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RESEARCH REPORT

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Clarifying gambling subtypes: the revised pathways model of problem gambling

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Abstract

Background and Aims: The pathways model is a highly cited etiological model of problem gambling. In the past two decades, a number of studies have found support for the model's utility in classifying gambling subtypes. The aims of this paper were to refine empirically the model subtypes and to revise and update the model based on those findings.

Design and Measurement: Observational study using data collected from treatment-seeking problem gamblers using the Problem Gambling Severity Index (PGSI) and the Gambling Pathways Questionnaire (GPQ).

Setting: Treatment clinics in Canada, Australia and the United States.

Participants: A convenience sample of 1168 treatment-seeking problem gamblers, aged 18 years or older.

Findings: Empirically validated risk factors were analyzed using latent class analyses, identifying a three-class solution as the best-fitting model. Those in the largest class (class 1: 44.3%, *n* = 517) reported the lowest levels of all etiological risk factors. Participants in class 2 (39.5%, *n* = 461) reported the highest rates of anxiety and depression, both before and after gambling became a problem, as well as childhood maltreatment, and a high level of gambling for stress-coping. Those in class 3 (16.3%, *n* = 190) reported high levels of impulsivity; risk-taking, including sexual risk-taking; antisocial traits; and coping to provide meaning in life and to alleviate stress.

Conclusions: The revised pathways model of problem gambling includes three classes of gamblers similar to the three subtypes in the original pathways model, but class 3 in the revised pathways model is distinct from class 2, showing higher levels of risk-taking and antisocial traits and gambling motivated by a desire for meaning/purpose and/or to alleviate stress. Class 2 in the revised pathways model demonstrates high levels of childhood maltreatment as well as gambling for stress-coping.

KEYWORDS
Comorbidity, etiology, gambling, gambling assessment, gambling disorder, gambling treatment, problem gambling, subtypes

INTRODUCTION

The pathways model of problem gambling [1] was the first etiological model to assert that gamblers were a heterogeneous group and that gambling develops along differential but identifiable trajectories. Over nearly two decades, the pathways model has been highly cited and evaluated using select items or existing instruments that tap some, but not all, of the facets of the model [2–6] or indicators that lack some theoretical alignment with the model [7–11].

In general, ecological factors such as availability and accessibility of gambling within the cultural context of jurisdictions, combined with operant conditioning effects and cognitive distortions, are common to all individuals who develop gambling problems. However, the model proposes that there are identifiable etiological factors that distinguish the course of three specific subgroups of those with gambling problems. The pathway 1, 'behaviorally conditioned' subgroup is characterized by the absence of psychopathology, theorized to initiate gambling for recreation or socialization reasons and to increase the frequency and intensity of play in response to conditioning effects and distorted cognitions regarding the probability of winning and superstition. In contrast, the model asserts that 'emotionally vulnerable' individuals in pathway 2 gamble primarily to escape aversive mood states and evidence poor stress-coping and problem-solving skills, problematic family backgrounds and traumatic life events. Those in pathway 3, 'antisocial impulsivists', are considered by the model to be a subgroup of pathway 2, with the additive factors of heightened impulsivity, antisocial personality traits and behaviors, attentional deficits and comorbid substance use.

The model was supported by the authors' clinical experience and designed to offer guidance for individualized treatment planning based on addressing etiological risk factors most salient to specific subgroups of individuals with gambling problems. The model has also proved of interest to researchers as a theoretical framework to guide investigations into risk factors for high-risk gambling and to contextualize outcome evaluations of interventions. Multiple studies have explored the pathways model using select variables in existing instruments or questionnaires. Studies have found general support for the model; however, given the range of factors, none of the investigations was able to tap all the facets using existing instruments. A few studies have utilized a wide range of variables and subtyping analyses sufficient to yield credible results [2–6]. Only one study either used a nationally representative sample [5] or tested mood and substance use variables before and after the onset of problem gambling [3], a key feature of the model. In addition, select studies have explored elements of the model [12], used a portion of the model to guide related investigations [2] or as a framework to guide additional investigations in the area [7].

