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ORIGINAL ARTICLE

Spanish Adaptation and Psychometric Properties of the Protective Behavioral Strategies for Marijuana Scale: The Protective Behavioral Strategies for Cannabis Scale (S-PBSC)

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Abstract
The Protective Behavioral Strategies for Marijuana scale (PBSM) was initially developed using samples of university students in USA. A community sample of Spanish young adults was recruited to provide the Spanish full-length and short versions of the Protective Behavioral Strategies for Cannabis use (S-PBSC; S-PBSC-SF). We followed a rigorous item-selection process to select the most relevant items from the original 50-item pool developed by Pedersen et al. (2016), on the basis of evidence of reliability, evidence of validity according to the internal structure (factor loadings, invariance across genders and university status, and differential item functioning [DIF]), and evidence of validity based on the relationships between S-PBSC scores and cannabis outcomes. Our findings support a 31-item unidimensional measure and a 13-item short form with excellent fit and internal consistency, invariant across genders and college status and free of DIF. Both the S-PBSC and S-PBSC-SF scores were associated with reduced cannabis use and consequences.

Keywords Protective Behavioral Strategies · cannabis · marijuana · young adults · psychometric properties · Spanish adaptation

Cannabis is the most widely used illicit substance globally (United Nations Office on Drugs and Crime, 2023), and use of cannabis is particularly prevalent among young adults. It is estimated that, in 2022, almost one in five (18.2%) of the European population aged 15–24 years reported past-year cannabis use (European Monitoring Centre for Drugs and Drug Addiction [EMCDDA], 2023), while in the United States, past-year marijuana use

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among young adults (18–30 years old) has significantly increased in the last ten years, rising from 28.1% to 43.6% (Patrick et al., 2022). The use of cannabis has been associated with a variety of negative consequences, particularly among heavy users. These consequences include impaired cognitive functioning, legal complications, academic problems, and engagement in risky behaviors such as driving under the influence of cannabis and unsafe sexual practices (Grigsby et al., 2023). Protective behavioral strategies (PBS) are cognitive behavioral strategies employed before, during, after, or instead of marijuana consumption (Pedersen et al., 2017, e.g., Limit the amount of marijuana smoked in one sitting). In recent years, cannabis-specific PBS have emerged as a robust protective factor against the negative consequences associated with cannabis use (Grigsby et al., 2023). Mounting evidence indicates that the adoption of cannabis-PBS is associated with decreased cannabis use and its related consequences (González-Ponce et al., 2022; Richards et al., 2023). Moreover, interventions aimed at reducing cannabis use and consequences that include cannabis-PBS as a component have proven to be useful (Prince et al., 2020; Riggs et al., 2018). In this regard, studies adopting a within-subject approach showed that rather than the use of specific PBS, the use of a larger number of these strategies contributes to reducing adverse cannabis-related outcomes (Grigsby et al., 2023; Pearson et al., 2020).In the field of alcohol-PBS, a variety of measurement instruments have been created to assess alcohol-related PBS (see Prince et al., 2013 for a review). Among available measures, the Protective Behavioral Strategies Scale (PBSS, Martens et al., 2005; Treloar et al., 2015) is recognized as the most widely used and has strong psychometric support (Pearson, 2013; Peterson et al., 2021). The availability of standardized instruments with strong psychometric properties has boosted research in the alcohol-PBS field. Thus, alcohol-PBS have not only been shown to predict fewer negative consequences and reduced alcohol intake (Fernández-Calderón et al., 2021) but have also been identified as a robust protective factor against a variety of cannabis-related consequences, including poor mental health, coping motives for alcohol use, and impulsivity (González-Ponce et al., 2022; Peterson et al., 2021). In contrast, the development of measurement instruments for cannabis-PBS is considered an emerging field despite the widespread use of this substance and the emerging policies worldwide that point towards an increasing availability of cannabis products in the coming years (Manthey et al., 2023). In particular, to our knowledge, only one standardized instrument is currently available — the Protective Behavioral Strategies for Marijuana scale (PBSM, Pedersen et al., 2016; 2017, developed based on the alcohol-PBSS (Martens et al., 2005). The PBSM was developed to provide clinicians and researchers with an instrument to assess protective strategies that may help young adults limit their cannabis use and minimize the cannabis-related consequences they may experience (Pedersen et al., 2017).During the development of the initial version of the PBSM (Pedersen et al., 2016), a preliminary pool of 50 items was tested through an online survey administered to a sample of 210 U.S. undergraduate students (78% women) enrolled in psychology courses, all of whom reported past 6-months marijuana use. A principal component analysis was conducted to provide a final unidimensional measure comprising 39 items with excellent reliability in terms of internal consistency (alpha = 0.95) and evidence of validity (PBSM scores were negatively associated with marijuana-related consequences and frequency of use and positively associated with alcohol-PBSS scores). However, a year after the publication of the PBSM-39, the same research group introduced a revised version of the PBSM (Pedersen et al., 2017) to address certain limitations of their previous version (e.g., limited sample size and homogeneity). The new version was developed with a larger sample (n = 2117) that included a more heterogeneous group of students (60% women) from 11 universities spanning a variety of degree subjects across the US (25.5% of participants

