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Factorial Structure and Invariance Analysis of the BIS–BAS Scale, IPIP-R Version

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Abstract

Gray's Reinforcement Sensitivity Theory is a neurobiological model developed to explain the regulation of behavior and emotions, using the BIS and BAS systems as motivational constructs based on variables of sensitivity to reinforcement, associated with the emergence of internalizing and externalizing psychopathologies. The objective was to analyze the factor structure, and invariance of the BIS–BAS IPIP-R translated into the Spanish language. A non-probabilistic sampling of 288 people between the ages of 18 and 45 from the city of Bogotá, Colombia (167 women and 121 men, average age of 28.92 ($SD = 7.53$) was carried out. Among the results, a two-dimensional structure was verified with correlated factors and residual covariances, once included when reviewing the modification rates and the favorable adjustment of the model. In the invariance analysis of the correlated two-dimensional model, when imposing progressive and sequential restrictions, differential values are presented, indicating that the factor loads are invariant in nested groups. In conclusion, evidence of the two correlated dimensions that support Gray's theory of activation and inhibition systems independent of sex and age was obtained.

Keywords Behavioral activation · Behavioral inhibition · Reinforcement sensitivity · Factor analysis · Invariance

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Introduction

The theory of reinforcement sensitivity (TSR) (Gray 1970, 1981), is a neurobiological model developed to explain the regulation of behavior and emotions. It consists of three systems: (1) behavioral activation system (BAS) controls the motivation and generates an approach to appetitive stimuli—reward—and pleasant emotions, (2) the behavioral inhibition system (BIS) related to the mechanisms conditioned to the punishment and omission of the reward, (3) system of struggle, flight and freezing (FSSS) is a sensitive and mediating mechanism of aversive, conditioned, and unconditioned stimuli (Gray and McNaughton 2000; Martínez et al. 2012).

The BIS and BAS system, as motivational constructs based on reinforcement sensitivity variables, has allowed the development of research on the emergence of internalizing and externalizing spectrum psychopathologies (Johnson et al. 2014; Kubak and Salekin 2009). The approach and avoidance are constituted as explanatory mechanisms of the appearance of the different psychopathologies, in a single psychopathological factor defined as Eysenck's arousal/arousability, also recognized as a second-order factor as neuroticism (Corr 2008). These general higher-order dimensions suppose an underlying neurobiological framework of mental illness such as anxiety disorders, depression, and psychopathy (Wallace and Newman 2008; Zinbarg and Yoon 2008).

Evidence in this regard has been reported for emotional problems such as anxiety and impulsivity (Gray 1987; Torrubia et al. 2001), particularly, the BAS has shown predictive capacity for behaviors associated with perfectionist standards, while the BIS for perfectionist self-assessments (Mautz et al. 2017). In cases of comorbid pathological narcissism with substance abuse and poor self-control, it has been reported that they are predictable if there is a high BAS and a low BIS. However, the evidence is currently not clear yet (Mowlaie et al. 2016), it seems, these difficulties are due to differences in sex, at least in violent and criminal behaviors (Gray and Snowden 2016).

In turn, BIS, together with isolation and impulsivity, has been significant predictors of addictive behavior, especially in men (Li et al. 2016), while BAS has been identified a statistically significant association with ADHD in the dimension of impulsivity that would be moderated by age. However, it is not related to the borderline and antisocial symptoms of personality (Brooker et al. 2017).

The evidence in favor of this construct, related to psychopathologies, is broad. However, it is necessary to research the way they have been evaluated, about the possible differences manifested in their applicability in the different disorders.

Measurement of BIS and BAS Dimensions

In the initial stages of the measurement of this model, the Eysenck Personality Inventory analyzes in the extraversion and impulsivity subscales, reported equivalences with the BAS, while neuroticism with the BIS (Gray et al. 1975). Later, with the development of the Questionnaire of Sensitivity to Punishment and Sensitivity to Reward (CSCSR), it was reported that BIS (sensitivity to punishment) was

associated with neuroticism and negatively with extraversion. Also, they presented high associations with trait anxiety (STAI-Trait de Spielberger), while the BAS correlated with the dimension of extraversion, neuroticism, and impulsivity, and moderately with psychoticism (Torrubia et al. 2001).

