The Gambling Related Cognitions Scale (GRCS): development, confirmatory factor validation and psychometric properties

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ABSTRACT

Aims The aims of this study are to develop and validate a measure to screen for a range of gambling-related cognitions (GRC) in gamblers.

Design and participants A total of 968 volunteers were recruited from a community-based population. They were divided randomly into two groups. Principal axis factoring with varimax rotation was performed on group one and confirmatory factor analysis (CFA) was used on group two to confirm the best-fitted solution.

Measurements The Gambling Related Cognition Scale (GRCS) was developed for this study and the South Oaks Gambling Screen (SOGS), the Motivation Towards Gambling Scale (MTGS) and the Depression Anxiety Stress Scale (DASS-21) were used for validation.

Findings Exploratory factor analysis performed using half the sample indicated five factors, which included interpretative control/bias (GRCS-IB), illusion of control (GRCS-IC), predictive control (GRCS-PC), gambling-related expectancies (GRCS-GE) and a perceived inability to stop gambling (GRCS-IS). These accounted for 70% of the total variance. Using the other half of the sample, CFA confirmed that the five-factor solution fitted the data most effectively. Cronbach's alpha coefficients for the factors ranged from 0.77 to 0.91, and 0.93 for the overall scale.

Conclusions This paper demonstrated that the 23-item GRCS has good psychometric properties and thus is a useful instrument for identifying GRC among non-clinical gamblers. It provides the first step towards devising/adapting similar tools for problem gamblers as well as developing more specialized instruments to assess particular domains of GRC.

KEYWORDS Cognition, community, confirmatory factor analyses, gambling, problem gamblers.

INTRODUCTION

With the advancement of cognitive science and cognitive behaviour therapy, the role of cognitions in the aetiology and treatment of problem gambling (PG) has received much attention in research. The 'thinking aloud method' is a technique where gamblers are asked to provide commentary on everything that is going on in their minds including intentions, urges, ideas and images on their play as the game is proceeding. Using this method researchers have identified the existence of gambling-related cognitions (GRC), such as the ability to predict or control gambling outcomes among frequent/problem gamblers for a variety of games (Gilovich & Douglas...
not yet been discussed thoroughly in the gambling literature. Numerous studies have shown that these cognitions are important in the development and maintenance of substance related problems (Baldwin, Oei & Young 1993; Beck et al. 1993; Lee & Oei 1993; Lee, Oei & Greeley 1999). The first of these cognitions relates to individuals’ perceived expectations about the effects of the object(s) of interest. Expectancies have found to play a significant role in substance abuse (Oei & Baldwin 1994; Oei, Furgerson & Lee 1999). Very few studies have discussed gambling expectancies (e.g. Walters & Contr 1998; Oei & Raylu 2004). However, many studies have researched what motivates one to gamble and continue gambling, despite persistent losses. These include gambling to: demonstrate one’s worth; receive approval and social acceptance from others; rebel; relieve negative and painful emotions; participate due to social reasons; try to beat the odds; and participate to experience the excitement, reduce boredom or have fun (Murray 1993; Zuckerman 1999; Raylu & Oei 2002). This demonstrates that gamblers may have particular thoughts about how they expect gambling to affect them. These gambling-related expectancies (e.g. ‘gambling makes me more relaxed’) can be developed through exposure to gambling models, the media and cultural rituals and through one’s experiences. Expecting gambling to be the only way to achieve these can help to maintain gambling despite continuous losses. Such expectancies may also be related to rationalizing why they cannot stop gambling (e.g. ‘without gambling I will be very bored/lonely’). Termination of gambling is seen as a deprivation of satisfaction or a threat to wellbeing and functioning. These functions of gambling expectancies are similar to those put forward for substance-related expectancies (Beck et al. 1993).

The second cognition relates to the perceived inability to stop particular addictive behaviours (Beck et al. 1993; Oei & Burrow 2000). This is similar to drinking refusal self-efficacy (one’s perceived ability to resist drinking in high-risk situations) found for alcohol problems (Lee & Oei 1993; Lee & Oei 1994; Lee, Oei & Greeley 1999; Oei & Burrow 2000). Although little is written specifically about such perceived inability among gamblers, many researchers have stated that problem gamblers often try to stop gambling, especially when they become aware there might be a problem (Black & Moyer 1998; APA 1994). These are manifested usually in the thoughts related to their perceived inability to stop gambling or the activities they need to complete (e.g. borrowing and theft) in order to continue gambling (Blaszczynski 1994; Meyer & Fabian 1996; Sharpe 2002). They may perceive their feelings of disappointment and distress as intolerable and feel a sense of helplessness to control their behaviours. Such thoughts (e.g. ‘my gambling is overpowering’ or ‘I am not strong enough to stop gambling’) may upset them further and these beliefs may become self-fulfilling...
prophecies similar to what has been suggested for other types of addictive problems (Beck et al. 1993). If individuals believe that they are incapable of controlling their urges, they are less likely to try to control them. Thus, this will confirm their beliefs about being helpless in overcoming their addictive problem. Such cognitions about their inability to stop gambling can contribute to relapses and be responsible for depression, which is common among problem gamblers (Raylu & Oei 2002).