were recruited in a state in which recreational marijuana use was legal). The authors used the initial pool of 50 items produced by Pedersen et al. (2016) to conduct both Exploratory and Confirmatory Factor Analyses. This process yielded psychometric support for a unidimensional 36-item measure, retaining three items excluded from the previous PBSM version and excluding six previously retained items. Moreover, to enhance practicality in research and clinical settings and alleviate the burden on respondents, Item Response Theory techniques were employed to create a 17-item short form known as the PBSM-SF. This instrument excluded 19 items from the PBSM due to showing differential item functioning (DIF) in at least one of four factors (legal status of marijuana use, gender, race, and ethnicity).

Since its development, many studies (e.g., Bravo, et al., 2019a; Richards et al., 2023) have utilized the PBSM (Pedersen et al., 2017), which has been adapted to other languages. Notably, the German version of the 36-item PBSM was recently subjected to psychometric testing in a community online sample (n = 362; Genrich et al., 2021), while Côté et al. (2022) found support for the unidimensional structure of the French version of the short PBSM-17 in a sample of 211 university students. However, to our knowledge, no studies have examined the psychometric properties of an adapted Spanish version of the PBSM. Richards et al. (2021) conducted an online survey to compare marijuana-PBS use across genders and cultures in five samples of university students (Spain, n = 169; Argentina, n = 153; Uruguay, n = 46; U.S., n = 697; Netherlands, n = 66). They employed a translation and back-translation procedure to provide a Spanish version of the short 17-item PBMS, reporting acceptable Cronbach´s alpha values across the five samples (range = 0.78-0.94). Nonetheless, despite the subsequent use of this Spanish PBSM version in some studies (Herchenroeder et al., 2022, alpha = 0.87; Pilatti et al., 2022, alpha = 0.88), no evidence of validity has been provided.

The Present Study

The use of instruments in subpopulations and/or cultures different from those for which they were originally designed requires a process of adaptation extending beyond direct and inverse translation (AERA: American Educational Research Association, APA: American Psychological Association, & NCME: National Council on Measurement in Education, 2014; International Test Commission, 2017). This process requires consideration of the specific characteristics (e.g., language) of each culture/subpopulation to ensure equivalence across constructs. The PBSM (Pedersen et al., 2016, 2017) was initially designed for US college students, focusing on cannabis flower consumption (i.e., marijuana) since this is the form typically consumed in the US (Looby et al., 2021). In Spain, however, marijuana and hashish are consumed almost equally, and it is estimated that 89.5% of Spanish past-month cannabis users mixed cannabis with tobacco (Observatorio Español de las Drogas y las Adicciones [OEDA], 2022). Moreover, the legal status of cannabis varies between many US states and Spain, where both medical and recreational uses are not legal, which may impact cannabis-related social norms, behaviors, and the utility of certain PBS (e.g., Do not keep marijuana in the car, whether as a driver or passenger). Moreover, the PBSM was designed with college students, limiting its generalizability to young non-college adults. Therefore, our primary objective is to provide an adapted Spanish version of the PBSM (the Spanish Protective Behavioral Strategies for Cannabis scale, S-PBSC) in a community-based sample of young adults reporting past-month cannabis use. Given the contextual

and cultural differences between the US and Spain, we used the initial 50-item pool developed by Pedersen et al. (2016). We conducted an item selection process based on evidence of validity (internal structure) and reliability (corrected item-total correlation). Through cross-validation, two random (exploratory and confirmatory) samples were employed to select items based on factor loadings and discrimination indices.

Research has consistently shown that women use both alcohol and cannabis PBS more frequently than men (Bravo et al., 2017; Jongenelis et al., 2016; Richards et al., 2021). Moreover, previous studies have found larger correlations between cannabis-PBS and cannabis-related outcomes for men than women (Richards et al., 2021). It has also been shown that men and women with similar levels of PBS use have different probabilities of endorsing certain PBSM items, with Pedersen et al. (2017) identifying DIF across genders in 13 items. In addition to gender differences, previous research has shown that college students, compared with their non-college counterparts, are more motivated to respond to tests with which they are more familiar and possess superior cognitive skills to do so (Foot & Sanford, 2004; Hooghe et al., 2010). Given that the PBSM was originally developed with college students, and these individuals report significantly lower rates of cannabis use compared to their non-college counterparts (Patrick et al., 2022), it is essential to investigate potential differences in the functioning of the S-PBSC according to university status. Thus, our second objective was to examine the invariance of the S-PBSC according to gender and university status. The third objective was to explore differential item functioning according to gender and university status. Finally, as a fourth objective, we aimed to develop a short-form version of the S-PBSC (the S-PBSC-SF) through item selection based on the relationship between each item and cannabis-related consequences and cannabis use (Crocket & Algina, 1986). For both the S-PBSC and the S-PBSC-SF, we will assess their relationships with cannabis outcomes (evidence of criterion validity) and alcohol PBS use (evidence of convergent validity).

