

Data Concerning the Psychometric Properties of the Behavioral Inhibition/Behavioral
Activation Scales for the Portuguese Population

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The authors do not have any interests that might be interpreted as influencing the research. The study was conducted according to APA ethical standards.

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Abstract

The BIS-BAS scales (Carver & White, 1994), which allow rating the Gray's motivational systems, were translated and adapted into Portuguese. In this study we present the procedure and the psychometric analyses of the Portuguese version of the scales, which included basic item and scales psychometric characteristics, as well as confirmatory and exploratory factor analyses. After the psychometric analyses provided evidence for the quality of the Portuguese version of the scales, the normative data was provided by age and school grade. Our Confirmatory Factor Analysis of the BIS/BAS scales did not demonstrate satisfactory fit for the two-factor, nor for the four-factor solution. We also tested the more recent five-factor model, but the fit indices remained inadequate. As fit indices were not satisfactory we proceeded with an Exploratory Factor Analysis in order to examine the structure of the Portuguese scales. These psychometric analyses provided evidence of a successful translation of the original scales. Therefore these scales can now be used in future research with Portuguese or Brazilian population.

Keywords: BIS/BAS scales, motivational systems, psychometric analysis

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Scales for the Portuguese Population

Gray (1981, 1987a, 1987b), after Fowles (1980), defined *personality traits* in terms of individual differences in the sensitivity/reactivity of two basic separate brain-motivational systems responsible for behavior: the aversive, i.e. *behavioral inhibition system*, BIS, and the appetitive, i.e. *behavioral activation system*, BAS. This model assumes the independence of the BIS and BAS systems from each other (Gray, 1991; Sutton & Davidson, 1997), and has been used to explain individual differences in various forms of psychopathology, including psychopathy (Fowles, 1980), bipolar disorders (Depue & Iacono, 1989), anxiety disorders (Gray & McNaughton, 2000), and depression (Harmon-Jones & Allen, 1997). After some attempts to develop assessment instruments for Gray's model of personality (e.g., Ball & Zuckerman, 1990; Wilson, Gray, & Barrett, 1990), Carver and White (1994) developed the *BIS/BAS* scales, which rely directly on the two motivational systems proposed by Gray. Specifically, these brief self-report scales are intended to measure the reactivity of the Inhibition and the Activation systems, and are responded in a 4-point Likert scales (see Method).

The BIS/BAS originally included just one subscale for individual differences in BIS functioning, and three subscales related to BAS functioning: Reward Responsiveness (RR), Drive (D), and Fun Seeking (FS). BIS items capture subjective distress associated with *bad* occurrences. Namely, some items (see Methods) appear to relate mainly to worrying or anxiety, while others are related to fear, referring to the breadth of fear concerns or to both fear and anxiety. Regarding BAS subscales, the RR comprises items taping excitement associated with attaining a reward, the D comprises items related to persistence in the pursuit of goals, and FS comprises items are intended to assess both a desire for new rewards and a tendency to

impulsively approach a potentially rewarding opportunity. Dividing BAS into three subscales is explained by the lack of a clear definition of how exactly BAS sensitivity is likely to be manifested (Carver & White, 1994).

Gray and McNaughton (2000) updated the Reinforcement Sensitivity Theory (RST), which inspired the BIS/BAS scales, highlighting the dissociation between anxiety and fear. In fact, an anxiety-related factor and a fear-related factor were distinguished within the existing BIS subscale (Corr & McNaughton, 2008). Heym, Ferguson, and Lawrence (2008) tested three competing structural models of the BIS scale: (a) a single BIS factor model; (b) a two-factor BIS model – BIS Fear and BIS Anxiety – with two BIS-Fear items, according to a previous work by Johnson, Turner, and Iwata (2003); and (c) the same two-factor BIS model with three BIS-Fear items. The results supported this last model and its advantage was confirmed in later studies (e.g., Beck, Smits, Claes, Vandereycken, & Bijttebier, 2009; Dissabandara, Loxton, Dias, Daglish, & Stadlin, 2012; Segarra, Poy, López, & Moltó, 2014). Thus, three items of the BIS subscale refer to fear and seem to load on a separate factor (Heym et al., 2008), whereas the remaining items of this subscale are instead related to anxiety (Smillie, Pickering, & Jackson, 2006), which is consistent with the updated RST.