Other studies purported to test or validate the model with insufficient or different variables [8, 9], a non-problem gambling participant sample [9, 11] or variables that were not hypothesized in the model to differentiate among subtypes [10]. For example, the model is expressly designed to identify etiological factors in individuals that pre-dated the onset of gambling and problem gambling. However, two studies utilized non-problem gambling participants in the analyses [9, 11]. In one of those studies, fewer than 4% of participants were classified with a gambling problem [9]. A third study chose only one or two non-validated items to represent a small selection of model variables and utilized regression rather than latent class, profile or cluster analyses to identify subgroups [6]. Another study included gambling-related cognitions [10] in the analyses; however, cognitions are hypothesized to be common across those with gambling problems not specific to any pathway; therefore, they should not be included in a test of the model's ability to identify subgroups. These misinterpretations and misapplications have greatly confounded the application of the model across studies.

To address these limitations, Nower & Blaszczynski [13] utilized a large sample of treatment-seeking problem gamblers to investigate a range of items, specifically targeting the pathways model variables, as well as a range of etiological variables that have proved predictive of problem gambling in prior studies without reference to subtype. The objectives of the study were: (1) to explore the existence of problem gambling subtypes using both indicators in the original model as well as additional indicators reported in the research literature since model publication; and (2) to revise the pathways model based on empirical findings. Findings related to the first objective resulted in the creation and validation of the Gambling Pathways Questionnaire (GPQ) [13], a subtyping instrument designed to assist counselors with individualized treatment planning. The results also suggested changes that should be made to the original model, including the removal of attention deficit hyperactive disorder (ADHD) symptoms and substance misuse, which did not discriminate among the pathways.

The aims of the current analyses were: (a) to revise and update the original pathways model, which was purely theoretical, with empirical evidence of etiological risk-factors, classified by subgroup; and (b) to use a sample of treatment-seeking individuals with gambling problems to ensure that the results could most effectively inform the development of session-based treatment strategies to address all risk factors for each subgroup. Consistent with the original model, we hypothesized that there would be three classes of problem gamblers, correlating to the three pathways, with considerable overlap between the emotionally vulnerable (pathway 2) and antisocial impulsivist (pathway 3) subgroups. We also hypothesized that some notable differences between the original and revised models would emerge, resulting in revisions to the model.

METHODS

Participants

Data were collected at intake from individuals with gambling problems in Canada, Australia and the United States who presented for gambling counseling in community, university and/or hospital out-patient clinics. Further details of the sampling frame and analysis of etiological variables are given elsewhere [13]. Ethics approval was obtained from two participating universities and three hospitals with independent

review boards. Participants included in the current study were aged 18 years or older, consented to participate and registered problem symptoms on the Problem Gambling Severity Index (PGSI) [14] at intake. The PGSI is a widely used problem gambling subscale of the Canadian Problem Gambling Severity Index. Participants who were classified as low-risk gamblers (PGSI score ≤ 2) were excluded from the analysis. As a result, the analysis included 1168 participants [696 men, 59.6%; mean age = 46.19 years, standard deviation (SD) = 13.51] who were classified at moderate-risk (PGSI score = 3–7) or high-risk (PGSI score ≥ 8) for problem gambling. Participants' PGSI scores ranged from 3 to 27 (mean = 17.54, SD = 5.57).

Measures

At initial intake, participants completed the PGSI [14], a widely used measure of problem gambling severity, and the Gambling Pathways Questionnaire (GPQ) [13], a validated, 48-item instrument with good validity and reliability to detect membership in etiological subgroups in clinical settings. The PGSI had an internal consistency of α = 0.84 in the current sample. The GPQ consists of 11 subscales that measure etiological variables of problem gambling, including mental distress symptoms pre- and post-problem gambling, childhood maltreatment, stress-coping motivation, meaning motivation, impulsivity, risk-taking, sexual risk-taking and antisocial traits and behavior. The factor structure of the GPQ subscales has been validated in this sample [13]. The internal consistencies of the GPQ subscales in the current sample range between 0.74 (impulsivity) to 0.92 (anxiety at post- problem gambling).

