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A Reliability Generalization Meta-analysis of the South Oaks Gambling Screen (SOGS)

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Abstract

Background: The South Oaks Gambling Screen (SOGS) is one of the most widely used screening instruments for evaluating addiction to gambling. **Method:** The main objective of this study is to analyze whether the SOGS is a reliable instrument and what characteristics of studies on the SOGS are linked to its reported reliability. **Results:** A meta-analysis was carried out with 63 studies including 65 independent samples. The mean value of a was .86 (95% CI of .84–.88), with high heterogeneity (I2 = 98.27%). The variables that explain the most heterogeneity were the continent where the study was performed (R2 = .61), application to participants with or without clinical problems (R2 = .58), the form of administration of the questionnaire (R2 = .56), and the standard deviation in the SOGS score (R2 = .13). **Conclusions:** The results show that the SOGS is a reliable instrument for evaluating gambling addiction. However, the meta-analysis highlights the need to report the reliability values for each empirical study and to provide a set of recommendations for researchers and professionals who use this instrument.

Keywords: SOGS; gambling addiction; meta-analysis; reliability; validation study.

Resumen

Meta-análisis de Generalización de la Fiabilidad del South Oaks Gambling Screen (SOGS). **Antecedentes:** el South Oaks Gambling Screen (SOGS) es uno de los instrumentos de screening más utilizados para los problemas de adicción al juego. **Método:** el objetivo de esta investigación es analizar si el SOGS es un instrumento fiable y qué características de los estudios tienen efectos en su fiabilidad. **Resultados:** se llevó a cabo un meta-análisis con 63 estudios incluyendo 65 muestras independientes. El valor medio de a fue .86 (95% CI .84□.88), con una elevada heterogeneidad (I2 = 98.27%). Las variables que explicaron más heterogeneidad fueron el continente en que se desarrolló el estudio (R2 = .61), la aplicación en participantes con o sin problemas clínicos (R2 = .58), la forma de administración del cuestionario (R2 = .56) y la desviación estándar en la puntuación del SOGS (R2 = .13). **Conclusiones:** los resultados muestran que el SOGS es un instrumento fiable para evaluar los problemas de adicción al juego. Por otro lado, el meta-análisis recalca la necesidad de reportar los valores de fiabilidad en cada investigación empírica que se realice, y proporciona una serie de recomendaciones para investigadores y profesionales que utilicen este instrumento.

Palabras clave: SOGS; adicción al juego; meta-análisis; fiabilidad; estudio de validación.

Gambling addiction is a maladaptive and persistent pattern of gambling that can generate lasting clinical problems (Rash et al., 2016). Its importance is such that it was the first addictive behavior recognized by the Diagnostic and Statistical Manual of Mental Disorders 5th Ed. (DSM-5; American Psychiatric Association [APA], 2013) that is not related to the consumption of certain substances (Mann et al., 2016).

In a study with more than 3500 participants on the prevalence of this problem in the USA, it was found that 60% of the sample had gambled in the last year, with 1.4% classified as individuals meeting criteria for gambling disorder (Massati et al., 2016). In Canada, 1.8% of a sample of 2,187 over-55s were found to be individuals meeting criteria for gambling disorder, with 25.7% being individuals who played regularly in the last year (van der Maas et al., 2018). In Europe, the prevalence of this problem was analyzed in a sample of 6,816 Spanish adults (Chóliz et al., 2019). This study found that more than 70% of participants had gambled at some point; 7.36% of them fitted the criteria for a diagnosis of pathological gambling.

Winters and Derevensky (2019) carried out a systematic review that included different studies on the prevalence of pathological gambling. Among other data they found that 4.4% of a total of 7,756 participants in England met the criteria for this disorder. On the other hand, of 659 Spanish participants who engaged in sports betting, 19% were identified as having pathological gambling problems, in addition to 16% with a moderate risk of these problems.