Another measure of this model appears in the development of the BIS/BAS scale that is composed of a subscale for the search of emotions or sensations (BAS-B), one for persistent motivation (BAS-M), and one for responsiveness and reinforcing anticipation (BAS-R) (Carver and White 1994). It is a test consisting of seven reagents for the BIS, and thirteen for the BAS, divided into four for the search for emotions, five for Responsivity, and four more for motivation. In adapting this scale with a Mexican sample, the authors reported through exploratory factor analysis that the items coincided with the four original subscales, demonstrating favorable indicators of the predictive validity of the test (Pulido et al. 2016).

The Instrument of the Present Study

The BIS–BAS IPIP-R Personality Questionnaire (Goldberg 1999) was psychometrically reviewed with a sample of 417 Argentine participants between the ages of 16 and 55 (Martínez et al. 2012). This instrument contains 16 Items with five response options, obtained a satisfactory two-factor solution (39.81% of the total variance explained by orthogonal solution varimax type), presented a high correlation with the CSCSR and Cronbach alpha internal consistency indexes of .77 in each of the subscales. Regarding the test structure, it has been suggested that this construct should be two-dimensional, given that there is not enough evidence of the BAS subdimensions as a general activation factor, while the BIS has not reported a factor other than one-dimensional (Maack and Ebesutani 2018). However, factor structures with four factors, and a higher-order behavioral activation system have been reported (Campbell-Sills et al. 2004).

In Mexico, the two-factor structure of EBIS/EBAS was verified (Carver and White 1994). However, it obtained a low internal consistency ($\alpha = .72$) and an explained variance of 23.3%, forced to two factors, with a correlation between the same of $r = .18$, values that indicated weaknesses in the validity of the EBIS/BAS construct (Barranco-Jiménez et al. 2009). With these reports, the two-dimensional version of the BIS–BAS IPIP-R would have more significant empirical support derived from other studies on this construct, such as EBIS/EBAS, that demonstrated a structure with additional factors.

Despite the above limitations, in the analysis of the instrument according to the TSR, it can be summarized in three different factorial models: (a) a one-dimensional model assuming a single dimension of reinforcement sensitivity (TSR) (Gray 1970); (b) two-dimensional model with uncorrelated factors, in two orthogonal components, the BIS (Neuroticism) and the BAS (Extraversion and impulsivity) (Eysenck and Eysenck 1975); and (c) two-dimensional oblique BIS and BAS model with correlated factors (Carver and White 1994; Martínez et al. 2012; Torrubia et al. 2001). It is assumed that based on the limitations of Mexican work (Barranco-Jiménez et al. 2009), the BIS–BAS IPIP-R version would present a factorial structure with better

adjustment indicators and much more favorable reliability indices for the population of the present study.

Differences by Sex and Age in BIS/BAS Dimensions

Evidence has been reported that questions the few variations in psychopathy between men and women, an aspect that would favor the scores in the BAS dimension of the instrument, however, in internalizing scores in favor of women could be related to the BIS dimension and the psychopathy (Falkenbach et al. 2017). In sex, therefore, it can be hypothesized that the structure of the test varies in the BIS/BAS measures, given that there are reports of differences in a larger BIS obtained with samples of adolescent women (Brooker et al. 2017). In other reports, on the other hand, men seem to respond differentially higher on the scale of response to the rewards of the BAS dimension (Torrubia et al. 2001).

Other differences could be associated with the variations of age (Brooker et al. 2017), it has been documented in the analysis of BIS and BAS measures in ages grouped according to children, adolescents, young adults and adults over 45 years, that the scores are higher at the earliest ages. However, the conclusions in this regard remain questionable and attributed to the relationship between the construct and the personality (Pagliaccio et al. 2016).

