Journal of Gambling Issues
Volume 44, Spring 2020
http://igi.camh.net/doi/pdf/10.4309/jgi.2020.44.5
DOI: http://dx.doi.org/10.4309/jgi.2020.44.5

GamTest: Psychometric Evaluation in a Low-Gambling General Population

David Forsström,[1,2] Philip Lindner,[1,3] Markus Jansson-Fröjmark,[1] Hugo Hesser,[4,5] & Per Carlbring[2]

[1] Centre for Psychiatry Research, Department of Clinical Neuroscience, Karolinska Institutet, Stockholm Health Care Services, Region Stockholm, Stockholm, Sweden
[2] Department of Psychology, Stockholm University, Stockholm, Sweden
[3] Centre for Dependency Disorders, Stockholm County Council, Stockholm, Sweden
[4] Department of Behavioural Sciences and Learning, Linköping University, Linköping, Sweden
[5] Center for Health and Medical Psychology, Örebro University, Örebro, Sweden

Abstract

Instruments that investigate different aspects of gambling activities are needed to distinguish negative consequences. Because gambling is a complex activity that occurs both offline and online, different questionnaires are necessary for screening and risk classification. GamTest, an instrument used by several gambling companies, was designed to cover different aspects of gambling: money and time spent, as well as social, financial, and emotional consequences. This study explores GamTest's psychometric properties in a general population. A total of 2,234 Swedish respondents completed an online survey containing demographic questions, the questionnaire (GamTest), and the Problem Gambling Severity Index (PGSI). A confirmatory factor analysis was performed and GamTest's reliability and validity tested. The confirmatory factor analysis yielded an inclusive fit. The internal consistency (omega) for the five factors was high (.79–.91), indicating good reliability, and a high positive correlation with the PGSI supported the validity of the GamTest. The inclusive fit of the confirmatory factor analysis can be explained by the low endorsement of negative consequences of gambling in the sample. However, GamTest seems to have good reliability and validity. The utility of GamTest is discussed in relation to its psychometric properties and its use in the responsible gambling tool Playscan.

Keywords: GamTest, psychometric testing, validity, reliability, confirmatory factor analysis

Résumé

Pour être en mesure d'évaluer les conséquences négatives du jeu, il nous faut des instruments qui étudient différents aspects de ces activités. Comme le jeu est une activité complexe qui se déroule à la fois hors ligne et en ligne, différents questionnaires sont nécessaires à des fins de dépistage et de classification des risques. Le GamTest est un instrument utilisé par plusieurs entreprises de jeux d'argent. Il a été conçu pour couvrir différents aspects du jeu: l'argent dépensé et le temps passé, ainsi que les conséquences sociales, financières et émotionnelles. Cette étude explore les propriétés psychométriques du GamTest dans une population en général. Au total, 2234 Suédois ont répondu à un sondage en ligne contenant des questions démographiques, le questionnaire (GamTest) et l'indice de gravité du jeu problématique. Une analyse factorielle de confirmation a été effectuée. La fiabilité et la validité du GamTest ont également été testées. L'analyse factorielle de confirmation a donné un ajustement inclusif. La cohérence interne (Omega) pour les cinq facteurs était élevée (0,79 à 0,91) indiquant une bonne fiabilité. Une corrélation positive élevée avec l'IGPJ a confirmé la validité du GamTest. L'ajustement inclusif de l'analyse factorielle peut s'expliquer par le faible endossement des conséquences négatives du jeu dans l'échantillon. Cependant, le GamTest semble être fiable et valide. L'utilité du Gamtest est abordée sous l'angle de ses propriétés psychométriques et de son utilisation dans l'outil de jeu responsable Plyscan.

Introduction

The advent of gambling through the Internet (dating back to 1995) has increased the need to screen and monitor the negative consequences, risk, and problem gambling experienced by individuals who gamble online. Before online gambling, instruments for measuring such traits among gamblers were primarily applied in clinical trials (e.g., Hodgins et al., 2009) and prevalence studies (e.g., the Swedish Longitudinal Gambling Study; Swelogs; Romild et al., 2014). However, with the increase in websites that provide Internet gambling, instruments that can measure the negative consequences of online gambling are becoming increasingly important. Further, risk assessments of online gamblers, which can help limit the harm they experience, are also becoming important for gambling companies and researchers worldwide. Thus, there is a strong need to develop and psychometrically test instruments that can accurately assess negative consequences, risk, problem gambling, and harm.

Screening Instruments for Adverse Consequences of Gambling, Risk, and Problem Gambling

Several instruments are currently available to screen the negative consequences of gambling, determine the degree of risk concerning gambling, and identify problem gambling. These instrument include the Brief Problem Gambling Screen (Volberg & Williams, 2011), the Canadian Problem Gambling Index (CPGI; Wynne, 2003), Gambling Anonymous Twenty Questions (Toneatto, 2008), the Gambling Problem Index (Neighbors et al., 2002), the Gambling Symptom Assessment Scale (Kim et al., 2009), the Lie/Bet Questionnaire (Johnson et al., 1997), the Massachusetts Gambling Screen (Shaffer et al., 1994), the NORC Diagnostic Screen for Gambling Problems (Gerstein et al., 1999), the Problem Gambling Severity Index (PGSI; Ferris & Wynne, 2001), and the South Oaks Gambling Screen (SOGS; Lesieur & Blume, 1987).

The SOGS is a widely used, valid, and reliable screening instrument for pathological gambling (Lesieur & Blume, 1987). Its items are dichotomous (accommodating "yes" or "no" answers), and an endorsement of five or more of them indicates pathological gambling. The SOGS has been found to be valid and reliable among several populations, including a Brazilian sample (de Oliveira et al., 2009), an Asian community sample in Singapore (Abdin et al., 2012), and a Chinese sample (Tang et al., 2010). Using Rasch modelling and confirmatory factor analysis (CFA), Strong et al. (2003) reported that it may be possible to use a shortened version of the instrument to detect problem gambling. A potential criticism of the SOGS is that it cannot determine the level of negative consequences: It can only help assess whether a problem is present. In addition, its use of binary responses limits the SOGS' ability to measure the degree of negative consequences.

The gold standard, and the most widely used instrument for measuring the negative consequences of gambling, is the PGSI, which was developed by Ferris and Wynne (2001). The instrument's psychometric properties have been examined in several studies (more information regarding this instrument is presented in the Methods section). Designed to measure a single factor, the PGSI contains nine items in total, which are derived from the 34-item CPGI. Initial evaluation of the PGSI showed that the instrument has good psychometric properties (Ferris & Wynne, 2001). Good psychometric properties were also reported for an Italian sample (Colasante et al., 2013), an indigenous Australian population (Bertossa et al., 2014), a Spanish sample (which also found a single-factor structure; Lopez-Gonzalez et al., 2018), and a Chinese sample (Loo et al., 2011). Miller et al. (2013) confirmed the PGSI's one-factor structure, but found that the PGSI was weak for assessing low-to-moderate risk in a gambling population. In contrast, Boldero and Bell (2012) found that the PGSI works best to measure moderate problem gambling. They also concluded that a 12-item weighted scale (instead of nine items) would provide more information regarding gambling frequency; this suggests that modifications to the scale are necessary. Holtgraves (2009) compared the PGSI to the SOGS, and found that the PGSI was a suitable alternative for assessing degrees of gambling severity in a non-clinical context. However, Holtgraves also found that the number of factor structures could vary depending on the user's level of problem gambling.

