Predicting problem gambling:

A prospective study of the influence of sex, temperament, risk taking behaviour and mental health on the evolution of problem gambling during adolescence

December 2012

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Victorian Responsible Gambling Foundation

This study was originally funded and managed by the Department of Justice through the Grants for Gambling Research Program. Management of the study was transferred to the Victorian Responsible Gambling Foundation on its establishment on 1 July 2012.

The study prospectively followed up 156 participants with no history of problem gambling to investigate how gender interacts with risk taking behaviour, temperament and psychiatric symptoms to predict the development of problem gambling. The findings of the study have potential implications for the development of prevention and intervention programs.

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Final Report prepared for the Victorian Responsible Gambling Foundation

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Synopsis: This research reports data from a longitudinal adolescent development study (the Orygen Adolescent Development Study) conducted in Melbourne, Victoria, the broad aim of which was to investigate risk and resilience factors for the development of emotional and behavioural problems (including problem gambling) during adolescence and emerging adulthood. This specific study involves data collected from 156 early adolescents, who were initially recruited in early-adolescence with no history of problem gambling. These adolescents were prospectively followed up into late adolescence, and during three assessment waves conducted during the follow-up period, measures of temperament, psychiatric symptoms, and risk-taking behaviour (among other data) were collected. The results of this study showed both sex-independent and sex-dependent effects of risk taking behaviour and longitudinal changes in temperament and psychiatric symptoms in the prediction of risk for problem gambling during emerging adulthood.

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Executive Summary

Objective: There is a host of complex and interlinked set of psychological, social and biological factors involved in the development of problem gambling (PG), which often manifest in sex-dependent manner. While, existing research shows that emerging adulthood is a critical period for problem gambling, the risk factors for problem gambling during this period are unknown. Here, we sought to examine how sex interacts with risk taking behavior and developmental changes in temperament and psychiatric symptoms to predict individuals who go on to become 'at-risk' of developing PG.

Method: We recruited a sample of 156 early adolescents with no history of PG (mean age 12.6 years) and prospectively followed them up into late adolescence (mean age 18.9 years) to comprehensively investigate the role of sex, risk taking behaviour and longitudinal changes in temperament and psychiatric symptoms in the evolution of 'at-risk' state for PG.

Results: There were general (i.e., sex independent) effects of temperament and risk taking behaviour with greater temperamental negative affectivity, lower temperamental attention, and greater involvement in a variety of risky behaviour predicting greater likelihood of at-risk PG in both males and females. In addition, there were sex-specific effects in which reduced social and attentional problems were more predictive of at-risk PG in males, and greater levels of aggression were more predictive of at-risk PG in females.

Conclusions: These findings highlight how sex-dependent and independent factors across the early- to mid-adolescent period influence the risk for PG in later adolescence. Further, these finding inform the development of prevention and early intervention strategies that may be targeted towards those that we can identify as being vulnerable.

Key words: gambling, addiction, risk, personality, adolescent.

List of Acronyms

PG	Problem Gambling
EATQ-R	Early Adolescent Temperament Questionnaire – Revised
CESD	Centre for Epidemiological Studies for Depression
BAI	Beck Anxiety Inventory
CBCL	Child Behaviour Checklist
SOGS-RA	South Oaks Gambling Screen – Revised for Adolescents
SOGS	South Oaks Gambling Screen
EC	Effortful Control
NA	Negative Affectivity
SES	Socioeconomic Status
ANU	Australian National University
YRBS	Youth Risk Behavior Survey
SD	Standard Deviation

Introduction

In Australia, gambling is viewed as a socially accepted leisure activity. Less socially acceptable is the rise of Problem Gambling (PG), especially among youth groups. While only 3-5% of gamblers are classified as 'dysfunctional', this represents ~1 million Australians and over 40% of the money spent on gambling (Productivity Commission, 2010). Given the clear link between gambling problems and adverse social outcomes, there is a considerable gap between the burden of PG on the individual, the community and broader society, and the extent of scientific investigations of this topic to inform public health policy.

Adolescent Problem Gambling

A recent review of the existing literature suggests that around the globe, age is significantly associated with PG, with younger populations (i.e., below age 25) being over-represented in PG groups (Johansson, Grant, Kim, Odlaug, & Gotestam, 2009). Youth gambling has been suggested as a major concern due to a strong link with adult PG (Griffiths & Wood, 2000). To this end, despite a number of theoretical models being proposed regarding risk-factors for PG during adolescence (e.g., A. Blaszczynski & Nower, 2002; Brown, 1986), to date, there has been no longitudinal research that has prospectively examined risk factors for PG.

Risk factors: Risk-taking behaviour

Risk-factors suggested by cross-sectional and retrospective research now need to be examined longitudinally and prospectively. In particular, a recent review of this literature (Johansson, et al., 2009) suggests that risk-taking behaviours such as delinquency and illegal

acts, and alcohol and other drug use, might be particularly important risk-factors that warrant further investigation. These types of risk-taking behaviours have been cross-sectionally associated with PG (e.g., Feigelman, Kleinman, Lesieur, Millman, & Lesser, 1995; Potenza et al., 2001). Further, one twin study found between 12% and 20% of the genetic variation in the risk for PG was accounted for by the risk for alcohol dependence (W. S. Slutske et al., 2000). While there is some longitudinal research with adults showing substance use problems to prospectively predict PG, it is not currently known, whether substance use problems and other types of risk-taking behaviours may predispose one to PG during adolescence.

Risk factors: Temperament/Personality

Another important risk factor is individual differences in temperament. This literature suggests that certain temperamental dispositions, which are thought to emerge at a young age and are fairly stable over the lifespan (Goldsmith et al., 1987), likely contribute to PG (Shead, Derevensky, Fong, & Gupta, 2012). Impulsivity, the tendency to behave in a spontaneous or unintentional manner without thought or self-control, has been most widely implicated (Shead, et al., 2012). There are an emerging number of longitudinal studies providing support for temperamental impulsivity as a prospective risk factor for PG (Auger, Lo, Cantinotti, & O'Loughlin, 2010; Dussault, Brendgen, Vitaro, Wanner, & Tremblay, 2011; Wendy S. Slutske, Moffitt, Poulton, & Caspi, 2012). While temperamental neuroticism and negative mood states have consistently been found to be associated with PG (MacLaren, Best, Dixon, & Harrigan, 2011; Myrseth, Pallesen, Molde, Johnsen, & Lorvik, 2009), less research utilising longitudinal designs has been conducted to examine the prospective relationship between these temperamental factors and PG (W.S. Slutske, Caspi, Moffitt, & R., 2005). Research investigating the link between temperamental novelty or sensation seeking

and PG has provided inconsistent results (see Myrseth, et al., 2009), although there has been some longitudinal research suggesting prospective links between this temperamental disposition and PG in adolescents (A. E. Goudriaan, Slutske, Krull, & Sher, 2009).