Several studies investigated the psychometric properties and factorial structure of this instrument (e.g., Ross, Millis, Bonebright, & Bailley, 2002) in languages like German (Müller, Smits, Claes, & de Zwaan, 2013; Strobel, Beauducel, Debener, & Brocke, 2001) and Polish (Müller & Wytykowska, 2005). Translations are also known for French (Caci, Deschaux, & Baylé, 2007), Spanish (Segarra et al., 2014), Dutch (Franken, Muris, & Rassin, 2005; Yu, Branje, Keijsers, & Meeus, 2011), and Sinhalese (Dissabandara et al., 2012). Furthermore, the psychometric features of the BIS/BAS were estimated for a cross-cultural sample (Leone,

Perugini, Bagozzi, Pierro, & Mannetti, 2001), although with a 5-point Likert scale. Following the previous works, the main objective in this study was to test the structure of the BIS/BAS scales in Portuguese. It was expected to obtain a satisfactory fit for the Carver and White's four-factor solution (1994), as in similar studies (e.g., Heubeck, Wilkinson, & Cologen, 1998; Jorm et al., 1999; Leone et al., 2001; Ross et al., 2002).

Method

Participants

Nine hundred and sixteen individuals, 438 female, willing to fill the BIS/BAS scales online, were recruited from the Portuguese population with access to computers and Internet. Participants were recruited amongst university students, members of the Portuguese Society of Psychiatry and Psychology of Justice (SPPPJ), and also people attending to cultural and recreational institutions, as a means to cover a wider range of age and education. All participants were native and fluent Portuguese speakers, and knowledgeable of the culture. Their average age was 33.5 years ($SD = .41$) and 11.8 ($SD = 1.93$) years of schooling. After the local ethics committee approved the study, all participants completed the BIS/BAS scales voluntarily and anonymously, with no financial compensation involved. Besides BIS/BAS no other questionnaires were administered to the participants in this study. Our sample was stratified according to age and years of schooling (demographic distribution of the sample may be observed in table 3).

Instruments and Procedure

The original BIS/BAS scales contain 20 statements, answered on a 4-point Likert scale, ranging from 1 (*very true for me*) to 4 (*very false for me*), indicating the level of agreement. Cronbach's α for the BIS, BAS-RR, BAS-D, and BAS-FS scales in the original study ($N = 732$

college students) were .74, .73, .76, and .66, respectively (Carver & White, 1994). Factor analysis of the final set of BIS/BAS items in the original study used oblique rotation to permit correlations between the factors. The analysis yielded four factors with eigenvalues greater than 1, which together accounted for 49.0% of the overall variance. However, the four-factor structure proposed by Carver and White (1994) did not replicate in the study of Poythress et al. (2008). Instead, they found that a five-factor structure fits the BIS/BAS scales better. The three BAS subscales remained unaltered, but the BIS subscale seems to be supported by two factors, one comprising anxiety-related items (BIS-A), while the second one relates to fear (BIS-F).

Standards for Educational and Psychological Testing (AERA/APA/NCME, 1999) were used to guide the Portuguese translation and adaptation reported here. The first step was a parallel translation of the original version and its adaptation to the Portuguese context by the author and two independent researchers, who were familiar with the purpose of the scales, and the constructs being measured (AERA/APA/NCME, 1999).

The second step was to reach a consensus version, from the three initial translators and the assistance of a senior researcher with expertise in forensic psychology. The Portuguese version was tested in a pilot study, with six individuals with low/intermediate schooling (four to nine years of education), in order to examine the intelligibility of the items, instructions, and response scheme for the general population, and to test for the face validity of the translated version. Their debriefing allowed elucidating about the difficulties and the meaning that participants attributed to the items while answering them. Thus, the debriefing protocol contained questions focusing on the ability to understand the instructions, statements, and response alternatives. Participants' questions about the meaning of any statement and their comments or suggestions were considered in a following phase, in order to improve the scales.

