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Predicting Problem Gambling Severity Interplay between Emotion Dysregulation and Gambling-related Cognitions

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Abstract

Understanding how emotion regulation and gambling-related cognitive distortions relate to gambling problems has direct relevance for problem gambling prevention and treatment. Although these factors have been identified as robust psychological correlates for problem gambling, the interplay between emotional regulation and cognitive biases in influencing problem gambling behaviours is yet to be fully understood. Accordingly, this study examined the explanatory role of cognitive distortions in the association between emotion regulation difficulties and problem gambling behaviours and also explored the interaction between emotion regulation and cognitive distortions in predicting gambling severity. A total of 301 adults (182 males and 119 females; age range: 18-71 years, $M = 32.62$, $SD = 10.03$) completed an online questionnaire comprising measures of emotional regulation difficulties, gambling-related beliefs and problem gambling severity. Analyses revealed that emotion regulation difficulties and erroneous gambling beliefs were positively related to problem gambling severity. Further, cognitive distortions partially accounted for the relationship between emotional regulation difficulties and problem gambling, although emotion regulation retained a direct relationship with problem gambling. There was no interaction between emotional regulation and cognitive distortions. The findings indicate that emotion regulation may serve as a precursor to the development of cognitive distortions, while also directly influencing problem gambling. Implications for assessment and treatment of problem gambling are discussed.

Keywords: problem gambling, emotion regulation, cognitive distortions, moderation, mediation analysis

Introduction

Deficits in emotion regulation and gambling-related cognitive distortions are considered among the most critical variables associated with problematic gambling severity, outcomes and prognosis. The relative importance of these factors is highlighted by the inclusion of shift in emotional experience as a diagnostic criterion for Gambling Disorder (American Psychiatric Association 2013) and the notion that the correction of gambling-related distortions is a primary avenue for the clinical treatment of problem gambling (Goodie & Fortune, 2013; Gooding & Tarrier, 2009). Further, emotional and cognitive factors are underscored in etiological models of gambling. Cognitive behavioural perspectives suggest that problem gambling is a learnt behaviour shaped through reinforcement and maintained by erroneous cognitions (Blanco et al., 2015; Raylu et al., 2016) and the emotion regulation model highlights the function of gambling to modulate emotional states (Guyonne & Patrizia, 2019). Although emotion regulation and cognitive distortions are recognised as key psychological factors in the onset and maintenance of problem gambling, their joint role in determining problem gambling severity is yet to be fully understood. Specifically, most studies have examined cognitive distortions and emotion regulation as separate sets of gambling predictors, however, very few have explored how and when these factors combine to exert their influence in gambling behaviours. Accordingly, this study investigates the interplay between emotional regulation and erroneous cognitions to clarify psychopathological mechanisms of problem gambling. Insights into this relationship could potentially advance the development of gambling prevention strategies and psychological interventions.

Problem Gambling and Emotional Regulation

In recent times, emotion regulation deficits have been considered a significant contributor in the aetiology and maintenance of gambling problems (Elmas et al., 2017; Jauregui et al., 2016; Navas et al., 2019, Marchica et al., 2019). Healthy emotional regulation is characterised by four core emotional capacities: awareness and understanding of emotions; acceptance of emotions; impulsivity control and goal-directed behaviours; and ability to modulate emotional responses according to individual goals (Linehan, 1993). The deficiency in these emotional capacities indicates the presence of emotion dysregulation (Gratz & Roemer, 2004; Linehan, 1993), typically exhibited in a range of psychopathology and mental disturbances (Aldao et al., 2010).

In the context of problem gambling, studies have shown that emotion dysregulation is related to problem gambling severity (Ciccarelli et al., 2020; Jauregui et al., 2016). Measures of emotion dysregulation have been found to be positively associated with gambling severity, with problem gamblers reporting significantly fewer

uses of emotional strategies, reduced emotional clarity, more impulse-control difficulties and less emotional awareness (Navas et al., 2017); as well as more difficulties in accepting, adjusting and tolerating emotions compared to healthy counterparts (Orlowski et al., 2019). Consistent with these findings, Marchica and colleagues (2019) found that non-acceptance of emotions, lack of emotional clarity, inability to execute goal-directed behaviours and inflexibility in using emotion regulation strategies were associated with worse gambling outcomes and higher severity. In addition, emotion dysregulation was found to significantly predict problem gambling severity when other affect disorders such as anxiety, depression, stress, and alexithymia were controlled (see Aïte et al., 2014; Elmas et al., 2017). Research has consistently demonstrated that individuals with gambling problems often report gambling as a coping mechanism for unwanted emotions (Riley, 2014; Wood & Griffiths, 2007). Similarly, deficiency in modulating emotional responses, such as impulsivity and under-controlled temperament have been found to be a risk factor for disordered gambling (Dowling et al., 2017).

