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Where Do Gambling Problems Fit in the Structure of Psychopathology During Emerging Adulthood?

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Abstract

Research suggests major mental disorders co-occur at higher than chance levels. In adult samples, a two factor structure emerges when modeling the higher order structure of psychopathology. Specifically, disorders tend to co-aggregate into two dimensions: Internalizing (depression and anxiety) and Externalizing (acting out, impulsive, and addictive) disorders. Despite this large body of evidence, few studies have integrated problem gambling into this overall model. We used confirmatory factor analysis to model how the symptom count of gambling fits into the structure of psychopathology in a large, community based young adult twin sample of men and women (age 24; N=1329). Twins were assessed via in-person, structured diagnostic interviews on disorders including: Major Depression, Phobias, Post-Traumatic Stress Disorder and Anxiety Disorders (internalizing) and Substance Use Disorders, Gambling Problems (self-report), and Antisocial Behaviors (externalizing). The data were fit to a two-factor structure, with gambling symptoms loading most highly on externalizing, rather than internalizing. The problem gambling loadings did not differ by sex. Implications of these findings suggest that during emerging adulthood gambling problems are best classified and conceptualized in the realm of externalizing disorders for both males and females. Results also suggest prevention and intervention efforts be aimed at young adults who exhibit commonly co-occurring psychopathology.

Psychiatric disorders commonly co-occur, and several studies examining common mental disorders suggest that disorders tend to aggregate into two spectrums: internalizing (e.g., anxiety and depressive symptoms) and externalizing psychopathology (disorders characterized by impulsivity, and disinhibition; e.g., Antisocial Personality Disorder and Substance Use Disorders; Carragher, Krueger, Eaton, & Slade, 2015; Krueger, 1999; Krueger, Hicks, Patrick, Carlson, Iacono & McGue, 2002 and other examples include Impulse Control Disorder and Borderline Personality Disorder). In this context, there is a key scientific question: To what extent do gambling and other addictions fall within the externalizing or internalizing spectrum? In previous studies modelling the structure of major mental disorders, substance related disorders were the most common addictive disorders included and these disorders tend to load on the externalizing dimension. Despite multiple studies examining internalizing and externalizing spectrums, there have been few, if any, to investigate where gambling fits in the context of this model. Understanding the patterns of co-occurrence of gambling problems in the larger structure of psychopathology has the

potential to impact classification and treatment and inform our understanding of gambling in the larger context of psychopathology.

Some studies have modeled the underlying structure of psychopathology in order to improve diagnostic classification and uncover common origins and traits among disorders. Findings from large data sets have demonstrated that the major mental disorders tend to co-aggregate into a two dimensional factor structure: internalizing and externalizing (Blais, 2010; Krueger, 1999). The internalizing disorder spectrum is composed of anxiety disorders and major depression (for example, Major Depressive Disorder, Generalized Anxiety Disorder, and Post-Traumatic Stress Disorder (PTSD); note PTSD has moved from an anxiety disorder classification). Externalizing tends to include substance use disorders and disorders related to impulsive personality (such as Antisocial Personality Disorder). Within the internalizing and externalizing spectrums, disorders may share some similar underlying genetic factors, but different environments may impact which disorder is expressed (Eaton, South, & Krueger, 2010; South & Krueger, 2011; Krueger et al., 2002). While previous studies have found common underlying genetic and environmental factors within the spectrums, there is also evidence of specific genetic and environmental contributions to disorders within and between spectrums (Krueger et al., 2002). Specifically, gambling disorder and other addictions may have overlapping etiologies (Grant & Chamberlain, 2015; Leeman & Potenza, 2013; Xian, Giddens, Scherrer, Eisen, & Potenza, 2014; Vitaro, Hartl, Brengden, Laursen, Dionne, & Boivin, 2014). Various definitions of problem gambling exist in the literature, and a developmentally-informed approach to measuring problem gambling may utilize a sub-syndromal definition in adolescence and young adulthood due to growth in problem gambling behaviors during the life course (Winters, Stinchfield, & Fulkerson, 1993). Research and progress in the area of diagnostic classification has also benefited from studies focused purely on the structure of psychopathology.