Comments and suggestions of the pilot participants were taken into account in such a way that always ensured that the final pool of items meet the original requirements, and the response/scoring procedures were consistent with the purpose of the test (AERA/APA/NCME, 1999).

Finally, a native English speaker with a graduation in Psychology performed the back-translation of the Portuguese version, which was sent to and approved by Carver, the author of the original BIS/BAS scales.

Then, we defined the characteristics of the intended Portuguese sample of test takers and procedures for administration (AERA/APA/NCME, 1999). We decided to prepare the scales in Google Docs (2013, Google Inc., California, USA) and administer them via the Google Questionnaire Online Module (2013, Google Inc., California, USA). Participants were invited to fill the online scales through personal and dynamic emails that were sent to students of various Portuguese universities, as well as to members of the SPPPJ. Also computers were made available in three social and cultural establishments in which users with lower educational levels and/or higher age could fill the scales.

Results

Results concerning descriptive statistics for the Portuguese version are presented for each item of the BIS/BAS in Table 1.

[Table 1 about here]

Factor Analysis

Confirmatory Factor Analysis. The dimensionality of the scales was assessed through Confirmatory Factor Analysis (CFA), which was conducted to test: the four-factor model proposed by Carver and White (1994), the two-factor model proposed by Müller and

Wytykowska (2005), and the five-factor models suggested both by Segarra et al. (2014) and by Corr and McNaughton (2008) and confirmed by Heym et al. (2008). The models were evaluated using the χ^2 goodness-of-fit analyses, the Comparative Fit Index (CFI) and the Root Mean Square Error of Approximation (RMSEA). The resulting models did not show satisfactory fit indices: for a four-factor solution, $\chi^2 (164, N = 916) = 1583.97, p < .001, CFI = .797, RMSEA = .097$; for a two-factor solution, $\chi^2 (169, N = 916) = 1897.85, p < .001, CFI = .753, RMSEA = .106$; for Heym et al.'s five-factor solution (2008), $\chi^2 (160, N = 916) = 1127.76, p < .001, CFI = .862, RMSEA = .081$, and for Segarra et al.'s five-factor solution (2014), $\chi^2 (158, N = 916) = 1023.43, p < .001, CFI = .876, RMSEA = .077$. The five-factor solution provided better fit indices than the two- and four-factor solutions. However, as fit indices were still not completely satisfactory we proceeded with an exploratory factor analysis.

Exploratory Factor Analysis. After Principal Component Analysis (PCA, following oblique rotation) four factors presented eigenvalues above 1, explaining 56.8% of the variance from the model. The first factor explained 31.5% of the variance (eigenvalue = 6.30), the second factor 12.5% of the variance (eigenvalue = 2.51), the third 6.83% (eigenvalue = 1.37), and a fourth factor 5.90% of the variance (eigenvalue = 1.18).

The cumulative explained variance by this four-factor solution (56.8%) was better than the results obtained in Carver and White's (1994) original version, which was 49.0%. The factor-loadings for a four-factor solution were presented in Table 2.

[Table 2 about here]

Items 2, 13, 15, and 22 were deleted after the four-factor solution, because they presented low loadings (below .5) and/or double loading (difference lower than .1 between two factors). Items included in Factor 2 correspond to the BIS subscale, while items of Factor 1, 3, and 4

correspond to BAS-RR, BAS-D, and BAS-FS, respectively.

Internal Consistency

Intercorrelations. There were significant positive correlations between the three subscales of BAS and also between BAS subscales and BIS, though more moderate between BIS and BAS-FS, and BIS and BAS-D. Specifically, BAS-RR was strongly correlated with BAS-FS, $r(914) = .624$, and with BAS-D, $r(914) = .540$, (both $p < .01$). BAS-FS was also strongly correlated with BAS-D, $r(914) = .514$, $p < .01$. Finally, correlations between BIS and BAS subscales were $r(914) = .331$ for BAS-D, $r(914) = .389$ for BAS-FS, and $r(914) = .538$ for BAS-RR (all $p < .01$).

