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RESEARCH REPORT

Impulsivity predicts problem gambling in low SES adolescent males

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Abstract

Aims. *This study investigated whether impulsivity measured in 12–14-year-olds could predict problem gambling in late adolescence, above and beyond other personality factors such as aggressiveness and anxiety.* **Design**. *A prospective-longitudinal design was used, thus overcoming limitations of past studies which used concurrent or retrospective designs.* **Participants and measurements**. *The sample included 154 boys living in economically deprived neighborhoods. Impulsivity measures comprised self-reports, teacher ratings and laboratory tasks, and were administered during early adolescence. Gambling behavior was assessed at age 17 using a self-report measure. Early gambling behavior and socio-demographic information were also collected for control purposes.* **Findings**. *Results revealed that a self-report measure of impulsiveness and a card-sorting task significantly predicted problem gambling, even after controlling for socio-demographic variables, early gambling behavior and other personality variables such as aggressiveness and anxiety. Moreover, the predictive link held across all levels of aggressiveness and anxiety. Both impulsivity measures seemed to tap an inability to foresee negative consequences and an inability to stop responding despite unfavorable contingencies.* **Conclusion**. *These findings suggest that disinhibited individuals with response modulation deficits are at risk for problem gambling, thus supporting the DSM-IV classification of pathological gambling as an impulse control deficit.*

Introduction

Gambling for money is a popular activity among adolescents. Between 40% and 80% of adolescents admit that they have gambled in the past year, with the percentage depending on age of respondents, type of gambling activity and socio-geographic factors (Jacobs, 1989). These rates are roughly equivalent in the United States, European countries and Canada (Lesieur & Klein, 1987; Ladouceur & Mireault, 1988; Fisher, 1993). Between one-third and one-half of adolescents gamble weekly or more often (Lesieur & Klein, 1987; Ladouceur & Mireault, 1988; Gupta, Derevensky & Della Cioppa, 1994). When using DSM criteria, between 4% and 7% of adolescents manifest gambling problems (Lesieur & Rosenthal, 1991; Ladouceur, Dubé & Bujold, 1994; Jacobs, 1989; Fisher, 1993).

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These adolescents manifest additional problems varying from school truancy to stealing in order to finance their gambling.

The American Psychiatric Association classified pathological gambling in DSM-III (APA, 1980) and DSM-IV (APA, 1994) as a disorder of impulse control. In adults, pathological gambling is characterized by four behavioral attributes that parallel the DSM-IV criteria for pathological gambling (Rosenthal, 1989). The first is perseverance. Pathological gamblers will not quit if they are winning, nor will they quit if they are losing. Consequently, they will wager for longer periods, bet more than expected, and keep increasing the size of their bets. Given that the odds are against them in most gambling activities, pathological gamblers lose more by playing more. The second attribute, intolerance of losing, is the inability to accept failure. Because of this, pathological gamblers are always trying to win back what has been lost. Pathological gamblers feel an urgency to resume playing in order to regain their lost money immediately. Lesieur (1984) described this as "chasing". The third attribute is disregard for consequences. Pathological gamblers are so preoccupied with gambling that they borrow money under false pretences, commit illegal acts or jeopardize their families and social lives in order to gamble. The fourth and final attribute is preoccupation with gambling activities. For the most part, the gamblers' thoughts are about gambling.

The attributes of pathological gambling can be viewed as manifestations of impulsive behaviors. Indeed, impulsivity can be reduced to four basic elements: (a) excessive sensitivity to potential reward and desire for immediate reinforcement, (b) tendency to respond impetuously without forethought about negative consequences, (c) excessive insensitivity to threatened punishment (or non-reward) and (d) deficits in inhibitory control that keep the person responding despite the risk of negative consequences (Buss & Plomin, 1975; Eysenck & Eysenck, 1977; Barratt & Patton, 1983; Carlton & Manowitz, 1987; Gray *et al.*, 1983; White *et al.*, 1994). Schachar and colleagues (Schachar & Logan, 1990; Schachar & Wachsmuth, 1991) define impulsivity as a deficit in inhibitory control. They devised a task that assesses children's ability to inhibit a well-established response pattern when presented with a stop signal. Other theorists, however, hold views congruent with other aspects of Gray's theoretical model (Gray *et al.*, 1983). Sonuga-Barke and colleagues (Sonuga-Barke & Taylor, 1992; Sonuga-Barke *et al.*, 1992), for example, conceptualize impulsive behavior in children not as an inability to inhibit action but as an inability to delay gratification because of the aversive nature of waiting. They predict that impulsive children will prefer an immediate small reward at the expense of a delayed larger reward and consequently designed a task to assess this propensity.

