.00 | .002** |
| Motor | 35.73 | 19.73 | 127.00 | .000*** |
| Motor | 37.07 | 18.75 | 97.50 | .000*** |
| Perseverance | 28.75 | 24.85 | 280.50 | .353 |
| Non Planning | 34.70 | 20.48 | 149.50 | .001** |
| Self-Control | 32.41 | 22.17 | 200.00 | .015* |
| Cognitive Complexity | 34.45 | 20.67 | 155.00 | .001** |
| Impulsivity[a] | 37.80 | 18.22 | 81.50 | .000*** |

*Note*.[a] Total score; *p < .05; **p < .01; ***p < .001, two-tailed.

HPA present higher values, comparative to controls, in all variables measured by the BART, with the exception of Money at the last stage of the task (Table 7). However, no significant differences were found between the groups on the most relevant dependent variables of this task to evaluate risk propensity.

**Table 7**

BART's Mann-Whitney test according to the group

| | HPA (*N*=30) | HCI (*N*=30) | | |
|---|---|---|---|---|
| | Mean Rank | Mean Rank | MW | *p* |
| Pumps 1-10 | 31.62 | 29.38 | 416.50 | .620 |
| Pumps 11-20 | 34.92 | 26.08 | 317.50 | .050* |
| Pumps 21-30 | 33.33 | 27.67 | 365.00 | .209 |
| Total of Pumps | 34.07 | 26.93 | 343.00 | .114 |
| Adj avg[a] Pumps 1-10 | 31.65 | 29.35 | 415.50 | .610 |
| Adj avg Pumps 11-20 | 34.77 | 26.23 | 322.00 | .058 |
| Adj avg Pumps 21-30 | 32.97 | 28.03 | 376.00 | .274 |
| Total of Adj avg Pumps | 33.78 | 27.22 | 351.50 | .145 |
| Money 1-10 | 30.83 | 30.17 | 440.00 | .882 |
| Money 11-20 | 33.62 | 27.38 | 356.50 | .167 |
| Money 21-30 | 30.43 | 30.57 | 448.00 | .976 |

| | | | | |
|---|---|---|---|---|
| Total of Money | 32.97 | 28.03 | 403.00 | .478 |
| Explosions 1-10 | 34.47 | 26.53 | 331.50 | .065 |
| Explosions 11-20 | 35.03 | 25.97 | 314.00 | .040* |
| Explosions 21-30 | 33.57 | 27.43 | 358.00 | .164 |
| Total of Explosions | 34.78 | 26.22 | 321.50 | .056 |

*Note.*[a]Adj avg pumps = adjusted average number of pumps; * p < .05, two-tailed.

HPA present higher values than HCI on the first 2 Blocks of the IGT. But, from the third Block on, HCI begin to score higher, what leads us to think that they have achieved knowledge relative to advantageous Decks, as well as the low punishment Decks, scoring each time upper than previously. However, the same effect does not apply to HPA, which performance begins to decline from Block 3 to the end of the task. HCI also present higher values on [(B+D)-(C+A)] variables, scoring each deck higher than previously, contrarly to HPA that do not evolve. A possible reason for this dissimilarity may be related to learning process differences between groups, being the only significant difference between groups found on Block 5 (Table 8).

**Table 8**

*IGT's U Mann-Whitney test according to the group*

| | HPA (*N*=30) | HCI (*N*=30) | | |
|---|---|---|---|---|
| | Mean Rank | Mean Rank | MW | *p* |
| Block 1 (C+D)-(A+B) | 31.02 | 29.98 | 434.50 | .816 |
| Block 2 (C+D)-(A+B) | 33.57 | 27.43 | 358.00 | .169 |
| Block 3 (C+D)-(A+B) | 30.13 | 30.87 | 439.00 | .869 |
| Block 4 (C+D)-(A+B) | 29.77 | 31.23 | 428.00 | .743 |
| Block 5 (C+D)-(A+B) | 28.27 | 32.73 | 383.00 | .319 |
| Total (C+D)-(A+B) | 30.30 | 30.70 | 444.00 | .929 |
| First 40 (C+D)-(A+B) | 33.25 | 27.75 | 367.50 | .221 |
| Last 60 (C+D)-(A+B) | 28.13 | 32.87 | 379.50 | .293 |
| Block 1 (B+D)-(C+A) | 29.77 | 31.23 | 428.00 | .749 |
| Block 2 (B+D)-(C+A) | 28.45 | 32.55 | 388.50 | .360 |
| Block 3 (B+D)-(C+A) | 28.63 | 32.37 | 394.00 | .406 |
| Block 4 (B+D)-(C+A) | 27.75 | 33.25 | 367.50 | .221 |
| Block 5 (B+D)-(C+A) | 25.50 | 35.50 | 300.00 | .026* |
| Total (B+D)-(C+A) | 27.58 | 33.42 | 362.50 | .195 |
| IGT net score | 29.33 | 31.67 | 415.00 | .605 |

*Note.* * p < .05, two-tailed.

From the global score, Total (C+D)-(A+B), we can classify participant's performance (Advantageous, Borderline, Disadvantageous) by calculating the cut-off point of a two-tailed distribution (Bakos, Denburg, Fonseca & Parente, 2010) (Table 9).

**Table 9**

*IGT final balance and self-reported deck preference according to the group*

| | HPA ($n$=30) | HCI ($n$=30) |
|---|---|---|
| | *n* (%) | *n* (%) |
| Successful[a] | 11 (36.7%) | 16 (53.3%) |
| Unsuccessful[b] | 19 (63.3%) | 14 (46.7%) |
| Performance Rating | | |
| Advantageous ≤ 18 | 1 (3.3%) | 3 (10%) |
| Borderline ]-18; 18[ | 20 (66.7%) | 20 (66.7%) |
| Disadvantageous ≥ 18 | 9 (30%) | 7 (23.3%) |
| Deck Preference | | |
| A | 12 (40%) | 9 (30%) |
| B | 6 (20%) | 8 (26.7%) |
| C | 5 (16.7%) | 8 (26.7%) |
| D | 7 (23.3%) | 5 (16.7%) |

*Note*.[a] Final balance ≥ 2000; [b] Final balance < 2000.

It is remarkable that self-reported deck preference does not coincide with actual deck choices on the IGT. Our results concerning deck choices along the blocks is consistent with previous studies that found that Deck B is chosen more often (Hawthorne, Weatherford, Tochkov, 2011; Lin, Chui, Lee & Hsiehet, 2007) while Deck C is often avoided (Chiu & Lin, 2007) (Figures 1, 2, 3, 4, 5).

