



Archived at the Flinders Academic Commons:

<http://dspace.flinders.edu.au/dspace/>

'This is the peer reviewed version of the following article: Smith D, Battersby M and Harvey P (2015) Does gender moderate the subjective measurement and structural paths in behavioural and cognitive aspects of gambling disorder in treatment-seeking adults? Addictive Behaviors 48: 12-18, doi <http://dx.doi.org/10.1016/j.addbeh.2015.04.001>

© 2015. This manuscript version is made available under the CC-BY-NC-ND 4.0 license <http://creativecommons.org/licenses/by-nc-nd/4.0/>

which has been published in final form at

DOI: <http://dx.doi.org/10.1016/j.addbeh.2015.04.001>

Copyright (2015) Elsevier, Ltd.

Title

Does gender moderate the subjective measurement and structural paths in behavioural and cognitive aspects of gambling disorder in treatment-seeking adults?

Date of submission

4 April 2015

Authors

David Smith<sup>a</sup> (Corresponding author)

Affiliation: Flinders University, Department of Psychiatry

Email: [david.smith@flinders.edu.au](mailto:david.smith@flinders.edu.au)

Malcolm Battersby<sup>a</sup>

Affiliation: Flinders University, Department of Psychiatry

Email: [malcolm.battersby@flinders.edu.au](mailto:malcolm.battersby@flinders.edu.au)

Peter Harvey

Affiliation: Flinders University, Department of Psychiatry

Email: [peter.harvey@flinders.edu.au](mailto:peter.harvey@flinders.edu.au)

<sup>a</sup>Address: Flinders Human Behaviour and Health Research Unit, GPO Box 2100, Adelaide  
SA 2001

Country: Australia

Manuscript details

Number of pages: 16

Number of tables: 3

Number of figures: 1

## **Abstract**

### **Introduction**

Gender differences have been observed in the pathogenesis of gambling disorder and gambling related urge and cognitions are predictive of relapse to problem gambling. A better understanding of these mechanisms concurrently may help in the development of more directed therapies.

### **Methods**

We evaluated gender effects on behavioural and cognitive paths to gambling disorder from self-report data. Participants (N=454) were treatment-seeking problem gamblers on first presentation to a gambling therapy service between January 2012 and December 2014. We firstly investigated if aspects of gambling related urge, cognitions (interpretive bias and gambling expectancies) and gambling severity were more central to men than women. Subsequently, a full structural equation model tested if gender moderated behavioural and cognitive paths to gambling severity.

### **Results**

Men (n=280, mean age=37.4 years, SD=11.4) were significantly younger than women (n=174, mean age=48.7 years, SD=12.9) ( $p < 0.001$ ). There was no gender difference in conceptualising latent constructs of problem gambling severity, gambling related urge, interpretive bias and gambling expectancies. The paths for urge to gambling severity and interpretive bias to gambling severity were stronger for men than women and statistically significant ( $p < 0.001$  and  $p = 0.004$ , respectively) whilst insignificant for women ( $p = 0.164$  and  $p = 0.149$ , respectively). Structural paths for gambling expectancies to gambling severity were insignificant for both men and women.

### **Conclusion**

This study detected an important signal in terms of theoretical mechanisms to explaining gambling disorder and gender differences. It has implications for treatment development including relapse prevention.

Keywords: Gambling disorder, Gambling urge, Gambling cognitions, Gender, Moderation, Structural equation modelling

## 1. Introduction

While treatments are efficacious for gambling disorder, relapse to problem gambling is pervasive (Hodgins, Currie, el-Guebaly, & Diskin, 2007; Hodgins & el-Guebaly, 2004) and gambling related urge and cognitions are predictive of relapse (Hodgins & el-Guebaly, 2004; Oakes et al., 2012; Smith et al., 2015). These variables are underpinned by two important approaches to explaining gambling behaviour, encompassing the brain reward system (psychobiological approach) and erroneous cognitions (cognitive approach) and their anomalous interaction (Clark, 2010). Patterns of urge-cognition circuitry are likely to vary at the individual level due to differences in brain function or neurochemistry (Clark, 2010). In addition, gender differences have been observed in the pathogenesis of gambling disorder such as disease severity, hereditary links and premorbid psychopathology (Grant, Chamberlain, Schreiber, & Odlaug, 2012) as well as treatment needs and response (Crisp et al., 2000). Gender may also moderate neural correlates in decision-making during gambling (Clark, 2010). Therefore, a better understanding of potential gender differences in urge and cognition mechanisms could significantly benefit the development of treatments for gambling disorder.

