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## Compounded effect of early adolescence depressive symptoms and impulsivity on late adolescence gambling: A longitudinal study

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### Abstract

**Purpose**—Depression and impulsivity have been positively correlated to problem gambling, but no study has focused on the combined effects of both on the onset of problem gambling. This study examined the possible synergistic effect of depressive symptoms and impulsivity in early adolescence on late adolescence gambling behaviors among a longitudinal cohort of 678 students from Baltimore, MD.

**Methods**—The South Oaks Gambling Screen-Revised for Adolescents (SOGS-RA), Teacher Observation of Classroom Adaptation Revised (TOCA-R), and Baltimore How I Feel-Adolescent Version (BHIF-AY), were used to assess late adolescence gambling behaviors, early adolescence impulsivity and depressive symptoms, respectively. Data analyses were conducted using ANOVA and binary logistic regression models.

**Results**—Twelve percent of the sample were problem gamblers (includes at-risk and problem gamblers), 87.5% of whom were males and 12.5% were females ( $p < 0.001$ ). Among males, there appeared to be a slight association between early adolescence depressive symptoms and late adolescence problem gambling. Compared to nongambling (NG) and social gambling (SG), depressive symptoms increased the odds of problem gambling by four-fold (PG vs. NG: OR=4.1, 95% CI=0.73–22.47,  $p=0.11$ ; PG vs. SG: OR=3.9, 95% CI=0.78–19.31,  $p=0.10$ ). Among those with high depressive symptoms, increases in impulsivity decreased the odds of problem gambling while among those with high impulsivity, increases in depressive symptoms decreased the odds of problem gambling.

**Conclusions**—Early adolescence depressive symptoms appear to be more positively associated with late adolescence problem gambling than early adolescence impulsivity, there seems to be a divisive interaction between depressive symptoms and impulsivity on problem gambling.

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## Keywords

Depressive symptoms; Impulsivity; Problem gambling; Early Adolescence; Late Adolescence

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## Introduction

As gambling venues and opportunities become more accessible and normalized, increasing numbers of underaged youths are participating in these activities. Between 70–90% of adolescents have gambled [1], and 3–8% are problem gamblers with another 10–15% at risk for the development of a gambling problem; considerably higher than the 1–3% of problem gamblers among the general adult population [2]. Adolescents at risk for problem gambling could go on to experience gambling-related consequences that may negatively impact their lives [3].

Adolescence is a vulnerable period marked by increased risk-taking. Studies suggest adolescents to be highly sensitive to environmental influences, and become more socially aware and engage in risk-taking behavior under the influence of social pressure [4]. Another explanation suggests that despite being cognitively aware of the risks involved, adolescents engage in risky behaviors due to their underestimation of the risks and belief that the risks are acceptable [5]. Adolescent gambling is a high-risk behavior believed to be a gateway to other deviant behaviors such as substance use, and is associated with adverse mental health outcomes such as depression and suicide [6].

Studies indicate an association between depression and problem gambling [7–9]. Generally, adolescent problem gamblers report increased depressive symptomatology compared to other adolescents [7]. Beaudoin and Cox [8] suggest that excessive gambling behavior is undertaken as a means to alleviate depressive symptoms. These coping gamblers can develop severe gambling problems because motivations behind coping with negative emotions and life concerns are associated with addictive behaviors [9].

Impulsivity, defined as a predisposition toward rapid, unplanned reactions to stimuli without regard to the negative consequences of these reactions to himself or to others [10], is a normative behavior during childhood development related to the neurobiological changes in both brain organization and function. Adolescents' inability to refrain from impulsive behaviors is thought to be due to their underdeveloped inhibitory control [11]. Impulsivity is an important aspect of the personality of problem gamblers. Vitaro and colleagues [12] report that disruptiveness and low inhibition during childhood distinguished problem gamblers from social/nonproblem gamblers during adolescence.

While both depression and impulsivity have individually been found to be positively correlated to problem gambling [13], the studies have generally been univariate in that they focused on only one variable at a time in its association with gambling. However, several studies have shown a significant multiplicative interaction between depression and impulsivity on aggressive behaviors and alcohol involvement, both of which have been shown to be positively correlated to problem gambling [14,15]. Therefore this paper hypothesizes that the presence of both depressive symptoms and impulsivity exhibited in early adolescence (age 11) is positively associated with problem gambling during late adolescence (ages 17–20), and the association will be synergistic. This study aims to elucidate the probable relationship between depressive symptoms and impulsivity, and problem gambling.