Another widely used instrument (developed in 2009)—and the focus of this article—is GamTest (Jonsson et al., 2017; more information about this instrument is provided in the Methods section). GamTest is used to measure the negative consequences of gambling, mainly on Swedish gambling sites, and is part of the responsible gambling

(RG) tool Playscan. GamTest is also available as part of Playscan on the Norsk Tipping (the national Norwegian lottery) gambling site. Thus, several hundred thousand Playscan users have the option of responding to GamTest. Jonsson et al. (2017) explored the psychometric properties of GamTest by using a Nordic sample comprising individuals recruited at five different gambling sites. Consequently, exploratory structural equation modelling analysis returned a five-factor solution, which was similar to the intended structure of GamTest. The reliability, measured with Cronbach's alpha, was .90. However, Jonsson et al. (2017) currently represents the only published study that concerns the psychometric properties of GamTest, meaning that there is a need to explore the tool in different contexts.

Research of RG Tools Featuring GamTest

GamTest is part of the RG tool Playscan, which targets at-risk gamblers and aims to help them decrease the time and money they spend on various online gambling activities. RG can be defined as the application of policies and practices to reduce the potential harmfulness of gambling (Blaszczynski et al., 2004). Playscan facilitates behaviour change through three functions: risk assessment, feedback on risk assessment, and advice on how to decrease time and money spent on gambling. The risk assessment is based on the amount of time and money that a user has spent on gambling activities, and it also considers key behavioural markers (e.g., "chasing losses," which concerns making increasingly higher bets in an attempt to recoup the money lost in a previous bet, and "night-owling," which concerns staying up at night to gamble). Self-rated negative consequences, measured through GamTest, are included in the risk assessment, and the GamTest result is given equal weight to the risk assessment. The assessment result is categorized into three levels: low, moderate, and high risk, which are communicated through a traffic-light system that shows green, yellow, or red, respectively. The feedback and advice provided are tailored for respondents who have an elevated or high risk of gambling problems.

Forsström et al. (2016) examined the use of the different Playscan functions (logging on to Playscan, answering a self-test, and receiving advice regarding the means of addressing negative gambling behaviours). They consequently found, for both first-time and repeat users, that GamTest was the most widely used Playscan feature. However, although 80.4% of the total sample of 9,528 began responding to GamTest, only 65.4% completed the entire questionnaire on their first attempt. This means that 14.6% (1,391 users) stopped answering during their self-test for unknown reasons. A later qualitative study by Forsström et al. (2017) found that most users were satisfied with the risk assessment provided by the tool and that the vast majority successfully answered the self-test. The utility of accurate risk assessments (based on gambling data) is supported by other studies (Adami et al., 2013; Braverman & Shaffer, 2012; Dragicevic et al., 2011; Philander, 2013). Forsström et al. (2017) found that interviewed users perceived GamTest to be an important function of the Playscan tool and as the basis of the risk assessment; GamTest also served as a gateway to using the Playscan tool, as the majority of the participants accessed Playscan by initially accessing GamTest (Forsström et al., 2017).

Need for Further Psychometric Testing

The findings of Forsström et al. (2016, 2017) highlight the importance of GamTest for gamblers who use Playscan. However, further exploration of GamTest's psychometric properties is necessary to improve the tool. In addition, further development of GamTest will improve the tool's ability to distinguish between different levels of at-risk gambling. It is essential to examine all aspects of the tool in-depth in order to understand the conditions of use and the process by which users are classified into different categories of gambling-associated risk. Exploring GamTest's psychometric aspects might, for example, contribute to developing a hypothesis regarding why so many people did not complete the first self-test, as reported in Forsström et al. (2016); such a hypothesis could help improve the future use of the tool and GamTest.

Jonsson et al. (2017) did not discuss GamTest's psychometric properties in relation to the overall properties of Playscan. In addition, the study did not investigate GamTest's psychometric properties for a general population (only a heavy gambling population). Holtgraves (2009) reported that an instrument can have differing factor structures for different populations, which indicates the need for additional psychometric testing of GamTest. In the case of Playscan's application of GamTest, this is important, as the range of gamblers that use Playscan extends from low-risk recreational players to high-risk heavy gamblers. Thus, it is necessary to determine GamTest's structure for recreational gamblers; this can be achieved by testing the factor structure proposed by Jonsson et al. (2017) and the tool's validity in the context of a low-gambling general population. Further, examining GamTest's reliability by using omega instead of Cronbach's alpha (used by Jonsson et al., 2017) would also be significant because omega provides a better estimate of reliability when CFA is being used (Dunn et al., 2014).

Aim of the Current Study

In this study, we aimed to examine the above-mentioned areas of GamTest by analysing a general sample that features a range of gambling levels. This type of sample was chosen to determine how GamTest functions for low-to-medium risk samples. Our analysis includes conducting a CFA that is based on Jonsson et al.'s previous factor analysis. Further, we examine GamTest's internal reliability (using omega) and different aspects of validity by using correlation and regression analysis. The results are discussed in relation to GamTest's use as part of the risk assessment provided in Playscan.

Method

Procedure

The researchers responsible for this study prepared a Swedish-language survey (available at https://osf.io/s287j/). The instruments included were GamTest, the PGSI (Ferris & Wynne, 2001), Generalized Anxiety Disorder-7 (GAD-7; Spitzer et al., 2006), and the Patient Health Questionnaire-9 (PHQ-9; Kroenke et al., 2001). GAD-7 and PHQ-9 were added to investigate the relationship between the negative consequences of gambling and anxiety and depression, as well as to gain information about the sample from a health perspective. General questions regarding gambling habits and demographic information were also included. These questions were sourced from the Swelogs study (Romild et al., 2014). In total, the survey contained 85 multiple-choice questions (44 sourced from the Swelogs study). Most of the questions taken from Swelogs concerned whether the respondents engaged in a particular form of gambling and, if so, the amount of time and money they spent gambling. The frequency of gambling activities was also surveyed. To avoid possible order effects, we presented the instruments in the survey to the respondents in random order.

The survey sample comprised individuals recruited by a company (SKOP) that specialized in conducting online surveys. This company was based in Stockholm, and the recruitment field comprised the entire country of Sweden. The inclusion criteria were as follows: (1) 18–85 years old, (2) fluent in Swedish, and (3) access to a computer. An email containing information regarding the study (available at https://osf.io/s287j/) and an offer to participate was sent to 5,000 possible respondents. After this initial email, three reminder emails were sent to potential respondents who had yet to answer the survey. The respondents received no compensation for their participation. The email did not specifically target individuals who gambled, as the sample was designed to mirror the general Swedish population. Interested respondents followed a link in the email and answered the survey online. The respondents were required to answer each question before they could move to the next section, which ensured that there were no missing data points among the completed surveys. The respondents provided informed consent before participating. A total of 2,376 (47.5%) respondents began answering the questionnaire, and 2,257 (45.0%) completed the entire survey. Of these, 23 were excluded because they took over 2 days to complete their survey; it was assumed that these replies were unreliable because of the long time spent answering the survey and that these individuals answered the survey on several occasions during the time the survey link was active. Consequently, data for 2,234 respondents were advanced to the analysis phase.