The commonalities between gambling disorder and substance use disorders (SUD) in neurocognitive and physiological pathways (Paris, Franco, Sodano, Frye, & Wulfert, 2009; Tamminga & Nestler, 2006) was a key catalyst to the reclassification of Pathological Gambling (PG) from ‘Impulse-Control Disorders Not Elsewhere Classified’ to ‘Addiction and Related Disorders’ in DSM-5.(American Psychiatric Association, 2013). Central to the maintenance of SUD and relapse after a period of abstinence are urge or craving states experienced by individual users (Bohn, Krahn, & Staehler, 1995; Tiffany, 1992). Whilst not a diagnostic criterion for substance dependence, craving is stated to be experienced by ‘most (if not all)’ individuals with the disorder (American Psychiatric Association, 2013). Similarly, urge states play an important role in gambling pathology (Raylu & Oei, 2004b) and have been proposed to increase during periods of psychological disturbances, such as depression and stress (American Psychiatric Association, 2000). The physiological state of gambling urge can arise from internal triggers (e.g. depression) and external triggers (e.g. gambling cues) that activate arousal and gambling related cognitions (Sharpe, 2002).

Neuroimaging studies have established links between intensities of self-reported gambling urges and changes in brain activity including retrieval and processing of emotion and impulse regulation (Balodis, Lacadie, & Potenza, 2012; Potenza et al., 2003). Similarly, subjective reports of craving by cocaine dependent individuals have shown to be commensurate with corticostriatal-limbic activations (Potenza et al., 2012). The combination of neuroimaging and neurocognitive tasks has revealed gender dimorphism in decision-making during gambling. Women have shown to utilize different cognitive strategies and neural networks than men when performing the Iowa Gambling Task (IGT) (Bolla, Eldreth, Matochik, & Cadet, 2004). Animal models have also supported gender differences in reward based decision-making based on a rodent version of the IGT (van den Bos, Jolles, van der Knaap, Baars, & de Visser, 2012).

Beyond the laboratory, men and women in the general community have shown to be at variance in self-reports of gambling related cognitions (Raylu & Oei, 2004a). Furthermore, cognitions relating to gambling expectancies (GE) or desired outcomes (e.g. “Having a gamble helps reduce tension and stress” (Raylu & Oei, 2004a)) may be mediated by ‘escapist motivation’ and moderated by gender where paths are stronger in women than men (Balodis, Thomas, & Moore, 2014; Bonnaire, Bungener, & Varescon, 2009; Thomas, Allen, & Phillips, 2009). In conjunction with GE, interpretive bias (IB) (e.g. “Relating my winnings to my skill and ability makes me continue gambling” (Raylu & Oei, 2004a)) is also rewarded, learned, and becomes habitual in gambling pathology. Different levels of IB have also been shown to occur between men and women in the general community (Raylu & Oei, 2004a).

To date, there is uncertainty to whether gender moderates the paths in behavioural and cognitive aspects of gambling disorder in treatment-seeking adults. In this study, we investigated the following questions. Firstly, are different characteristics of subjective reports of gambling urge, cognitions (interpretive bias and gambling expectations) and gambling disorder more central to men than women? Secondly, are the latent predictor variables of urge and cognitions equally salient to predicting disordered gambling in men and women?

## **2. Methods**

### **2.1 Study Design**

We retrospectively evaluated gender effects on structural paths in behavioural and cognitive aspects of gambling disorder from self-report measures. Data was collected at participant's first presentation to an outpatient gambling treatment centre between January 2012 and December 2014. The study was approved by the Southern Adelaide Health Service/Flinders University Human Research Ethics Committee.

## **2.2 Service and Participants**

The Statewide Gambling Therapy Service (SGTS) offers free cognitive-behavioural therapy (CBT) for help-seeking problem gamblers in South Australia. The service is staffed by a psychiatrist and therapists with professional registration in psychology, nursing or social work. All therapists have Masters level qualifications in CBT (Battersby, Oakes, Tolchard, Forbes, & Pols, 2008). The dataset consisted of records for 454 adult treatment-seeking problem gamblers.

## **2.3 Measures**

*Problem Gambling Severity Index (PGSI)*: A self-report questionnaire that was developed to reflect severity of problem gambling behaviour from a social context (Table 1). Each of the 9 items are rated on a Likert (0 – 3) scale. A total score is indicative of either non-problem gambling (score of 0), low level of problems (1 – 2), moderate level of problems (3 – 7) or problem gambling (8 +). The classification of 'problem gambling' is considered to be equivalent to DSM-IV Pathological Gambling (Ferris & Wynne, 2001). Whilst PGSI was originally developed for use in prevalence surveys involving general populations, it has also shown sound psychometric properties in a clinical setting (Young & Wohl, 2011).