Cronbach's α . The internal consistencies of the subscales with items resulting from EFA were $\alpha = .77$ for BIS, $\alpha = .81$ for BAS-D, $\alpha = .79$ for BAS-RR, and $\alpha = .64$ for BAS-FS, which were satisfactory and agreed with those reported by Carver and White (1994). Note that BAS-RR subscale showed a slightly higher consistency when compared to findings from other studies (e.g., $\alpha = .73$ in Heubeck et al., 1998; $\alpha = .65$ in Jorm et al., 1999; $\alpha = .58$ in Müller & Wytykowska, 2005).

Normative Data

Table 3 presents average scores stratified by age and education for the Portuguese version of the BIS/BAS scales.

[Table 3 about here]

Discussion

There are many data concerning the validation of the BIS/BAS scales, with some authors criticizing them on psychometric and conceptual grounds (e.g., Cogswell, Alloy, van Dulmen, & Fresco, 2006). The evidence to its psychometric structure is mixed regarding the relative

adequacy of a two-factor fit – one BIS and one BAS scale – versus a four-factor structural model of the scales – one BIS and three BAS – or, after the updated RST, a five-factor model – two BIS and three BAS. Torrubia, Ávila, Moltó, and Caseras, (2001) argue that it is unclear how to interpret intercorrelations among the subscales, or to predict how the subscales should differentially relate to external criteria. They also suggested that a three-factor BAS bears little theoretical alignment with Gray's unidimensional BAS construct. However, there is a large consensus in favor of the multi-factor BAS model (Heubeck et al., 1998; Jorm et al., 1999; Leone et al., 2001; Ross et al., 2002), and a similar consensus is starting to build up on a two-factor BIS, even if our exploratory factor analysis does not favor such model.

In the first part of this paper, other adaptations of the Carver and White's BIS/BAS scales (1994) were referred with respect to their psychometric properties. In those studies, different statistical approaches were applied in order to best characterize the structure of the scales and test its concordance with Gray's conceptual framework.

As other studies (e.g., Cogswell et al., 2006) our CFA of the BIS/BAS scales (Carver & White, 1994) did not demonstrate satisfactory fit for the two-factor BIS and BAS solution, nor for the four-factor solution. The five-factor solution was slightly better, but still not completely satisfactory. As fit indices were not satisfactory we proceeded with an exploratory factor analysis. After such analysis, we decided for a four-factor structure, as in previous studies (e.g., Carver & White, 1994; Müller & Wytykowska, 2005), and in accordance with the theoretical perspective of a multidimensional BAS (Carver & White, 1994). Contrary to our expectations, we found moderate positive relations between BIS and BAS subscales, particularly BAS-RR. However, this finding is not unique, as in the study by Beck et al. (2009) the BAS-RR also correlated positively with the BIS-A scale. Perhaps age is moderating this correlation, as impulsivity and

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anxiety are both negatively related to age (Aluja & Blanch, 2011), but further analyses are necessary to shed light on this possibility.

Our results support the notion that the scales measure Gray's concepts concerning the behavioral activation and inhibition systems, with the former not appearing to be an unitary construct. After item analyses and once confirmed the structure of the Portuguese version of the BIS/BAS scales, we present average scores by age and school groups in order to provide normative data for its use in other studies. It shall be emphasized that our version of the scales can also serve for research with Brazilian participants, although normative data for Brazilians are necessary. Summing-up, besides providing additional empirical data for the theoretical understanding of behavior under the operation of the BIS and BAS systems, this study offers a new tool in Portuguese for the investigation of BIS/BAS systems in different populations and/or different conditions.

Further studies should be implemented, namely for proving concurrent validity measures.

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ADDITIONAL DATA FOR THE VALIDATION OF BIS/BAS SCALES

Table 1

Mean scores, Standard Deviation, and measures of distribution for the items of the