Respondents' Characteristics

Of the 2,234 respondents included in the study, the gender distribution was 1,184 (53%) men and 1,048 (47%) women; two respondents (0.1%) reported their gender as "other." This is similar to the gender distribution among the Swedish general population: 48%–54% women, depending on age group (Statistics Sweden, 2016). The mean age for the total sample was 51.4 years (*SD* = 16.2): 52.4 years (*SD* = 16.7) for men and 50.3 years (*SD* = 15.5) for women. The Swedish mean age for the age span 18–85 years is 48.5 years (48.0 for men and 49.0 for women; SCB, 2015). The mean monthly income for the total sample was 33,161 Swedish kronor (SEK; median = 30,000; *SD* = 25,149). For men, the mean monthly income was SEK 36,607 (median = 32,000; *SD* = 27,016), and for women, it was SEK 29,133 (median = 28,350; *SD* = 22,090). This is similar to the corresponding data for the general Swedish population, for

Table 1
Gambling Activities in the Total Sample (N = 2,234)

Gambling activity	*n*	% of sample
Horse racing	567	25.4%
Bingo	113	5.1%
Lottery	739	36.4%
Sports betting	626	28.0%
Charity lotteries	1,521	68.1%
Electronic gambling machines	148	6.6%
Poker (land-based and online)	107	4.8%
Casino (land-based and online)	154	6.9%

whom the average salary is SEK 32,000 (SEK 34,100 for men and SEK 29,900 for women; Statistics Sweden, 2016). For the entire participant group, the mean amount spent on gambling over the 30 days preceding the questionnaire was SEK 275 (median = 30; *SD* = 997). For men in the general population, the mean monthly amount spent on gambling is SEK 356 (median = 100; *SD* = 1,112), whereas for women, it is SEK 183 (median = 30; *SD* = 840). The main gambling activities performed by the overall sample (n = 2,234) are presented in Table 1. This shows that charity lotteries were the most common gambling activity, followed by lotteries, sports betting, and horse racing (see Table 1).

Of the 2,234 respondents, 413 experienced, according to GamTest, negative consequences as a result of their gambling. These respondents were distinguished from the rest of the sample by being allocated to a separate group labelled "gamblers who scored over 15 points." These respondents showed higher correlations between PHQ-9 and GAD-7 scores when compared with the respondents who did not endorse negative consequences (for the entire sample, the correlation between GamTest and PHQ-9 scores and between GamTest and GAD-7 scores was $r = .32$, $p < .001$, and $r = .28$, $p < .001$, respectively; the respondents who scored over 15 points showed correlations between GamTest and PHQ-9 scores and between GamTest and GAD-7 scores of $r = .57$, $p < .001$, and $r = .49$, $p < .001$, respectively).

For both the full sample and the subsample of 413, the sample was skewed for both total GamTest scores and money spent (see Figure 1). Money spent showed a single high-spending outlier; this respondent was removed from the analysis (for further information, see the Statistical Analyses subsection).

Attrition

One hundred twenty-one respondents began answering the survey but did not complete it. The mean age for this group was 47.3 years (*SD* = 17.7): 49.4 years (*SD* = 17.7) for men and 45.2 years (*SD* = 17.5) for women. The mean monthly income for this group was SEK 27,516 (*SD* = 12,893): SEK 31,512 (*SD* = 11,601) for men and

Figure 1. Distribution of GamTest scores and money spent.

SEK 23,682 (SD = 13,015) for women. Both the mean age, $t(2088) = 2.176$, $p = .030$, and the mean income, $t(2373) = 2.702$, $p = .007$, were significantly lower in this attrition group than among the 2,234 who completed the questionnaire. However, the difference in income and age do not explain why these respondents did not complete the survey. In addition, as the survey instruments were presented in random order to the respondents, it is not possible to ascertain whether the respondents found some questions especially difficult, or whether they ceased participation because of responder fatigue.

Measures

GamTest. GamTest (Jonsson et. al, 2017) is a 15-item self-report instrument that assesses gambling habits and their consequences. It also contains a question regarding whether the gambler has experienced gambling problems during the past 3 months ("Have you experienced any gambling-related problems within the past three months?"). In the original version of GamTest, the time frame for all questions is the preceding 3 months but, for the present study, this time frame was extended to 12 months. This was to allow comparisons between GamTest scores and those of the PGSI, which also covers a 12-month period.

The 15 GamTest items focus on negative aspects of gambling. The areas that constitute the conceptual basis of GamTest are time spent gambling, money spent on gambling, economic consequences (i.e., long term), social consequences, and emotional consequences. GamTest was developed by the Swedish clinical psychologist Jakob Jonsson, who applied the Delphi method (Danial-Saad et al., 2013) and received assistance from seven psychologists who had experience in treating problem gambling.

Jonsson et al. (2017) conducted a factor analysis of GamTest and found a five-factor solution; this accorded with the number of factors that were proposed during the scale's development. Specifically, the factors that Jonsson et al. (2017) identified were "OverConsumption; Time" (three questions), "OverConsumption; Money" (two questions), "Negative Consequences; Money" (three questions), "Negative Consequences; Social" (two questions), and "Negative Consequences; Emotions" (five questions). The two OverConsumption factors focus on behaviour, more specifically, excessive gambling behaviour. "Negative Consequences; Money" contains items concerning the consequences of overspending on gambling and how to resolve problems that arise afterward. "Negative Consequences; Social" contains items that concern whether people close to the gambler think that he or she spends too much time gambling. "Negative Consequences; Emotions" contains questions concerning negative emotions that are induced by excessive gambling.

In the current study, the item response format comprised a Likert scale that ranged from 1 to 10, with verbal descriptors at 1 (*Do not agree at all*) and 10 (*Fully agree*). The minimum scale score was 15 and the maximum was 150. In the Playscan version of GamTest, the scale ranges from 0 to 10, with the same verbal descriptors; this minor alteration in the response range was judged to have a negligible impact on the psychometric properties investigated.

Problem Gambling Severity Index. The PGSI is a nine-item instrument derived from the 34-item CPGI that is subsequently scored for case finding. It comprises nine questions covering various different aspects of gambling. The scale's test-retest reliability is .78, and Cronbach's α is .84. The instrument has a single-factor solution (Ferris & Wynne, 2001). Item responses range from 0 (Never) to 3 (Almost always), and the maximum score is 27.

Generalized Anxiety Disorder-7. The GAD-7 is a short self-report instrument designed to measure anxiety. Its internal consistency is excellent (Cronbach's α = .92), and it has good test-retest reliability (intraclass correlation = .83; Spitzer et al., 2006). The instrument contains seven questions and has a single-factor solution. Item responses range from 0 (Not at all) to 3 (Almost every day; Spitzer et al., 2006), giving a total score range of 0–21 points.

Patient Health Questionnaire-9. The PHQ-9 is a nine-item instrument that measures depression. This instrument has excellent internal consistency (Cronbach's α = .89) and good test-retest correlation (.84; Kroenke et al., 2001). The instrument has a single-factor solution. Items are scored from 0 (Not at all) to 3 (Nearly every day); total scores range from 0 to 27 (Kroenke et al., 2001).

Statistical Analyses

The R statistical environment (version 3.2.3) was used for data processing and statistical analyses. As expected from a survey of the general population, most of the participants in the total sample (1,821 of 2,234) returned total scores corresponding to the minimum possible GamTest score (15). As it is not possible to estimate the internal structure (e.g., factor solution and internal reliability) when item variation is substantially floor-constrained, we performed such analyses on a subsample (n = 413), which comprised participants who scored at least one point over the minimum score. This approach allowed us to make more reliable estimates of the internal structure. The latent structure of GamTest was assessed by using weighted least squares means and variance-adjusted (the optimization method used was nlminb) CFA. This type of analysis was chosen because our data were skewed. Beauducel and Herzberg (2006) found that weighted least squares means and variance-adjusted CFA outperform maximum likelihood when the sample scores have a skewed distribution. The number of participants (n = 413) was deemed sufficient, based on the benchmark of 20 respondents per item. Additional CFAs were conducted to determine whether other types of CFA would yield better fits. These CFAs are presented in the Appendix.

Internal reliability was assessed by calculating omega at a factor level. Omega has several advantages over Cronbach's alpha; for instance, omega uses more realistic assumptions, which results in less inflation and attenuation problems regarding internal consistency. Overall, omega provides a better assessment of internal consistency (Dunn et al., 2014). The recommendations of Dunn et al. (2014) were used for calculating omega values.

