Psychological Science

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Abstract

Using data from the large, 30-year prospective Dunedin cohort study, we examined whether preexisting individual differences in childhood temperament predicted adulthood disordered gambling (a diagnosis covering the full continuum of gambling-related problems). A 90-min observational assessment at age 3 was used to categorize children into five temperament groups, including one primarily characterized by behavioral and emotional undercontrol. The children with undercontrolled temperament at 3 years of age were more than twice as likely to evidence disordered gambling at ages 21 and 32 than were children who were well-adjusted at age 3. These associations could not be explained by differences in childhood IQ or family socioeconomic status. Cleanly demonstrating the temporal relation between behavioral undercontrol and adult disordered gambling is an important step toward building more developmentally sensitive theories of disordered gambling and may put researchers in a better position to begin considering potential routes to disordered-gambling prevention through enhancing self-control and emotional regulation.

Gambling in some form is nearly ubiquitous across history and cultures (Schwartz, 2006). External factors, such as laws regulating gambling and the accessibility of games of chance, have had a major influence on the extent of gambling involvement across time and place. Although gambling is a common practice, only a small fraction of people who gamble end up developing a gambling disorder. This suggests that there are also important differences between individuals in the tendency to gamble to excess, that is, to develop a gambling disorder (in this article, we use the term *disordered gambling* to describe the full continuum of gambling-related problems, including pathological gambling as well as subclinical gambling problems; Shaffer, Hall, & Vander Bilt, 1999).

Theories of the development of disordered gambling invariably include the personality traits of impulsivity, risk taking, and sensation seeking as vulnerability factors (Blaszczynski & Nower, 2002; Sharpe, 2002). However, recent research employing comprehensive assessments of personality suggests that it may be premature to limit the search for vulnerability factors to just the traits of impulsivity or risk-taking. In a previous study, we examined data from a 3-year follow-up of 939 individuals from a complete birth cohort and found that the personality traits of aggression and alienation predicted disordered gambling at age 21 even better than the traits of impulsivity and sensation seeking did (Slutske, Caspi, Moffitt, & Poulton, 2005). We also found that, of the Big Three personality dimensions, negative emotionality was a better predictor of disordered gambling than was low constraint. In a cross-sectional study of 292 adults, Bagby and his colleagues (2007) found that a high score on the Big Five higher-order personality dimension of neuroticism predicted disordered gambling nearly as well as a

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low score on the dimension of conscientiousness did. Perhaps it is the combination of impulsivity (or risk taking) in conjunction with the tendency toward negative emotions, such as anger, hostility, and anxiety, that constitutes the personality vulnerability for disordered gambling.

Nearly all of the research from which disordered-gambling theories have been developed has been conducted with individuals who are already habitual gamblers (usually seeking treatment for a gambling disorder) or have at least begun gambling regularly (Orford, 2011; Sharpe, 2002). This is problematic for making inferences about preexisting vulnerability, because excessive alcohol and substance use often coexist with disordered gambling. Even without alcohol and drug involvement, neural systems may undergo neuroadaptive changes in response to repeated exposures to gambling (Olsen, 2011; Verdejo-Garcia, Lawrence, & Clarke, 2008). Furthermore, negative emotionality may be a sequela rather than a precursor of disordered gambling.

Longitudinal investigations that begin prior to the initiation of any gambling involvement are required to cleanly identify vulnerability factors. Such investigations are a difficult undertaking and have rarely been achieved because the onset of gambling can occur at a remarkably young age. A survey of 1,320 grade-school children in Quebec, Canada, found that 81% of 8- to 9-year-olds had wagered money and that 40% bet once a week or more (Ladouceur, Dube, & Bujold, 1994). A review of national surveys conducted in Canada and the United States suggests that about one third of young people begin gambling prior to 11 years of age (Jacobs, 2000).

In the present study, we examined potential preexisting vulnerability factors for adult disordered gambling by focusing on assessments obtained in childhood. Behavior observed at age 3 was used to categorize children into five temperament groups. We hypothesized that the personality constellation of low impulse control and high negative affectivity puts individuals at the highest risk for the later development of disordered gambling. This is the first prospective study, to our knowledge, that has taken such a person-centered approach to characterizing the personality vulnerability for disordered gambling. The assessment at age 3 allowed us to cleanly identify vulnerability factors for disordered gambling prior to the initiation of any gambling involvement and to answer the question of whether individual differences in personality observed as early as preschool could predict adult disordered gambling as many as three decades later.