Despite the significance of GRC among frequent and problem gamblers, research in this area has been hindered by the lack of adequate measures of GRC. Currently, two measures that attempt to assess GRC have been introduced in the literature. Both these scales reported good consistency and validity. However, both of them have several limitations. First, although the Video Gaming Device Inventory (VGDI) developed by Pike (2002) includes some items to assess GRC, it also includes items that assess emotions/feelings and behaviours related to PG. Furthermore, this scale does not have separate subscales to measure the three domains (i.e. GRC, PG behaviours and emotions/feelings related to PG). The VGDI is also restricted in assessing PG related to video gambling. Secondly, Steenbergh et al. (2002) reported on the development and validation of the 21-item Gamblers’ Beliefs Questionnaire designed to assess GRC. This instrument consisted of only two closely related subscales (luck and illusion of control). Reviews (e.g. Toneatto 1999; Raylu & Oei 2002) suggest that there are more types of GRC. Furthermore, neither of these scales was examined using confirmatory factor analyses (CFA).

In view of the detrimental effects of GRC on gamblers and the lack of instruments to assess them, it would be desirable to have a self-report measure to help screen for GRC. Thus, the present study focuses on developing a scale that assesses a wide range of GRC (erroneous cognitions about success at gambling as well as items related to beliefs about self in relation to gambling) in the general population. Given the link between GRC and PG, such a tool can help to screen for those individuals in the community that may be at risk of developing gambling problems and provide the first step towards developing/adapting such an instrument for a clinical sample of problem gamblers and developing specialized instruments to assess particular domains of GRC. Thus, the purpose of this paper is to report on the development and psychometric properties of the Gambling Related Cognitions Scale (GRCS).

**METHOD**

**Participants**

Participants were volunteers \((n = 968)\) drawn from a community-based population. The aim was to ensure that the sample contained a range of individuals covering a wide range of cultural groups, educational backgrounds and socio-economic status. Thus, the study was advertised in various cultural (Chinese, Greek, Indian, etc.) clubs and society magazines, newsletters and notice-boards. Furthermore, the opportunity to participate for course credit was also advertised on the first-year psychology student website. Advertisement of the study and request for assistance with the study were also sent to several chosen employment organizations from the Brisbane business directory. All participants were between the ages of 16 and 73 years: 50.2% of participants were single, 42.8% reported living together/married and others (7.0%).

The sample was divided randomly into two groups using the odds and evens split method. Thus, each group consisted of 484 participants. Group B (35.7% male; mean age of 31.73 years, \(SD = 15.14\) years) was used for the CFA and group A (37.3% male; mean age 31.78 years, \(SD = 15.19\) years) was used for the exploratory factor analyses (EFA). Group A consisted of 75.4% Caucasians, 12.6% Chinese, 4.5% Indians, 3.6% other Asians (including Vietnamese, Korean, Japanese) and 3.9% other ethnic groups. In group B, 81.8% identified themselves as Caucasians, 8.1% Chinese, 4.1% as Indians, 3% as other Asians and 3% as other ethnic groups. The South Oaks Gambling Screen (SOGS; Lesieur & Blume 1987), which assesses extent of PG, identified 4.5% of participants as probable pathological gamblers (SOGS 5 or greater); 33.1% had SOGS scores between 1 and 4 and 62.4% had SOGS score of 0 (see full description of SOGS in the next section). The distribution for group B was 5.4%, 29.3% and 65.3%, respectively. These PG figures are consistent with reviews published in the gambling literature (Petry & Armentano 1999; Raylu & Oei 2002) that have stated that lifetime prevalence rates ranged from 0.1 to 5.1% (our figure of 4.5% is within the literature range). Both groups had a similar age range (16–73 years), and there were no significant differences in relation to SOGS score, amount gambled, education levels, marital status, ethnic group, employment status and income levels.

**Measures**

**South Oaks Gambling Screen (SOGS)**

The SOGS is a 20-item questionnaire based on *Diagnostic and Statistical Manual* (DSM)-III criteria to screen for lifetime PG. It has been used with patients in a therapeutic community (Lesieur & Heineman 1988), psychiatric admissions (Lesieur & Blume 1990) and numerous treatment settings as an aid in diagnostic and forensic screening (Rosenthal 1989). It has shown to have high validity (by cross-tabulating patients scores with counsellors’

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independent assessment scoring \( r = 0.86, P < 0.001 \) as well as high internal consistency reliability. Cronbach’s alpha = 0.97, \( P < 0.001 \) (Lesieur & Blume 1987).