*Gambling Urge Scale (GUS)*: A self-report questionnaire measuring the extent of gambling urge (Table 1). The scale consists of six items rated on a Likert (1-7) scale. A final score is generated as a total of the response to each item. Research into concurrent, predictive and criterion-related validity of the GUS suggest that it is a valid and reliable instrument for assessing gambling urges among treatment seeking problem gamblers (Smith, Pols, Battersby, & Harvey, 2013) and non-clinical or non-treatment seeking gamblers (Raylu & Oei, 2004b).

*Gambling Related Cognitions Scale (GRCS)*: A self-report questionnaire that records common thoughts associated with problem gambling. The 23 items of the GRCS contribute

to five subscales reflective of the broader categories of gambling related cognitions that have been described in the literature. In this study, two subscales were the central focus based on the previous literature: interpretative bias (GRCS-IB) and gambling-related expectancies (GRCS-GE) (Table 1). Problem gamblers use a Likert (1 -7) scale to indicate how much they agree with each of the statements. The final score is created by adding the values gained from the items, with a higher score reflecting more gambling-related cognitions. A previous comparison with the South Oakes Gambling screen indicated the scale has good psychometric properties in measuring gambling cognitions in a non-clinical sample (Raylu & Oei, 2004a).

Table 1 here

## **2.4 Internal Consistency**

The Cronbach alpha coefficient was used to measure internal consistency. It is dependent on the average correlation or covariance of the items with one another and the number of items. For health status questionnaires, values between 0.70 and 0.95 are indicative of good internal consistency. Low coefficient values suggest that test scores are less reliable due to a lack of correlation and very high scores indicate redundancy of one or more items (Terwee et al., 2007).

## **2.5 Measurement and structural models**

Confirmatory factor analysis (CFA) was used to model associations between factor variables and observed items plus unique variances of each item using Stata 13.0 (Acock, 2013; StataCorp, 2013). Firstly, patterns of common factor loadings for men and women were compared. If patterns were similar then configural invariance was considered to have been established and subsequent testing was meaningful. Post-estimation modification indices were calculated to identify any omitted covariance paths that would otherwise improve model fit. Secondly, factor loadings were constrained to be equal for like items across gender to test for metric invariance. Modification indices were calculated to test for any linear constraints that could be relaxed to improve model fit whilst accounting for changes in all the parameters in the model (Sörbom, 1989). If metric invariance or partial metric invariance could not be achieved then it was indicative of a gender difference in subjective reporting of the latent construct. Model estimates were generated from maximum likelihood (ML) estimation and used all available data. Missing data was assumed to be missing at random (MAR).

Based on a satisfactory CFA result for measurement invariance, a full structural equation model (SEM) was run for men and women simultaneously. It predicted problem gambling severity from a person's level of gambling related urge and cognitions. An initial model was fitted where factor loadings and intercepts were constrained to be equal across gender. The same model was then rerun but with structural path coefficients constrained across gender. Both standardized and unstandardized path coefficients were produced. R-squared values were calculated at the structural equation level to assess how much variance was explained in problem gambling severity by gender. To determine if structural paths were different between men and women at a statistically significant level, Lagrange multiplier tests were used to indicate how much the model fit would improve if constraints were removed (Acock, 2013). This information was used in combination with chi-squared differences between models (described in the following section) in deciding which model provided the best fit for the data (Acock, 2013).

## **2.6 Assessing model fit**

To evaluate how well measurement models fitted the data, a range of post-estimation tests were conducted. Firstly, a likelihood-ratio (LR) test was used to compare each fitted model with degrees of freedom versus a saturated model with no degrees of freedom. A significant  $\chi^2$  statistic indicated that the model was not perfect at  $p < 0.05$ . Likelihood-ratio tests were also used to compare full models against nested models in order to determine the best fitting model. Goodness-of-fit indices were also calculated to assess how well each model fitted the data (Kline, 2011). The confirmatory fit index (CFI) was used to determine how much better the fitted model did compared to a null model where all items were assumed to be independent of one another. A cut score of 0.90 indicated a reasonable relationship among item scores and 0.95 for a strong relationship. To evaluate invariance based on change in CFI, a cut score of 0.002 was used.

The root mean squared error of approximation (RMSEA) with 90% confidence intervals (CIs) was calculated for each model. It considered how much error there was for each degree of freedom. Smaller values indicated a better fitting model with an upper limit of 0.08. The coefficient of determination (CD) was calculated to assess the proportion of variance explained by an overall model. A CD value near 1 indicated a good model fit. Finally, Akaike's information criterion (AIC) and Bayesian information criterion (BIC) were used to compare nested models where smaller values reflected a better model fit.