Risk factors: Mental health/Behavioural problems

A third and potentially important set of risk-factors identified are mental health problems. In particular, depressive and anxiety symptoms have been cross-sectionally associated with PG (Ibanez et al., 2001), and a genetic study found that 34% of the genetic variance for major depressive disorder contributed to PG and vice versa (Potenza, Xian, Shah, Scherrer, & Eisen, 2005). There are an emerging few longitudinal studies that have now shown prospective links between depressive symptoms and the development of PG in young people (e.g., Lee, Storr, Ialongo, & Martins, 2011), however, no longitudinal studies to our knowledge have investigated the prospective association between anxiety symptoms and PG.

Sex differences

While males and females differ in their propensity to gamble, whether they differ in the risk factors associated with PG is unclear. Many studies focus only on males, as they are at higher risk for PG. However, there are a small number of studies providing evidence for sex differences in risk factors. For example, some studies have found higher rates of depression and anxiety among female problem gamblers compared to male problem gamblers (Desai & Potenza, 2008), while others have found temperamental negative emotionality to predict PG more strongly in males (King, Abrams, & Wilkinson, 2010). Some research has found that females with PG are more likely than males to have a history of substance use problems (Ellenbogen, Derevensky, & Gupta, 2007). Thus, while studies have also shown that many of

the risk taking, temperamental and mental health related risk factors can interact with sex to predict PG, there is a lack of longitudinal research investigating how these interactions prospectively predict the emergence of PG during the course of adolescence.

Summary of Literature

To summarise, while existing research shows that emerging adulthood is a critical period for PG (Griffiths & Wood, 2000), and that PG shows strong associations with other risk-taking behaviours (e.g., delinquency, alcohol and other drug use), temperament, and mental health problems (e.g., depression and anxiety), no research has employed a longitudinal design and comprehensive multi-method assessment strategy to examine whether these individual difference factors (and their interaction with sex) are prospectively related to PG in emerging adulthood.

Aims and Hypotheses

In the current study, we conducted an assessment of PG, individual differences in temperament, risk-taking behaviours and the experience of mental health problems in a group of 156 late adolescents (aged 18-20), initially recruited at age 10-12 from a temperamentally risk-enriched community sample. Available data on temperament, risk-taking and mental health problems from prior assessments of these adolescents (from age 10 to 20) were used in the prospective prediction of PG at age 18-20. We hypothesised that trajectories of temperament (particularly inhibitory and negative affective temperaments), mental health problems (depression and anxiety symptoms, and behavioural problems), and risk-taking behaviours (particularly delinquency, alcohol and other drug use) during adolescence would predict PG during emerging adulthood.

Methods

Participants

The sample consisted of 156 adolescents (80 females and 76 males), recruited as part of a larger study (the Orygen Adolescent Development Study) investigating the relationship between early adolescent temperament and risk for later mental illness. Mean age at the baseline assessment (early adolescent assessment) was 12.5±0.4 years, mean age at an interim assessment (mid-adolescent assessment) was 16.7±0.4 years, and mean age at the follow-up assessment (late-adolescent assessment) was 18.8±0.5 years. Informed consent was obtained in accordance with the guidelines of the Human Research Ethics Committee of the University of Melbourne, Australia.

Participant recruitment and screening procedure

The initial screening phase of this study involved administering the Early Adolescent Temperament Questionnaire-Revised (EATQ-R; Ellis & Rothbart, 2001) to 2479 final-year primary school students from 97 schools in Melbourne, Australia within a classroom setting. The EATQ-R is comprised of ten subscales that load onto four higher order factors (Negative Affectivity [NA], Effortful Control [EC], Surgency, and Affiliation). In accordance with the aims of the larger study, participants' scores on the EATQ-R were used to select a smaller sample that maximized the range of risk and resiliency for later onset of psychopathology. Specifically, this procedure involved selecting equal numbers of participants from the following ranges of scores on NA and EC: 0-1 standard deviations (SDs) above and below the

mean, 1-2 SDs above and below the mean, 2-2.5 SDs above and below the mean, and >2.5 SDs above and below the mean. This ensured that all students scoring in the extreme ranges of NA and EC were included. This procedure resulted in a sample of 415 students (17% of the larger sample) that showed even distribution of scores across dimensions and maintained the range of scores seen in the larger screening sample. See Figure 1 for an illustration of the temperament distribution of the initial screening sample versus the selected sample (NA is shown as an example, but distributions for EC look similar). Of these adolescents, 245 (59%) agreed to participate in one or more intensive phases of research, and of these, 156 participants completed the follow-up assessment (i.e., gambling assessment at age 18-20 years). There were no differences between those who completed the follow-up assessment and those who were selected but declined (i.e., n = 415) on any demographic variables (SES [t[413] = -1.51, p =.132); gender (χ^2 = 0.03, p = .868), or on temperament (NA (t[413] = .41, p = .685); Surgency (t[413] = -.79, p = .430); Affiliation (t[413] = -1.58, p = .115); EC (t[413] = -.75, p = .452).

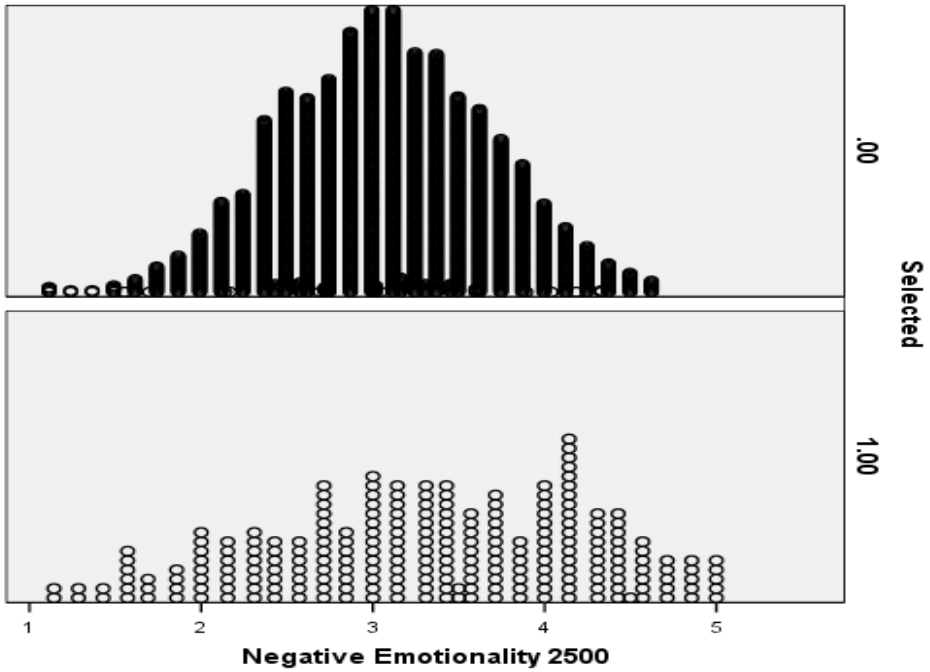

Figure 1. Distribution of EATQ-R NA scores for the screening sample (top panel) and selected sample (bottom panel).

Measures

Socioeconomic Status (SES)

A measure of SES was derived using data on participants' parents' occupation and education. Parental occupations were coded according to the ANU_4 scale (Jones and McMillan, 2001), a SES index derived specifically for the Australian context that classifies occupation based on education and market income. For participants with missing data, or for those not in employments, a measure of parental education was substituted (total years in school, scaled to reflect ANU_4 codes).