The South Oaks Gambling Screen (SOGS; Lesieur & Blume, 1987) is an instrument developed for the evaluation of gambling addiction. It consists of 20 items (mostly dichotomous) and includes 3 previous items that do not count towards the total score and are used to assess the type of gambling or betting, the maximum amount wagered, and whether they are close to other people with gambling

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problems. The total score ranges from 0 to 20, and a score higher than 5 is indicative of problems with gambling. In the original version, all the items evaluate gambling addiction throughout a person's life. In its original validation (Lesieur & Blume, 1987) the scale showed good internal consistency (Cronbach's α = .97) and test-retest reliability (r = .71). It also showed good convergent validity (r = .94) with the criteria for gambling addiction in the *Diagnostic and Statistical Manual of Mental Disorders* 3rd Ed. Revised (DSM–III-R; APA, 1987) and in the Diagnostic and Statistical Manual of Mental Disorders 4th Ed. (DSM–IV; APA, 1994) and DSM-5 (APA, 2013; Goodie et al., 2013).

These good psychometric properties helped the SOGS become the main screening instrument for gambling addiction. Due to its importance, the South Oaks Gambling Screen – Revised for Adolescents (SOGS-RA; Winters et al., 1993) has been elaborated for use in adolescents, and has been adapted and validated in many countries, including Spain (Echeburúa et al., 1994) and Brazil (Oliveira et al., 2002).

Today, the SOGS is one of the most widely used instruments for assessing gambling addiction. However, despite its frequent use, no study has been carried out to establish its average reliability, across multiple application studies, and some studies report low reliability values (Bierbrodt et al., 2018; Stinchfield, 2002). Reliability generalization meta-analyses are used to statistically integrate the reliability estimates calculated in different applications of an instrument. In addition, these studies provide information on how the different characteristics of the samples affect variation in the reliability indices of an instrument (Badenes-Ribera et al., 2020). After a previous search, no examples of this type of meta-analysis have been found for the SOGS in the Cochrane, Medline, Psycinfo, Scopus, or Web of Science (WoS) databases.

The objective of this research was to perform a reliability generalization meta-analysis to estimate the internal consistency of the SOGS and to analyze some possible factors that may affect it. A secondary objective was to assess if its reliability is affected by year of application (by collecting information on the years of publication of the articles and the years of data collection), the mean score (and standard deviation) on the SOGS, the mean age (and standard deviation) of the sample, the percentage of women, the continent in which it was applied, the form of application (face-to-face or otherwise), and the condition of the sample (depending on whether it was a clinical or non-clinical sample), as moderators of the consistency of the scale.

It was hypothesized that the SOGS would continue to be an instrument with good internal consistency reliability.

Method

Participants

After not locating any similar systematic reviews or meta-analyses to the one that we planned, we searched the Medline, Psycinfo, Scopus, and WoS databases. As a search formula, all articles that cited the original article introducing the SOGS (Lesieur & Blume, 1987) were included. This method instead of using a search equation has previously been applied in other reliability generalization meta-analyzes (Guillén-Riquelme, & Buela-Casal); all the investigations that apply a questionnaire must cite it, so this system will allow to find all the articles where it is applied. Finally, a complementary search was carried out in Google Scholar to include "gray" literature and avoid being over-influenced by publication bias. The search was carried out in May 2019 and the results were not limited by year of publication, in order to analyze whether this influenced the reliability of the instrument. Later, we updated the search in January 2021 to include all documents published between June 2019 and January 2021.

Once duplicate articles were eliminated if they were in more than one of the databases, 2103 articles were obtained for analysis. After this, an attempt was made to locate the full text of all of them, leading to 114 articles (5.42%) being discarded as their full text could not be accessed.

A screening of the 1989 selected articles was carried out in accordance with a set of inclusion and exclusion criteria. On the one hand, we included those studies that complied with the following inclusion criteria:

a) Experimental, quasi-experimental or prevalence studies.
b) Written in English or Spanish.
c) Studies in which the SOGS was applied in its original English version without modifications.
d) The research participants were older than 18 years.
e) The articles reported the reliability of the instrument in their samples using Cronbach's α or another indicator.
f) The sample size was indicated.

On the other hand, we discarded those studies that met at least one of the exclusion criteria:

a) Studies that were not experimental, quasi-experimental, or prevalence.
b) Written in languages other than English or Spanish.
c) Studies in which a modified version of the SOGS was applied.
d) The sample included people under 18 years of age.
e) The articles did not report the reliability of the instrument or reported values from previous research instead of their own.
f) Research that treated the SOGS as a bifactorial instrument and reported two reliability values.
g) The sample size was not indicated.
h) Those articles that used a duplicate sample with other articles were eliminated. In these cases, only the oldest article was selected, and the rest were discarded.