Method

Participants

Participants are members of the Dunedin Multidisciplinary Health and Development Study, an ongoing longitudinal investigation of the health and behavior of a complete birth cohort born between April 1, 1972, and March 31, 1973, in Dunedin, New Zealand (Silva, 1990). Perinatal data were obtained at delivery, and when the children were traced for follow-up at age 3 years, 91% of the eligible children participated in the assessment, which resulted in a base sample of 1,037 individuals (52% male, 48% female) for longitudinal study. Cohort families represent the full range of socioeconomic status (SES) in the general population of New Zealand's South Island and are primarily (~93%) of White European ancestry. (For more information about the Dunedin cohort, see Moffitt, Caspi, Rutter, & Silva, 2001.)

In the study reported here, we focused on assessments of temperament obtained at age 3 and disordered gambling assessments obtained at ages 21 and 32. These assessments were supplemented by multiwave composite indices of childhood intellectual ability and SES. These measures were included to test (and potentially rule out) alternative explanations for associations between childhood temperament and adult disordered gambling.

Data were available for 1,023 of the cohort members at the age-3 temperament assessment, 939 of the cohort members at the age-21 disordered-gambling assessment, and 959 of the cohort members at the age-32 disordered-gambling assessment. Participation at age 21, $\chi^2(4, N = 1,023) = 2.86$, $p = .58$, and at age 32, $\chi^2(4, N = 1,023) = 7.36$, $p = .12$, was not significantly associated with the age-3 temperament classification.

Measures

Temperament. At age 3, participants underwent a 90-min assessment of cognitive and motor abilities. After the primary assessment, the examiner completed a standardized behavioral-observation inventory. The inventory consisted of 22 items based on scales used in the Collaborative Perinatal Project (Klebanoff, 2009). The raters were provided with definitions for rating the children (see Caspi, Henry, McGee, Moffitt, & Silva, 1995, for a full list of the temperament items and their descriptions). The 22 behavioral descriptors were submitted to a series of multivariate analyses to arrive at five temperament groups: undercontrolled (10.4%), inhibited (7.8%), confident (27.5%), reserved (14.8%), and well-adjusted (39.6%; see Caspi et al., 1995, and Caspi & Silva, 1995, for more details).

The undercontrolled children were at least 1 standard deviation above the sample mean on the following 8 of the 22 behavioral descriptors (in descending order of *z*-score magnitude): restless, fleeting attention, willful, impulsive, emotionally labile, impersistent, expresses negativism, and withdraws from tasks. The inhibited children were at least 1 standard deviation above the sample mean on the following 8 items (in descending order of *z*-score magnitude): fearful, shy, flat affect, self-critical, expresses negativism, requires attention, withdraws from tasks, and impersistent. The confident children were at least 1 standard deviation above the sample mean on the behavioral descriptors of shows little caution and quick adjustment. The reserved and well-adjusted children were not substantially different from the sample mean on any individual behavioral descriptor, but the reserved children differed from the well-adjusted children by being more than 1 standard

deviation higher on the behavioral descriptor of shy. The membership of the five temperament groups was as follows: undercontrolled (38% girls, 62% boys), inhibited (60% girls, 40% boys), confident (48% girls, 52% boys), reserved (52% girls, 48% boys), and well-adjusted (48% girls, 52% boys); girls were significantly underrepresented in the undercontrolled temperament group and significantly overrepresented in the inhibited temperament group.

The adult personality traits of individuals in these five temperament groups were measured when the children reached the ages of 18 and 26 (Caspi et al., 2003). The most striking personality difference observed in adulthood was that the undercontrolled temperament group scored about 3 standard deviations above the sample mean on the primary trait of alienation and the higher-order dimension of negative emotionality. They were also rated by a close informant at age 26 as being about 3 standard deviations below the sample mean on the traits of agreeableness and conscientiousness, and above the sample mean on neuroticism. The inhibited temperament group scored about 3 standard deviations below the sample mean on the primary trait of social potency and the higher-order dimension of positive emotionality. The other three temperament groups did not exhibit personality differences in adulthood as extreme as those observed in the undercontrolled and inhibited groups.

