

Title: Co-morbidity between Gambling Problems and Depressive Symptoms: A Longitudinal
Perspective of Risk and Protective Factors

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Abstract

In both adolescents and adults, gambling problems and depressive symptoms co-occur and share some common risk factors (e.g., impulsivity and socio-family risk). However, little is known about (1) the developmental course of the co-morbidity of these problems; (2) variables that may moderate the effect of these common risk factors on gambling problems and depressive symptoms. Of specific interest could be individuals' social relationships with significant others such as parents and friends, because research shows that they moderate the effect of other risk factors on gambling problems and depressive symptoms. The goals of this study were to: (a) identify developmental pathways for gambling problems and depressive symptoms, with a focus on co-morbidity; (b) assess the moderating effect of relationship quality with parents and friends on the link between common risk factors and the trajectories of gambling problems and depressive symptoms. Study participants were 878 males. Predictors were assessed during childhood and adolescence and gambling problems and depressive symptoms were assessed in late adolescence and young adulthood. Latent class analysis revealed 4 distinct joint trajectories of gambling problems and depressive symptoms. Subsequent logistic revealed that impulsivity predicted membership in all pathogenic trajectories, and quality of the relationship with parents predicted membership in depressiogenic trajectories. In addition, we found that the membership in the comorbid trajectory can be predicted by an interaction between friendship quality and socio-family risk.

Keywords: gambling problems, depressive symptoms, comorbidity, impulsivity, relation with parents, relation with peers.

Co-morbidity between Gambling Problems and Depressive Symptoms: A Longitudinal Perspective of Risk and Protective Factors

Gambling is a popular activity among adolescents. Between 70% and 85% of adolescents report involvement in gambling activities at some point in their life and between 66 and 78% report having gambled within a given year (National Research Council, 1999). Although most adolescent gamblers are ‘social’ (i.e., recreational) or ‘occasional’ gamblers, a non-negligible portion can be considered problem gamblers (i.e., gamblers with gambling related problems) (National Research Council, 1999). Indeed, some authors argue that between 10% and 15% of adolescents are at risk of developing gambling related problems, with 3% and 8% having serious problems (Turchi & Derevensky, 2006). These data raise major concerns about gambling activity among adolescents because of the significant, if moderate stability of gambling behavior from adolescence to early adulthood (Wanner, Vitaro, Carbonneau, & Tremblay, 2009) and because of the problems that adolescent gamblers may experience (Chambers, Taylor, & Potenza, 2003).

Depressive symptoms represent one important adjustment problem that seems to repeatedly co-occur with gambling problems, with almost half of problem gamblers also presenting with a major depressive disorder (Lorains, Cowlishaw, & Thomas, 2011). However, the nature of this relationship, particularly over time, remains unclear as existing studies on the co-occurrence of gambling problems and depressive symptoms have relied on measures collected at a single-time point only. While results from these studies are important from a public health perspective to establish prevalence rates of comorbidity, such research does not provide any information about potential developmental changes and linkages between gambling problems and depressive symptoms. Consequently, the first goal of this study was to determine how the two sets of problems co-evolve over an 11-year period (i.e., from ages 17 through 28 years) using a person-oriented approach. More specifically, we aimed to empirically derive latent longitudinal classes of problem gamblers and-or depressed individuals. To further

document the etiology of gambling problems and depressive symptoms, as well as their longitudinal overlap, we also examined whether a series of risk and protective factors were differentially related to the empirically derived longitudinal (single or joint) trajectory classes.

Latent Trajectory Classes of Problem Gamblers and-or Depressed Individuals

To our knowledge, only one study so far has examined average developmental trends of gambling problems. Specifically, using growth modeling, Edgerton and colleagues (2014) found that gambling problems tend to decrease over time in young adults (i.e., from ages 18 to 24 years). More studies have modeled changes in depressive symptoms across adolescence (Cole et al., 2002; Garber, Keiley, & Martin, 2002; Keenan, Feng, Hipwell, & Klostermann, 2009; Measelle, Stice, & Hogansen, 2006) and from adolescence to early adulthood (Galambos, Barker, & Krahn, 2006; Galambos, Leadbeater, & Barker, 2004; Ge, Lorenz, Conger, Elder, & Simons, 1994; Kim, Capaldi, & Stoolmiller, 2003). These studies have consistently found that levels of depressive symptoms are rather low during middle childhood but increase significantly over the course of early adolescence, albeit mainly in girls. While informative, these growth curve analyses mainly describe general developmental patterns but they do not indicate how many individuals deviate from this general course and in which way. Failure to consider this heterogeneity may yield results of limited interpretability, however, as different etiologic factors might operate to produce different levels of severity or different developmental trajectories of problems (Bauer & Curran, 2003). This problem can be circumvented using growth-mixture models for longitudinal data (Muthen & Muthen, 2000), which allow testing whether subgroups exist with the population that follow qualitatively distinct developmental trajectories (i.e., latent trajectory classes), with respect to both gambling problems and depressive symptoms.

