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Psychometric properties and normative data for the Spanish 15-item Barratt impulsiveness scale in adolescents (BIS-15-A)

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Abstract

The Barratt Impulsiveness Scale (BIS 15-item version) has not been validated in adolescents in Spain. We aimed to evaluate the psychometric properties of the Spanish BIS-15 in adolescents (N=8520) aged 11–19 years from 62 different Spanish high schools and established normative data. Exploratory factor analysis with Promax rotation identified two moderately correlated latent factors (r=.42): Drive Action, which includes Motor control-related items potentially linked to cortical-subcortical motor and premotor areas, and Executive Control, encompassing items related to Attentional processes and planning, potentially reflecting the efficiency of prefrontal cortex-related functions. This 2-factor model is hypothesized to capture the neuroanatomical distinctions between prefrontal executive functions and motor control, accounting for 42.0% of the total initial variance of BIS-15-A responses. Internal consistency reliability was acceptable (ω=.77 to .83). BIS-15-A Drive Action and Executive Control scale scores showed moderate to high (r=.55 to .63) correlations with UPPS-P subscale scores, except Sensation Seeking. Our results suggest that the BIS-15-A is a valid and reliable instrument for adolescents. We provide whole population normative data regardless of gender or age. BIS-15-A scores can contribute to determining whether a particular impulsive behavior might stem from executive dysfunction or issues with motor control.

Keywords Adolescents · Barratt · Impulsivity · Normative data · Validation

Introduction

Impulsivity is defined as "*a predisposition toward rapid, unplanned reactions to internal or external stimuli with diminished regard to the negative consequences of these reactions to the impulsive individual or to others*" (Potenza & Taylor, 2009, p. 1). Adolescence is a developmental stage marked by heightened emotional reactivity and reduced inhibitory control, making individuals more susceptible to impulsive actions and engagement in potentially risky behaviors such as substance use, self-damaging behavior, risky sexual activity, or delinquent and aggressive conduct compared to older age groups which underscores the importance of assessing impulsivity in adolescent populations (Shulman et al., 2016; Steinberg, 2010).

Barratt (1959) conceptualized impulsivity as a multidimensional trait encompassing both cognitive and behavioral components, leading to the development of the Barratt Impulsiveness Scale (BIS). Subsequent work further differentiated impulsivity and anxiety as distinct higher-order personality dimensions, with impulsivity linked to

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action-oriented tendencies and anxiety to mood-related processes (Barratt, 1987). This distinction anticipated the way for later theoretical frameworks separating behavioral activation processes from regulatory and affective control systems. Subsequent refinements, particularly by Patton et al. (1995), resulted in the BIS-11, a 30-item measure widely used to assess impulsivity. This work reinforced the view that impulsivity is not a unidimensional construct. However, despite its broad adoption, the factor structure of the BIS-11 has shown inconsistencies across studies, and its underlying model remains controversial, with ongoing debate regarding the optimal representation of impulsivity dimensions (Barratt, 1987; Stanford et al., 2009; Vasconcelos et al., 2012). In particular, the BIS version proposed by Spinella had not been psychometrically evaluated in Spanish adolescents prior to this study.

Regarding demographic variables, most studies found no significant differences between male and female adults and adolescents on BIS scores (Stanford et al., 2009). However, some studies reported higher scores for males, but with only marginal significance (Bhat et al., 2018; Fossati et al., 2002; Spinella, 2007), whereas others found the opposite (Yao et al., 2007). In terms of age, from adolescents to older adults, adults generally reported lower levels of impulsivity traits, particularly on the Non-planning score, with gradual decline over the years (Spinella, 2007; Vasconcelos et al., 2012). Most studies have found no significant gender or age differences in BIS scores, which justifies examining these demographic variables to clarify whether impulsivity, a construct with developmental aspects, shows consistent patterns across groups.

One of the most widely abbreviated versions used is the BIS-15 (Spinella, 2007), consisting of 15 items selected from the original BIS-11. BIS-15 offers the benefit of reduced length, minimizing time and effort for respondents in this developmental stage, which can otherwise contribute to bias (Fortgang & Cannon, 2022). It is also a useful tool for early identification advantages in schoolbased psychological assessments and risk assessment in clinical settings (Martínez-Loredo et al., 2015), particularly when incorporated into primary care or mental health screening to detect adolescents with elevated impulsivity traits (e.g., substance use, eating disorders). This shorter version has been adapted into different languages and used with adolescent populations (Bhat et al., 2018; Rousselle & Vigneau, 2016). Spinella (2007) identified a 3-factor structure in a community sample: Non-planning impulsivity (lack of future orientation or forethought), Motor impulsivity (acting without thinking), and Attentional impulsivity (lack of focus or concentration). This 3-factor structure of the BIS-15 was supported by the work of Meule et al. (2011) and Bhat et al., (2018) but not by other studies (Rousselle & Vigneau, 2016; Vasconcelos et al., 2012). Hence, findings on its internal structure have been inconsistent, with some items (particularly Attentional and Motor items) not loading on the expected factors. Moreover, other studies have proposed a 2-factor model (Charles et al., 2021; Reise et al., 2013a, 2013b), combining the Non-planning and Attentional factors (Cognitive Impulsivity) and maintaining the Motor (Behavioural Impulsivity) factor separately. In addition, the BIS-15 scores showed internal consistency coefficients ranging from poor to acceptable reliability, as reported in several studies (e.g., Stanford et al., 2009; Vasconcelos et al., 2012). Regarding convergent validity, Spinella (2007) found moderate to strong relationships between the BIS-15 and the Frontal Systems Behavior Scale scores (Grace & Malloy, 2001), particularly with the Disinhibition and Executive Dysfunction scale scores, as well as with the Executive Function Index (Spinella, 2005). Furthermore, BIS-15 scale scores were found to correlate with specific impulsivity traits measured by facets of the UPPS-P Impulsive Scale (Lynam et al., 2006; Meule et al., 2011), such as Lack of Premeditation (the tendency to act without regard for potential consequences) and Negative Urgency (impulsive responding triggered by heightened negative affect).