In the light of research findings outlined above, problem gambling can be considered as an emotional regulation affliction, insofar as an inadequate capacity to regulate emotion has been consistently linked with problem gambling predispositions and greater problem gambling severity.

Theoretical Models of Gambling: Emotion Regulation and Cognitive Distortion

The role of emotional and cognitive factors in the etiopathology of problem gambling is incorporated in existing and emerging models of problem gambling and the association among these factors can be explained in several ways. First, the cognitive behaviour model of gambling behaviours suggests that gambling behaviour is acquired through exposure and associative learning (Clark, 2010). Reinforcement occurs when negative emotional states are reduced and positive affect is increased (Stewart et al., 2008). As gambling becomes habitual, the tendency to accept erroneous beliefs regarding personal skill and over-estimation of the chances of winning emerge (Michalczuk et al., 2011; Raylu et al., 2016). Complex interactions emerge among a range of biopsychosocial factors including perception of reward, emotional and physiological arousal, amelioration of negative emotions and the rise in urges to gamble, despite repeated losses (Loo et al., 2014).

To test the cognitive-behavioural model of gambling Raylu and colleagues (2016) used cross-sectional data gathered from community samples to examine associative relationships among emotions, cognitions, and gambling. They found that negative emotional states (depression, anxiety, and stress), avoidance coping and gambling urges directly and indirectly predicted gambling behaviours via cognitive distortions, providing

support to the pathways proposed in the cognitive behavioural model of gambling. These results were largely consistent with other studies demonstrating irrational gambling cognitions are highly correlated with negative emotional states (Barrault & Varescon, 2013; Ciccarelli et al., 2017), avoidance coping styles, such as escape, denial, distraction (Oei & Goh, 2014) and impulsivity (Devos et al., 2019). Although Raylu and colleagues (2016) did not directly measure emotion regulation construct in their study, negative emotional states, poor regulation strategies, and failure to resist urges are all indicative of a common transdiagnostic factor in the form of emotional dysregulation. Taken together, these findings indicated that difficulties in modulating internal states, and inability to regulate impulses, are associated with gambling behaviours mediated by erroneous beliefs about gambling.

Second, predicated on a neurocognitive framework, is the somatic markers hypothesis of addiction (SMH; Damasio, 1994). The SMH postulates that emotions play an important role in biasing decision-making (consciously or unconsciously), whereby emotional experience and cognitive appraisal interact to facilitate decisions and judgement on subsequent behaviours. Specifically, failures in emotion processing and self-regulation can lead to faulty decision-making and difficulties in implementing adaptive behaviours (Olsen et al., 2015). When decision making is compromised, it lends gamblers to greater susceptibility to cognitive biases. These biases tend to be automatic, pervasive, and readily available heuristic tools in decision-making (Clark, 2010; Fortune & Goodie, 2012). Further, gamblers' apparent inability to use information contained in an aversive emotional state related to loss, precludes the interruption of gambling behaviour, consequently favouring chasing behaviour despite negative consequences (Brevens et al., 2012). Studies have found that compared to healthy controls, problem gamblers displayed reduced self-awareness, difficulties in forecasting the future consequences of a behaviour, diminished inhibitory control (Bevens & Noel., 2013) and also demonstrated poorer decision making and higher scores on measures assessing cognitive distortions (Ciccarelli et al., 2020).

Indeed, problem gamblers are likely to have distorted beliefs about randomness, overestimation of chances of winning, and illusions of control over winning, which have been found to obscure their capacity to implement sound choices regarding gambling (Steenberg et al., 2002; Goodie & Fortune, 2013; Perales et al., 2019).

Research has also shown that problem gamblers typically endorse a wider range of erroneous beliefs (Devos et al., 2019; Wood & Williams 2011), have a greater tendency to overestimate their control of outcomes (Orgaz et al., 2013) and to express stronger conviction in their endorsements (Sevigny & Ladouceur, 2004) compared to infrequent and controlled gamblers.