At the conceptual level, these elements of impulsivity seem to correspond to the characteristics of pathological gambling described by Rosenthal (1989). For example, perseverance, the gamblers' unwillingness to quit if they are either winning or losing, suggests a deficit in inhibitory control that keeps the person responding in the face of (positive or negative) consequences. Impulsive individuals ignore cues for punishment (or do not take time to think about them) and fail to stop responding even when it becomes unlikely that they will be reinforced. Additionally, chasing, the gambler's attempt to immediately win back what has been lost, encompasses an excessive sensitivity to promised reward and a desire for immediate reinforcement. Regardless of consequences, the gambler's shortsighted willingness to do whatever it takes to secure gambling money reveals a lack of forethought about negative consequences. This may also be related to excessive sensitivity to reward and excessive insensitivity to non-reward or punishment. Finally, preoccupation, the gambler's continual thinking about gambling, may also be related to lack of forethought because of an exclusive focus on immediate action and immediate contingencies for reinforcement. Wilson & Herrnstein (1985) also suggested that a "present orientation", an inability to foresee and plan for the future, characterizes impulsive behavior.

Empirical confirmation of a relationship between problem gambling and impulsivity would support the American Psychiatric Association's classification of pathological gambling in the DSM-III (APA, 1980) and the DSM-IV (APA, 1994) as a disorder of impulse control. If, in addition, impulsive behaviors are predictively related to problem gambling, then a developmental model in which impulse control deficits are a predisposing (although not a sufficient) factor for pathological gambling can be proposed.

Pathological gamblers have already been found to be highly distractible and to have poor impulse control (Lacey & Evans, 1986; Carlton & Goldstein, 1987; Carlton & Manowitz, 1987; Carlton & Manowitz, 1992; Rugle & Melamed, 1993; Castellani & Rugle, 1995). Pathological gamblers reported more childhood behaviors indicative of attention deficit, hyperactivity and impulsivity than matched controls. Pathological gamblers also scored lower than controls on an ego-control scale measuring ability to moderate impulses and inhibit action when it was adaptive to do so (McCormick *et al.*, 1987). Pathological gamblers also view achievement through sustained effort and delayed gratification as less interesting than immediate gratification and success (Taber *et al.*, 1986).

Overall, the literature suggests that impulsivity is a dispositional attribute of gambling. However, some exceptions exist. For example, Allcock & Grace (1988) found that pathological gamblers were indistinguishable from normal individuals on the Barratt Impulsivity Scale. Moreover, most of studies that reported a link between impulsivity and pathological or problem gambling suffered important methodological problems. Most of studies have used gamblers who were entering into or already in treatment, and the number of subjects were often very small. In addition, almost all studies used cross-sectional designs, which are limited for establishing the direction of any possible relationship, between personal predispositions and gambling. Consequently, the persistence of gambling behavior (i.e. progression or chasing) might not result from personality characteristics such as impulsivity at all. Instead, persistence might be due to partial reinforcement of past gambling behavior, which would render the behavior very resistant to extinction. Three studies departed from the cross-sectional design (Carlton & Goldstein, 1987; Carlton & Manowitz, 1992; Rugle & Melamed, 1993) by using a longitudinal, yet retrospective, approach. As previously mentioned, these authors found that problem gamblers had poor impulse control. Despite the merits of these studies, distortion and memory problems frequently limit the utility of retrospective reports. Moreover, these studies failed to distinguish between different dimensions of impulsivity. Finally, all of these studies used adult samples. Adolescent samples, assessed prior to the onset of pathological gambling, may be more appropriate to study predisposing personality factors. As such, it remains unknown whether impulse control problems precede gambling in problem gamblers and, if so, which aspects of impulsivity are most distinctive. If this is found to be so, more about the personality precursors of gambling will be known.