Gambling problems are often comorbid with a variety of common mental disorders and are related to increased mental health problems (Brooker, Clara & Cox, 2009; Skidmore, Tate, Drapkin & Brown, 2015). Specifically, gambling disorder has been tied to other psychiatric disorders including depression, anxiety, substance use disorders, Post-Traumatic Stress Disorder, Borderline Personality Disorder and eating disorders (Brown, Allen & Dowling, 2015; Petry, Andrade, Alessi & Rash, 2016; Quigley et al., 2015). In addition, studies have suggested that major depression and anxiety disorders show overlapping comorbidities and common features with gambling disorder (Potenza, Xian, Shah & Scherrer, & Eisen, 2005; Scherrer, Xian, Slutske, Eisen & Potenza, 2015). There are links between Neuroticism and gambling problems (Bagby, Vachon, Bulmash, Toneatto, Quilty & Costa, 2007; MacLaren, Best, Dixon, & Harrigan, 2011), suggesting negative emotions may account for some of the underlying vulnerability or etiological underpinnings of the association between gambling and mental disorders. In this context, one of the most relevant theoretical models is the “pathways” model (Blaszczynski & Nower, 2002). The model details several types of gambling including gamblers with mood disorders and impulsive gamblers in the context of a lifespan developmental approach. The theory and data supporting a pathways model provides a rationale for future research to fully examine relationships between gambling, mood and anxiety disorders, and disorders of impulsivity during emerging adulthood. Larger scale studies using a fine-tuned approach to examining these relationships advances our

understanding of the biological, social and emotional underpinnings of gambling disorder pathways.

In part due to the high rates of comorbidity between substance use and gambling disorders, researchers have suggested that gambling disorder be repositioned from its previous place in the Impulse Disorders Category to the addictive disorders domain in the latest version of the Diagnostic and Statistical Manual of Mental Disorders-Fifth Edition (DSM-5; Fifth Edition, American Psychiatric Association, 2013). This re-positioning of gambling disorder is supported by the empirical literature suggesting gambling disorder shares common underlying etiological and psychological processes with other addictions and frequently co-occurs with them (Barnes, Welte, Tidwell & Hoffman, 2015; Bussu & Detotto, 2015). Alcohol, nicotine, and drug use disorders have been associated with gambling disorder and gambling treatment commonly involves techniques that may be effective for other addictions. Understanding common co-occurrence patterns with problem gambling symptoms in young adulthood can help clinicians and prevention scientists develop a better approach to treatment, classification and prevention. Research in this area can address the implications of repositioning gambling disorder into the addictions realm in DSM-5.

In one of the only studies to investigate where gambling falls in the structure of common mental disorders, Oleski and colleagues (2011) used the National Epidemiological Survey of Alcohol and Related Conditions (NESARC) data (a large representative sample of adults) to examine pathological gambling using an externalizing-internalizing model. Problem gambling was associated with the externalizing spectrum in both men and women. However, in women, the best fitting model was one where problem gambling was allowed to load on externalizing along with a lower order anxious-misery factor (mostly mood disorders). The study did not formally test for differences in the factor loadings for men and women.

The structure of common mental disorders must be examined in the context of a developmentally informative model, with the idea that problem gambling emerges across the lifetime, and may be related to disorders differently at different time points. Problem gambling tends to emerge in young adulthood as individuals come of legal age to gamble and encounter more opportunities to take risks both financially and psychologically (Bray, Lee, Liu, Storr, Ialongo, & Martins, 2014). Young adults may learn money management skills from parents in their home environment. After they gain independence, youth may have more control over their finances, leading to increased risk for gambling problems (Bray et al., 2014; Delfabbro & Thrupp, 2003). The structure of internalizing and externalizing disorders has been modelled in young adults (Krueger et al., 2002), yet few studies to date have explored where problem gambling falls in this model. In light of the few studies in this area, we utilize data from a community sample that has reached emerging adulthood (Hasin et al., 2013; Martin & Winters, 1998).