Finally, the association among emotions, cognition and gambling has also featured in the analyses of heterogeneity among gamblers. The pathways model of gambling (Blaszczynski & Nower 2002) identified three distinct gambling courses; namely behaviourally-conditioned, emotionally-vulnerable, and impulsivist gamblers. According to Blaszczynski and Nower (2002), thinking errors related to gambling arise from gambling experience and associative learning and are thus present within all three subtypes of problem gamblers. However, problem gambling coinciding with internalising (e.g. anxiety and mood disorders) and externalising (e.g. impulsivity, high-risk behaviours) problems are associated with worse gambling outcomes (Edgerton et al., 2015; Flack & Buckby, 2020; Johnson et al., 2017; Vaughan & Flack, 2021). This premise is particularly relevant with the latter two subgroups, where comorbid psychological affliction, emotional sensitivities, and affect regulation play a vital role in the development and maintenance of gambling behaviours.

To illustrate, research on the joint role of emotional and cognitive factors using cluster analyses found that among the groups of gamblers, those with both elevated impulsivity and gambling-related cognitions displayed the highest score in measures of gambling severity (Devos et al., 2019). Similarly, using mixed-effect modelling Ruiz de Lara and colleagues (2019) investigated the interrelationship between emotion regulation, impulsivity, motivation and cognitive distortions to differentiate gambling profiles. They used the Cognitive Emotion Regulation Questionnaire (CERQ; Garnefski & Kraaij 2007) as a measure of nine different emotional strategies (e.g. reappraisal, refocussing, rumination) and Gambling-Related Cognitions Scale (GRCS; Raylu & Oei, 2004), which measures facets such as illusion of control gambling expectancies, interpretative biases and predictive control. They found a group of gamblers who exhibited a combination of high scores in cognitive distortions, impulsivity and reward sensitivity displayed heightened gambling motivation and self-deceptive reasoning. The authors remarked that for this group, seemingly adaptive regulation strategies (e.g. cognitive appraisal) were employed to justify gambling continuity, which is most likely driven by an underlying heightened need for arousal. It appears that gambling cognitions work together with emotional dispositions and processes to promote further gambling. This observation is consistent with the emotional processing model (Gross, 2011) where individuals deploy emotion regulation strategies depending on the value they attached to the situation (Guyonne & Patrizia, 2018). Thus, gambling is heterogenous, with gamblers displaying varying levels of emotional and cognitive indicators as well as a diversity of motivations to gamble. However, research consistently shows that individuals with more severe gambling problems gamble to alleviate/avoid aversive emotional states and dysphoric mood and enhance positive feelings (Flack & Morris, 2015,16; Rogier et al., 2019).

Considered together, while some of the above evidence suggests that difficulties in processing and regulating emotions predict problem gambling severity by increasing a gambler's susceptibility to cognitive biases, other studies provide evidence that is indicative of the notion that difficulties in emotion regulation and cognitive distortion are likely to interact together to predict gambling outcomes. That is, difficulties in emotion regulation could potentially exacerbate the impact of irrational thinking on gambling behaviours.

Current Study

This study aims to extend the knowledge about the role of emotion regulation as operationalised by Linehan (1993) and Gratz and Roemer (2004) in influencing problem gambling behaviours. While many researchers have examined the contribution of emotional regulation in the context of problem gambling, most have focused on specific emotion regulation strategies (e.g., appraisal, suppression, avoidance), indicators of dysregulated affect (negative emotional states), or emotional traits (e.g. impulsivity). Instead, this study uses a comprehensive conceptualisation of emotion regulation, which encompasses core competencies such as emotional awareness, acceptance of emotions, impulse control, ability to execute goal-directed behaviours, and ability to implement emotional regulation strategies according to situational demands (Gratz & Roemer, 2004). Specifically, this study investigates the interrelationships among emotion regulation deficits, cognitive distortions, and problem gambling by examining two propositions.

The first proposition is that cognitive distortions will mediate the influence of emotion regulation on problem gambling. Based on the cognitive behavioural conceptualisation of gambling, this proposition is predicated on the notion that gambling functions as an emotion modulator and indicators of emotion dysregulation are likely to increase gambler's susceptibility to developing irrational beliefs about gambling. This mediation model was supported by the research findings of Raylu et al. (2016). Accordingly, it is hypothesised that greater difficulties in emotion regulation will be associated with greater problem severity, and this association will be mediated by irrational beliefs about gambling.