For adolescents, the most recent version of the BIS-11, the BIS-11-A (Fossati et al., 2002), introduced modifications to certain items (e.g., rewording items related to the professional/work sphere) to better suit this population while maintaining the same six first-order factor structure as in adults but considering only Non-planning and Motor impulsiveness as second-order factors (Vasconcelos et al., 2012). Even though the BIS-15 is widely used, its internal structure in adolescent populations remains unclear. Previous studies conducted in adolescents have reported inconsistent factor solutions, with both 3-factor and 2-factor models emerging depending on the sample, language, and analytic approach, and with frequent cross-loadings between Attentional and Non-planning items (Rousselle & Vigneau, 2016; Vasconcelos et al., 2012). These inconsistencies suggest that the original adult-derived factor structure may not fully capture the organization of impulsivity during adolescence. From a developmental perspective, adolescence is characterized by ongoing maturation of executive and self-regulatory systems, during which core cognitive control processes such as inhibitory control, attentional regulation, planning, working memory, and cognitive flexibility may still be insufficiently differentiated (Leshem & Glicksohn, 2007; Shulman et al., 2016). In this context, it is theoretically plausible that attentional and planning-related aspects of impulsivity cluster together within a broader regulatory dimension, whereas more overtly action-oriented tendencies toward rapid responding may form a separate dimension. This view is also consistent with multidimensional frameworks of impulsivity, such as the UPPS model (Whiteside & Lynam, 2001), in which difficulties related to premeditation and perseverance

are more closely aligned with regulatory aspects of behavior than with overt motor impulsivity (Barratt, 1987; Lynam et al., 2006). Accordingly, when examining the psychometric properties of the BIS-15 scores in adolescents (BIS-15-A), it is methodologically appropriate not only to test the originally proposed 3-factor model, but also to explore theoretically plausible 2-factor alternatives that may better reflect the developmental organization of impulsivity during this life stage. Table S1 (supplementary material) summarizes the factor models obtained in previous research conducted on adolescents.

In the Spanish language, several versions of the BIS have been developed. In adolescents, and following Fossati's version of the BIS-11-A (2002), Martínez-Loredo et al. (2015) identified a 2-factor structure. However, review studies such as by Vasconcelos et al. (2012) did not identify a stable solution (whether 2- or 3-factor) across studies using comparable statistical approach. Furthermore, both confirmatory and exploratory factor analysis conducted to date have failed to converge on a consistent internal structure in adolescent samples. In parallel, few psychometric investigations of short versions of the BIS have been conducted in adolescence to date, particularly in educational settings where time constraints and respondent burden are critical considerations (Diersch & Walther, 2016). Crucially, despite the widespread use of the BIS-15, this short version has not been uniformly validated across developmental stages and cultural contexts. In particular, while Spanish adaptations of longer versions of the BIS for adolescents are available, no psychometric validation of the BIS-15-A has been conducted specifically in Spanish-speaking adolescent populations.

Against this background, in this study, we aimed (a) to test whether the original 3-factor structure proposed by Spinella (2007) for the BIS-15-A presents adequate psychometric properties in the adolescent population, and, if not, to identify the most optimal factor structure; (b) to establish the internal consistency of the BIS-15-A dimensions; (c) to examine the convergent validity of the BIS-15-A scores with another self-reported measure of impulsivity (the UPPS-P Impulsive Behavior Scale; Lynam et al., 2006); (d) to explore the relationship between the BIS-15-A and demographic aspects such as gender and age; and (e) to provide normative data for the Spanish adolescent population.

Materials and methods

Participants

Participants were recruited by using cluster sampling of students from secondary schools located across the territory of Catalonia, Spain. The database of the Department of Education of the Generalitat de Catalunya (Government of Catalonia, 2022a, 2022b) was used to select schools of various types (private, public, and subsidized) and different high school academic courses. Data clustering was based on population density and family income level, as indicated by the Institut d'Estadística de Catalunya (IDESCAT, 2022a, 2022b). A total of 62 secondary schools participated in the study during the academic year 2021–2022. The inclusion criterion for participants enrolled in these schools was being between 11 and 19 years old. Exclusion criteria comprised students who were enrolled in special education or adapted courses, as well as those with insufficient reading comprehension in Spanish.

The initial sample included 8600 participants who agreed to take part in the study. Participants who omitted sociodemographic data or left the survey blank during the data collection process ($n=64$) and those who fell outside the specified age range ($n=16$) were not considered, resulting in a final sample of 8520 participants. Sociodemographic variables were self-reported by the students in an ad hoc survey, which also included questions about mental health disorders. Specifically, participants were asked to report any diagnoses made by mental health professionals, with a detailed list of specific disorders provided for reference; an open-ended question captured any additional disorders not listed. In fewer than 10% of the schools, psychological disorders were instead identified by the school's psychological services after survey administration. Sample characteristics are displayed in Table 1.

Instruments

BIS-11-A. As a starting point, we used the 30-item Spanish version of the BIS-11 for adolescents adapted by Martínez-Loredo et al., (2015), which addressed content-related modifications to certain items from the adult version when applied to adolescents (Table S2). The present study aimed to examine the psychometric properties of the BIS-15 as originally proposed by Spinella (2007), rather than to develop a new abbreviated version. We used the Spinella 15 item's version (2007) to preserve conceptual consistency and facilitate comparability with previous and future studies (detailed information on item number, content, original factor assignment and correspondence between versions is available in Table S3). Each item is a statement about impulsivity-related thoughts or behaviors in different situations (e.g., "I concentrate easily" or "I plan tasks carefully") and is scored on a 4-point Likert-type scale ranging from 1 (*rarely/never*) to 4 (*almost always/always*). Subscale scores are calculated by summing the corresponding item responses (reversing scores when necessary).

Table 1 Sociodemographic characteristics of the final sample (N=8520)

Characteristic	Value
Age, *M* (*SD*), years	14.7 (1.5)
Gender; *n* (%)	
Male	4153 (48.8%)
Female	4220 (49.5%)
Non-binary	147 (1.7%)
Place of birth; *n* (%)	
Spain	7895 (92.7%)
Other European countries	154 (1.8%)
Outside Europe	471 (5.5%)
Have siblings; *n* (%)	7158 (84.0%)
Socio-economic status[1]; *n* (%)	
Low	990 (11.6%)
Medium–low	3163 (37.1%)
Medium	1644 (19.3%)
Medium–high	1252 (14.7%)
High	1471 (17.3%)
Current education level; *n* (%)	
Mandatory secondary high school	7233 (84.9%)
Post-obligatory high school preuniversity studies	961 (11.3%)
Post-obligatory basic professional education	13 (0.1%)
Post-obligatory middle and higher grades	313 (3.7%)
Type of school; *n* (%)	
Public	3662 (43.0%)
Subsidized	4775 (56.0%)
Private	83 (1.0%)
Is a repeat course; *n* (%)	667 (7.8%)
Disorder	
Without disorder	6682 (78.4%)
Attention deficit hyperactivity disorder	470 (5.5%)
Language/learning impairment	451 (5.3%)
Anxiety	386 (4.5%)
Eating disorders	185 (2.2%)
Autism spectrum disorders	150 (1.8%)
Depression/mood disorders	148 (1.7%)
Epilepsy	13 (0.2%)
Other	35 (0.4%)

[1]Based on IDESCAT database: https://www.idescat.cat/pub/?id=rfdbc

For participants with more than one diagnosis, only the main diagnosis was analyzed. Language/learning impairment includes language disorder, dyslexia, dyscalculia, dysorthographia; eating disorders include anorexia I or II, bulimia, or binge disorder. The "Other" category predominantly includes intellectual giftedness (26 of 35)

UPPS–P Impulsivity Scale (Lynam et al., 2006). We used the Spanish version of the UPPS-P adapted by Verdejo-García et al. (2010) and validated by Montasell-Jordana et al. (2025). This self-report questionnaire consists of 59 items designed to assess five distinct personality pathways to impulsive behavior: Negative Urgency, Lack of Perseverance, Lack of Premeditation, Sensation Seeking, and Positive Urgency. Each item is rated on a 4-point Likert scale ranging from 1 (*strongly agree*) to 4 (*strongly disagree*). Subscale scores are calculated by summing the item responses (reversed when necessary). In the present sample, internal consistency reliability was satisfactory (omega coefficients ranged from .83 to .94).