GamTest was validated against the PGSI by using correlation analysis. A multiple regression prediction model was also used to investigate, at a factor level, the association between GamTest and different PGSI scores and between GamTest and money spent on gambling.

One outlier was removed from the analyses concerning money spent on gambling, as this respondent returned a score that was almost twice that of the closest respondent (SEK 27,680 compared with SEK 15,200).

Ethical Considerations

The data were collected anonymously and in accordance with the 1964 Helsinki Declaration as outlined by the World Medical Association and Swedish legislation. Informed consent was given by all respondents. More specifically, before answering the survey, the respondents checked a box indicating that they had read the information regarding the study and that they were thus giving their informed consent. The Central Ethical Review Board in Stockholm approved the study and the data collection procedure (Dnr. 2014/545). The respondents received an offer to participate in the study and did not receive compensation; they were not coerced to answer the survey. The study information was carefully prepared and aimed at ensuring full disclosure regarding the nature of the study. The first researcher's email address and telephone number were included with the information. The respondents could also request the results on a group level by contacting the researcher. The researchers could not provide respondents with individual data.

Results

Factor Structure

The presented CFA results are based on the recommendations of Cabrera-Nguyen (2010) and Jackson et al. (2009). For the subsample of gamblers who scored over 15 points, CFA was used to test the five-factor solution suggested in Jonsson et al. (2017). The results from the analysis revealed an inconclusive fit. The chi-square result was $\chi^2(80) = 189.984$, $p < .01$. A common recommendation is that χ^2 values should be less than the degrees of freedom (Sun, 2005) and that the model should be non-significant; however, obtaining a non-significant model can also result from a small sample and skewed data. The root-mean-square error of approximation (RMSEA) was 0.058, 95% confidence interval [0.047, 0.068]. For a sample of over 250 respondents, RMSEA of < 0.06 indicates a good fit (Hu & Bentler, 1998), which meant that our sample showed a good fit. The comparative fit index was 0.751, and the Tucker-Lewis Index was 0.673. These values should exceed 0.90 (Hu & Bentler, 1998). Thus, the values we obtained are not close to the recommended cut-offs. Finally, the standardized root-mean-square residual was 0.050; a value under 0.08 indicates a good fit (Hu & Bentler, 1998). For results of the CFA, see Table 2.

The factor correlations (see Table 3) are strong and significant for all factors. The heat map (see Figure 2) indicates that a small number of items had a low correlation.

Validity

For the overall sample, GamTest scores correlated positively with the PGSI ($r = .82$, $p < .001$) and with money spent gambling in the preceding 12 months ($r = .43$, $p < .001$). For the subsample of gamblers who scored over 15 points, GamTest correlations with the PGSI ($r = .83$, $p < .001$) and with money spent gambling in the preceding 12 months ($r = .37$, $p < .001$) were similar to the respective correlations for the full sample.

Regression analysis confirmed the link between GamTest and PGSI and between GamTest and money spent on gambling on an overall level and at a factor level (see Table 4). However, the regression analysis yielded negative associations in two of the four models for predicting money spent by using all subscales as predictors in the same model. The negative beta coefficients are likely the result of non-normal distribution of money spent and/or multicollinearity: Because the subscales correlate highly with one another, controlling for others creates an artificial scoring situation.

Reliability

All of the factors had a high omega, ranging from 0.79 to 0.91. For the factor "OverConsumption; Money" omega was 0.79, for "Negative Consequences; Social" it was 0.87, for "OverConsumption; Time" it was 0.89, for "Negative Consequences; Money" it was 0.90, and for "Negative Consequences; Emotions" it was 0.91. Overall,

Table 2
Factor Loadings for the GamTest

Factor	Indicator	Estimate	*SE*	*Z*	*p*
OC Time	Sometimes I forget the time when I'm gambling[a]	1.000[a,b]			
	Sometimes I gamble for longer than I intend	1.110	0.043	25.7	< .001
	I devote time to my gambling when I really should be doing something else	0.936	0.064	14.7	< .001
OC Money	I sometimes try to gamble back money that I have lost	1.000[a]			
	Sometimes I gamble for more than I intend	1.103	0.059	18.8	< .001
NC Money	I sometimes borrow money to enable me to gamble	1.000[a]			
	Sometimes my gambling has left me short of money	2.309	0.374	6.2	< .001
	I sometimes gamble with money that really should have been used for something else	1.970	0.313	6.3	< .001
NC Social	Other people say that I spend too much time gambling	1.000[a]			
	People close to me think I gamble too much	1.086	0.096	11.3	< .001
NC Emotions	My gambling sometimes makes me irritated	1.000[a]			
	I do not want to tell other people about how much time and money I spend on my gambling	0.742	0.078	9.5	< .001
	I feel restless if I do not have the opportunity to gamble	0.826	0.056	14.6	< .001
	Sometimes I feel bad when I think of how much I have lost gambling	1.019	0.065	15.6	< .001
	Sometimes I feel bad when I think about gambling	1.024	0.053	19.2	< .001

Table 3
Factor Correlations

	OC Time	OC Money	NC Money	NC Social	NC Emotions
OC Time	1	0.78**	0.66**	0.57**	0.69**
OC Money	0.78**	1	0.71**	0.56**	0.77**
NC Money	0.66**	0.71**	1	0.57**	0.82**
NC Social	0.57**	0.56**	0.53**	1	0.58**

Note. OC = Over Consumption; NC = Negative Consequences.
**Significant at $p < .001$.

the omega results indicated that GamTest has excellent reliability. These results were sourced from the sample that scored over 15 points on GamTest (the same sample used in the factor analysis).

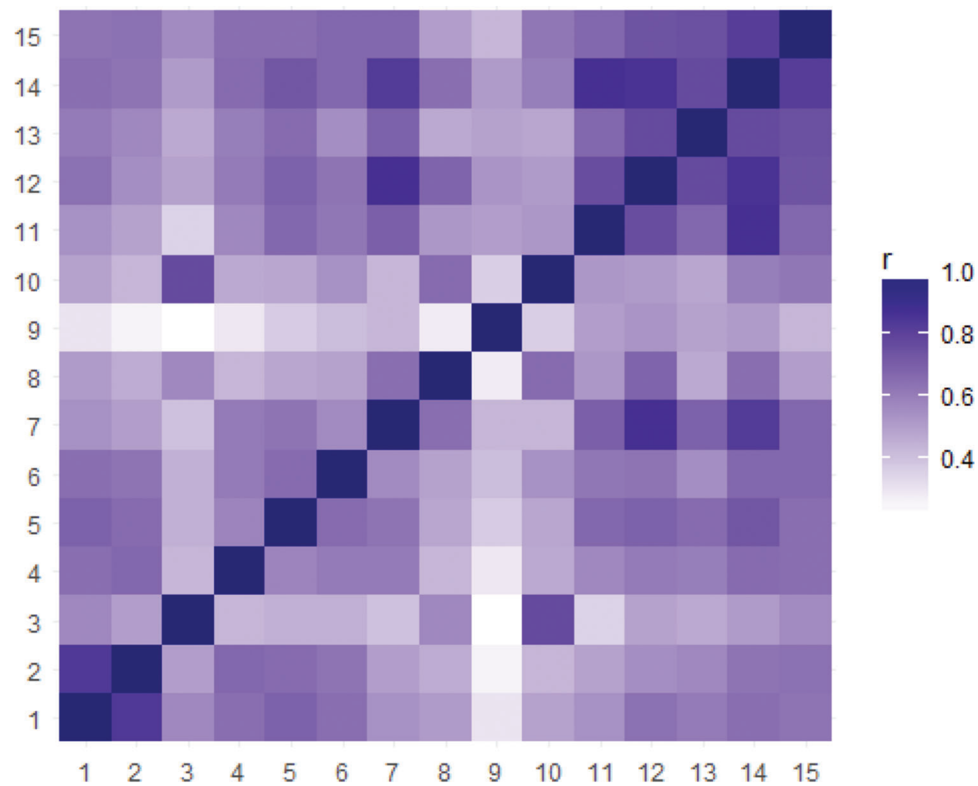

Figure 2. Heat map for item correlations.