Disordered gambling. Diagnostic assessments of past-year disordered gambling were administered via structured face-to-face interviews conducted at ages 21 and 32. At age 21, the disordered-gambling assessment comprised eight items from the South Oaks Gambling Screen (SOGS; Lesieur & Blume, 1987; see Slutske et al., 2005, for more details); these questions were asked only of those participants who reported that they had bet $50 or more in a single month in the past year. A diagnosis of disordered gambling at age 21 was based on meeting the "$50 or more" criterion and endorsing one or more of the eight SOGS items. Of the 939 participants in the age-21 assessment, 86.5% reported that they had gambled in the past year, and 13.3% met the criteria for disordered gambling. Men were significantly more likely than women to report disordered gambling at age 21 (19.2% versus 7.3%), $\chi^2(1, N = 939) = 28.47$, $p < .001$, odds ratio = 3.00.

The disordered-gambling assessment at age 32 differed from the assessment at age 21. It was based on two different published gambling assessments—the Sydney Laval Universities Gambling Screen (SLUGS; Blaszczynski, Ladouceur, & Moodie, 2008) and the National Opinion Research Center DSM-IV Screen for Gambling Problems (NODS; Gerstein et al., 1999). The SLUGS assessment includes seven items that focus on gambling-related impaired control, severity of harm, and expressed need for treatment (coefficient α = .84). The NODS was administered to participants who endorsed one or more of the SLUGS items (5.9% of the sample).

The NODS consists of 16 items that are used to assess the 10 symptoms of pathological gambling, as defined by the fourth edition of the *Diagnostic and Statistical Manual of Mental Disorders* (DSM–IV; American Psychiatric Association, 1994). Disordered gambling at age 32 was defined as endorsing one or more of the SLUGS items and one or more of the 10 DSM–IV symptoms according to the NODS items. Of the 959 participants in the age-32 assessment, 79.1% reported that they had gambled in the past year, and 4.2% met the criteria for disordered gambling; 1.4% of the age-32 participants met the strict DSM–IV criteria for a past-year diagnosis of pathological gambling (i.e., endorsing five or more symptoms from the NODS assessment). Men were significantly more likely than women to report disordered gambling at age 32 (6.4% versus 1.9%), $\chi^2(1, N = 959) = 11.92$, $p = .001$, odds ratio = 3.50.

The primary outcome of interest in this study was an adult disordered-gambling composite that was based on meeting the criteria for disordered gambling at either age 21 or 32 (full sample: 16.3%; men: 23.6%, women: 9.0%), but we also examined disordered gambling at ages 21 and 32 as separate outcomes. Although outcomes at the two ages were significantly associated with each other, $\chi^2(1, N = 915) = 21.85$, $p < .0001$, odds ratio = 4.64, there were only a handful of individuals who met the criteria for disordered gambling at both ages 21 and 32 (1.5% of the full sample and 11.7% of individuals with disordered gambling at age 21). This is not surprising given the intraindividual variability of disordered gambling that has been documented in previous longitudinal studies (Abbott, Williams, & Volberg, 2004; Slutske, Jackson, & Sher, 2003) and cross-sectional studies (Slutske, 2006). As in previous research, disordered gambling persisting across more than 5 years was relatively uncommon.

Childhood intellectual ability (IQ). The Wechsler Intelligence Scale for Children (Wechsler, 1974) was administered by trained psychometricians at ages 7, 9, 11, and 13. The scores obtained at these four ages were highly correlated with each other (rs = .75–.94). The mean of the full-scale IQs obtained at these four time points was used as an indicator of childhood intellectual ability.

Family SES. The SES of study members' families was measured with a 6-point scale assessing parents' occupational status (Elley & Irving, 1985). The scale places each occupation into one of six categories based on the educational levels and income associated with that occupation in data from the New Zealand census. The scale ranges from 1, *unskilled laborer*, to 6, *professional*. Family SES was the average of the highest SES level of either parent across six waves of the study from birth through age 15 (assessed at ages 1, 5, 9, 11, 13, and 15; coefficient α = .92). This variable reflects the socioeconomic conditions experienced by the participants while they were growing up.

Statistical analysis. Logistic regressions were conducted to compare the age-3 undercontrolled, inhibited, confident, and

reserved temperament groups with the age-3 well-adjusted group on each of the adult disordered-gambling outcomes. Analyses were repeated controlling for the effects of sex, childhood IQ, and family SES to determine whether any associations obtained could be explained by these variables. Analyses were also repeated with sex included as a moderator to determine whether the effects differed for men and women.