Previous studies examining longitudinal taxonomies of depression symptoms in adolescence and early adulthood reported between four and six trajectory groups, depending on the range of the developmental period and the sample size (Costello, Swendsen, Rose, & Dierker, 2008; Olino, Klein,

Lewinsohn, Rohde, & Seeley, 2010; Stoolmiller, Kim, & Capaldi, 2005; Wickrama & Wickrama, 2010). Overall, the results from these studies suggest that between 1.3% and 24.3% of individuals show persistently high or increasing depressive symptoms at some time between adolescence and young adulthood. Regarding gambling, mostly trajectories of participation have been modeled in adolescence (Dussault et al., 2013; Vitaro, Wanner, Ladouceur, Brendgen, & Tremblay, 2004). To our knowledge, only one recent study examined the evolution of problem gambling over time. Carbonneau et al. (2010) investigated the developmental trajectories of gambling problems from age 15, to age 22 and age 30, in a mixed-gender cohort from the general population. They identified two distinct trajectories based on the probability of having at least one gambling-related problem or none: one trajectory including males and females who were unlikely to have experienced gambling problems across the 15-year period, and one trajectory including participants likely to have experienced at least one GP over the last 12 months at each time of assessment (7.4% of sample), with probabilities ranging from .89 to .93 to .70, respectively, at ages 15, 22 and 30. However, no study has assessed the combined developmental trajectories of gambling problems and depressive symptoms. From a theoretical perspective the examination of these combined trajectories is crucial to clarify whether trajectories of gambling problems and trajectories of depressive symptoms are associated over a transitional period such as from late adolescence to early adulthood and, if so, to what degree.

Another point of interest regarding the possible joint development of gambling problems and depressive symptoms is the presence of potential common antecedent (risk and/or protective) factors. Indeed, if gambling problems and depressive symptoms are associated throughout time, as would be indicated by joint trajectories, we can expect that they share some common antecedent risk factors. Alternatively, participants on a single trajectory of gambling problems (i.e., without depressive symptoms) might enjoy protective factors that are not available to individuals on a joint (i.e., co-morbid) trajectory. The examination of the early risk and protective factors associated with joint or

single trajectories of gambling problems and depressive symptoms is important from a clinical perspective because it would allow maximizing prevention effects already at an early age, before adjustment difficulties increase and spiral out of control.

Impulsivity and Socio-family Risk as Predictors of Gambling Problems and Depressive Symptoms

The few longitudinal studies examining risk factors associated with problem gambling suggest that impulsivity present at a young age (i.e., in middle or even early childhood) is an important predictor of later gambling problems in adulthood (Shenassa, Paradis, Dolan, Wilhelm, & Buka, 2012; Slutske, Moffitt, Poulton, & Caspi, 2012). Impulsivity is a personality factor described by: (1) a drive for immediate reinforcement, (2) a tendency to act without thinking about negative consequences, (3) an insensitivity to punishment, and (4) a lack of inhibitory control (Barratt & Patton, 1983). This pattern of responses puts impulsive individuals at risk for developing and maintaining gambling problems (Wanner et al., 2009). Impulsivity has also been found to predict elevated depressive symptoms (Granö et al., 2007). This can be explained by the fact that impulsive individuals (1) are more likely to encounter adverse situations, which, in turn, can lead to depression (Granö et al., 2007) and (2) have poor emotion regulation strategies when facing negative events, as they are more prone to rumination, self-blame and catastrophizing than others, which may make them especially vulnerable to depression (d'Acremont & Van der Linden, 2007). In consequence, it is possible that individuals who are following a joint trajectory of gambling problems and depressed symptoms are particularly high on impulsivity already at a relatively young age, compared to individuals who follow a single trajectory of either gambling problems or depressed symptoms and more so compared to individuals with no problem.

Another early risk factor that might be associated with both gambling problems and depressive symptoms in later life is socio-family risk during childhood, which refers to an accumulation of stressors such as poverty and family hardship (Evans, Li, & Whipple, 2013). Indeed, childhood socio-

family risk has been linked to a variety of adjustment problems in adolescence, including externalizing and internalizing behaviors (Appleyard, Egeland, van Dulmen, & Sroufe, 2005). A high level of socio-family risk in childhood may lead to subsequent adjustment problems in part through its negative impact on parents' mental health and behavior toward their children (Doan, Fuller-Rowell, & Evans, 2012), which in turn, has been shown to increase the risk of externalizing problems such as gambling or internalizing problems such as depression in the offspring (McLaughlin et al., 2012). Again, individuals following a joint high trajectory of gambling problems and depressed symptoms may experience particularly high levels of socio-family risk during childhood compared to those presenting with consistently high levels of only one problem or those without any problems.

Importantly, while the predictive roles of impulsivity and socio-family risk on gambling problems and depressive symptoms have mostly been tested in terms of additive effects only, findings from at least one study suggest that the two predictors may interact (Auger, Lo, Cantinotti, & O'Loughlin, 2010). Specifically, in line with a diathesis-stress process, impulsivity may be associated with gambling problems only for youth from low SES families. However, the Auger et al. study examined gambling frequency rather than the severity of gambling problems. In addition, Auger and colleagues measured gambling participation at only one point in time. In sum, no study to date has assessed the additive and interactive effect of impulsivity and socio-family risk on the comorbidity of gambling problems and depressive symptoms captured from adolescence to young adulthood.

Potential Protective Factors: Relationships with Parents and Friends

Although both impulsivity and socio-family risk are significantly linked to gambling problems and depressive symptoms, effect sizes - either separately or interactively - are relatively modest, with odds ratios typically well below 0.2 (e.g., Vitaro et al., 1999; Granö et al., 2007). The modest effect sizes may indicate the presence of moderator variables that might act as protective factors. These protective factors might be particularly salient in regard to participants who follow a single trajectory

with respect to gambling problems (and possibly depressive symptoms). One such possible protective factor may be the quality of the relationship with parents, which has been consistently linked to the reduced development of externalizing problems (Barnes, Mitic, Leadbeater, & Dhimi, 2009) and internalizing problems (Brown, Meadows, & Elder, 2007). It has been suggested that a strong affective bond with parents fosters the child's acceptance and internalization of social behavioral norms, which in return decreases the risk of externalizing behavior (Hirschi, 2002). In addition, a good parent-child relationship is believed to instigate the child to develop positive views of the self and of others, thus preventing the development of depressive symptoms (Cassidy, Ziv, Mehta, & Feeney, 2003). These processes may also protect youngsters whose personal characteristics (e.g., impulsivity) or environmental circumstances (e.g., socio-familial risk) put them at risk of developing externalizing or internalizing problems. In support of this notion, some studies showed that parental support can mitigate the effect of pre-existing risk factors on externalizing (Henrich, Brookmeyer, Shrier, & Shahar, 2006) and internalizing (Helsen, Vollebergh, & Meeus, 2000) problems. However, no study has assessed such a potential protective effect of parental support in regard to the development of gambling problems or its comorbidity with depressive symptoms.