The BIS/BAS IPIP-R scale analysis with a Colombian sample would provide an empirical approximation of the psychometric properties with these reference populations. Although this context does not represent the Latin American idiosyncrasy, it can serve as a starting point for new research on the construct of behavioral activation and inhibition, providing an alternative instrument for this structural measure of personality and the development of new directions of research in the Colombian context, with possibilities of generalization for the rest of Latin America. The present study aimed to analyze the factor structure and invariance, taking into account the above, according to the sex and age of the BIS–BAS IPIP-R translated into the Spanish language, in a Colombian sample.

Method

Participants

A non-probabilistic sampling was carried out because of incidental convenience, which was used to select participants according to their accessibility or availability. The inclusion criteria included having an active and voluntary participation in the development of the study, while excluding those individuals who presented serious medical alterations, acute psychiatric illnesses, or were under the influence of psychoactive substances at the time of answering the psychometric instruments. Thus, with a population of 48.2 million Colombians according to reports for 2017 (n suggested = 267, a confidence interval of 95% and 6% margin of error), a final sample of 288 persons was obtained between 18 and 45 years old, in the city of Bogotá,

Colombia. 58% were female ($n=167$) and 42% were male ($n=121$); primarily single (60.8%, $n=175$); with primary (18.1%, $n=52$), intermediate (18.8%, $n=54$), and higher (59.4%, $n=171$) education levels; and an average age of 28.92 years ($SD=7.53$; ranging between 18 and 45).

The sample was divided into two groups according to each participant's age and sex with the aim of carrying out an invariance analysis. The distribution for males ($n=121$) showed that most were single (60.3%, $n=73$) and married (15.7%, $n=19$), with a higher educational level (59.5%, $n=72$) and an average age of 29.17 ($SD=7.57$). The distribution for females ($n=167$) showed that most were single (61.1%, $n=102$), with a higher educational level (59.3%, $n=99$) and an average age of 28.74 ($SD=7.27$). The age distribution corresponded to under 25 years old ($n=118$), single (85.6%, $n=101$), with a higher educational level (58.5%, $n=69$) and an average age of 22.18 years ($SD=2.15$) and over 25 years old ($n=170$), single (43.5%, $n=74$), married (23.5%, $n=40$), and divorced (25.3%, $n=43$), with a higher educational level (60%, $n=102$ people) and an average age of 33.61 ($SD=5.97$).

Instruments

BIS/BAS Scale IPIP-R Version (Martínez et al. 2012*)* It is a scale adapted to the Spanish language with an Argentine population, developed to consolidate a personality measure that allows differentiating between the BIS and the BAS. It includes 16 items that allow two BIS/BAS dimensions to be evaluated (items 1 through 8 make up the subscale of the BAS, and items 9 through 16 the subscale of the BIS). Each item describes typical behaviors of people, which are evaluated through a scale of five response options, which acquires values 1="strongly disagree", 2="somewhat disagree", 3="neither agree nor disagree", 4="somewhat agree" and 5="strongly agree". This instrument showed favorable reliability according to Cronbach's alpha indexes $\alpha=.74$ in the BIS dimension and $\alpha=.86$ in the BAS. The convergent validity of this test was favorable given that the authors indicated a correlation $r=.34$ of the BAS IPIP-R with the EBAS-P (impulsivity), a $r=.57$ with the EBAS-Search for pleasure, and a $r=.20$ with EBAS-SR (reward sensitivity), with EBIS a $r=.45$. With the sample of the present study, an $\alpha=.90$ was obtained in the BIS dimension, an $\alpha=.89$ in the BAS, and an $\alpha=.86$ in the total scale.

Procedure

In the data collection, all the people agreed to participate voluntarily in the investigation and signed the informed consent, then proceeded to respond to the items of the self-applied instrument, the researcher was meanwhile available to answer questions. Finally, the answers in the database were tabulated, and the documents passed to reserved custody.

