ARTICLE

Predicting Gambling Behavior in Sixth Grade From Kindergarten Impulsivity

A Tale of Developmental Continuity

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Objective: To examine the relationship between early impulsive behavior, rated by kindergarten teachers, and self-reported gambling in sixth grade.

Design: Prospective longitudinal study.

Setting: The 1999 kindergarten cohort of the Montreal Longitudinal Preschool Study in Canada.

Participants: Written parental consent was obtained for 181 of the 377 children from intact families at kindergarten exclusively selected for follow-up telephone interviews in the fall of sixth grade, 6 years after the initial assessments. Of these, 163 children had complete data in kindergarten (mean age, 5.5 years) and sixth grade (mean age, 11.5 years) for the key variables in the analyses.

Main Outcome Measure: Self-reported gambling behavior in sixth grade.

Results: A 1-unit increase in kindergarten impulsivity corresponded to a 25% increase in later self-reported child involvement in gambling (SE = .02). This was above and beyond potential child- and family-related confounds, including parental gambling.

Conclusions: Our findings offer insight about how the nature and course of early impulsivity might relate to a significantly higher propensity toward involvement in games of chance in later childhood. It is suggested that developmentally continuous risks associated with early impulsivity place individuals on a risk trajectory toward excessive gambling involvement in adolescence and emerging adulthood.

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POLICY CHANGES IN THE LAST century have transformed legalized gambling into a leisure activity. Social norms have progressed from early 20th-century prohibition to outright encouragement, especially given today's user-friendly, available, and seductive advertisement campaigns.[1] Although gambling is considered an adult behavior, adolescents are especially receptive to this trend. In fact, gambling has become so normative that it characterizes typical Western youth.[2]

There are public health risks despite becoming statistically normative by adolescence. More than ever, greater numbers of adolescents and young adults are engaging in at-risk, problematic, and pathological gambling.[3] Problematic gambling in adults is associated with substance use, depression and suicide, psychopathology, poor general health, and a multitude of family, legal, and criminal problems.[1,4,5] Most disconcerting is that young people seem more vulnerable than adults to gambling-related morbidity[2,6] and suicidality.[7]

Data suggest that in most cases, youthful recreational gambling predates pathological gambling in adulthood.[1,2,8,9] A cornerstone question might be, what predates youthful gambling? Much like with other addictions, there is a proneness to dysfunctional behavior that explains the developmental nature of adolescent gambling as a risk behavior and its course from use to abuse.[10] This represents part of a larger group of clinical problems that share common psychosocial underpinnings. This chain of risk factors predicts developmental psychopathology across the life course.

A tale of developmental continuity would need a theoretical latent characteristic that links problems from one childhood period to the next. Impulsivity represents an important diagnostic component of both pathological gambling in adults and attention-deficit/hyperactivity disorder (ADHD) in children.[11] Although most hyperkinetic symptoms are outgrown by adulthood, impulsivity associated with ADHD persists

throughout the life course.[12] Pathological gambling and ADHD not only share impulsivity as a clinical feature[13] but also harbor common risks for long-term impairment in the realm of psychosocial, familial, and occupational dysfunction.[1,14,15] Impulsivity also represents a major risk indicator for suicidal ideation and behavior.[16]

Earlier neuroscience research using cross-sectional[17] and retrospective[18,19] methods with small clinical samples suggests a link between both disorders in adults. This has led to more recent confirmatory evidence of an executive function problem.[20] Unfortunately, the methodological nature of these studies does not inform us about developmental issues. Moreover, laboratory experiments, although very controlled, need to be tested with a wider range of typically developing children found in population-based longitudinal studies.

One such data set with boys has found evidence of a longitudinal link. Impulsivity in early adolescence predicted involvement in gambling, substance use, and delinquency in later adolescence.[21,22] This link has been replicated with impulsivity as a predictor at age 10 years.[23] Although these results harvest better conclusions than in the past, one can never be sure whether the boys' gambling involvement did not overlap with the impulsivity measure (at ages 10, 12, and 14 years), creating a chicken-and-egg problem of which came first. Given that diagnosis of ADHD is often cued by teacher complaints during preschool or early schooling,[12] it is unlikely that impulsivity and gambling are comorbid but rather might be operating in a developmental chain of prediction.