Analyses

Latent class analysis (LCA) was used to create empirically-derived subgroups of individuals with problem gambling using the mean scores of 11 subscales from the GPQ. The LCA was performed using Mplus version 8.4 [15], which estimates latent class models using full information maximum likelihood estimation. The preferred number of subgroups was decided based on a review of model selection indices. Within the present study, lower values for the Akaike's information criterion (AIC) and Bayesian information criterion (BIC) were indicative of better model fit [16, 17]. Additionally, the Lo–Mendell–Rubin (LMR) likelihood ratio test was conducted. A significant *P*-value of the LMR test implies that the model with *k* subgroups is preferred over a model with *k*-1 subgroups [18]. To test the robustness of the solution on the number of the latent classes (i.e. subgroups of the problem gamblers) the entire sample was split into 50% random subsamples, and the LCA was conducted on both subsamples to determine whether the solution replicated. Reliability was evaluated by comparing the classification results of the split-half and combined latent class solutions. Finally, the three-step approach, described in Vermunt [19] and Asparouhov & Muthen [20], was used for *post-hoc* comparisons among the subgroups of problem gamblers based on age, gender, country of origin and problem gambling severity. The three-step approach for *post-hoc* comparisons was performed using Mplus version 8.4 [15], which accounts for uncertainly in class assignment. These analyses were not pre-registered.

RESULTS

The LCA revealed a three-class solution in the overall sample (Table 1). The model was checked for model fit and model assumptions, including conditional independence [21]. Means of the GPQ subscales across the three latent classes are presented in Table 2.

Participants in class 1 (44.3%, *n* = 517) emerged as the largest class, evidencing the lowest mean scores of any subgroup on each of the GPQ subscales. Class 2 (39.5%, *n* = 461) reported the highest levels of both pre- and post-problem gambling anxiety and depression and childhood maltreatment, including neglect, abuse and witnessing trauma, and a higher level of coping with stress than those in class 1; in addition, those in class 2 reported moderate levels of impulsivity and motivation to find meaning and purpose through gambling. Individuals in class 3 (16.3%, *n* = 190) emerged as a distinct group, reporting significantly higher levels of impulsivity; risk-taking, including sexual risk-taking; antisocial traits and behavior; and meaning motivation for gambling. Individuals in class 3 reported significantly lower levels of childhood maltreatment and anxiety and/or depression before and after problem gambling than those in class 2, however, like class 2, they were strongly motivated to gamble to cope with stress. Compared to class 1, class 3 did not significantly differ on

TABLE 1 Fit indices for 1- to 6-class latent class models of total sample (*n* = 1168)

No. of classes	AIC	BIC	Adjusted BIC	Log-likelihood	Entropy	*P*-values of LMR test	*P*-values of BLRT
1	46 083.84	46 195.23	46 125.35	−23 019.92			
2	43 325.07	43 497.22	43 389.22	−21 628.54	0.924	0.0000	0.0000
3*	41 473.27	41 706.17	41 560.06	−20 690.64	0.897	0.0006*	0.0000
4	40 798.66	41 092.32	40 908.09	−20 341.33	0.882	0.2152	0.0000
5	40 090.71	40 445.12	40 222.78	−19 975.36	0.887	0.0795	0.0000
6	39 780.08	40 195.25	39 934.79	−19 808.04	0.881	0.0375	0.0000

LMR = Lo–Mendell–Rubin likelihood ratio test; BLRT = bootstrapped likelihood ratio test; AIC = Akaike's information criterion; BIC = Bayes' information criterion.

TABLE 2 Predicted means, standard deviations and 95% confidence intervals of the GPQ subscales across the three classes