Wechsler Intelligence Scale for Children (WISC)

Three subtests (Vocabulary, Matrix Reasoning and Symbol Search) from the Wechsler Intelligence Scale for Children (WISC) were utilised to calculate an estimated full scale IQ (IQ). Sattler and Dumont (2004) report high reliability and validity estimates for this three subtest short-form (rss = .92, r = .90) using the Tellegen and Briggs (1967) method for estimating full standard IQ (FSIQ) based on the standardization sample and psychometric properties of the subtests.

Temperament (Early- and Mid-Adolescent Assessments): EATQ-R

Temperament was assessed using the EATQ-R. This measure has been specifically designed to assess trait affective temperament within the cohort age group by tapping experiences common to adolescents, and consists of 65 items that participants have to rate on a 5-point Likert scale according to whether they agree or disagree with a particular statement. The EATQ-R yields four higher order factors comprised of 10 subscales: NA (frustration), EC (attention, activation control, inhibitory control), Surgency (high intensity pleasure, shyness [reverse-scored], and fear [reverse-scored]), and Affiliation (affiliation, perceptual sensitivity, pleasure sensitivity). Only data concerning the NA and EC subscales and the Surgency subscale: high intensity pleasure, were included in subsequent analyses given the link between the types of constructs measured by these temperament dimensions and PG.

Risk Taking Behavior (Mid-Adolescent Assessment): YRBS

At the interim assessment, participants completed the Youth Risk Behaviour Survey (YRBS; CDC, 1999). An adapted version of the 2007 Youth Risk Behavior Survey (YRBS) (Centers for Disease Control and Prevention, 2004) was used as the primary measure of risk taking

participation. The YRBS items were developed to assess adolescent participation in a broad range of risk taking behaviours that are associated with the leading causes of youth morbidity and mortality in the United States. Items are revised biannually to ensure these adhere to updates in morbidity and mortality statistics thus providing evidence of construct and content validity (Centers for Disease Control and Prevention, 2004). Six major risk-taking categories are covered in the YRBS: behaviors that contribute to unintentional injuries and violence, tobacco use, alcohol and other drug use, sexual behaviors that contribute to unintended pregnancies and STDs, unhealthy dietary behaviors, and physical inactivity (Centers for Disease Control and Prevention, 2008;Centers for Disease Control and Prevention, 2010). Test-retest reliability of YRBS items are reported to be moderate-to-strong (Brener et al., 2002). Importantly, as demonstrated in Chapter 1, the broad categories of risk taking associated with morbidity and mortality in the U.S. (and assessed by the YRBS) are directly comparable to those for Australian adolescents (Australian Bureau of Statistics, 2008; Australian Institute of Health and Welfare, 2008). Items in the YRBS are also variably scaled and included nominal, ordered categorical (ordinal), and ratio data. The majority of YRBS items sample frequency of participation using an ordinal scale. The YRBS has no systematic scoring method and provides no overall measure of general risk taking behaviour. For the current study, a score for each risk-taking domain was established by adding the number of behaviors endorsed (i.e., ever versus never engaged in activity). A total risk-taking score was obtained by subsequently adding all individual domain scores.

Symptoms and Behavioural Problems (Early- and Mid-Adolescent Assessment): CES-D, BAI, CBCL

At the Early- and Mid-Adolescent assessments, adolescents completed questionnaires to assess symptoms of depression (Center for Epidemiologic Studies Depression Scale, CES-D, Radloff, 1977), and anxiety (Beck Anxiety Inventory, BAI, Beck, Epstein, Brown, & Steer, 1988). Parents completed a questionnaire to assess adolescent behavioral problems/externalizing symptoms (Child Behavior Checklist, CBCL, Achenbach, Howell, Quay, Conners, & Bates, 1991). The CES-D –R is a 20 item self-report questionnaire that measures depressive symptoms over the past week. Items scored on a four-point response scale: 0 = rarely, 1 = sometimes, 2 = occasionally, 3 = most of the time. The CES-D has been found to be valid and reliable for adults and adolescents, with Cronbach's alpha of .85 reported in both a general population sample of adults (Radloff, 1977) and a nonclinical sample of junior high school students (Radloff, 1991). The BAI is a 21 item self-report scale of common anxiety symptoms experienced during the past week. Items are scored on a four-point scale: 0 = not at all, 1 = mildly, 2 = moderately, 4 = severely. The BAI has demonstrated good psychometric properties in a nonclinical college sample, showing a high internal consistency with Cronbach's alpha of .90. The CBCL is a self-administered, standardized questionnaire completed by parents. It is designed to assess the competencies and behavior problems of children between 4 and 16 years old. Only items loading onto externalizing and behavioral scales (i.e., not internalizing scales) were administered, which comprised 50 items scored on a three-point response scale: 0=not true, 1= sometimes true and 2= often true. The items are scored on four syndrome scales: Social Problems, Attention Problems, Delinquent Behaviour and Aggressive Behaviour. The scores of these scales are summed to create an overall externalizing/behavioral probles score. Reliability and validity have been well established (Achenbach, et al., 1991).

Gambling (Late-Adolescent Assessment): SOGS and SOGS-RA

At the follow-up assessment, adolescents completed the South Oaks Gambling Screen-Revised for Adolescents (SOGS-RA, Winters, Stinchfield, & Fulkerson, 1993). The SOGS-RA (Winters, Stinchfield, & Fulkerson, 1993) is an adolescent adaptation of the SOGS for adults (Lesieur & Blume, 1987).This 12-item questionnaire is used to screen for at-risk and problem gamblers. The questionnaire has been used in several epidemiological studies (Adlaf & Lalomiteanu, 2000; Govoni, Rupcich, & Frisch, 1996; Poulin, 2000). Previous research has found the SOGS-RA to have acceptable internal consistency reliability (alpha = 0.80), and to significantly discriminate between regular and non-regular gamblers. The scores have also been shown to relate significantly to continuous measures of gambling frequency and the amount of money wagered.

In order to assess parental PG, we also asked one parent to complete the SOGS. The SOGS is a 20-item questionnaire based on DSM-III criteria for pathological gambling. A total SOGS Score is determined by scoring one point for each question that shows an "at risk" response and adding the total points. Acceptable internal consistency and test-retest reliability has been established, and the instrument correlates well with the criteria of the revised version of DSM-III (DSM-III-R) (Lesieur & Blume, 1987).

Analyses

Statistical analysis was performed using PASW Statistics (Version 20.0). As suggested by Poulin (2000), we used the SOGS-RA total score and regularity items to identify subjects at risk for PG. Poulin proposes a total score >=2 with weekly gambling as indicative of PG. We

chose a SOGS total score >=1 along with gambling frequency of at least once per week as indicative of 'at-risk' for PG ('At-risk', n=17; 'Not-at-risk', n=139).