Other personality variables, some of which are correlated with impulsivity, have been found to predict problem gambling in adolescents. For example, Vitaro *et al.* (1996) reported that aggressiveness and low anxiety during childhood, which these authors related to dishinibition, distinguished problem gamblers from non-gamblers during adolescence. These measures are correlated with impulsivity, as shown by Loeber (1988) and Moffitt (1993). Consequently, to ensure that any relationship between impulsivity and problem gambling is not spurious, it is important to control for these personality variables in a study intended to verify the predictive relationship between impulse control deficits and problem gambling. Moreover, it is important to verify if impulsivity predicts problem gambling across the various levels of these other personality factors. It is indeed possible that impulsivity might predict problem gambling only for aggressive or non-anxious but not for non-aggressive or anxious individuals. Similarly, it is important to demonstrate that impulsivity predicts problem gambling across all levels of SES as well as for children who were already involved in early gambling (i.e. early onset gamblers). The above relationships would establish the generalizability of impulsivity as a predictor of problem gambling.

The first objective of the present study was to predict problem gambling assessed at age 17 using impulsivity measures collected at 13 and 14 years of age, above and beyond other personality factors such as aggressiveness and anxiety and across different levels of these other personality factors. Impulsivity measures included teacher ratings, self-reports and two laboratory tasks, one delay-of-gratification task and one card-playing task. The use of several measures of impulsivity is required given their low inter-correlations, possibly because different measures tap into different dimensions of impulsivity (Milich & Kramer, 1983; Schachar & Wachsmuth, 1991; Sonuga-Barke & Taylor, 1992; White *et al.*, 1994). Finally, because pathological gambling is more prevalent in males than females, especially

during adolescence, only males were studied (Lesieur & Klein, 1987; Ladouceur *et al.*, 1994). SES and early gambling behavior were also included as control/moderator variables.

Method

Sample and data collection

Participants were part of an ongoing longitudinal study started with 1034 kindergarten boys (Tremblay *et al.*, 1994). Boys were French-speaking Caucasians who came from disadvantaged neighborhoods in Montreal, Canada. They were selected from the original sample based on their physically aggressive and anxiety behaviors as reported by teachers using the Social Behaviour Questionnaire (SBQ; Tremblay *et al.*, 1987, 1991) at ages 6, 10, 11 and 12. Briefly, the boys were classified as stable aggressive if they were above the 70th percentile at age 6 and at least one other time between ages 10 and 12. They were considered non-aggressive if they were below the 70th percentile. The boys were also classified on the basis of their anxious or non-anxious behaviors, using an averaged score across the same 4 years and a cut-off point at the 70th percentile. A subsample of 333 boys met these criteria and they were invited to come at the university laboratory at age 13. Two hundred and three participants came the first year at age 13 and 177 of them returned the second year when they were 14 years old. Gambling data were collected on 168 of these boys at 17 years of age. These latter participants constitute the sample for the present study.

Self-reports of impulsiveness were collected when the boys were 13 and 14 years old, whereas teacher ratings of impulsivity were collected when the boys were 12 and 13 years old. All measures were administered in the spring near the end of the school year. Scores averaged across both years were used in the following analyses because they are more representative than 1-year scores. If data for both years were not available, data for 1 year were used, thereby reducing attrition of participants. (Data over the 2 years were available for 80% of the subjects.) Parents provided socio-family information, which was used for control purposes. This information pertained to parental occupation.