	Class 1 Behaviorally conditioned 44.26% (*n* = 517)	Class2 Emotionally vulnerable 39.47% (*n* = 461)	Class 3 Antisocial impulsivist 16.27% (*n* = 190)
GPQ subscales			
Anxiety pre-problem gambling onset	2.05[a] (1.06)	4.15[b] (1.30)	2.14[a] (1.27)
	[1.96, 2.15]	[4.03, 4.27]	[1.96, 2.32]
Anxiety post-problem gambling onset	3.23[a] (1.47)	4.87[b] (1.13)	4.53[c] (1.11)
	[3.10, 3.36]	[4.77, 4.97]	[4.37, 4.69]
Depression pre-problem gambling onset	1.82[a] (1.10)	4.58[b] (1.39)	1.80[a] (1.38)
	[1.72, 1.91]	[4.45, 4.71]	[1.60, 2.00]
Depression post-problem gambling onset	2.67[a] (1.55)	5.02[b] (1.17)	2.81[a] (1.76)
	[2.54, 2.80]	[4.92, 5.13]	[2.55, 3.06]
Childhood maltreatment	1.65[a] (0.91)	2.69[b] (1.32)	2.02[c] (1.10)
	[1.57, 1.73]	[2.57, 2.81]	[1.86, 2.18]
Stress-coping motivation	3.23[a] (1.21)	4.69[b] (1.01)	4.75[b] (0.98)
	[3.12, 3.33]	[4.60, 4.79]	[4.61, 4.89]
Meaning motivation	2.24[a] (1.04)	3.40[b] (1.27)	4.94[c] (1.16)
	[2.15, 2.33]	[3.29, 3.52]	[4.77, 5.11]
Impulsivity	2.58[a] (0.98)	3.54[b] (1.05)	5.18[c] (0.59)
	[2.50, 2.67]	[3.44, 3.63]	[5.10, 5.27]
Risk-taking	1.99[a] (0.89)	2.63[b] (1.06)	4.85[c] (0.87)
	[1.91, 2.06]	[2.53, 2.72]	[4.73, 4.98]
Sexual risk-taking	1.57[a] (0.90)	1.84[b] (1.12)	3.91[c] (1.60)
	[1.49, 1.65]	[1.74, 1.94]	[3.68, 4.13]
Antisocial traits/behavior	1.87[a] (0.65)	2.59[b] (0.85)	4.74[c] (0.86)
	[1.81, 1.93]	[2.51, 2.67]	[4.62, 4.86]

Different superscripts (a,b,c) indicate that the mean scores between the two classes are statistically significant at $P < 0.01$. GPQ = Gambling Pathways Questionnaire.

pre-gambling anxiety or depression or on post-gambling depression; also, class 3 had significantly higher scores on post-gambling anxiety and childhood maltreatment compared to class 1. The relationships among the classes are depicted in Figure 1.

To further confirm the reliability of the three-class solution, the sample was randomly split into halves and separate, sequential latent class models were conducted on both random subsamples. In both split-half subsamples, the three-class solution was retained based on the fit indices (AIC, BIC, sample size-adjusted BIC (SSBIC) and LMR test results; see Table 3).

The means and proportions for each latent class in the subsamples were similar to the sample as a whole (see Supporting information, Table S1). The cross-classifications of the three-class solution from the split-half and full sample models are provided in Table 4. The exact percentage agreement across all latent classes was 97.43% and Cohen's kappa was 0.96. The percentage agreement for all three latent classes was above 90%. The split-half solution identified eight participants as class 1 ('behaviorally conditioned') who were identified as class 2 ('emotionally vulnerable') in the full sample. The split-half solution also identified nine participants as class 3 ('antisocial impulsivists') who were identified as class 2 in the full sample. In summary, findings from both analyses identified highly similar classes.

Equality tests of means across classes using the three-step approach yielded a significant difference among the three latent classes on PGSI scores ($\chi^2 = 120.80$, $P < 0.001$; see Table 5). Participants assigned to class 2 ('emotionally vulnerable') evidenced the highest levels of problem gambling, followed by those assigned to class 3 ('antisocial impulsivists') and class 1 ('behaviorally conditioned'). Further, the results revealed a significant difference on age ($\chi^2 = 24.98$, $P < 0.001$) and gender ($\chi^2 = 35.05$, $P < 0.001$) among the three classes. Participants in classes 1 and 2 were significantly older than those in class 3. As shown in Table 5, a significantly larger proportion of women was classified as members of class 2 compared to the other classes; in contrast, a significantly larger proportion of men was classified in class 3. These findings by both gender and age are consistent with our hypotheses. Finally, results revealed that, compared to the US subsample, the Canadian and Australian subsamples had significantly lower odds of being classified as members to