The second proposition is that the relationship between cognitive distortions and problem gambling severity will be contingent on the level of difficulties in emotion regulation. This proposition is more exploratory, although there is preliminary evidence supporting this contention. For instance, analyses in the heterogeneity of gamblers have identified distinct groups of gamblers with varying levels of cognitive and emotional vulnerabilities and the group that reported highly in indicators of emotion dysregulation coinciding with high scores in measures of cognitive distortions had the most severe problem gambling symptoms (Devos et al., 2019; Michalczyk et al.,

2011). However, the conditional effects of emotion regulation are still unexplored. Therefore, it is hypothesised that emotion regulation will moderate the relationship between cognitive distortion and problem gambling; specifically, this relationship will strengthen with increased difficulties in emotion regulation.

Method

Participants

A total of 301 adults (60.5% male) who gambled at least once in the past 12 months completed an anonymous online survey. The average age of the participants was 32.62 ($SD = 10.03$). All participants were USA residents and most identified as North American (68.4%), 9% European, 8.7% Asian, 6% African, 4.7% South American, and the remainder selected the 'other' ethnicity option. Slightly over half of the participants had attained university degrees (39.2% undergraduate; 15.9% postgraduate). Of the sample, 62.1% were employed, 17.3% unemployed, 14% students, 6.3% on home duties, and 0.3% were retired. Of the 309 participants who began the online survey, 98% of these individuals completed all the measures. As measured by the Problem Gambling Severity Index (PGSI; Ferris & Wynne 2001), 38.5% of the participants were classified as problem gamblers, 27.9% moderate-risk gamblers, 21.3% low risk, and 12.3% non-problem gamblers.

Measures

Problem Gambling Severity Index (PGSI). The PGSI is a 9-item scale, derived from the 31-item Canadian Problem Gambling Index (CPGI; Ferris & Wynne, 2001). This scale assesses the occurrence of problem gambling behaviours in the last 12 months on 4-point Likert scales ranging from 0 = never to 3 = almost always, with a total score ranging from 0 to 27. A typical item on this scale is "Have you bet more than you could really afford to lose?". Cut-off points are used to categorise gamblers from 'non-problem gamblers' (PGSI = 0), to 'problem-gambler' (PGSI >7). Validation studies suggest the PGSI forms a unidimensional factor structure (Orford et al., 2010; Sharp et al., 2011), representing distinct types of gamblers within the continuum of problem gambling severity (Ferris & Wynne 2001; Orford et al., 2010). PGSI generates a good internal consistency with Cronbach's α of .84 (Stinchfield et al., 2012) and the total full-scale score has been used as an indicator of problem gambling in similar studies (Marchica et al., 2019; Flack & Buckby, 2020).

Difficulties in Emotion Regulation Scale (Modified) M-DERS. The M-DERS (Bardeen, et al., 2016) is a 29-item modified version of the original 36-item Difficulties in Emotion Regulation Scale (DERS; Gratz & Roemer, 2004) designed to assess clinically relevant domains of emotional competence thought to be a critical

dimension of emotion regulation. The M-DERS is comprised of five subscales measuring five domains of emotional competence such as (1) lack of clarity and awareness of own emotions; (2) non-acceptance of emotions; (3) impulse control difficulties; (4) limited access to emotion regulation strategies; and (5) difficulties engaging in goal-directed behaviours when emotionally aroused. Items are endorsed on a 5-point Likert scale, and typical items are "When I'm upset, I lose control over my behaviours.;" and "When I'm upset, I believe that I'll end up feeling very depressed." Psychometric properties of the M-DERS have been previously established, which showed good internal consistency ranging from Cronbach's $\alpha = .91$ to $.97$ (Osborne et al., 2017; Benfer et al., 2018). Factor analytic studies revealed that M-DERS generated a superior model fit and greater replicability of the latent structure of the emotion regulation construct compared to the original DERS (Benfer et al., 2018), with all factors loading significantly to one higher-order construct, providing support for use of a total scale score to index emotion regulation (Bardeen, et al., 2016). Higher scores on the M-DERS reflect greater emotion regulation difficulties. Similar studies demonstrated DERS total score to be positively correlated with problem gambling (Christensen et al., 2013; Elmas et al., 2017; Rogier & Velotti, 2018) and other addictive behaviours (Cavicchioli et al., 2020).

