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Longitudinal Links between Gambling Participation and Academic Performance in Youth:

A Test of Four Models

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### Abstract

**Background:** Gambling participation and low academic performance are related during adolescence, but the causal mechanisms underlying this link are unclear. It is possible that gambling participation impairs academic performance. Alternatively, the link between gambling participation and low academic performance could be explained by common underlying risk factors such as impulsivity and socio-family adversity. It could also be explained by other current correlated problem behaviors such as substance use. The goal of the present study was to examine whether concurrent and longitudinal links between gambling participation and low academic performance exist from age 14 to age 17 years, net of common antecedent factors and current substance use. **Methods:** A convenience sample of 766 adolescents (50.6% males) from a longitudinal twin sample participated in the study. **Results:** Analyses revealed significant, albeit modest, concurrent links at both ages between gambling participation and academic performance. There was also a longitudinal link between gambling participation at age 14 and academic performance at age 17, which persisted after controlling for age 12 impulsivity and socio-family adversity as well as current substance use. **Conclusions:** Gambling participation predicts a decrease in academic performance during adolescence, net of concurrent and antecedent personal and familial risk factors.

*Keywords:* Gambling participation; Academic performance; Impulsivity; Socio-family risk; Substance use; Adolescence.

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Gambling (e.g., lottery products, card games, games of skill and sports betting) is a popular activity among adolescents. Depending on age, between 25% and 50% report having gambled within a given year (Ellenbogen et al., 2007) and an important proportion (around 15%) gambles at least once a week (Ladouceur et al., 1999). These data raise concern, because high gambling participation has been found to predict later gambling problems, net of current gambling problems (Carbonneau et al., 2015). Moreover, gambling participation might also impair important developmental tasks during adolescence such as academic achievement. Indeed, participation in gambling activities is related to poor grades, and the strength of this association increases from early to late adolescence (Bergevin et al., 2006; Ladouceur et al., 1999). Yet, the directionality of the link between gambling participation and reduced academic performance remains unclear because the few studies that have examined the link between the two behaviors used a cross-sectional design. This contrasts with the many longitudinal studies that examined the association between academic performance and other risk-taking behaviors such as tobacco use, alcohol and drug use, unprotected sexual behaviors, inadequate physical activity, and unhealthy dietary behaviors (Bradley & Greene, 2013). In addition, none of the cross-sectional studies controlled for possible confounding variables. As explained below, the association between gambling participation and low academic performance could simply result from common antecedent factors such as impulsivity or socio-family adversity or from correlated risk behaviors such as alcohol and drug use. These alternative scenarios imply that the link between gambling participation and low academic performance could be spurious. The goal of the present study was to examine whether directional links between gambling participation and

academic performance exist from early to late adolescence, even when controlling for the stability of these behaviors and for common antecedent factors (i.e., impulsivity and socio-family adversity) and current correlated risk behaviors (i.e., alcohol and drug use). Following Rodgers' et al. (2009) recommendation, this study focused on gambling participation, not gambling problems. More specifically, we focused on gambling diversity (i.e., number of different gambling activities participants engaged in) instead of gambling frequency, because there is evidence to suggest that gambling diversity is more predictive of later gambling problems than gambling frequency (Carbonneau et al., 2015).

### **Gambling Participation and Low Academic Performance**

According to the 'Causal model', gambling participation could result in low academic performance. For example, time spent gambling after school is time lost for school-related work. Gambling is also incompatible with attending classes during school hours, as many gamblers have been found to skip classes (Ladouceur et al., 1999). Gambling preoccupation and money problems that may result from gambling participation may also distract from school-related work. Finally, gambling activities could expose adolescents to antisocial peer groups, which in turn might diminish school engagement and school performance, either directly or through the increase of behavioral and social problems.

In contrast to the 'Causal model', the 'Common Antecedents model' suggests that the cross-sectional and longitudinal links between gambling participation and low academic performance may be a by-product of common underlying risk factors, notably impulsivity and socio-family adversity. Several studies point specifically to the predictive role of impulsivity in early gambling participation and the development of gambling problems during adolescence (Barnes et al., 1999; Pagani et al., 2009; Vitaro et al., 1999). Impulsivity has also been linked to

low academic performance, as well as early dropping out from school (Vitaro et al., 2005).