Instruments

Gambling. A French version of the South Oaks Gambling Screen for adolescents (SOGS-RA, Winters, Stinchfield & Fulkerson, 1993) was used to assess gambling behavior and gambling-related problems. The SOGS-RA assesses gambling severity over the past 12 months, using 12 items that are similar to those in the SOGS (Lesieur & Blume, 1987) and which are relevant to the DSM-IV criteria for pathological gambling. Each item could be answered yes (scored 1) or no (scored 0). Higher scores indicate more problems. The frequency and diversity of gambling over the life-time and the past 12 months were also assessed using the SOGS-RA. Diversity refers to the number of different gambling activities reported and was based on 11 different activities. For each activity, respondents indicated whether they had never (scored 0) or at least once (scored 1) participated in it over their life-time and whether they had never (scored 0), less than monthly (scored 1), monthly (scored 2), weekly (scored 3) or daily (scored 4) participated in it over the past 12 months. Winters *et al.* (1993) reported good internal consistency and validity for the problem severity scale of the SOGS-RA among 1101 15–18-year-old respondents.

Problem gamblers were classified using a combination of scores from the problem severity and from the frequency/diversity scales. Hence, problem gamblers scored 1 or more on the problem severity scale and had a score of 3 or 4 with respect to one or more of the 11 gambling activities, indicating that they gambled at least weekly or daily for one or more activities over the past 12 months ($n = 25$). Fifteen participants in the problem gambler group had a score of 3 or more on the problem severity scale, which corresponds to the cut-off recommended by Winters *et al.* (1993) to identify problem gamblers. This cut-off could not be used here, however, because it would have produced a group with too few participants. The other participants who scored 0 on the problem severity scale were included in the non-problem gambler group (i.e. non-gambler group; $n = 143$).

Data were also available about participants' gambling behavior when they were aged 13 years. At this age, the following question was used: "How often did you gamble for money with people who are not family members over the past 12 months?" Possible responses were: never, a few times, often, very often. As indicated earlier, gambling behavior is already pre-

sent by early adolescence. Hence, it seemed necessary to control for possible early gambling behavior in order to assess the "pure" predictive power of impulsivity measures collected during the same period.

Self-reported impulsivity. Self-reported impulsivity was assessed at ages 13 and 14 using a French translation of the Eysenck Impulsiveness scale (Eysenck & Eysenck, 1978; Eysenck, Easting & Pearsons, 1984).

The original scales contain 23 impulsiveness items and 23 venturesomeness items. In the present study, we used the five impulsiveness items that had the highest factor loadings on the original scales (Eysenck & Eysenck, 1978; Eysenck *et al.*, 1984). These five impulsiveness items were: (a) "Do you generally do and say things without stopping to think?", (b) "Do you often get into trouble because you do things without thinking?", (c) "Are you an impulsive person?", (d) "Do you usually think carefully before doing anything?" and (e) "Do you mostly speak before thinking things out?"

Internal consistencies for the original scale vary from 0.74 with pre-adolescent boys to 0.85 with young adult males (Eysenck & Eysenck, 1978; Eysenck *et al.*, 1984). In the present study, internal consistencies for the five-item impulsiveness scale were 0.69 and 0.71 at ages 13 and 14, respectively.

Teacher-rated impulsivity. Teachers rated boys' impulsive behaviors at ages 12 and 13 years using three items from the Social Behavior Questionnaire (Tremblay *et al.*, 1987, 1991). These items were: (a) "Jumps from one activity to another without finishing", (b) "Attracts attention by shouting" and (c) "Acts without reasoning". Items were scored 0, 1 or 2, with higher numbers meaning they were more applicable to the boy being rated. The internal consistency alphas were 0.72 at age 12 and 0.71 at age 13.

Card-playing task. The card-playing task (Newman, Patterson & Kosson, 1987) was administered to boys individually at the university laboratory when they were 14 years old. This computer-controlled task is programmed to display playing cards, one at a time, each time that a subject presses a button until either (a) a subject presses a second button to quit the game or (b) 100 cards have been played. Each time that the subject "plays" a face card, the computer displayed the message "You win" and participants were given 5 cents. Each time that a number card (i.e. 2–10) appeared, the message "You lose" appeared and 5 cents were taken away. Participants began the task with 50 cents or 10 5-cent pieces.

The card-playing task was designed to measure "response perseveration" or the tendency to persist in making previously rewarded responses that have become maladaptive (i.e. punished). The 100 cards are arranged in a preprogrammed order so that playing cards is highly rewarded (i.e. 90%) initially but becomes less rewarding with each block of 10 cards. Paralleling the decrease in rewards, the rate of punishment increases by 10% with each block of 10 trials until the final block in which the probability of a face card is 0 and the probability of a number card is 100%. The number of trials played before stopping is the subject's score.