The present study aims to resolve questions about the patterns of co-occurrence of problem gambling and other forms of psychopathology in young adulthood. In the current study, confirmatory factor analysis is used to examine the structure of major mental disorders in a young adult population-based study of twins and their families, thereby examining where problem gambling symptoms fit into the structure. Based on existing studies finding a

pattern of comorbidity among addictive disorders and problem gambling symptoms, we hypothesized that in the context of a two-factor model, gambling would align with the externalizing compared to internalizing spectrum. We utilized a large-scale twin sample examining symptom counts of disorders on a phenotypic level. Researchers have suggested that problem gambling should be assessed using a developmentally sensitive approach (Blanco et al., 2015). In this study, we examine sub-syndromal problem gambling in young adulthood, which is inclusive of a fuller spectrum of gambling problems to address the following questions:

1. When we fit a two factor model including common forms of psychopathology in young adults, where do problem gambling symptoms fit within this structure?
2. In a two factor model, what are the patterns of association between problem gambling and the latent internalizing and externalizing factors?
3. Does the two factor structure of psychopathology, including problem gambling symptoms, differ for males and females?

Method

Participants

Participants were a cohort of 1329 young adult twins (646 males; 683 females), first assessed at age 11 (N=1512 at baseline) and followed every three years thereafter as part of the Minnesota Twin Family Study, a longitudinal study of twins and their families (Iacono et al., 1999). Data were collected between the years of 2005 and 2007. During this period, the following forms of gambling were available in Minnesota: 18 tribal casinos, two race tracks, lottery and charitable gambling (including pull tabs and bingo). For the current study, twins with available data for gambling problems and diagnoses from the fourth follow-up, assessed at a target age of 24 years ($M = 25.4$ years; $SD = 1.1$), were included. We utilized data at this specific time point because young adults would be more likely to have started gambling on a regular basis. Retention at this follow-up was excellent (88% of the baseline sample). Moreover, non-participants at follow-up (N=182) did not differ significantly from participants on baseline symptoms of childhood ADHD or oppositional defiant disorder [$t(1510) = -0.04$ or -1.57 , respectively, both $ps > .10$] and had only slightly more (0.2 symptom) symptoms of conduct disorder than did participants [$t(1510) = -2.98$, $p < .01$]. Parents of twins were also interviewed at intake assessment. While sample method and demographics are detailed elsewhere (e.g., Iacono et al, 1999), twins were generally representative of the population of the state of Minnesota for the birth years sampled (e.g., 97% were white). All procedures performed in this study involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and have passed the University institutional review board.

Measures

Gambling Problems—Twins were administered a twelve-item measure of gambling problems during the past twelve months: The South Oaks Gambling Screen-Revised for Adolescents (SOGS-RA; Winters, Stinchfield & Fulkerson, 1993). The scale has demonstrated evidence of solid psychometric properties in youth populations (Wiebe, Cox &

Mehmel, 2000), and a preliminary principal components analysis of the age 24 SOGS-RA data confirmed that this scale represented primarily a single factor or dimension at this age, as only one factor had an eigenvalue greater than 1.00. Items included questions such as family problems, chasing losses, arguments, and other gambling related problems. Although we used the original instrument, our scoring procedures deviated some from the original scoring algorithm in order to estimate a symptom count.

We coded items present if a twin said yes to the item; items with a “sometimes” option were also coded as present. If a twin endorsed an item, it was counted as a symptom. Symptoms were then summed to create a symptom count and log transformed due to skewness of the data. Given the low rate of endorsement of gambling problems at this age, few, if any of the participants met criteria for a full-blown gambling disorder, therefore we used symptom count variables for problem gambling to capture gambling involvement. Moreover, because the endorsement of specific gambling problems was rather low, particularly for females, the reliability of the gambling measure was somewhat less than optimal ($\alpha=.63$; also reported in King et al., 2017). Gambling symptoms were not assessed at every wave of the study, limiting the possible time frames that could be examined. We examined the underlying genetic and environmental factors explaining variance in gambling across time in a twin sample in another recent paper (see King, Keyes, Winters, McGue, & Iacono, 2017).