Therefore, it is possible that impulsivity may be responsible for the association between gambling participation and academic performance. Socio-family risk could also explain, at least partially, the link between gambling participation and academic performance. Socio-family risk is a multi-faceted construct that refers to circumstances such as poverty, broken home environment, low parental education level, or teen parenthood. Especially when occurring cumulatively, these socio-familial circumstances have been related to elevated levels of gambling participation and low academic performance in adolescent offspring (Fisher, 1993; Shaw & Emery, 1988). Finally, according to the ‘Correlated Behavior Problems model’, correlates of gambling participation and academic performance, such as substance use, might also obscure the link between gambling participation and academic performance. Indeed, substance use has been linked repeatedly, both concurrently and longitudinally, to gambling participation and low academic performance (Bradley & Greene, 2013; King et al., 2006). The three models described above are not mutually exclusive. For instance, even if common antecedent factors explain the link between gambling participation and low academic performance during early adolescence, it remains possible that - once established - the two behaviors subsequently influence each other throughout adolescence. This fourth model would correspond to a mix of the ‘Causal model’ and the ‘Common Antecedents model’ and is therefore termed the ‘Mixed model’.

The above models were tested using a convenience sample of twins. Twin samples have been used in previous studies even when genetic effects were not the focus of the research question (Arseneault et al., 2006; Brendgen et al., 2016). Importantly, empirical evidence

suggests that twins do not differ from non-twins in regard to externalizing problem behaviors and academic performance (Andrew et al., 2001; Christensen et al., 2006).

## **Methods**

### **Participants**

The 766 children (402 girls, 364 boys) participating in this study were part of a population-based sample of twin pairs (1324 individuals) recruited at birth (Boivin et al., 2012). Participants were recruited from the Québec Newborn Twin Registry, which identified all twin births occurring in the Province of Quebec between 1995 and 1998. All parents in the registry living in the Greater Montreal area were asked to enroll with their twins in the study ( $n = 989$  families) and 662 families agreed to participate. Eighty-four percent of the families were of European descent, 3% were of African descent, 2% were of Asian descent, 2% were Native North Americans, and 9% did not specify ethnicity. At 5 months of age, the demographic characteristics of the twin families resembled that of a representative sample of singleton families from large urban centers in the province of Quebec (Santé Québec et al., 1998).

### **Measures and Procedure**

Instruments were administered either in English (21%) or in French (79%), depending on the language spoken by the children and their parents. Gambling participation and academic performance were measured at ages 14 and 17 through self-reports and parent reports respectively, whereas substance use at ages 14 and 17 was only self-reported. Socio-family adversity was based on parent reports, whereas impulsivity was measured through teacher ratings when the children were 12 years old. After approval from the School Board and the Sainte-Justine Hospital Research Centre ethics committee, teachers and parents were contacted by mail

and invited to participate. Active written consent at each of the three waves of data collection was obtained from parents, as well as active verbal assent from the adolescents.

**Gambling participation.** Gambling participation was assessed with the South Oaks Gambling Screen for adolescents (SOGS-RA) (Winters et al., 1993). Participants rated their involvement over the past 12-months in 12 gambling activities on a scale ranging from 1 (*never*) to 7 (*daily*) (e.g., purchased lottery tickets, played online sports betting game, bought scratch offs, played Bingo for money, bet on games on the internet, played video lottery games, played cards or games with others for money, bet on sporting events/games for money, gambled at a casino, bet on games of skill (pool, basketball), played dice games for money, and bet on other games). Because frequencies for any individual gambling activity were very low and because skewness and kurtosis were high (*skewness* = 4.25 and 3.11, at age 14 and 17, respectively; *kurtosis* = 25.58 and 12.43 at age 14 and 17, respectively), the scale for each gambling activity was dichotomized (never vs. at least once) and the total number of gambling activities endorsed over the past 12 months was computed: At age 14, the number of gambling activities endorsed by the participants varied from 0 to 10, with a mean of .37 and a standard deviation of .94. At age 17, the range varied from 0 to 8, with a mean of .49 and a standard deviation of 1.03; 21.8% and 27.5% of participants engaged in at least one gambling activity respectively at age 14 and age 17. These proportions are in line with other prevalence studies (Pica et al., 2012; Volberg et al., 2011).