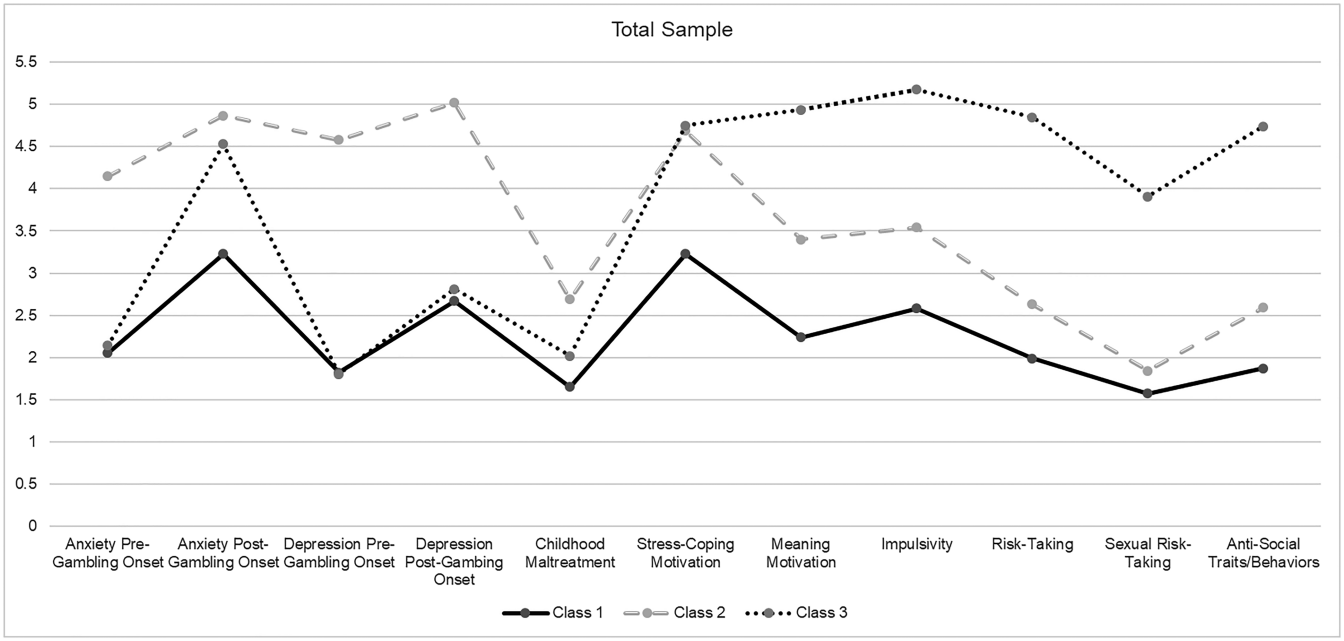

FIGURE 1 Mean scores of Gambling Pathways Questionnaire (GPQ) subscales across the three latent classes

TABLE 3 Fit indices for 1–6-class latent class models of random split-half subsamples

No. of classes	AIC	BIC	Adjusted BIC	Log-likelihood	Entropy	*P*-values of LMR test	*P*-values of BLRT
Subsample 1 (*n* = 584)							
1	22 916.86	23 012.99	22 943.15	−11 436.43			
2	21 708.30	21 856.88	21 748.94	−10 820.15	0.887	0.0144	0.0000
3*	20 814.48	21 015.49	20 869.46	−10 361.24	0.898	0.0144	0.0000
4	20 508.51	20 761.96	20 577.83	−10 237.56	0.879	0.0786	0.0000
5	20 113.78	20 419.68	20 197.45	−9986.89	0.899	0.2391	0.0000
6	19 932.26	20 290.60	20 030.23	−9884.13	0.904	0.0010	0.0000
Subsample 2 (*n* = 584)							
1	23 190.87	23 287.01	23 217.16	−11 573.43			
2	21 632.85	21 781.43	21 673.49	−10 782.42	0.945	0.0000	0.0000
3*	20 692.95	20 893.96	20 747.93	−10 300.47	0.899	0.0096	0.0000
4	20 314.00	20 567.45	20 383.32	−10 098.00	0.894	0.1692	0.0000
5	20 024.08	20 329.97	20 107.75	−9942.04	0.891	0.0819	0.0000
6	19 817.59	20 175.92	19 915.60	−9826.80	0.894	0.5129	0.0000

LMR = Lo–Mendell–Rubin likelihood ratio test; BLRT = bootstrapped likelihood ratio test. AIC = Akaike's information criterion; BIC = Bayes' information criterion.

class 3 versus class 1 [odds ratio (OR) = 0.18, 95% confidence interval (CI) = 0.11, 0.30; OR = 0.10, 95% CI = 0.05, 0.20] and class 2 (OR = 0.21, 95% CI = 0.13, 0.34; OR = 0.14, 95% CI = 0.07, 0.28).