In longitudinal studies or those that included more than one measurement carried out on the same subjects, the first study was selected. Conversely, studies that presented several independent samples reporting reliability values, and the N of each of these, were coded as independent samples (an equal number as were presented), with several studies contributing two or more samples to the meta-analysis.

Instruments

The reliability index used was Cronbach's α in every case, since no articles were found that presented an index other than this one. In order to carry out a meta-analysis, it is important that the reliability scores (the α value in this case) follow a normal distribution (Sánchez-Meca & López-Pina, 2008). To achieve this, the values of α were transformed into T values with the

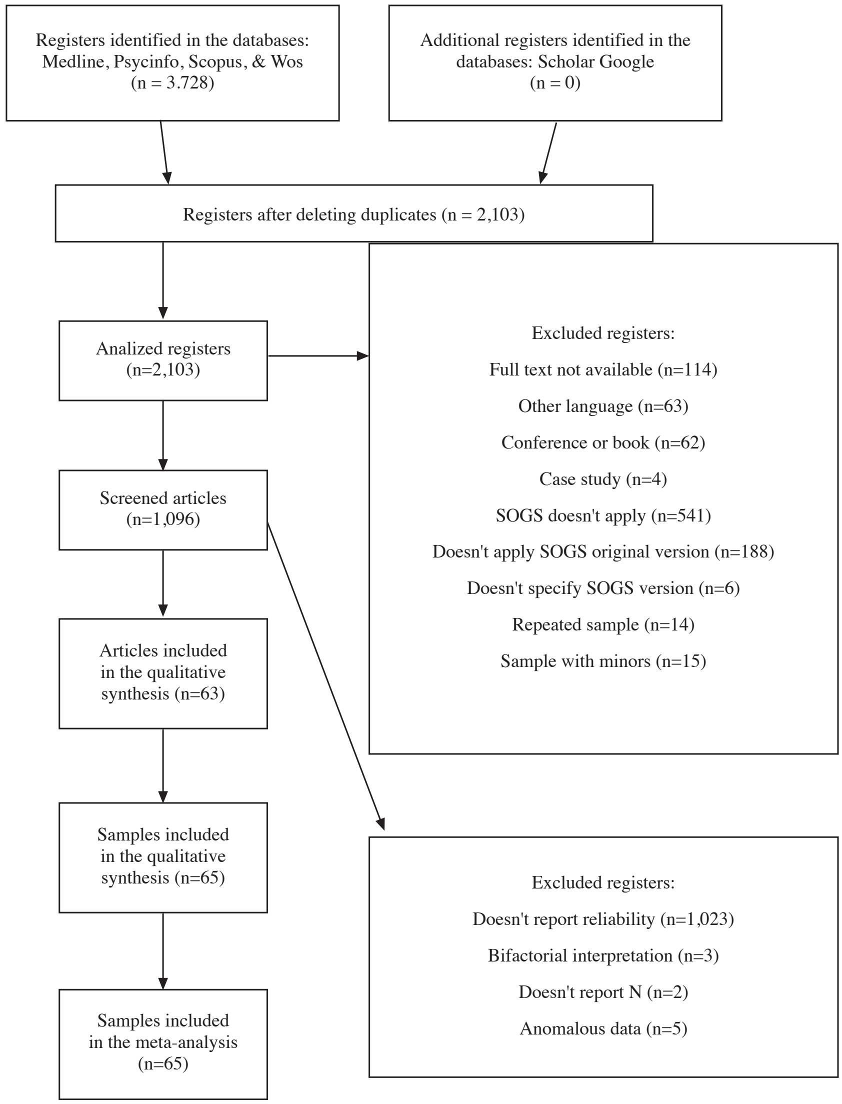

Figure 1. Flowchart of the selection and screening process of the articles for the meta-analysis

formula $T = (1- \alpha)/3$ (where α represented the reliability index of each sample), as has been done in other reliability generalization meta-analyzes (e.g., Guillén-Riquelme & Buela-Casal, 2014). The scores obtained were weighted by the inverse of the variance of the studies to obtain the mean size of the *T* scores. After this process, the *T* scores were converted back to α values to facilitate the interpretation of the results.