**Academic performance.** Each parent reported how well each twin was doing at school (rated on a 5-point scale, from 1 (*much below average*) to 5 (*much above average*)). The correlation between mother and father ratings was  $r = .76$  at age 14 and  $r = .75$  at age 17 ( $p < .001$ ). An average score across both parents was calculated for every year (*Mean* = 2.86 and 2.82

at age 14 and 17, respectively;  $SD = 1.06$  and  $1.05$  at age 14 and 17, respectively;  $skewness = .65$  and  $.60$  at age 14 and 17, respectively;  $kurtosis = .43$  and  $.41$  at age 14 and 17, respectively).

**Substance use.** Frequency of substance use was assessed with the Personal Experience Screening Questionnaire (PESQ) (Henly & Winters, 1989). Substance use was computed by averaging the standardized scores of four items (frequency of alcohol, marijuana, and other drug use and binge drinking). Participants rated the frequency of substance use over the past 12 months on a scale ranging from 1 (*never*) to 7 (*daily*), with the exception of binge drinking, which was rated on a scale from 1 (*never*) to 6 (*5 times or more*). As was done for gambling participation, we dichotomized the frequency scale for each substance-related item (never vs. at least once) and computed the total number of substances used over the past 12 months ( $skewness = 1.64$  and  $.14$  at age 14 and 17, respectively;  $kurtosis = 2.22$  and  $.97$  at age 14 and 17, respectively). At age 14, the number of substances used by the participants varied from 0 to 4, with a mean of  $.58$  and a standard deviation of  $.91$ . At age 17, the range varied from 0 to 4, with a mean of  $1.91$  and a standard deviation of  $1.21$ ;  $36.6\%$  and  $82.7\%$  of participants used at least one substance respectively at age 14 and age 17. These proportions are also in line with past prevalence studies (Johnston et al., 2013; Pica et al., 2012).

**Impulsivity.** Teacher-Reports of impulsivity were assessed via three items (e.g., difficulty waiting his-her turn; acting without thinking, being impulsive) from the Child Social Behavior Questionnaire (Tremblay et al., 1991). All of the items were scored on a 3-point scale ( $0 = never$ ,  $1 = sometimes$ ,  $2 = often$ ) and item scores were averaged to create scale scores ( $Mean = .45$ ;  $SD = .52$ ;  $skewness = 1.14$ ,  $kurtosis = .63$ ) (Cronbach's  $\alpha = .83$ ).

**Socio-family adversity.** A socio-family index was created by combining mother reports on: (a) the educational level of both parents, (b) the occupational status of both parents (or

occupation of the parent with whom the child was living) based on the Blisshen et al. (1987) occupational prestige scale, and (c) mother's and father's age at the birth of the first child and (d) family structure. The co-occurrence of several of these factors has been found to predict a variety of offspring adjustment problems in adolescence and early adulthood (Loeber & Farrington, 2000). 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 -1 was given to scores in the top quartile of the distributions and a score of 0 to all other values. For family structure, a score of -1 was attributed if the child was living with both biological parents, a score of +1 for single parent families and a score of 0 for the others. A total socio-family adversity index was then computed by averaging individual item scores, with a high value indicating a high level of co-occurring socio-family risk (*Mean* = -.34, *SD* = .51; *skewness* = .45, *kurtosis* = .56).

## Results

### Preliminary Analyses

In Table 1, bivariate correlations of all study variables are presented. Impulsivity and socio-family adversity at age 12 years were significantly correlated with all other variables, except gambling participation at age 14 and substance use at ages 14 and 17 years for socio-family adversity. Gambling participation and academic performance scores were relatively stable from age 14 to 17 years. Finally, there were significant concurrent correlations between gambling participation and academic performance at age 14 years and gambling participation and academic performance at age 17 years.