Internalizing and Externalizing Disorders—Symptom counts of all disorders were utilized, as these provide an index of severity (e.g., for substance use disorders; Hasin et al., 2013) and maximize detection of emerging disorders as well (Martin & Winters, 1998). At the time data were collected there was a focus on the Diagnostic and Statistical Manual Fourth Edition and much of the processed twin data was in this format (DSM-IV, American Psychiatric Association [APA], 2013). Twins were assessed in person for DSM-IV disorders using a revised form of the SCID (Structured Clinical Interview for the DSM IV; First, 1997). Past three-year status of DSM-IV symptoms were assigned based on a method of case review (or consensus) between two trained individuals reviewing the semi-structured interviews. Participants were then assigned symptoms based on this review and a symptom count was computed based on the number of symptoms judged to be fully endorsed. For the current study, we used a log transformation on these symptom counts due to skewness of the data. We used mental disorders and symptom counts that were included in previous work on the underlying structure of common major adult mental disorders (see Krueger, 1999) and the following disorders were included in this investigation: Major Depressive Disorder, Generalized Anxiety Disorder, Simple Phobia, Social Phobia, PTSD, Panic Disorder, Alcohol Dependence, Cannabis Dependence, Nicotine Dependence, Adult Antisocial Behavior, and Problem Gambling.

Data Analysis

Structural equation modeling analyses were conducted in Mplus version 7.31. Full-information maximum likelihood produced unbiased estimates for data missing at random, permitting all age-24 participants to be included (since all had data on most disorders), even when data on a specific disorder was missing. The level of missingness in our sample was sufficiently low for FIML to produce unbiased estimates even in the case that our data are

not missing at random (e.g., 4.1% were missing gambling data). Log-transformed symptom counts for all externalizing and internalizing disorders and problem gambling were used along with an MLR estimator to address the non-normality of the data. The COMPLEX samples option accounted for correlated twin data via a sandwich estimator. We fit a two factor model to the data based on existing research on externalizing and internalizing disorders, allowing problem gambling to load on both a latent internalizing and externalizing factor. A series of two-group models were fit to test for differences in the factor structure by sex (male/female). Each baseline model included all possible paths, allowing paths and residual variances to vary by sex. Whether a path could be dropped or constrained equal across sex was tested within a nested model, including the constraint on the path being tested, and prior, successively-imposed constraints. Each subsequent model was compared to the baseline model, using the Satorra-Bentler scaled chi-square test for nested models (Satorra & Bentler, 2010). Degrees of freedom thus correspond to the difference in parameters between each model excluding or constraining a specific path (including all previously-applied constraints), compared to the baseline model (including all paths).

Results

Psychopathology at Age 24

The results of past three year prevalence rates of diagnoses are presented in Table 1 and organized by sex. At this age, men and women had significantly different rates of most forms of psychopathology (See Table 1). Results from the chi-square analyses of differences in proportions are presented in Table 1. Women had significantly higher rates of most internalizing disorders examined at age 24 (MDD, Social Phobia, Simple Phobia, Panic Disorder, PTSD). Men had higher rates of all externalizing disorders (Nicotine Dependence, Alcohol Dependence, Cannabis Dependence, and Adult Antisocial Behavior). Gambling problems were uncommon in this sample, with an average of .35 (SD=.84) problem gambling symptoms. Men reported more gambling problems than women, $M=0.46$ (SD=0.93) and $M=0.26$ (SD=.75), respectively.