Procedure

This reliability generalization meta-analysis was carried out in accordance with the recommendations of the PRISMA guide for systematic reviews and meta-analyses (Moher et al., 2009; Urrutia & Bonfill, 2010). Indications have also been taken from the guide for the performance and reporting of reliability generalization meta-analyses (REGEMA; Sánchez-Meca et al., 2021).

The Cronbach's α index (or indices in those cases with multiple samples) was extracted from all the selected studies. Additionally, in the selected studies, a set of variables were coded, in order to subsequently analyze their effect on the homogeneity of the reliability coefficients. The coded variables were:

a) Year of publication of the article.
b) Year in which the sampling of participants was completed.
c) Continent in which the SOGS was applied.
d) The form of application of the test, depending on whether it was completed face-to-face or not.
e) Condition of the sample, taking into account whether it belonged to a clinical or non-clinical population.
f) Gender balance of participants, as indicated by the percentage of women in the sample.
g) Mean age (and standard deviation) of the sample.
h) The mean SOGS score (and standard deviation) obtained by participants in the test.

Two researchers took part in the process of study selection; in cases in which discrepancies were found, they reached consensus about their final decision. Two research assistants reviewed 50%

of the selected articles, obtaining an inter-rater reliability of 87.6% using Cohen's kappa index.

Data analysis

A random effects statistical model was used to calculate the mean value of α utilizing the restricted maximum likelihood estimation (REML) method, and a 95% confidence interval was calculated for this value using the method proposed by Hartung and Knapp (2001). To estimate the influence of the moderating variables and the variance between studies, a mixed-effects model was evaluated using the REML. To calculate the mean value of α and the statistical significance of each moderator, the improved method developed by Knapp and Hartung (2003) was used following the recommendations of previous research (Rubio-Aparicio et al., 2019; Rubio-Aparicio et al., 2020; Sánchez-Meca & Marín-Martínez, 2008).

Publication bias was assessed using the Egger test, and inter-rater reliability using Cohen's kappa index. For analysis of the homogeneity of the reliability coefficients, the Cochrane Q statistic was used, complemented with the I^2 index, since this corrects some of the problems with the Q statistic and allows comparing the homogeneity of the reliability coefficients with that of other similar studies that could be performed using the SOGS in future.

To check the sources of variability, each moderating variable was analyzed in isolation. For continuous variables, a series of simple linear meta-regressions were performed using α as the dependent variable, while for categorical variables, a series of weighted ANOVAS were performed. For all the analyses performed, version 2.1-0 of the Metafor package was used within the R statistical environment (Viechtbauer, 2010).

Results

Reliability induction rate

Figure 1 shows how after eliminating duplicate articles and passing the initial screening criteria, a total of 1096 articles were selected. Of these, 1023 were excluded for not reporting reliability, representing 93.3% of the articles that had passed the first screening. The exclusion criterion removed two types of studies: on the one hand, those that did not indicate any reliability value for the SOGS; and on the other, those that instead of providing the reliability value corresponding to the study sample, indicated a value obtained in previous research.

Reliability generalization meta-analysis

The total number of participants collected in the meta-analysis across the 65 selected samples was 26,743. The first analysis performed was an Egger test to detect the presence of a possible selection bias. The test results gave no evidence of of such a bias, $t(63) = -0.16$, $p = .88$. The mean α value for the 65 samples from the meta-analysis was .86 (95% CI: .84–.88). Figure 2 shows the transformed α value for each of the samples analyzed, as well as their 95% confidence intervals and sample sizes.

After this, a homogeneity analysis was performed to check the variability of α in the different samples. The results reflected significant heterogeneity across the total sample, $Q(64) = 3{,}064.31$, $p < .0001$). The I^2 index was calculated due to its potential for correcting some errors of the Q statistic. According to this index the proportion of the variability attributable to sample heterogeneity was 98.27%, (a value of 75% or over is considered high).

Given the heterogeneity of the studies, the next step was to carry out an analysis of the moderators in order to find out to what extent they affected the homogeneity of the reliability coefficients. In carrying out these analyses, the α values occupied the role of the dependent variable (DV), while the other variables coded from the studies were treated as independent variables (IVs).