**Motivation Towards Gambling Scale (MTGS; Chantal, Vallierand & Valleres, 1994)**

This scale contains 28 items evaluating seven types of motivation. This includes intrinsic motivation toward knowledge, accomplishment and stimulation from the gambling activities, extrinsic motivation assessing external regulation (external reward), introjected external regulation (where the individual participates in gambling to attain another important goal such as socializing) and motivation when there are no perceived relations between actions and outcomes. Individuals are asked to respond to each item using a seven-point scale, indicating the degree to which each statement corresponds to the reasons why they play their favourite game, ranging from 1 (does not correspond at all) to 7 (corresponds exactly). Chantal et al. (1994) reported good reliability and validity for this scale.

**Depression Anxiety Stress Scale (DASS-21; Lovibond & Lovibond, 1995)**

This scale assesses levels of depression, anxiety and stress using 21 items. Individuals are asked to respond to each item using a four-point scale to indicate the extent to which each items applied to them in the last 2 weeks, ranging from 0 (did not apply to me at all) to 4 (applied to me very much, or most of the time). It has been normed for Australian populations and been validated against other Beck Depression and Anxiety Inventories (Lovibond & Lovibond 1995). This scale has been shown to have high concurrent validity \( r = 0.84 \) and reliability (i.e. Cronbach’s alpha of 0.94, 0.87 and 0.91 for subscales depression, anxiety and scale, respectively; Anthony et al. 1998).

A short questionnaire pertaining to demographic information (e.g. gender, age, employment status, education level and ethnicity) was also included. The above measures used for this study are parts of a larger project on problem gamblers funded externally by a government agency.

**Procedure**

**Generation of the original Gambling Related Cognitions Scale (GRCS) questionnaire**

The aim of the study was to develop a brief scale to screen for gambling cognitions among a community sample. Items for the questionnaire were generated to cover the wide range of GRC that have been reported in the gambling literature. Consequently, an original 59-item questionnaire was developed to reflect a range of GRC. Items were constructed by the authors using the examples and/or description of the various categories of GRC provided by previous studies in this area (e.g. Gaboury & Ladouceur 1989; Griffiths 1994; Toneatto et al. 1997; Toneatto 1999). Other items (e.g. those reflecting gambling-related expectancies and perceived inability to stop gambling) were constructed using examples of these specific types of cognitions provided by general addictive studies (e.g. Beck et al. 1993; Lee & Oei 1993; Oei & Baldwin 1994; Lee, Oei & Greeley 1999; Oei & Burrow 2000) because they have mentioned only recently being in the gambling literature (e.g. Walters & Contri 1998; Raylu & Oei 2004). Generally, a minimum of four items reflecting each category was constructed. Before the questionnaire was distributed to the participants, the 59 items were assessed for their clarity and relevance by the two authors and two other independent evaluators. Minor revisions (either deletion or rephrasing of items) were made based upon this process. Consequently, six items were deleted and this resulted in a 53-item Gambling Related Cognitions Scale (GRCS).

The participants were asked to use a seven-point Likert scale (1 = strongly disagree, 2 = moderately disagree, 3 = mildly disagree, 4 = neither agree nor disagree, 5 = mildly agree, 6 = moderately agree, 7 = strongly agree) to indicate the extent to which they agreed with the value expressed in each statement. Total score consisted of adding the values gained from each of the 23 items. The higher the total score the higher the number of GRC displayed.

**Distribution of the questionnaires**

Participants who agreed to participate in the study were provided with a set of questionnaires and asked to return them to the researchers in stamped self-addressed envelopes. The overall response rate (% of questionnaires returned) was 90%, while the overall completion rate (% of returned questionnaires that were answered completely) was 95%. Responses were confidential to the researchers, and identification codes were used rather then names. Minor missing data (e.g. 1–2 unanswered item/s per questionnaire) were found for approximately 2% of individuals and these were replaced with means.

**Generation of the final GRCS questionnaire**

Principal axis factoring with varimax rotation using the Statistical Package for the Social Sciences (SPSS) was used to develop the final GRCS questionnaire that met the
following criteria: (a) minimum factor eigenvalues of 1; (2) minimum factor membership of four items; (c) exclusion of items with factor loadings less than 0.4; and (d) conceptual coherence of individual factors. All data (groups A and B combined) were used for this process.

The following process was used to reduce the original 53-item questionnaire to the final 23-item version. First, all loadings less than 0.4 were suppressed based on Stevens’ (1992) suggestion that this cut-off point was appropriate for interpretative purposes. Then, the inter-item correlations and item-total correlations for all 53 items were calculated. The aim of this was to examine, through item analysis, which of the items were very similar to another. First, any items with double factor loading were deleted. This included deletion of 10 items. For each item that correlated significantly highly with another (greater than correlation of 0.75), the item with the lower item total correlation was deleted (DeVellis 1991). This process deleted five items from the 53 items. A further eight were deleted based on the fact that they were items that appeared to measure the same thing. This was also done to reduce multi-collinearity in the data. Commonalities (how much each item correlated with total) were calculated for the remaining. As suggested by DeVellis (1991), in order to produce a scale measuring relatively specific construct, all items with communalities of less than 0.3 were deleted. This process was repeated until deleting more items could not increase further the internal consistency of the scale (Rapee et al. 1996). This resulted in a 23-item questionnaire representing five factors. Three of the factors are consistent with the categories suggested by previous studies (Toneatto et al. 1997; Toneatto 1999), including illusion of control (e.g. ‘I have specific rituals and behaviours that increase my chances of winning’), predictive control (e.g. ‘Losses when gambling, are bound to be followed by a series of wins’) and interpretative bias (e.g. ‘Relating my winnings to my skill and ability makes me continue gambling’). The other two categories were consistent with gambling-related expectancies (e.g. ‘Having a gamble helps reduce tension and stress’) and perceived inability to stop gambling (e.g. ‘My desire to gamble is so overpowering’) discussed earlier in the paper.