Table 4
Result of Multiple Regression Prediction Models

	Outcome: Money spent on gambling			Outcome: PGSI		
	B	*SE*	*p*	*B*	*SE*	*p*
Model 1						
Intercept[a]	-281.95	35.16	< .001	-1.885	0.038	< .001
Summary risk	31.12	1.632	< .001	0.12	0.002	< .001
Model 2						
Over Consumption: Time	205.29	28.74	< .001	0.199	0.039	< .001
Negative Consequences: Money	-223.75	38.14	< .001	0.98	0.051	< .001
Negative Consequences: Social	-214.99	31.60	< .001	0.925	0.043	< .001
Negative Consequences: Emotions	376.36	37.46	< .001	0.557	0.0551	< .001

Note. PGSI = Problem Gambling Severity Index.
[a]Intercepts are negative because the lowest possible score on the GamTest is 15.

Discussion

The aim of this study was to examine the psychometric properties of the GamTest instrument, which is included in the RG tool Playscan. The CFA conducted in the present study returned inconclusive results regarding the fit of the five-factor solution proposed by Jonsson et al. (2017). Some fit indices suggested a poor fit, while others indicated a good fit. The validity of the instrument was, in part, confirmed through correlations with the PGSI. Regression analysis results further substantiated these conclusions. These results indicate that GamTest covers a gambling problem construct and can be used to assess the negative consequences of gambling. However, the results warrant further discussion.

Fit of the Five-Factor Model

The fit of the five-factor solution was inconclusive. The chi-square test, comparative fit index, and Tucker-Lewis Index indicated a poor fit when considered in terms of established benchmarks. In contrast, the RMSEA and standardized root-mean-square residual were under the recommended values, indicating a good fit.

There are several possible reasons for the inconclusive fit of the five-factor solution. First, the method used to analyse our data differed from that used by Jonsson et al. (2017) and, thus, may have produced different outcomes. Further, GamTest scoring scales differed between the studies (0–10 in Jonsson et al. vs. 1–10 in the present study), which may also have caused the inconclusive fit. Moreover, the composition of the samples may have had an influence. For instance, the PGSI item scores in Jonsson et al. (2017) were higher than the mean score for our study (0.26 for the entire sample and 1.34 for gamblers who scored over 15 points on GamTest). A possible explanation for this is the argument raised by Holtgraves (2009): Gamblers who have a low or moderate risk of developing gambling problems may endorse different items in comparison to those endorsed by gamblers who have a high risk of developing gambling problems. Thus, such an effect would result in an inconclusive model fit for our sample. Holtgraves' (2009) analysis indicated that PGSI has several factors. That our CFA resulted in an inconclusive fit, but still endorsed the factor structure, suggests that GamTest is less influenced by a low endorsement of negative consequences. Gamblers who have low levels of gambling problems may have different response patterns, which would induce an inconclusive fit. A possible reason for this is that such gamblers provide a limited range of answers; however, in our results, the restriction in range was mainly due to a lack of high scores (see Figure 1). Another possible reason for the inconclusive fit is the relatively small sample size. Potthast (1993) tested different CFA models and found that larger samples provided better results. In addition, Perry et al. (2015) tested, across a number of different samples, models that were based on complex instruments and that contained several factors, but could not reach the cut-off for several fit indices. The authors consequently proposed other methods of assessing model fit as alternatives to conducting a CFA. In conclusion, the results indicate that the five-factor model can be retained, but that CFA must be repeated in other samples to validate the factor structure.

Validity

The validity analysis results, confirmed by GamTest's high correlation with the PGSI and the results of the regression analysis, suggest that GamTest partly covers a construct that can be defined as problem gambling and negative consequences of gambling. This indicates that GamTest is suitable for investigating different degrees of gambling-induced harm. Also important to note is that the PGSI has a different purpose than GamTest does, as the PGSI was primarily designed for use in population surveys. Thus, when combining the result of the factor analysis and that of the validity analysis, it is important to acknowledge that GamTest is mainly used on gambling sites and as part of RG tools. A general screening instrument should use questions that provide the most accurate assessment of gambling problems in any population, and the phrasing of the items in GamTest are not as well-suited for this purpose when compared with those of the PGSI.

When using GamTest in the setting of a gambling site, the total score is not the only important measure: Attention should also be given to the items that have been endorsed. Including information regarding the aspects that gamblers experience problems with may help users understand their different problem areas. Further, GamTest can aid online gamblers because feedback can be tailored to fit gambling patterns, negative emotions, and problematic behaviours.

Comparison With PGSI

Jonsson et al. (2017) emphasized that the factor covering negative emotions is the most important part of the PGSI. They argued that negative emotions are the primary indicator of gambling harm and that, compared with the PGSI, GamTest focuses on emotional consequences to a greater degree. However, compared with those on GamTest, the PGSI items are more general and open, which makes them suitable for prevalence studies and screening. The PGSI also focuses on behaviours that occur as a result of gambling-induced problems. GamTest's focus on emotional consequences makes GamTest more suitable for assessing risk because increased risk results in negative emotional states. This focus can be compared with two items on the PGSI that, to some degree, investigate emotional and negative consequences of gambling from a general health perspective. Regarding the behavioural items, the instruments are similar, with a focus on losing, betting, and trying to recoup losses.

Reliability

The reliability coefficient, omega, returned values of 0.79–0.91 across the factors, indicating that GamTest has excellent internal reliability (Streiner, 2003). However, according to Streiner (2003), such a high internal consistency implies that several items may be redundant. Consequently, from a practical perspective, reducing the length of the scale may be warranted. The low item correlations (Figure 2) indicate that there are redundant items as well. In a previous study, 80.4% of the respondents began to answer GamTest, but only 65.4% completed it (Forsström et al., 2016).

A study that examined different methods of shortening instruments found that stochastic curtailment by algorithms produces the largest reduction in items (Fokkema et al., 2014); a similar analysis could be used to decide which GamTest items to exclude.

One option for removing items is to administer the entire GamTest the first time a Playscan user answers it, and then, if the user answers it on future occasions, to present only those items that were previously endorsed. Another method of administering GamTest would be to initially present the questions that have the highest loadings on the respective factors, which would determine whether the user has experienced any negative consequences; if the user shows negative consequences, the remainder of the questions could then be administered. Using Rasch analysis to identify the items that can determine the severity of negative consequences could be a method of exploring which GamTest questions should be presented to respondents.

Methodological Discussion

The results of our study and those of Holtgraves (2009) suggest the pertinence of using several different populations when investigating the factor structure of an instrument that targets the consequences of gambling. Different populations can be used to examine how the instrument functions for various levels of spending on gambling. Using multiple samples and understanding how the instrument functions can help to establish guidelines for the use of the instrument and for interpreting the results.

Studies that focus on low-to-moderate gambling populations should be investigated by using Rasch analysis. This would help to identify the most important items for assessing the consequences of gambling and for determining the most common types of harm experienced by different samples.

Results in Relation to Playscan

The low endorsement of items in the present sample may indicate that GamTest items are more sensitive to a heavy-gambling population. This may partially explain why, in Forsström et al. (2016), so many Playscan users did not finish their self-test. In other words, low-risk gamblers may not have felt inclined to answer the self-test if they thought that the instrument contained questions that were not pertinent. Furthermore, because the five-factor solution had a poor fit, the feasibility of GamTest for a low- to moderate-risk population of Playscan users is questionable. Perhaps it would be more suitable to use gambling data for such gamblers only when assessing risk and to use GamTest for heavy gamblers when there is a need to know more about the specific negative consequences of gambling.