Between-group comparisons were performed using the Mann-Whitney *U* test, since the Kolmogorov-Smirnov test indicated that distributions were non-normal. Effect sizes were calculated using the formula $r=z/\sqrt{n}$ (Field, 2005). The variables included symptom scales (CES-D, BAI, CBCL subscales), temperament (EC and NA subscales, high positive affect subscale), risk-taking (domain scores) and parental gambling (total SOGS score). For data collected at two time points (symptom scales and temperament) we calculated change scores – using linear regression, we removed the variance at T2 that was explained by T1, and saved the unstandardized residuals to be used for between-group comparisons. In addition, we examined the data of male and female participants separately to identify gender-specific variables associated with risk for PG.

Results

Demographic and gambling characteristics

There were no significant differences between the lifetime gambling groups (ever gambled [n = 123] vs never gambled [n = 33]) on age (U = -.96, p = 0.335), gender distribution ($\chi^2[1]$ = 0.57, p = 0.451), or socio-economic status (U = -.84, p = 0.401).

There were no significant differences between the risk groups (At-risk vs Not-at-risk) on age (U = -.65, p = 0.513), gender distribution ($\chi^2[1]$ = 0.78, p = 0.377), or socio-economic status (U = 1.50, p = 0.135).

The percentage of males and females who gambled at least once in their lifetime were comparable (76.3% of males and 81.5% of females), as was the percentage of individuals 'at-risk' for PG (13.2% of males and 8.6% of females).

The most popular forms of gambling in the entire sample were electronic gaming machines or 'pokies' with 47.3% having engaged in this form of gambling in their lifetime, followed by scratch tabs (37.3%) and then 'the races' (33.7%). Figures 2 and 3 show the percentage of participation in different forms of gambling for the at-risk and not at-risk groups. Figure 4 shows the number of participants in the at-risk and not at-risk groups reporting gambling-related problems (by problem type) Of note, no adolescents in the not at-risk group reported gambling-related problems. The betting amounts were typically small, with 43.8% of participants reporting that the largest amount ever gambled was <$1, however a small portion of the sample had gambled using larger amounts ($10-49, 15%; $50-99, 4.4%; >$200, 3.8%).

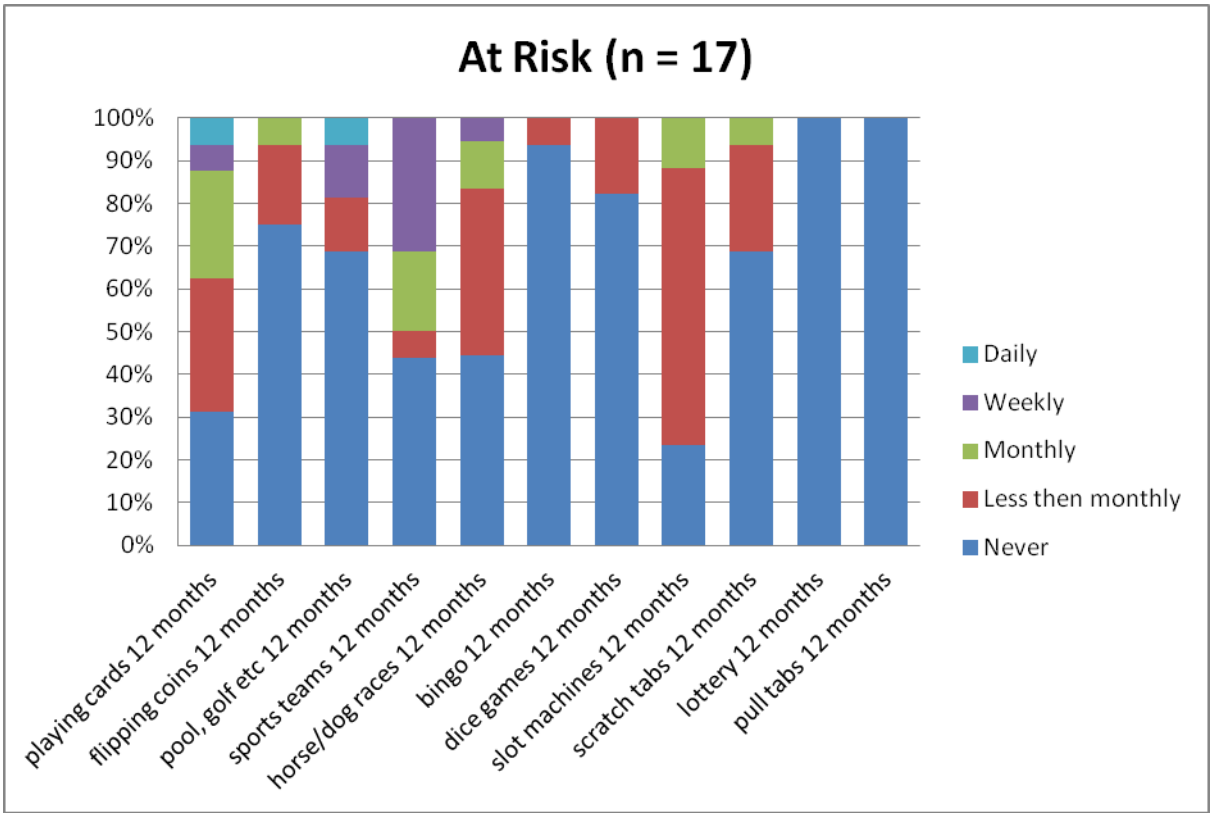

Figure 2. Participation in gambling activities in the past 12 months for the at-risk group.