### **3. Results**

#### **3.1 Participant characteristics**

Table 2 shows descriptives for 454 treatment-seeking problem gamblers at baseline assessment. On average, men were younger and a greater proportion were employed, married or in a defacto relationship when compared to women ( $p < 0.001$ ). Most women self-reported EGMs as their main form of gambling problem whereas men had a higher incidence of horse and dog racing ( $p < 0.001$ ). There was no statistically significant gender effect on mean scores for PGSI, GUS, GRCS- IB, GRCS- GE and duration of gambling problems. Mean PGSI values indicated that most participants met DSM-5 criteria for gambling disorder at the more severe end of the spectrum.

Table 2 here

#### **3.2 Descriptives of measures and internal consistency**

Table 1 shows the descriptive statistics for each measure. For most items, the mean score appeared similar across gender. The only discernible difference was for GRCS- IB items 5 and 10 which were higher in men. The majority of item variances for PGSI and GRCS- IB were higher for men, indicating greater heterogeneity in ratings. For GUS and GRCS- GE, women tended to be more heterogeneous in ratings on individual items. The internal consistency of each measure was satisfactory by conventional standards for both men and women. For PGSI, Cronbach's alpha was 0.87 for men and 0.80 for women. For GUS, Cronbach's value was 0.94 for men and 0.95 for women. For GRCS-IB and -GE, coefficients were 0.73 and 0.75 for men, and 0.70 and 0.69 for women, respectively.

#### **3.3 Measurement invariance**

Table 3 presents goodness-of-fit indices for the gender invariance analysis of all available data ( $N = 454$ ). For PGSI data, the best fitting configural model was a model with error covariances for Items 4 and 8 and Items 5 and 9. For GUS data, the best fitting configural model was a model with error covariances for Items 1 and 2, Items 4 and 5 and Items 3 and 6. The chi-squared results indicated that models were not a perfect fit but they did come reasonably close to providing a good fit of the data based on CFI, RMSEA and CD values. These fit indices also indicated that configural invariance for PGSI, GUS and GRCS factors was established from patterns of common factor loadings between men and women being

similar. It showed that participant conceptualisation of problem gambling severity and gambling related urge and cognitions was stable across gender. To assess metric invariance, equality constraints on factor loadings were imposed. The fit indices showed that metric models for all measures retained a good fit of data relative to configural models ( $p > 0.05$ ). This indicated that observed variables were of similar importance to men and women in measuring latent constructs of gambling severity, urge, interpretive bias, and gambling expectancies.

Table 3 here

### 3.4 Structural equation model

Following the satisfactory result from the measurement invariance analysis, a full SEM was then specified to predict problem gambling severity (PGSI) from urge (GUS) and cognitions (GRCS-IB, -GE). Firstly, a model was fitted with factor loadings and intercepts constrained across gender but structural path coefficients were free to vary. Results for this model are presented in Figure 1. The fit indices CFI and RMSEA indicated a reasonable fit of the data. The difference in R-squared values between women ( $R^2 = 0.09$ ) and men ( $R^2 = 0.26$ ) was evidence that more factors were involved in explaining gambling severity for women, other than urge and cognitions, compared to men.

The standardized path coefficient for GUS to PGSI and GRCS-IB to PGSI were stronger for men than women and statistically significant ( $p < 0.001$  and  $p = 0.004$ , respectively) whilst insignificant for women ( $p = 0.164$  and  $p = 0.149$ , respectively). Structural paths for GE to PGSI were insignificant for both men and women. In a rerun of the model, structural paths were constrained across gender. The difference in chi-squared values between the constrained model ( $\chi^2(480) = 838.26$ ) and the initial unconstrained model ( $\chi^2(477) = 826.75$ ) was significant ( $p = 0.009$ ). For the constrained model, Lagrange multiplier tests indicated that if constraints were removed individually then a statistically significant improvement in model fit would result for GUS path ( $p = 0.003$ ), IB ( $p = 0.003$ ) and GE ( $p = 0.007$ ). This evidence, combined with the statistically significant differences in chi-squared values, supported the model in which structural paths were allowed to vary across gender.

Figure 1 here

## 4. Discussion

This is the first study to investigate for gender differences in the measurement and pathways of cognitive and behavioural aspects of gambling disorder. Treatment-seeking men ( $n = 280$ ) were comparable to women ( $n = 174$ ) in conceptualising latent constructs of problem gambling severity (PGSI), gambling related urge (GUS), interpretive bias and gambling expectancies (GRCS- IB, -GE). The indicator variables for each construct were also of matching importance across gender. Subsequently, a full structural equation model was fitted to the data. It revealed a gender effect for two of the three paths to problem gambling severity. Men reported statistically significant stronger levels of gambling related urge and interpretive bias relative to women. In contrast, the evidence favoured more similarities than differences between men and women on the gambling expectancies path. It is noted that these findings are limited to testing of hypotheses for selected measurement scales. Additional measures relevant to cognitive and behavioural paths could be evaluated in a larger dataset for forecasting purposes.