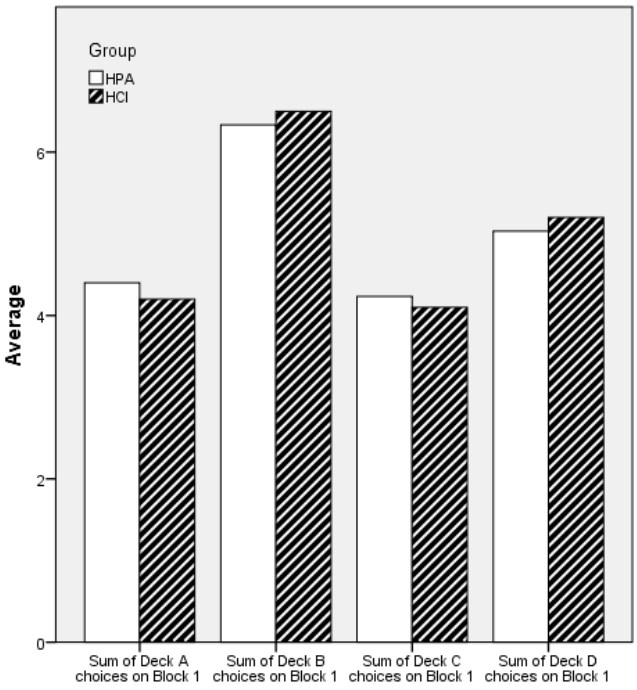


**Figure 1.** Sum of Deck selections on Block 1 according to the group.

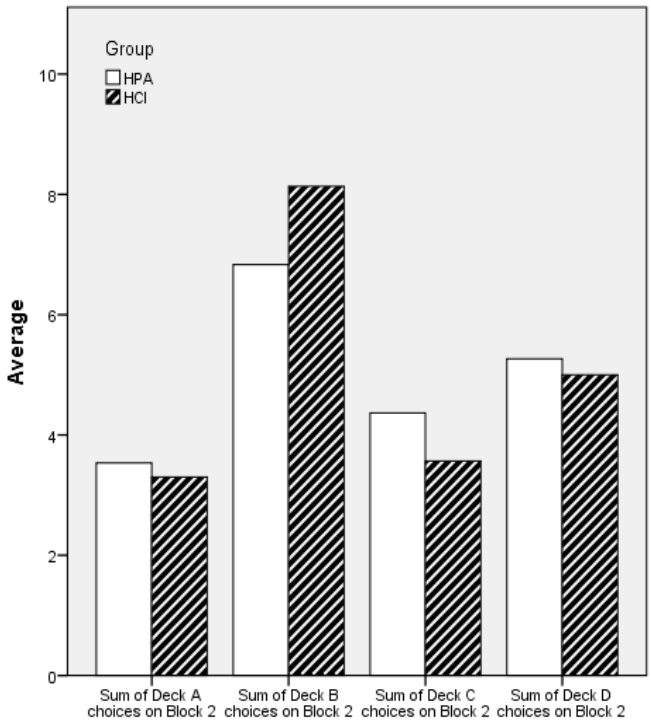


**Figure 2**. Sum of Deck selections on Block 2 according to the group.

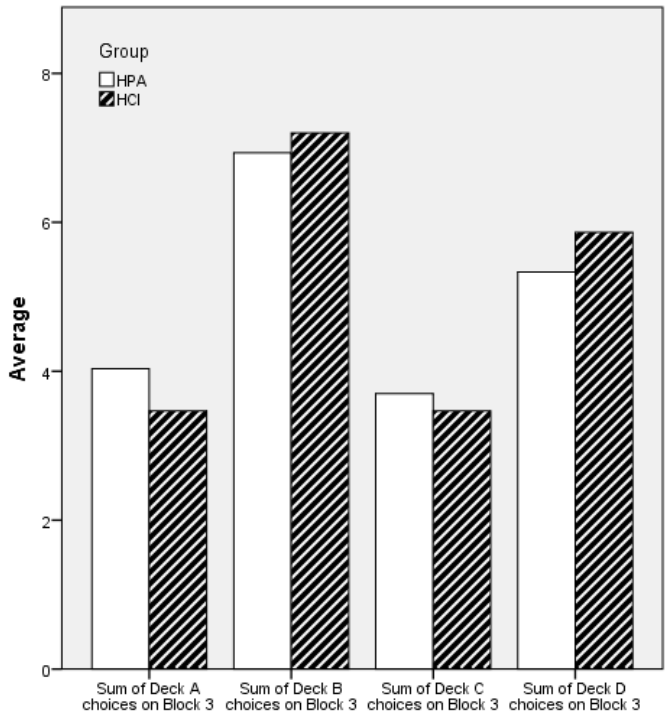


**Figure 3.** Sum of Deck selections on Block 3 according to the group.

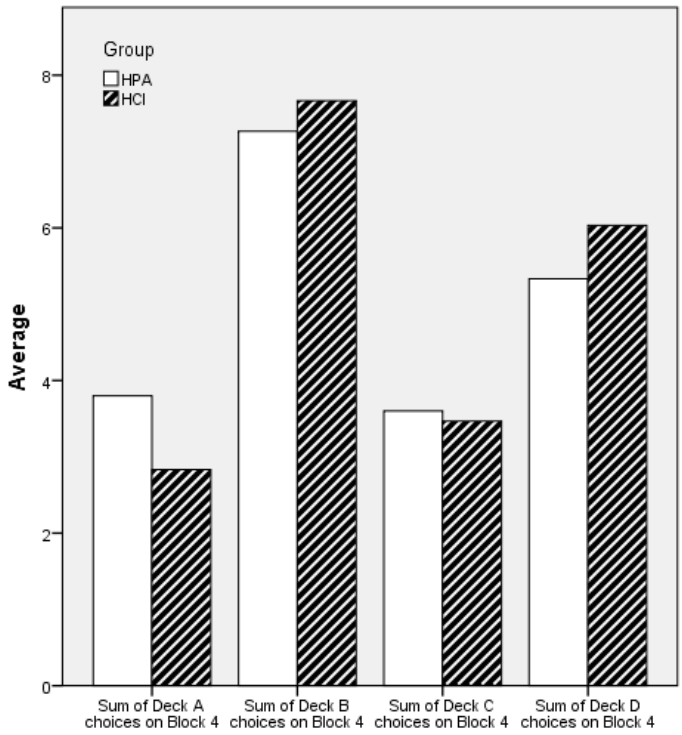


**Figure 4.** Sum of Deck selections on Block 4 according to the group.

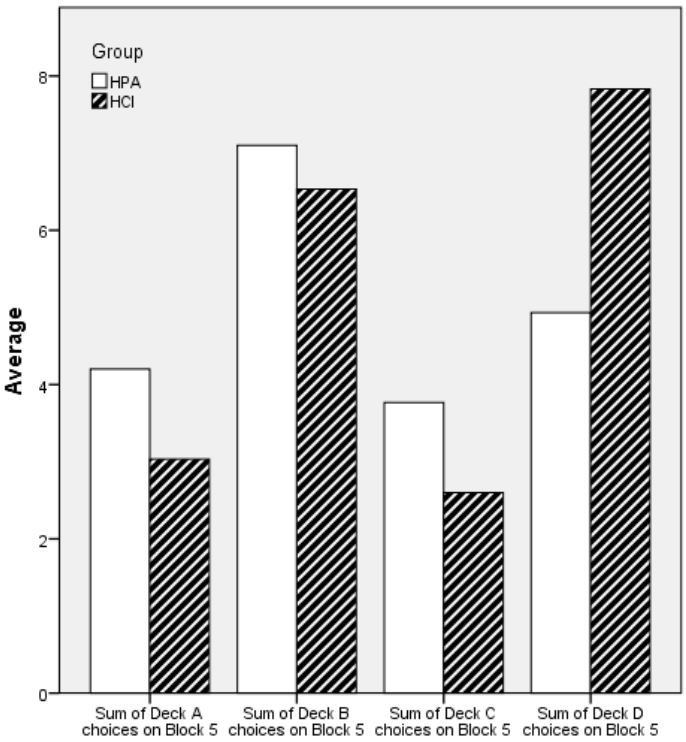


**Figure 5.** Sum of Deck selections on Block 5 according to the group.

HCI demonstrate a preference for Deck B since Block 1. Decks A and C were selected less than 4 times (on average) since Block 2 until the end of the task. Deck B was the most selected by controls until Block 5, when Deck D was the most chosen one. On the contrary, HPA have a similar pattern all over the IGT, Deck B is always the most chosen, followed by Deck D, and Decks A and C have a similar preference (Figures 1, 2, 3, 4, 5).

Overall, HCI and HPA have a preference for decks with low punishments (B and D) over decks with high punishments (C and A). However the magnitude of this preference may be relevant enough, given that the only significant difference between groups is upon Block 5 (B+D)-(C+A), when HCI score over 12 times (on average) Decks B and D.

The reason why HPA present higher values than HCI on the first 2 Blocks (C+D)-(A+B) of the IGT, may be related to Deck B preference, which is an unadvantageous with low punishments deck. However, HCI begin to score higher at Deck 3, what leads us to think that they start to identify advantageous and low punishment Decks, scoring each time upper than previously, this fact may be related to the continuous growing Deck D preference, achieving approximately 8 selections on the last deck. Nonetheless, the same effect does not apply to HPA that begin to score lower from Block 3 to the end of the task, scoring higher than controls on Decks A and C on Blocks 4 and 5. It is clearer why HCI and HPA have different learning curves (Figure 6).

HPA begin to perform more positivily (Block 1 and 2), but at Block 3 controls “recover” from exploring all possibilities, as they begin to understand the mechanism of the task and they are able to distinguish advantageous from disadvantageous decks (Figure 6), more detailed in Figure 7.

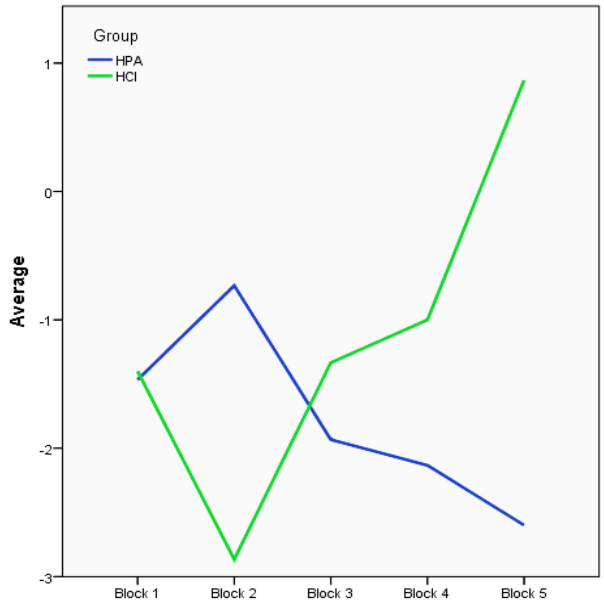


**Figure 6.** IGT performance across blocks, measured by [(C+D)-(A+B)] for both groups

.