Finding prospective markers of later gambling behavior could facilitate developmental targets for preventive interventions. That is, a more rigorous understanding of developmental continuity of risk-oriented addictive behaviors will better inform the application of timely and effective clinical strategies. Early childhood interventions, often implemented before parenting and child interaction routines have crystallized, promise better long-term economic returns for both the individual and society as a whole.[24-27]

This study uses a prospective longitudinal design to examine the relationship between early impulsivity, rated by kindergarten teachers, and self-reported gambling involvement in sixth grade. Our definition of impulsivity is broad and reflects a lack of inhibitory control and cognitive self-regulation of attention. Of course, any observation of such a link could potentially be explained by other individual and family influences. As such, we tested whether children's early behavior remains predictive of later involvement in gambling activities while accounting for plausible alternative explanations.

METHODS

PARTICIPANTS

Children in this study represent a selected subsample from the Montreal Longitudinal Preschool Study,[28] which comprises several sequential longitudinal cohorts launched from the fall of 1997, 1998, 1999, and 2000. At the launch of each sequential cohort of the Montreal Longitudinal Preschool Study, 4- and 5-year-old children were enrolled in preschool in disadvantaged areas of Montreal, Quebec, Canada. Each sequential cohort represents one-third of its catchment area and was actually selected following a multilevel consent process involving school board administrators, local school committees, and teachers. Once parents gave consent, their children were assessed individually and by the children's teachers. Parents were requested to complete survey materials as well.

In spring 2005, funds were obtained for grafting a small institutional review board–approved gambling involvement research component with the Montreal Longitudinal Preschool Study. The 1999 kindergarten-entry cohort was selected for this purpose (n=467), mainly because children would be in sixth grade in fall 2005. Children from intact families at kindergarten were exclusively selected for follow-up (n=377) given that it was desirable to have information on gambling involvement for both natural parents. A divorce during the course of a longitudinal study of child development often means data loss for 1 parent (usually the father).

Written parental consent was first requested for eligibility to participate in a follow-up study on parent and child gambling involvement. Of these, 181 families remained for the follow-up gambling study. We conducted telephone interviews of parents and children in the fall of sixth grade, 6 years after the initial assessments.

The criteria for the study reported here (n=163; 53.0% boys) required that the participant had complete data in kindergarten (mean age, 5.5 years) and sixth grade (mean age, 11.5 years) for the 2 key variables. Nonretained cases for analyses are attributable to incomplete child (n=6) or parental (n=12) gambling data at follow-up. Although there are socioeconomic differences between the larger Montreal Longitudinal Preschool Study and its subsample intended for study (maternal education is higher for the selected sample, $P=.03$), there are no remarkable differences in sociodemographic, family process, or behavioral characteristics between the subsample intended for study (n=181) and the subsample finally retained for data analysis. Weighted propensity scores were computed to compare participants who were lost to follow-up with those who were not, revealing no significant differences (mean [SD] predicted probability, 0.31 [0.05] for the nonretained group and 0.32 [0.04] for the retained group).

MEASURES

Youth Gambling Behavior as Dependent Variable

The assessment by telephone interview began with a statement about gambling:

> The following questions deal with gambling and money. Gambling is an activity where you bet money or objects of value in order to gain prizes of more money or objects. But, there is also a risk of losing everything. There are no right or wrong answers to these questions; we ask that you answer according to your own personal experience as a kid.

This 5-item scale aims to generate a global construct of child involvement in gambling in the past year.[29] When youngsters were in sixth grade, they were asked, "How many times have you done the following?": cards (14.0% of the sample had participated to some degree); bingo (7.9%); bought lottery, instant lottery (scratch and win), or sports lottery tickets (4.0%); played video games for money or video poker (eg, at arcades) (13.0%); and placed bets at sports venues with friends or on games that require skill (eg, billiards, pool, bowling) (8.0%). Lottery tickets, video poker, and video lottery terminals are considered adult-only venues in the Canadian province of Quebec and are thus illegal if used by youth younger than 18 years. Responses ranged from never (score of 0) to less than once per

Table 1. Basic Child and Family Characteristics of Participants Retained for Analysis

Sociodemographic Variable	Mean (SD)
Family income in 1999, Can$	25 000 (5000)
Family size in 1999, No.	3.89 (1.26)
Maternal age at childbirth, y	25.34 (5.10)
Maternal education, y	12.57 (3.76)
Paternal education, y	12.86 (3.61)
Family functioning scale score in 2005	19.62 (5.01)

month (score of 1), 1 to 3 times per month (score of 2), and once per week or more (score of 3). The total score ranged between 5 and 15 with higher scores indicating greater levels of gambling behavior ($\alpha = .75$; mean [SD] score, 6.4 [1.4]).