Methods

Participants and Procedure

As part of an ongoing longitudinal study, between June 2022 and July 2023, targeted sampling (Watters & Bernacki, 1989) was used to access a sample of 616 community young adults aged 18–25 ($M = 21.04$ [$SD = 2.16$], men = 60.6%) who reported past-month cannabis use. The responses of four participants were excluded due to inconsistent response patterns, resulting in a final analytic sample of 612 participants. The sampling began by identifying potential settings where participants could be recruited through a qualitative procedure. Young adults who self-identified as cannabis users were interviewed, and a list of settings across the cities of Huelva and Sevilla, including parks, squares, and areas with bars/pubs, was compiled. Additionally, to ensure a diverse socioeconomic status among participants, the various districts of each city were identified. Subsequently, three psychologists experienced in social psychology visited the predetermined settings and walked the streets in each district. Young adults who appeared to meet the age criteria were approached, and those expressing interest in participating were contacted in the following days to confirm that they met the cannabis use criterion (using cannabis at least one day in the past month). Recruiters also posted basic information about the study across the various city districts.

Consistent with targeted sampling principles (Vervaeke et al., 2007; Watters & Biernacki, 1989), some participants were given the opportunity to nominate potential candidates from their social networks (i.e., snowball sampling, Goodman, 1961). A maximum limit of five nominations per participant was set to avoid sample homogeneity. Moreover, data were continuously analyzed throughout the sampling procedure to adapt the recruitment and sampling techniques (Thompson & Collins, 2002), ensuring a heterogeneous sample in terms of age, gender, university status, and cannabis use profile. The baseline sample (n = 612) consisted of 128 (21.0%) participants directly recruited by the field researcher, 198 (32.4%) nominated by other participants, and 286 (46.7%) who had contacted the researcher after seeing a poster in the street. The questionnaire was self-administered, individually or in groups of no more than five people. The sessions took place in rooms at the University of Huelva and collaborating organizations in Sevilla, specifically those working in the drug-related field. Before completing the questionnaire, participants received detailed instructions, and they provided informed consent. The interviewer assisted in the completion process, and after finishing the questionnaire, each participant received a 15-euro Amazon voucher. The study protocol was approved by the Regional Committee for Bioethics Research of Andalusia (Regional Ministry of Health, Andalusia, Spain).

Among our sample (n = 612), 41.0% were studying at university, with the majority (65.0%) living with their parents, 18.0% with flatmates, and 6.5% with their partners. Almost a third (30.1%) self-identified as non-heterosexual, and a job served as the main source of income for 35.3% of the participants (47.9% reported a family allowance as their main source of income). In terms of socioeconomic status, the mean score in the MacArthur Scale of Subjective Social Status was = 5.86 (range 1–10, $SD = 1.51$; percentile 25 = 5, $P_{50} = 6$, $P_{75} = 7$). Regarding the frequency of cannabis use in the past six months, 18.7% reported using it three or fewer times per month, 26.5% between 1–3 days per week, and 54.9% four or more days per week. The mean number of days of cannabis use in the past month was 18.16 ($SD = 10.88$), and the mean quantity of grams used in a typical week during the past month was 8.50 ($SD = 10.46$). In a typical past-month day of cannabis use, participants reported using a mean of 1.39 g ($SD = 1.34$) of cannabis and being under its effects for a mean duration of 225.77 min ($SD = 210.54$) [in hours: $M = 3$ h, 45 m ($SD = 3$ h, 30 m)].

Instruments

Subjective Social Status

The MacArthur Scale of Subjective Social Status (Adler et al., 2000) was used to assess subjective social status. The participants were asked to report their perceived social status regarding the Spanish population. Answers ranged between 1 (that identifies the people with the least money, least education, and the least respected jobs or no job) and 10 (the higher social status).