Like the quality of the relationship with parents, a vast number of studies showed that adolescents with a good relation with a best friend are significantly less likely to develop externalizing and internalizing problems, even if they are initially part of a 'at-risk' group (Bollmer, Milich, Harris, & Maras, 2005; Bukowski, Laursen, & Hoza, 2010). Having a good relationship with a friend could attenuate or even prevent the risk associated with personality factors such as impulsivity or with adverse environmental conditions such as like socio-family risk. Indeed, the stress buffering model (Cohen & Wills, 1985) posits that the beneficial influence of social support will be especially salient in stressful environments. However, similar to the relationship with parents, the potential moderating role

of social support from friends on the link between risk factors (e.g., socio-family risk and impulsivity) and gambling problems/depressive symptoms still remains to be examined.

Study Objectives

To address the issues noted previously, the *first* objective of this study was to identify simple and joint (e.g., co-morbid) latent longitudinal classes of gambling problems and depressive symptoms, from late adolescence to young adulthood (i.e., ages 17 through 28 years) in a normative population sample. Based on the evidence reviewed above, two or three latent classes were expected for each outcome. We also expected that high/chronic levels of gambling problems would have a strong association with high/chronic levels of depressive symptoms. However, we expected to find a certain number of participants high on depressive symptoms but not on gambling problems, given that depressive problems are more prevalent than gambling problems in the general population. The *second* objective was to contrast the joint latent classes in regard to two well established risk factors of gambling problems and depressive symptoms (e.g., socio-family risk and impulsivity) and to determine whether these two risk factors operate additively or interactively in predicting class membership. Finally, the *third* objective was to test whether a good relationship with parents and-or with the best friend can play a protective role with respect to the link between the risk factors and membership in the joint trajectories of gambling problems and depressive symptoms. Of note, previous findings show that boys tend to gamble considerably more often, spend more time and money and experience more problems than girls (Gupta & Derevensky, 1998). Some studies have also reported ethnic differences in gambling involvement (Stinchfield, Cassuto, Winters, & Latimer, 1997). For these reasons, gender and ethnicity were controlled methodologically by using a sample of Caucasian boys.

Method

Participants

Participants were part of an ongoing longitudinal study that started in 1984 with 1162 kindergarten boys. They attended 53 schools in economically disadvantaged areas in Montreal, Canada (Mean age = 6.02; SD = .52). Boys included in the initial sample represented 87% of all boys attending the 53 schools that participated in the study. Socio-family risk data were collected when the boys were 10 years old. Impulsivity data were collected when the boys were 14 years old. Data on the quality of the relationship with parents and friends were collected when the boys were 14 and 15 years old. Gambling and depression data were collected at ages 17, 23 and 28 years. To be included in the present study, participants had to have valid gambling and depression data during at least one of the three measurement times, resulting in an N of 888.

After approval from the School Board, teachers and parents of the boys in the target classrooms were contacted by mail and invited to participate. Active written consent was obtained from parents and teachers, as well as active verbal assent from the boys during adolescence. In adulthood, active written consent was obtained from all participants. Participants were informed that their answers were strictly confidential and that they could stop their participation at all times.

Measures

Socio-family risk. Mothers reported on: (a) family structure (two parents or single), (b) educational level of both parents, (c) occupational status of both parents (or occupation of the parent with whom the child was living) based on the Blishen, Carroll and Moore (1987) occupational prestige scale, and (d) mother's and father's age at the birth of the first child. The co-occurrence of several of these factors has been found to predict a variety of offspring adjustment problems in adolescence and early adulthood (Evans et al., 2013). A score of 0 was attributed to family structure if the child was living with both natural parents and a score of 1 was attributed to all other cases. Parental educational level, parental occupational status, and mother's or father's age at the birth of the first child were scored 1 when the individual scores were in the lower quartile of the respective variable distribution. A

score of 0 was given to scores above the first quartile of the distributions. A total Family Adversity index was then computed by summing individual scores. As such, a high value on this composite variable indicates a high level of family adversity ($M = 1.06$, $SD = 1.05$).

Impulsivity. To partly overcome the problem of shared method variance (e.g., quality of the relationship with parents and best friend, gambling problems and depressive symptoms were all based on self-reports), we used participants', teachers' and mothers' reports to create a composite score of participants' impulsivity. Self-reported impulsivity was assessed when participants were 14 years old using a French version of the Impulsiveness Scale (EIS; Eysenck & Eysenck, 1978), which is composed of the following five items: 'do you generally do and say things without stopping to think?', 'do you often get into trouble because you do things without thinking?', 'are you an impulsive person?', 'do you usually think carefully before doing anything?', 'do you mostly speak before thinking things out?' Items could be answered yes (1) or no (0) (Cronbach's $\alpha = .69$, $M = 1.72$, $SD = 1.59$). When the boys were 14 years old, teachers and mothers rated the degree of boys' impulsivity using three items from the Social Behavior Questionnaire (SBQ; Tremblay, Loeber, Gagnon, Charlebois, & et al., 1991), which closely correspond to behaviors reflective of the DSM-IV hyperactivity-impulsivity syndrome (Achenbach, Dumenci, & Rescorla, 2003). These items were: 'jumps from one activity to another without finishing', 'attracts attention by shouting', 'acts without reasoning'. Together, the items from the three sources capture both the cognitive and the behavioral dimensions involved in the impulsivity construct (Moeller, Barratt, Dougherty, Schmitz, & Swann, 2001). Each item was scored 0, 1 or 2, with higher numbers indicating the item was more applicable to the boy being rated (Cronbach's $\alpha = .89$ for the teachers' assessment; $M = 2.76$, $SD = 3.44$; Cronbach's $\alpha = .80$ for the mothers' assessment; $M = 4.11$, $SD = 3.08$). Inter-informant correlations were moderate (r s between .20 and .30) but significant ($p < .01$). The scores were z-standardized and a mean value of the three scores was computed to create the composite impulsivity score.