Early Impulsive Behavior as Independent Variable

At the beginning of kindergarten, teachers completed the Social Behavior Questionnaire, which comprises a number of factors that assess children's behavioral adjustment. The impulsivity measure in this study combines the inattentive, distractible, and hyperactive factors into one 9-item subscale ($\alpha = .91$): inattentive (2 items: inattentive; does not listen attentively; $\alpha = .81$); distractible (2 items: easily distractible; unable to concentrate; $\alpha = .82$); and hyperactive (5 items: seems agitated and has difficulty staying in one place; keeps moving; seems impulsive; has difficulty waiting his or her turn; has difficulty staying calm; $\alpha = .90$). All of the items are rated on a scale of 1 (often or very true) to 3 (never or not true), reverse scored (except for the negatively worded attentive items), and then summed. A higher value on the scale indicates a higher degree of teacher-reported symptoms associated with ADHD. The Social Behavior Questionnaire represents a reliable estimate of current and later psychosocial and academic adjustment.[30-32] Childhood norms are available from the National Longitudinal Study of Children and Youth.

Covariates

Sex. Given that there are sex differences for both gambling and ADHD,[33-35] we considered this information from official records in our data-analytic strategy.

Maternal Education. Although indicators of socioeconomic status do not seem to play a role in risk for ADHD or gambling, this variable acts as a proxy for a number of often unmeasured endogenous parental characteristics such as economic resources, motivation, perseverance, cognitive stimulation, and achievement orientation in the home environment that are associated with proneness to problem behavior in youth.[10] Parents completed a sociodemographic questionnaire when their children were in kindergarten.

Family Dysfunction. Problems in the home seem to be correlated with both ADHD and gambling.[34,36] When their children were in kindergarten, mothers completed a 12-item scale developed by researchers at Chedoke-McMaster Hospital, McMaster University and used extensively in the National Longitudinal Study of Children and Youth. This scale aims to generate a global construct of family functioning such as problem solving, communication, roles, affective involvement, affective responsiveness, and self-regulation in times of conflict. The unit of analysis for this Likert-response scale is the family and is rated 3 for strongly agree, 2 for agree, 1 for disagree, and 0 for strongly disagree.[37,38] Negatively worded items were reverse scored so that a higher score indicates greater agreement with the statement. The total score varies between 0 and 36 with higher scores indicating greater levels of family dysfunction ($\alpha = .88$).

Parental Gambling Involvement. There is an abundance of research on the intergenerational transmission of problem behaviors,[39] ADHD,[40] and gambling.[41] Interviews began with the following statement:

> Gambling is an activity where we bid money or objects in the intention of winning more money or more objects but where the risk of losing it all is present.

We then assessed a general construct of gambling involvement in the past year for both mothers and fathers using a 4-item scale when their children were in sixth grade. Parents responded to the interview question, "How often have you and your spouse played the following activities?": cards (6.3% of mothers and 8.1% of fathers had participated in the past year); slot machines or video lottery (4.4% of mothers, 3.8% of fathers); lottery (21.9% of mothers, 21.3% of fathers); and casino games (12.5% of mothers, 10.6% of fathers). Responses ranged from never (score of 0) to less than once per month (score of 1), 1 to 3 times per month (score of 2), and once per week or more (score of 3). The items were answered by the mother and then for the respective spouse. Given that the scale addresses both parents, the total score varied between 4 and 24 with higher scores indicating greater levels of parental gambling behavior ($\alpha = .58$).

Emotionally Distressed Behavior. Depressive symptoms and ADHD often coexist,[42] as do depression and gambling.[8] The depressed and anxious scales from the Social Behavior Questionnaire were combined into 1 reliable composite factor ($\alpha = .81$) representing emotional distress manifested in the kindergarten classroom: anxious (3 items: seems worried or fearful; seems anxious; is nervous or tense) and depressed (2 items: seems unhappy, sad, or depressed; cries a lot).