## Methods

### Sample

The data came from the Johns Hopkins Center for Prevention and Early Intervention Cohort 3 [16], a study initiated as a randomized prevention trial targeting academic achievement and aggression. Recruitment occurred in Fall 1993 at nine urban primary schools, primarily located in western Baltimore, MD. Within each school, there were three 1<sup>st</sup> grade classrooms, which were randomly divided into two intervention and one control groups. The classroom-centered (CC) intervention, which created opportunities for more positive attention from teachers and peers, consisted of three components: curricular enhancements; improved classroom behavior management practices; and supplementary strategies for children not performing adequately [17]. The family-school partnership (FSP) intervention was designed to improve achievement and reduce early aggression and shy behavior by enhancing parent-school communication and providing parents with effective teaching and child behavior management strategies [17]. There was no prevention program for the control group, only the usual curriculum was provided [17].

At the time of school enrollment, first graders were randomly assigned to each of the three designated classrooms. Across the 27 classrooms, there were 678 children; 86% were African Americans, and 53% were males. Sixty-nine percent of the participants received free or reduced-price lunches, a proxy for family poverty. While the intervention only lasted for one year, the cohort was followed-up annually. Study protocols were approved by institutional review boards (IRB) of Johns Hopkins University.

### Measures

**Late Adolescent Gambling**—The South Oaks Gambling Screen-Revised for Adolescents (SOGS-RA), a 12-item adaptation of the adult orientated SOGS, assesses gambling behavior in the past 12 months using wording of items and response options that reflect adolescence gambling behavior at an age appropriate reading level [18]. The scale correlates with gambling activity ( $r=0.39$ ), gambling frequency ( $r=0.54$ ), and the amount of money gambled in the past year ( $r=0.42$ ). The Cronbach's alphas are 0.86 for males and 0.76 for females [18]. The suggested scoring criteria set a cutoff score of 4 or more to indicate problem gambling, 2–3 to indicate at-risk problem gambling, and 0–1 to indicate social gambling among those who reported having gambled in the past 12 months [19]. Those who reported not having gambled in the past 12 months are nongamblers. Adolescent at-risk and problem gamblers have similar profiles [3]; therefore they were grouped together in the present study and will be collectively referred to as “problem gamblers” from this point on. The SOGS-RA were only administered in 2004, 2006, and 2007 (when respondents were aged 17, 19, and 20, respectively), and the three waves were combined as a cumulative measure of gambling behavior in this study's sample.

**Early Adolescent Impulsivity**—The Teacher Observation of Classroom Adaption-Revised (TOCA-R) assesses childhood behaviors [20]. Trained assessors guide the 6<sup>th</sup> grade teachers through a structured interview of 36 items pertaining to the child's adaptation to classroom task demands over the preceding three-week period. For this study, we focused on the subscale of Self regulation/Impulsivity (Cronbach's alpha=0.79), which consists of three items—waits for turn, interrupts or intrudes on others, and blurts out answer before question is complete. Adaptation is rated on a six-point frequency scale, from 1 = almost never to 6 = almost always. An impulsivity score is created by taking the mean of the total sum, with a higher score indicating higher impulsivity. The four-month test-retest reliability for the subscale is over 0.60. The 6<sup>th</sup> grade TOCA-R data was used as the early adolescent measure of impulsivity.

**Early Adolescent Depressive Symptoms**—The Baltimore How I Feel-Adolescent Version (BHIF-AY) is a 45-item self-report scale assessing depressive and anxious symptoms among middle and high school youths [21]. Adolescents report the frequency of symptoms over the last two weeks on a four-point scale, from 1 = never to 4 = always or almost always. Depressive symptom scores are created by taking the means of the total responses to the 14 items, with higher scores indicating higher frequencies of symptoms. The Depression subscale has a two-week test-retest reliability coefficient of 0.83 and Cronbach's alpha of 0.83 [22]. The 6<sup>th</sup> grade BHIF-AY data was utilized during analysis.