Procedure

The study received approval from the ethics committee of Universitat Autònoma de Barcelona (CEEAH n°6494) and authorization from the Department of Education of the Government of Catalonia (Spain) for recruiting centers (Register: n°: 9067/490777/2021). Initial contact with schools was established with their directors, who were provided with an overview of the research goals and a request for cooperation. Upon the schools' agreement to participate, each institution's administration reviewed and approved the detailed study protocol. An information sheet was provided to each participating institution, and a video document explaining the study's characteristics, objectives, and guidelines was sent to the school administration for parental communication. Parents were provided with a 2-week period to withdraw their child from participating in the research. Finally, written informed consent was obtained from all participating adolescents. The self-reported questionnaires and the ad hoc survey for sociodemographics and mental health problems were administered collectively during a 1-h academic session. A teacher assisted in the administration, and the main researcher was present at that time. An online platform was used to facilitate data collection. All students received an information sheet assuring them that their data would be treated confidentially and only used at the group level. In four centers, the ad hoc survey for sociodemographics did not include the mental health section, and school services reported the diagnosis of mental disorders directly to the first author (on the basis of their own internal data protection protocols). Part of the data used in the current study has already been published in the context of a research paper focusing on the psychometric properties of the UPPS-P Impulsive Behavior Scale (Montasell-Jordana et al., 2025).

Statistical analysis

Analyses were conducted with SPSS29 and MPlus 8.10 programs. To evaluate the internal structure, a confirmatory factor analysis (CFA) was initially performed to test the originally proposed 3-factor model (Spinella, 2007), consisting of the dimensions of Non-planning impulsivity, Motor impulsivity, and Attentional impulsivity, of 5 items each. We used weighted least squares means and variance

adjusted (WLSMV) estimator, a robust estimator which does not assume normally distributed variables and provides the best option for modelling categorical or ordered data, and the factor-variance strategy for model identification. The following goodness-of-fit indices were used (Jackson, et al., 2009): root mean square error of approximation (RMSEA), comparative fit index (CFI), and Tucker and Lewis index (TLI). We followed the conventional cutoff points for interpretation (Brown, 2015): RMSEA < .05 and CFI and TLI > .95 for excellent fit, and RMSEA < .08 and CFI and TLI > .90 for moderate fit. Given that this CFA did not provide adequate fit indices, we examined the internal structure by using exploratory factor analysis (EFA) with WLSMV estimator and oblique Promax rotation using the default Mplus setting for power (exponent) value. Eigenvalues above 1 and the Cattell's scree test were used as criteria for determining the number of factors to be retained. Items exhibiting salient cross-loadings (> .30) were assigned to the factor with the highest loading when the difference with respect to the second highest value was above .20; in contrast, when such difference was below .20, the content of the item was taken into account, considering its theoretical importance in defining the construct, to ensure content validity, before making a final decision about its retention or removal.

The internal consistency reliability of the BIS-15-A scale scores was assessed by using the omega coefficient (McDonald, 1999). Pearson's correlation coefficients were calculated to evaluate the relationship between BIS-15-A scores and UPPS-P scores.

To establish normative data groups, we assessed gender and age differences by using a 2-factor mixed analysis of variance (ANOVA). To define age stages, we followed the World Health Organization [WHO] guidelines (2024). Specifically, early adolescence was defined as ages 10 to 13, middle adolescence as 14 to 16, and late adolescence as 17 to 20, which aligns with the distribution of our sample. In our study, participants aged 11 to 19 years were included, since students younger than 11 were not enrolled in the participating schools. Three criteria were combined to identify significant differences in raw scores for these variables. We used Cohen's guidelines for η^2 values: 0.01 for small, 0.06 for medium, and 0.14 for large effects (Cohen, 1988) to determine the effect size as a primary criterion. Next, from the omega coefficient and the standard deviation of the raw scores, we calculated the standard error of measurement (SEm). From the SEm values, a 95% confidence interval (CI) was established, offering a range for the "true" scores. Also, a difference above 5–6 points on raw subscale scores was considered an indicator of practical importance. Normative data for each factor were calculated by using T-scores and percentile ranks based on the designated normative reference groups.

Results

Item mean (and standard deviation) values ranged from 1.87 (0.87) to 2.70 (1.08). The median (in absolute value) skewness was 0.38 and kurtosis was 0.90. None of the items showed floor or ceiling effects. There were no missing item responses.

Goodness-of-fit indexes for the 3-factor model with CFA were all inadequate (CFI = .864, TLI = .836, RMSEA = .102, 90% CI [.100, .104]). From this result, we conducted an EFA. The first four factors showed an eigenvalue > 1 (4.592, 1.707, 1.215, and 1.060), whereas the fifth was below (0.926). The scree plot suggested extracting only two factors (Figure S1), which accounted for 42.0% of the total variance (sum of squared loadings after extraction and rotation: 2.60 and 2.35, for the first and second factors, respectively). Goodness-of-fit indexes for the 2-factor model with EFA were mostly adequate (CFI = .896, TLI = .856, RMSEA = .062, 90% CI [.059, .064]).

From the magnitude of the factor loadings and the interpretability of the factors related to item content, we retained the model shown in Table 2. This model consists of a first factor that we labeled Drive Action, which consists of items that reflect impulsive behaviors, including motor control-related items potentially linked to cortical-subcortical motor and premotor areas (Dalley & Robbins, 2017) and a second factor that we labeled Executive Control, as it contains items that reflect functions as inhibitory control, working memory or cognitive flexibility (e.g., Diamond, 2013). Items 2 ("I do things without thinking"; F1 = .43, F2 = .50) and 14 ("I say things without thinking"; F1 = .50, F2 = .40) showed cross-loadings with a difference less than .20 between their primary and alternative factor loadings. The items were maintained as they reflect action-oriented impulsivity involving both motor output and higher-order cognitive control, consistent with hierarchical models of control and inhibitory regulation (Badre & Nee, 2018; Dalley & Robbins, 2017). The factor correlation was moderate (.42). In addition, CFAs comparing the proposed 2-factor model against the original 3-factor model and other competing 2-factor models showed that the former provided a better fit to the data (CFI = .854 vs. ≤ .826, TLI = .823 vs. ≤ .801, RMSEA = .106 vs. ≥ .112, SRMR = .063 vs. ≥ .067) (detailed information upon request). Standardized parameters for the EFA 2-factor solution are displayed in Table 2.

Internal consistency reliability was satisfactory for all BIS-15-A scale scores, with omega values of .80 for Drive Action, .77 for Executive Control, and .83 for the total score (Table 2, bottom left). Regarding convergent validity with the UPPS-P, Lack of Premeditation and Lack of Perseverance scores correlated highly to moderately with the Spanish BIS-15-A Executive Control and the total score.