Portuguese version of the BIS/BAS

Item (number and content)	<i>M</i>	<i>SD</i>	Skewness	Kurtosis
2. Even if something bad is about to happen to me, I rarely experience fear or nervousness	2.80	.888	-.204	-.789
3. I go out of my way to get things I want	2.05	.803	.379	-.385
4. When I'm doing well at something I love to keep at it	1.51	.854	1.736	2.192
5. I'm always willing to try something new if I think it will be fun	1.84	.863	.898	.206
7. When I get something I want, I feel excited and energized	1.50	.853	1.800	2.442
8. Criticism or scolding hurts me quite a bit	2.19	.831	.212	-.587
9. When I want something I usually go all-out to get it	1.99	.809	.489	-.278
10. I will often do things for no other reason than that they might be fun	2.43	.865	.047	-.661
12. If I see a chance to get something I want I move on it right away	2.01	.784	.432	-.245
13. I feel pretty worried or upset when I think or know somebody is angry at me	1.93	.878	.715	-.191
14. When I see an opportunity for something I like I get excited right away	1.78	.787	.907	.554
15. I often act on the spur of the moment	2.54	.862	-.122	-.634
16. If I think something unpleasant is going to happen I usually get pretty "worked up"	2.19	.818	.210	-.549
18. When good things happen to me, it affects me strongly	1.97	.862	.663	-.150
19. I feel worried when I think I have done poorly at something important	1.66	.845	1.288	1.077
20. I crave excitement and new sensations	2.22	.884	.287	-.649
21. When I go after something I use a "no holds barred" approach	2.57	.843	-.042	-.595
22. I have very few fears compared to my friends	2.54	.850	-.164	-.588
23. It would excite me to win a contest	1.87	.845	.811	.116
24. I worry about making mistakes	1.71	.873	1.145	.560

Note. The missing items (1, 6, 11, and 17) were never used in the original scales.

ADDITIONAL DATA FOR THE VALIDATION OF BIS/BAS SCALES

Table 2

Factor loadings for the four-factor solution

Item (number and content)	Factor 1	Factor 2	Factor 3	Factor 4
7. When I get something I want, I feel excited and energized	.867			
4. When I'm doing well at something I love to keep at it	.825			
19. I feel worried when I think I have done poorly at something important	.730			
24. I worry about making mistakes	.661			
5. I'm always willing to try something new if I think it will be fun	.646			
14. When I see an opportunity for something I like I get excited right away	.633		.308	
18. When good things happen to me, it affects me strongly	.574			
23. It would excite me to win a contest	.550			
13. I feel pretty worried or upset when I think or know somebody is angry at me	.480	-.416		
16. If I think something unpleasant is going to happen I usually get pretty "worked up"		-.730		
8. Criticism or scolding hurts me quite a bit		-.718		
15. I often act on the spur of the moment		-.446		.429
22. I have very few fears compared to my friends		.437	.381	
3. I go out of my way to get things I want			.784	
9. When I want something I usually go all-out to get it	.388		.693	
21. When I go after something I use a "no holds barred" approach			.642	.318
12. If I see a chance to get something I want I move on it right away	.401		.538	
2. Even if something bad is about to happen to me, I rarely experience fear or nervousness		.385	.410	
10. I will often do things for no other reason than that they might be fun				.754
20. I crave excitement and new sensations	.322			.663
Total = 56.79	31.52	12.54	6.83	5.90

Note. Vertical grey sections indicate the factors in which the items load – from the highest to the lowest loadings – while horizontal sections indicate items that were excluded because did not load above .50 in any factor.

ADDITIONAL DATA FOR THE VALIDATION OF BIS/BAS SCALES

Table 3

Mean total BIS/BAS scores by age and education for the sample (standard deviations are given in parenthesis)

Education (years)	Age (years)			Total
	18-39	40-61	62-83	
1-4	37.7 (3.22) n = 6	40.0 (1.45) n = 32	-	39.7 (1.31) n = 38
5-6	37.3 (1.97) n = 16	36.8 (1.39) n = 14	-	37.1 (1.21) n = 30
7-9	38.2 (1.18) n = 24	36.0 (1.51) n = 24	-	37.2 (.96) n = 48
10-12	42.0 (.59) n = 238	39.6 (1.31) n = 43	38.6 (2.73) n = 5	41.6 (.54) n = 286
>12	41.6 (.45) n = 356	42.3 (.68) n = 149	45.4 (2.80) n = 9	41.9 (.37) n = 514
Total	41.5 (.34) n = 640	40.7 (.50) n = 262	43.0 (2.18) n = 14	41.3 (.28) n = 916