### Statistical Analysis

Chi-square statistics were used to uncover the baseline demographic trends of the cohort. Individuals were divided into 3 gambling categories—nongamblers (NG), social gamblers (SG), and problem gamblers (PG). In an effort to create a cumulative measure of gambling, individuals were categorized based on their highest level of gambling behavior. ANOVA explored differences in the mean scores of the BHIF-AY and TOCA-R subscales across the three gambling categories, and the Pearson correlation coefficient was calculated for the depressive symptom and impulsivity scores.

An interaction term was created for the depressive symptoms and impulsivity scores. To eliminate any potential confounding that gender could introduce, ANOVA and logistic regressions were conducted separately for males and females. Several logistic regression models both with and without the interaction term, compared SG to NG (reference group=NG), PG to NG (reference group=NG), and PG to SG (reference group=SG). Depressive symptoms and impulsivity scores were further centered for better interpretation of the interaction effects [23]. Logistic regressions with the centered covariates, their interaction, adjusted for demographic variables, modeled the associations among early adolescence depressive symptoms and impulsivity and late adolescence gambling behavior.

Due to the initial study design, students were clustered within schools. Individuals belonging to the same cluster were likely to resemble one another due to their shared environment; and if the resemblances in outcomes among those in each cluster were ignored, the standard errors would be underestimated, inflating the Type I error [24]. As a result, using STATA 11.0 [25], a variant of the Huber-White sandwich estimator of variance was used to obtain robust standard errors and variance estimates.

## Results

### Demographics

Approximately 92% (n=618) of the original cohort of 678 were available for at least one of the 2004, 2006, and 2007 follow-ups. With the exception of race, those lost to follow-up did not differ from those who were available in terms of demographics, early adolescence depressive symptom and impulsivity. African-Americans were underrepresented (80.0% vs 86.9%) while Caucasians (18.3% vs 13.1%) were overrepresented among those lost to follow-up compared to those who were followed up (p=0.003). After gender stratification, the race disparity became insignificant among males but remained so among females (p=0.003).

Of the 618 participants, 45.2% (n=279) were NG, 43.2% (n=267) were SG, and 11.6% (n=72) were PG. There were no significant differences among the three gambling categories in terms of race, group assignment, and lunch status (Table 1). However, great disparity was found for gender (p<0.001) across the gambling groups. Females were more likely to be NG

(59.1% vs 40.9%) while males were more likely to be SG (56.2% vs 43.8%) and PG (87.5% vs 12.5%).

### Impulsivity and Depressive Symptom Effects

Early adolescence depressive symptoms and impulsivity did not appear to be correlated to each other in the overall sample ( $r=-0.03$ ,  $p=0.54$ ), nor among males ( $r=-0.02$ ,  $p=0.87$ ) and females ( $r=-0.03$ ,  $p=0.70$ ). Little differences were found in the mean scores of depressive symptoms (NG=0.72, SG=0.72, PG=0.74,  $p=0.75$ ) and impulsivity (NG=2.27, SG=2.32, PG=2.70,  $p=0.67$ ) across the gambling categories. Females were 33% and 87% less likely than males to become SG and PG, respectively, in late adolescence ( $p<0.001$ ).

Due to the gender disparity across the gambling categories ( $p<0.001$ ), gender stratification was employed to eliminate any potential confounding gender might introduce. The small sample size of female PG ( $n=9$ ) compromised the power of the analysis among females, therefore the presented results would be limited to only the males.

Prior to accounting for the interaction between depressive symptoms and impulsivity, the logistic regression model, adjusted for race, group assignment, and lunch status, showed that neither covariate differ significantly between male NG and SG (depressive symptoms: OR=1.31, 95% CI=0.29–5.05,  $p=0.73$ ; impulsivity: OR=1.00, 95% CI=0.70,1.43;  $p=1.00$ ). A similarly adjusted model without the interaction, comparing PG to NG, showed that while PG was not associated with impulsivity (OR=1.52, 95% CI=0.76–3.05,  $p=0.23$ ), depressive symptoms reached borderline significance (OR=7.01, 95% CI=0.77–63.80,  $p=0.08$ ). A third model comparing PG to SG found both covariates to be slightly associated with PG (depressive symptoms: OR=7.74, 95% CI=0.83–72.32,  $p=0.07$ ; impulsivity: OR=1.80, 95% CI=0.87–3.69;  $p=0.11$ ).