Results

Participants in the age-3 undercontrolled temperament group were significantly more likely than those in the well-adjusted group to exhibit disordered gambling as adults, $\chi^2(1, N = 915) = 12.07, p = .001$, odds ratio = 2.64; this was not the case for participants in the inhibited group, $\chi^2(1, N = 915) = 2.96, p = .09$, the confident group, $\chi^2(1, N = 915) = 0.90, p = .34$, and the reserved group, $\chi^2(1, N = 915) = 0.60, p = .44$ (see Fig. 1). Adult disordered gambling was significantly associated with sex, $\chi^2(1, N = 924) = 33.59, p < .0001$, odds ratio = 3.13, low childhood IQ, $\chi^2(1, N = 902) = 6.03, p = .01$, odds ratio = 0.98, and low childhood SES, $\chi^2(1, N = 919) = 11.97, p = .001$, odds ratio = 0.75, but the association between membership in the undercontrolled temperament group (as opposed to the well-adjusted group) and the adult disordered-gambling composite remained statistically significant after controlling for sex, IQ, and SES, $\chi^2(1, N = 891) = 8.23, p = .004$, odds ratio = 2.35. There were no significant interactions between sex and membership in any of the temperament groups in predicting adult disordered gambling.

All of the models were rerun to predict past-year disordered gambling at age 21 or 32. Participants in the age-3 undercontrolled temperament group were significantly more likely than those in the well-adjusted group to exhibit disordered gambling at age 21, $\chi^2(1, N = 930) = 6.98, p = .008$, and at age 32, $\chi^2(1, N = 948) = 7.30, p = .007$. Participants in the inhibited, confident, and reserved temperament groups were not more likely than those in the well-adjusted group to exhibit disordered gambling at either age 21 or 32. Table 1 summarizes the results of comparisons of the undercontrolled temperament group with the well-adjusted group for all three adult disordered-gambling outcomes. Results are shown separately for the full sample and for men and women separately, both before and after controlling for covariates.

A sensitivity analysis with another measure of childhood self-control (from Moffitt et al., 2011) predicting adult disordered gambling demonstrated that the results based on a person-centered typological approach for characterizing childhood personality were also observed using an alternate variable-centered approach (see the Supplemental Material available online for further details).

Discussion

In the study reported here, we found that children in a complete birth cohort who were rated as behaviorally and emotionally undercontrolled at 3 years of age were more than twice as likely to exhibit disordered gambling at ages 21 and 32 than children who were rated as well-adjusted at age 3. This level
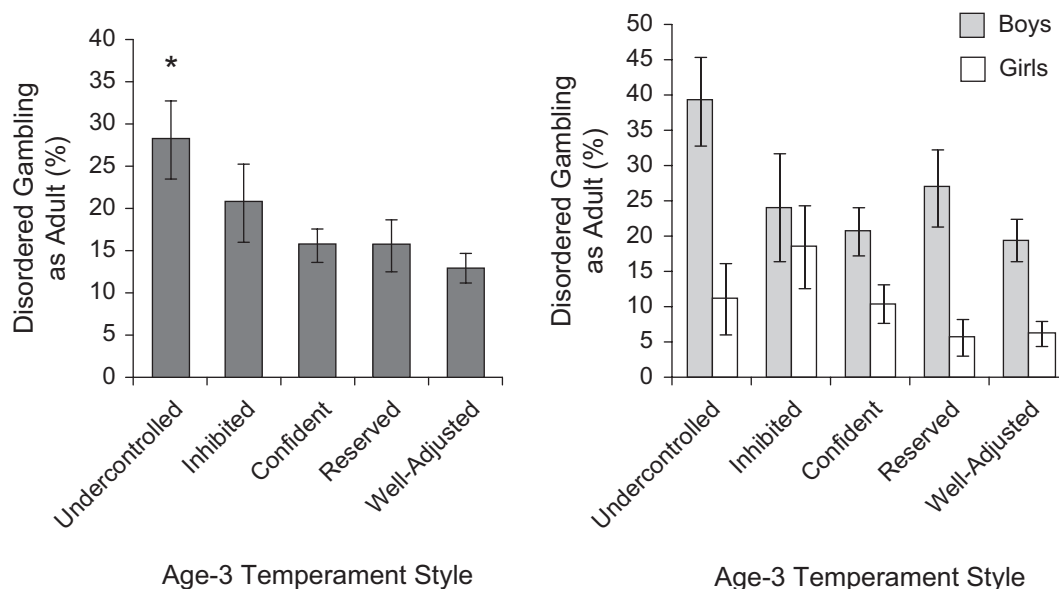