Delay-of-gratification task. The delay-of-gratification task is a measure of self-control or ability to inhibit immediate responding in order to increase the probability of positive reinforcement (Newman, Kosson & Patterson, 1992). This task was administered individually at the university laboratory when boys were 13 years old. During the first 10 trials, participants saw on the left part of a computer screen a red rectangle that was associated with a 40% probability of winning a nickel when they pressed button A. For the next 10 trials, they had to wait 10 seconds before seeing the red rectangle on the right part of the screen. However, for these trials, the probability of winning was set at 80% when participants pressed button B. These 20 training trials served to set the contingencies of reinforcement for immediate or delayed responding. To make sure participants learned the contingencies, the experimenter asked them to count the number of winning trials during each set of 10 training trials. For the 30 test trials, participants were instructed that they could choose between pressing button A in response to the immediate red rectangle on the left or waiting and pressing button B in response to the delayed red rectangle on the right which would bring a more desirable outcome. The experimenter gave participants a nickel after each winning trial. The number of responses to the immediate red rectangle served

as the measure of immediate (or non-delayed) responding.

Socio-demographic information. When the boys were 13, 14 and 17 years of age, mothers completed a questionnaire regarding occupations of either parents, or the parent with whom child was living. Parental occupation was scored on a continuous scale using the Blishen Carroll & Moore (1987) occupational prestige scale.

Results

Socio-demographic variables

Parents' occupational prestige scores were correlated to the SOGS-RA problem severity score to see whether it was necessary to include them as control variables in the following analyses. Each parent's scores (or one parent's only for single-parent families) were averaged over all years for which data were available. Pearson's product correlations revealed significant associations between paternal and maternal prestige and SOGS-RA scores, $rs = -0.15$, $p < 0.05$ and -0.19, $p < 0.01$, respectively. Consequently, it was necessary to control for these variables in the following analyses. However, because of the high correlation between paternal and maternal prestige ($r = 0.62$), only maternal prestige was included.

Dichotomizing the predictors and relationships among them

Like the gambling measure, the predictors (i.e. the four impulsivity measures) were not normally distributed. Following the example of Mezzacappa *et al.* (1997), it was decided to dichotomize them using the 70th percentile. This cut-off produced sufficient numbers in the cells for the following analysis (see Table 1). The 70th percentile on the card-playing task corresponded to 99, which was close to the maximum of 100 cards participants could play. Hence, those who quit before the end of the deck of cards were distinguished from those who perseverated until the end. The 70th percentile for the delay of gratification task corresponded to a score of 66.7 (minimum 0, maximum 100). For the Eysenck impulsiveness scale, the 70th percentile was equal to a score of 2 (minimum 0, maximum 5). Finally, the 70th percentile corresponded to a score of 1.5 on the teacher-rated impulsivity scale (minimum 0, maximum 5.5).

As already mentioned, participants were recruited on the basis of their aggressiveness and anxiety scores. These scores also were dichotomized using the 70th percentile, which proved a valid cut-off in other studies (Kerr *et al.*, 1997; Tremblay *et al.*, 1994). The aggressive participants had a score equal or higher to 1.5 on the physical aggressiveness scale (minimum 0, maximum 3). Those who were anxious received a score equal or superior to 3 on the anxiety scale (minimum 0, maximum 6). These cut-off scores correspond to the 80th and the 85th percentile for a nation-wide representative sample of 1000 boys assessed at the same ages using the same instruments.

The other two control variables (i.e. maternal occupational prestige and early gambling) were also dichotomized. Given that the whole sample was from a low SES neighborhood, a median split was used on maternal prestige. The value associated with the median was 33.6. Comparatively, the median score for maternal occupational prestige in a nationwide representative sample was 40.28. Finally, those who never or sometimes gambled at age 13 where distinguished from those who gambled often (and who represented 29.5% of the sample).