Quality of the relationship with parents. Quality of the relationship with parents was measured through participants' self-reports at ages 14 and 15 years. For this purpose, three items were used that were part of a larger scale designed to measure family relations and developmental adjustment (Le Blanc, 1992; Le Blanc & Fréchette, 1989): 'do your parents encourage and compliment you?', 'do your parents know about your feelings and thoughts?' and 'how often do you engage in conversations with your parents?'. Items were answered on a four-point scale that ranged from 1 (*never*) through 4 (*always*) and were summed to create a global score, with a higher score indicating a better relationship with parents (Cronbach's alpha = .70 at age 14 and .71 at age 15, means ranging from $M = 7.94$, $SD = 2.08$, at age 14 to $M = 7.41$, $SD = 2.12$, at age 15). Total scores at ages 14 and 15 years were significantly correlated ($r = .52$, $p < .001$) and were averaged to form a total score.

Quality of the relationship with the best friend. Quality of the relationship with the best friend was measured through participants' self-reports at ages 14 and 15 years. For this purpose, four items were used that were part of a larger scale designed to measure affective attachment to the best friend (Le Blanc & Fréchette, 1989): 'do you ask your best friend for advice when you have to decide something?', 'does your best friend know about your feelings and thoughts?', 'do you talk of problems you have at home with your best friend?' and 'do you totally trust your best friend?'. Items were answered on a four-point scale ranging from 1 (*never*) through 4 (*always*) and were summed to create a global score, with a higher score indicating a better relationship with the best friend (Cronbach's alpha = .72 at age 14 and .70 at age 15, means ranging from $M = 12.16$, $SD = 2.59$, at age 14 to $M = 12.27$, $SD = 2.42$, at age 15). Total scores at 14 and 15 years old were significantly correlated ($r = .46$, $p < .001$) and averaged to create a total score.

Gambling problems. At age 17 years the South Oaks Gambling Screen for Adolescents (SOGS-RA; Winters, Stinchfield, & Fulkerson, 1993) was administered (Cronbach's alpha = .76, $M = .40$, $SD = 1.12$). At ages 23 and 28 years, the South Oaks Gambling Screen (SOGS; Lesieur & Blume, 1987)

was administered (Cronbach's alphas of .88 and .96, means ranging from $M = .50$, $SD = 1.48$, at age 23 to $M = .54$, $SD = 1.33$, at age 28). These instruments assess (a) gambling frequency and diversity as well as (b) the number of gambling-related problems experienced by the participants over the past 12 months using a list of possible problems (e.g., feeling of guilt, debts caused by gambling activities, etc.). For this study, only the total problem scale score (ranging from 0 to 12 for both instruments) was used. Higher scores indicate more problems.

Depressive symptoms. At age 17 years, the Child Depression Inventory (CDI; Kovacs, 1992) was administered. The CDI is a self-reported 27-item scale assessing affective, cognitive, motivational and somatic symptoms of depression. Individual item scores ranged from 0 to 2 and were summed, with higher ratings indicating more severe symptoms (Cronbach's alpha = .80, $M = 7.87$, $SD = 5.48$). At ages 23 and 28 years, the Diagnostic Interview Schedule for the DSM-IV (DIS; Robins, 1995) was used to assess symptoms of depression. The DIS-IV is a structured psychiatric interview designed to assess psychiatric symptoms based on the DSM-IV (American Psychiatric Association, 1994). To increase variability, we used a four-point scale ranging from '0' (*never*) to '3' (*often*) instead of a yes-no response. Individual item scores were summed, with a higher score on the total measure indicating more severe depressive symptomatology (Cronbach's alpha = .90 at age 23 and .91 at age 28, means ranging from $M = 13.41$, $SD = 8.03$, at age 23 to $M = 13.12$, $SD = 10.43$, at age 28).

Analyses and Results

Separate Trajectories of Gambling Problems and Depressive Symptoms

We used MPlus Version 6.11 (Muthén & Muthén, 1998-2012) to determine the number of groups with homogenous trajectories of gambling problems and depressive symptoms, respectively. The Sample Size Adjusted Bayesian Information Criterion (SSA-BIC) was used to evaluate model fit. Although, theoretically, the optimal model is the lowest SSA-BIC, models were consistently improving with the addition of new trajectory groups. Indeed, for gambling problems, the SSA-BIC for models