The data in this study has extended the evidence-base by examining subjective reports of urge and cognitions in individuals seeking treatment at a community-based gambling help service. The finding of a differential gender effect is important as both urge and erroneous cognitions are antecedents to lapse or relapse in gambling disorder (Oakes et al., 2012; Raylu & Oei, 2002; van Holst, van den Brink, Veltman, & Goudriaan, 2010). A benefit of investigating gender is that it is a readily identifiable demographic, leading to more prompt selection of individualised therapy by the clinician. The findings suggest that the development of gambling-specific treatments and relapse prevention strategies should consider techniques targeting urge and cognitions in light of potential gender effects.

The theoretical underpinnings of CBT include cognitive and psychobiological mechanisms and are two dominant approaches to explaining gambling disorders (Clark, 2010). Gambling-specific cognitive therapy (CT) focuses on teaching the concept of randomness, increasing awareness of inaccurate perceptions and restructuring erroneous gambling beliefs (Ladouceur et al., 2001). Cognitive restructuring plays an important role in CT and has been shown to be clinically efficacious in treating a range of mental health conditions (Beck & Dozois, 2011). Treatments that target gambling related psychobiological states (e.g. urge to gamble) are predominantly behavioural (exposure-based) (Battersby et al., 2008; Tolchard, Thomas, &

Battersby, 2006). Exposure therapy is grounded in both operant and classical conditioning paradigms and cue-exposure with extinction processes (e.g. elimination of gambling urge) has been proposed as more beneficial than other types of behavioural therapy (e.g. aversive therapy) in treating gambling addiction (Brown, 1987). Both CT and ET approaches have generally been shown to be efficacious; however there is limited data in relation to their benefits at gender and other sub-group levels (Smith, Dunn, Harvey, Battersby, & Pols, 2013). Future clinical research should address this shortcoming with the goal to guide stratified CBT approaches and treatment-seeker selection.

The association between gender and gambling severity has been explored in a number of previous studies involving a range of correlates. For example, Ladd and Petry (2002) found that men were more likely to develop gambling problems at a younger age and consequently seek treatment. Women were more likely to be cohabitating with a problem gambler whilst having fewer alcohol and legal problems (Ladd & Petry, 2002). Potenza and colleagues (2001) established that in help-seeking gamblers, more men reported problems with strategic gambling forms such as poker whereas women preferred more non-strategic and less socially shared forms such as EGMs (Potenza et al., 2001).

We anticipated a gender effect for the gambling expectancies to gambling severity path. This was based on previous research showing that women may be more prone to gamble as an escapist motivation. For example, in a study by Ledgerwood and Petry (2006) involving treatment-seeking problem gamblers, it was found that a principal motivator for women to gamble was to escape negative emotions (Ledgerwood & Petry, 2006). Items for the 'Escape' factor such as "To cope with stress" were analogous to GRCS- GE items used in this study (e.g. "Having a gamble helps reduce tension and stress"). Similarly, in an evaluation of the continuum of gambling problems using the DSM-IV, the evidence showed that women with the same level of gambling problem severity as men were more likely to report gambling to "lift a bad mood and to forget problems" (Strong & Kahler, 2007). However, the data was sparse for the more severe end of gambling disorder. In this current study, men and women were also comparable in severity levels of problem gambling but at the more severe end. In addition, a large proportion of the sample reported EGMs as the primary form of problem gambling. Problem gamblers who seek to extricate themselves from intolerable emotional states may choose more socially isolative and repetitive types of gambling such as EGMs (Blaszczynski & Nower, 2002).

A main limitation of this study was that the findings were not generalizable to a broader range of sub-populations of gamblers, for example ethnic minorities and probable problem gamblers in the general community (Petry, 2005). Our study sample was comprised of treatment-seeking problem gamblers who were first time presenters to a specialised gambling therapy service. Whilst some sample characteristics were concordant with those of problem gamblers in the general population, for example younger males, it consisted of a relatively large proportion of women. Previous treatment studies involving cognitive-behavioural approaches have consisted of a preponderance of men (Smith, Dunn, et al., 2013). However, in more recent years the gender gap has narrowed based on surveys involving treatment-seekers (Petry, 2005). One possible reason is the model of service delivery. Crisp and colleagues (2004) found in their study that women represented almost half of the total population of presenters to a community based counselling service- a much higher rate compared to facilities such as veterans' centres (Crisp et al., 2004; Mark & Lesieur, 1992). Gender differences were also noted including women, on average, being older than men and mostly EGM users. Our study was conducted in South Australia (total population 1.6 million) where problem gambling is mainly a result of the widespread availability of 12,688 EGMs in venues in nearly all towns and cities across the state (Government of South Australia: Consumer and Business Services, 2012).