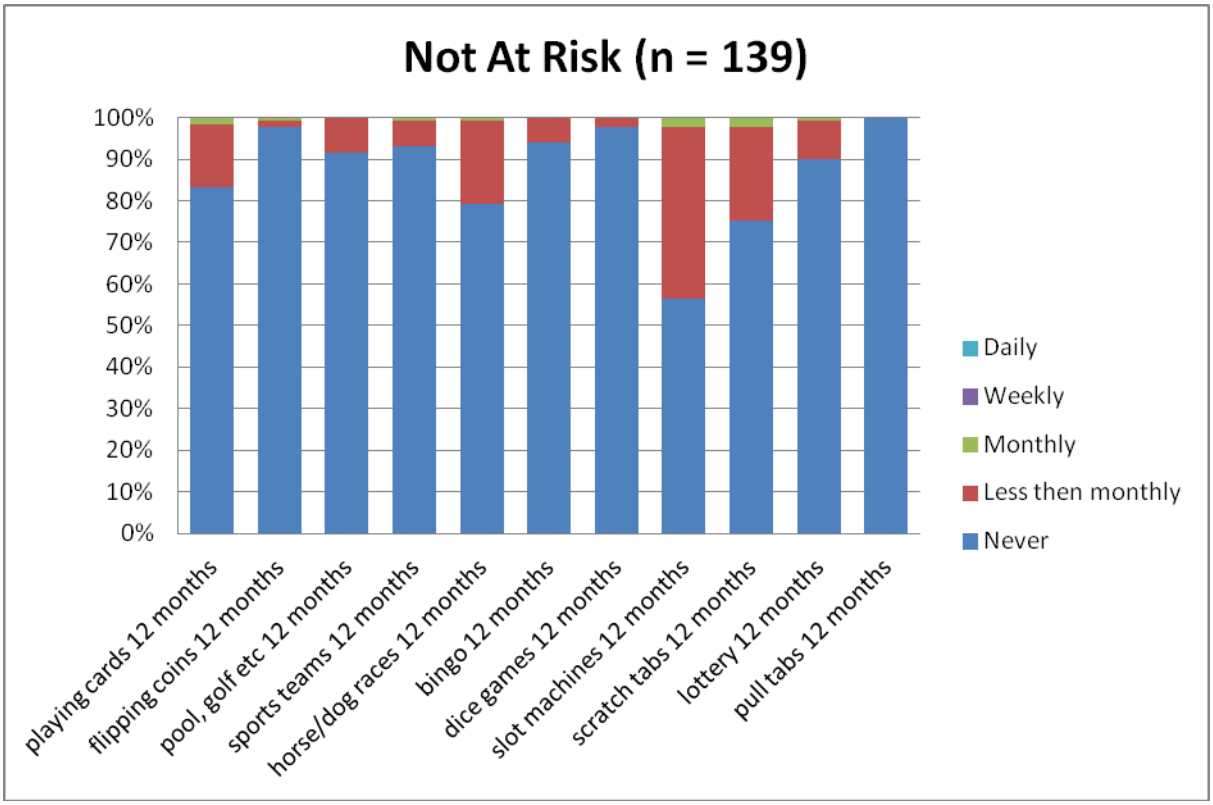

Figure 3. Participation in gambling activities in the past 12 months for the not at-risk group.

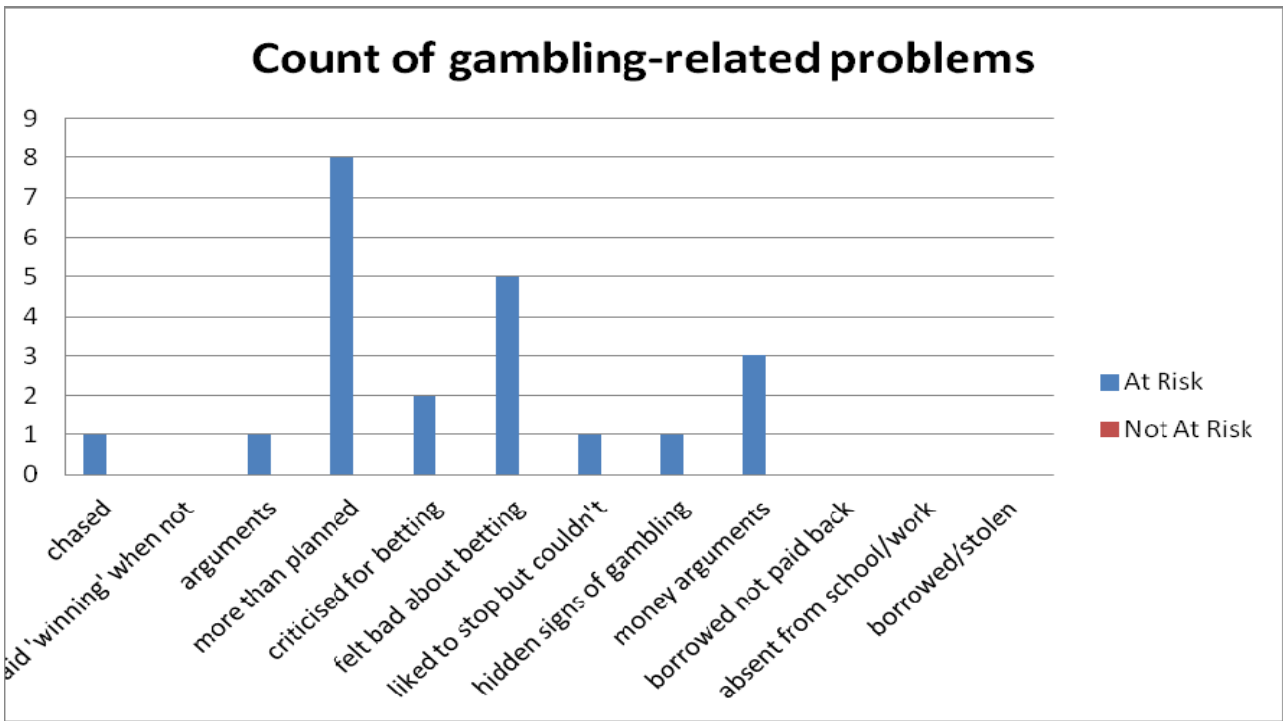

Figure 4. Count of gambling-related problems in the at-risk and not at-risk groups.

Predictors of risk for problem gambling

Tables 1 to 6 depict means, standard deviations, and significance tests (with effect sizes) for all variables (from both time points where relevant) and their ability to predict gambling risk group status. Individuals at-risk for PG show lower temperamental attention and higher frustration during mid- but not early-adolescence (Table 1), greater risk-taking overall during mid-adolescence, and also specifically with regard to tobacco and alcohol (Table 2). Neither parental gambling nor adolescent psychiatric symptoms (depression, anxiety, externalizing/problem behaviors) predict gambling risk for the whole sample (Table 3).

Table 1. Temperament: descriptive data and prediction of PG risk groups (whole sample).

Variable	Whole sample			
	Not-at-risk Mean (SD)	At-risk Mean (SD)	p	Effect size
Activation control[1]				
T1	3.36 (0.86)	3.21 (0.93)	0.588	-0.044
T2	2.84 (0.88)	2.64 (0.73)	0.341	-0.079
Attention[1]				
T1	3.46 (0.73)	3.38 (0.77)	0.817	-0.019
T2	3.34 (0.77)	2.91 (0.55)	**0.018**	-0.196
Frustration[2]				
T1	3.09 (0.72)	3.07 (0.64)	0.927	-0.008
T2	2.89 (1.62)	3.46 (0.59)	**0.018**	-0.195
Inhibition control[1]				
T1	3.77 (0.65)	3.62 (0.62)	0.326	-0.079
T2	3.58 (1.71)	3.45 (1.08)	0.522	-0.053
High Positive Affect				
T1	3.26 (0.96)	3.54 (0.79)	0.272	-0.091
T2	3.23 (1.74)	3.50 (0.94)	0.676	-0.034

T1 = early-adolescent assessment; T2 = mid-adolescent assessment
[1] Effortful Control subscale
[2] Negative Affectivity subscale
Note: bold font = significant at trend level ($p < 0.1$), bold underlined font = significant at $p < 0.05$ level.

Table 2. Risk-taking behaviour: descriptive data and prediction of PG risk groups (whole sample).

Variable	Whole sample			
	Not-at-risk Mean (SD)	At-risk Mean (SD)	p	Effect size
Safety	0.91 (0.88)	1.38 (1.09)	**0.091**	-0.140
Violence	0.46 (0.86)	0.69 (0.87)	0.194	-0.107
Suicide	0.25 (0.69)	0.19 (0.40)	0.809	-0.020
Tobacco	0.94 (1.52)	1.63 (1.86)	**0.044**	-0.166
Alcohol	2.25 (2.07)	3.88 (2.19)	**0.003**	-0.246
Cannabis	0.25 (0.59)	0.50 (0.73)	**0.070**	-0.149
Other drugs	0.13 (0.42)	0.25 (0.45)	0.110	-0.132
Sex	0.61 (1.19)	1.31 (1.92)	0.104	-0.134
Total	5.79 (5.61)	9.81 (5.55)	**0.003**	-0.244

Note: bold font = significant at trend level ($p < 0.1$), bold underlined font = significant at $p < 0.05$ level.

