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Impulsivity and Decision Making

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ABSTRACT

The purpose of the present study was to explore the links among the four facets of impulsivity (urgency, lack of premeditation, lack of perseverance, and sensation seeking) proposed by Whiteside and Lynam (2001) and decision-making processes. Thirty undergraduate students completed a self-report questionnaire evaluating impulsivity as well as a task measuring decision-making processes, the Iowa Gambling Task. Zero-order correlations and multilevel analysis revealed that only lack of premeditation was specifically linked to disadvantageous decisions on the Gambling Task. This suggests that premeditation is related to decision making influenced by somatic (or emotional) markers.

Impulsivity is a key concept in psychopathology and is included in the diagnostic criteria of many disorders (Evenden, 1999). However, research on impulsivity has suffered from a lack of agreement on what constitutes this trait and on the best way to measure it. Whiteside and Lynam (2001) recently clarified the multifaceted nature of impulsivity by identifying four distinct components associated with impulsive behavior: urgency, premeditation (lack of), perseverance (lack of), and sensation seeking. They also developed the UPPS Impulsive Behavior Scale, which assesses these four facets of impulsivity, and which has been derived from a factor analysis of frequently used impulsivity scales (including items of the NEO-PI-R questionnaire considered to be related to impulsivity; Costa and McCrae, 1992). The first dimension of the scale, urgency, "refers to the tendency to experience strong impulses, frequently under conditions of negative affect" (Whiteside and Lynam, 2001, p. 685). The second dimension, premeditation, "refers to the tendency to think and reflect on the consequences of an act before engaging in that act" (p. 685).

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The third dimension, perseverance, "refers to an individual's ability to remain focused on a task that may be boring or difficult" (p. 685). Finally, sensation seeking "incorporates 2 aspects: 1) a tendency to enjoy and pursue activities that are exciting and 2) an open- ness to trying new experiences that may or may not be dangerous" (p. 686). Recently, Miller et al. (2003) observed specific relations between the four impulsivity-related traits and a number of psychological disorders and problematic behaviors, suggesting that the UPPS model offers a useful way of understanding forms of psychopathology considered to be characterized by some form of impulsivity.

Nevertheless, the specific psychological (and brain) mechanisms involved in the four facets of impulsivity re- main, to a large degree, an open question. This study constitutes a first step in relating the facets of impulsivity with specific cognitive and affective processes. More specifically, our objective is to explore the psychological processes related to one of the impulsivity components, premeditation. We propose that premeditation may correspond to the decision-making processes, influenced by somatic (or emotional) markers, which can be measured by the Gambling Task (Bechara et al, 1994). The Gambling Task simulates real-life decision making in the way it factors uncertainty of premises and outcomes as well as reward and punishment. The participants were given play money and had to make a series of card selections out of four decks, with the goal of maximizing profit. Two decks resulted in large gains but were disadvantageous in the long run because the costs were higher, whereas two other decks resulted in smaller gains but were advantageous in the long run because the costs were lower. Anatomically, a deficit in decision making as explored by the Gambling Task (the persistence of disadvantageous choices) can arise from a dysfunction in the anterior ventromedial prefrontal cortex (Bechara et al., 1998). This deficit has been interpreted as the consequence of insensitivity to future consequences, positive or negative.

The present study was designed to examine the relationship between the four aspects of impulsivity, as measured by the UPPS Scale, and the decision-making processes, as assessed by the Iowa Gambling Task. More precisely, our hypothesis was that lack of premeditation would be specifically related to disadvantageous decisions on the Gambling Task.

METHODS

The participants were 30 undergraduate students (15 women and 15 men) aged between 19 to 31 years and enrolled at the University of Geneva. All participants gave their informed consent. The mean age was 23.30 years, and *SD* was 2.56.

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All subjects completed a French version of the UPPS Impulsive Behavior Scale, translated from Whiteside and Lynam (2001). This French version was shown to have good psychometric properties according to a confirmatory factor analysis made in a community sample of adults (Van der Linden et al., In press). The scale consists of 45 items evaluating four different facets of impulsivity, labeled urgency (12 items), (lack of) premeditation (11 items), (lack of) perseverance (10 items), and sensation seeking (12 items). Items of the scale are scored from 1 to 4, with 1 = "I agree strongly," 2 = "I agree somewhat," 3 = "I disagree somewhat," and 4 = "I disagree strongly." Some items were reversed in such a way that a high score reveals an impulsive trait of personality.