Fig. 1. Percentage of adults who met the criteria for disordered gambling as a function of temperament at age 3. The left panel shows results for the full sample, and the right panel shows results separately for boys and girls. The asterisk indicates the group that was at significantly increased risk for disordered gambling compared with the well-adjusted group. Error bars indicate ±1 standard error of estimate.

Table 1. Results of Models Predicting Adult Disordered Gambling From Undercontrolled Temperament at Age 3

Sample	Unadjusted model		Adjusted model	
	Odds ratio	95% CI	Odds ratio	95% CI
Full sample				
Age 21 and 32 composite	2.64	[1.53, 4.57]	2.47	[1.40, 4.38]
Age 21	2.22	[1.23, 4.02]	2.19	[1.18, 4.06]
Age 32	3.52	[1.41, 8.76]	3.17	[1.23, 8.16]
Men				
Age 21 and 32 composite	2.68	[1.40, 5.12]	2.59	[1.31, 5.10]
Age 21	2.58	[1.30, 5.12]	2.57	[1.25, 5.25]
Age 32	2.52	[0.91, 6.96]	2.51	[0.86, 7.31]
Women[a]				
Age 21 and 32 composite	1.89	[0.57, 6.30]	1.67	[0.48, 5.84]
Age 21	0.88	[0.19, 4.14]	0.80	[0.16, 3.91]

Note: The adjusted model controlled for the effects of childhood IQ and childhood family socioeconomic status. The odds ratio represents the increased risk for disordered gambling associated with being in the undercontrolled relative to the well-adjusted temperament group. CI = confidence interval.
[a]Across the five temperament groups examined in the study, only 8 women met the criteria for disordered gambling at age 32. Thus, odds ratios for this age were unstable and are not reported here.

of prediction across nearly 30 years is remarkable considering that the classification of the children's temperaments was based on observing a child for only 90 min. Also remarkable is the finding that this brief assessment conducted at age 3 appeared to predict disordered gambling as well as a much more extensive multioccasion, multirater behavioral undercontrol composite did (see the Supplemental Material).

It is noteworthy that the adult personality correlates of being classified as an undercontrolled child at age 3, that is, scoring high on the higher-order dimension of negative emotionality and low on the higher-order dimension of constraint (Caspi et al., 2003), are also the predictors of disordered gambling in adulthood (Slutske et al., 2005). This study represents a downward extension of a previous study, in which disordered gambling at age 21 was predicted by personality characteristics measured at age 18 (Slutske et al., 2005). The results from both of these studies suggest that the personality predictors of adult disordered gambling are strikingly similar whether personality is measured at age 3 or at age 18.

Unfortunately, there was no information available on the gambling behaviors and problems of the cohort members during their childhood and adolescence. Therefore, we could not address the role of undercontrol in the earlier stages of gambling (i.e., initiation of gambling, regular gambling, or gambling problems prior to adulthood) or in the unfolding of gambling involvement over time. Previous research based on variable-centered analyses of dimensional measures of impulsivity can fill in some of these gaps. Two longitudinal studies have demonstrated that 6- and 8-year-old children were more likely to take up gambling by ages 10 and 12 if they scored high on a measure of impulsivity than if they scored low (Pagani, Derevensky, & Japel, 2009; Vitaro & Wanner, 2011).

Boys with high impulsivity at age 13 were more likely than boys with low impulsivity at age 13 to take up gambling and to have gambling problems at age 17 (Vitaro, Arsenault, & Tremblay, 1997).

In addition, two cross-sectional studies of adolescents have shown that impulsivity is associated both with whether or not one gambles as well as with disordered gambling (Gupta, Derevensky, & Ellenbogen, 2006; Langhinrichsen-Rohling, Rohde, Seeley, & Rohling, 2004). In sum, undercontrolled individuals are more likely to take up gambling at an early age and may be especially vulnerable to lose control over their gambling behavior once they start gambling (Sharpe, 2002). Behavioral undercontrol may play an important role in the many stages of the development and course of disordered gambling.