Confirmatory Factor Analysis Data analysis was carried out using the R-Proyect lavaan software package 0.6–3 (Rosseel 2012). The maximum likelihood estimation method was used, which allows comparing adjustment indices of several factorial models. In this case, a two-dimensional model with uncorrelated factors, BIS/

Neuroticism, BAS (Extraversion and impulsivity) (Eysenck and Eysenck 1975), a two-dimensional model with correlated factors (Carver and White 1994; Martínez et al. 2012; Torrubia et al. 2001), and a two-dimensional model with correlated factors and residual covariances (Carver and White 1994; Martínez et al. 2012; Torrubia et al. 2001) and thus, select the superior model (Thompson 2004); Likewise, the modeling indicators with structural equations (Structural Equation Modeling, SEM) were used. These procedures allow the evaluation of theoretical models by defining whether the structure of the data conforms to the previous assumptions (Kahn 2006). The Satorra–Bentler's Chi square approximation of goodness-of-fit (S–B χ^2) statistics was calculated to determine the fit of each confirmatory factor model, in addition to the Comparative Fit Index (CFI) and the Tucker Lewis Index (TLI) with values expected higher than .90 as favorable adjustment rates. It was also reviewed that root mean square error approximation (RMSEA), its robust version (R-RMSEA), and its 90% confidence interval (90% CI), with lower expected values to .08 (Hu and Bentler 1999). The Akaike's information criterion (AIC) and the Bayesian information criterion (BIC) were used as one of the recommended methods to select among several alternatives the best-confirmed model (Li-Chung et al. 2017).

Invariance Analysis Based on the results obtained in the AFC, we proceeded with the analysis of the factor invariance of the best model obtained for the male, female, minor, and over 25 years old groups. It began with the analysis of the configurational invariance, verifying that the number of factors and the pattern of the factor loads is equivalent in the groups. Subsequently, the analysis of metric, structural, and strict invariance was continued in order to establish the level of similarity between the groups in terms of measurement and structure parameters (Byrne 2008) reviewing the variations $\Delta S\text{–}B\ \chi^2$, among the factor models for each sample. In this regard, Cheung and Rensvold (2002) recommend that the variations in the *CFI* between the comparative models have a cut-off point $\Delta CFI = \leq 0.01$ and $\Delta RMSEA \leq 0.015$, to accept the invariance between the analyzed groups (Chen 2007).

Ethical Considerations The well-being and rights of the participants were guaranteed, by the guidelines stipulated in the Declaration of Helsinki (Asociación Médica Mundial (WMA) 2017), and each participant was provided with an informed consent document in which it was explicitly stated the handling of personal data specifically for research purposes, affirming the confidentiality and professional management of the data provided and the results obtained from the study.

Results

In the evaluation of the normality of the data set, according to the Mardia Coefficient ($CM = 47.68$), since the cut-off point ($z = 1.96$) was greater than 3, it was assumed that the set of variables presented multivariate abnormality (Yuan et al. 2002). The analyzes were carried out considering for the AFC the scaled comparative values of Satorra–Bentler (S–B χ^2), recommended for non-normal distributions (Satorra and Bentler 2010), and variables composed of scales of five or more options of response as continuous variables (Rhemtulla et al. 2012).

Confirmatory Factorial Analysis of the BIS–BAS, IPIP-R Version

The adjustment indicators of each proposed model were used, taking into account the standardized error approximation values combined with RMSEA and SRMR are recommended to avoid rejecting models that indicate a good fit (Hu and Bentler 1999). Table 1 shows the goodness of fit indices obtained for each model evaluated. It can be observed that the one-dimensional model was the one that showed the worst indicators of adjustment of all the models. Also, it was found that the bifactorial models, in general, presented favorable adjustments, unlike the first.