DISCUSSION

Findings from this study, using variables tapping all elements of the pathways model, suggest that revisions are necessary to the theoretical conceptualization. Earlier analyses [13] examined a range of etiological variables specified by, or related to, the model and identified the strongest items that differentiated among the pathways. The current study extended those findings in order to revise the model by identifying three classes or etiological subgroups of gamblers, defined by those indicators.

As in the original model, findings suggest there are three distinct pathways to problem gambling, but there are key differences in the relationship between pathways 2 and 3. Unlike in the original model and our hypotheses, this study established that pathway 3 (class 3) was distinct from pathway 2 (class 2) rather than a subgroup with

TABLE 4 Cross-classification of latent classes from full and split-half samples

	Full sample solution				
	Class 1 Behaviorally conditioned	Class 2 Emotionally vulnerable	Class 3 Antisocial impulsivist	n	Exact percentage agreement
Merged split-half samples solution					
Class 1: Behaviorally conditioned problem gamblers	510	8	1	519	98.27%
Class 2: Emotionally vulnerable problem gamblers	6	444	5	455	97.58%
Class 3: Antisocial impulsivist problem gamblers	1	9	184	194	94.84%
n	517	461	190		

TABLE 5 Demographics and problem gambling severity across the three latent classes

	Class 1	Class 2	Class 3	Overall sample
Age: mean (95% CI)	47.36[a]	46.81[a]	41.55[b]	46.19
	[46.09, 48.63]	[45.60, 48.02]	[39.57, 43.53]	[45.41, 46.96]
Gender (%)				
Male (*n* = 696)	64.20%	48.80%	73.67%	59.59%
Female (*n* = 472)	35.80%	51.20%	26.33%	40.41%
Country (%)				
United States (*n* = 672)	38.24%	37.50%	24.26%	57.53%
Canada (*n* = 281)	50.18%	43.42%	6.41%	24.06%
Australia (*n* = 215)	55.35%	40.47%	4.19%	18.41%
PGSI: mean (95% CI)	15.50[a]	19.47[b]	18.39[c]	17.54
	[15.02, 15.98]	[18.97, 19.97]	[17.63, 19.15]	[17.23, 17.85]

Different superscript letters indicate significant mean differences between classes ($P < 0.05$). CI = confidence interval; PGSI = problem gambling severity index.

additional indicators. In contrast to individuals in pathway 2, the revised model asserts that those in pathway 3 will report relatively low levels of depression and anxiety before and after the onset of problem gambling as well as lower prevalence of childhood maltreatment. While individuals in both pathways 2 and 3 appear to use gambling as a stress-coping strategy, those in pathway 3 may gamble in response to a search for meaning and purpose as well as due to heightened levels of impulsivity, antisocial traits and risk-taking behaviors. ADHD and substance misuse were removed from pathway 3 based on findings in a prior study [13]. Individuals assigned to pathway 1 (class 1) in this study proved to be the largest group in the sample, in contrast to the original model, which suggested that pathway 2 (class 2) would be over-represented. This finding paralleled another study [5] using a nationally representative sample, lending theoretical support to the model's assertion that gambling alone, in the absence of pre-morbid indicators, could lead one subgroup of players to develop gambling problems. Longitudinal studies are needed to examine the role of ecological factors, operant conditioning and/or gambling-related cognitions in the movement of individuals without known etiological risk factors across the spectrum from recreational to problem gambling in both clinical and general population settings.

The revised pathways model is presented in Figure 2.