Of course, low behavioral control predicts more than just disordered gambling (Moffitt et al., 2011), and high self-control "has profound benefits across every major domain of life functioning" (Duckworth, 2011, p. 2640). Perhaps the most striking example comes from the Terman Life-Cycle Study of children, which showed that self-control at age 11 predicted whether one would live beyond age 70 (Friedman et al., 1993). Indeed, self-control is a construct of theoretical importance across a variety of disciplines. A previous report from the Dunedin study found that a composite measure of poor self-control predicted a range of important life outcomes at age 32, including poor physical health, lower SES and income, substance-use disorder, single parenting, and criminal convictions (Moffitt et al., 2011). Previous reports from the Dunedin study based on the age-3 temperament typology used in the present study have also demonstrated that children who were classified as behaviorally and emotionally undercontrolled at age 3 were more likely than

children who were well-adjusted at age 3 to be diagnosed with antisocial personality disorder and alcohol dependence at age 21 (Caspi, 2000). Thus, it may not be surprising that behavioral undercontrol in childhood also predicts who will later develop a gambling disorder in adulthood.

A limitation of this study is that, because of the low prevalence of DSM–IV diagnoses of pathological gambling, we focused on a broad definition of disordered gambling that included individuals with only mild problems. This is consistent with approaches taken in previous research, which has shown that endorsing even a single symptom of disordered gambling is associated with clinically significant outcomes (Slutske et al., 2003). In all likelihood, stronger associations would have been observed had we been able to focus on more severe cases of disordered gambling. Because gambling pathology is a continuously distributed phenomenon (Shaffer, LaBrie, LaPlante, Nelson, & Stanton, 2004; Slutske, Zhu, Meier, & Martin, 2011), the insights gained from studying milder forms of gambling disorders will contribute to an understanding of more severe forms of disorders.

This study provides convincing evidence that childhood undercontrol is a vulnerability factor for disordered gambling in adulthood and that this vulnerability might be observable in children as young as 3 years of age. Cleanly demonstrating the temporal relation between childhood undercontrol and adult disordered gambling is an important step toward building more developmentally sensitive theories of disordered gambling. However, many questions remain to be addressed in future research, including the intriguing question of whether enhancing self-control and emotional regulation may help in redirecting some individuals who may be on a pathway to developing a gambling problem.

Supplemental Material

Additional supporting information may be found at http://pss.sagepub.com/content/by/supplemental-data

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Supplemental Material

Sensitivity analysis with another measure of childhood self control

We examined whether the results based on a person-centered typological approach for characterizing childhood personality would also be observed using an alternate variable-centered approach. The alternate approach utilized a multi-method, multi-occasion, dimensional measure of childhood behavioral under-control that extended beyond age 3 to include assessments obtained through age 11 (Moffitt et al., 2011). A single self-control factor was extracted via principal components analysis from the following measures: observational ratings of children's lack of control (3 and 5 years of age) and parent, teacher, and self reports of impulsive aggression, hyperactivity, lack of persistence, inattention, and impulsivity (5, 7, 9, and 11 years of age). This measure of childhood behavioral under-control was recently used to longitudinally predict adult health, wealth, and criminal offending (Moffitt et al., 2011). The person-centered and variable-centered approaches to characterizing childhood personality also differed in their breadth; the age-3 person-centered under-control measure was based on a single cross-sectional assessment from a single observer whereas the variable-centered age-3-to-11 under-control measure was based on multiple assessments obtained by self-report and from observers, parents, and teachers.

The composite childhood behavioral under-control factor significantly predicted the adult disordered gambling composite ($\chi^2 = 22.58$, df =1, p < 0.0001), even after controlling for sex ($\chi^2 = 11.17$, df =1, p = 0.001), IQ ($\chi^2 = 12.60$, df =1, p < 0.0001), and SES ($\chi^2 = 15.74$, df =1, p < 0.0001). Each standard deviation increment on the childhood behavioral under-control dimension was associated with a 50% greater likelihood of experiencing disordered gambling in adulthood. In comparison, each standard deviation decrement in childhood IQ and SES was

associated with a 25% and a 40% greater likelihood of experiencing DG in adulthood, respectively. There was not a significant sex difference in the association between the composite childhood behavioral under-control factor and adult disordered gambling.