### Model Testing

Structural equation modeling was used to test the four models described earlier. The

proportion of missing data points across all variables at all times of measurement was 22.3%. Missing values were not assumed to be MCAR or MAR because participants at higher risk (e.g., those with higher levels of impulsivity or socio-family risk) might have been less likely to engage in the study in a consistent way. The full information maximum likelihood (FIML) method was therefore used to account for missing values, because it allows to deal with samples with moderate or large amounts of missing data, even those MNAR, if the predictors of missingness are included in the model (Widaman, 2006). Given that twins in each pair were living in the same family, all analyses, including the bivariate correlations presented above, were controlled for non-independence of the data using the Huber-White sandwich estimator. Sex was also controlled in all the analyses. Finally, to take into account the non-normality of the data in reference to both substance use and gambling participation, we used maximum likelihood estimation with robust standard errors (MLR).

**The Causal Model.** Figure 1 illustrates the results of the basic cross-lagged model between gambling participation and academic performance. Gambling participation at age 14 was significantly linked to academic performance at age 17 ( $\beta = -.14, p < .01$ ), above and beyond concurrent and auto-regressive correlations. This was the first step in establishing the plausibility of the Causal model.

**The Common Antecedents Model.** Figure 2 illustrates the results after controlling for impulsivity and socio-family adversity in the cross-lagged model. As can be seen, impulsivity at age 12 predicted both gambling participation and low academic performance at ages 14 and 17. Socio-family adversity at age 12 also predicted gambling participation at age 17, but not gambling participation at age 14. Socio-family adversity at age 12 also predicted academic performance at age 14 and at age 17. In line with the Causal model, the cross-lagged link

between gambling involvement at age 14 and academic performance at age 17 remained significant. Yet, in accordance with the Common Antecedents model, the concurrent link between gambling participation and academic performance at age 14 became non-significant after introducing impulsivity and socio-family adversity in the model.

**The Correlated Behavior Problems Model.** Figure 3 illustrates the results after including substance use in the cross-lagged model. Although substance use was correlated with both gambling involvement and academic performance at age 14, the cross-lagged links between gambling involvement and academic performance from age 14 to age 17 remained virtually unchanged. Interestingly, gambling involvement at age 14 contributed to the escalation of drug use from age 14 to age 17. Inversely, substance use at age 14 contributed to the escalation in gambling participation from age 14 to age 17. This latter association only reached a statistical trend, however. Overall, these results are not in line with the Concurrent Problems model.

**The Mixed Model.** Figure 4 illustrates the results after controlling for impulsivity, Socio-family adversity, and Substance use in the cross-lagged model. This final model corresponds to the Mixed model. Results with respect to the links between gambling involvement and academic performance remained virtually unchanged from the results illustrated in Figure 2 in reference to the Common Antecedents model.

### Discussion

The goals of the present study were to examine 1) whether gambling involvement and academic performance were cross-sectionally and longitudinally related, 2) whether impulsivity and socio-family risk could explain the cross-sectional or longitudinal links between gambling involvement and academic performance, and 3) whether concurrent substance use could explain the cross-sectional or longitudinal links between gambling involvement and academic

performance. For this purpose, four theoretical models were proposed: a Causal model, a Common Antecedents model, a Correlated Behavior problems model, and a Mixed model. Results from the bivariate correlations showed that gambling participation and academic performance were significantly, albeit modestly, concurrently correlated both at age 14 and at age 17. More importantly, results from the cross-lagged multivariate analyses showed that a higher level of gambling participation at age 14 predicted a decrease in academic performance from age 14 to age 17. Results also showed that, with only one exception, higher levels of impulsivity and of socio-family risk at age 12 predicted higher gambling participation and lower academic performance at age 14 and at age 17. When these common antecedent factors were controlled, the concurrent relation between gambling participation and academic performance at age 14 and at age 17 disappeared. However, the longitudinal link from gambling participation at age 14 to decreased academic performance from age 14 to age 17 remained unaffected. This longitudinal link was also unaffected by the control of concurrent substance use. Overall, the results thus support the Mixed model: Common antecedent factors explain the initial association between gambling participation and academic performance in early adolescence; thereafter, however, gambling participation adversely affects academic performance above and beyond these common antecedent risk factors as well as concurrent behavior problems such as substance use. These results are compatible with a possible causal role of gambling in regard to academic performance.