with 1 to 5 trajectory groups consistently decreased from 5885.81 (for the one-group model) to 5108.98, 4607.39, 4254.32 and 3969.50 (for the five-group model). Similarly, for depressive symptoms, the SSA-BIC for models with 1 to 5 trajectory groups consistently decreased from 13120.10 (for the one-group model) to 12833.16, 12710.86, 12682.86 and 12636.60 (for the five-group model). Consequently, we used the entropy estimates to help identify the best fitting solution. Entropy estimates, which reflect the ability of a mixture model to provide well separated clusters, can range from 0.00 to 1.00, with higher values indicating a better solution (Celeux & Soromenho, 1996). For gambling problems, entropy estimates for models with 2 to 5 trajectories ranged from 0.965 (for the two-group model) to 0.962, 0.942 and 0.941 (for the five-group model). Based on these criteria, we chose the two-group model as the best model for gambling problems **Fig. 1** *Estimated trajectories of gambling problems, between 17 and 28 y.o.* In this model, 96.8% of participants were classified as always low on gambling problems between 17 and 28 years old. The remaining 3.2% of participants were classified as being on an increasing and then chronic trajectory of gambling problems. Average posterior assignment probabilities for latent class membership were very high (0.99 for Class 1 and 0.96 for Class 2). For depressive symptoms, entropy estimates with models with 2 to 5 trajectories ranged from 0.76 (for the two-group model) to 0.79, 0.71 and 0.74 (for the five-group model). Therefore, we chose the three-group model as the best model for depressive symptoms **Fig. 2** *Estimated trajectories of depressive symptoms, between 17 and 28 y.o.* In this model, 73.7% of participants were classified as always being low on depressive symptoms between ages 17 and 28 years, 10.2% of participants were classified as always being moderately depressed and 16.1% of participants were classified as being on a high increasing trajectory of depression symptoms. Average posterior assignments for latent class membership were high to very high (0.93 for Class 1, 0.84 for Class 2 and 0.84 for Class 3).

Joint Trajectories of Gambling Problems and Depressive Symptoms

Joint Probabilities of Trajectory Group Membership. The joint trajectory analysis identified six groups of participants with distinct developmental patterns of gambling problems and depressive symptoms. The top part of Table 1 shows the proportion of participants in each group. The rows represent the two gambling trajectories, the columns represent the three depressive symptoms trajectories and the 2 x 3 combinations of the cells represent the proportion of participants in each of the six joint trajectory groups. Group 1 represents participants who were classified in trajectories of low gambling problems and low depressive symptoms, 76.69% of the sample ($n = 681$). Group 2, with low depressive symptoms and high gambling problems, consists of 0.07% of the participants ($n = 7$). Group 3 comprises 7.9% of the participants who were classified in trajectories of moderate depressive symptoms and low gambling problems ($n = 71$). Group 4 contains participants in trajectories of moderate depressive symptoms and high gambling problems (0.03% of the sample; $n = 3$). Group 5, those in a high depressive symptoms and low gambling problems, comprises 12.39% of the sample ($n = 110$). Finally, group 6 contains participants in trajectories of high depressive symptoms and high gambling problems (1.8% of the sample; $n = 16$).

Probabilities of Depressive Symptoms Conditional on Gambling Problems. The middle part of Table 1 presents conditional probabilities of depressive symptoms given gambling problems membership. Participants low in gambling problems as well as those high in gambling problems were most likely to be classified in the low depressive symptoms trajectory (conditional probability = .92 and conditional probability = .77, respectively). Compared to participants in the low gambling problems trajectory, however, those in the high gambling problems group were more likely to be classified as moderate (conditional probability = .11 versus .03) and high on depressive symptoms (conditional probability = .12 versus .04).

Probabilities of Gambling Problems Conditional on Depressive Symptoms. The bottom part of Table 1 presents participants' conditional probabilities of gambling problems given their depressive

symptoms trajectory. Participants moderate on depressive symptoms were more likely to be classified as high on gambling problems (conditional probability = .23), compared to the low depressive symptoms group (conditional probability = .08). However, given the significant correlation between gambling problems and depressive symptoms, the risk for high gambling problems varied little between those showing moderate and high depressive symptoms over time (conditional probability = .23 versus .17 for individuals with high depressive symptoms).

Associations of Risk and Protective Factors with Joint Trajectories of Gambling Problems and Depressive Symptoms

Hierarchical multinomial logistic regression analysis was conducted to assess the additive and interactive predictive links between socio-family risk, impulsivity, quality of the relationship with parents and with the best friend on membership, on one hand, and the joint trajectories of gambling and depressive symptoms, on the other hand, using the ‘low depressive symptoms/low gambling problems’ trajectory as the reference group. Because the joint trajectory groups 2 and 4 (i.e., the ‘low depressive symptoms/high gambling problems’ and the ‘moderate depressive symptoms /high gambling problems’ trajectory groups) only comprised 7 and 3 participants, respectively, these groups were excluded from the analyses, resulting in a final N of 878. Results are presented in Table 2. Main effects of the risk factors (i.e., socio-family risk and impulsivity) were assessed on the first step. On the second step, the main effects of the potential protective variables (i.e., quality of the relationship with parents and quality of the relationship with the best friend) were added to the model. On the third step, the double interaction between socio-family risk and impulsivity was included. On the fourth step, the following double interaction terms were included to assess potential protective (i.e., moderating) effects: ‘socio-family risk x quality of the relationship with parents’, ‘socio-family risk x quality of the relationship with best friend’, ‘impulsivity x quality of the relationship with parents’ and ‘impulsivity x quality of the relationship with best friend’. To aid interpretability of regression coefficients, all independent

variables were standardized before creating the interaction terms (Jaccard, Wan, & Turrisi, 1990). The procedure described by Holmbeck (2002) was used to probe significant interactions (see below).