Structure of Psychopathology and Gambling at Age 24

Using confirmatory factor analysis (CFA), we examined the underlying factor structure at age 24 in the sample. We fit a two factor CFA with diagnostic and gambling data at age 24 (total $N=1,329$) in which Major Depressive Disorder, Generalized Anxiety Disorder, Simple Phobia, Social Phobia, PTSD, and Panic Disorder loaded on a latent internalizing factor and Alcohol Dependence, Cannabis Dependence, Nicotine Dependence, and Adult Antisocial Behavior loaded on a latent externalizing factor. We conducted a principal components analysis of the age 24 SOGS-RA data. The results of this analysis and visual inspection of the scree plot confirmed that this data was represented primarily by a single factor or dimension, with only one factor having an eigenvalue greater than 1.00. A model in which gambling problems loaded on both the internalizing and externalizing factors was then fit to the data. Each loading (from internalizing to gambling problems and from externalizing to gambling problems) was separately constrained to zero in a nested model and was compared to the full, unconstrained model. The model in which gambling problems loaded only on the externalizing factor (Figure 1) showed acceptable model fit ($\chi^2(1) = 0.16$, $p = 0.69$; CFI =

0.955, TLI = 0.943, RMSEA = 0.027, 90% CI: [0.018, 0.036]). The model in which gambling problems loaded only on the internalizing factor fit significantly worse than the full model ($\chi^2(1) = 52.48$, $p < 0.0001$), and fit the data worse than the retained model (Figure 1; CFI = 0.903, TLI = 0.876, RMSEA = 0.040, 90% CI: [0.032, 0.048]). The loading of gambling problems on the latent externalizing factor is smaller than for other observed variables but is significantly different from zero ($\chi^2(1) = 69.6$, $p < 0.0001$). Complete model fit indices are given in Supplemental Table 1. In supplemental Table 1, we present model fit statistics with loadings on both internalizing and externalizing and also with internalizing and externalizing each constrained to zero.

Differences in the factor structure based on sex were then investigated. The best fitting overall model (see Figure 1) was fit to males and females separately allowing all parameters to vary. Sequential models were then tested that constrained one parameter at a time to be equal across males and females. Each nested model was compared to the full, unconstrained model. The best fitting two-group model, with standardized estimates reported for males and females separately, is shown in Figure 2. Additional model fit indices for the two-group models are given in Supplemental Table 2. The factor loadings for gambling problems could be constrained to be equal across sex without significant loss of fit ($\chi^2(1) = 0.95$, $p = 0.33$). Additionally, the factor loadings for Alcohol Dependence, Adult Antisocial Behavior, Major Depressive Disorder, Social Phobia, and Simple Phobia, as well as the covariance between the latent internalizing and externalizing factors, could be constrained to be equal for males and females without a significant loss of model fit. This indicates the presence of partial metric invariance suggesting that males and females ascribe similar meaning to the underlying latent constructs.

While we focus our results on a two-factor model of psychopathology, because recent research suggests that bi-factor and higher order models are important alternatives to consider (Carragher et al., 2016; Caspi et al., 2014; Castellanos-Ryan et al., 2016), these models were also fit to the data for completeness. Fit indices were comparable across all models. Fit indices for the two-factor model are: AIC = 14073.566, BIC = 14252.411, CFI = 0.953, TLI = 0.939, RMSEA = 0.028 (90% CI: [0.019, 0.037]). Fit indices for the bi-factor model are: AIC = 14060.955, BIC = 14285.789, CFI = 0.941, TLI = 0.901, RMSEA = 0.035 (90% CI: [0.026, 0.045]). Fit indices for the higher-order model are: AIC = 14075.566, BIC = 14259.521, CFI = 0.955, TLI = 0.939, RMSEA = 0.028 (90% CI: [0.019, 0.037]).

Discussion

Several studies have observed a two-factor structure of psychopathology yielding internalizing and externalizing factors. Using a sample of emerging adults, we extended the scope to include gambling problems in the model. Our efforts aimed to integrate problem gambling symptoms into the hierarchical structure of psychopathology. In the current study, we hypothesized our data would fit a two dimensional structure of psychopathology and gambling would most clearly align with the externalizing factor. Our results suggest that gambling problems may be best conceptualized and classified within the externalizing domain of psychopathology, though the associations with gambling were less strong than for other disorders in the realm. This pattern and structure did not differ by sex.