First, a simple linear meta-regression was performed to analyze the association given between the different continuous IVs and the DV. Table 1 shows the results of these meta-regressions. The only significant predictor was the standard deviation in the score obtained in the SOGS ($Q(26) = 1.40$, $p < .05$), explaining 13.37% of the variance in the homogeneity of the α values, so that with higher standard deviation, there was greater heterogeneity.

To analyze the relationship of the categorical IVs to the DV, a series of weighted ANOVAS were performed. Table 2 shows the results, showing which of the IVs were significantly related to the alpha coefficients; weighted values of α were also collected for each level of the IVs.

All the analyzed categorical variables showed statistically significant results. In all cases, the proportion of the explained variance was significant and high, with the continent where data was collected, $Q(61) = 192.92$, $p < .0001$, being the variable that explained the highest percentage of the variance with 61.16%, followed by the clinical condition of the subjects, $Q(62) = 263.32$, $p < .0001$, with 57.99%, and the administration method, $Q(63) = 405.77$, $p < .0001$, with 55.92%.

Discussion

The purpose of a reliability generalization meta-analysis is to analyze the internal consistency values of an instrument in different samples with their own characteristics and to analyze the possible causes of the variations that occur in these (Sánchez-Meca & López-Pina, 2008; Guillén-Riquelme & Buela-Casal, 2014). In the case of the current study, it was possible to observe the mean α value of a total of 63 articles that included 65 independent samples, working with a total of 26,743 participants. The average obtained value implies a very good reliability, close to .9 that many authors consider to be excellent (Sánchez-Meca et al., 2016). These results indicate that the SOGS is a reliable instrument, which is probably one of the reasons why it continues to be such a widely used measure of gambling addiction.

One of the objectives of the meta-analysis was to analyze if the passing of time was affecting the scale's reliability. The results show that despite the SOGS being more than 30 years old, its reliability has not been affected, since neither the year of publication nor the year of data collection affected the homogeneity of the variance of reliability. These results are in line with the hypothesis of the study, and therefore it does not seem necessary to carry out a revision of the instrument or otherwise modify it, since it continues to show good reliability despite its age.

The high heterogeneity of the reliability values made it necessary to carry out an exhaustive analysis of the moderating variables that might be affecting reliability (Molina, 2018), although it is important to bear in mind that since this meta-analysis analyzed a large number of samples, the results would tend to be more heterogeneous.