Cannabis use

Participants reported their frequency of cannabis use (hashish or marijuana) over the past six months and the mean days of use in the past month. We also asked them to reflect on a typical day of past-month cannabis use and report the number of grams used and minutes spent under the effects during that specific day. To aid in estimating grams of cannabis, participants were presented with images displaying marijuana and hashish in

various quantities (0.25 / 0.5 / 1.0 / 2.5 g) accompanied by bottle tops (see supplemental Figure S1). The Marijuana Use Grid (MUG, Pearson & Marijuana Outcomes Study Team, n.d.) was used to assess the quantity of cannabis used in a typical week during the past month. The MUG divides each day of the week into six blocks of four hours (42 blocks in total), and participants are asked to report the grams of cannabis used during each block. The reported quantities are then summed to calculate the overall quantity used during a typical week of cannabis use. Given that hashish and marijuana are consumed at similar rates in Spain (Observatorio Español de las Drogas y las Adicciones [OEDA], 2022), participants were asked to consider a typical past-month week of cannabis use and then report, separately, the quantity of marijuana and hashish used.

Spanish Version of the Protective Behavioral Strategies for Marijuana Scale (S-PBSC)

Given the differences between the US and Spain in terms of cultural aspects and cannabis presentation typically used (i.e., marijuana vs. hashish), we used the initial 50-item pool designed by Pedersen et al. (2016). Adhering to the International Test Commission Guidelines (2017), we first considered the equivalence of the construct underlying the PBSM between the Spanish and US cultures, taking into account potential linguistic, psychological, and cultural differences.

Four research team members were involved in the translation and adaptation of the instrument. These researchers were experienced in psychometrics and drug-related harm reduction behaviors, and one of them was a native English speaker researcher in the field of alcohol and cannabis PBS. Since both marijuana and hashish are used in Spain (Observatorio Español de las Drogas y las Adicciones [OEDA], 2022), we initially decided to replace "marijuana" with "cannabis" in the wording of the items and scale instructions. The adaptation and translation process was conducted across four phases. In the first phase, the corresponding author created a template with the original 50 items, each designated for the researchers to independently provide an initial translation to be returned to the corresponding author. In the second phase, the corresponding author integrated the proposals from all four researchers, along with the original PBSM items, and returned them. The researchers were instructed to consider the Phase 1 proposals of the other three members and provide new proposals for each item. Following this phase, consensus was reached concerning the wording of 39 of the 50 items. The remaining 11 items were discussed within the research group during a meeting (Phase 3) until consensus was reached. Finally, the Spanish version of the 50 items was submitted to a professional American translator (Ph.D. in Psychology) for back-translation. Minor adjustments were made to the wording of some items (see Table 2 for item wording). Similar to the original PBSM (Pedersen et al., 2016, 2017), we used a six-point Likert response format ranging from never to always (see Appendix A).

Negative Cannabis-Related Consequences in the Past Month

We used the Brief Marijuana Consequences Questionnaire (B-MACQ, Simons et al., 2012) in its Spanish version (Bravo et al., 2019b), which consists of 21 dichotomous items (presence = 1/absence = 0) measuring a range of negative consequences experienced in the past month that are summed to produce a total score of cannabis-related problems. As recommended by Bravo et al. (2019b), Item 5 (I have gotten into physical fights because of my marijuana use) was removed. Cronbach's Alpha and McDonald's Omega values for this sample were 0.80 and 0.81, respectively.

Alcohol-Protective Behavioral Strategies

The 20-item Protective Behavioral Strategies Scale (PBSS-20, Treloar et al., 2015), in its Spanish version (S-PBSS-20, Sánchez-García et al., 2020), was administered to measure alcohol PBS. Participants were queried about their frequency of use of each strategy when they used alcohol during the past two months. Response options ranged from 1 (never) to 5 (always), with an Alpha of.82 and Omega of 0.82.

Data Analysis

Given the cultural differences between the US and Spain (e.g., the legal status of cannabis, prevalent forms of cannabis –marijuana vs. hashish-), we used the 50-item pool created by Pedersen et al. (2016) to identify the most suitable items for the Spanish PBSC. In this selection process, we took into account evidence of a) reliability (corrected total-item correlation), b) validity based on the internal structure (factor loadings, invariance, and differential item functioning), and c) validity based on the relationships between the S-PBSC and other external variables (item correlation with cannabis outcomes).

Item Selection Procedure

To provide cross-validation evidence and mitigate the capitalizing on chance errors (Lorenzo-Seva, 2022; Luijben, 1989), we randomly divided our sample (n = 612) into two subsamples of 306 participants. One subsample was designated for exploring the factor structure, and the other was used to confirm this structure. The equivalence of subsamples was verified using the corresponding test statistic (Student´s *t* or chi-square) according to sociodemographic characteristics (gender, age, and college status) and past-month cannabis use profile (quantity used in a typical week, days of use, and time under cannabis effects in a typical day of use). In addition, the S index (communality ratio, Lorenzo-Seva, 2022) was calculated, which compares the values of the KMO statistic to determine the suitability of applying unidimensional factor analysis to the 50 PBSM items (Pedersen et al., 2016) in each subsample: S = KMOminor/KMOmajor. Values close to 1 indicate that the two subsamples are homogeneous. Subsequently, Confirmatory Factor Analysis (CFA) was employed to test a unidimensional model in two phases. In the first phase, CFA was applied using an exploratory approach with subsample 1. In the second phase, cross-validation evidence was obtained by validating the factorial model obtained in Phase 1 using the second subsample.