Beside the UPPS Impulsivity Scale, subjects completed the computerized version of the Iowa Gambling Task by Bechara et al. (1994). In this task, subjects have to choose one card at a time from four available decks (A', B', C', and D'). The task requires the subject to make 100 choices (100 trials), and in each trial, subjects may win or lose a certain amount of money. The subject's aim is to gain as much money as possible, and the subject starts the task with 2000 US dollars (of fake money) in his account. During the instruction of the game, subjects are told that some decks are more advantageous than others, but they do not know which decks are better. Actually, two of the four decks (A' and B') produce immediate large rewards but even higher punishment at unpredictable points. In the long run, these two decks are disadvantageous. The other two decks (C' and D') produce immediate modest reward, but lower punishment as well. These two decks are advantageous in the long run. To calculate a score that takes into account the evolution of subjects' choices, performance was divided into five blocks, representing five periods of 20-card selection. In each block of 20 cards, the number of cards selected from advantageous decks was calculated (C' + D'). A net score for each block as well as a total score was obtained.

STATISTICAL ANALYSIS

Pearson correlations were used to evaluate the effect of impulsivity on decision making. According to Cohen (1988), a correlation of between .10 and .30 corresponds to a small effect, between .30 and .50 to a medium effect, and above .50 to a large effect. Estimated parameters are reported within the 95% confidence interval (CI). The null hypothesis is tested at $\alpha = .05$.

To see how decisions changed over the trials of the Gambling Task and how they were related to impulsivity, we also computed linear multilevel models (Snijders and Bosker, 1999). When multilevel analysis is applied to repeated measures, it allows one to test changes over time on an individual basis. Unlike regression models that only calculate coefficients for an entire sample (called *fixed effects*), multi-level analyses also calculate coefficients for each participant (called *random effects*). This means that the initial level of the outcome at the first measure (the intercept) and the degree of change over repeated measures (the slope) can be different for each subject. These differences are expressed with the *SD* of the intercept and the slope. Multilevel analyses

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were computed with the "lme" function of the R Project for Statistical Computing (http://www.r-project.org, nlme package). Models were fitted by maximizing the restricted log-likelihood (REML method).

RESULTS

CORRELATIONS

The Cronbach α of the UPPS Scale was .88 for urgency, .85 for premeditation, .82 for perseverance, and .85 for sensation seeking. These values correspond to a very good internal consistency. Gender differences regarding the four dimensions of impulsivity were nonsignificant. The effect of age could not be evaluated because its distribution was not uniform.

Concerning the Gambling Task, the number of good cards selected was summed over all trials and used as an indicator of advantageous decision making (mean = 57.60; *SD* = 13.35). Gender difference regarding the total number of good cards was nonsignificant.

To assess the relationship between impulsivity as measured by the UPPS and decision making as measured by the gambling task, Pearson correlations between each dimension of the UPPS Scale and the number of cards selected from the good (advantageous) decks were calculated: *r* = .07, *p* = .73 for urgency; *r* = —.39, *p* = .03 for lack of premeditation; r = —.12, *p* = .51 for lack of perseverance; and r = —.24, *p* = .20 for sensation seeking (Table 1). Based on these results, it is concluded that the effect size of lack of premeditation is moderate and statistically significant. The effect sizes of lack of perseverance and sensation seeking are small and nonsignificant. The effect of urgency is negligible.

MULTILEVEL ANALYSIS

To prepare the data for multilevel analysis, the 100 trials of the Gambling Task were divided into five blocks of 20 trials to define the repeated measure. Data from the five blocks were nested by subjects. Block values were set to 0, 1, 2, 3, and 4 so the intercept of the multilevel model corresponds to performance at the first block.

The number of cards selected from the good decks during the Gambling Task was used as the dependent variable. In each block, the subject can select between 0 and 20 good cards. The selection of 10 good cards indicates that the subject has selected the same number of bad and good cards.

We first computed a model with no dependent variable. For a given subject, the choice made in one block is correlated to the choice made in the other blocks, as indicated by the small and significant intraclass correlation of the empty model (.19, F [29, 120] = 2.13; $p <$ .01).

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The block was added to the empty model as a predictor. Results indicated that the progression across the blocks was independent of the performance at the first block. Indeed, when the correlation between the intercept and the slope was removed from the model, this yielded a nonsignificant drop of the model fit (χ^2 [1] = 2.54; p = .11). The correlation between the intercept and the slope was removed to get a more parsimonious model before performing the computation again. The intercept of this latter model indicated that subjects chose about nine good cards during the first block (γ=9.13; t [119] = 16.39; p < .01; CI = 8.02, 10.23). The CI around the intercept was about two good cards. From one block to the other, there was an increase in approximately one good card (γ = 1.20; t [119] = 4.93; p < .01; CI = 0.72, 1.68), which indicated that there was a learning process. The CI around the block effect was approximately one good card.

Table 1 *- Pearson Correlations Between the UPPS Scales and the Number of Good Cards Selected at the Gambling Task*

UPPS scale	Correlations	*df*	*t*	*p*	Lower	Upper
Urgency	.07	28	.0.35	.73	—.30	.42
Lack of premeditation	—.39*	28	—2.27	.03	—.66	—.04
Lack of perseverance	—.12	28	—0.66	.51	—.46	.25
Sensation seeking	—.24	28	—1.31	.20	—.55	.13

*p < .05.