Gambler's Beliefs Questionnaire (GBQ). Cognitive distortions construct was measured using GBQ, a 21-item questionnaire that assesses participant endorsement of two categories of gambling beliefs: Luck/Perseverance (13 items) and the Illusion of Control (8 items), with all items measured on a 7-point Likert scale (Steenbergh et al., 2002). The Illusion of Control measures an individual's perception of their ability to determine the outcome of a game. A typical item for the IOC subscale is "My knowledge and skill in gambling contribute to the likelihood that I will make money." Whereas, Luck/Perseverance subscale reflects the tendency to overestimate the likelihood of winning, and a typical item is "If I continue to gamble, it will eventually pay off and I will make money". Steenbergh and colleagues (2002) reported good internal consistency generating GBQ full-scale Cronbach's $\alpha = 0.92$ with a test-retest reliability of $r = .77$. Previous gambling studies found the total GBQ scale score to be positively related to problem gambling severity (e.g. Flack & Morris, 2017; Weinstock et al., 2012)

Procedures

This study was presented as a survey of gambling attitudes and beliefs and was advertised to Microworkers users aged 18 and above. Microworkers is an online crowdsourcing platform in which users are paid a small amount to complete short tasks such as completing surveys. The characteristics of Microworkers users approximately matches the distribution of internet users in terms of age, gender and employment status (Crone

& Williams, 2017). For the current study, users who chose to participate in this survey were instructed to copy a weblink to access the questionnaire and received US\$1.00 upon completion. To participate, users were required to have gambled at least once in the previous 12 months. The survey comprised questions relevant to the selected measures above. Finally, participants indicated their age, sex, ethnicity, education, and employment status.

To minimise potential confounding effects of geographical differences in gambling characteristics, the sampling frame was set to sample USA residents only. Sampling stratification was not applied, so the sample was not expected to reflect the general population. However, the distribution of responses collected from Microworkers tends to be representative of internet users in general (Crone & Williams, 2017). Ethics approval was obtained from the Researchers' University Human Ethics Committee.

Results

Data Preparation and Analytical Plan

Prior to conducting regression analyses, the suitability of variables was examined using SPSS 26. Skewness and Kurtosis statistics revealed absolute scores between .31 and .40 for MDERS; .16 and .40 for GBQ; and .65 and .69 for PGSI, respectively, indicating that these variables were not substantially skewed, with all values falling below 1 (George & Mallery, 2016). To identify multivariate outliers, residual statistics were examined, revealing a maximum Mahalanobis Distance of 11.40, which was less than the critical value $\chi^2 = 18.47$, $df = 4$, $\alpha = .01$, indicating the multivariate outliers are not of concern. The variance inflation factor (VIF) for all variables were all below the critical value of 10, and tolerances were substantially higher than the .2 cut off (VIF ranged from .53 to .96), indicating that multicollinearity would not interfere with the analysis.

Both hypotheses were examined using emotion regulation as a single construct as opposed to assessing the different facets of emotional regulation difficulties. Consistent with the standard practice for scoring DERS (Gratz & Roemer, 2004; Elmas et al., 2017), 29 items of the M-DERS were summed to generate a total scale score, with higher scores indicating greater emotional regulation difficulties.

Table 1 presents intercorrelations, means, and standard deviations of variables examined. Significant positive relationships exist between emotional dysregulation, cognitive distortions, and problem gambling severity. Similarly, age was significantly correlated with cognitive distortions and gambling severity and was consequently included as control variables in the models (not shown in the models).

Table 1

Inter-correlations among problem gambling severity (PGSI), emotion regulation difficulties (M-DERS) and cognitive distortions

	1	2	3	M	SD
1. PGSI	-			6.40	5.52
2. MDERS	.36**	-		112.37	35.63
3. Cognitive Distortions	.64**	.42**	-	75.75	23.78
4. Age	.12*	.11	-.12*	32.62	10.03
5. Sex	.11	.11	-.05		
Cronbach's alpha	.89	.96	.94		

** Correlation is significant at $p < .01$ level (2-tailed).

* Correlation is significant at $p < .05$ level (2-tailed).