Table 3. Psychiatric Symptoms: descriptive data and prediction of PG risk groups (whole sample).

Variable	Whole sample			
	Not-at-risk Mean (SD)	At-risk Mean (SD)	p	Effect size
CESDR				
T1	31.17 (9.14)	31.14 (9.14)	0.959	-0.004
T2	30.62 (8.40)	30.64 (5.72)	0.616	-0.042
BAI				
T1	7.71 (7.79)	9.67 (10.51)	0.394	-0.069
T2	8.60 (7.87)	9.81 (9.93)	0.740	-0.028
CBCL Total				
T1	14.16 (10.85)	13.17 (8.10)	0.960	-0.004
T2	13.26 (11.74)	13.88 (12.46)	0.925	-0.008
Social problems				
T1	2.47 (2.68)	1.44 (1.05)	0.437	-0.064
T2	1.98 (2.38)	1.13 (1.15)	0.344	-0.079
Attention problems				
T1	3.32 (3.01)	2.76 (1.79)	0.848	-0.016
T2	3.26 (3.20)	2.38 (2.83)	0.209	-0.105
Delinquency				
T1	1.68 (1.76)	1.96 (1.93)	0.599	-0.043
T2	2.40 (2.81)	3.19 (3.25)	0.410	-0.069
Aggression				
T1	7.12 (6.04)	7.29 (5.79)	0.771	-0.024
T2	5.91 (6.25)	7.25 (6.55)	0.498	-0.057
Parent SOGS	0.48 (1.52)	0.23 (0.60)	0.748	-0.028

T1 = early-adolescent assessment; T2 = mid-adolescent assessment
Note: bold font = significant at trend level ($p < 0.1$), bold underlined font = significant at $p < 0.05$ level.

Males at-risk for PG show greater risk-taking during mid-adolescence overall as well as in relation to alcohol and cannabis (Table 5). However, they have fewer social and attention problems during mid-adolescence, as indicated by the CBCL (Table 6) than males not-at-risk. Females at-risk for PG show significantly greater risk-taking behaviours during mid-adolescence overall as well as in relation to alcohol and tobacco use (Table 5). Females also score greater on CBCL aggression during early-adolescence (Table 6).

Table 4. Temperament: descriptive data and prediction of PG risk groups (by gender).

Variable	Female				Male			
	Not-at-risk Mean (SD)	At-risk Mean (SD)	p	Effect size	Not-at-risk Mean (SD)	At-risk Mean (SD)	p	Effect size
Activation control								
T1	3.57 (0.80)	3.46 (0.98)	0.838	-0.023	3.10 (0.87)	3.04 (0.90)	0.803	-0.029
T2	3.01 (0.82)	2.66 (0.71)	0.210	-0.144	2.65 (0.91)	2.62 (0.78)	0.979	-0.003
Attention								
T1	3.63 (0.65)	3.27 (0.90)	0.302	-0.118	3.27 (0.78)	3.45 (0.71)	0.425	-0.095
T2	3.33 (0.75)	2.89 (0.59)	0.112	-0.182	3.35 (0.80)	2.92 (0.56)	**0.079**	-0.211
Frustration								
T1	2.94 (0.73)	3.10 (0.60)	0.646	-0.053	3.25 (0.69)	3.04 (0.70)	0.642	-0.055
T2	2.77 (2.11)	3.51 (0.77)	0.125	-0.174	3.02 (0.68)	3.41 (0.45)	**0.055**	-0.232
Inhibition control								
T1	3.80 (0.66)	3.60 (0.57)	0.321	-0.111	3.73 (0.65)	3.64 (0.69)	0.723	-0.042
T2	3.42 (2.25)	3.66 (0.64)	0.820	-0.026	3.78 (0.61)	3.29 (1.35)	0.560	-0.07
High Positive Affect								
T1	3.29 (0.93)	3.25 (0.79)	0.815	-0.027	3.21 (1.00)	3.75 (0.76)	0.113	-0.189
T2	3.11 (2.28)	3.14 (1.05)	0.505	-0.076	3.38 (0.72)	3.78 (0.79)	0.203	-0.153

T1 = early-adolescent assessment; T2 = mid-adolescent assessment

[1] Effortful Control subscale

[2] Negative Affectivity subscale

Note: bold font = significant at trend level ($p < 0.1$), bold underlined font = significant at $p < 0.05$ level.

Table 5. Risk-taking behavior: descriptive data and prediction of PG risk groups (by gender).

Variable	Female				Male			
	Not-at-risk Mean (SD)	At-risk Mean (SD)	p	Effect size	Not-at-risk Mean (SD)	At-risk Mean (SD)	p	Effect size
Safety	0.86 (0.87)	1.14 (0.69)	0.288	-0.120	0.95 (0.89)	1.56 (1.33)	0.192	-0.157
Violence	0.32 (0.65)	0.43 (0.79)	0.735	-0.038	0.62 (1.04)	0.89 (0.93)	0.240	-0.141
Suicide	0.31 (0.80)	0.29 (0.49)	0.547	-0.068	0.18 (0.54)	0.11 (0.33)	0.831	-0.026
Tobacco	1.06 (1.62)	2.00 (2.24)	0.206	-0.143	0.80 (1.39)	1.33 (1.58)	**0.092**	-0.203
Alcohol	2.39 (2.07)	3.86 (2.54)	**0.089**	-0.193	2.08 (2.08)	3.89 (2.03)	**0.013**	-0.298
Cannabis	0.28 (0.61)	0.43 (0.79)	0.568	-0.065	0.22 (0.56)	0.56 (0.73)	**0.047**	-0.239
Other drugs	0.11 (0.32)	0.14 (0.38)	0.813	-0.027	0.15 (0.52)	0.33 (0.50)	**0.067**	-0.22
Sex	0.70 (1.26)	1.86 (2.12)	**0.059**	-0.214	0.50 (1.10)	0.89 (1.76)	0.592	-0.065
Total	6.04 (5.63)	10.14 (4.81)	**0.034**	-0.239	5.50 (5.63)	9.56 (6.35)	**0.034**	-0.255

Note: bold font = significant at trend level ($p < 0.1$), bold underlined font = significant at $p < 0.05$ level.

Table 6. Psychiatric Symptoms: descriptive data and prediction of PG risk groups (by gender).