DATA-ANALYTIC STRATEGY

We began by estimating an ordinary least squares regression in which sixth-grade gambling behavior is regressed on kindergarten impulsivity. Our interest was in correctly modeling this linear relationship, which can be interpreted as the effect of early childhood impulsivity on later childhood behaviors that are, in principle, precursors to adolescent gambling involvement. Once we established this link, we had to ensure that we accounted for the possibility of omitted variable bias, which was likely to arise if unobserved family or child characteristics were statistically or substantively correlated with our key variables. To secure an unbiased estimation of the variable, we took into account parental gambling involvement, aiming to approximately account for some genetic and environmental predispositions. The equation also controls for child (sex and early emotionally distressed behavior) and family (maternal education and family dysfunction) factors. Our results bear on this fully controlled model: $CGB_{i6GR} = a_1 + \beta_1 IMP_{iKE} + \beta_2 PG_{i6GR} + \gamma_1 CHILD_{iKE} + \gamma_2 FAMILY_{iKE} + e_{it}$, where a and e represent the intercept and stochastic error, respectively, CGB indicates sixth-grade gambling behavior (6GR), IMP indicates kindergarten impulsivity, KE indicates kindergarten entry, and PG indicates parental gambling involvement, for each individual i.

RESULTS

Descriptive statistics of child and family characteristics are reported in **Table 1**. The preliminary results re-

Table 2. Prediction of Gambling Behavior in Sixth Grade by Kindergarten Impulsivity Operationalized as Teacher-Rated Inattentive, Distractible, and Hyperactive Behaviors

Characteristic	Simple Model, Standardized β (SD)[a]	Fully Controlled Model, Standardized β (SD)[a]	Unstandardized β (95% CI)[b]
Impulsivity	.25 (.02)[c]	.25 (.02)[c]	–.06 (–.02 to .11)
Sex		.10 (.22)	.24 (–.19 to .67)
Emotional distress		.14 (.06)	–.10 (–.03 to .22)
Family functioning		.02 (.02)	.01 (–.03 to .04)
Maternal education		.11 (.22)	.28 (–.17 to .72)
Parental gambling		.05 (.15)	.09 (–.20 to .38)

Abbreviation: CI, confidence interval.
[a] For the simple model, R^2=0.06; for the fully controlled model, R^2=0.16.
[b] The CIs, based on unstandardized βs, are derived for the fully controlled model.
[c] P=.008.

vealed a significant bivariate correlation between our 2 key variables of interest (standardized β=.25; SE=.02; $P<.001$). In the fully controlled multiple regression equation, early impulsive behavior remained a significant predictor of self-reported gambling behavior in sixth grade ($F_{6,111}$=3.44; P=.008; R^2=0.16; multiple R^2=0.40). As noted in **Table 2**, a 1-unit increase in kindergarten impulsivity was associated with a corresponding 25% increase in later self-reported child gambling involvement (SE=.02), holding all other variables in the model constant.

COMMENT

For quite some time, we have known that people who start gambling in youth are more likely to experience severe gambling problems in adulthood.[9] This has stimulated an interest in youthful gambling involvement. The youngest in samples have been early adolescents. As this field of research becomes more developmentally oriented, the urge to address predictors from concomitants becomes stronger. This study gets us a bit closer to the chicken-and-egg issue. Our results suggest that early behaviors associated with ADHD symptoms reliably forecast gambling involvement in sixth grade. Higher levels of problematic kindergarten classroom behavior at age 5 years predicted a higher propensity toward later gambling behavior. This truly prospective association over a 6-year period is above and beyond important confounds that are not often considered in this type of research.

Our results suggest that behavioral features such as inattentiveness, distractibility, and hyperactivity at school entry represent a vulnerability factor for precocious risk-oriented behavior like gambling in sixth grade. It is very plausible that these childhood characteristics snowball into cumulative risks for youngsters who do not eventually outgrow the distractibility and inattentiveness from early childhood and become involved in gambling as a typical pastime for many youth. Most importantly, our observations suggest a developmentally continuous effect of impulsivity that places individuals on a life course trajectory toward gambling involvement in adolescence and emerging adulthood.