To assess both the mediation and moderation models, the SPSS macro (PROCESS version 3.5) by Hayes (2017) was used. In addition to generating regression estimates, direct, indirect, interaction effect estimates, as well as bootstrapped standard errors and confidence intervals, were also produced. The standard errors were generated using 95% confidence interval and bias-corrected bootstrapped based on 5000 samples.

Mediation Model

Consistent with hypothesis 1, the mediation model with corresponding standardised beta weights displayed in Figure 1 revealed a significant positive indirect effect of emotional regulation difficulties on problem gambling. Difficulties in emotional regulation were found to partially exert its influence via cognitive distortions ($b = .037$, 95% CI [0.025, 0.051]). Although cognitive distortions emerged as a significant mediator, the direct path between emotion regulation difficulties and problem gambling severity remained significant ($b = .020$, 95% CI [0.005, 0.035]), indicating cognitive distortions did not fully mediate the relationship between emotion regulation difficulties and problem gambling. The mediation model accounted for 41.7% of the variance in problem gambling severity, $R^2 = .417$, $F(3,297) = 70.784$, $p < .001$

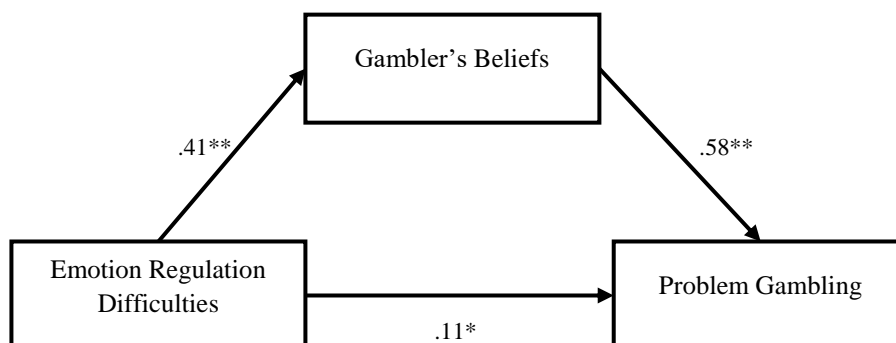


Figure 1 Indirect Effects of Emotion Regulation Difficulties via Cognitive Distortions. Note. Single and double asterisks indicate path is significant at $p < .05$ and $p < .01$, respectively. To improve clarity, age is excluded from the model.

Moderation Model

Table 2 presents the unstandardised beta weights, standard error, and confidence intervals for emotion regulation difficulties moderator model with all variables centred to facilitate meaningful interpretation (Hayes, 2018). Inconsistent with Hypothesis 2, the interaction term in the model shown in Table 2 was not statistically significant, indicating that deficits in emotion regulation did not moderate the relationship between gambling-related beliefs and problem gambling severity. Overall, this model explained 42.22% of the variance in problem gambling severity scores, $R^2 = .422$, $F(4, 296) = 54.135$, $p < .001$.

Table 2

Testing of moderation effects of emotion regulation difficulties (M-DERS) on the relationship between cognitive distortions (GBQ) and problem gambling (PGSI)

Variable	<i>b</i>	SE <i>B</i>	95% CI	
			Lower bound	Upper bound
M-DERS	.020	.008	.005	.035
Cognitive Distortions	.133	.011	.110	.155
M-DERS x Cog Distortions	.001	.001	.000	.001
Age	-0.21	.025	-.069	.027

Discussion

The current study tested the relationship between emotion regulation difficulties and cognitive distortions in exerting influence on problem gambling. Specifically, the study examined whether cognitive distortions mediate the relationship between emotion regulation difficulties and problem gambling (hypothesised mediation model); and whether the effect of cognitive distortions on problem gambling is contingent on the level of emotion regulation difficulty (hypothesised moderation model). The hypotheses were partially supported. That is, the mediation model was supported, although emotion regulation did not moderate the relationship between cognitive distortion and problem gambling.