Table 2 Exploratory factor analysis with Promax rotation (standardized parameters) for BIS-15-A items and omega coefficients of derived scale scores

Item factor loadings[1]	F1	F2
2. I do things without thinking [M]	**.43**	**.50**
14. I say things without thinking [M]	**.50**	**.40**
17. I act on impulse [M]	**.55**	**.34**
19. I act on the spur of the moment [M]	**.31**	.00
22. I buy things on impulse [M]	**.31**	.23
11. I squirm at plays or lectures [A]	**.82**	−.17
18. Easily bored solving thought problems [A]	.29	.24
28. I am restless at lectures or talks [A]	**.84**	−.10
5. I don't pay attention [A]	.27	**.39**
9. *I concentrate easily [A]	.11	**.46**
1. *I plan tasks carefully [NP]	−.13	**.64**
10. *I save regularly [NP]	.00	**.39**
13. *I plan for the future [NP]	−.23	**.51**
20. *I am a careful thinker [NP]	−.03	**.70**
16. I change my mind about what I will do when I grow up [NP]	.24	.03
Factor correlation[2]	*.42*	
Internal consistency reliability (omega coefficient)		
F1 (Drive Action)	*.80*	
F2 (Executive Control)		*.77*
Total score BIS	*.83*	

Original item numeration has been maintained from the BIS-11-A. In brackets: original BIS-15 subscale from Spinella et al. (2007): *A* Action; *M* Motor; *NP* Non-planning

*Inverse items reversed prior to analysis

[1]In bold: Salient factor loading ≥ .30; shaded cells indicate the factor to which the item was allocated

[2]For factor correlation: *p*-value < .05

Table 3 Pearson's correlations of BIS-15-A with UPPS-P scores

UPPS-P scores	F1 (Drive Action)	F2 (Executive Control)	Total score BIS
Negative Urgency	.58	.50	.59
Positive Urgency	.55	.48	.56
Lack of Premeditation	.46	.63	.59
Lack of Perseverance	.35	.58	.53
Sensation Seeking	.22	.13	.19

Negative and Positive Urgency scores correlated highly to moderately with Executive Control, Drive Action, and the total score. The correlation with Sensation Seeking was much lower with all BIS-15-A scale scores (Table 3).

Table 4 displays the results of the 3 × 9 ANOVA, with the analysis of Spanish BIS-15-A scale scores based on gender (females, males, and non-binary) and age (from 11 to 19 years old). The analysis indicates very small or null effects for both main effects (gender η^2 .002—.003; age η^2 .001 -.002) and their interaction ($\eta^2 \leq .003$). Furthermore, the 95% CI for the range of "true" scores, based on the SEm, was wider than the range between the highest and lowest observed group means (for cells with $n > 30$). Overall, gender and age differences were considered negligible. As a result, we calculated norms exclusively on the basis of the total sample for each derived scale score. The T-scores and percentile ranks for the Spanish BIS-15-A are displayed in Table 5.

Discussion

Our aim in this study was to examine the psychometric properties of the Spanish version of the BIS-15-A in terms of its factor structure, internal consistency, convergent validity with the UPPS-P, and relationships with gender and age. We also aimed to provide normative data for the BIS-15-A in the Spanish adolescent population. Our findings did not support the original 3-factor model proposed by Spinella (2007), as evidenced by poor fit indices in the CFA (e.g., CFI and TLI = .84-.86, RMSEA = .10). Overall, our results suggest an acceptable internal consistency reliability and convergent validity with the UPPS-P Lack of Perseverance, Lack of Premeditation, and Negative Urgency scores. Furthermore, minimal differences were observed in terms of gender and age, and subsequently the normative data were calculated for the whole sample. Contrary to the expected 3-factor structure proposed by Spinella (2007), a more parsimonious 2-factor solution seems to provide the best fit to the present data, with factors showing a moderate intercorrelation, reflecting a still-maturing but relatively balanced organization of impulsivity during this developmental stage. The factor structure found in the current study, which differs from that found in previous studies conducted on various versions of the BIS, can be attributed to several reasons, including the type of sample and item content. For example, Spinella's (2007) validation study included

Table 4 Comparison of BIS-15-A scale scores by gender and age for establishing norm groups

	ANOVA						Reliability	Mean of subgroups		
	Gender		Age		Interaction		95% CI range true score**	Lowest	Higher	Range
BIS score	*F* (2, 8494) (*p*)	η^2	*F* (8, 8494) (*p*)	η^2	*F* (13, 8494) (*p*)	η^2				
Drive Action	10.94 (<.005) *	.003	1.87 (.059)	.002	1.84 (.052)	.002	9	18.0	22.1	4.0
Executive Control	7.91 (<.005) *	.002	0.85 (.559)	.001	1.10 (.354)	.001	9	17.4	19.9	2.5
Total score	11.54 (<.005) *	.003	1.27 (.254)	.001	1.40 (.152)	.001	12	31.8	37.0	5.2

*All Cohen's *d* values ≤ 0.16 (in absolute value)

** ± 1.96 *SEm*

Table 5 Normative data for the Spanish adolescent BIS-15-A (N=8520)

Raw score	Drive Action		Executive Control		Total score	
	T	Pc	T	Pc	T	Pc
8	-	-	28	1	-	-
9	30	1	30	2	-	-
10	32	1	32	3	-	-
11	34	3	35	6	-	-
12	36	6	37	10	-	-
13	38	11	39	15	-	-
14	40	17	41	20	-	-
15	42	23	43	27	25	1
16	44	30	46	34	27	1
17	46	37	48	42	28	1
18	48	44	50	50	29	1
19	50	52	52	58	31	2
20	52	59	54	66	32	3
21	53	66	56	74	34	4
22	55	72	59	80	35	6
23	57	77	61	86	36	8
24	59	82	63	90	38	11
25	61	86	65	93	39	14
26	63	89	67	95	40	18
27	65	92	70	97	42	22
28	67	94	72	98	43	26
29	69	96	74	99	44	31
30	71	97	76	99	46	35
31	73	98	78	99	47	40
32	75	99	81	99	48	45
33	77	99	-	-	50	51
34	79	99	-	-	51	56
35	81	99	-	-	53	61
36	83	99	-	-	54	66
37	-	-	-	-	55	71
38	-	-	-	-	57	75
39	-	-	-	-	58	79
40	-	-	-	-	59	82
41	-	-	-	-	61	86
42	-	-	-	-	62	88
43	-	-	-	-	63	91
44	-	-	-	-	65	93
45	-	-	-	-	66	94
46	-	-	-	-	67	95
47	-	-	-	-	69	96
48	-	-	-	-	70	97
49–50	-	-	-	-	72–73	98
51–54	-	-	-	-	74–79	99
55–60	-	-	-	-	≥80	99
M	19.22		18.05		33.12	
SD	5.12		4.57		7.36	
*SE*m	2.3		2.2		3.0	