How can academic performance be affected by gambling participation? Gambling during after-school hours reduces time for school-related work. Moreover, many gamblers have been found to skip classes during school hours (Ladouceur et al., 1999). Finally, gambling activities could expose adolescents to antisocial peer groups, which in turn might diminish school

engagement and school performance, either directly or through the increase of behavioral and social problems. Finally, reciprocal longitudinal links were found between gambling participation and substance use. Although not central to the present study, these findings need to be acknowledged as they replicate similar results in past studies (Wanner et al., 2009) and because they suggest possible indirect pathways between gambling participation and academic performance via increased substance use.

In line with the Common Antecedent model, impulsivity and socio-family risk accounted for the concurrent links between gambling participation and academic performance. These results are in line with past findings showing that teacher-rated and self-reports of impulsivity in childhood predict gambling participation in adolescence (e.g., Barnes et al., 1999; Vitaro et al., 1999) as well as low academic performance and substance use, above and beyond a host of other behavioral symptoms and socio-family factors (Dawe & Loxton, 2004; Vitaro et al., 2005). Our results also confirm the pervasive role of socio-familial risk, which has been related to both elevated levels of gambling involvement and low academic performance among adolescents in previous studies (Fisher, 1993). Attenuating these risk factors through prevention should result in a reduction in gambling participation and substance use as well as in improvement in academic performance. However, once established, gambling participation and academic performance become partially independent from their underlying antecedent factors, such that one behavior (i.e., gambling) influences the other (i.e., academic performance). Future studies should examine the potential intra- and inter-individual mechanisms involved.

### **Strengths, Limitations, and Implications**

Overall, this study has important strengths. First, it is the first study to examine longitudinal links between gambling participation and academic performance. Second, the use of

different reporting sources (participants' self-reports for gambling participation and substance use, mother reports for socio-family risk and academic performance and teacher reports for impulsivity) reduced shared method variance bias. A final strength of this study is the rigorous control of possible spurious links through the use of a cross-lagged model with control variables.

Despite these strengths, the study also has several limitations. First, external validity is somewhat limited, since participants are twins and mostly of European origin. Second, the relative small sample size combined with the complexity of the models being tested precluded the use of sex as a moderator. Third, despite strong controls through the use of a cross-lagged design, the current study remains correlational and only directionality, but not causality of associations could be demonstrated.

Despite these limitations, the present study offers important insights into the links between gambling participation and low academic performance. At a theoretical level, the findings suggest that similar antecedent factors may explain the initial association between the two behaviors in early adolescence, but that – thereafter – gambling participation may adversely affect academic performance above and beyond these common antecedent risk factors. From a clinical perspective, these findings suggest that children living in an unfavorable environment and manifesting high levels of impulsivity should be targeted for early prevention purposes. Failing early prevention, reducing gambling involvement may also curb to some extent the decline in academic performance.

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Table 1

*Bivariate correlations, means and standard deviations of variables at study*

	1	2	3	4	5	6	7	8
1. Gambling Participation Age 14	--							
2. Academic Performance Age 14	-.09 <sup>†</sup>	--						
3. Substance Use Age 14	.25 ***	-.10 *	--					
4. Gambling Participation Age 17	.44 ***	-.02	.18 ***	--				
5. Academic Performance Age 17	-.21 ***	.71 ***	-.09 <sup>†</sup>	-.11 *	--			
6. Substance Use Age 17	.19 ***	-.10 *	.40 ***	.20 ***	-.19 ***	--		
7. Impulsivity Age 12	.10 *	-.31 ***	.12 *	.15 **	-.28 ***	.13 **	--	
8. Socio-family Adversity Age 12	.05	-.17 ***	-.05	.11*	-.21 ***	-.04	.07	--