Samuelsson et al. (2019) tested a sample by using PGSI and found that several participants who reported having problems did not report any negative consequences in follow-up interviews. Their conclusion was that the questions were ambiguous.

The same may be true for GamTest. The questions included in the instrument might confuse gamblers who have a low-to-moderate risk, which could result in higher scores and, according to Playscan, a higher risk rating. Again, a possible means of addressing this issue among RG tools would be to use gambling data as a first step toward assessing risk.

Administering the instrument in a manner similar to that for item-response theory may increase the information gathered from the instrument. Through such a method, fewer item answers are required from the users of the RG tool. An instrument for which the items have incrementally increasing levels of severity could limit the number of questions asked and thus obtain better estimates.

Another important aspect in relation to Playscan and the use of GamTest is that the respondents who scored over 15 on GamTest showed a higher correlation with GAD-7 and PHQ-9 scores when compared with the respondents who did not report any negative consequences of gambling. Several studies have found an overlap between gambling problems and anxiety and depression; for example, one study found an overlap of 37.9% for mood disorders and 37.4% for anxiety disorder (Lorains et al., 2011). From the correlations observed in our study and the overlap reported in other studies, one suggestion for the development of RG tools is to include a short inventory that assesses general health or that assesses anxiety and depression, which would provide information regarding the negative emotions associated with harmful gambling.

Limitations

One major limitation to this study is the fact that only half of the contacted respondents answered the survey. Thus, self-selection bias may be present for the group who completed the survey. This bias might have resulted in skewed data, producing a lower or higher degree of reporting of gambling-related consequences. However, this should not have affected the results in a significant way, as the size and variability of the data were adequate for data analysis. In addition, because so many respondents reported that they had not experienced any negative consequences of gambling, adding more respondents may not have changed the data in any way.

Self-reporting creates an inherent limitation in research, as the data are based on respondents' answers. However, in gambling research, this bias can have a greater impact on the result because gamblers are prone to act on cognitive biases. Several studies have explored gamblers' cognitive bias (Griffiths, 1994; McCusker & Gettings, 1997) and distortions. Kuentzel et al. (2008) found that self-report data for gambling problems may be influenced by individuals' desire to present themselves in an overly positive way, which would make them more likely to underestimate their problems. Self-report bias in gambling research poses a major problem, and further studies of each applicable instrument are needed to assess different aspects of their psychometric qualities.

Another limitation is that only population data were available and were collected in a non-gambling setting. GamTest is usually administered and answered on gambling sites or electronic gambling machines in Sweden. In addition to resulting in floor-constrained data (handled appropriately in associated analyses), our approach may limit the extent to which the findings can be extrapolated to data collected in gambling settings.

Another possible limitation is that the survey was answered online and not administered via telephone interviews, as was conducted for the Swelogs study (Romild et al., 2014). However, administering the survey online was not considered to affect the answers. Studies have found that Internet administration of psychiatric self-rating scales produces data comparable to those obtained through traditional forms of administration (Carlbring et al., 2007; Holländare et al., 2010; Lindner et al., 2013). GamTest is almost exclusively used on gambling sites and electronic gambling machines, which makes the online method a suitable choice for administering the survey.

Survey length could have been another limitation, as 121 respondents did not finish the survey. However, it is plausible that most of these respondents had not experienced negative consequences of gambling.

Another limitation could be that we changed the time frame for GamTest from 3 to 12 months. However, Wulfert et al. (2005) changed the time frames for the SOGS and the NORC Diagnostic Screen for Gambling Problems from 12 to 3 months, and this change did not seem to alter the psychometric properties of the respective scales. The alteration we made to GamTest might have led to more respondents' reporting negative consequences of gambling, but should not have influenced the overall results of the study.

The omega was the only reliability measure used, and this is another limitation. A test-retest reliability score would have provided an additional reliability measure that would make the instrument applicable in clinical settings, as well as for measuring change on an individual level by using the Reliable Change Index (Jacobson & Truax, 1991). As there was a degree of similarity among the questions, the omega coefficients were inflated, indicating that the instrument could be shortened. A similar method to that used in Wood et al. (2017) could be used to investigate how the scale could be shortened. In addition, Wood et al. (2017) discussed, for new gambling scales, the levels at which cut-offs should be applied to differentiate between gamblers. This avenue of investigation would be important for promoting GamTest outside of RG tools. When more data on GamTest are collected, the possibility of creating reliable cut-offs should increase.

Future Research

Research is needed to compare GamTest results with gambling data, which could help create benchmarks when one source of data is missing. This could also be used to improve the categorization of the three different risk levels. Such benchmarks could also be used in several settings outside of Playscan, where it is vital to determine the level of risk among gamblers.

How GamTest results relate to the different levels of problem gambling (as measured by using the PGSI) must be investigated. The four levels suggested in the research literature should be compared with GamTest scores in order to create benchmarks for GamTest's future use in an RG tool setting. Because PGSI and GamTest use different scales and endpoints, it is difficult to determine the corresponding GamTest score for each level of risk.

Another interesting means of further investigating GamTest's validity would be to compare a gambler's GamTest results with data from interviews with the gambler or the gambler's family and friends; such interviews should be conducted by clinicians who have experience in treating problem gambling. Besides creating benchmarks, future research could also focus on comparing GamTest results with actual gambling data from gambling sites to investigate the validity of the instrument and provide proof of the instrument's ecological validity. This could also provide further insights into the means of addressing self-report bias in gambling research. This approach could be discussed in relation to the findings of Auer and Griffiths (2016), who examined how gamblers underestimate their losses.

Conclusions

The CFA had an inconclusive fit, which can, in part, be explained by the participants' low GamTest scores. The validity of GamTest was supported by its correlations with the PGSI, and regression analysis indicated that GamTest covers a problem-gambling construct. Although the validity of the instrument was confirmed, the factor analysis fit indicates that the instrument should be used for heavy gamblers, and not for a population of recreational gamblers. Further testing of different gambling populations is needed to understand how GamTest functions as an instrument that assesses the negative consequences of gambling.

References

Abdin, E., Subramaniam, M., Vaingankar, J. A., & Chong, S. A. (2012). Reliability and validity of the English version of the South Oaks Gambling Screen in a multiracial Asian community sample in Singapore. *International Gambling Studies*, *12*(3), 275–293. https://doi:10.1080/14459795.2012.669777

Adami, N., Benini, S., Boschetti, A., Canini, L., Maione, F., & Temporin, M. (2013). Markers of unsustainable gambling for early detection of at-risk online gamblers. *International Gambling Studies*, *13*(2), 188–204. https://doi:10.1080/14459795.2012.754919

Auer, M., & Griffiths, M. D. (2016). Self-reported losses versus actual losses in online gambling: An empirical study. *Journal of Gambling Studies*, *33*(3), 795–806. https://doi:10.1007/s10899-016-9648-0

Beauducel, A., & Herzberg, P. Y. (2006). On the performance of maximum likelihood versus means and variance adjusted weighted least squares estimation in CFA. *Structural Equation Modeling*, *13*(2), 186–203. https://doi:10.1207/s15328007sem1302_2

Bertossa, S., Harvey, P., Smith, D., & Chong, A. (2014). A preliminary adaptation of the Problem Gambling Severity Index for Indigenous Australians: Internal reliability and construct validity. *Australian and New Zealand Journal of Public Health*, *38*(4), 349–354. https://doi:10.1111/1753-6405.12254

Blaszczynski, A., Ladouceur, R., & Shaffer, H. J. (2004). A science-based framework for responsible gambling: The Reno model. *Journal of Gambling Studies*, *20*(3), 301–317. https://doi:10.1023/B:JOGS.0000040281.49444.e2

Boldero, J. M., & Bell, R. C. (2012). An evaluation of the factor structure of the Problem Gambling Severity Index. *International Gambling Studies*, *12*(1), 89–110. https://doi:10.1080/14459795.2011.635675

Braverman, J., & Shaffer, H. J. (2012). How do gamblers start gambling: Identifying behavioural markers for high-risk internet gambling. *The European Journal of Public Health*, *22*(2), 273–278. https://doi:10.1093/eurpub/ckp232

Cabrera-Nguyen, Elián. (2010). Author guidelines for reporting scale development and validation results in the *Journal of the Society for Social Work and Research*. *Journal of the Society for Social Work and Research*, *1*, 99–103. https://doi:10.5243/jsswr.2010.8.