T T-score; *Pc* Percentile rank; *SEm* standard error of measurement

participants 15 to 80 years old, whereas our sample included the adolescent period, from preadolescence to late adolescence. In terms of item content, adolescents' responses may incorporate different linguistic meanings and generational changes in social desirability compared with adult responses and parental reports (Carvalho et al., 2023), making adolescents a complicated population for assessment. The 2-factor solution obtained is consistent with findings from

the Spanish version of the BIS-11-A in preadolescents (Martínez-Loredo et al., 2015) and with prior evidence in adolescents indicating instability in the factor structure of impulsivity measures (Charles et al., 2021; Benk Durmuş et al., 2022; Kata & Poleszak, 2021; Rousselle & Vigneau, 2016; Shulman et al., 2016; Yao et al., 2007; Vasconcelos et al., 2012). At the same time, our results diverge from studies that retained a clearer 3-factor structure or a factor distribution closer to Spinella's original proposal (e.g., Bhat et al., 2018). These inconsistencies across studies may reflect differences in developmental stage, suggesting that the factorial structure of impulsivity becomes more differentiated with age as executive and motor systems mature (Badre & Nee, 2018; Dalley & Robbins, 2017; Freis et al., 2022; Leshem & Glicksohn, 2007; Menon & D'Esposito, 2022; Morean et al., 2014; Reise et al., 2013a, 2013b) as well as variations in the expression of impulsivity across psychopathological conditions (Schaub et al., 2023; Zelazo, 2020). Overall, the literature indicates that no single factorial solution has consistently demonstrated cross-cultural stability in adolescent samples (Vasconcelos et al., 2012). Based on the present findings, the best-fitting solution was a 2-factor model in which the original "attention-related" items are divided between both factors.

The decision to allocate two items (Items 2 and 14) to both factors was based on their capacity ability to capture action-oriented impulsivity, that which integrates motor execution with higher-order cognitive control processes, consistent with hierarchical models of hierarchical cognitive control (Badre & Nee, 2018; Dalley & Robbins, 2017). Behaviors such as acting or speaking without thinking involve inhibitory control, contextual regulation, and coordination of motor and premotor systems, as well as prefrontal mechanisms supporting schematic representations (e.g., cognitive maps) and decision-making (Menon & D'Esposito, 2022).

Developmental and psychological perspectives

The 2-factor structure obtained in the present sample (Drive Action and Executive Control) may be interpreted within established frameworks of executive function and impulsivity (Diamond, 2013; Whiteside & Lynam, 2001). First, the traditional 3-factor structure of the BIS-15, which includes Attentional, Non-planning, and Motor factors, can be contextualized in the executive functions model (Diamond, 2013), which includes inhibitory control (Fino et al., 2014) working memory (Whitney et al., 2004), and cognitive flexibility (Yu et al., 2020) for the Attentional and Non-planning factors. Both executive functions and impulsivity are components of self-regulation (e.g., those regulated by affectivity, impatience, boredom, or decision making) linked to psychopathology (Schaub et al., 2023; Zelazo, 2020). Similarly, from a developmental perspective, impulsive behaviors change from a lack of cognitive inhibition to behavioral inhibition that extends from executive control to motor action (Bari & Robbins, 2013; Menon & D'Esposito, 2022). Cognitive and motor inhibition share overlapping brain networks, as suggested by findings that psychiatric patients are typically impaired on tasks that assess inhibition of motor responses and inhibition of cognitive material (Bari & Robbins, 2013; Schaub et al., 2023). During adolescence, cognitive breakdowns and impaired response inhibition linked to inefficient executive control are associated with an increased risk of general psychopathology across academic and social domains (Zelazo, 2020).

Neurobiological and system models

The 2-factor structure identified in the present study as the best fitting solution appears to be broadly consistent with established neuroanatomical frameworks of impulsivity. Neuroanatomically, adolescence is a crucial period in life for the development of the executive systems and self-regulation (Luna et al., 2015). Dalley and Robbins (2017) discriminated between two systems of impulsivity: "waiting impulsivity" and "stopping impulsivity," which may provide a useful framework for interpreting the 2-factor solution obtained. Waiting impulsivity, which primarily depends on top-down prefrontal cortical interactions, encompasses aspects such as planning and organization, as seen in the Planification and Organization subscale of the Executive Function Index (Spinella, 2005) and in the Attentional and Non-planning dimensions of the adult BIS-11 subscales under the Executive Control factor. Stopping impulsivity, which depends on dissociable neuronal circuitry involving cortical motor areas (such as the primary motor cortex, supplementary motor area [SMA]/pre-SMA, dorsal premotor area, and subcortical areas, among others), covers motor components and motivational drive subscales, such as the BAS Drive subscale from the Behavioral Inhibition and Activation Systems Scales (Carver & White, 1994), which are encompassed in the Drive Action factor. The low to moderate correlation observed between the two factors supports their relative independence, yet interconnected nature, which aligns with theories positing that top-down executive processes and bottom-up impulsive responses rely on distinct, albeit interactive, neural mechanisms (Badre & Nee, 2018). Similarly, the 2-factor solution found may be interpreted in light of Steinberg's (2010) dual systems model, which proposes an early-maturing affective system sensitive to reward and novelty, and a slower-developing cognitive control system.

In terms of convergent validity, the Spanish BIS-15-A showed the strongest correlations with the UPPS-P Lack

of Perseverance, Lack of Premeditation, and Negative and Positive Urgency scores. Specifically, Lack of Premeditation and Lack of Perseverance were more related to Executive Control than to Drive Action, probably due to the core symptoms derived from the Non-planning and Attentional classical subscales of the BIS, which reflect fundamental executive characteristics (Freis et al., 2022). At the same time, the correlations of the Urgency subscale scores with both BIS-15-A factors were similar, with a slightly higher correlation for Drive Action. Researchers have theorized that the relationship between emotional experiences and actions involves the activation of the motor cortex by subcortical structures (Cyders & Smith, 2008). For instance, studies targeting substance use and addictive disorders have shown that emotional stimuli, regardless of their valence, may enhance motor cortex excitability (Braine & Georges, 2023). Since the Drive Action factor reflects impulsive, action-oriented behaviors, these emotion-driven problem behaviors (i.e., disorderly alcohol use, online gambling disorder, obsessive–compulsive disorder behaviors or social media addiction) may explain the stronger correlation observed (Willie et al., 2022).

Regarding demographic variables, we did not find substantial differences in the BIS-15-A subscale scores, similar to previous research regarding both gender (Stanford et al., 2009) and age (Leshem & Glicksohn, 2007; Stanford et al., 2009). This can be partially explained by the fact that impulsivity tends to decrease during the transition to adulthood (Leshem & Glicksohn, 2007). Regarding gender, the absence of significant differences in impulsivity scores among adolescents may be related to two other factors. First, socialization pressures, particularly among females, may encourage responses aligned with socially desirable norms (Carvalho et al., 2023; Holden & Passey, 2010). Second, the association between depressive symptomatology and engagement in risky behaviors, particularly those driven by negative urgency, may partially account for the absence of significant differences (Petitet et al., 2021; Porcelli et al., 2023).