A series of cross-tabs served to verify which predictors were related. Anxious group membership was related to age 13 gambling, $\chi^2(1) = 8.16$, $p < 0.01$. Fewer anxious children reported gambling at age 13 (i.e. 14.5%) than non-anxious counterparts (i.e. 35.2%). In addition, aggressive group membership and anxious group membership were highly related, $\chi^2(1) = 5.91$, $p < 0.01$, but each cell still contained at least 20 participants.

Predicting age 17 problem gambling from individual impulsivity measures

The next step was to use logistic regression to test if each impulsivity measure individually predicted problem gambling assessed at age 17 after controlling for all covariates. Interaction terms between the impulsivity measures and each covariate (i.e. maternal occupational prestige, early gambling, aggressive group membership and anxious group membership) were also added to see whether impulsivity predicted problem gambling at all levels of the covariates.

Table 1. *Results of logistic regressions using each impulsivity measure separately to predict gambler group membership while considering control variables and interaction terms*

Variables	B	Wald	Odds ratio	*p*-value
Control variables (parameters are calculated before the entry of the impulsivity measures)				
Maternal occupational prestige[1] (low: $n = 82$; high: $n = 86$)	1.02	4.45	2.77	0.04
Age 13 gambling[2] (low: $n = 120$; high: $n = 48$)	1.24	7.42	3.66	0.006
Aggressive group member[1] (low: $n = 120$; high: $n = 48$)	− 0.35	0.43	0.70	0.51
Anxious group member[1] (low: $n = 123$; high: $n = 45$)	− 0.32	0.26	0.73	0.61
Impulsivity measures[3] (considered separately)				
Card playing[1] (low: $n = 119$; high: $n = 49$)	1.02	4.59	2.77	0.03
Teacher-rated impulsivity[1] (low: $n = 114$; high: $n = 54$)	0.27	0.27	1.31	0.60
Eysenck impulsivity (low: $n = 107$; high: $n = 61$)	1.69	11.60	5.42	0.001
Delay of gratification (low: $n = 64$; high: $n = 104$)	0.67	1.82	1.95	0.18
Interaction terms[4] (for all interaction terms, $p > 0.32$)				

[1]Below the cut-off served as the reference group. [2]The never gambled group served as the reference group. [3]Every impulsivity measure was considered separately after having included the control variables. [4]Interaction terms were computed between each impulsivity measure and each control variable. Since no interaction terms were significant, they were not reported in the Table.

As can be seen in Table 1, children who were involved in gambling activities at age 13 were significantly more at risk of belonging to the problem gambler group than the ones who were not involved in such activities. Similarly, boys whose mothers were below the median on maternal occupational prestige were significantly more at risk of belonging to the problem gambler group than the others. Belonging to the aggressive or anxious group, however, did not predict who would become problem gamblers and who would not. Two of the impulsivity measures also significantly and separately predicted membership in the problem gambler group. These measures were the card-playing task and the Eysenck impulsivity self-rated scale. Children who persevered more on the card-playing task and those who were high on the Eysenck scale were more at risk of becoming gamblers than the others. Children who were high on the delay of gratification task were also twice more at risk of belonging to the problem gambler group but this result was not statistically significant. Finally, teacher-rated impulsivity did not contribute at all in predicting problem gambler group membership. The predictive contribution of the impulsivity measures did not depend on the level of mothers' occupational prestige or the level of children's aggressiveness, anxiety or previous gambling behavior given that no interaction term was significant.

Predicting problem gambling from a combination of impulsivity measures

A hierarchical logistic regression was performed next to predict problem gambler group membership from the two impulsivity measures that were found to predict individually in the previous analysis. The same four control variables were included at the first step. As found previously and as shown in Table 2, being involved in gambling activities and having a mother who scored below the median on maternal occupational prestige significantly increased the risk of belonging to the problem gambler group by late adolescence (model χ^2 (2) = 8.59, $p < 0.01$; goodness of fit$_{(162)}$ = 152.18, $p = 0.75$).