The finding that emotion regulation difficulties positively predicted problem gambling severity is consistent with previous research (Elmas et al., 2017; Rogier & Velotti, 2018; Williams et al., 2012). This result presents further empirical support for the notion that impairment in emotion regulation mechanisms is a key risk factor for problem gambling. Beyond modulation of emotional arousal and expression, this study highlights the integrative conceptualisation of emotion regulation (Gratz & Roemer, 2004), which underscores other emotional capacities such as awareness and acceptance of emotions, as well as the ability to respond in a desired way irrespective of emotional state. Indeed, previous research has shown that indicators of emotion dysregulation such as misrepresentation of emotion (Rogier & Vellioti, 2018); difficulties in accepting emotional states, thoughts, and bodily sensations (William et al., 2012); high levels of emotional suppression and avoidance (Reid et al., 2014); under-controlled urges (Devos et al., 2019); and reduced capacity to forecast long-term consequences (Bever & Noel, 2013) are associated with greater problem gambling severity. Further, problem gambling has been consistently associated with negative emotional states (Tang et al., 2019; Wong et al., 2018) and mood disorders (Dowling et al., 2017), which can be considered as manifestations of emotion regulation difficulties.

The support for the hypothesised mediation model indicates that greater difficulty in emotion regulation was associated with greater problem severity, and this association was partially explained by cognitive distortions about gambling. Although the indirect effect was significant, it appears that emotion dysregulation may not solely exert its influence on problem gambling via cognitive distortions. Nevertheless, this finding is consistent with cognitive-behavioural perspectives of gambling behaviours, which underscores the relevance of emotional processes in the emergence of gambling-related cognitive biases, which, in turn, reinforces problematic gambling (Michalczuk et al., 2011; Raylu et al., 2016; Stewart et al., 2008). The hypothesised mediated pathway corresponded with the research findings of Raylu et al. (2016). Although Raylu and colleagues did not measure emotion regulation directly, they found significant indirect effects of indicators of emotion regulation difficulties (negative emotional states, avoidance coping strategies, and gambling urges) and gambling behaviours via irrational beliefs.

This mediation effect can be explained in several ways. First, problem gambling may be a way of regulating negative emotions, as well as a consequence of failures to effectively modulate emotional responses and impulses (Tice et al., 2001). In the absence of adaptive regulatory strategies, and as gambling becomes habitual, gamblers may become more prone to irrational thinking about personal skills and randomness of winning, potentially due to the heuristic values (Clark, 2010; Fortune & Goodie, 2012) and self-serving features (Ruiz de

Lara et al., 2019) associated with cognitive distortions. Second, in line with the somatic markers hypothesis (Damasio, 1994), the mediating effect of cognitive distortion is consistent with the notion that failures in emotion regulation are likely to lead to poor reasoning and decision-making impairments, thus increasing gamblers' susceptibility to irrational beliefs and counterintuitive actions, resulting in continued gambling despite significant losses. Finally, failures in representing and making sense of emotions are likely to preclude expression and validation of emotions and prevent gamblers from taking rational steps to modulate responses (Leahy et al., 2011). Consequently, gamblers are more likely to use problematic coping styles such as suppression, escape, or avoidance, which further reinforce compulsive reliance on gambling and potentially using irrational thinking and self-defeating cognitive strategies to justify gambling continuity.

Contrary to the hypothesised moderation model, the interaction between emotion regulation and cognitive distortions was not significant, indicating the relative independence of emotion dysregulation and cognitive distortion in exerting influence in gambling behaviours. However, the direct path between emotion regulation and problem gambling was retained, suggesting that the capacity to regulate emotion remained a significant predictor of gambling severity. Despite the absence of conditional effects, the findings coincide with previous studies on the heterogeneity of problem gambling insofar as implicating emotional factors in explaining the severity of gambling notwithstanding the presence of cognitive distortions (Devos et al., 2019) and the recruitment of cognitive strategies (Ruiz de Lara et al., 2019).

Understanding the mechanisms by which self-regulatory strategies and cognitive beliefs perpetuate problem gambling is particularly important in light of previous research suggesting that gamblers may use seemingly adaptive cognitive-emotion strategies to rationalise gambling perseveration (Ruiz de Lara et al., 2019). That is, heightened need for thrill and reward may amplify a gambler's susceptibility interpretative biases (overestimation of winning and skills to win) by employing strategies (cognitive appraisal, refocusing) to create a self-deception loop leading to further reinforcement of gambling. Thus, for gamblers with undeveloped emotion regulatory capacities, cognitive restructuring may not be an adequate mechanism for change, and underlying emotion regulatory factors may need to be addressed. Indeed, Bechara et al. (2005) argued that reasoning alone is usually not sufficient for making sound decisions, and the role of emotion in decision-making is just as important but usually underestimated.