Taken together, our findings suggest that impulsive behavior is not a unitary construct but reflects diverse phenotypes with distinct mechanisms. This supports dismantling the broad notion of impulsivity in favor of a more nuanced framework distinguishing sensation seeking from impulsivity, executive from effortful control, and impulsivity as deficit versus stable trait (Cross et al., 2011; Strickland & Johnson, 2021).

Several limitations must be acknowledged. The sample was drawn exclusively from adolescents in Catalonia, which may limit the generalizability of the findings to adolescents from other sociocultural regions of Spain. The framework for proposing our 2-factor solution, based on Diamond's (2013) work on executive functions, is not the only model for executive function theory, and there is currently no consensus on a single framework (Sambol et al., 2023). Moreover, our proposal regarding the theoretical and neuroanatomical underpinning of the two factors identified in the current study should be confirmed by further research by using neuroanatomical data and/or neuropsychological assessment (e.g., behavioral tasks assessing executive functions). An additional limitation concerns the non-uniform identification of pre-existing mental health conditions across participating centers, as most data was obtained via self-report, while a small proportion of cases (less than 10%) was derived from institutional records. As this information was collected solely for descriptive purposes and not included into any psychometric analyses, the potential impact of this heterogeneity is likely limited and confined to the interpretation of sample characteristics. Importantly, all other aspects of the data collection protocol including questionnaire administration procedures, instructions, and assessment conditions were fully standardized across centers. The study relied exclusively on self-report measures. Future research would benefit from incorporating multimethod approaches, including behavioral tasks and informant reports, to provide a more comprehensive assessment of impulsivity. Although the online platform offered several technical advantages, reliance on self-report measures collected within a single session may have introduced common method variance (e.g., response style effects), which should be considered when interpreting the observed associations.

Despite these limitations, our findings are based on a very large and diverse sample that represents the adolescent population across various family situations, types of schools, income levels, and population densities. In addition, our self-reported data on disorders closely mirrors the prevalence observed in adolescent epidemiological studies in Spain (Haro et al., 2006). Furthermore, our Spanish BIS-15-A conceptual model aligns with the transdiagnostic approach involving neurocognitive endophenotypes, whereby changes in behavioral or cognitive processes are associated with discrete deficits in defined neural systems (Freis et al., 2022; Schaub et al., 2023).

Our findings suggest that the BIS-15-A is a valid and reliable instrument for adolescents, offering the benefit of reduced length, minimizing the time and effort required for respondents in this population (Fortgang & Cannon, 2022). We also provide normative data for future application in Spain. Upcoming studies on the BIS-15-A could consider additional cross-cultural validation studies to further evaluate its internal structure in clinical and nonclinical settings.

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Data availability The dataset can be found in the Open Science Framework (OSF) in the following link (https://osf.io/64uyk).

Declarations

Ethical approval The procedure received approval from the ethics committee of Universitat Autònoma de Barcelona (CEEAH nº6494) and also authorization from the Department of Education of the Government of Catalonia (Spain) for recruiting centers (register no: 9067/490777/2021) who provided us with the informed (parental) consent of all students, as well as the internal data protection protocol of each participating high school.

Competing interests The authors declare no competing interests.

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Table S1 Supplementary Material

Adolescent BIS internal structures

BIS version	Study	Sample				Factor method/Rotation	Factor solution
		N	*M* age (*SD*)	Age range	Sex F/M Nº		
Adult version	Salvo & Castro (2013)	763	16.0 (1.2)	14-19	390/373	EFA/Promax	6-factor first-order solution but not 3-factor second-order solution Perseverance (Per) Motor (M) Attention (Aten) Cognitive instability (Cog Ins) Self-control (Self Con) Cognitive complexity (Cog Com)
3 factors identical to original proposed	Orozco-Cabal et al. (2010)	164 psychiatric outpatients	25.94 (9.37)	18-65	NP	EFA/Varimax	Motor impulsivity[a] (Per + M factors) Attentional impulsivity[b] (Aten + Cog Ins factors) Non-planning impulsivity[c] (Self Con + Cog Com factors)
		283 undergraduates	19.59 (1.73)	18-65	NP		
	Soodsawang et al. (2019)	900	NP	13-22	444/456	CFA	Motor impulsivity (Per + M factors) Attentional impulsivity (Aten + Cog Ins factors) Non-planning impulsivity (Self-Con + Cog Com factors)

BIS version	Study	Sample				Factor method/Rotation	Factor solution
		N	*M* age (*SD*)	Age range	Sex F/M Nº		
	Niv et al. (2012) 27 items	750 pairs of twins	14.69 (.63)	11-16	384/366	EFA/CFA	Motor impulsivity (Per + M factors) Attentional impulsivity (Attention + Cog Ins factors) Non-planning impulsivity (Self-Con + Cog Com factors)
	Wan et al. (2016)	406 Community sample	17.78 (3.69)	12-26	208/198	CFA	Motor impulsivity (Per + M factors) Attentional impulsivity (Aten + Cog Ins factors) Non-planning impulsivity (Self Con + Cog Com factors)
		258 mental health disorders	Female sample 17.25 (3.72) Male sample 17.02 (4.22)	12-26	130/126		
		331 delinquent juveniles	Female 20.28 (3.02) Male 19.02 (2.56)	14-25	65/266		
Short version 3 factors	Spinella (2007)	Study 1 700	29.3 (12.9)	15-89	418/279/3 (NP)	EFA/Varimax	Motor impulsivity (Per + M factors) Attentional impulsivity (Aten + Cog Ins factors) Non-planning impulsivity (Self Con + Cog Com factors)
		Study 2 100	27 (11.2)	17-57	49/51		

BIS version	Study	Sample				Factor method/Rotation	Factor solution
		N	*M* age (*SD*)	Age range	Sex F/M Nº		
3-factor models	von Diemen et al. (2007)	464	17.3 (1.7)	15-20	NP	EFA/Varimax	Factor 1: Non-planning impulsivity + Attentional impulsivity items Factor 2: Motor impulsivity + Non-planning impulsivity items Factor 3: Non-planning impulsivity items
	Willhelm et al. (2020)	304	15.36 (1.16)	13-18	116/188	CFA + WLSMV (version of 12 items)	Motor impulsivity (Per + M factors) Attentional impulsivity (Aten + Cog Ins factors) Non-planning impulsivity (Self Con + Cog Com factors)
	Hartmann et al. (2011)	659	13.30 (2.58)	10-20	355/304	EFA/Promax	Factor 1: Motor impulsivity + Attentional impulsivity items Factor 2: Non-planning impulsivity items Factor 3: Motor impulsivity items
	Pechorro et al. (2015)	221 Forensic sample	16.75 (1.41)	13-20	Only male	CFA/EFA/Promax	6-factor first-order solution but not 3-factor second-order solution Per M Aten Cog Ins Self Con Cog Com