Carlbring, P., Brunt, S., Bohman, S., Austin, D., Richards, J., Öst, L.-G., & Andersson, G. (2007). Internet vs. paper and pencil administration of questionnaires commonly used in panic/agoraphobia research. *Computers in Human Behavior*, *23*(3), 1421–1434. https://doi:10.1016/j.chb.2005.05.002

Colasante, E., Gori, M., Bastiani, L., Siciliano, V., Giordani, P., Grassi, M., & Molinaro, S. (2013). An assessment of the psychometric properties of Italian version of CPGI. *Journal of Gambling Studies*, *29*(4), 765–774. https://doi:10.1007/s10899-012-9331-z

Danial-Saad, A., Kuflik, T., Weiss, P. L., & Schreuer, N. (2013). Building an ontology for assistive technology using the Delphi method. *Disability and Rehabilitation: Assistive Technology*, *8*(4), 275–286. https://doi:10.3109/17483107.2012.723238 de Oliveira, M. P. M. T., da Silveira, D. X., de Carvalho, S. V. B., Collakis, S. T., Bizeto, J., & Silva, M. T. A. (2009). Reliability, validity and classification accuracy of the South Oaks Gambling Screen in a Brazilian sample. *Journal of Gambling Studies*, *25*(4), 557–568. https://doi:10.1007/s10899-009-9152-x

Dragicevic, S., Tsogas, G., & Kudic, A. (2011). Analysis of casino online gambling data in relation to behavioural risk markers for high-risk gambling and player protection. *International Gambling Studies*, *11*(3), 377–391. https://doi:10.1080/14459795.2011.629204

Dunn, T. J., Baguley, T., & Brunsden, V. (2014). From alpha to omega: A practical solution to the pervasive problem of internal consistency estimation. *British Journal of Psychology*, *105*(3), 399–412. https://doi:10.1111/bjop.12046

Ferris, J., & Wynne, H. (2001). *The Canadian Problem Gambling Index*. Canadian Centre on Substance Abuse.

Fokkema, M., Smits, N., Finkelman, M. D., Kelderman, H., & Cuijpers, P. (2014). Curtailment: A method to reduce the length of self-report questionnaires while maintaining diagnostic accuracy. *Psychiatry Research*, *215*(2), 477–482. https://doi:10.1016/j.psychres.2013.11.003

Forsström, D., Hesser, H., & Carlbring, P. (2016). Usage of a responsible gambling tool: A descriptive analysis and latent class analysis of user behavior. *Journal of Gambling Studies*, *32*(3), 889–904. https://doi:10.1007/s10899-015-9590-6

Forsström, D., Jansson-Fröjmark, M., Hesser, H., & Carlbring, P. (2017). Experiences of Playscan: Interviews with users of a responsible gambling tool. *Internet Interventions*, *8*, 53–62. https://doi:10.1016/j.invent.2017.03.003

Gerstein, D., Hoffmann, J., Larison, C., Engelman, L., Murphy, S., Palmer, A., Chuchro, L., Toce, M., Johnson, R., Buie, T., Hill, M. A., Volberg, R., Harwood, H., Tucker, A., Christiansen, E., Cummings, W., & Sinclair, S. (1999). *Gambling impact and behavior study: Report to the national gambling impact study commission*. National Opinion Research Center.

Griffiths, M. D. (1994). The role of cognitive bias and skill in fruit machine gambling. *British Journal of Psychology*, *85*(3), 351–369. https://doi:10.1111/j.2044-8295.1994.tb02529.x

Hodgins, D. C., Currie, S. R., Currie, G., & Fick, G. H. (2009). Randomized trial of brief motivational treatments for pathological gamblers: More is not necessarily better. *Journal of Consulting and Clinical Psychology*, *77*(5), 950–960. https://doi:10.1037/a0016318

Holländare, F., Andersson, G., & Engström, I. (2010). A comparison of psychometric properties between Internet and paper versions of two depression instruments (BDI-II and MADRS-S) administered to clinic patients. *Journal of Medical Internet Research*, *12*(5), e49. https://doi:10.2196/jmir.1392

Holtgraves, T. (2009). Evaluating the Problem Gambling Severity Index. *Journal of Gambling Studies*, *25*(1), 105–120. https://doi:10.1007/s10899-008-9107-7

Hu, L. T., & Bentler, P. M. (1998). Fit indices in covariance structure modeling: Sensitivity to underparameterized model misspecification. *Psychological Methods*, *3*(4), 424–453. https://doi:10.1037/1082-989X.3.4.424

Jackson, D. L., Gillaspy, J. A., Jr., & Purc-Stephenson, R. (2009). Reporting practices in confirmatory factor analysis: An overview and some recommendations. *Psychological Methods*, *14*(1), 6–23. https://doi:10.1037/a0014694

Jacobson, N. S., & Truax, P. (1991). Clinical significance: A statistical approach to defining meaningful change in psychotherapy research. *Journal of Consulting and Clinical Psychology*, *59*(1), 12–19. https://doi:10.1037/0022-006X.59.1.12

Johnson, E. E., Hamer, R., Nora, R. M., Tan, B., Eisenstein, N., & Engelhart, C. (1997). The Lie/Bet Questionnaire for screening pathological gamblers. *Psychological Reports*, *80*(1), 83–88. https://doi:10.2466/pr0.1997.80.1.83

Jonsson, J., Munck, I., Volberg, R., & Carlbring, P. (2017). GamTest: Psychometric evaluation and the role of emotions in an online self-test for gambling behavior. *Journal of Gambling Studies*, *33*(2), 505–523. https://doi:10.1007/s10899-017-9676-4

Kim, S. W., Grant, J. E., Potenza, M. N., Blanco, C., & Hollander, E. (2009). The Gambling Symptom Assessment Scale (G-SAS): A reliability and validity study. *Psychiatry Research*, *166*(1), 76–84. https://doi:10.1016/j.psychres.2007.11.008

Kroenke, K., Spitzer, R. L., & Williams, J. B. W. (2001). The PHQ-9: Validity of a brief depression severity measure. *Journal of General Internal Medicine*, *16*(9), 606–613. https://doi:10.1046/j.1525-1497.2001.016009606.x

Kuentzel, J. G., Henderson, M. J., & Melville, C. L. (2008). The impact of social desirability biases on self-report among college student and problem gamblers. *Journal of Gambling Studies*, *24*(3), 307–319. https://doi:10.1007/s10899-008-9094-8

Lesieur, H. R., & Blume, S. B. (1987). The South Oaks Gambling Screen (SOGS): A new instrument for the identification of pathological gamblers. *American Journal of Psychiatry*, *144*(9), 1184–1188. https://doi:10.1176/ajp.144.9.1184

Lindner, P., Andersson, G., Ost, L. G., & Carlbring, P. (2013). Validation of the Internet-administered Quality of Life Inventory (QOLI) in different psychiatric conditions. *Cognitive Behaviour Therapy*, *42*(4), 315–327. https://doi:10.1080/16506073.2013.806584