Finally, the result of the current study may also account for common clinical observations that gambling disorder co-occurring with mood disorders typically are associated with worse gambling severity and poor

treatment prognosis (Johnson et al., 2017; Hartmann & Blaszczynski, 2018). In clinical settings, pathological gamblers with a comorbid lifetime mood disorder (e.g. depression, bipolar disorder, dysthymia) were found to take a longer time to achieve gambling abstinence and were more at risk of relapse (Hodgins et al., 2005).

Implications, Limitations, and Future Research

The findings from this study should be considered against several limitations. First, the reliance on a cross-sectional design precludes inferences about causality. Empirical justification of causal inferences among the variables of interest will require experimental manipulation or measurement over time, and thus, are recommended in future studies. Secondly, although some studies indicated the viability of online crowdsourcing in psychological research (Brehend et al., 2011), a potential limitation is the representativeness of data gathered through this means. Guidelines on best practices for psychological research using online crowdsourcing (Chandler & Shapiro, 2016) were followed throughout this study. Finally, the current study used the general construct of emotion regulation in investigating associations among variables of interest. However, investigation of the nuances of different facets of emotion regulation was beyond the scope of the study. Future research could further clarify the interplay among the variables by investigating how these facets (acceptance and awareness of emotions, impulse control, ability to implement goal-directed behaviours and emotion strategies) individually interact with cognitive distortions. Specifically, previous studies found that individual facets predicted gambling behaviours in varying degrees (Rogier et al., 2018).

An unusually large proportion of participants in this study identified as problem gamblers (38.5 % scored > 8 on the PGSI), indicating a much higher level of problem gambling in the sample than in the population at large. The observed high prevalence in the sample could be attributed to the data collection method employed, which enabled effective recruitment of participants from the population of interest thus, providing a good opportunity to study characteristics of problem gamblers. This high prevalence of problem gambling was consistent with other gambling research (Mishra & Carleton, 2017), demonstrating crowdsourcing platforms appear to offer access to samples with remarkably high proportions of problem gamblers.

The current findings extend the literature on the role of emotional regulation difficulties and cognitive biases in the development of problem gambling. For instance, emotional regulation difficulties and cognitive biases may serve as useful indicators when assessing problem gambling, treatment prognosis, change mechanism, and relapse prediction. In terms of implications for clinical practice, this study highlights the role of emotion regulation as an important avenue in the treatment of problem gambling. Gamblers who present with comorbid

mood disorders are likely to benefit from psychological interventions that enhance emotion regulation capacities. Identifying and modifying maladaptive irrational and erroneous beliefs are typically the primary mechanism of change in the treatment of gambling disorder. However, the current study's findings indicate emotion regulation skills enhancement as a candidate treatment for problem gambling. Indeed, research on treatments that target emotion regulation has shown that integrating general emotion-regulation skills training into CBT-based treatments improved treatment efficacy, particularly on skills application (Berking et al., 2008). Treatment options such as Dialectical Behaviour Therapy (Christensen et al., 2013; Narago-Gainey et al., 2017) and mindfulness-based interventions (Brockman et al., 2017) have been found to reduce symptomology of addictions by improving acceptance and expression of emotions, sense of self-control, and promoting adaptive behaviours in the presence of strong urges and emotional distress. Considered together, emotion regulation is a transdiagnostic factor that often intertwines with problem gambling symptomology. Thus, further research into the improvement of emotion regulation in combination with cognitive-based approach treatments may be of great value in advancing the understanding of the presentation and treatment of pathological gambling.

Conclusion

Deficits in emotional regulation and cognitive biases about gambling are crucial factors that are likely to maintain and contribute to pathological gambling. Indeed, correction of gambling-related distortions and enhancement of emotion regulatory capabilities have been targets for clinical treatment of problem gambling, suggesting that consideration of these factors is vital in the prognosis of gambling addiction. This study provides a greater understanding of the role of emotion regulation and cognitive distortion in problem gambling. Specifically, findings indicate that unsuccessful emotional regulation processes may serve as a precursor to the development of problem gambling behaviours, which provides support for targeting emotion regulation as a potential mechanism for change and a protective factor for emerging gamblers. Therefore, an in-depth investigation into emotion regulatory mechanisms is warranted to develop more effective assessment, treatment, and preventative approaches.

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