Analyses of the 23-item GRCS

Exploratory factor analyses and CFAs were used to confirm the five scales and explore the characteristics of the 23-item GRCS. Cronbach’s alpha analyses were used to assess the reliability of the GRCS and its five subscales. Statistical tests such as bivariate correlations, analyses of variance analyses (ANOVA), discriminant analyses and multiple regression analyses were used to explore the criterion-related validity, predictive validity and concurrent validity of the 23-item GRCS. Finally, ANOVAs were used to explore gender differences in the GRCS scores as well as in the five subscale scores.

RESULTS

Exploratory factor analysis (EFA)

Principal CFA was performed on the 23 items using group B data. Kaiser’s Meyer Olkin measure of sampling adequacy was 0.93, showing that the patterns of correlation are relatively compact, and so factor analysis should produce distinct and reliable factors (Field 2000). Bartlett’s Test of Sphericity was significant (P < 0.001), showing that there were some relationships between the variables. The factors were subjected to orthogonal (varimax) rotation to maximize the dispersion of the loadings within factors so that loading a smaller number of variables highly onto each factor results in more interpretable clusters of factors (Field 2000).

Factor analysis and scree test showed that a five-factor was most appropriate. All 23 items had factor loadings of greater than 0.4, communalities of greater than 0.5, no hyperplane items (items failing to show salient loadings on any of the factors) and no items with substantial cross-loadings on other factors. The five factors accounted for 70% of variance in scores. Factor I (GRCS-IS) accounted for 44.00% of the variance (eigenvalue = 10.12), factor II (GRCS-IB) accounted for 8.29% (eigenvalue = 1.91), factor III (GRCS-IC) for 6.72% (eigenvalue = 1.55), factor IV (GRCS-GE) for 5.96% (eigenvalue = 1.37) and factor V (GRCS-PC) accounted for 4.44% of the variance (eigenvalue = 1.02). Factor 1 appeared to assess cognitive dysfunctions reflecting their inability to stop gambling, factor II appeared to assess interpretative bias among the gamblers, factor III taped into illusion of control such as superstitious beliefs, factor IV appeared to assess gambling expectations and factor V appeared to assess predictive control. Factor I had five items, factor 5 had six items and factors 2–4 had four items each. Factor loadings and communalities are shown in Table 1. A copy of the scale is included in Appendix I.
data. However, for very large sample sizes it is often difficult to achieve a non-significant result (Marsh, Bella & McDonald 1988). Thus, the fit of the model should be interpreted on the basis of a range of other fit indices. The EQS program produces a range of goodness of fit indices including outputs for the Bentler Bonett Normed Fit Index (NFI) and the Bentler Bonett Non-Normed Fit Index (NNFI), which takes into account the degrees of freedom of the model), and the Comparative Fit Index (CFI). By convention these values are regarded acceptable if they are generally greater than 0.9 (Bentler 1995). The root mean square residual (RMR) reflects the proportion of discrepancy between elements in the sample and the hypothesized covariance matrix. If there is a good fit between the hypothesized model and the sample, the RMR will be close to 0.05 or lower. The root mean square error of approximation (RMSEA), which is based on population error of approximation measures ‘discrepancy per degree of freedom’ (Joreskog & Sorbom 1993, p. 124). A value of 0.05 or less is recognized as suggesting a close fit (values up to 0.08 is recognized as a reasonable error of approximation).

Using maximum likelihood estimation, three models were tested. The first model to be examined was a one-factor model in which all items were predicted to load onto a single factor reflecting a general gambling cognition factor, with minimal clustering of cognitions. The analyses showed that the single factor solution was not a good fit of the data. All fitted indices were less than the accepted value of 0.9 (i.e. CFI = 0.64; NFI = 0.62; NNFI = 0.60). Furthermore, the RMR value of 0.09 and RMSEA value of 0.15 were both outside the accepted values.

The second model to be examined was the five-factor model where factors were allowed to intercorrelate. Although this was a better fit than the one-factor model, the fit was not adequate as all fit indices were less than 0.9 (CFI = 0.80; NFI = 0.77; NNFI = 0.78). Also, both the RMR and RMSEA values were outside the accepted value (RMR = 0.34; RMSEA = 0.12), further suggesting that the second model was not the best fit to the data.