Following the Akaike criteria (AIC) as an indicator of the best statistical model obtained from the data organized according to the goodness of fit and its Bayesian probabilistic version—Bayesian information criterion (BIC)—(Yang 2003), the two-dimensional model with correlated factors and residual covariances (Carver and White 1994; Martínez et al. 2012; Torrubia et al. 2001) presented the lowest values and can be assumed as indicators of a better-resulting model, once the residual covariances derived from the revision of the Modification rates were included (i2 and i8, i3 and i4, i6 and i7, i6 and i8, i7 and i8, i10 and i11, i10 and i14, i13 and i14) and the changes in the correlated model.

Invariance of the BIS–BAS IPIP-R Version, According to Sex and Age

Once the model with the best adjustment indicators was chosen, the adjustment of the test was reviewed by each of the nested groups of participants (male and female, older and younger than 25 years old), using the two-dimensional model correlated with residual covariances verified, imposing progressive and sequential restrictions. Firstly, the *S–B* χ^2 values with a significance of $p < .05$, .01 and .001 obtained for the groups reviewed, indicated a non-acceptance of the models, however, this indicator has been questioned given its sensitivity to the sample size, which can lead to rejecting parsimonious and theoretically acceptable models (Hu and Bentler 1999). The other values obtained (*R-CFI*, *R-TLI*, *R-RMSEA*, and *SRMR*) in Table 2 appear optimal adjustments in the factor loads for the models of each sex and age, although in those over 25 years *R-TLI* values = 0.898, *R-CFI* = 0.919, and *R-RMSEA* = 0.080, suggest a barely favorable adjustment compared to the other groups.

In the indicators of configurational invariance, it is observed that the model adjustments were adequate for the nested groups formed by the sexes (*R-CFI* = 0.981, *R-RMSEA* = 0.053 (90% CI = 0.025–0.057), and the ages (*R-CFI* = 0.953, *R-RMSEA* = 0.065 (90% CI = 0.049–0.080). Which means that the models with no restrictions on factor loads, intercepts and covariances were equivalent, once the restriction on factor loads was imposed, in the metric invariance test, differences less than $\Delta CFI \leq 0.01$ and $\Delta RMSEA \leq 0.015$ were obtained, values that indicated that the factor loads are invariant between the groups. The following restriction imposed was on the intercepts to identify scalar (strong) invariance, the values indicated that the nested groups were invariant; the response and structure profiles are similar between the groups. Then a final restriction on structural residual

Table 1 Goodness-of-fit indices for the models assessed (n = 288). *Source*: Created by the authors

Model	χ^{2a}	*S–B* χ^2	*df*	*CFI*	*TLI*	*RMSEA (90% CI)*	*SRMR*	*AIC*	*BIC*
One-dimensional model–reinforcement sensitivity (TSR) (Gray 1970)	145.6179***	1.285.786***	104	0.446	0.360	0.211 (0.201–0.222)	0.229	14.546.981	14.722.804
Two-dimensional model with uncorrelated factors–BIS (neuroticism) and BAS (extraversion and impulsivity) (Eysenck and Eysenck 1975)	38.2076***	320.099***	104	0.893	0.887	0.093 (0.081–0.104)	0.079	13.472.879	13.648.701
Two-dimensional model with correlated factors (Carver and White 1994; Martínez et al. 2012; Torrubia et al. 2001)	379.973***	318.748***	103	0.893	0.876	0.093 (0.082–0.105)	0.067	13.472.775	13.652.261
Two-dimensional model with correlated factors and residual covariances (Carver and White 1994; Martínez et al. 2012; Torrubia et al. 2001)	203.148***	168.574***	95	0.963	0.954	0.057 (0.043–0.071)	0.057	13.311.951	13.520.740

χ^2, Chi square approximation of goodness of fit; *S–B* χ^2, Satorra–Bentler's Chi square approximation of goodness of fit; *df*, degrees of freedom; CFI, Comparative Fit Index; TLI, Tucker Lewis Index; RMSEA, root mean square error approximation; 90% CI, confidence interval; SRMR, standardized root mean square; AIC, Akaike's information criterion; BIC, Bayesian information criterion

***$p < 0.001$

Table 2 Invariance model fit parameters of the BIS–BAS IPIP-R across groups. *Source*: Created by the authors