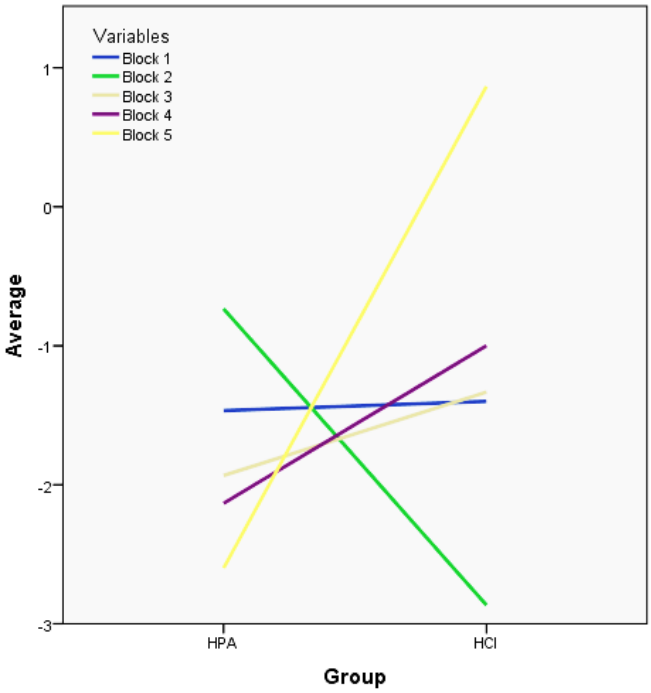


**Figure 7.** Inter-group comparasion among Blocks.

When comparing the main variables of the IGT and the BART, no significant correlations were detected (Table 10). Although there are no high correlations, it is remarkable that correlations on the HPA group are all negative, except on Block 4 and final balances obtained on both tasks. The last 60 card selections from HCI are significantly correlated to adjusted number of pumps, which is consistent with recent studies that defend that

both tasks are correlated, indeed, but only on second or third re-tests (Xu, 2013) or at later stages of the IGT (Upton et al., 2011).

**Table 10**

*IGT and BART Spearman Correlations according to the group*

| | HPA (*n*=30) | | | | HCI (*n*=30) | | | |
|---|---|---|---|---|---|---|---|---|
| | TP[a] | AAP[b] | TM[c] | TE[d] | TP[a] | AAP[b] | TM[c] | TE[d] |
| Block 1 [cdab] | -0.240 | -0.231 | -0.112 | -0.180 | .286 | .243 | .234 | .208 |
| Block 2 [cdab] | -0.377* | -0.353 | -0.255 | -0.333 | -0.005 | .048 | .106 | .008 |
| Block 3 [cdab] | -0.131 | -0.128 | -0.125 | -0.123 | .035 | .086 | .129 | .039 |
| Block 4 [cdab] | .060 | .054 | .189 | .062 | .303 | .319 | .363* | .290 |
| Block 5 [cdab] | -0.155 | -0.138 | -0.183 | -0.113 | .267 | .344 | .384* | .276 |
| Total [cdab] | -0.265 | -0.230 | -0.127 | -0.193 | .264 | .311 | .350 | .260 |
| First 40 [cdab] | -0.450* | -0.436* | -0.266 | -0.405* | .108 | .138 | .185 | .072 |
| Last 60 [cdab] | -0.104 | -0.081 | -0.038 | -0.056 | .313 | .367* | .399* | .321 |
| Net Outcome | -0.136 | -0.111 | .056 | -0.086 | .219 | .265 | .288 | .252 |

*Note.*[a] TP = Total of Pumps; [b] AAP = adjusted average number of pumps; [c] TM= Total of Money; [d] TE = Total of Explosions; [cdab](C+D)-(A+B);* p < .05, two-tailed.

Variables regarding the formula (B+D)-(C+A) were also considered but did not reveal significant differences , so all Blocks referred and taken into account respect the classic formula (C+D)-(A+B) to measure the IGT performance.

Considering the relationships between the BIS-11 and the BART:

We found that the Total of Pumps (BART) was significantly correlated to BIS-11 subscale perseverance ($r_s$= .387; p= .034) on the control group, whereas in the dependent group it was correlated to BIS-11 subscale cognitive complexity ($r_s$= .474; p= .026). HCI explosions occurred on the last 10 balloons (BART) were correlated to BIS-11 Motor Impulsivity ($r_s$=.375; p= .041). On the HPA group, Total of Explosions (BART) were correlated to BIS-11 subscale cognitive complexity ($r_s$= .46; p= .031) and Impulsivity ($r_s$= .423; p= .050). BART Adjusted Average of Pumps was associated to BIS-11 subscale cognitive complexity ($r_s$= .469; p= .028) and Impulsivity ($r_s$= .442; p= .040) on the dependent group. BART adjusted average of pumps on the last 10 balloons was correlated to BIS-11subscale perseverance ($r_s$=.402; p= .028) on controls. Total of Money collected by HPA was correlated to subscale cognitive complexity ($r_s$= .506; p= .026), specially on the first ten balloons ($r_s$= .713; p < .0001).

Considering the relationships between the BIS-11 and the IGT:

On the dependent group, the IGT net outcome was positively related to BIS-11 subscale self-control ($r_s$= 0.465; p= .029), but negatively to BIS-11 subscale cognitive instability ($r_s$= -0.444; p= .038). In the same group, IGT Block 1 was negatively associated with BIS-11 subscale perseverance ($r_s$= -0.444; p=.039) while IGT Block 3 was positively related to BIS-11 Attentional Impulsivity (rs= 0.435; p=.043). On the control group correlations were found between BIS-11 subscale motor with IGT Block 1

($r_s$= 0.395; p= .031); IGT Block 3 ($r_s$= 0.479; p= .007) and IGT performance [(C+D)–(A+B) total] ($r_s$= 0.397; p= .030).

Regarding age and schooling significant relationships with the BIS-11, the IGT and the BART:

HPA age was negatively correlated with BIS-11 subscale cognitive complexity ($r_s$= -0.483; p= .023), whereas HCI age was negatively associated with BIS-11 subscale self-control ($r_s$= -0.426; p= .019).

On the dependent group, schooling was negatively related to IGT Block 1 ($r_s$= -0.395; p= .031), but positively to IGT Block 5 ($r_s$=0.364; p= .048). On the control group, schooling was related to IGT Block 3 ($r_s$= 0.503; p= .005).

No significant differences were found between schooling and impulsivity (BIS-11), neither between schooling and the BART.

Concerning IQ estimate significant relationships with the IGT and the BART:

IQ estimate was found to be negatively correlated with the Sum of Deck A choices on IGT Block 5 on HPA ($r_s$= -0.436; p= .018) and HCI ($r_s$= -0.465; p= .011). IQ estimate was also significantly correlated to IGT Blocks 3 ($r_s$= 0.444; p= .016) and 5 ($r_s$= 0.431; p= .020) on the control group. IQ was also associated to the IGT net outcome ($r_s$= 0.418; p= .024) on the control group.

No differences were found between the BART and the IQ estimate.

Considering BSI significant relationships with the IGT:

Somatization was found to be related to IGT Blocks 2 ($r_s$= 0.463; p= .017) and 5 ($r_s$= 0.436; p= .026) on the Dependent Group. Controls showed significant correlations between Interpersonal Sensivity and Block 1 ($r_s$= 0.465; p= .010) while Phobic Anxiety was related to IGT Blocks 3 ($r_s$= -0.477; p= .008) and 5 ($r_s$= 0.499; p= .005).

Regarding BSI significant relationships with the BART:

The only significant correlation found between the BSI and the BART was in the HPA group, between Paranoid Ideation and Explosions on the last 10 balloons ($r_s$=0.406; p= .040).

Considering MoCA significant relationships with the IGT:

Delay Recall was related to IGT Block 2 ($r_s$= 0.412; p= .026), whereas IGT Block 5 was negatively associated with Verbal Fluency (rs= -0.382; p= .041), but positively correlated on the control group ($r_s$=0.403; p= .027).

Concerning MoCA significant relationships with the BART:

On the dependent group, Delay Recall was negatively related to several BART variables: Total of Pumps ($r_s$= -0.398; p= .033); Average of Adjusted Pumps ($r_s$= -0.382; p= .041) and Total of Explosions ($r_s$= -0.465; p= .011). No significant correlations were found on the control group.