Structure of Psychopathology Including Gambling Problems

Results from studies aiming to inform a more comprehensive understanding of gambling in the larger structure of psychopathology have the potential to lend insights into common underlying psychological traits and risk factors. Practical implications of research on the structure of psychopathology can be used to inform intervention by offering clinicians data to tailor intervention approaches and exploring whether evidence based interventions are effective for disorders within a similar spectrum (internalizing and externalizing disorders). Moreover, a larger picture approach of gambling in the context of other psychopathology can help develop core and central hypotheses around common and specific risk factors causing gambling relative to other addictive behaviors. Existing research has largely neglected the question of where problem gambling symptoms fits into the larger structure of psychopathology. Research in the areas of diagnostic classification and etiology suggest there are common and specific underlying genetic and environmental influences on disorders within the internalizing and externalizing realm. Until recently, problem gambling was largely left out of research on common and specific factors, and to date there have been very few studies modeling common influences on these disorders (Brooker, Clara & Cox, 2009; Nower, Martens, Lin & Blanco, 2013). Future research should aim to deepen our understanding of shared genetic and environmental influences on psychopathology.

The results of the present study suggest that in young adulthood, problem gambling symptoms fit into the externalizing factor. Our results suggest that when incorporating gambling problems into the structure of psychopathology, in a young adult sample, the two-factor, bi-factor, and higher-order models fit the data comparably. Most model fit indices give an edge to the two-factor model, which is presented here. These results are in line with previous work by Caspi et al. (2014) who found similar fit of correlated-factors and bi-factor models to psychopathology, though this study did not incorporate gambling. Caspi et al. (2014) also suggests that the addition of internalizing and externalizing factors adds information about the structure of psychopathology beyond a general psychopathology factors. Recent research has suggested that gambling and other addictions share common traits and causes (Bussu & Detotto, 2015; Grant & Chamberlain, 2015). However, the results suggest it is the least robust loading of the externalizing domains measured in this study. There could be several explanations for a lower loading. First, many individuals have not passed the window of risk for problem gambling symptoms, and the disorder may tend to be more fully expressed later in life, when individuals have greater opportunities to manifest symptoms. Additionally, it may be difficult to obtain a full picture of the role of gambling in this sample due to a low base rate of gambling problems.

A re-positioning of gambling disorder into the addictions realm was part of changes made in DSM-5. While a great deal of previous research indicated gambling and other addictions are highly comorbid and have similar etiological influences, few studies explicitly aim to empirically test a model of gambling as integrated into a higher order structure of psychopathology. Given the paucity of existing classification research on gambling in the larger context of psychopathology, a decision to move gambling into the addictions realm may have been premature. Problem gambling has received relatively less attention in the research literature on addictions than substance use disorders. Perhaps a repositioning

highlights the similarities of the disorder with others in the addiction realm and draws attention as worthy of additional research attention. The research presented here suggests that at least in young adulthood, it more clearly fits into the general externalizing spectrum. However, follow up studies examining the longitudinal course of the disorders using large-scale data sets will help to determine if problem gambling shifts in relation to the externalizing and internalizing factors. Importantly, treatment and intervention efforts will need to utilize information about common underlying mechanisms of risk and psychological disorders in order to work toward better gambling and mental health outcomes in patients.

The results also demonstrate that gambling problems in youth are associated with the internalizing spectrum, despite not loading onto the internalizing component modeled here. There are high rates of comorbidity between anxiety disorders, depression and gambling disorder. Research has demonstrated common underlying factors related to gambling disorder and major depression (Potenza et al., 2005) and OCD (Scherrer et al., 2015). In treatment seeking adult gamblers, for example, there are higher rates of Major Depressive Disorder and impulsivity (Knezevic & Ledgerwood, 2012), suggesting risk for both increased externalizing and internalizing disorders. In addition, gambling may be etiologically associated with depression and they may be genetically related (Blanco, Myers, & Kendler, 2012).