BIS version	Study	Sample				Factor method/Rotation	Factor solution
		N	*M* age (*SD*)	Age range	Sex F/M Nº		
	Pechorro et al. (2017)	103 Forensic sample	16.41 (1.19)	14-19	Only female	CFA	6-factor first-order solution but not 3-factor second-order solution Per M Aten Cog Ins Self Con Cog Com
		274 Community sample	16.17(1.44)	14-19			
3 factors different than original proposed Spinella factors	Bhat et al. (2018)	1806	17.14 (1.64)	14-20	866/940	Principal component analysis	Different item distribution on factors. Two of the three dimensions (Non-planning and Attentional impulsivity) showed slight variations from the original in their number of items
	Maggi et al. (2022)	534	36.82 (13.65)	18-61	382/152	PCA	pure impulsivity planning and thinking lack of attention and concentration, impulsive buying
2-factor structure	Yao et al. (2007)	396	16.2 (.95)	14-19	200/196	CFA	6 first-order factors General impulsivity (Atten, M, and Cog Ins) Non-planning impulsivity (Self-Con, Cog Com, Per)

BIS version	Study	Sample				Factor method/Rotation	Factor solution
		N	*M* age (*SD*)	Age range	Sex F/M Nº		
	Fossati et al. (2002)	563	16.4 (1.5)	13-19	354/209	CFA	6 first-order factors (Lack of Delay instead of Cog Ins) Motor impulsivity (M, *Lack of Delay*, Aten, Per) Non-planning impulsivity (Cog Com + Self Con)
	Martinez-Loredo et al. (2015)	1183	12.98 (.54)	12-14	533/650	EFA/Promin rotation	2 factors General impulsivity (items related to attentional, motor, and cognitive aspects of impulsiveness) Non-planning impulsivity (mainly compounded by items loaded in the Self-Con and Cog Com factors of Fossati's adaptation) Items 16, 21, 23, 24, and 27 had weights lower than .30, being not adequate in that sample
2 factors (Morean et al., 2014)	Benk et al. (2022)	116	15.22 (1.58)	13-18	39/77	EFA/Varimax	Poor self-regulation (as difficulty in focusing on goal-oriented thoughts and behaviors) Impulsive behavior (defined as a tendency to react quickly to various stimuli and the inability to restrict or prevent these responses) The loading of Item 4 ("I am self-controlled") on a different subscale may be caused by cultural differences or a factor arising from translation or language differences
		175	15.16 (1.86)	13-18	68/107		

BIS version	Study	Sample				Factor method/Rotation	Factor solution
		N	*M* age (*SD*)	Age range	Sex F/M Nº		
	Mathias et al. (2018)	356 controls	NP	10-17	204/152	CFA	2-factor solution Poor self-regulation Impulsive behavior
		302 Family history of substance use disorder group	NP	10-12	151/151		
		322 Patient group	NP	12-17	163/159		
2 factors (Reise et al., 2013). Not evaluated in Adolescents 28 items	Reise et al., (2013)	691 Community sample	NP	21–50	325/366	EFA/CFA	Factor cognitive impulsivity Factor behavioral impulsivity **Note from the authors: "We note, however, that an alternative interpretation is that these factors are "method" factors reflecting items that are phrased in terms of constraint and items that are phrased in terms of impulsivity. Further research is needed to clarify the meaning of these factors.*
	Lindstrøm et al., (2016)	110 patients (47 controls; 43 Parkinson;	37.6 (NP) 69.5 (NP) 41.1 (NP)	20–52 42–85 21–63	38/9 13/30 16/4	EFA/CFA Promax rotation	Factor cognitive impulsivity Factor behavioral impulsivity

BIS version	Study	Sample				Factor method/Rotation	Factor solution
		N	*M* age (*SD*)	Age range	Sex F/M Nº		
		20 chronic headache)					items 10, 22, and 25 loaded almost exclusively on factor 2, while items 2, 5, and 14 had large loadings on both factors two factors
2 factors (Haden & Shiva, 2008). Not evaluated in Adolescents. 23 items.		425 male forensic psychiatric inpatients	33.75 (10.91)	18-64	-/425	PCA/Varimax rotation	Factor Motor Impulsivity Factor Non planning Impulsivity
1 factor (Steinberg, et al., 2013), 8 items	Rousselle & Vigneau (2016)	366	20.29 (3.02)	16-40	236/104/26 (NP)	PCA + CFA	Unidimensional
	Kata & Polezak (2021)	6710	15.51 (1.72)	12-20	3355/3355	EFA main components and non-orthogonal rotation	2-factor solution Poor self-control Impulsive behavior
	Charles et al. (2021)	315	16.72 (0.72)	16-19	59/256	CFA with maximum-likelihood estimation	2-factor solution Poor self-regulation Impulsive behavior
Child-preadolescent version structure	Cosi et al. (2008)	377	10.4 (0.9)	8-12	195/182	EFA WLSMV/Promin/oblique rotation	Motor impulsivity (Per + M factors) Attentional impulsivity (Aten + Cog Ins factors) Non-planning impulsivity (Self Con + Cog Com factors)

BIS version	Study	Sample				Factor method/Rotation	Factor solution
		N	*M* age (*SD*)	Age range	Sex F/M Nº		
Barratt Impulsiveness Scale-11 for children (Cosi et al., 2008)							Different item loading. Attentional impulsivity included only 3 items
	Chahin et al. (2010)	616	13 (2.38)	8-16	310/306	EFA WLSMV/Promin/oblique rotation	Motor impulsivity (Per + M factors) Attentional impulsivity (Aten + Cog Ins factors) Non-planning impulsivity (Self Con + Cog Com factors)
Studies did not investigate the scale factor structure	Paaver et al. (2007)	483	15.3 (.50)	15	261/222	NC	NC

Note. EFA = exploratory factor analysis; CFA = confirmatory factor analysis; NC = not calculated; Per = perseverance; Self Con = Self-control; Cog Ins = cognitive instability; Cog Com = cognitive complexity; Aten = attention; M = motor; WLSMV = weighted least squares means and variance adjusted.

[a] Motor impulsivity: An action without inhibition of prepotent or ongoing responses. Includes the first-order factor solution Perseverance (giving up on things quickly) and Motor (doing things without thinking about them first).

[b] Attentional impulsivity: Includes the first-order factor solution Attention (defined as an inability to focus attention or concentrate) and Cognitive Instability (having extraneous thoughts when thinking).

[c] Non-planning impulsivity: Involved in lack of ‘‘futuring” or forethought. Includes the first-order factor solution Self-control (having difficulty refraining from certain actions, such as spending money) and Cognitive complexity (having difficulty focusing on a problem).