HPA score higher in adjusted average of pumps, positively associated with risk taking, in the BART (Figure 8), as they do in higher order factors of impulsivity measured by the BIS-11 (Figure 9).

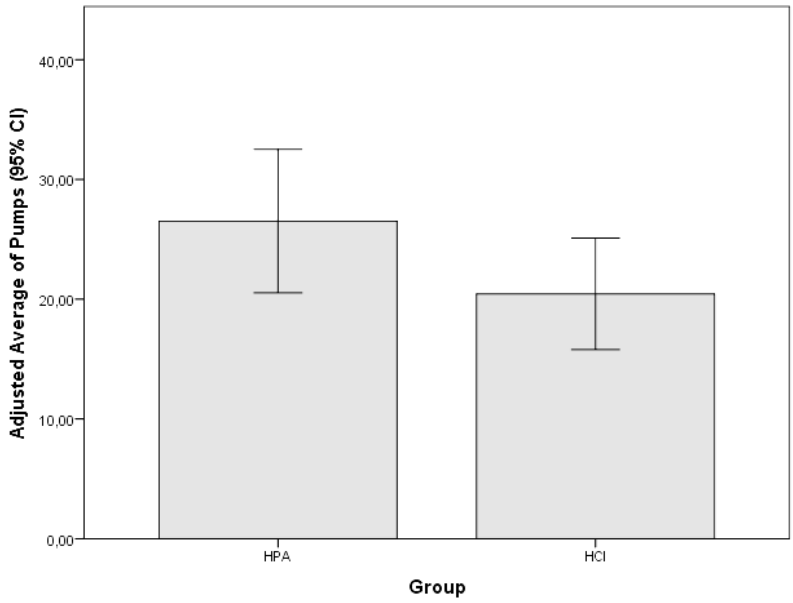


**Figure 8**. Mean values on BART performances for both groups. Standard errors are represented in the figure by the error bars attached to each column.

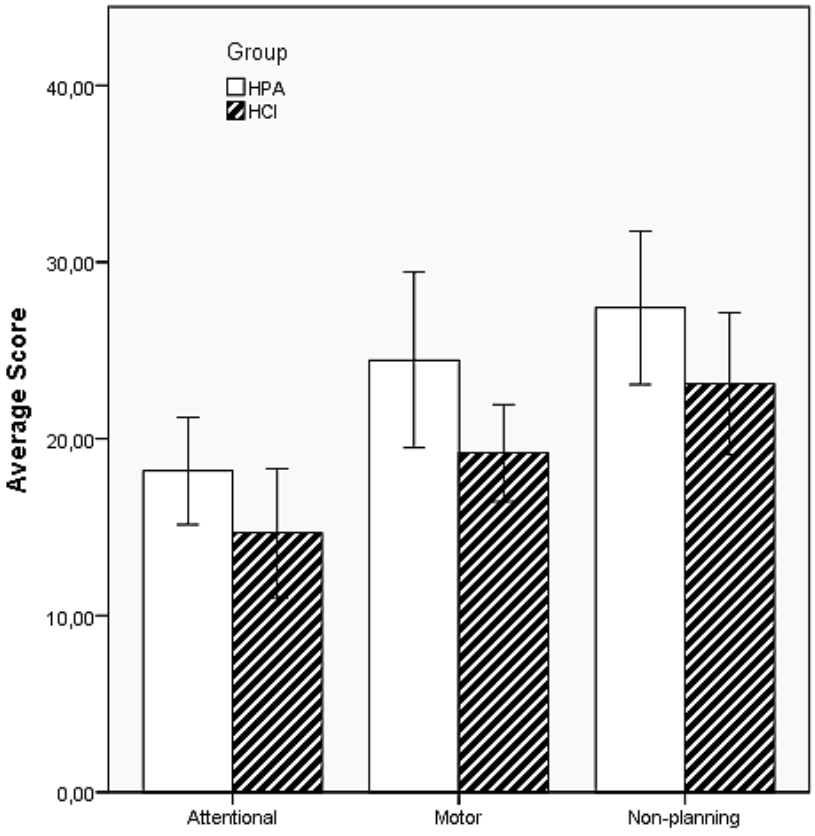


**Figure 9.** Mean values of the three higher order factors of the BIS-11. Standard errors are represented in the figure by the error bars attached to each column.

## V – Discussion

"Drug abuse involves direct activation of brain reward system, which is related to behavior reinforcement and memories production. They produce such an intense activation of the reward system that normal activities may be neglected. Instead of achieving reward system activation through adaptive behaviors, drugs abuse directly activate the reward pathways (…). Furthermore, individuals with lower levels of self-control, which may reflect impairments of brain inhibitory mechanisms, may be particularly predisposed to develop SUDs" (APA, 2013, p. 481).

The deficits in executive control functions present in polysubstance abusers are prominent in different domains associated with cognitive impulsivity, including response inhibition and decision-making (Rogers & Robbins, 2001; Verdejo-García, López-Torrecillas, Orozco, & Pérez-García, 2004; Verdejo-García et al., 2007). As stated before, one form of impulsivity is related to the inability to delay gratification, modelled by complex decision-making tasks, such as the IGT, that has been recently considered to better understand possible impulsivity differences (Leeman & Potenza, 2012).

In the IGT, HPA showed several significant correlations with Attentional Impulsivity (Block 3), self-control (net outcome) and perseverance (Block 3). HPA performance was negatively correlated to cognitive instability (net outcome and Sum of Deck D choices on Block 2) and perseverance (Block 1). The positive correlation between Block 3 and Attentional Impulsivity implies a supposed focus on the task that may be disturbed by secondary thoughts, which may be related to poor thinking involving rapid decisions without adequate information (Verdejo-Garcia et al., 2008).Verdejo-García et al. (2007) revealed that HPA were strongly related to Motor Impulsivity, although we only found a significant correlation with explosions on the last 10 balloons on controls. Still, this correlation may depend critically on if subjects are consuming presently or abstinent, as suggested by the authors.

HCI also showed many significant correlations with Non-planning Impulsivity (Sum of Deck D choices on Block 1; Sum of Deck A choices on Block 5) and motor subscale (Blocks 1 and 3). In this group, Block 3 was significantly correlated to IQ estimate and schooling. IQ estimate was found to be positively correlated to Block 5 and net outcome, but negatively with the Sum of Deck A choices on Block 5 on both groups.

Relatively to the BART, HPA showed significant correlations with Impulsivity (average of adjusted balloons); cognitive complexity (total number of pumps and total of money); motor subscale (average of adjusted number of balloons on the first 10 balloons) and Non-planning Impulsivity (total of money).

Still relatively to the BART, HCI do not show as much correlations as HPA. Controls revealed to be correlated mostly with perserverance (total of pumps and average of adjusted balloons on the last 10 balloons). They also correlate to motor impulsivity (explosions on the last 10 balloons).

Overall, these results show that impulsivity trait is correlated to the IGT and to the BART performance on opioid dependents and healthy subjects, although the relation with the BART is supposed to be stronger given the correlation between the main dependent variable of the task - average adjusted number of balloons – and the total score of the BIS-11 on the HPA group.

Regarding the classic formula (C+D)-(A+B), differences between HPA and HCI on overall performance was not significant, even if a poorer performance of HPA on the IGT is evidenced, which is consistent with previous studies (Verdejo-García, 2010), including a similar Portuguese study (Areias, 2012). Still regarding the HPA poorer performance, 13 subjects (44.7%) consumed cannabis 30 days prior to the evaluation, so we consider important to mention a previous study that has positively correlated cannabis use with poorer decision making performance for males (Crane, Schuster, & Gonzalez, 2013). Also 11 subjects (37.9%) consumed cocaine 30 days prior to the evaluation, but cocaine dependents according to Verdejo-Garcia et al. (2007) show a similar pattern of impaired performance on the IGT as heroin dependents.

A poor performance on the IGT could be explained by reduced decision consistency (Bishara et al., 2009), given that deficit in choice consistency indicate that individual's choices were highly indifferent to their evaluation of different hypotheses (Khodadadi, Dezfouli, Fakhari, & Ekhtiari, 2010). Lower decision consistency may represent a general preference for exploratory over exploitative search strategies (Bishara et al., 2009). An impaired decision-making as measured by the IGT reflects a poor tendency to think and reflect on the costs of an act before engaging in that act (Beshara, 2004). Correspondingly, a poor performance on the BART may be influenced by choice consistency factors too (Khodadadi et al., 2010).