The third model that was tested using the CFA was a higher-order model, where the high level of covariation between the five factors could be accounted for by some higher-order factor of ‘gambling cognition’. The analyses showed that this was a good fit of the data as all fit indices were greater than 0.9 (CFI = 0.93; NFI = 0.91; NNFI = 0.93). Furthermore, both the RMR and RMSEA values were in the accepted range (RMR = 0.05; RMSEA = 0.06).

<table>
<thead>
<tr>
<th>Table 1</th>
<th>Factor loadings, communalities and Cronbach’s alpha coefficients for the GRCS.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Item</td>
<td>GRCS-IS</td>
</tr>
<tr>
<td>12</td>
<td>0.848</td>
</tr>
<tr>
<td>7</td>
<td>0.871</td>
</tr>
<tr>
<td>2</td>
<td>0.811</td>
</tr>
<tr>
<td>17</td>
<td>0.706</td>
</tr>
<tr>
<td>21</td>
<td>0.704</td>
</tr>
<tr>
<td>10</td>
<td>0.814</td>
</tr>
<tr>
<td>5</td>
<td>0.811</td>
</tr>
<tr>
<td>20</td>
<td>0.783</td>
</tr>
<tr>
<td>15</td>
<td>0.778</td>
</tr>
<tr>
<td>13</td>
<td></td>
</tr>
<tr>
<td>18</td>
<td></td>
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<tr>
<td>3</td>
<td></td>
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<tr>
<td>8</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td></td>
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<tr>
<td>6</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td></td>
</tr>
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<td>16</td>
<td></td>
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<td>22</td>
<td></td>
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<td>19</td>
<td></td>
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<tr>
<td>23</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td></td>
</tr>
<tr>
<td>%</td>
<td>44.00</td>
</tr>
<tr>
<td>α</td>
<td>0.89</td>
</tr>
</tbody>
</table>

% = percentage of variance; α = Cronbach’s alpha coefficient. N = 968.
Validation CFA with group A

To validate the five-factor higher-order model, a CFA was undertaken through EQS7.5b using the data from group A of the random data split. Results indicated that the five-factor higher-order model was a stable and a good fit of the second data. Analyses showed that all fit indices were over 0.9 (CFI = 0.92; NFI = 0.90; NNFI = 0.91). Furthermore, both the RMR and RMSEA values were acceptable (0.06 and 0.07, respectively), thus suggesting a good fit.

Reliability and validity of the GRCS

Reliability and validity of the GRCS were examined using both group A and group B data.

Reliability

Cronbach’s alpha for the overall scale was high (alpha = 0.93). Moderate to high reliability was also found for each of the five subscales: GRCS-GE (alpha = 0.87); GRCS-IS (alpha = 0.89); GRCS-PC (alpha = 0.77); GRCS-IC (alpha = 0.87); and GRCS-IB (alpha = 0.91).

Factor intercorrelations for the five-factor model

To explore the correlation between the factors the factor scores were computed by adding the items for each subscale. The score for each subscale correlated significantly \((P = 0.01)\) with other subscale scores and the total score, as shown in Table 2. The factors were found to be strongly intercorrelated, with all values exceeding 0.4.

Validity

The three types of validity that were explored for the GRCS using both group A and group B included criterion-related validity, predictive validity and concurrent validity.

Concurrent validity

At the time of the study, there was an absence of similar cognitive instruments with which to compare the GRCS. Consequently, to investigate the concurrent validity of the questionnaire, a range of variables (e.g. anxiety, depression, stress, gambling behaviour and motivations towards gambling) that the gambling literature has shown to be positively correlated with PG were correlated with the GRCS. Studies in the gambling literature have shown that individuals that score higher on such variables tended to have higher GRC. Thus, we expected a positive correlation between these variables (e.g. anxiety, depression, stress, gambling behaviour and motivations towards gambling) and the total number of GRC. Several questionnaires were used to assess these variables (i.e. MTGS, SOGS and DASS).

Results showed evidence of concurrent validity with the total GRCS score correlating significantly with related variables. Significant positive low correlations were established with the DASS subscales (anxiety, depression and stress) and positive moderate correlations were established with the motivation towards gambling subscales and SOGS score. All correlations were significant at 0.01 level (two-tailed). The correlations are shown in Table 3.

Criterion-related validity

In order to investigate whether the GRCS could discriminate between non-problem gamblers and probable problem gamblers, participants were divided into two groups based on their scores on the SOGS: SOGS group 1 (those with SOGS = 0, \(n = 620\)) and SOGS group 2 (those with SOGS of 4 or higher, \(n = 71\)). To maximize the number of participants in each SOGS groups, both data sets were used (i.e. both group A and group B).