Exploratory Phase CFA was conducted to test a unidimensional model using the 50 original PBSM items for the first exploratory sample. The analysis employed diagonal weighted squares (DWLS) estimation, implemented with the 'cfa' module of the R package 'lavaan' (Rosseel, 2012). DWLS is a suitable estimation method for ordinal data when multivariate normality cannot be assumed (Mindrila, 2010; Rhemtulla et al., 2012). To assess model fit, we used the following fit indices: the comparative fit index (CFI), the Tucker–Lewis index (TLI), the root-mean-square error of approximation (RMSEA), and the standardized root mean square residual (SRMR). CFI and TLI values > 0.95 and RMSEA and SRMR values < 0.06 and 0.08 indicate good fit (Hu & Bentler, 1999). The process of item selection was based on factor loading (items with factor loading < 0.40 were removed) and item discrimination index values (corrected item-test correlation). Although some authors suggest

a minimum value of 0.20 for these correlations (Schmeiser & Welch, 2006), we used a more conservative criterion of 0.30 or higher to retain items. The elimination process was conducted iteratively, removing one item at a time. After the elimination of each item, all the indices described were recalculated.

Confirmatory Phase *Cross-validation*. In the cross-validation process, the items selected in the previous phase were tested using the confirmatory sample. The same criteria employed in Phase 1 were followed for item selection in this confirmatory phase.

Analysis of Invariance Considering the total sample (n = 612), an invariance analysis was carried out with the items selected after cross-validation. Specifically, the invariance of the factor structure was examined with respect to three variables: exploratory vs. confirmatory sample, men vs. women, and university students vs. non-university students. The analysis involved four testing steps: configural, metric, scalar, and strict invariance. To verify that the invariance assumptions were met at each step, the fit of the most restricted model was compared with that of the least restricted model. Changes in CFI and RMSEA values of less than 0.01 and 0.015, respectively, were interpreted as evidence of invariance (Chen, 2007; Cheung & Rensvold, 1999). If the invariance criterion was not met for all items, modification indices were used to identify items with non-invariant parameters.

Differential Item Functioning (DIF) To identify items with DIF and remove them from the S-PBSC, we used the comparison groups of male vs female and university students vs non-students. The 'Mantel. Poly' procedure in R (Wells, 2023) was used to calculate the DIF, testing the null hypothesis of no difference between the compared groups. Given the high number of comparisons, the Bonferroni correction was used, considering alpha levels based on the number of comparisons (Stark et al., 2006).

Short-Form Development (S-PBSC-SF)

In developing the S-PBSC-SF, the item selection process was based on the relationship between the 31 selected items and two external criteria. Items with correlations ≥ 0.30 with at least one of the following two criteria were retained: 1) cannabis-related consequences, 2) grams of cannabis used in a typical consumption week during the past month.

Reliability and Validity Evidence of S-PBSC and S-PBSC-SF

The internal consistency of the items, as evidence of reliability, was assessed using Cronbach´s Alpha and Mcdonald's Omega, calculated with the R package 'semTools' (Jorgensen et al., 2022). To establish evidence of the validity of the test scores based on their relationships with other variables, we examined the correlations between test scores and four past-month cannabis outcomes (quantity used in a typical week, days of use, time under cannabis effects in a typical day of use, and cannabis-related consequences). Finally, we conducted eight hierarchical regression models, including the four cannabis outcomes mentioned above as dependent variables and S-PBSC and S-PBSC-SF as predictors. These analyses were conducted using IBM SPSS 29. All models included sociodemographic characteristics as covariates, while models with cannabis-related consequences as dependent variables also included cannabis use variables (quantity, frequency, time under effects of cannabis) as covariates.

Secondary Analyses

As a secondary objective, considering the significance of the differences in cannabis-PBS scores regarding gender and university status, bivariate analyses were conducted to examine whether test scores differed according to these two variables. Additionally, cannabis-related outcomes were also examined according to gender and university status.

Results

Subsample splitting

After splitting our sample into two random samples, each consisting of 306 participants, the results revealed no significant differences in terms of sociodemographic characteristics (gender, university status, age) and past-month cannabis outcomes (quantity used in a typical week, days of use, time under cannabis effects in a typical day of use, and cannabis-related consequences). The S Index (communality ratio) was 0.978 ($KMO_{exploratory\ sample} = 0.884$; $KMO_{confirmatory\ sample} = 0.904$), and therefore both samples can be considered homogeneous.