Bornovalova et al., (2009) concluded that impulsivity moderated the effect of reward magnitude on the BART, with those low in impulsivity being even more risk opposed at higher amounts, and no differences were found for those high in impulsivity. According to the authors, these results suggest that individuals high in impulsivity are either less sensitive to potential loss, or have a relatively balanced sensitivity to both losses and gains compared to those low in impulsivity.

Bechara and Damasio (2002) suggested that poor IGT performance may reflect a hypo-sensivity to punishment. However, other studies showed that during the IGT they are more attentive to gains (Stout et al., 2004), whereas polysubstance abusers are more sensitive to changes in rewards during the BART (Pleskac, 2008). Still, other authors state that substance abusers generally differ in how they evaluate payoffs in both tasks influenced by a different learning process (Pleskac et al., 2007).

According to Pleskac et al., (2007) and Bishara et al. (2009) substance abusers differ from controls in their learning process on the BART, stating that "their differences outweigh their similarities and that their differences have important consequences in terms of the specific

characteristics of the cognitive processes used during each task" (Pleskac et al., 2007, p. 19). In fact, there is no meaningful difference between performance of control group and heroin-abusers after 6 months of treatment (Khodadadi et al., 2010).

In this study IGT Blocks 4 and 5, as well as the last 60 card selections, from HCI are significantly correlated to adjusted number of pumps (BART), which is consistent with recent studies that defend that both tasks are correlated, indeed, but only on second or third re-tests (Xu et al., 2013) or at later stages of the IGT (Upton et al., 2011) on control groups. The IGT evaluates risk taking (act or fact of doing something that involves danger or risk in order to achieve a goal) and the BART measures risk propensity (the degree an entity is prepared to take a chance with the risk of a loss). The late correlations between both tasks may be due to an evolution across the IGT that leads risk taking at the beginning to risk propensity by the end of the task. This hypothesis only applies to controls and not HPA. A possible reason for this process may be negatively correlated to cognitive impairment caused by drug addiction. Further studies should confirm this conclusion on controls and explore the reasons why this does not occur on dependent subjects.

"Decision-making is a complex process that depends on systems for memory, emotion, and feeling" (Bechara, 2004, p. 56). Attention and working memory are basic executive functions that are relevant to impulsivity (Bechara & Martim, 2004; Finn, 2002; Rugle & Melamed, 1993). Regarding the MoCA, HPA Delay Recall was related to Deck 2, whereas Block 5 was negatively associated with verbal fluency, but positively correlated on the control group. Delay Recall was negatively related to total of pumps; average of adjusted pumps and total of explosions, three main dependent variables of the BART, which may lead forward investigations to include memory assessments to better examine this relation. All these correlations, including the significant difference on MoCA total scores between groups, suggest a faster cognitive decline or impairment on executive functions on drug addicts, further investigation is required to corroborate these explanatory hypotheses.

Future studies should consider applying the Wisconsin Card Sorting Task, as it measures Attentional Impulsiveness (inability to inhibit a recurrent thought held in working memory, e.g., will to consume drugs by drug addicts), according Bechara (2004).

Future studies should also include personality assessment, such as the *Eysenck Personality Questionnaire – Revised, short version* (Eysenck, Eysenck, & Barrett, 1985). It has been used to understand how different personalities influence the performance on decision-making tasks to accomplish an individual's need or desire (Hjelle & Ziegler, 1981; Lopes, 1987), and maybe if we can understand this relation part of the problem will be clarified. Also pertinent is to include as impulsivity measures such as go/ no go tasks in order to confirm motor impulsivity differences between opioid dependents and controls, by testing motor response inhibition. It seems that decision-making is still unclear even if there are several of studies around

this subject for so long, and contradictory conclusions are found very often. It seems that more studies are needed and several variables should be taken into account. Decision making is such a complex process that emotion, mood, personality, anxiety, impulsivity, intelligence, reinforcement, social desirability, memory, motivation, along with other variables may all have a part when it comes to decide.

## VI – Conclusion

Impulsivity and decision-making processes were assessed by means of several neuropsychological measures in a group of abstinent polysubstance abusers (users of several substances with a marked preference for heroin mostly), one widely abused substance, being the average prevalence of problem opioid use in the European Union and Norway between 0.36% and 0.44% (APA, 2014, p. 577) and one group of healthy controls.

Results show that HPA have a lower performance in decision making, lower IQ estimate; higher cognitive deterioration and a higher impulsivity trait (as measured by the BIS-11) as well. They also present several serious psychopathological symptoms. IQ and Impulsivity-trait are significantly correlated to some decision-making tasks dependent variables but they do not have statistical power to explain entirely the decision-making process.

The learning curves represented on Figures 6 and 7 reveal learning process differences according to the group. We believe control subjects begin the task by exploring all decks, all possibilities, which justifies the low performances on Blocks 1 and 2, until they realize which decks are more advantageous and with lower punishments, in order to reach the main goal of the task – to earn as much money possible. HPA start to perform similarly to HCI, they actually reach a pick on Block 2, but from Block 3 to Block 5, HPA decline. That fact leads us to conclude that the learning process during the task was not successful as it was for HCI, which can be explained by different strategies and patterns implemented.

One of the main goals was to evaluate the correlation between both decision-making tasks used and our results are coeherent with recent studies that also concluded that the IGT and the BART are only correlated on the last blocks of the IGT (Upton et al., 2011) or at re-test sessions (Xu et al., 2013), but only with controls.

"Investigation into neuropsychological processing underlying decision under uncertainty is important for medical treatments of neuropsychiatric disorder*"* (Inukai & Takahashi, 2006, p. 1). There is only one study about decision making in opioid dependents in Portugal, and it is important to continue this research in order to comprehend the problem in its different dimensions, and to treat it in the future in a more efficacious way, preventing relapses. It is also important to expand the research to other drugs that are also highly consumed nowadays in our society.

As limitations of this study, we may point: the reduced sample of both groups; the fact that we used the original version of the BART, since a validation for the Portuguese population is yet to be done and it was not

possible to be arranged along with this work. The IGT, an instrument from 1994, has been widely used all over the globe, but not so much in Portugal. It would be interesting to apply it to a massive representative sample of the Portuguese population to elucidate future authors to what it is normative as a result in our country (according to sex, age, education...) and then compare it to other foreign results. It is also remarkable that HPA were more motivated to participate than controls, such fact might be due to HPA's routine in the residential drug use treatment center where they often feel excited about doing something different and new. On the other hand, HCIs were usually liberated sooner or during work to participate, but they showed some anxiety due to the time required to complete the evaluation.

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# Appendix

## Appendix A

**DECLARAÇÃO DE CONSENTIMENTO**

Caro Participante,

A participação neste projecto é voluntária. Caso aceite participar, deverá realizar um jogo de tomada de decisão. Também lhe será solicitada a realização de alguns testes e inquéritos.

Todos os dados recolhidos são confidenciais e toda a informação que o/a permita identificar será codificada.

Se desejar, poderá solicitar posteriormente informação sobre o seu desempenho.

Assim, compreendi o que me é pedido, sei que posso interromper este consentimento em qualquer altura, dando conhecimento dessa intenção ao responsável do projecto e assino, em baixo, que aceito participar no referido estudo.

Coimbra, dia……de…… de 20……

……..……

(Assinatura)

Atenciosamente

……..……

(Maria da Graça Fontinha Areias Cardoso)

(Ana Mafalda Luzes Pais Pinto)

## Appendix B

**DADOS SÓCIO-DEMOGRÁFICOS E CLÍNICOS**

Idade:.....

Sexo:.....

Anos de Escolaridade (completos):.....

Estado civil:

- Solteiro.....
- Casado.....
- União de facto.....
- Divorciado.....
- Separado.....
- Viúvo.....
- Desconhecido.....

Situação Profissional:

- Trabalho estável.....
- Trabalho ocasional.....
- Desempregado há menos de um ano.....
- Desempregado há um ano ou mais.....
- Estudante / Formação Profissional.....
- Doméstica(o) .....
- Reformado(a) /Pensão Social.....
- Outra situação.....
- Desconhecido.....

Profissão (atual/ última):.....

Tem/teve problemas judiciais?

.....