Results of an ANOVA showed that there was a significant difference between the two groups in relation to their total score \((F_{1,690} = 174.47, P < 0.001)\). Similar results were found for each subscale, GRCS-GE \((F_{1,690} = 174.29, P < 0.001)\), GRCS-IS \((F_{1,690} = 113.05, P < 0.001)\), GRCS-PC \((F_{1,690} = 92.91, P < 0.001)\), GRCS-IB \((F_{1,690} = 151.87, P < 0.001)\) and GRCS-IC \((F_{1,690} = 28.10, P < 0.001)\). Means and standard deviations of the GRCS subscale and total scores for each of the SOGS groups are shown in Table 4.

Table 2  Factor intercorrelations between factors and total score.

<table>
<thead>
<tr>
<th>Factor</th>
<th>GRCS-GE</th>
<th>GRCS-IS</th>
<th>GRCS-PC</th>
<th>GRCS-IB</th>
<th>GRCS-IC</th>
<th>GRCS-TOT</th>
</tr>
</thead>
<tbody>
<tr>
<td>GE</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IS</td>
<td>0.53</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PC</td>
<td>0.61</td>
<td>0.49</td>
<td>1.00</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>IB</td>
<td>0.57</td>
<td>0.52</td>
<td>0.62</td>
<td>1.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>IC</td>
<td>0.50</td>
<td>0.51</td>
<td>0.59</td>
<td>0.52</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>TOT</td>
<td>0.81</td>
<td>0.74</td>
<td>0.86</td>
<td>0.81</td>
<td>0.76</td>
<td>1.00</td>
</tr>
</tbody>
</table>

\(n = 968\).
Discriminant analyses were completed to explore the ability of the GRCS subscale scores and GRCS total scores to classify participants into the two SOGS groups. The two SOGS groups were regarded as the grouping variables, while the five GRCS subscale scores and GRCS total score were regarded as the predictor variables. The first discriminant analyses (using the subscales of GRCS as predictors) revealed that the discriminant function ($L = 0.75$, $c^2 = 200$, $P < 0.001$) was significant. The univariate $F$ ratios were also significant for all subscales ($P < 0.001$). Subscales GRCS-GE, GRCS-IB, GRCS-IS and GRCS-PC correlated highly with discriminant function ($r = 0.81$, $r = 0.76$, $r = 0.66$ and 0.33, respectively), while subscales GRCS-IC correlated moderately with the discriminant function ($r = 0.33$). The discriminant functions classified correctly 86% of the participants into the two SOGS groups (88% of SOGS group 1 and 72% of SOGS group 2). The second discriminant analyses (using total GRCS score as the predictor variable) also revealed a significant discriminant function ($L = 0.88$, $c^2 = 185$, $P < 0.001$). The discriminant function classified correctly approximately 85% of the participants into the two SOGS groups (87% of SOGS group 1 and 79% of SOGS group 2).

Predictive validity

Multiple regression analyses were conducted to investigate the extent to which GRCS subscales and GRCS total scores could predict level of gambling problem. Age and gender were controlled for all these multiple regression analyses. First, a multiple regression analysis was completed with SOGS as the dependent variable and the GRCS-TOT as the independent variable. Nineteen per cent (19% adjusted: 18% by GRCS-TOT and 1% by gender) of the variance in SOGS scores was accounted for by the predictors ($r = 0.44$, $P < 0.01$). Participants scoring higher on SOGS score were more likely to score higher on GRCS-TOT.

The second multiple regression analyses used SOGS score as the dependent variable and the five GRCS subscales as the independent variables. Twenty-seven per cent (27% adjusted) of the variance in SOGS scores was accounted for by the predictors ($r = 0.52$, $P < 0.01$). Both the demographic factors could not significantly predict SOGS scores. The proportion of variance in SOGS scores accounted by GRCS-GE, GRCS-IS, GRCS-IB and GRCS-IC could significantly predict SOGS scores. These four subscales accounted for 4%, 6%, 3% and 3% of variance, respectively. The GRCS-PC could not significantly predict SOGS scores. Together, the five subscales accounted approximately 16% of the variance in SOGS scores.

The results of the second multiple regression analyses also demonstrated that the subscale GRCS-IC had a negative beta and partial correlation in the multiple regression analyses. However, the bivariate correlations of all subscales with the total SOGS score were significantly positive. The bivariate correlation between the SOGS total score and each of the GRCS subscales were as follows: GRCS-GE (0.42), GRCS-IS (0.41), GRCS-PC (0.31), GRCS-IB (0.39) and GRCS-IC (0.19). In order to explore whether the negative beta for GRCS-IC was due to multicollinearity, tolerance statistics was calculated. Tolerance values below 0.1 (Field 2000) or 0.2 (Menard 1995)
indicate serious problems with multi-collinearity. However, the tolerance values of all subscales were found to be above 0.2. One possible reason for obtaining a negative beta and positive bivariate correlation (e.g. for GRCS-IC) could be the presence of a suppressor variable, where a predictor variable appears to have a significant effect only when another variable is constant (Field 2000). Consequently, a further multiple regression analyses was performed with GRCS-IC as a constant to investigate this possibility further. When the GRCS-IC subscale was held as a constant, the GRCS-PC subscale could predict SOGS scores significantly, similar to the other subscales. Results of the multiple regression analyses are displayed in Table 5.