Groups and invariances	χ^{2a}	*S–B* χ^2	*df*	*R-TLI*	*R-CFI*	*R-RMSEA (90% CI)*	*SRMR*	*ΔS–B* χ^2	*ΔCFI*	*ΔR-RMSEA*
Female	155.375*	126.966*	95	0.962	0.970	0.050 (0.023–0.071)	0.066			
Male	139.074**	128.956*	94	0.956	0.965	0.056 (0.028–0.080)	0.061			
Configurational invariance	280.792***	242.512**	188	0.976	0.981	0.053 (0.025–0.057)	0.064	–	–	–
Metric invariance	295.654***	258.387**	202	0.977	0.981	0.041 (0.024–0.055)	0.066	15.679	−0.002	−0.001
Escalar invariance	344.066***	307.955***	218	0.953	0.958	0.057 (0.41–0.071)	0.073	62.349	−0.009	0.005
Strict invariance	372.867***	337.174***	234	0.951	0.952	0.058 (0.044–0.072)	0.074	30.256	−0.006	0.002
Under 25 years old	152.989***	133.369**	95	0.965	0.972	0.052 (0.029–0.072)	0.066			
Over 25 years old	186.815***	153.598***	95	0.898	0.919	0.080 (0.056–0.102)	0.069			
Configurational invariance	339.804***	287.559***	190	0.941	0.953	0.065 (0.049–0.080)	0.067	–	–	–
Metric invariance	347.639***	297.965***	204	0.948	0.955	0.061 (0.045–0.076)	0.070	8.127	0.002	−0.004
Escalar invariance	378.296***	331.889***	218	0.942	0.947	0.064 (0.50–0.078)	0.072	41.025	−0.008	0.003
Strict invariance	398.975***	353.335***	234	0.944	0.945	0.063 (0.049–0.076)	0.074	21.000	−0.002	−0.001

χ^2, Chi square approximation of goodness of fit; *S–B* χ^2, Satorra–Bentler's Chi square approximation of goodness of fit; *df*, degrees of freedom; R-TLI, Robust Tucker Lewis Index; R-CFI, Robust Comparative Fit Index; R-RMSEA, robust root mean square error approximation; IC90%, confidence interval; SRMR, standarized root mean square

*$p<0.05$; **$p<0.01$; ***$p<0.001$

was implemented to identify the strict invariance; the resulting values also indicated invariance, this evidenced that the differences between the groups of the items are only due to the differences between the latent factors.

Discussion

This study analyzes the factor structure of the BAS–IPIP-R BIS, and the invariance according to the female and male sex, and the age groups under 25 years of age, in a Colombian sample. According to the data obtained in the verification of the evaluated models, as well as the analysis of the test structure imposing sequential restrictions, it can be affirmed that the proposed objective was achieved.

The factor structure obtained was presented with the best adjustment indicators in a two-dimensional model with a final solution of 16 items in two correlated factors (Martínez et al. 2012), with residual covariances between items. This model composed of two subscales (BIS and BAS), theoretically adjusted to the Gray TSR (1970), and the revised reports of other instruments that have generated similar evidence of the correlated BIS and BAS dimensions (e.g. Carver and White 1994; Muris et al. 2005; Torrubia et al. 2001). These results do not support reports of a four-factor structure in adolescent and adult samples on the BIS/BAS scale (Cooper et al. 2007; Kingsbury et al. 2013; Pagliaccio et al. 2016), it seems that the components of the BIS–BAS IPIP-R better support the oblique two-dimensional version of the original construct.

The evidence obtained about the two correlated dimensions supports the activation and inhibition systems in Gray's theory independent of sex and age, associated with personality structures based on temperament and neuroticism; Evidence in this regard has been found in positive correlations between BIS and neuroticism, and negative correlations with extraversion, while BAS has presented inverse correlations to BIS (Muris et al. 2005).