The Role of Sex

In this study, we tested whether there were differences in the structure of psychopathology between men and women. The results suggest that how gambling problems fit into the factor structure is not different in men and women at this age. With gambling, internalizing and externalizing disorders occurring at different rates in men and women, it is worthwhile to examine sex differences in the patterning of comorbidity of these disorders at different ages and windows of risk. In one of the only studies to test the structure of psychopathology in a model including gambling, gambling disorder (pathological gambling) loaded on the externalizing spectrum for men and women, and for women, on a lower order anxious-misery factor as well (Oleski et al., 2011). Although Oleski et al. (2011) did not test whether factor loadings differed by sex, our study directly tested whether the relationship between problem gambling symptoms and the externalizing factor differed for men and women and found no evidence of a difference. A factor that may have influenced this result is the lower frequency of gambling symptoms during this window of development in the sample.

Our findings suggest that during emerging adulthood, gambling disorder symptoms may be more clearly aligned with an externalizing spectrum of psychopathology and therefore may be better classified alongside disorders in that realm (substance use disorders, antisociality) for both men and women. The relationship between gambling problems and the latent externalizing factor does not differ by sex. Additionally, the presence of partial metric invariance across sexes for the two-factor structure suggests that males and females assign the same meaning to the underlying latent factors. One limitation of the study is we did not test for underlying etiological factors (genetic and environmental) in men and women, therefore we cannot make inferences on etiological similarities or differences. In addition, we did not complete a longitudinal study which may have shed light on the impact of

developmental effect on these relationships. Allowing means and thresholds to vary by sex in all models, however, effectively adjusted for this relatively lower endorsement.

Conclusions and Implications

The results of this study have implications for the development of more effective treatments that target underlying personality or vulnerabilities leading to gambling disorder. The results suggest that gambling disorder fits into the externalizing psychopathology realm. Future research should explore whether interventions related to impulsivity and acting out behaviors may be most beneficial in reducing risk for problem gambling. If problem gambling symptoms more strongly co-aggregate with disorders in the externalizing, rather than internalizing spectrum, treatment and prevention approaches for gambling disorder may need to address and complement treatments for externalizing disorders. Although gambling disorder aggregates with disorders in the externalizing realm, it is yet unclear if it shares etiological factors with those disorders. Future studies should aim to test models of common and specific etiological factors involved in problem gambling and disorders in the externalizing and internalizing realm.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Figure 1. Best fitting two-factor model in the full group analysis with standardized factor loadings and standard errors. For simplicity, residual variances are not shown.

Figure 2.

Best fitting model in the two-group analysis split by sex. Standardized factor loadings are reported as male estimate (standard error)/female estimate (standard error). Bolded text indicates paths in which the unstandardized parameter estimates could be constrained to be equal across sex without significant loss of model fit. For simplicity, residual variances are not shown.

Table 1.

Percentage of Sample with Externalizing and Internalizing Disorders at age 24

Age 24	Men (% , n)	Women (% , n)	χ^2
<u>Internalizing Disorders</u>			
Major Depressive Disorder	10.7, 68	17.0, 115	10.17, p=.001
Social Phobia	2.6, 17	5.5, 37	5.76, p<.05
Simple Phobia	.6, 4	3.4, 23	11.09, p<.001
Panic Disorder	.8, 5	4.4, 30	15.38, p<.0001
Generalized Anxiety Disorder	.5, 3	1.6, 11	3.10, p=.08
Post-Traumatic Stress Disorder	1.1, 7	3.3, 22	6.05, p<.05
<u>Externalizing Disorders</u>			
Nicotine Dependence	34.2, 220	22.1, 151	23.31, p<.001
Alcohol Dependence	19.3, 124	10.9, 74	17.77, p<.0001
Cannabis Dependence	8.7, 56	4.0, 27	11.78 p<.001
Adult Antisocial Behavior	24.6, 156	10.3, 70	45.71, p<.0001