Exploratory Sample (n = 306). CFA in an Exploratory Context

CFA was initially conducted with the exploratory sample to test a unidimensional model with the 50 initial items, which showed adequate fix indices ($\chi^2_{(1175)} = 2091.78$, $p < 0.001$; CFI = 0.95; TLI = 0.95; RMSEA = 0.051). However, several items did not meet the two established selection criteria (factor loadings ≥ 0.40 and corrected item-total correlation ≥ 0.30), and therefore, a step-by-step process of item selection was conducted. First, the item with the worst values was removed, and the values for the remaining items were re-estimated according to a unidimensional model. After repeating this process in subsequent steps, a 35-item unidimensional model with good fit indices was obtained ($\chi^2_{(560)} = 894.16$, $p < 0.001$; CFI = 0.98; TLI = 0.98; RMSEA = 0.044), where every item met the selection criteria.

Confirmatory Sample (n = 306). Cross-Validation

CFA was conducted to test a unidimensional model with the 35 previously selected items, showing adequate fit indices ($\chi^2_{(560)} = 914.02$, $p < 0.001$; CFI = 0.98; TLI = 0.98; RMSEA = 0.046). After applying the step-by-step item selection process, two items were removed due to presenting factor loadings < 0.40. The 33-item unidimensional model showed an adequate fit ($\chi^2_{(495)} = 820.26$, $p < 0.001$; CFI = 0.98; TLI = 0.98; RMSEA = 0.046).

Analysis of Invariance and Differential Item Functioning (n = 612)

Table 1 displays the results of the invariance analysis for the 33 previously selected items across random subsamples, university status, and gender. The fit indices for all the tested models were adequate, both for the groups tested separately and those specified

Table 1 33-item unidimensional model measurement invariance across samples (Exploratory vs. Confirmatory, university students vs Non-university students, and men vs women)

Model tested	χ^2	df	χ^2/df	CFI	ΔCFI	TLI	SRMR	RMSEA	ΔRMSEA	RMSEA 90% CI
Exploratory vs Confirmatory										
Exploratory	831.90	495	1.69	.974		.972	.073	.048		.042/.053
Confirmatory	813.98	495	1.64	.979		.978	.070	.046		.040/.052
M1: configural invariance	1645.88	990	1.66	.977		.975	.070	.047		.043/.051
M2: metric invariance (M1 vs M2)	1850.71	1022	1.81	.971	.006	.970	.074	.052	.005	.048/.056
M3: scalar invariance (M2 vs M3)	1872.48	1054	1.78	.971	.000	.971	.074	.051	.000	.047/.054
M4: strict invariance (M3 vs M4)	1898.17	1087	1.75	.971	.000	.972	.075	.050	.000	.046/.053
Men vs Women										
Men	949.61	495	1.92	.973		.971	.070	.050		.045/.055
Women	715.69	495	1.45	.981		.980	.076	.044		.036/.051
M1: configural invariance	1665.30	990	1.68	.976		.975	.070	.048		.044/.052
M2: metric invariance (M1 vs M2)	1979.82	1022	1.94	.966	.010*	.965	.076	.056	.008	.052/.059
M3: scalar invariance (M2 vs M3)	2052.20	1054	1.95	.965	.001	.965	.077	.056	.000	.052/.060
M4: strict invariance (M3 vs M4)	2094.69	1087	1.93	.965	.000	.966	.078	.055	.000	.052/.059
Non-Students vs Students										
Non-Students	909.23	495	1.84	.976		.974	.068	.049		.044/.053
Students	850.75	495	1.72	.960		.957	.081	.054		.048/.060
M1: configural invariance	1759.98	990	1.78	.971		.969	.072	.051		.047/.055
M2: metric invariance (M1 vs M2)	1970.02	1022	1.93	.964	.007	.963	.075	.055	.004	.052/.059
M3: scalar invariance (M2 vs M3)	2021.35	1054	1.92	.963	.001	.963	.076	.055	.000	.052/.059
M4: strict invariance (M3 vs M4)	2125.15	1087	1.96	.960	.003	.962	.079	.055	.000	.053/.060

Configural invariance = factor structure is equal between groups; metric invariance = restriction added: factor loadings are equal; scalar invariance = restriction added: intercepts are equal; strict invariance = restriction added: residuals are equal. *CFI difference is .01, although RMSEA difference is below .015, and therefore invariance is assumed

in the invariance stages. Additionally, upon comparing the nested models, it is evident that all the contrasts performed satisfy the invariance assumptions. Thus, no items were removed after the invariance analyses.