With the *depressive symptoms*  $\times$  *impulsivity* interaction term ( $p=0.67$ ) added to the logistic model comparing SG to NG, depressive symptoms and impulsivity remained to have little association (data not shown, available upon request). The interaction term reached borderline significance ( $p=0.06$ ) in the model comparing PG to NG (Table 2). While depressive symptoms was slightly associated by increasing the odds of PG by 4.1-fold (95% CI=0.73–22.47,  $p=0.11$ ), impulsivity did not appear to be associated (OR=0.54, 95% CI=0.59–1.31,  $p=0.54$ ). Additionally, assignment into the FSP intervention group during grade 1 increased the odds of PG by more than 2-fold (OR=2.59, 95% CI=1.15–5.87,  $p=0.02$ ). In a similar model with the interaction term ( $p=0.05$ ), comparing PG to SG (Table 2), depressive symptoms reached borderline significance by increasing the odds of PG by 3.9-fold (95%CI=0.78–19.31,  $p=0.10$ ) while impulsivity had little effect (OR=0.90, 95% CI=0.63–1.30,  $p=0.57$ ). FSP group assignment was slightly associated with PG (OR=2.56, 95% CI=0.90–7.30,  $p=0.08$ ). Figure 1 displays the relationship between depressive symptoms and impulsivity among the three gambling groups. The divisive interaction between depressive symptoms and impulsivity among PG is particularly apparent as its slope is the steepest and most negative, indicating that the higher the PG's score in one variable, the lower his score in the other.

Depressive symptoms and impulsivity scores were further centered to emphasize their divisive interaction on PG [23]. Depressive symptoms scores were centered at the 90<sup>th</sup> percentile and impulsivity scores at the 10<sup>th</sup> percentile, and an interaction term for the two centered covariates was created. A model comparing PG to NG, adjusted for demographics, showed that while an increase in depressive symptoms among those at the 10<sup>th</sup> percentile of impulsivity yielded little change in the odds of PG (OR=2.35, 95% CI=0.66–8.39,  $p=0.19$ ), an increase in impulsivity among those at the 90<sup>th</sup> percentile of depressive symptoms decreased the odds of PG (OR=0.40, 95% CI=0.17–0.99,  $p=0.05$ ). A similar model



comparing PG to SG showed that while an increase in depressive symptoms among those at the 10<sup>th</sup> percentile of impulsivity had little effect on PG (OR=1.95, 95% CI=0.69–5.49,  $p=0.21$ ), an increase in impulsivity for those at the 90<sup>th</sup> percentile of depressive symptoms decreased the odds of PG (OR=0.34, 95% CI=0.11–0.99,  $p=0.05$ ). Figure 2 displays the divisive interaction between the two centered scores on PG compared to SG.

Logistic models with centered depressive symptoms scores at the 10<sup>th</sup> percentile and impulsivity scores at the 90<sup>th</sup> percentile, their interaction term, and adjusted for demographics, were used next. Compared to NG, an increase in depressive symptoms among those at the 90<sup>th</sup> percentile of impulsivity, decreased the odds of PG (OR=0.50, 95% CI=0.15–1.01,  $p=0.05$ ) while impulsivity appeared to have little effect among those at the 10<sup>th</sup> percentile of depressive symptoms (OR=0.82, 95% CI=0.54–1.22,  $p=0.33$ ). A similarly adjusted model comparing PG to SG showed that an increase in depressive symptoms among those at the 90<sup>th</sup> percentile of impulsivity decreased the odds of PG (OR=0.28, 95% CI=0.07–1.06,  $p=0.06$ ) while an increase in impulsivity among those at the 10<sup>th</sup> percentile of depressive symptoms had little effect on PG (OR=0.82, 95% CI=0.55–1.21,  $p=0.31$ ).

## Discussion

While there appeared to be a slight association between early adolescence depressive symptoms and late adolescence problem gambling among boys, it only appeared after adjusting for impulsivity, the interaction between depressive symptoms and impulsivity, race, intervention group assignment, and lunch status. Additionally, the combined effects of both depressive symptoms and impulsivity appeared to have a divisive effect on problem gambling, instead of the hypothesized synergistic effect.