\* $p < .05$ ; \*\* $p < .01$ ; <sup>†</sup> $p = .06$

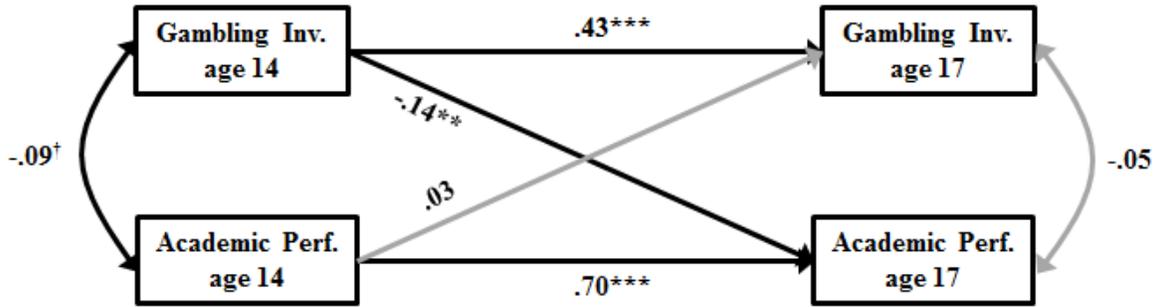


Figure 1. Test of the Causal model

Significant links are in black, non-significant are in grey; standard errors varied between .03 and .07 for all study variables in the model

\*\*\*  $p < .001$ ; \*\*  $p < .01$ ; \*  $p < .05$ ;  $\dagger p = .06$ .

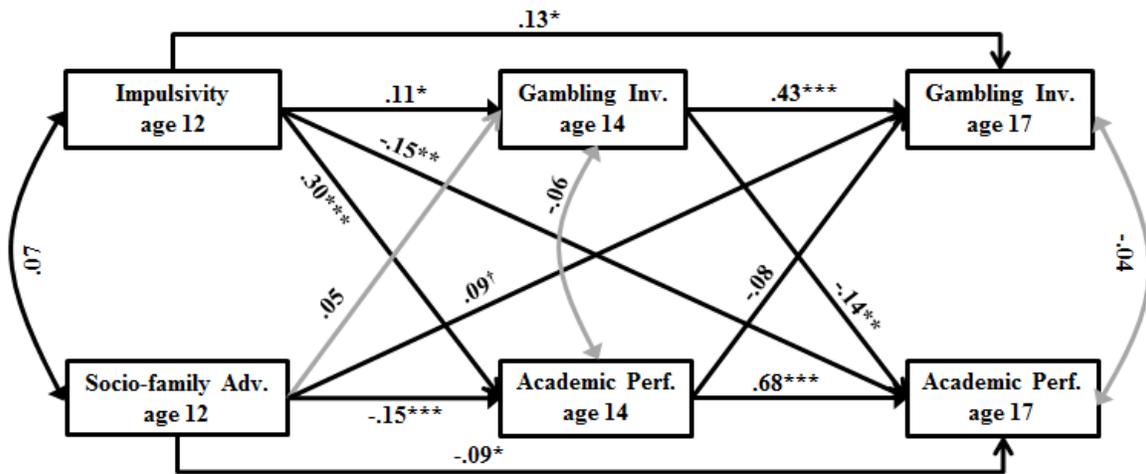


Figure 2. Test of the Common Antecedents models.

Significant links are in black, non-significant are in grey; standard errors varied between .04 and .09 for all study variables in the model.