Subjects showed a comparable performance during the first block because when the *SD* of the intercept, ν= 1.34, was removed from the model, it yielded a nonsignificant drop of the fit (χ^2 [1]= 1.03; p = .31; CI = 0.46, 3.91). The *SD* of the slope was also nonsignificant (ν = 0.72; χ^2 [1] = 2.81; p = .09; CI = 0.36, 1.45).

To see how impulsivity was related to decision making, the total score on one dimension of the UPPS Scale was added after the block. Results are first presented for lack of premeditation because the correlation with decision making was the greatest compared with the other three aspects of impulsivity (Table 1). The premeditation (lack of) by block interaction was added after the block in a multilevel model. The correlation between the intercept and the slope was not included because it was not significant. The learning process was observed again (γ = 1.20; t [118] = 5.76; p < .01; CI= 0.79, 1.61). Concerning the effect of impulsivity, results showed that subjects

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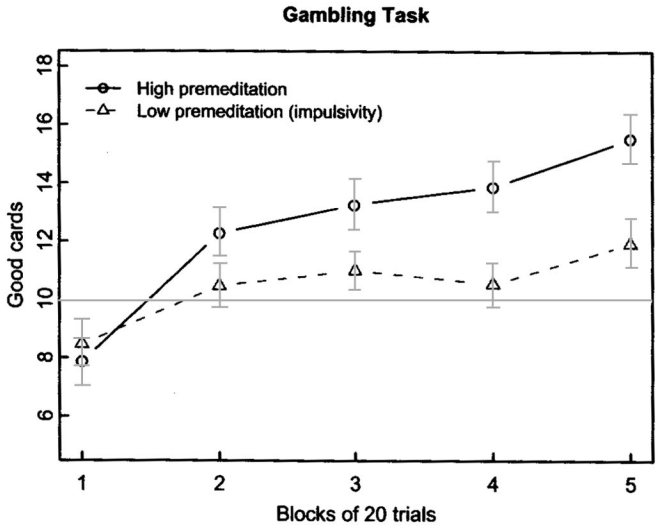
with low score of premeditation (impulsive subjects) learned more slowly to choose the good cards (Fig. 1). This was confirmed by the negative value of the interaction premeditation (lack of) by block ($\hat{\gamma}$ = —0.13; t [118] =—3.65; p < .01; CI = —0.20, —0.06), a value that was significant.

As a follow-up, the lack of premeditation in the previous model was replaced by another dimension of impulsivity. Results indicated that the urgency by block interaction effect was not significant ($\hat{\gamma}$ = 0.00; t [118] = 0.08; p = .93; CI = —0.06, 0.06). In another model, the perseverance (lack of) by block interaction effect was not significant ($\hat{\gamma}$ = —0.02; t [118] = —0.44; p = .66; CI = —0.11, 0.07). In the last model, the sensation seeking by block interaction effect was also not significant ($\hat{\gamma}$ = —0.04; t [118] = —1.35; p = .18; CI = —0.10, 0.02). Thus, the lack of premeditation was the aspect of impulsivity having the most important relationship to decision making: subjects with a low premeditation score learned more slowly to choose from the good decks during the Gambling Task.

FIGURE 1. *Number of good cards selected at the Gambling Task (mean and SE) in function of the block and the score of premeditation (median split).*



DISCUSSION

The purpose of this study was to explore the links between various dimensions of impulsivity and decision making. The results show that lack of premeditation is the impulsivity facet that is most related to decision-making performance on the Iowa Gambling Task, an effect that was of

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moderate size and statistically significant. An analysis across trials further indicates that all subjects made comparable decisions at the beginning of the task, independent of their premeditation score. However, subjects with a lower premeditation score learned more slowly to choose from the advantageous decks. Learning to choose advantageously in this task was not significantly related to any other dimension of impulsivity as assessed by the UPPS Scale. In sum, lack of premeditation seems to be the only facet of impulsivity related to decision-making processes influenced by somatic (or emotional) markers as assessed by the Iowa Gambling Task.

It should be noted that other cognitive tasks, such as the delay discounting task (Petry, 2002) or the Cambridge Gambler task (Rahman et al., 2001; Rogers et al., 1999) appear to tax more or less the same decision making function mediated by the anterior ventromedial prefrontal cortex and assessed by the Iowa Gambling Task. Thus, an intriguing question is whether the premeditation facet of impulsivity would relate to scores from delayed discounting tasks as well as the Cambridge Gambler task.

More generally, our study suggests that it would be useful to explore systematically the relationships between other impulsivity facets and specific cognitive/affective mechanisms by means of adequate tasks.

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