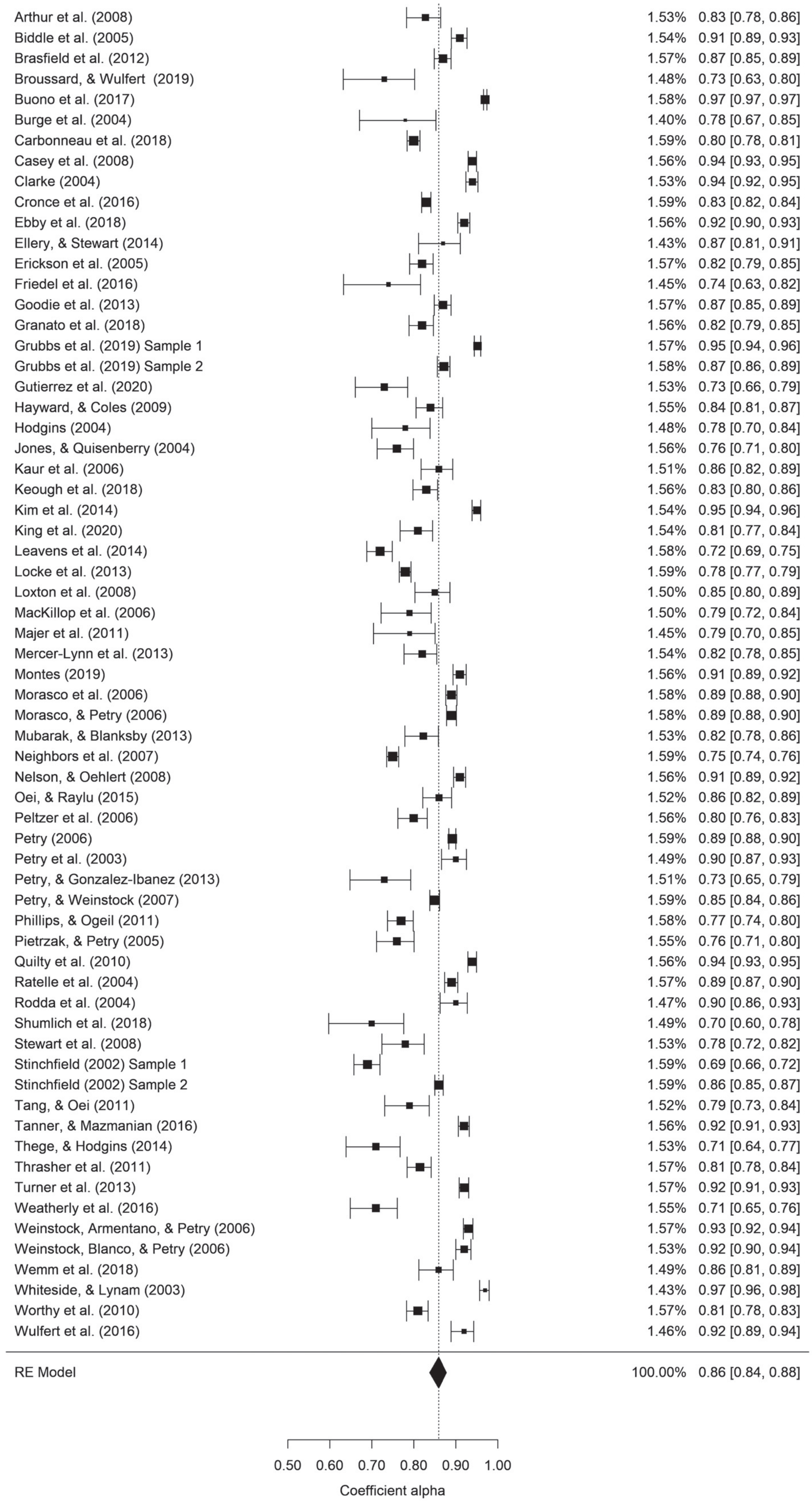

Figure 2. Forest plot with weighted α values

Table 1
Continuous moderating variables analysis

IV (k)	b	CI (95%)	Q_M	p	Q_E	R^2
Publication year (65)	-.01	-.03-.02	.30	.58	3,057.39***	0%
Sample year (23)	.02	-.02-.05	.84	.37	1,105.02***	0%
Score (mean) (29)	.01	-.02-.05	.25	.62	783***	0%
Score (SD) (28)	.14*	.01-.26	4.96	.03	677.81***	13.37%
Age (mean) (44)	.01	-.01-.02	1.40	.24	1,839.85***	1.35%
Age (SD) (42)	.03	-.004-.06	3.06	.09	1,775.72***	4.94%
Percentage women (51)	-.002	-.01-.005	.35	.56	2,419.86***	0%

* $p<.01$. *** $p<.0001$. *b*= regression coefficient of the moderating variable. Q_M= statistic to test the statistical significance of the moderating variable. Q_E= statistical to check if the model is well specified. R^2= proportion of the variance explained by the moderating variable

Table 2
Categorical moderating variables analysis

IV (k)	Levels VI (k)	α*	CI95%	p	Q_W	Q_B	R^2
Continent (65)	Africa (1)	.80	.76-.83	<.001	3,044.81***	192.92***	61.16%
	America (54)	.86	.83-.88	<.001			
	Asia (1)	.83	.78-.86	<.001			
	Oceania (9)	.87	.81-.90	<.001			
Administration method (65)	Face-to-face (50)	.85	.83-.87	<.001	2,896.03***	405.77***	55.92%
	Other (15)	.88	.83-.92	<.001			
Clinical condition (65)	Clinical (15)	.86	.80-.91	<.001	2,960.75***	263.32***	57.99%
	No clinical (47)	.86	.83-.88	<.001			
	Mixed (3)	.90	.64-.97	.02			

* The coefficients have been retransformed with the formula α=1-T3. ***$p<.001$. *k*= number of samples. Q_W= statistic to check if the model is well specified. Q_B= Statistic to test the statistical significance of the moderating variable. R^2= proportion of the variance explained by the moderating variable.