Variable	Female				Male			
	Not-at-risk Mean (SD)	At-risk Mean (SD)	p	Effect size	Not-at-risk Mean (SD)	At-risk Mean (SD)	p	Effect size
CESDR								
T1	30.09 (8.99)	30.46 (9.85)	0.861	-0.020	32.34 (9.22)	31.62 (9.13)	0.858	-0.021
T2	30.89 (8.33)	32.80 (5.72)	0.374	-0.108	30.32 (8.54)	29.44 (5.68)	0.879	-0.018
BAI								
T1	6.87 (7.61)	8.26 (5.92)	0.321	-0.111	8.68 (7.94)	10.66 (13.05)	0.994	-0.001
T2	9.29 (7.19)	8.71 (3.55)	0.705	-0.043	7.82 (8.58)	10.67 (13.17)	0.837	-0.025
CBCL Total								
T1	10.91 (9.31)	16.43 (9.43)	0.111	-0.180	17.89 (11.35)	10.89 (6.58)	0.073	-0.211
T2	11.35 (11.90)	18.43 (14.26)	0.177	-0.158	15.36 (11.30)	10.33 (10.31)	0.121	-0.187
Social problems								
T1	1.97 (2.35)	1.43 (.53)	0.692	-0.045	3.05 (2.93)	1.44 (1.33)	0.153	-0.168
T2	1.74 (2.40)	1.71 (1.11)	0.373	-0.104	2.24 (2.34)	0.67 (1.00)	**0.033**	-0.257
Attention problems								
T1	2.62 (2.91)	3.00 (1.83)	0.334	-0.109	4.12 (2.94)	2.60 (1.84)	0.163	-0.164
T2	2.68 (3.03)	3.29 (3.50)	0.717	-0.042	3.90 (3.27)	1.67 (2.12)	**0.032**	-0.259
Delinquency								
T1	1.02 (1.17)	1.71 (2.21)	0.594	-0.06	2.44 (2.00)	2.13 (1.81)	0.704	-0.045
T2	2.03 (2.59)	4.14 (3.80)	0.104	-0.19	2.79 (3.02)	2.44 (2.74)	0.670	-0.051
Aggression								
T1	5.61 (4.92)	10.86 (6.59)	**0.034**	-0.240	8.83 (6.74)	4.80 (3.71)	**0.079**	-0.207
T2	5.12 (6.17)	9.43 (7.70)	0.177	-0.158	6.78 (6.26)	5.56 (5.34)	0.573	-0.068
Parent SOGS total	0.32 (0.89)	0.40 (0.89)	0.896	-0.025	0.64 (1.95)	0.13 (0.35)	0.573	-0.068

T1 = early-adolescent assessment; T2 = mid-adolescent assessment

Note: bold font = significant at trend level ($p < 0.1$), bold underlined font = significant at $p < 0.05$ level.

Longitudinal change in predictors of risk for PG

Longitudinal changes across the early- to mid-adolescent period in temperament and the experience of psychiatric symptom of anxiety, depression and behavioral (externalizing) problems are presented in Tables 7 and 8. Individuals at risk for PG in the whole sample (Table 7), as well as specifically males (Table 8), show a worsening of attention (poorer attentional control) and frustration (increased frustration levels) over time.

Table 7. Longitudinal change in temperament and symptoms: prediction of PG risk groups (whole sample).

Variable	Whole sample			
	Not-at-risk Mean (SD)	At-risk Mean (SD)	p	Effect size
CESD	-0.07 (7.81)	0.18 (5.76)	0.557	-0.051
BAI	-0.08 (7.75)	0.40 (7.45)	0.840	-0.017
EATQ activation	0.02 (0.70)	-0.16 (0.79)	0.209	-0.105
EATQ Attention	0.04 (0.69)	-0.36 (0.62)	**0.029**	-0.186
EATQ Frustration	-0.06 (1.23)	0.41 (0.52)	**0.005**	-0.236
EATQ Inhibition	0.01 (1.70)	-0.06 (0.87)	0.579	-0.046
EATQ High Positive Affect	-0.01 (1.32)	0.04 (0.76)	0.894	-0.011
CBCL total	-0.11 (9.01)	1.25 (10.61)	0.974	0.003
CBCL Social problems	0.03 (1.86)	-0.16 (1.29)	0.853	-0.016
CBCL Attention Problems	0.06 (2.59)	-0.41 (2.57)	0.308	-0.087
CBCL Delinquency	-0.06 (2.52)	0.53 (3.18)	0.613	-0.043
CBCL Aggression	-0.11 (4.69)	1.05 (5.39)	0.417	-0.069

Note: bold font = significant at trend level ($p < 0.1$), bold underlined font = significant at $p < 0.05$ level.

Table 8. Longitudinal change in temperament and symptoms: prediction of PG risk groups (by gender).

Variable	Female				Male			
	Not-at-risk Mean (SD)	At-risk Mean (SD)	p	Effect size	Not-at-risk Mean (SD)	At-risk Mean (SD)	p	Effect size
CESD	0.41 (7.75)	2.95 (4.57)	0.180	-0.169	-0.58 (7.91)	-1.36 (6.00)	0.963	-0.006
BAI	0.76 (6.97)	-0.16 (3.95)	0.928	-0.010	-1.08 (8.55)	0.83 (9.58)	0.762	-0.037
EATQ activation	0.05 (0.74)	-0.23 (0.46)	0.184	-0.152	-0.02 (0.65)	-0.09 (1.00)	0.562	-0.071
EATQ Attention	-0.06 (0.66)	-0.33 (0.59)	0.294	-0.123	0.15 (0.71)	-0.38 (0.68)	**0.041**	-0.253
EATQ Frustration	-0.05 (1.57)	0.45 (0.72)	0.175	-0.158	-0.08 (0.61)	0.38 (0.32)	**0.009**	-0.325
EATQ Inhibition	-0.18 (2.22)	0.17 (0.52)	0.766	-0.034	0.24 (0.57)	-0.24 (1.06)	0.408	-0.101
EATQ High Positive Affect	-0.09 (1.66)	-0.17 (0.81)	0.536	-0.072	0.10 (0.70)	0.21 (0.72)	0.787	-0.034
CBCL total	0.30 (9.38)	3.91 (13.11)	0.646	-0.054	-0.57 (8.61)	-0.82 (8.44)	0.765	-0.037
CBCL Social problems	0.08 (1.81)	0.38 (1.24)	0.446	-0.089	-0.03 (1.93)	-0.58 (1.24)	0.404	-0.103
CBCL Attention Problems	-0.05 (2.53)	0.35 (3.38)	0.844	-0.023	0.19 (2.67)	-0.99 (1.70)	0.224	-0.15
CBCL Delinquency	0.03 (2.49)	1.72 (3.46)	0.130	-0.177	-0.17 (2.58)	-0.40 (2.80)	0.681	-0.051
CBCL Aggression	0.11 (4.93)	1.32 (7.13)	0.542	-0.071	-0.36 (4.42)	0.84 (4.03)	0.601	-0.064

Note: bold font = significant at trend level ($p < 0.1$), bold underlined font = significant at $p < 0.05$ level.

Discussion

The current study found aspects of temperament, externalizing symptoms/behavioral problems, and risk-taking behaviors during early- and mid-adolescence to significantly predict risk for PG during late-adolescence. Further, there were both gender differences in

the patterns observed, and developmental effects (i.e., changes in temperament over time predicted risk for PG). Specifically, low temperamental attention, high temperamental negative affectivity (i.e., frustration), and their exacerbation over time, predicted risk for PG (particularly in boys). Other risk-taking behaviors, particularly substance-use, predicted risk for PG in both genders. Externalizing/behavioral problems predicted risk for PG in gender-specific ways, with aggression predicting risk for PG in females, and *fewer* social and attention problems predicting risk for PG in males. Finally, neither internalizing (i.e., depressive, anxiety) symptoms, nor parental gambling, predicted risk for PG in adolescents.