The examination of DIF across genders revealed differential functioning for Item 43, leading to its removal. DIF was then re-examined for the remaining 32 items, indicating no differential functioning in any item according to gender. After repeating the DIF analyses across university status, the differential functioning of Item 14 was identified and subsequently removed. Finally, we re-examined the DIF of the remaining 31 items across genders and university status, confirming that none presented any DIF. The 31 items selected for the final S-PBSC and the removed items (and the rationale behind their exclusion) are specified in Table 2.

Development of the S-PBSC Short-Form (S-PBSC-SF)

After examining the correlation between the 31 items of the full-length S-PBSC version and two external factors (cannabis-related negative consequences and cannabis quantity), a total of 13 items showed correlations ≥ 0.30 with at least one of these two criteria (see supplemental Table S1), and were therefore selected for the S-PBSC-SF (full versions of the S-PBSC and S-PBSC-SF, including instructions for application, are available in Supplementary Appendix-A).

Evidence of Reliability and Validity of the S-PBSC and S-PBSC-SF

Table 3 indicates that both the S-PBSC and S-PBSC-SF showed excellent fit and internal consistency. In terms of validity, based on their relationships with other variables, Table 4 illustrates the correlations between S-PBSC and S-PBSC-SF with various factors. As expected, alcohol PBS were positively correlated with S-PBSC ($r = 0.416$, $p < 0.001$) and S-PBSC ($r = 0.314$, $p < 0.001$), while the remaining correlations were negative and statistically significant (and higher than |.38|). For three out of four cannabis outcomes, S-PBSC-SF correlations were slightly higher than the S-PBSC correlations.

In terms of predictive validity (Table 5), regression models showed that both the S-PBSC and the S-PBSC-SF were significant predictors of cannabis outcomes, significantly contributing to the explained variance even after introducing the covariates into the models.

Secondary Results

As a secondary analysis, differences in scale scores and cannabis outcomes were tested according to gender and university status. As shown in Supplemental Table 2, compared to men, women scored higher in S-PBSC, although the effect size was small ($d = -0.193$). Moreover, compared to university students, their non-college counterparts reported higher PBS use for both the S-PBSC and the S-PSC-SF ($d = -0.501$ and -0.528, respectively).

For three out of four cannabis outcomes, no gender differences were observed. However, men reported spending more time under the effects of cannabis during a typical

Table 2 Means, standard deviations, corrected total-item correlation, and factor loading for the unidimensional model (n = 612, items selected for the 13-item S-PBSC short form are in bold)

Retained items (S-PBSC and S-PBSC-SF)		Mean	*SD*	Corrected item-total correlation	Factor loading
1	PBSM2* Consumir cannabis solo con personas de confianza [Use marijuana only among trusted peers]	4.96	1.18	.442	.452
2	**PBSM5* Evitar consumir cannabis antes de ir al trabajo o a clase [Avoid using marijuana before work or school]**	4.88	1.50	.513	.531
3	**PBSM6* Evitar consumir cannabis para afrontar emociones como la tristeza o la depresión [Avoid using marijuana to cope with emotions such as sadness or depression]**	3.72	1.71	.420	.438
4	PBSM7 Elegir a alguien que no consumirá cannabis para poder conducir [Use a designated driver (i.e., someone who has not used) after using marijuana]	4.11	1.94	.461	.470
5	PBSM8* No llevar cannabis en el vehículo (coche. moto…). tanto si conduzco como si voy de pasajero/a [Do not keep marijuana in the car, whether as a driver or passenger]	3.45	1.79	.557	.571
6	**PBSM9* Evitar llevar cannabis a eventos o lugares donde es posible que te registren [Avoid bringing marijuana into events or venues where you are likely to be searched]**	3.83	1.69	.587	.604
7	**PBSM10* Limitar el consumo de cannabis a los fines de semana [Limit use to weekends]**	2.99	1.78	.592	.629
8	PBSM11* Evitar conducir un vehículo (coche. moto…) después de consumir cannabis [Avoid driving a car after using]	4.77	1.81	.503	.509
9	**PBSM13* Evitar consumir cannabis habitualmente (es decir, todos los días o varias veces a la semana) [Avoid using marijuana habitually (that is, every day or multiple times a week)]**	3.48	1.83	.650	.695
10	PBSM16* Evitar consumir cannabis desde varios días antes de un examen importante, una entrevista u otro compromiso en el que seré evaluado/a y para el que debo estar despejado/a [Avoid using marijuana for several days in advance of a big test, interview, performance, or other engagement for which you need to be crisp and are being evaluated]	3.42	1.83	.568	.593
11	PBSM17* Consumir un poco y esperar a ver cómo me siento antes de consumir más [Use a little and then wait to see how you feel before using more]	3.43	1.68	.487	.507
12	PBSM18* Evitar comprar cannabis [Avoid buying marijuana]	2.63	1.49	.525	.556
13	PBSM19 Evitar consumir cannabis si estoy tomando algún medicamento que pueda intensificar sus efectos (por ejemplo. hacer que me sienta más cansado/a) [Avoid using marijuana if currently taking any kind of prescription drug that might intensify the effects (e.g., make you feel more tired)]	3.83	1.84	.530	.539
14	PBSM20* Evitar mezclar cannabis con otras drogas [Avoid mixing marijuana with other drugs]	4.08	1.84	.433	.438
15	**PBSM21* Consumir solo por la noche (es decir. no durante el día) [Only use at night (that is, not during the day)]**	3.66	1.65	.604	.641