Inclusion of the anxious and aggressive group memberships at the second step did not contribute significantly in predicting problem gambling, $p = 0.63$. Finally, the two impulsivity measures, entered in a stepwise manner at two consecutive steps, each contributed to predict problem gambling. The Eysenck impulsivity measure improved significantly the prediction of problem gambling (− 2 log likelihood = 116.52, $p = 0.997$; improvement = 11.92, $p < 0.01$; goodness of fit$_{(162)}$ = 131.93, $p = 0.91$). Boys who were high on the Eysenck impulsivity measure (i.e. above the 70th percentile) were six times more at risk of becoming problem gamblers than those who were low (i.e. below the 70th percentile). Addition of the card-playing variable im-

Table 2. *Results of the hierarchical logistic regression using impulsivity measures to predict SOGS-RA scores after controlling for maternal occupational prestige, teacher ratings and age 13 gambling*

Step	Measures	B	Wald	Odds ratio	*p*
1	Maternal occup. prestige	1.46	7.15	4.33	0.01
	Age 13 gambling	1.34	6.48	3.81	0.01
2	Aggressive group member	−0.89	2.39	0.41	0.12
	Anxious group member	−0.21	0.10	0.81	0.75
3	Eysenck impulsiveness scale	1.81	11.08	6.10	0.001
4	Number of cards	1.15	4.99	3.15	0.03

[1]These parameters were obtained at the last step of the analysis.

proved even further the prediction of problem gambling (−2 log likelihood = 113.47, $p = 0.999$; model improvement = 5.06, $p < 0.05$; goodness of fit$_{(161)}$ = 124.99, $p = 0.98$) suggesting that card-playing and Eysenck impulsivity scores had an additive contribution in the prediction of problem gamblers. Being high on card-playing (i.e. above the 70th percentile) increased the risk of becoming problem gambler by three times, above and beyond the risk attributable to the Eysenck impulsivity score and the control variables. Together, being high on both impulsivity measures increased the risk of becoming problem gambler by a factor of more than 18 (i.e. 6.1×3.1). Given the non-significant findings of the interaction terms in the previous analysis, it was considered unnecessary to re-assess whether maternal occupational prestige, previous gambling status or previous behavioral profile (i.e. aggressive or anxious) moderated the risk for impulsive children to become problem gamblers.

Discussion

The objective of the present study was to predict problem gambling by late adolescence based on impulsivity measures collected during early adolescence. A related goal was to verify if the predictive link between impulsivity measures, if any, depended on SES factors, early involvement in gambling activities or personality factors such as an aggressive or an anxious behavior profile. Results indicated that, beyond the effect of maternal occupational prestige, gambling during early adolescence, aggressiveness and anxiety at age 12, two impulsivity measures additively predicted problem gambling at age 17. These measures were the Eysenck self-rated impulsivity scale and the card-playing task. These measures seem to tap the non-anticipation and/or insensitivity to the possible or actual negative consequences of one's behavior (although some authors suggested they reflect different dimensions of impulsivity, i.e. the cognitive and the behavioral dimensions according to White *et al.*, 1994). In addition, present results showed that the increased risk for impulsive early adolescents to become problem gamblers by late adolescence did not depend either on socio-family factors or on previous gambling or personality factors.

The finding that teacher-rated impulsivity and the delay of gratification task did not predict problem gambling calls for a tentative explanation. The aspect of impulsivity that these measures represent (i.e. the inability to postpone gratification) might not be related to gambling. Given the long reinforcement schedules to which gamblers are submitted, it would indeed suggest that they are no different from non-gamblers in their ability to delay gratification, at least temporarily. In that respect, present findings contradict results reported by Taber *et al.* (1986) indicating that gamblers lack delay of gratification and capability for sustained effort more than non-gamblers. Differences in participants' characteristics may explain the seemingly contradictory results between the two studies: adults in treatment in the Taber *et al.* study and adolescents from a community sample in the present study. In addition, Taber *et al.* (1986) looked at concurrent links between delay of gratification and problem gambling whereas we assessed predictive links over a period of 5 years. Finally, it must be noted that the individual contributions of the delay-of-gratification measure, although non-significant, was nevertheless in the expected direction despite the control for previous variables such as age 13 gambling behavior. Without such controls or with a larger sample, it is possible

that this measure could have contributed to the prediction model.