Results revealed that high levels of impulsivity were associated with increased odds of following either a ‘low gambling problems/moderate depressive symptoms’ trajectory (O.R. = 1.364, $p = .02$), a ‘low gambling problems/high depressive symptoms’ trajectory (O.R. = 1.381, $p < .01$) or a ‘high gambling problems/high depressive symptoms’ trajectory (O.R. = 2.168, $p < .001$) rather than following a ‘low gambling problems/low depressive symptoms’ trajectory. In contrast, a good relationship with parents decreased the odds of following a ‘low gambling problems/moderate depressive symptoms’ trajectory (O.R. = .74, $p = .03$) or a ‘low gambling problems/high depressive symptoms’ trajectory (O.R. = .742, $p = .01$) but, unexpectedly, was unrelated to the odds of following a ‘high gambling problems/high depressive symptoms’ trajectory. The quality of the relationship with the best friend did not, in and of itself, predict membership in any of the joint trajectory groups. However, the quality of the relationship with the best friend significantly moderated the effect of socio-family risk on following a ‘high gambling problems/high depressive symptoms’ trajectory (O.R. = 1.849, $p = .05$). Probing the interaction showed that, contrary to predictions, socio-family risk was related to increased odds of following a ‘high gambling problems/high depressive symptoms’ trajectory when the quality of the relationship with best friend was high (O.R. = 3.252, $p = .04$, when friendship quality was 2 SD above the mean and O.R. = 2.005, $p = .06$, when friendship quality was 1 SD above the mean). In contrast, when the quality of the relationship with the best friend was low, socio-family risk no longer predicted the odds of following the ‘high gambling problems/high depressive symptoms’ trajectory (O.R. = .470, $p = .18$, when friendship quality was 2 SD below the mean and O.R. = .762, $p = .46$, when friendship quality was 1 SD below the mean).

Discussion

The goal of this study was to examine how gambling problems and depressive symptoms co-evolve from adolescence to emerging adulthood by empirically deriving single and joint latent trajectory classes. In addition, we also assessed whether a series of risk and protective factors were differentially related to these single or joined trajectory classes.

In terms of gambling problems, the results from the present study suggest that only a small minority (around 3%) are at risk of experiencing increasing and chronic gambling problems from the end of adolescence through young adulthood. This result, based on a sample of males from low SES families, is similar to Carbonneau and colleagues' (2010) report based on a mixed-gender cohort from the general population, which also identified two trajectories of gambling problems (Low and High) between ages 15 and 30. Moreover, our finding concords with the prevalence rate of problem gambling in the general adult population, which varies between 1% and 3% (Wiebe & Volberg, 2007). However, the developmental course of gambling trajectories identified in our study and in the Carbonneau et al. (2010) study does not seem to be in line with Moffitt's taxonomy of deviant behaviors (Moffitt, 1993), which posits the existence of a high-and-then-declining pathway. The failure to identify a declining trajectory of gambling problems may be explained by the fact that, contrary to delinquent behavior such as violence or theft, gambling is no longer illegal once individuals reach adulthood. Also, delinquency and illegal activities may be influenced partly by social factors (e.g., affiliation with deviant peers) that may not be as important by early adulthood as during adolescence. In contrast, gambling problems may be more a personal problem similar to an addiction: once acquired, they are difficult to get rid of. Our results also indicate that individuals following an increasing gambling problems trajectory experience more severe symptoms than others already at the end of adolescence (i.e., at age 17). Consequently, it seems possible to screen individuals with high gambling problems already prior to adulthood and before their symptoms increase even further. We cannot exclude the possibility, however, that at least some of the high problem gamblers identified in the present study

show decreasing problem behavior at the beginning of their thirties, when many males form families and enter more stable career paths.

Three single trajectories of depressive symptoms (low, moderate and increasing) and two single trajectories of gambling problems (low and increasing/chronic) were also identified in the present study. The percentage of participants in the ‘high depressive symptoms’ trajectory group (12.5%) is concordant with the prevalence estimates of depressive disorders in young adulthood, which vary between 8.2% (Pine, Cohen, Gurley, Brook, & Ma, 1998) and 16.8% (Newman et al., 1996). Nevertheless, despite similar patterns in terms of overall longitudinal trends, the number of depressive symptoms trajectories identified in our study based on three available measurement points is not entirely concordant with other studies covering a similar developmental period but using more measurement points, which identified between four and six distinct trajectories (Costello et al., 2008; Olinio et al., 2010; Stoolmiller et al., 2005). However, with one exception (Olinio et al., 2010), previous studies did not assess depressive symptoms beyond age 24 years, which roughly corresponds to our second measurement time point.

More importantly, this is the first study to investigate to what extent longitudinal trajectories of gambling problems coincide with trajectories of depressive symptoms. The results from the joint trajectory analysis indicate that most young males with high levels of gambling problems follow a joint trajectory of high depressive symptoms. Indeed, participants with high gambling problems and low or moderate depressive symptoms only constituted 1% of the sample. These findings are noteworthy as they support the notion that ‘pure’ gamblers without comorbid internalizing problems are an exception rather than the rule, at least during the late adolescence-early adulthood period. In addition, the results suggest that chronic problem gambling could indicate the presence of depressive symptoms, even if the opposite is not necessarily the case. The elevated co-morbidity between depressive symptoms and gambling problems may result from the mutual influence between the two sets of problems from late

adolescence through early adulthood. In support of this notion, Dussault et al. (2011) showed that gambling problems and depressive symptoms mutually influence each other from adolescence to emerging adulthood, even after accounting for common risk factors.

In regard to the assessment of early risk factors, results showed that impulsivity, but not socio-family risk, was uniquely associated with the odds of following a moderate to high trajectory of depressive symptoms, with or without comorbid gambling problems. The predictive value of early impulsivity regarding depressive symptoms and gambling problems is in line with the results of other studies (Granö et al., 2007; Shenassa et al., 2012; Slutske, Caspi, Moffitt, & Poulton, 2005; Slutske et al., 2012). However, highly impulsive males were especially likely to have chronically high levels of both depressive symptoms and gambling problems. These results speak to the important role of impulsivity at a young age as a risk factor of multiple adjustment problems rather than a single problem later in life.