The current study is limited by the use of a cross-sectional design and inclusion of only treatment-seeking individuals from countries with different gambling landscapes. The model originated from the clinical experience of the primary authors and, as such, was designed to apply primarily in clinical settings. For that reason, the study utilized participants who presented for treatment who may, arguably, differ in some respects from those in the general population. Providing clinicians with not only the indicators relevant to each client but also the relative severity of each indicator will offer important guidance for individualized treatment planning.

In addition, it is possible that the cultural context may influence participant responses to sensitive questions pertaining to the model. In the current study, for example, Canadian and Australian participants had lower odds of being assigned to class 3; however, this finding could be due to smaller sample sizes compared to the US sample. Anecdotally, researchers norming the GPQ [13] in Italy have reported

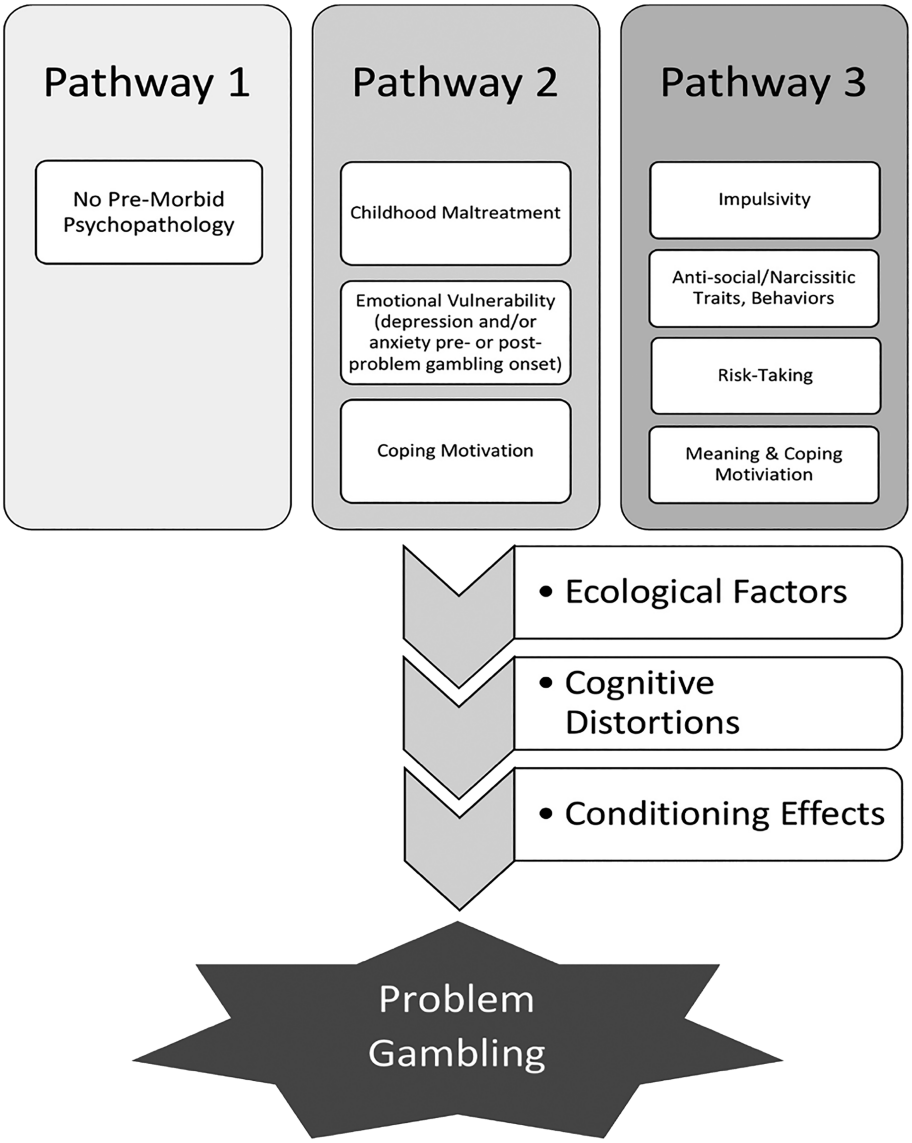

FIGURE 2 Revised pathways model

to the authors that some participants were reticent to endorse childhood maltreatment due to the perceived stigma to the family, necessitating changes to the scoring to account for that cultural difference. In future, the GPQ could be used to test the applicability of the model in different countries and contexts and broaden our understanding of problem gambling subgroups.