Unlike impulsivity, which has been shown to decrease over time, childhood depressive symptoms have been shown to have lasting effects [26,27]. The recurrence of episodes was common among youths with major depression, with 18%–26% report a new episode within 1 year of recovery, 40%–45% within 2 years, and 75% within 5 years [28]. Childhood depressive symptoms are also strongly associated with poor adaptive functioning and various personality disorders in young adulthood [26]. Therefore, our finding that early adolescence depressive symptoms, both individually and upon interaction with impulsivity, had a borderline significant association with late adolescence problem gambling seems consistent with previous studies that have shown the enduring consequences of depressive symptoms.

While the divisive effect of the presence of both seemed surprising, it was found that most literature regarding individuals with comorbid depression and high impulsivity/impulse-related personality disorders focused on suicidality [29]. For example, a study sampling inpatients with major depression found that those admitted for suicide attempts scored significantly higher in impulsivity than their non-attempt counterparts [29]. Such studies could imply that individuals with comorbid depression and high impulsivity direct their disinhibitions inward in the form of self-destructive ideations, which could explain the divisive effect of the interaction of depressive symptoms and impulsivity on problem gambling as gambling tends to be a more outward form of escapism.

On the other hand, because one of the appeals of gambling is its alleviation of current stress, engaging in this behavior could be problematic for youths who have not yet developed healthy, adaptive coping skills. When gambling no longer fulfills their need to escape from their painful realities and instead adds to their stress through problems such as debt, many problem gamblers turn to suicide [30]. Within a sample of 500 problem gamblers, 48% reported suicide ideation and 13% reported suicide attempts [30]. Furthermore, major

depressive disorder is positively associated with suicide [31]. Therefore the high prevalence of suicidality among problem gamblers further demonstrates the long-term adverse outcomes of those with major depressive disorder in that not only can early adolescence depressive symptoms place one at risk for late adolescence problem gambling, symptoms exhibited by problem gamblers can also place them at risk for suicide.

While the current findings may not be generalizable beyond inner-city African-American male adolescents, their clinical implications are significant. Urban African-American male youths' high rates of incarceration, unemployment, death, and high school drop-out have been attributed to environmental factors such as poverty, lack of neighborhood social organization, and deviant peer associations [32,33]. Such factors have also been associated with depression [34]. The present study found evidence to suggest that depressive symptoms exhibited as early as middle school to be associated with late adolescence problem gambling. Furthermore, those who received the one-year FSP intervention during 1<sup>st</sup> grade had increased odds of problem gambling in late adolescence. An evaluation of the intervention shows that FSP decreased problem behaviors, such as fighting and breaking rules, among boys a year after its implementation [35]. The success could indicate strong parent-child relationships where parents were attending to the well-being of their children. However urban families experience high rates of marital disruptions, and single-parent households tend to have lower parental-monitoring [36]. The attenuation in parental attention following marital disruption could cause children to feel rejected, and parental rejection has been positively associated with depression [37]. Therefore, early adolescence could be a point of entry for interventions in that youths observed to be depressed by teachers or counselors, receive referrals to cognitive behavioral therapy where they can learn adaptive coping strategies to deal with their environmental and familial stressors. Such therapy could lower their depressive symptom, odds of gambling initiation, and other adverse outcomes such as suicide as previously discussed.

There are several limitations to the study. While the original cohort was prospectively followed-up annually, the method with which the depressive symptoms and impulsivity data were collected was cross-sectional. As a result, it was difficult to discern which preceded the other. Furthermore, because the gambling data was not collected until the subjects were around age 17 in 2004, age of gambling initiation was unknown for those who responded as having ever gambled in that first wave. Therefore, while the current study shed light on the association between early adolescence depressive symptoms and impulsivity and late adolescence problem gambling, the true temporal sequencing of depressive symptoms, impulsivity, and problem gambling was not established. Such temporality would be vital toward effective intervention methods aiming to prevent and treat problem gambling in that different approaches would be necessary if problem gambling were a precursor for depressive symptoms and impulsivity, a mediator between depressive symptoms and impulsivity, or an outcome of depressive symptoms and impulsivity.

Due to the low prevalence of problem gambling, at-risk and problem gamblers were combined into one group for the present study. While the two groups were found to be similar in terms of their levels of sensation seeking, anxiety, self-discipline, self-esteem, and maladaptive coping skills, not all at-risk gamblers progress into problem gamblers [1,23]. As a result, the current findings could be biased due to some unmeasured difference between the two groups. Future studies could aim to uncover the protective factors that may differentiate at-risk gamblers from problem gamblers.