A further limitation was that we did not collect data in relation to formal assessments of co-morbid disorders, thus further limiting the generalisability of findings to other help-seeking populations. A previous review of the literature revealed that the proportion of treatment-seekers with lifetime diagnoses of alcohol or other substance use disorders was 25% to 65% greater than that in the general population (Petry, 2005). Furthermore, treatment-seeking gamblers with co-morbid substance use disorders tended to have more severe gambling symptoms and related problems than gamblers without substance use problems (Petry, 2005). The prevalence of co-morbidity is not only very high in people with gambling disorder but also in "at-risk" problem gamblers particularly for substance abuse disorders (Bischof et al., 2013; Kessler et al., 2008).

A key strength of this study was the large sample size and use of a full structural equation model. The model specification was informed by a strong theoretical basis of gambling aetiology. A limitation was that we did not account for additional variables such as risk factors (e.g. co-morbidity) and confounders (e.g. socio-economic status). Likewise,

individual differences in personality may play an important role in behavioural and cognitive paths to gambling disorder as well as treatment outcomes such as failure and relapse (Ramos-Grille, Gomà-i-Freixanet, Aragay, Valero, & Vallès, 2015).

A discernible threat to treatment efficacies exists due to high rates of relapse and dropout (Hodgins et al., 2007; Hodgins & el-Guebaly, 2004; Melville, Casey, & Kavanagh, 2007). This may, at least partly, be explained by an inherent assumption in the development of treatment programs that problem gamblers form a homogenous population (Blaszczynski & Nower, 2002). The findings from this study are important in terms of two dominant approaches to explaining gambling disorder (cognitive and psychobiological) and the moderating effects of gender. A better understanding of these effects in treatment-seeking problem gamblers would enable the delivery of more targeted therapies (Grant et al., 2012; Ladd & Petry, 2002; Potenza et al., 2001). Future larger scale studies should also consider further sub-populations that integrate factors such as age, gender and gambling form (e.g. horse and dog racing versus EGMs).

In conclusion, we used SEM to confirm behavioural and cognitive paths to gambling disorder for men and women simultaneously. This method produced unbiased estimates by explicitly modelling measurement error from the subjective reports of gambling severity, urge and cognitions. The findings supported those from previous neuroimaging and neurocognitive studies where men and women varied and extended the evidence in terms of generalizability to treatment-seeking problem gamblers. This has implications for treatment development including relapse prevention.