Table S2

Item selection from Martinez-Loredo et al. (2015)

(1) Planifico lo que tengo que hacer (I plan tasks carefully)
(2) Hago las cosas sin pensarlas (I do things without thinking)
(3) Tomo decisiones rápidamente (I make up my mind quickly)
(4) Soy una persona despreocupada (I am happy-go-lucky)
(5) No presto atención a las cosas (I do not ‘‘pay attention’’)
(6) Mis pensamientos van demasiado rápido (My thoughts are racing too fast)
(7) Planifico mi tiempo libre (I plan my spare time)
(8) Soy una persona que se controla bien (I am self-controlled)
(9) Me concentro fácilmente (I concentrate easily)
(10) Soy ahorrador (I save regulary)
(11) No puedo estar quieto en el cine o en la escuela (I cannot stand still at movies or school)
(12) Me gusta pensar y darle vueltas a las cosas (I like to think carefully about things)
(13) Planifico mi futuro (I plan for my future)
(14) Digo cosas sin pensarlas (I say things without thinking)
(15) Me gusta pensar en problemas complicados (I like to think about complex problems)
(16) Cambio de parecer sobre lo que quiero hacer cuando sea mayor (I change my mind about what I will do when I grow up)
(17) Actúo impulsivamente (I act ‘‘on impulse’’)
(18) Me aburro fácilmente cuando trato de resolver problemas mentalmente (I am easily bored when solving thought problems)
(19) Actúo según el momento (I act on the spur of the moment)
(20) Pienso bastante bien las cosas (I am a careful thinker)
(21) Cambio de amigos (I change friends)
(22) Compro cosas por impulse (I buy things on impulse)
(23) Puedo pensar en un solo problema a la vez (I can think about one problem at a time)
(24) Cambio de aficiones y deportes (I change hobbies and sports)
(25) Gasto más de lo que debería (I spend more than Ishould)
(26) Cuando pienso en algo, otros pensamientos se agolpan en mi mente (When I think about something, other thoughts pop up in my mind)
(27) Estoy más interesado en el presente que en el futuro (I am more interested in the present than in the future)
(28) Estoy inquieto en los cines y en las clases (I am restless at the movies or lectures)
(29) Me gustan los juegos de tablero como el ajedrez, las damas o el parchís (I like to play chess or checkers)
(30) Pienso en el futuro (I am future oriented)

Selected items are shown in bold.

Table S3

Cross-reference of items and factor assignments between Spinella (2007) and Martínez-Loredo et al. (2015) versions.

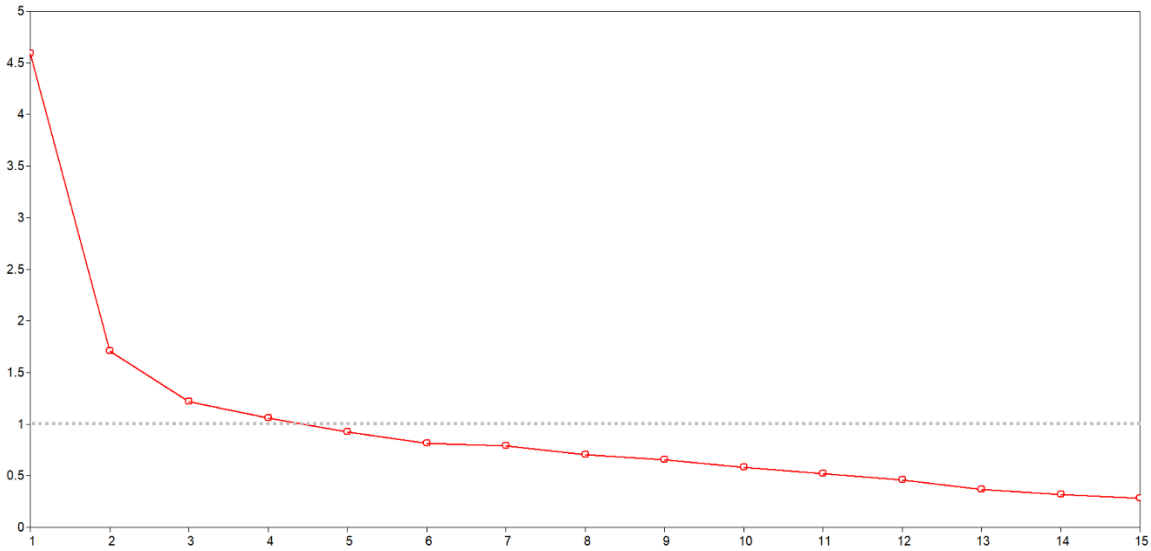
Original Spinella item	Spinella factor	Spinella item content	Martínez-Loredo et al. (2015) Item	Martinez-Loredo et al. factor	Martinez-Loredo et al. Item content	Mapping Type	Authors' factor
1	Motor	I act on impulse. [inverted]	17	General impulsivity	I act on impulse. [inverted]	Exact match	Drive Action
2	Motor	I act on the spur of the moment.	19	General impulsivity	I act on the spur of the moment.	Exact match	Drive Action
3	Motor	I do things without thinking.	2	General impulsivity	I do things without thinking.	Exact match	Executive Control + Drive Action
4	Motor	I say things without thinking.	14	General impulsivity	I say things without thinking.	Exact match	Drive Action + Executive Control
5	Motor	I buy things on impulse.	22	General impulsivity	I buy things on impulse.	Exact match	Drive Action
6	Attentional	I plan for job security. [inverted]	16	Excluded (loading < .30)	I change my mind about what I will do when I grow up.	Adapted (Fossati et al., 2002) → Excluded†	Drive Action
7	Attentional	I plan for the future. [inverted]	13	Non-planning impulsivity	I plan for the future. [inverted]	Exact match	Executive Control

8	Attentional	I save regularly. [inverted]	10	Non-planning impulsivity	I save regularly. [inverted]	Exact match	Executive Control
9	Attentional	I plan tasks carefully. [inverted]	1	Non-planning	I plan tasks carefully. [inverted]	Exact match	Executive Control
10	Attentional	I am a careful thinker. [inverted]	20	Non-planning	I am a careful thinker. [inverted]	Exact match	Executive Control
11	Non-planning	I am restless at lectures or talks.	28	General impulsivity	I am restless at lectures or talks.	Exact match	Drive Action
12	Non-planning	I squirm at plays or lectures.	11	General impulsivity	I squirm at plays or lectures.	Exact match	Drive Action
13	Non-planning	I concentrate easily. [inverted]	9	Non-planning	I concentrate easily. [inverted]	Exact match	Executive Control
14	Motor	I don’t pay attention.	5	General impulsivity	I don’t pay attention.	Exact match	Executive Control
15	Motor	I am easily bored solving thought problems.	18	Non-planning	I am easily bored solving thought problems.	Exact match	Drive Action

Notes: Items are mapped from Spinella (2007) to Martínez-Loredo et al. (2015). Mapping Type: Exact match = identical wording. † Item 6 (‘I plan for job security’) from Spinella (2007) was adapted by Fossati (2002) as ‘I change my mind about what I will do when I grow up.’ Martínez-Loredo et al. (2015) retained this adapted version but excluded it from their factorial solution due to a factor loading below .30.

Figure S1

Scree plot of eigenvalues for determining the number of factors to be retained



Note: Factors with eigenvalues above 1: 4 factors; relevant changes in slope based on Cattell's scree test: first elbow at factor 2 suggesting 1 factor and second elbow at factor 3 suggesting 2 factors

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