The absence of an interactive effect between impulsivity and socio-family risk in the present study is not concordant with the study by Auger and colleagues (2010), who found that the prospective link between impulsivity and the onset of gambling behavior was lower in youth from higher SES families. Several factors can explain these discrepant results. First, whereas we used a severity scale of gambling problems, Auger and colleagues used the age of onset of gambling behavior as outcome variable. Second, the developmental period assessed in both studies is not the same, with Auger and colleagues focusing on gambling at the beginning of emerging adulthood. Third, Auger et al. used a single-time measure of gambling instead of examining longitudinal trajectories as outcomes. Fourth, whereas only males were assessed in the present study, Auger and colleagues assessed both sexes. Finally, we used a low SES sample in the current study, thus possibly reducing the range of socio-family adversity, both as a moderator and as a risk factor. Further research is thus needed to draw any

conclusions regarding a possible interactive effect of early individual and social-environmental risk factors of gambling problems in young adulthood.

Regarding the assessment of protective factors, our results showed that a high quality relationship with parents was associated with decreased odds of experiencing moderate to high levels of depressive symptoms from late adolescence through young adulthood. These results are concordant with previous studies on the role of the parent-offspring relationship in the developmental of depressive symptomatology (Galambos et al., 2006; Meadows, Brown, & Elder, 2006). Interestingly however, this protective effect of a good relationship with parents was not observed for males whose depression symptoms co-occurred with high levels of gambling problems. This absence of results is surprising considering the well-established link between the parent-child relationship and externalizing behaviors in the offspring (White & Renk, 2012). However, it possible that even a very good parent-child relationship cannot counterbalance or mitigate the particular risk factors (such as a very high level of impulsivity) that lead to comorbid internalizing and externalizing problems.

Contrary to the relationship with parents, the quality of the relationship with best friend was not uniquely related to the odds of following any of the joint trajectories of depressive symptoms or gambling problems. However, the quality of the relationship with the best friend significantly moderated the effect of socio-family risk, leading to increased odds of following the joint ‘high gambling problems/high depressive symptoms’ trajectory. While it may seem surprising at first glance, there is some evidence that friendships characterized by a high level of closeness may constitute an especially fertile ground for the contagion of externalizing and internalizing problems due to individuals’ frequent opportunities for observing their friends’ behaviors and for discussing their thoughts and feelings (Dishion, Spracklen, Andrews, & Patterson, 1996; Rose, 2002). In line with this notion, many gamblers have a buddy environment that may reinforce rather than discourage their problem behavior (Ocean & Smith, 1993). This is particularly true in a high risk environment where

friends would also endorse externalized (e.g., gambling) behaviors. These friends would also likely experience negative consequences. These would, in turn, feed a cycle of co-rumination of personal problems, which is especially pronounced in very close friendships, resulting into a contagion of depressed thoughts and feelings between friends (Rose, Carlson, & Waller, 2007). Having a close relationship with a friend who exhibits externalizing as well as internalizing problems could thus be especially harmful.

Strengths, Limitations and Conclusions

This study has important strengths. First, while numerous studies have identified a co-occurrence between gambling problems and depressive symptoms, this is the first study to assess the joint longitudinal trajectories of these problems. A second strength of this study is its relatively large sample size. Moreover, our study showed a link between risk and protective factors assessed at a relatively early age – and possibly before the development of the comorbid gambling and depression problems –, which provides further support for the predictive value of our theoretical model. Our study also has some limitations, however. First, external validity is limited since all participants came from low SES family backgrounds and were French-Canadian males of European origin. Because European American youths tend to gamble less often than youths from other ethnic backgrounds (Stinchfield et al., 1997), the findings of the present study need to be replicated with ethnically more diverse samples. Another limitation is the exclusive use of self-reports to assess the quality of the relationship with parents and the best friend, gambling problems and depressive symptoms. However, given that these variables refer to private and sometimes secretive behaviors or feelings (Gupta & Derevensky, 1997), self-reports are arguably the most reliable source of information in this regard. Fourth, some joint trajectories of interest (e.g., high problem gamblers without comorbid depression) had to be dropped from analyses due to their extremely small prevalence and an associated lack of statistical power. In that respect, even the group with joint high gambling problems and high depressive symptoms was

limited in terms of size. However, small extreme groups are to be expected when using a normative (i.e., nonclinical) sample such as in the present study. Indeed, the correlation between gambling problems and depressive symptoms is typically rather modest in normative samples (see Dussault et al., 2011, using the same sample, or Scholes-Balog, Hemphill, Dowling, & Toumbourou, 2014), compared to clinical samples where both gambling problems and depression are more prevalent and more chronic. Moreover, the significant results with respect to the conjoint group indicate that statistical power was sufficient to identify specific risk factors of following the joint trajectory of high gambling problems and high depression symptoms, despite its small size. Nevertheless, it is important to replicate our research findings in future studies with other and larger samples. Another limitation concerns the moderate internal consistencies of some of the study variables, which may underestimate true associations. Finally, the lack of information about friends' gambling behavior prevented a further examination of the specific processes that may explain why a good relationship with the best friend is associated with increased risk of high gambling problems. This issue remains to be addressed in future research.