## References

- Acock, A. (2013). *Discovering structural equation modeling using Stata*. College Station, Texas: Stata Press
- American Psychiatric Association. (2000). *Diagnostic and Statistical Manual of Mental Disorders (4th Edition, Text Revision )* (4th ed.). Washington DC.
- American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental health disorders: DSM-5* (5th ed.). Washington, DC: American Psychiatric Publishing.
- Balodis, I., Lacadie, C., & Potenza, M. (2012). A preliminary study of the neural correlates of the intensities of self-reported gambling urges and emotions in men with pathological gambling. *Journal of Gambling Studies*, 28(3), 493-513.
- Balodis, S., Thomas, A., & Moore, S. (2014). Sensitivity to reward and punishment: Horse race and EGM gamblers compared. *Personality and Individual Differences*, 56, 29-33.
- Battersby, M., Oakes, J., Tolchard, B., Forbes, A., & Pols, R. (2008). Cognitive behavioural treatment for problem gamblers. In M. Zangeneh, A. Blaszczynski & N. E. Turner (Eds.), *In the pursuit of winning* (pp. 179-197). New York: Springer.
- Beck, A. T., & Dozois, D. J. A. (2011). Cognitive Therapy: Current Status and Future Directions. *Annual Review of Medicine*, 62(1), 397-409.
- Bischof, A., Meyer, C., Bischof, G., Kastirke, N., John, U., & Rumpf, H.-J. (2013). Comorbid Axis I-disorders among subjects with pathological, problem, or at-risk gambling recruited from the general population in Germany: results of the PAGE study. *Psychiatry Research*, 210(3), 1065-1070.
- Blaszczynski, A., & Nower, L. (2002). A pathways model of problem and pathological gambling. *Addiction*, 97(5), 487-499.
- Bohn, M. J., Krahn, D. D., & Staehler, B. A. (1995). Development and initial validation of a measure of drinking urges in abstinent alcoholics. *Alcoholism: Clinical and Experimental Research*, 19(3), 600-606.
- Bolla, K. I., Eldreth, D. A., Matochik, J. A., & Cadet, J. L. (2004). Sex-related Differences in a Gambling Task and Its Neurological Correlates. *Cerebral Cortex*, 14(11), 1226-1232. doi: 10.1093/cercor/bhh083
- Bonnaire, C., Bungener, C., & Varescon, I. (2009). Subtypes of French Pathological Gamblers: Comparison of Sensation Seeking, Alexithymia and Depression Scores. *Journal of Gambling Studies*, 25(4), 455-471. doi: 10.1007/s10899-009-9142-z
- Clark, L. (2010). Decision-making during gambling: an integration of cognitive and psychobiological approaches. *Philosophical Transactions of the Royal Society B: Biological Sciences*, 365(1538), 319-330.
- Crisp, B. R., Thomas, S. A., Jackson, A. C., Smith, S., Borrell, J., Ho, W.-y., . . . Thomason, N. (2004). Not the same: a comparison of female and male clients seeking treatment from problem gambling counselling services. *Journal of Gambling Studies*, 20(3), 283-299.
- Crisp, B. R., Thomas, S. A., Jackson, A. C., Thomason, N., Smith, S., Borrell, J., . . . Holt, T. A. (2000). Sex differences in the treatment needs and outcomes of problem gamblers. *Research on Social Work Practice*, 10(2), 229-242.
- Ferris, J., & Wynne, H. (2001). *The Canadian Problem Gambling Index: Final Report*: Canadian Centre on Substance Abuse.
- Government of South Australia: Consumer and Business Services. (2012). *Gaming Machines Act 1992, Annual Report 2011-2012*
- Grant, J. E., Chamberlain, S. R., Schreiber, L., & Odlaug, B. L. (2012). Gender-related clinical and neurocognitive differences in individuals seeking treatment for pathological gambling. *Journal of Psychiatric Research*, 46(9), 1206-1211.

- Hodgins, D., Currie, S., el-Guebaly, N., & Diskin, K. (2007). Does Providing Extended Relapse Prevention Bibliotherapy to Problem Gamblers Improve Outcome? *Journal of Gambling Studies*, 23(1), 41-54.
- Hodgins, D., & el-Guebaly, N. (2004). Retrospective and prospective reports of precipitants to relapse in pathological gambling. *Journal of Consulting and Clinical Psychology*, 72(1), 72-80.
- Kessler, R. C., Hwang, I., LaBrie, R., Petukhova, M., Sampson, N. A., Winters, K. C., & Shaffer, H. J. (2008). DSM-IV pathological gambling in the National Comorbidity Survey Replication. *Psychological Medicine*, 38(09), 1351-1360.
- Kline, R. B. (2011). *Principles and practice of structural equation modeling*: Guilford press.
- Ladd, G. T., & Petry, N. M. (2002). Gender differences among pathological gamblers seeking treatment. *Experimental and Clinical Psychopharmacology*, 10(3), 302.
- Ladouceur, R., Sylvain, C., Boutin, C., Lachance, S., Doucet, C., Leblond, J., & Jacques, C. (2001). Cognitive treatment of pathological gambling. *Journal of Nervous and Mental Disease*, 189, 774-780.
- Ledgerwood, D. M., & Petry, N. M. (2006). Psychological experience of gambling and subtypes of pathological gamblers. *Psychiatry Research*, 144(1), 17-27.
- Mark, M. E., & Lesieur, H. R. (1992). A feminist critique of problem gambling research. *British Journal of Addiction*, 87(4), 549-565.
- Melville, K. M., Casey, L. M., & Kavanagh, D. J. (2007). Psychological treatment dropout among pathological gamblers. *Clinical Psychology Review*, 27(8), 944-958.
- Oakes, J., Pols, R., Battersby, M., Lawn, S., Pulvirenti, M., & Smith, D. (2012). A focus group study of predictors of relapse in electronic gaming machine problem gambling, part 1: Factors that 'push' towards relapse. *Journal of Gambling Studies*, 28(3), 451-464.
- Paris, J. J., Franco, C., Sodano, R., Frye, C. A., & Wulfert, E. (2009). Gambling pathology is associated with dampened cortisol response among men and women. *Physiology and Behavior*, 99, 230-233.
- Petry, N. (2005). *Pathological Gambling: Etiology, comorbidity and treatments*. Washington, DC: American Psychological Association.
- Potenza, M., Hong, K., Lacadie, C., Fulbright, R., Tuit, K., & Sinha, R. (2012). Neural correlates of stress-induced and cue-induced drug craving: influences of sex and cocaine dependence. *American Journal of Psychiatry*, 169(4), 406-414.
- Potenza, M., Steinberg, M., Skudlarski, P., Fulbright, R., Lacadie, C., Wilber, M., . . . Wexler, B. (2003). Gambling urges in pathological gambling: a functional magnetic resonance imaging study. *Archives of General Psychiatry*, 60(8), 828.
- Potenza, M. N., Steinberg, M. A., McLaughlin, S. D., Wu, R., Rounsaville, B. J., & O'Malley, S. S. (2001). Gender-related differences in the characteristics of problem gamblers using a gambling helpline. *American Journal of Psychiatry*, 158(9), 1500-1505.
- Ramos-Grille, I., Gomà-i-Freixanet, M., Aragay, N., Valero, S., & Vallès, V. (2015). Predicting treatment failure in pathological gambling: The role of personality traits. *Addictive Behaviors*, 43, 54-59.
- Raylu, N., & Oei, T. (2002). Pathological gambling: A comprehensive review. *Clinical Psychology Review*, 22(7), 1009-1061.
- Raylu, N., & Oei, T. (2004a). The Gambling Related Cognitions Scale (GRCS): development, confirmatory factor validation and psychometric properties. *Addiction*, 99(6), 757-769.