There are additional caveats to highlight regarding the continued utility of the pathways model as a research tool. First, the model is intended to apply only to problem gamblers, those who manifest symptoms of gambling-related harm and inability to control the urge to gamble. It is not intended as a subtyping scheme for recreational gamblers nor as a grouping measure for all gamblers in community or epidemiological samples. In addition, the indices in the model represent only etiological factors that differentiate among the subgroups; there are many variables associated with problem gambling; however, the factors in the model differentiate one subgroup from another. As such, ecological factors (e.g. availability, accessibility, acceptability), cognitive distortions and operant conditioning, which are commonly reported by all problem gamblers, should not be included in analyses if researchers are testing the model. In addition, other factors such as age of onset, gender, age and/or problem gambling severity, while not elements of the model, may be useful to explore the differential presentation of subtypes across jurisdictions or cultures in a given context. In this study, for example, women were over-represented in class 2 and men in class 3; however, those findings, like age and level of problem severity, differ based on sampling, venue or location and are not a part of the model.

Apart from these considerations, the revised pathways model suggests important theoretical implications for prevention and treatment planning. While individuals in pathway 2 may use gambling as one of many stress-coping strategies, they may not be the 'typical' problem gambler as commonly suspected. Rather, findings from this study support the theory that individuals in the largest problem gambling subgroup, pathway 1, may develop problems simply due to exposure and continued participation which, in turn, can foster conditioning effects and faulty cognitions. A primary contributor to

problem gambling, therefore, may simply be the repeated and escalating involvement in the activity itself. This suggests that limit-setting options, ideally incorporated at sign-up for loyalty programs or on-line accounts, combined with implementation of responsible gambling intervention frameworks across all gambling offerings, should be standard, not optional, components of gambling regulation. Pathway 1 participants in this study were older and reported lower problem gambling severity scores, further suggesting that strategies to promote responsible play and early intervention could arrest the progression to disorder in this group. In addition, individuals in pathway 1 are unlikely to be identified across settings and could escape early detection when gambling-related harm is relatively minimal. As such, it would be critical to adopt a syndemic approach [22] to identifying these individuals, instituting brief screens at schools, credit counselling centers, health facilities and other locations where screening might identify individuals who would otherwise evade detection.

The revised model also underscores the role of emotional dysregulation and childhood maltreatment (i.e. abuse, neglect, witnessing trauma) with individuals in pathway 2; impulsivity, antisocial traits and meaning motivation with pathway 3; and stress-coping motivation for both pathways 2 and 3. Studies focused upon treatment attendance have consistently reported higher dropout rates among individuals with comorbid mental health and substance use disorders [23, 24] as well as traits such as impulsivity [25]. Therefore, treatment planning with these groups should include an in-depth assessment of each of the risk factors and incorporation of specific interventions to address them. The GPQ [13], which was used in this study and based on the conceptual model, is an effective, validated measurement tool that provides both pathway classification and risk level by indicator. Utilizing the GPQ for assessment could help to identify those who might benefit, for example, from brief, highly focused therapy sessions that integrate strategies to address impulse control, stress-coping, and problem-solving skills into gambling treatment. This strategy could prove useful for increasing retention and/or completion rates and addressing potential relapse triggers early in treatment.

DECLARATION OF INTERESTS

L.N. and A.B. have both received travel funds and hospitality from, and undertaken research and consultancy for regulators, gaming operators, problem gambling groups and others associated with the provision of gambling products and/or services to individuals with gambling problems. In addition, L.N. and A.B. have served on paid scientific and responsible gaming advisory boards for operators and non-profit organizations and consulted and/or testified in legal cases involving issues related to gambling and/or video gaming. Such work was unrelated to the research undertaken in this study. W.L.A. has no declarations to report.

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AUTHOR CONTRIBUTIONS

Lia Nower: Conceptualization; formal analysis; methodology; project administration; visualization. **Alex Blaszczynski:** Conceptualization; investigation; methodology. **Wen Li Anthony:** Formal analysis.

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SUPPORTING INFORMATION

Additional supporting information may be found in the online version of the article at the publisher's website.

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