The present results support earlier findings that individuals who show problem gambling manifest impulse control deficits or had manifested such deficits during their childhoods (Carlton & Goldstein, 1987; McCormick *et al.*, 1987; Carlton & Manowitz, 1992). More specifically, present results support the view that problem gamblers have response modulation deficits as defined by Newman & Wallace (1993). That is, gamblers ignore (or do not foresee) negative cues from their environment and consequently do not alter their ongoing behavior. Those deficits are associated with self-regulation problems and reflect a deficit in the reallocation of attentional resources to new environmental stimuli. They also represent a difficulty to adjust ongoing behavior once a dominant response set is established given that the individual is unable to evaluate the appropriateness of this behavior in the face of changing reinforcement contingencies. These speculations are supported by the fact that card-playing and Eysenck's impulsivity scale rather than teacher-rated impulsivity and delay of gratification predicted problem gambling. As argued previously, both measures reflect disinhibited behaviors which represent a central component of impulsivity. Disinhibited behaviors, as measured by these instruments, seem to emerge from a lack of reflectivity which entail spontaneous acts and poor judgement about when to stop responding (Patterson & Newman, 1993).

Following this assumption, disinhibited individuals would be unable to pause and consider valuable information and/or make associations between certain acts and their consequences before initiating a behavior. This would result in poorly adapted behaviors and thoughtless acts. It is possible to associate this behavioral pattern to Rosenthal's (1989) disregard for consequences. Moreover, disinhibited individuals with response modulation deficits would be less disposed to modify the course of a behavior that is no more adapted because of their difficulty to redirect their attention to new informative stimuli. This process would engender perseveration of inadequate responses which, in turn, can be linked to impulsivity attributes such as progression and chasing. Clearly, those two determinants can explain some salient behaviors of problem gamblers. Following this, problem gambling could possibly be added to the list of disinhibited syndromes.

Altogether, these results are consistent with the DSM-IV (American Psychiatric Association, 1994) classification of pathological gambling as an impulse control deficit. They are also consistent with Rosenthal's (1989) description of the basic personality correlates of pathological gamblers; but these results go a step further. They show that impulse control deficits precede later problem gambling over a period of 5 years during adolescence whereas past studies used concurrent measures of impulsivity and problem gambling or a retrospective design. Moreover, almost all past studies used adult participants, many of whom were in treatment for problem gambling.

Deficits in impulse control and disinhibited behaviors have also been shown to be significant predisposing factors for adolescent substance abuse or delinquency problems (Gorenstein & Newman, 1980; Tremblay *et al.*, 1994; White *et al.*, 1994). Indeed, these problem behaviors correlate substantially with gambling during early adolescence (Vitaro *et al.*, 1996), and may even be stronger during late adolescence and adulthood (McCormick *et al.*, 1984; Lesieur, Blume & Zoppa, 1986; Blaszczynski, McConaghy & Frankova, 1989). In future studies, it would be interesting to verify if impulse control deficits, and more precisely its disinhibited component, can explain the possible links between drug use, problem gambling and delinquency. Limitations of the present study (i.e. socio-economically disadvantaged sample limiting generalization, use of a less severe cut-off on the SOGS-RA to define the problem gamblers than that recommended by Winters *et al.*, 1993) should also be circumvented in future studies.

Despite a possible restricted range on maternal occupational prestige, this variable still contributed in predicting problem gambling, the poorest adolescents being at the greatest risk. Similarly, being involved in gambling activities by age 13 also constituted a risk factor for later problem gambling by age 17. Finally, the findings that aggressiveness and anxiety did not contribute to predict problem gambling contradicts earlier findings (Vitaro *et al.*, 1996) but are explainable by differences in the age and socio-economic characteristics of the samples, the instruments used to assess gambling and the inclusion of control variables in the present

study. Indeed, belonging to the aggressive group was related to problem gambling in bivariate crosstabs. In addition, being aggressive doubled the risk of becoming problem gambler whereas being anxious cut it by half, but not in a statistically significant way. Consequently, present findings do not completely contradict earlier findings. In addition, these results suggest personality measures be controlled for while assessing the predictive power of impulsivity.

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