**Gender differences**

There was a significant gender difference on four of the GRCS subscales including: GE \([F_{1,483} = 24.43, P < 0.01]\), IS \([F_{1,483} = 7.28, P < 0.01]\), PC \([F_{1,483} = 14.35, P < 0.01]\) and IB \([F_{1,483} = 13.55, P < 0.01]\). The gender difference for GRCS-IC was not significant \([F_{1,483} = 4.00 (NS)]\). There was also a significant gender difference in the total GRCS score \([F_{1,483} = 17.28, P < 0.01]\). Males had higher GRCS scores than females. The means and standard deviations of scores are shown in Table 6. Males also scored higher on SOGS than females \([F_{1,966} = 20.86, P < 0.001]\).

**DISCUSSION**

The present study focused on developing and validating a questionnaire that can screen for a range of GRC in a community sample. The five-factor model reflected dimensions of interpretative bias/control, illusion of control, predictive control, perceived inability to stop gambling and expectations of gambling, and provided a good fit of the data. The former three factors are consistent with the categories provided by Toneatto et al. (1997), where interpretative bias reflects cognitions relating to reframing gambling outcomes, predictive control reflects cognitions relating to ability to predict gambling outcomes and illusion of control reflects cognitions relating to ability to control gambling outcomes. The latter two are similar to the cognitions found for other addictions (Beck et al. 1993; Oei & Baldwin 1994).

CFA confirmed the EFA five-factor model as the best fit for the data, suggesting the soundness of the psychometric properties of the GRCS (Appendix I). However, a high level of covariation was found between factors, which could be explained by a single, higher-order model, in which first order factors of cognition subtypes loaded upon a factor of general cognition. Although the first five order factors loaded strongly upon the higher order cognition factor, there was sufficient unique variance (70%) explained by the five first-order factors to justify regarding them as dimensions worthy of independent consideration.

The high level of internal consistency for the entire scale indicates that computing the total score is appropriate and useful for research and/or clinical screening activities and assisting in planning treatment. The internal consistencies for the five subscales were also high.
high. However, because the data used in this study were cross-sectional in nature, it does not assess the sensitivity of the scale to changes over time. Future studies need to determine the test–retest reliability of the 23-item scale, whether or not the scores change over time and where it is sensitive to changes in GRC, due especially to the result of successful cognitive therapy. Preliminary evidence of the latter has been provided by a study being conducted currently by the authors using the GRCS.

Significant positive correlations were demonstrated with other instruments assessing gambling-related variables including gambling-related thoughts, motivations towards gambling scale and gambling problems. Significant positive correlations were also established with DASS, a questionnaire used to assess mood states (levels of anxiety, depression and stress). These support previous studies that show that higher levels of GRC are associated with increased frequency of gambling, PG and with negative psychological states, such as anxiety, depression and stress (Raylu & Oei 2002). Additional testing should be conducted to assess with which variables the GRCS does not correlate (i.e. divergent validity of the GRCS). Given the significant correlations between the subscales, there is a need to explore construct validity separately for the five subscales. This can be achieved by using collateral measures that will support the distinct convergent and divergent validity of each scale.

The GRCS total score and the GRCS subscales have the ability to discriminate between non-problem gamblers and problem gamblers. This also supports research that suggests that GRC can be an important factor in the development and maintenance of PG (Raylu & Oei 2002). Higher GRCS scores were associated with higher SOGS scores. However, given the cross-sectional nature of the data, further research needs to be conducted to explore whether GRC could predict PG at a future date. Furthermore, it appeared that subscale GRCS-IC was masking the effects of GRCS-PC. Thus, when using subscales to predict PG, this needs to be taken into consideration. The GRCS appears to perform somewhat differently than the other scales. For example, the effect size for this scale in Table 4 is much lower with the SOGS than other scales, and it produces a negative beta in regression analyses. Future studies need to explore why this scale is distinct from other subscales. It may be more appropriate to use total GRC scores to predict PG, rather than the subscale scores.

One of the major strengths of this study is a large sample size (n = 968). Furthermore, a sample size of 484 was used for exploratory analyses. A high ratio of participants to GRCS items (ratio 10 : 1) ensured that stable factors could be detected in EFA (Kaiser 1970). Also, CFA was completed with a separate sample, which also had a large sample size (n = 484). Although our findings provide important support for the GRCS as a measure of GRC among gamblers, future studies need to assess the psychometric properties with other samples including clinical samples, especially those in treatment groups. Clinical validity of this sample is also restricted by the fact that the participants were self-selected into the study. This is important, as most of the participants in this study were non-problem gamblers and previous studies/reviews (e.g. Walker 1992; Murray 1993; Griffiths 1996; Zuckerman 1999; Raylu & Oei 2002) suggest that there are significantly more GRC among frequent/problem gamblers than non-frequent/non-problem gamblers. As the SOGS scores for community samples are not distributed normally, there is a strong need to explore the validity of the GRCS (e.g. predictive and criterion related validity) among clinical samples, where the SOGS scores generally tend to be normally distributed. For example, results showed that 18% of the variance in GRCS-TOT predicted SOGS scores. Even though this is a significant result, one would expect this percentage to increase in clinical samples.