- Raylu, N., & Oei, T. (2004b). The Gambling Urge Scale: Development, confirmatory factor validation, and psychometric properties. *Psychology of Addictive Behaviors, 18*(2), 100-105.
- Sharpe, L. (2002). A reformulated cognitive-behavioral model of problem gambling: A biopsychosocial perspective. *Clinical Psychology Review, 22*(1), 1-25.
- Smith, D., Battersby, M., Pols, R., Harvey, P., Oakes, J., & Baigent, M. (2015). Predictors of Relapse in Problem Gambling: A Prospective Cohort Study. *Journal of Gambling Studies, 31*, 299-313. doi: 10.1007/s10899-013-9408-3
- Smith, D., Dunn, K., Harvey, P., Battersby, M., & Pols, R. (2013). Assessing Randomised Clinical Trials of Cognitive and Exposure Therapies for Gambling Disorders: A Systematic Review. *Behaviour Change, 30*(03), 139-158.
- Smith, D., Pols, R., Battersby, M., & Harvey, P. (2013). The Gambling Urge Scale: Reliability and validity in a clinical population. *Addiction research & theory, 21*(2), 113-122.
- Sörbom, D. (1989). Model modification. *Psychometrika, 54*(3), 371-384.
- StataCorp. (2013). Stata: Release 13. Statistical Software. College Station, TX: StataCorp LP.
- Strong, D. R., & Kahler, C. W. (2007). Evaluation of the continuum of gambling problems using the DSM-IV. *Addiction, 102*(5), 713-721.
- Tamminga, C. A., & Nestler, E. J. (2006). Pathological gambling: focusing on the addiction, not the activity. *The American Journal of Psychiatry, 163*(2), 180.
- Terwee, C. B., Bot, S. D. M., de Boer, M. R., van der Windt, D. A., Knol, D. L., Dekker, J., . . . de Vet, H. C. (2007). Quality criteria were proposed for measurement properties of health status questionnaires. *Journal of Clinical Epidemiology, 60*(1), 34-42.
- Thomas, A. C., Allen, F. C., & Phillips, J. (2009). Electronic gaming machine gambling: Measuring motivation. *Journal of Gambling Studies, 25*(3), 343-355.
- Tiffany, S. T. (1992). A critique of contemporary urge and craving research: Methodological, psychometric, and theoretical issues. *Advances in Behaviour Research and Therapy, 14*(3), 123-139.
- Tolchard, B., Thomas, L., & Battersby, M. (2006). Single-Session Exposure Therapy for Problem Gambling: A Single-Case Experimental Design. *Behaviour Change, 23*(2), 148-155.
- van den Bos, R., Jolles, J., van der Knaap, L., Baars, A., & de Visser, L. (2012). Male and female Wistar rats differ in decision-making performance in a rodent version of the Iowa Gambling Task. *Behavioural Brain Research, 234*(2), 375-379. doi: <http://dx.doi.org/10.1016/j.bbr.2012.07.015>
- van Holst, R. J., van den Brink, W., Veltman, D. J., & Goudriaan, A. E. (2010). Brain imaging studies in pathological gambling. *Current Psychiatry Reports, 12*(5), 418-425.
- Young, M. M., & Wohl, M. J. (2011). The Canadian problem gambling index: an evaluation of the scale and its accompanying profiler software in a clinical setting. *Journal of Gambling Studies, 27*(3), 467-485.