Sofre de alguma doença? (em particular do foro neurológico ou psiquiátrico):

……
……

Bebe bebidas alcoólicas?.....Se sim, com que frequência…….……

/quantidade……..…

**Appendix C**

## BSI

L.R. Derogatis, 1993; Versão: M.C. Canavarro, 1995

A seguir encontra-se uma lista de problemas ou sintomas que por vezes as pessoas apresentam. Assinale, num dos espaços à direita de cada sintoma, aquele que melhor descreve o GRAU EM QUE CADA PROBLEMA O INCOMODOU DURANTE A ÚLTIMA SEMANA. Para cada problema ou sintoma marque apenas um espaço com uma cruz. Não deixe nenhuma pergunta por responder.

| **Em que medida foi incomodado pelos seguintes sintomas:** | **Nunca** | **Poucas vezes** | **Algumas vezes** | **Muitas vezes** | **Muitíssimas vezes** |
|---|---|---|---|---|---|
| 1. Nervosismo ou tensão interior | ☐ | ☐ | ☐ | ☐ | ☐ |
| 2. Desmaios ou tonturas | ☐ | ☐ | ☐ | ☐ | ☐ |
| 3. Ter a impressão que as outras pessoas podem controlar os seus pensamentos | ☐ | ☐ | ☐ | ☐ | ☐ |
| 4. Ter a ideia que os outros são culpados pela maioria dos seus problemas | ☐ | ☐ | ☐ | ☐ | ☐ |
| 5. Dificuldade em se lembrar de coisas passadas ou recentes | ☐ | ☐ | ☐ | ☐ | ☐ |
| 6. Aborrecer-se ou irritar-se facilmente | ☐ | ☐ | ☐ | ☐ | ☐ |
| 7. Dores sobre o coração ou no peito | ☐ | ☐ | ☐ | ☐ | ☐ |
| 8. Medo na rua ou praças públicas | ☐ | ☐ | ☐ | ☐ | ☐ |
| 9. Pensamentos de acabar com a vida | ☐ | ☐ | ☐ | ☐ | ☐ |
| 10. Sentir que não pode confiar na maioria das pessoas | ☐ | ☐ | ☐ | ☐ | ☐ |
| 11. Perder o apetite | ☐ | ☐ | ☐ | ☐ | ☐ |
| 12. Ter um medo súbito sem razão para isso | ☐ | ☐ | ☐ | ☐ | ☐ |
| 13. Ter impulsos que não se podem controlar | ☐ | ☐ | ☐ | ☐ | ☐ |
| 14. Sentir-se sozinho mesmo quando está com mais pessoas | ☐ | ☐ | ☐ | ☐ | ☐ |
| 15. Dificuldade em fazer qualquer trabalho | ☐ | ☐ | ☐ | ☐ | ☐ |
| 16. Sentir-se sozinho | ☐ | ☐ | ☐ | ☐ | ☐ |
| 17. Sentir-se triste | ☐ | ☐ | ☐ | ☐ | ☐ |
| 18. Não ter interesse por nada | ☐ | ☐ | ☐ | ☐ | ☐ |
| 19. Sentir-se atemorizado | ☐ | ☐ | ☐ | ☐ | ☐ |
| 20. Sentir-se facilmente ofendido nos seus sentimentos | ☐ | ☐ | ☐ | ☐ | ☐ |
| 21. Sentir que as outras pessoas não são amigas ou não gostam de si | ☐ | ☐ | ☐ | ☐ | ☐ |
| 22. Sentir-se inferior aos outros | ☐ | ☐ | ☐ | ☐ | ☐ |
| 23. Vontade de vomitar ou mal-estar do estômago | ☐ | ☐ | ☐ | ☐ | ☐ |
| 24. Impressão de que os outros o costumam observar ou falar de si | ☐ | ☐ | ☐ | ☐ | ☐ |
| 25. Dificuldade em adormecer | ☐ | ☐ | ☐ | ☐ | ☐ |
| 26. Sentir necessidade de verificar várias vezes o que faz | ☐ | ☐ | ☐ | ☐ | ☐ |

| **Em que medida foi incomodado pelos seguintes sintomas:** | **Nunca** | **Poucas vezes** | **Algumas vezes** | **Muitas vezes** | **Muitíssimas vezes** |
|---|---|---|---|---|---|
| 27. Dificuldade em tomar decisões | ☐ | ☐ | ☐ | ☐ | ☐ |
| 28. Medo de viajar de autocarro, de comboio ou de metro | ☐ | ☐ | ☐ | ☐ | ☐ |
| 29. Sensação de que lhe falta o ar | ☐ | ☐ | ☐ | ☐ | ☐ |
| 30. Calafrios ou afrontamentos | ☐ | ☐ | ☐ | ☐ | ☐ |
| 31. Ter de evitar certas coisas, lugares ou actividades por lhe causarem medo | ☐ | ☐ | ☐ | ☐ | ☐ |
| 32. Sensação de vazio na cabeça | ☐ | ☐ | ☐ | ☐ | ☐ |
| 33. Sensação de anestesia (encortiçamento ou formigueiro) no corpo | ☐ | ☐ | ☐ | ☐ | ☐ |
| 34. Ter a ideia que deveria ser castigado pelos seus pecados | ☐ | ☐ | ☐ | ☐ | ☐ |
| 35. Sentir-se sem esperança perante o futuro | ☐ | ☐ | ☐ | ☐ | ☐ |
| 36. Ter dificuldade em se concentrar | ☐ | ☐ | ☐ | ☐ | ☐ |
| 37. Falta de forças em partes do corpo | ☐ | ☐ | ☐ | ☐ | ☐ |
| 38. Sentir-se em estado de tensão ou aflição | ☐ | ☐ | ☐ | ☐ | ☐ |
| 39. Pensamentos sobre a morte ou que vai morrer | ☐ | ☐ | ☐ | ☐ | ☐ |
| 40. Ter impulsos de bater, ofender ou ferir alguém | ☐ | ☐ | ☐ | ☐ | ☐ |
| 41. Ter vontade de destruir ou partir coisas | ☐ | ☐ | ☐ | ☐ | ☐ |
| 42. Sentir-se embaraçado junto de outras pessoas | ☐ | ☐ | ☐ | ☐ | ☐ |
| 43. Sentir-se mal no meio das multidões como lojas, cinemas ou assembleias | ☐ | ☐ | ☐ | ☐ | ☐ |
| 44. Grande dificuldade em sentir-se "próximo" de outra pessoa | ☐ | ☐ | ☐ | ☐ | ☐ |
| 45. Ter ataques de terror ou pânico | ☐ | ☐ | ☐ | ☐ | ☐ |
| 46. Entrar facilmente em discussão | ☐ | ☐ | ☐ | ☐ | ☐ |
| 47. Sentir-se nervoso quando tem que ficar sozinho | ☐ | ☐ | ☐ | ☐ | ☐ |
| 48. Sentir que as outras pessoas não dão o devido valor ao seu trabalho ou às suas capacidades | ☐ | ☐ | ☐ | ☐ | ☐ |
| 49. Sentir-se tão desassossegado que não consegue manter-se sentado quieto | ☐ | ☐ | ☐ | ☐ | ☐ |
| 50. Sentir que não tem valor | ☐ | ☐ | ☐ | ☐ | ☐ |
| 51. A impressão de que, se deixasse, as outras pessoas se aproveitariam de si | ☐ | ☐ | ☐ | ☐ | ☐ |
| 52. Ter sentimentos de culpa | ☐ | ☐ | ☐ | ☐ | ☐ |
| 53. Ter a impressão de que alguma coisa não regula bem na sua cabeça | ☐ | ☐ | ☐ | ☐ | ☐ |

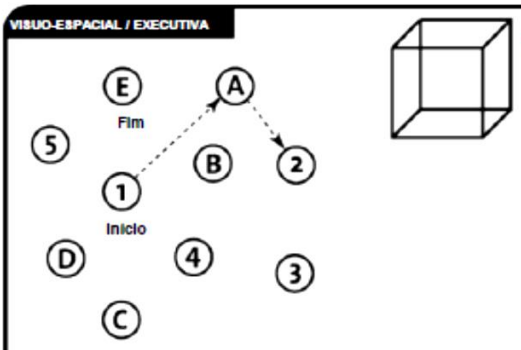
**Appendix D**

**MONTREAL COGNITIVE ASSESSMENT (MOCA)**

VERSÃO PORTUGUESA

Nome:_____ Idade: ____ anos
Sexo:_____ Data de Nascimento:_____
Escolaridade:_____ Data de Avaliação:_____

**VISUO-ESPACIAL / EXECUTIVA**




Copiar o cubo



[ ] [ ]

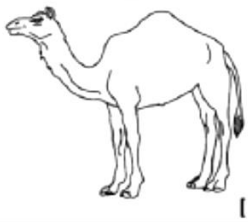
Desenhar um RELÓGIO (onze e dez) (3 pontos)

[ ] Contorno [ ] Números [ ] Ponteiros

Pontos: __/5

**NOMEAÇÃO**





[ ] [ ] [ ] __/3

**MEMÓRIA**

Leia a lista de palavras. O sujeito deve repeti-la. Realize dois ensaios. Solicite a evocação da lista 5 minutos mais tarde.

| | Boca | Linho | Igreja | Cravo | Azul |
|---|---|---|---|---|---|
| 1º ensaio | | | | | |
| 2º ensaio | | | | | |

Sem Pontuação

**ATENÇÃO**

Leia a sequência de números (1 número por segundo) — O sujeito deve repetir a sequência [ ] 2 1 8 5 4

O sujeito deve repetir a sequência na ordem inversa [ ] 7 4 2 __/2

Leia a série de letras. O sujeito deve dar uma panoadinha com a mão cada vez que for dita a letra A. Não se atribuem pontos se ≥ 2 erros.