Following the Eysenck model, the high scores in the BIS would be part of the introvert-neurotic end, low scores in the BIS correspond to the extraverts-stable. In turn, a high BAS would be related to impulsivity as part of an extraverted-neurotic profile, and a low BAS would be associated with stable-introverts (Gray 1994). These data justify from the origin of the TSR in which effects of neurophysiological systems on behavior in a conflict of inhibitory interaction are presumed mutual (Torrubia et al. 2001), an aspect that supports the high correlation obtained between the subscales of the test ($r = .77$, $p < .01$), and bases the oblique nature of the instrument.

Regarding the differences in the use of this scale, the results indicated that it is invariant for sexes and age categories. The structure of the test, according to comparisons between sexes and groups of children under 25 years of age, did not generate evidence of factor differences despite the restrictions imposed. However, it has been reported that BIS values increase with age by a margin between 20 and 25 years, with tendencies to present marked differences in women at this stage (Pagliaccio et al. 2016), in other studies have reported higher scores of women in the BIS only (Torrubia et al. 2008). However, these values do not differ significantly in the structure of this version of the TSR. It can be assumed that the measures to be

obtained with this instrument are invariant, at least in these groups according to ages and sexes.

Limitations and Recommendations

This study had some limitations to be solved in subsequent reviews. In the first place, the use of a cross-sectional research design does not allow monitoring the variations of the measures analyzed, the verification of the stability of the measure and the changes by age can be more precise using alternative methods complementary to the psychometric study such as latent class analysis and longitudinal follow-ups (Hickendorff et al. 2018).

Also, not having instruments that measure an adequate validity of convergent criteria was identified as a limitation of the study. The test should measure the elements derived from the initial model in which negative correlations between BIS-Extraversion, and positive between BAS-Intraversion and BAS-Neuroticism. Besides, to associations with measures of cerebral functioning at the septohippocampal and BIS levels, and BAS with the functioning of reward systems in the brain (Torrubia et al. 2008).

One of the questions made to the instruments derived from the TSR has been whether it constitutes a precise measure of personality. In this regard, the tendency of the BAS items to describe trends of positive traits has been discussed. In contrast, the BIS to negative traits, the fundamental limitation has been discussed around the predictive capacity of the specific items for the orientation to the reward in which the BIS reflects sensitivity to punishment rather than a tendency to the negative valence of the items for the Respondent (Pagliaccio et al. 2016), it can be affirmed that it is necessary to differentially analyze the content and valence of self-report items (Pettersson et al. 2011), an aspect that exceeds the objectives of the present study and invites further revisions of this instrument.

Among the clinical implications of this study are the psychotherapeutic possibilities offered by having a personality measure based on the BIS and BAS dimensions. A therapist can more accurately identify BAS activation systems in psychopathological profiles of patients with possible cluster B personality disorders, and BIS inhibition in cluster C disorders (Ross et al. 2013), in addition, to more accurately identify pathological risk profiles, such as in addictions with high BAS subscale scores, or phobias with high BIS scores (Omiya et al. 2015; Zinbarg and Yoon 2008), among other disorders associated with psychological dysfunction (Van Meter and Youngstrom 2015). Psychotherapeutic procedures can focus on decreasing BAS levels in cases of grandiosity narcissism and increasing BIS in vulnerability narcissism (Spencer et al. 2017), in addition to using mindfulness-based strategies and stress regulation (Harnett et al. 2016), with longitudinal follow-ups using the IPIP-R BIS–BAS scale periodically across different ages and sexes.

In conclusion, Gray's theory represents an explanatory model of aversive and appetitive motivation based on reinforcement, which has been associated with personality variables in two correlated dimensions, both based on activation and behavioral inhibition systems. An instrument such as the BIS–BAS IPIP-R is constituted

as a test with favorable indicators of construct validity, with two oblique factors invariant according to sex and age, recommended as a psychometric alternative with potential uses in the clinical psychological area.

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Compliance with ethical standards

Conflict of interest Ronald Toro, Juan García-García, and Flor Zaldívar-Basurto declare that they have no conflict of interest.

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