Firstly, in the analysis of the continuous moderators it was observed that only the standard deviation of the SOGS score affected the homogeneity in the α values. These results are supported by psychometric theory, according to which the variance in the scores obtained in a test increases its reliability (Sánchez-Meca et al., 2016).

Secondly, when analyzing the categorical moderators it is important to consider the number of samples collected for each level of the moderator, since samples with few studies will not be as representative as those with a higher number. Starting from this point, it was found that the continent in which the test is applied had a lot of weight on the heterogeneity of the reliability coefficients. Analyzing the mean α values obtained in the four continents in which the original version of the SOGS has been applied, it was observed that in North America (with studies from the USA and Canada) and Oceania (all studies carried out in Australia) scores were very similar. On the contrary, in Asia and Africa values were lower. These differences could be caused by the low number of studies in these last two continents, or by applying the original SOGS in different cultures instead of using culturally validated adaptations of the instrument (Lagunes, 2017).

The clinical condition of the participants also had an effect on the homogeneity of the studies. In this case, the mean value for the clinical and non-clinical conditions was the same, while for the mixed condition it was somewhat higher. As with the standard deviation of the SOGS scores, these results are in accordance with psychometric theory (Sánchez-Meca et al., 2016), since when including participants with and without clinical problems, the variability of the SOGS scores was higher, increasing the reliability of the scores.

Finally, the method of administering the SOGS instrument also had an effect on the heterogeneity of α values. Specifically, the average value for the online application of the instrument was slightly higher than for the face-to-face application.

This study tried to minimize the presence of biases that could alter the results. On the one hand, good inter-rater reliability was found. The Egger test indicated the absence of significant selection biases. Lastly, the inclusion of Google Scholar as one of the databases aimed at minimizing publication bias by including unpublished “gray” literature in the search (Molina, 2018).

In scientific research, authors frequently do not report the reliability that a certain instrument has shown in the analyzed sample, or they provide an index obtained previously in some previous study, having a conception of reliability as an intrinsic aspect of the test. This error is very frequent, and it is important to make researchers aware of the need always to report reliability results for the sample under analysis (Carvajal et al., 2011). The results obtained in the current study support this idea, since most of the articles that met the other inclusion criteria did not report a reliability value for the SOGS in their sample, with the consequent loss of information that this entails.

The main limitation of the present study is that it included only the original version of the SOGS (Lesieur & Blume, 1987). In future studies, it would be interesting to include other validated versions of the SOGS to analyze if there are any differences, and try to locate the studies that have been unreachable in this investigation. Similarly, it would be interesting to carry out research that analyzes other psychometric properties of the SOGS, such as its validity, specificity and sensitivity. Finally, another possible limitation of this research is not having used a search equation; in future research it could be used as a complement to the search strategy followed. It would also be interesting to carry out similar research on other instruments used to measure gambling addiction problems to compare the precision of different measurements.

Based on the results obtained in the current study, researchers or other professionals who apply the SOGS must take into account a set of points concerning reliability. The results show the importance of using a culturally validated version of the SOGS for particular countries to take cultural differences into account. On the other hand, despite being designed to be applied physically, the SOGS has proven to be reliable when applied in different ways (including online and over the telephone), so it can be used in research even when data collection is not carried out in person.

Finally, it is important to note that the recommended internal consistency value for application of a scale in the clinical setting is at least .90 (Charter, 2003): in the case of the SOGS, the mean value is close but does not quite reach this value. Based on these results, the use of the SOGS in the clinical setting would not be recommended, so it would be necessary to apply other such as the NORC DSM-IV Screen for Gambling Problems (NODS; Gerstein et al., 1999) that has been validated based on that criterion, or the Problem Gambling Severity Index (PGSI; Ferris, & Wynne, 2001). In the field of academic research, an internal consistency greater than .80 is recommended (Charter, 2003), so for these purposes the SOGS does not present reliability problems. In conclusion, the SOGS would be recommended only for research purposes, based on the internal consistency values obtained, to avoid precision problems in the measurements to be carried out. These findings are relevant for professionals in the clinical setting, since the SOGS is the most widely used instrument for evaluating gambling addiction problems and these results suggest precision problems in this setting.

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