[ ] F B A C M N A A J K L B A F A K D E A A A J A M O F A A B __/1

Subtrair de 7 em 7 começando no 100 [ ] 93 [ ] 86 [ ] 79 [ ] 72 [ ] 65

4 ou 5 subtracções correctas: 3 pontos; 2 ou 3 correctas: 2 pontos; 1 correcta: 1 ponto; 0 correctas: 0 pontos __/3

**LINGUAGEM**

Repetir: Eu só sei que hoje devemos ajudar o João. [ ] O gato esconde-se sempre que os cães entram na casa. [ ] __/2

Fluência verbal: Dizer o maior número possível de palavras que comecem pela letra "P" (1 minuto). [ ]_____ (N ≥ 11 palavras) __/1

**ABSTRACÇÃO**

Semelhança p.ex. entre banana e laranja = fruta [ ] comboio - bicicleta [ ] relógio - régua __/2

**EVOCAÇÃO DIFERIDA**

Deve recordar as palavras SEM PISTAS

| | Boca | Linho | Igreja | Cravo | Azul |
|---|---|---|---|---|---|
| | [ ] | [ ] | [ ] | [ ] | [ ] |
| Opcional — Pista de categoria | | | | | |
| Opcional — Pista de escolha múltipla | | | | | |

Pontuação apenas para evocação SEM PISTAS __/5

**ORIENTAÇÃO**

[ ] Dia do mês (Data) [ ] Mês [ ] Ano [ ] Dia da semana [ ] Lugar [ ] Localidade __/6

© Z.Nasreddine MD

Examinador: _____

TOTAL __/30

Atribuir um ponto se o sujeito tem ≤ de 12 anos de escolaridade

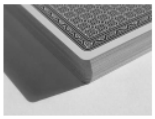
Versão Portuguesa: M.R. Simões, S. Freitas, I. Santana, H. Firmino, C. Martins, Z. Nasreddine & M. Vilar 2008 – Serviço de Avaliação Psicológica/FPCE-UC & HUC

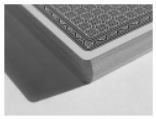
**Appendix E**

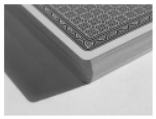
# Iowa Gambling Task

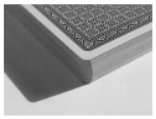
## Instruções

No écran estão quatro baralhos de cartas: 1, 2, 3 e 4.


Escolher baralho 1


Escolher baralho 2


Escolher baralho 3


Escolher baralho 4

Escolha uma carta (de cada vez) de um dos quatro baralhos, seleccionando e carregando com a tecla esquerda do rato o botão que está por baixo do baralho. É absolutamente livre para escolher as cartas que quiser e para se desviar de um baralho para outro em qualquer momento, e tão frequentemente quanto quiser.

Sempre que escolher uma carta vai ganhar algum dinheiro. No entanto, algumas vezes também vai perder dinheiro. O objectivo do jogo é ganhar o máximo dinheiro possível e se não conseguir ganhar, evitar perder. O seu saldo vai sendo constantemente actualizado à medida que realiza a tarefa. Não se sabe quando, nem quanto dinheiro vai ganhar. Vai descobrir à medida que for avançando.

Não tente saber quando acaba o jogo. Deve manter-se a jogar até o computador parar. É importante saber que tal como num jogo de cartas verdadeiro, o computador não modifica a ordem das cartas depois de o jogo começar. Pode não ser capaz de perceber exactamente quando vai perder dinheiro, mas o jogo é honesto. O computador não faz perder dinheiro ao acaso, mas em função da carta escolhida. Tudo o que se pode dizer é que alguns baralhos são piores do que outros. Independentemente do que tenha perdido, ainda pode ganhar mantendo-se afastado dos baralhos piores. Por favor, trate o dinheiro deste jogo como se fosse real, e toda a decisão deve ser tomada como se estivesse a usar o seu próprio dinheiro.

Inicia o jogo com 2000 euros. Carregue em "Começar" para iniciar.

Iniciar

**Appendix F**

| Data: Nº. | |
|---|---|
| ***Vocabulário*** | |
| **Item** **Resposta** | **Cotação** |
| (Interromper após 6 insucessos consecutivos) | (0,1,2) |
| 1. Cama | |
| | |
| 2. Pequeno-almoço | |
| | |
| 3.Euro | |
| | |
| **4.Inverno** | |
| | |
| 5.Barco | |
| | |
| 6.Concluir | |
| | |
| 7.Reparar | |
| | |
| 8.Consumir | |
| | |
| 9.Serenidade | |
| | |
| 10.Diferente | |
| | |
| 11.Reunir | |
| | |

| | |
|---|---|
| 12.Remorso | |
| | |
| 13.Gerar | |
| | |
| 14.Ontem | |
| | |
| 15.Santuário | |
| | |
| 16.Confidenciar | |
| | |
| 17.Ponderar | |
| | |
| 18.Compaixão | |
| | |
| 19.Evoluir | |
| | |
| 20.Balada | |
| | |
| 21.Sociedade | |
| | |
| 22.Sentença | |
| | |
| 23.Designar | |
| | |
| 24.Moralidade | |
| | |

| | |
|---|---|
| 25.Audacioso | |
| | |
| 26.Declamar | |
| | |
| 27.Plagiar | |
| | |
| 28.Contenda | |
| | |
| 29.Renitente | |
| | |
| 30.Discernir | |
| | |
| 31.Tangível | |
| | |
| 32.Épico | |
| | |
| 33.Intrincar | |
| | |
| **Pontuação Total Obtida (Máximo=66)** | |

**Appendix G**

## 5. Cubos

| Regra de Retrocesso | Critério de Interrupção | Cotação |
|---|---|---|
| Se o sujeito obtiver a cotação de 0 ou 1 ponto nos Itens 5 ou 6, aplicar os itens precedentes (Itens 1 a 4) em **sentido inverso**, até que alcance a cotação máxima (2 pontos) em 2 itens consecutivos. | Após **3 insucessos** consecutivos (itens cotados com 0 pontos). | - **Itens 1 a 6:** ***2 pontos***, por cada reprodução realizada com sucesso no Ensaio 1; ***1 ponto,*** por cada reprodução realizada com sucesso no Ensaio 2; ***0 pontos,*** se o sujeito não conseguir construir o desenho em nenhum dos ensaios.<br>- **Itens 7 a 14:** Rodear com um círculo a cotação obtida, até um máximo de 7 pontos. |