The main aim of this study was to develop and validate an instrument to assess GRC that have been identified irrational in nature (e.g. items that concern erroneous beliefs about success at gambling) as well as items related to beliefs about self in relation to gambling (i.e. gambling-related expectancies and perception of inability to control their gambling behaviour) rather than focusing on particular subtypes. Consequently, various cognitions were assessed in a more limited fashion compared to focusing on only one domain of gambling cognition. For example, this study did not separate cognitions surrounding personal skill/ability to influence outcomes, or acts that they believe may influence outcomes, because both reflect beliefs/behaviours to control gambling outcomes. However, an instrument such as the GRCS will provide the first step towards developing more specialized instruments to assess particular domains/types of GRC (e.g. subtypes of cognitions within the illusion of control category, only erroneous cognitions or beliefs about self in relation to gambling).

A significant gender difference was found in four of the five factors as well as the total score, where males tended to have significantly higher GRCS scores than females. Most studies in this area have not looked at the gender differences in GRC (Griffiths 1993, 1990a,b,c). Toneatto et al. (1997) reported no significant gender difference in his study. However, it must be noted that this was based on 38 participants, which were predominantly males. Consistent with other studies (Volberg & Steadman 1988; Volberg 1994; Wood & Griffiths 1998), this study found higher PG in males than females. Thus, it is possible that the higher rate of GRC in males compared...
to females may be accounted for by higher rates of PG among males. Also, males and females have differences in the structural as well as functional organization of the brain, thus leading to differences in responsiveness of the reward system, susceptibility to addictive problems, differences in information processing and different cognitive strategies utilized in problem-solving, all of which have significant impacts on cognition and behaviour (Pogun 2001). Because there are limitations associated with using a sample that is two-thirds female, especially when male gender is a known risk factor for development of gambling problems, future studies need to explore these gender differences further.

In conclusion, GRCS has good psychometric properties. It has good validity and reliability, suggesting that GRCS is a useful tool to assess cognitions among non-clinical gamblers. It is a much-needed self-report measure to help screen for individuals with high levels of GRCS among a community group and explore those that may be more at risk of developing gambling problems. This will provide a step towards developing similar tools or adapting this scale for a clinical sample of problem gamblers. Consequently, this will assist researchers and clinicians not only to identify the types of GRCS that occur for a gambler, but it will also aid in assessing success of cognitive therapy in both clinical and research settings for problem gamblers. More importantly, it provides the first step towards developing more specialized instruments to assess specific domains of GRCS.

References


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**APPENDIX I**

The Gambling Related Cognition Scale (GRCS)

Please indicate (by circling) the extent to which you agree with the value expressed in each statement (1 = strongly disagree; 2 = moderately disagree; 3 = mildly disagree; 4 = neither agree or disagree; 5 = mildly agree; 6 = moderately agree; 7 = strongly agree)

1 Gambling makes me happier.
2 I can’t function without gambling.
3 Praying helps me win.
4 Losses when gambling, are bound to be followed by a series of wins.
5 Relating my winnings to my skill and ability makes me continue gambling.
6 Gambling makes things seem better.
7 It is difficult to stop gambling as I am so out of control.
8 Specific numbers and colours can help increase my chances of winning.
9 A series of losses will provide me with a learning experience that will help me win later.
10 Relating my losses to bad luck and bad circumstances makes me continue gambling.
11 Gambling makes the future brighter.
12 My desire to gamble is so overpowering.
13 I collect specific objects that help increase my chances of winning.
14 When I have a win once, I will definitely win again.
15 Relating my losses to probability makes me continue gambling.
16 Having a gamble helps reduce tension and stress.
17 I’m not strong enough to stop gambling.
18 I have specific rituals and behaviours that increase my chances of winning.
19 There are times that I feel lucky and thus, gamble those times only.

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20 Remembering how much money I won last time makes me continue gambling.
21 I will never be able to stop gambling.
22 I have some control over predicting my gambling wins.
23 If I keep changing my numbers, I have less chances of winning than if I keep the same numbers every time.

Scoring

To obtain the raw subscale scores add values of items for each subscale. To obtain total raw GRCS score, add the five raw subscale scores.

To obtain mean subscale scores divide each of the raw subscale scores by the number of items in each subscale. To obtain a total mean GRCS score, add the five means subscale scores. The items that belong to each subscale are as follows:

- Gambling expectancies: 1, 6, 11, 16
- Illusion of control: 3, 8, 13, 18
- Predictive control: 4, 9, 14, 19, 22, 23
- Inability to stop gambling: 2, 7, 12, 17, 21
- Interpretive bias: 5, 10, 15, 20
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