\*\*\*  $p < .001$ ; \*\*  $p < .01$ ; \*  $p < .05$ ; †  $p = .06$

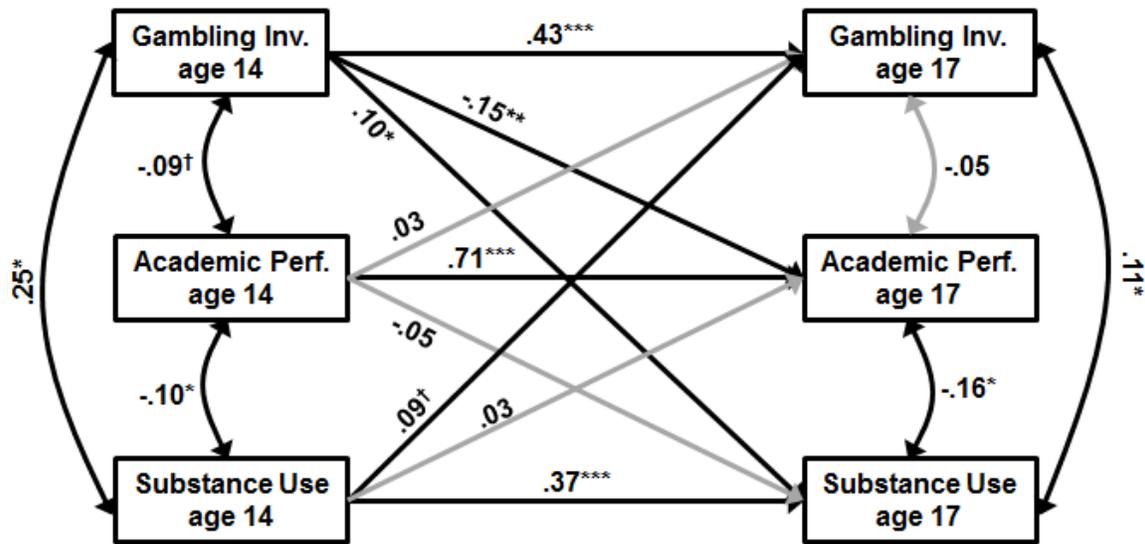


Figure 3. Test of the Correlated Behavior Problems model

Significant links are in black, non-significant are in grey; standard errors varied between .03 and .09 for all study variables in the model.

\*\*\*  $p < .001$ ; \*\*  $p < .01$ ; \*  $p < .05$ ; †  $p = .06$

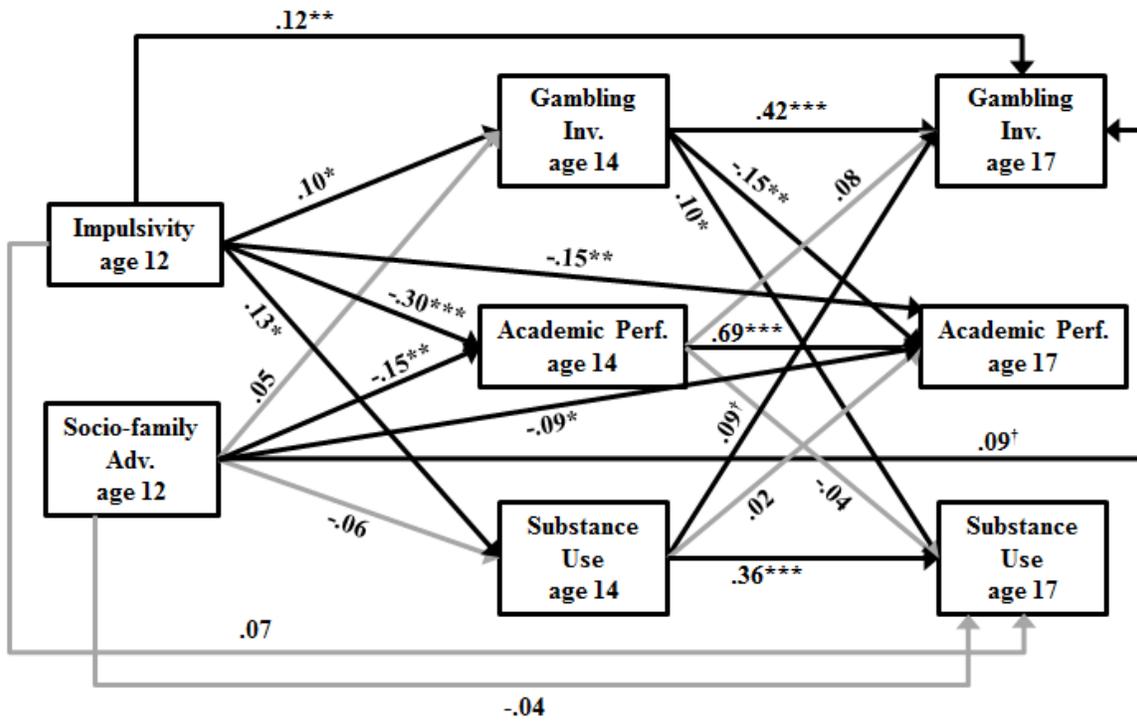


Figure 4. Test of the Mixed model

Significant links are in black, non-significant are in grey; cross-sectional links do not differ from previous models and are not shown for sake of clarity; standard errors varied between .03 and .09 for all study variables in the model.

\*  $p < .05$ ; \*\*  $p < .01$ ; \*\*\*  $p < .001$ ; †  $p = .06$