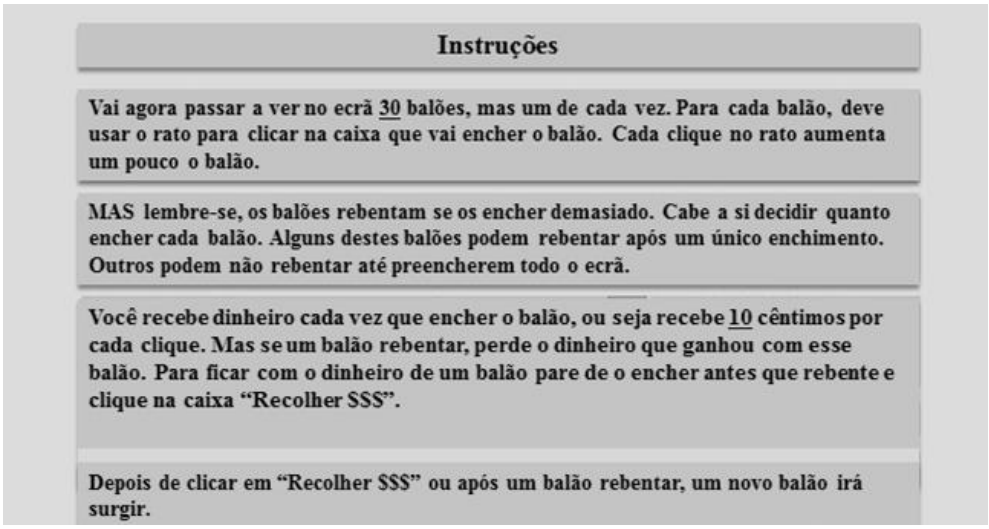
Sujeito

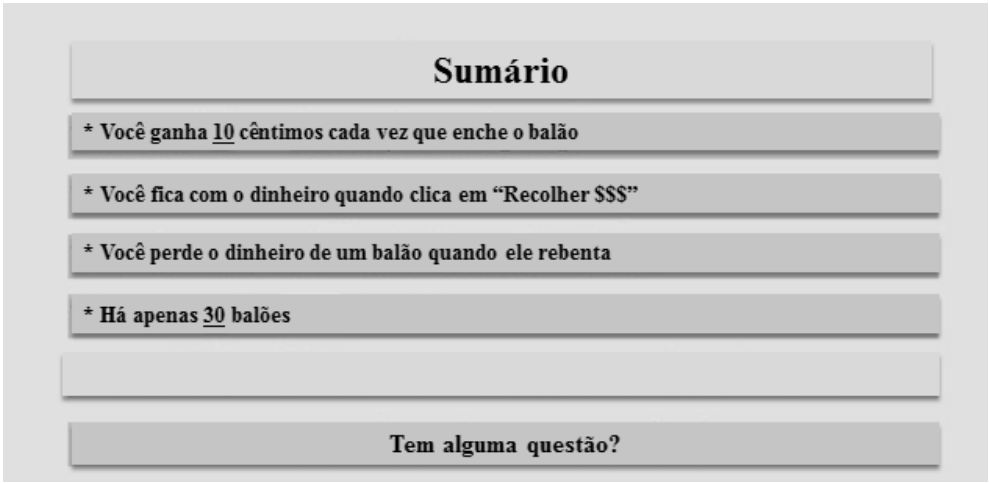
| Desenhos Correctos | Tempo Limite | Desenho Incorrecto | Tempo Dispon. | Reproduz c/ Sucesso | COTAÇÃO (Rodear com um círculo a cotação obtida) |
|---|---|---|---|---|---|
| 1. | 30" | Ensaio 1 / Ensaio 2 | | S N | Ensaio 2 Ensaio 1<br>0 1 2 |
| 2. | 30" | Ensaio 1 / Ensaio 2 | | S N | Ensaio 2 Ensaio 1<br>0 1 2 |
| 3. | 30" | Ensaio 1 / Ensaio 2 | | S N | Ensaio 2 Ensaio 1<br>0 1 2 |
| 4. | 30" | Ensaio 1 / Ensaio 2 | | S N | Ensaio 2 Ensaio 1<br>0 1 2 |
| 5. | 60" | Ensaio 1 / Ensaio 2 | | S N | Ensaio 2 Ensaio 1<br>0 1 2 |
| 6. | 60" | Ensaio 1 / Ensaio 2 | | S N | Ensaio 2 Ensaio 1<br>0 1 2 |
| 7. | 60" | | | S N | 16"-60" 11"-15" 6"-10" 1"-5"<br>0 4 5 6 7 |
| 8. | 60" | | | S N | 16"-60" 11"-15" 6"-10" 1"-5"<br>0 4 5 6 7 |
| 9. | 60" | | | S N | 21"-60" 16"-20" 11"-15" 1-10"<br>0 4 5 6 7 |
| 10. | 120" | | | S N | 36"-120" 26"-35" 21"-25" 1"-20"<br>0 4 5 6 7 |
| 11. | 120" | | | S N | 66"-120" 46"-65" 31"-45" 1"-30"<br>0 4 5 6 7 |
| 12. | 120" | | | S N | 76"-120" 56"-75" 41"-55" 1"-40"<br>0 4 5 6 7 |
| 13. | 120" | | | S N | 76"-120" 56"-75" 41"-55" 1"-40"<br>0 4 5 6 7 |
| 14. | 120" | | | S N | 66"-120" 46"-65" 36"-45" 1"-35"<br>0 4 5 6 7 |

Examinador

**Pontuação Total Obtida** (Máximo = 68)

**Appendix H**


Instruções
Vai agora passar a ver no ecrã 30 balões, mas um de cada vez. Para cada balão, deve usar o rato para clicar na caixa que vai encher o balão. Cada clique no rato aumenta um pouco o balão.
MAS lembre-se, os balões rebentam se os encher demasiado. Cabe a si decidir quanto encher cada balão. Alguns destes balões podem rebentar após um único enchimento. Outros podem não rebentar até preencherem todo o ecrã.
Você recebe dinheiro cada vez que encher o balão, ou seja recebe 10 cêntimos por cada clique. Mas se um balão rebentar, perde o dinheiro que ganhou com esse balão. Para ficar com o dinheiro de um balão pare de o encher antes que rebente e clique na caixa "Recolher $$$".
Depois de clicar em "Recolher $$$" ou após um balão rebentar, um novo balão irá surgir.


Sumário
* Você ganha 10 cêntimos cada vez que enche o balão
* Você fica com o dinheiro quando clica em "Recolher $$$"
* Você perde o dinheiro de um balão quando ele rebenta
* Há apenas 30 balões
Tem alguma questão?

## Appendix I

**BIS-11**

Patton, Stanford e Barratt, 1995

(versão para investigação desenvolvida para português europeu por Cruz e Barbosa, 2012, com base na versão de Português do Brasil de Malloy-Diniz e col., 2010).

**Instruções:**

As pessoas diferem no modo como atuam e pensam em diferentes situações. Esta escala permite avaliar algumas maneiras de agir e pensar. Leia cada afirmação e preencha o círculo apropriado no lado direito da página. Não demore muito tempo em cada afirmação. Responda rápida e honestamente.

① Nunca ou Raramente ② Ocasionalmente ③ Frequentemente ④ Quase sempre/sempre

| Afirmações | Nunca ou Raramente | Ocasionalmente | Frequentemente | Quase sempre/ Sempre |
|---|---|---|---|---|
| 1. Eu planifico cuidadosamente as tarefas. | ① | ② | ③ | ④ |
| 2. Eu faço coisas sem pensar. | ① | ② | ③ | ④ |
| 3. Eu tomo decisões rapidamente. | ① | ② | ③ | ④ |
| 4. Eu sou despreocupado e confio na sorte. | ① | ② | ③ | ④ |
| 5. Eu não presto atenção. | ① | ② | ③ | ④ |
| 6. Eu tenho pensamentos que se atropelam (mudam de forma rápida e descontrolada). | ① | ② | ③ | ④ |
| 7. Eu planifico viagens com bastante antecedência. | ① | ② | ③ | ④ |
| 8. Eu tenho autocontrolo. | ① | ② | ③ | ④ |
| 9. Eu concentro-me facilmente. | ① | ② | ③ | ④ |
| 10. Eu economizo (poupo) regularmente. | ① | ② | ③ | ④ |
| 11. Eu contorço-me na cadeira nas peças de teatro ou palestras. | ① | ② | ③ | ④ |
| 12. Eu penso nas coisas com cuidado. | ① | ② | ③ | ④ |
| 13. Eu faço planos para manter o emprego (tenho cuidado para não perder o emprego). | ① | ② | ③ | ④ |
| 14. Eu digo coisas sem pensar. | ① | ② | ③ | ④ |
| 15. Eu gosto de pensar em problemas complexos. | ① | ② | ③ | ④ |
| 16. Eu troco de emprego. | ① | ② | ③ | ④ |
| 17. Eu ajo por impulso. | ① | ② | ③ | ④ |
| 18. Eu aborreço-me facilmente quando estou a resolver mentalmente problemas. | ① | ② | ③ | ④ |
| 19. Eu atuo no "calor" do momento. | ① | ② | ③ | ④ |
| 20. Eu mantenho a linha de pensamento ("não perco o fio à meada"). | ① | ② | ③ | ④ |
| 21. Eu troco de casa (residência). | ① | ② | ③ | ④ |
| 22. Eu compro coisas por impulso. | ① | ② | ③ | ④ |
| 23. Eu só consigo pensar numa coisa de cada vez. | ① | ② | ③ | ④ |
| 24. Eu troco de interesses e passatempos ("hobbies"). | ① | ② | ③ | ④ |
| 25. Eu gasto ou compro a prestações mais do que aquilo que ganho. | ① | ② | ③ | ④ |
| 26. Enquanto estou a pensar numa coisa é comum que outras ideias me venham à cabeça. | ① | ② | ③ | ④ |
| 27. Eu estou mais interessado no presente do que no futuro. | ① | ② | ③ | ④ |
| 28. Eu sinto-me inquieto no teatro ou palestras. | ① | ② | ③ | ④ |
| 29. Eu gosto de quebra-cabeças. | ① | ② | ③ | ④ |
| 30. Eu sou orientado para o futuro. | ① | ② | ③ | ④ |