The female sample's lack of statistical power limited the findings to only males. The small number of female problem gamblers could be due to the time point at which data was collected. Studies found females to initiate gambling later than males [38], a phenomenon

reflected in our study with the higher number of female nongamblers and the lower numbers of female social and problem gamblers at late adolescence. Because it is during adulthood that most females initiate gambling, the timeframe of the current study's data may not adequately depict the issue of problem gambling among females.

Major strengths of the study include the sample, selected from an epidemiologically defined population representative of African-American students in schools in urban neighborhoods, and the 92% response rate. Therefore even though the sample size of the primary outcome of late adolescence problem gambling was small, its associations with early adolescence depressive symptoms and impulsivity, though somewhat imprecise, should be representative of the sample.

## Conclusion

Early adolescence depressive symptoms appear to be more positively associated to late adolescence problem gambling than early adolescence impulsivity, and there seems to be a divisive interaction between depressive symptoms and impulsivity on problem gambling. In recent years, the prevalence of problem gambling among adolescents has exceeded that of adults [1–2]. Adolescent problem gamblers are not only more likely to become adult problem gamblers but are also at risk of substance abuse and other psychiatric disorders [6]. More research is necessary in this area to uncover further risk and protective factors so that effective intervention methods could be proposed.

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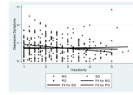
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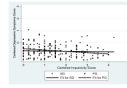


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**FIGURE 1. Depressive Symptoms and Impulsivity Scores of NG vs. SG vs. PG**  
Note. NG=Nongambler; SG=Social gambler; PG= problem gambler (includes at-risk gamblers)



**FIGURE 2. Depressive symptoms centered on 90<sup>th</sup> percentile and Impulsivity centered on 10<sup>th</sup> percentile of SG vs. PG**  
Note. SG=Social gambler; PG= problem gambler (includes at-risk gamblers)

**TABLE 1**

Characteristics of Nongamblers, Social Gamblers, and Problem Gamblers

	NG n (%)	SG n (%)	PG n (%)	p value *
Total	279 (45.2)	267 (43.2)	72 (11.6)	--
Gender				
Male	114 (40.9)	150 (56.2)	63 (87.5)	<0.001
Female	165 (59.1)	117 (43.8)	9 (12.5)	
Race				
African-American	245 (87.8)	228 (85.4)	64 (88.9)	0.61
Caucasian	34 (12.2)	39 (14.6)	8 (11.1)	
Group Assignment				
Control	97 (34.8)	85 (31.8)	18 (25.0)	0.40
CC	94 (33.7)	92 (34.5)	23 (31.9)	
FSP	88 (31.5)	90 (33.7)	31 (43.1)	
Lunch				
Free/reduced	188 (68.1)	183 (68.8)	53 (75.7)	0.46
Paid	88 (31.9)	83 (31.2)	17 (24.3)	

Note. NG=Nongambler; SG=Social gambler; PG=Problem gambler (includes at-risk and problem gamblers); CC=Classroom-centered intervention; FSP=Family-school partnership intervention.

\* produced from Chi-square statistics

TABLE 2

Adjusted Odds Ratios of the Interaction Effects of Early Adolescence Depressive Symptoms and Impulsivity on Late Adolescence Gambling Behaviors among Males

	PG vs. NG*		PG vs. SG <sup>+</sup>			
	OR	95% CI	p value	OR	95% CI	p value
Depressive Symptoms	4.06	0.73,22.47	0.11	3.88	0.78,19.31	0.10
Impulsivity	0.54	0.59,1.31	0.54	0.90	0.63,1.30	0.57
African-American	1.23	0.37,4.06	0.74	0.42	0.11,1.52	0.19
Group Assignment						
Control	1.00			1.00		
CC	1.77	0.59,5.35	0.31	1.04	0.34,3.17	0.95
FSP	2.59	1.15,5.87	0.02	2.56	0.90,7.30	0.08
Lunch						
Free/reduced	1.00			1.00		
Paid	0.83	0.34,2.05	0.69	0.60	0.26,1.39	0.24

Note. NG=Nongambler; SG=Social gambler; PG=Problem gambler (includes at-risk and problem gamblers); CC=Classroom-centered intervention; FSP=Family-school partnership intervention.

\* NG=reference group

<sup>+</sup> SG=reference group