Despite these limitations, the present study offers important insights into the co-occurrence of gambling problems and depressive symptoms. At a theoretical level, the findings suggest that pure gamblers with no associated problems may represent a minority of individuals, at least during the late adolescence-to-early adulthood interval. The results also suggest that spontaneous recovery from gambling problems during this period is unlikely. Finally, they suggest that moderate to high depressive symptoms occurring alone are predicted by different risk and protective factors than when coupled with gambling problems. At a clinical level, the present findings suggest that depressive symptoms may need to be addressed with participants who consult for gambling problems. They also suggest that primary prevention interventions that focus on the parent-child relationship may succeed in countering the emergence of moderate to high depressive symptoms, but this may be insufficient to

prevent comorbid gambling problems. In the latter regard, targeted early prevention programs to reduce individual-level risk factors such as a high level of impulsivity may be indispensable. The nature of at-risk youths' peer relations also warrants specific concern in this context. Our findings suggest that primary prevention strategies aimed at improving friendship skills may also need to consider other factors, such as the personal characteristics of youngsters' friends, to ensure healthy developmental adjustment and prevent possible iatrogenic effects of close friendships on gambling and internalizing problems.

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Table 1

Joint and Conditional Probabilities of Gambling Problems and Depressive Symptoms

		Depressive Symptoms		
Gambling Problems		Low	Moderate	High
Probabilities of joint trajectory group membership (cells total 1)				
Low		(1) 0.767	(2) 0.080	(3) 0.124
High		(4) 0.008	(5) 0.003	(6) 0.018
Probability of depressive symptoms conditional on gambling problems (rows total 1)				
Low		0.923	0.031	0.044
High		0.770	0.108	0.122
Probability of gambling problems conditional on depressive symptoms (columns total 1)				
Low		0.923	0.770	0.830
High		0.075	0.230	0.170

Table 2

*Multinomial Logistic Regression Predicting Joint Trajectories of Gambling Problems and Depression**Symptoms*

	Comparison groups					
	Low GP/Moderate DS		Low GP/High DS		High GP/High DS	
Socio-family risk	.957 ^a	.75 ^c	.903	.37	.707	.52
	(.14) ^b		(.11)		(.26)	
Impulsivity	1.364	.02	1.381	< .01	2.168	< .001
	(.13)		(.11)		(.21)	
Parent-child relationship	.740	.03	.742	.01	.912	.74
	(.14)		(.12)		(.28)	
Friendship	1.057	.67	1.012	.92	.805	.38
	(.13)		(.11)		(.25)	
Socio-family risk x Impulsivity	.877	.38	1.129	.30	.985	.96
	(.15)		(.12)		(.32)	
Socio-family risk x Parent-child relationship	.880	.37	1.252	.08	.679	.21
	(.14)		(.13)		(.31)	
Socio-family risk x Friendship	1.013	.93	.96	.76	1.849	.05
	(.15)		(.13)		(.32)	
Impulsivity x Parent-child relationship	1.027	.86	.946	.62	1.404	.19
	(.15)		(.11)		(.26)	
Impulsivity x Friendship	1.010	.94	.926	.45	1.131	.58
	(.13)		(.10)		(.22)	

Note. The reference group is the 'low depressive symptoms (DS)/low gambling problems (GP) trajectory group. ^aOdds ratio; ^b Standard error; ^c *p*

Figure 1

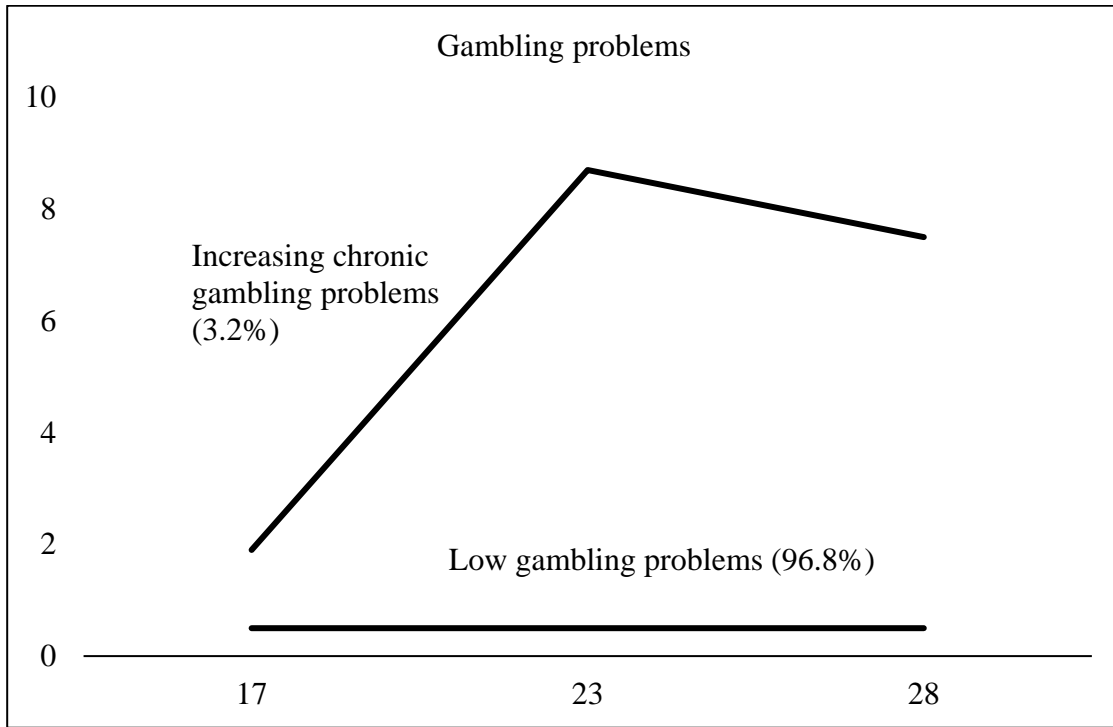


Figure 2