Loo, J. M. Y., Oei, T. P. S., & Raylu, N. (2011). Psychometric evaluation of the Problem Gambling Severity Index-Chinese Version (PGSI-C). *Journal of Gambling Studies*, *27*(3), 453–466. https://doi:10.1007/s10899-010-9221-1

Lopez-Gonzalez, H., Estévez, A., & Griffiths, M. D. (2018). Spanish validation of the Problem Gambling Severity Index: A confirmatory factor analysis with sports bettors. *Journal of Behavioral Addictions*, *7*(3), 814–820. https://doi:10.1556/2006.7.2018.84

Lorains, F. K., Cowlishaw, S., & Thomas, S. A. (2011). Prevalence of comorbid disorders in problem and pathological gambling: Systematic review and meta-analysis of population surveys. *Addiction*, *106*(3), 490–498. https://doi:10.1111/j.1360-0443.2010.03300.x

McCusker, C. G., & Gettings, B. (1997). Automaticity of cognitive biases in addictive behaviours: Further evidence with gamblers. *British Journal of Clinical Psychology*, *36*(4), 543–554. https://doi:10.1111/j.2044-8260.1997.tb01259.x

Miller, N. V., Currie, S. R., Hodgins, D. C., & Casey, D. (2013). Validation of the Problem Gambling Severity Index using confirmatory factor analysis and Rasch modelling. *International Journal of Methods in Psychiatric Research*, *22*(3), 245–255. https://doi:10.1002/mpr.1392

Neighbors, C., Lostutter, T. W., Larimer, M. E., & Takushi, R. Y. (2002). Measuring gambling outcomes among college students. *Journal of Gambling Studies*, *18*(4), 339–360. https://doi:10.1023/A:1021013132430

Perry, J. L., Nicholls, A. R., Clough, P. J., & Crust, L. (2015). Assessing model fit: Caveats and recommendations for confirmatory factor analysis and exploratory structural equation modeling. *Measurement in Physical Education and Exercise Science*, *19*(1), 12–21. https://doi:10.1080/1091367X.2014.952370

Philander, K. S. (2013). Identifying high-risk online gamblers: A comparison of data mining procedures. *International Gambling Studies*, *14*(1), 53–63. https://doi:10.1080/14459795.2013.841721

Potthast, M. J. (1993). Confirmatory factor analysis of ordered categorical variables with large models. *British Journal of Mathematical and Statistical Psychology*, *46*(2), 273–286. https://doi:10.1111/j.2044-8317.1993.tb01016.x

Romild, U., Volberg, R., & Abbott, M. (2014). The Swedish Longitudinal Gambling Study (Swelogs): Design and methods of the epidemiological (EP-) track. *International Journal of Methods in Psychiatric Research*, *23*(3), 372–386. https://doi:10.1002/mpr.1449

Samuelsson, E., Wennberg, P., & Sundqvist, K. (2019). Gamblers' (mis-) interpretations of Problem Gambling Severity Index items: Ambiguities in qualitative accounts from the Swedish Longitudinal Gambling Study. *Nordic Studies on Alcohol and Drugs*, *36*(2), 140–160. https://doi:10.1177/1455072519829407

Shaffer, H. J., LaBrie, R., Scanlan, K. M., & Cummings, T. N. (1994). Pathological gambling among adolescents: Massachusetts Gambling Screen (MAGS). *Journal of Gambling Studies*, *10*(4), 339–362. https://doi:10.1007/BF02104901

Spitzer, R. L., Kroenke, K., Williams, J. W., & Löwe, B. (2006). A brief measure for assessing generalized anxiety disorder: The GAD-7. *Archives of Internal Medicine*, *166*(10), 1092–1097. https://doi:10.1001/archinte.166.10.1092

Statistics Sweden. (2016). *Jämställdhetsstatistik*. (Women and men in Sweden – Facts and figures 2016). Retrieved from https://www.scb.se/contentassets/7516e7d2f0834a7b94bfd87593405c7b/le0201_2015b16_br_x10br1601eng.pdf

Streiner, D. L. (2003). Starting at the beginning: An introduction to coefficient alpha and internal consistency. *Journal of Personality Assessment*, *80*(1), 99–103. https://doi:10.1207/S15327752JPA8001_18

Strong, D. R., Breen, R. B., Lesieur, H. R., & Lejuez, C. (2003). Using the Rasch model to evaluate the South Oaks Gambling Screen for use with nonpathological gamblers. *Addictive Behaviors*, *28*(8), 1465–1472. https://doi:10.1016/S0306-4603(02)00262-9

Jun Sun (2005) Assessing Goodness of Fit in Confirmatory Factor Analysis, Measurement and Evaluation in Counseling and Development, 37:4, 240–256, https://doi:10.1080/07481756.2005.11909764

Tang, C. S.-k., Wu, A. M., Tang, J. Y., & Yan, E. C. (2010). Reliability, validity, and cut scores of the South Oaks Gambling Screen (SOGS) for Chinese. *Journal of Gambling Studies*, *26*(1), 145–158. https://doi:10.1007/s10899-009-9147-7

Toneatto, T. (2008). Reliability and validity of the Gamblers Anonymous Twenty Questions. *Journal of Psychopathology and Behavioral Assessment*, *30*(1), 71–78. https://doi:10.1007/s10862-007-9070-0

Volberg, R. A., & Williams, R. J. (2011). *Developing a brief problem gambling screen using clinically validated samples of at-risk, problem and pathological gamblers*. https://opus.uleth.ca/bitstream/handle/10133/2561/2011-Brief%20Screen-AGRI.pdf?sequence=1

Wood, R. T. A., Wohl, M. J., Tabri, N., & Philander, K. (2017). Measuring responsible gambling amongst players: Development of the positive play scale. *Frontiers in Psychology*, *8*, 227. https://doi:10.3389/fpsyg.2017.00227

Wulfert, E., Hartley, J., Lee, M., Wang, N., Franco, C., & Sodano, R. (2005). Gambling screens: Does shortening the time frame affect their psychometric properties? *Journal of Gambling Studies*, *21*(4), 521–536. https://doi:10.1007/s10899-005-5561-7

Wynne, H. (2003). *Introducing the Canadian Problem Gambling Index*. Wynne Resources.

****

Submitted February 4, 2020; accepted February 26, 2020. This article was peer reviewed. All URLs were available at the time of submission.

For correspondence: David Forsström, Ph.D., The Centre for Psychotherapy, Education & Research Liljeholmstorget 7, SE-117 63 Stockholm, Sweden.
E-mail: david.forsstrom@ki.se

Competing interests: None declared.

Ethics approval: This study and the data collection procedure were approved by the Central Ethical Review Board in Stockholm (Dnr. 2014/545 and 2017/1076-32). Final approval was given 2017-05-29.

Acknowledgements and funding sources: D.F. was funded by a grant from the Svenska Spel Research Council.

Appendix

Results of the Confirmatory Factor Analysis

Type of CFA	Chi-square (χ^2)	RMSEA (CI)	CFI	TLI	SRMR
Maximum Likelihood Standard[a]	712.2	0.138 (0.129-0.148)	0.895	0.862	0.060
Maximum Likelihood Robust	489.5	0.111 (0.104-0.119)	0.855	0.810	0.060

Note. CFA = confirmatory factor analysis; RMSEA = root-mean-square error of approximation; CI = confidence interval; CFI = comparative fit index; TLI = Tucker-Lewis index; SRMR = standardized root-mean-square residual.
[a]Same result for the maximum likelihood estimation with robust standard errors and a mean- and variance adjusted test statistic (MLMVS).