The temperament findings are consistent with previous cross-sectional and longitudinal research. In particular, similar measures of temperamental negative affectivity have been shown to cross-sectionally and prospectively predict PG in youth in previous research (MacLaren, et al., 2011; Myrseth, et al., 2009; W.S. Slutske, et al., 2005). It has been suggested that gambling may be used as a means to induce dissociation to reduce or escape states of chronic depressed mood (Alex Blaszczynski & McConaghy, 1989; Jacobs, 1986). Interestingly, the temperamental dimension measured in this study, Negative Affectivity, describes the tendency to feel *frustration* in the face of limitations, rather than low mood, per se. As such, our finding may be more consistent with research linking emotional/behavioral dysregulation and anger with PG (Korman, Cripps, & Toneatto, 2008). Similarly, however, it has been suggested that individuals may gamble in order to change or relieve feelings of anger/frustration (Korman, et al., 2008).

Our finding that low temperamental Attention (defined as the capacity to focus and shift attention when desired) predicted risk for PG is not directly comparable with previous research (as to our knowledge, no research has assessed this temperamental factor,

specifically), however, it is consistent with other research suggesting poor general executive function (Anna E. Goudriaan, Oosterlaan, De Beurs, & Van Den Brink, 2006), and specifically, attention deficits (Rugle & Melamed, 1993) in PG. While previous studies have been cross-sectional, our data suggest that attention problems may predate the development of PG.

Thus, given the prospective nature of our study, and the suggestion that individual differences in temperament are early appearing and relatively stable, our results are consistent with a causal relationship between pre-existing individual differences in temperament and problematic gambling behavior, rather than an acute "state-like" reaction to gambling problems, which has been suggested by other studies.

Our finding that risk-taking behaviors, and in particular substance-use, predicted risk for PG is consistent with much previous evidence for links between substance-use problems and PG (Feigelman, Kleinman, Lesieur, Millman, & Lesser, 1995; Potenza et al., 2001). It has been suggested that PG and substance-use problems may share common etiology (Vitaro, Ferland, Jacques, & Ladouceur, 1998), and that individuals with such concurrent problems tend to experience the most severe gambling-related problems (Steel & Blaszczynski, 1996). There is some evidence that substance use disorders precede the onset of PG (Cunningham-Williams, Cottler, Compton 3rd, & Spitznagel, 1998). Our study is the first to show that substance-use (not necessarily substance-use disorder) during mid-adolescence may predate and hence provide risk for the onset of PG in emerging adulthood.

Regarding psychiatric symptoms and problem behaviors, neither depressive or anxiety symptoms during early- or mid-adolescence predicted risk for PG during late-adolescence. This finding is in contrast with previous research showing both cross-sectional and

prospective links between these types of symptoms and PG (Ibáñez et al., 2001; Lee, et al., 2011). However, it is consistent with other research suggesting that problems with depression and anxiety are more likely to occur as a consequence of PG (Cunningham-Williams, et al., 1998). It is also possible that the way I which internalizing symptoms interact with other factors may be more important for predicting PG (Lee, et al., 2011). In our adolescence sample, externalizing behavior appeared to be a better predictor of risk for PG, but interestingly, the particular types of behaviors predictive of risk for PG were different for males and females. Aggressive behaviour specifically predicted risk for PG for females. Athough there is not a lot of previous research to support this female-specific finding, there is a recent cross-sectional study that found aggression in females but not males to be associated with PG (Casey et al., 2011). Our findings extend these results to suggest that aggression in females may represent a risk factor for the subsequent development of PG. Our results also support the suggestion that aggression in females might indicate greater maladjustment and lead to more negative outcomes (Crick, 1997). For males, *lower* social and attention behavioral problems predicted risk for PG. The former result suggests that boys who are social, get along with their peers, are liked by peers, are more likely to be at risk for PG. It is possible that for boys, one pathway to PG may be via increased socialising with peers. This is consistent with a recent model, suggesting that at least one route to PG may initially be through drive for entertainment or socialization (A. Blaszczynski & Nower, 2002). The latter finding is somewhat inconsistent with our finding that decreased temperamental attention predicted risk for PG in boys. However, on reflection of the types of attention problems that are captured by the EATQ-R attention subscale versus the CBCL attention problems scale, it does seem to appear that these measures are tapping into different aspects of attention. Indeed, these measures are significantly negatively correlated in our sample (r = -.36, p < 0.001). It has been suggested

that high scores on the CBCL attention problems scale may be associated with internalizing problems and disorders more so than externalizing problems (Biederman, Monuteaux, Kendrick, Klein, & Faraone, 2005). Conversely, low scores on CBCL attention may indicate higher externalizing symptoms, which is consistent with previous research linking a range of externalizing behaviors with PG (A. Blaszczynski & Nower, 2002).

Limitations

While this study is unique in terms of the sample and longitudinal methodology, and has uncovered potentially important insights into risk for PG during adolescence, the reported findings must be considered in light of some limitations. Firstly, due to the low frequency of PG in our sample, our outcome measure was risk for PG, as opposed to PG itself, although it must be said that the specific criteria for PG are not well established. Thus, it is not clear whether adolescents classified as at risk for PG will eventually go on to experience PG and associated negative outcomes. Second, we were interested in investigating a wide array of risk factors so as to provide a comprehensive picture of risk for PG during emerging adulthood. Although the investigated risk factors were selected on the basis of theory, analyses were exploratory in nature, and hence we did not correct significance levels to account multiple comparisons. Thus, our findings need to be replicated, preferably in larger samples, before any firm conclusions can be drawn. Finally, although we investigated risk factors spanning temperament, behaviour, psychiatric symptoms, in addition to some demographic variables (e.g., SES), and parental gambling, we did not assess a range of other factors that have been suggested as potentially important, including individual differences in neurobiology, family and peer relationships, childhood maltreatment, and other aspects of

the adolescent's social environment. Future work is needed to comprehensively examine all of these factors.

Implications and Conclusions

The findings of this research have potential implications for the development of prevention and intervention efforts, and public policy. Traditionally, services for problem gamblers have focused on those with established problems. Whilst significant gains in outcomes have been obtained in other areas of health by focusing on early intervention and prevention, in the gambling field this approach has been limited by (a) the inability to predict who is likely to go on to develop serious PG, and (b) a paucity of developmentally targeted treatment and prevention strategies that can be used earlier in life (i.e., prior to the peak onset of gambling problems.

This study provided unique information regarding risk factors during the critical phases of early- and mid-adolescence, and in particular suggested that a profile of temperament and behavioral problems best described as along the "externalizing" spectrum might act as markers of risk for the emergence of gambling problems during late adolescence and early adulthood. As such, these results suggest that intervention and prevention strategies should target adolescents with such temperamental and behavioral characteristics. Further, results suggest that there may be separate pathways to PG for males and females. Whereas aggressive problems should be targeted to aid in the prevention of PG in females, males who are particularly outgoing, and initially start gambling for social purposes, may be at risk for PG and hence, should be targeted in prevention and early intervention efforts.

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