What might be the fundamental mechanisms operating in this developmental chain? The underlying impulsivity trait points to abnormalities in the mesolimbic reward circuits. From an executive control perspective, gambling involves risk estimation, decision making, and feedback processing.[43] Such activities recruit the orbitofrontal cortex, the anterior cingulate cortex, and the dorsolateral and medial prefrontal cortices.[44] Children with ADHD show significant aberrations in the neural substrates associated with decision making and reward processing during guessing and gambling, to the extent that they experience enhanced sensitivity to unfavorable outcomes.[45] In turn, their greater vulnerability to a negative affective reaction to incorrect guessing and unexpected losses influences less insightful subsequent estimations in guessing and gambling. This creates a vicious circle of ineffective self-assessment and self-regulation processes. Interestingly, these characteristics are noted in adult pathological gamblers with a confirmed childhood history of ADHD.[46]

Most noteworthy is that the preschool period shows remarkable growth in the brain regions associated with affective decision making, thus explaining the rapid development of this characteristic prior to formal school entry.[47] As such, there are direct clinical implications for prevention and intervention as important mechanisms in circumventing later risks associated with impulsivity. Early childhood is viewed as a critical period in the development of cognitive self-regulation.[48] In fact, current data suggest that executive function training prior to first grade is most advantageous because it tends to influence general improvements in learning and social skills during the critical transition to formal schooling.[49] With respect to intervention, training of cognitive control in attentional processes[50] and working memory[51] has shown very positive results in children with ADHD. This specific line of work, which focuses on effortful control, has been successfully extended to more general applications of attention training in preschool children.[52] This research tells us that universal cognitive control training prior to first grade remains possible without being overly costly.

We are not overly concerned about the fact that the children in this study were living in disadvantaged neighborhoods. Residential settings in Canada are not as homogeneous as their American counterparts given differences in social policy and programming.[53] That is, poor and nonpoor people live in close quarters of each other. The neighborhoods were identified as disadvantaged because the

schools offered free breakfasts to their students. This program is in effect only in districts where welfare and unemployment are more prevalent. First, the application of abundant statistical control likely minimized any existing bias. Second, the parents who consented to participate in the longitudinal study, by nature of their consent, are intuitively less at risk than those who did not consent to participate. Third, assessing children from intact families afforded methodological strength. It not only balanced out some of the disadvantage issues but also restrained any possible influence of unmeasured family or parental correlates of single parenthood that could have confounded our observations. Last and most important, leisurely venues involving games of chance are distributed more densely in more impoverished districts.[54] In fact, neighborhood disadvantage is positively related to frequency of gambling and problem or pathological gambling.[55] These two findings alone make a strong argument that our sample characterizes an important ecological laboratory in which to examine the developmental precursors of gambling in youngsters.

Although we resolve the question of directionality in the life course relationship between 2 individual characteristics, our design does not help resolve causal issues. It is plausible that children with impulsivity problems in early childhood (such as ADHD) might be marginalized by peers. This in turn could play a role in a causal pathway toward subsequent involvement in games of chance to win money or prizes. Another limit is that the data did not include a professional diagnosis of ADHD or, even better, more phenotypic measures of impulsivity (given that it is not a unitary construct). Large population-based studies like this one provide a portrait of interindividual variations in typical development by using associated diagnostic symptoms. In fact, even low levels of symptoms associated with deficits in attention and inhibitory control in typically developing children risk limiting their individual potential and contribution to society.[56] At this time, we know of no other longitudinal study that comprises early childhood diagnoses and later measures of gambling behavior. We encourage others to extend our findings with more rigorous, population-based, prospective analyses.

Be it a consequence or correlate, youth gambling can easily unravel into a public heath issue. This study builds upon previous research on youthful risk behaviors in several ways. Its prospective nature and the age at which we assessed child gambling involvement are unprecedented. Because the past focus has been on prevalence issues, previous studies have surveyed older youth. We estimate a carefully specified model with intuitively little overlap between our key variables. That is, children were unlikely to be gambling in kindergarten, when teachers reported on inattentive, distractible, and hyperactive behaviors in the classroom. Last, by controlling for characteristics that are often comorbid in both clinical pictures, our predictive link suggests how the nature and course of impulsivity translate into risks of problematic gambling beyond childhood.

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