Table 2 (continued)

16	**PBSM22* Dejar de consumir cannabis si siento ansiedad o paranoia [Stop using marijuana if you become anxious or paranoid]**	4.25	1.75	.522	.544
17	PBSM23* Evitar consumir cannabis en lugares públicos [Avoid using marijuana in public places]	3.42	1.59	.479	.495
18	**PBSM24* Hacer descansos si siento que estoy consumiendo cannabis con demasiada frecuencia [Take periodic breaks if it feels like you are using marijuana too frequently]**	4.12	1.52	.640	.669
19	PBSM29 Evitar que mi consumo pueda ocasionarme problemas legales (por ejemplo, consumir cannabis solo en lugares seguros como mi casa, no llevar cannabis encima si creo que pueden registrarme. etc.) [Avoid possibilities of legal repercussions (e.g., smoke in a safe place like home, avoid having marijuana with you where you might get searched, etc.)]	4.00	1.70	.472	.487
20	PBSM31 Hacer un descanso en el consumo si siento que estoy perdiendo motivación por las cosas [Take a break from using if feeling a loss of motivation]	3.64	1.67	.549	.575
21	**PBSM32* Consumir solo cuando sé que no tengo nada importante que hacer el resto del día/noche [Only use when you know you have nothing important to do for the rest of the day/night]**	4.22	1.65	.593	.622
22	**PBSM34* Evitar consumir cannabis por aburrimiento [Avoid using marijuana out of boredom]**	3.63	1.65	.522	.545
23	PBSM35* Evitar formas de consumir cannabis que puedan hacer que me coloque más de lo que me gustaría (por ejemplo, usando bongs grandes. Vaporizadores, comestibles hechos con cannabis. etc.) [Avoid methods of using marijuana that can make you more intoxicated than you would like (e.g., using large bongs, volcano, "edibles," etc.)]	3.63	1.79	.408	.416
24	PBSM37* Dejar pasar el porro (o el bong, etc.) si ya me siento suficientemente colocado/a [Pass on shared joints, bongs, etc. if already feeling high]	4.77	1.32	.460	.472
25	**PBSM39* Consumir cannabis solo una vez al día/noche [Only use one time during a day/night]**	3.42	1.66	.632	.671
26	PBSM40* Evitar consumir cannabis en grandes reuniones o lugares multitudinarios [Avoid using marijuana in large gatherings or crowds]	3.81	1.54	.515	.531
27	**PBSM41* Limitar la cantidad de cannabis que consumo en una misma ocasión [Limit the amount of marijuana you smoke in one sitting]**	3.71	1.49	.548	.568
28	PBSM45* Evitar el consumo de productos concentrados (por ejemplo. polen. kifi. aceite o mantequilla. etc.) para evitar colocarme demasiado [Avoid using marijuana in concentrated forms (e.g., hashish, hashish/honey oil, kief, marijuana butter/oil, etc.) to avoid getting too high]	3.12	1.85	.473	.485
29	PBSM47* Para reducir la tolerancia, hago una pausa en el consumo de una o dos semanas (o más) [To decrease tolerance, take a break for a week or two, or take longer breaks than usual between use]	2.78	1.64	.520	.551

Table 2 (continued)

30	**PBSM48* Consumir lo suficiente como para colocarme solo un poco o evitar colocarme demasiado [Use enough only to achieve a slight buzz or to avoid getting "too high"]**	3.84	1.46	.550	.571
31	PBSM50* Evitar consumir cannabis antes de realizar una actividad física (p.ej. ejercicio, senderismo) [Avoid using marijuana before engaging in physical activity (i.e., exercise, hiking)]	4.65	1.55	.455	.471

Items removed due to factor loading < .40 and/or corrected item-total correlation < .30 (exploratory sample)

	Mean	*SD*
PBSM1 Consumir cannabis solo tras terminar con todas mis responsabilidades del día [Only use marijuana after completing all of the day's responsibilities]	4.33	1.50
PBSM3 Evitar mezclar cannabis con alcohol [Avoid mixing marijuana with alcohol]	3.58	1.65
PBSM4* Evitar consumir cannabis cuando estoy con mi familia [Avoid use while spending time with family]	5.13	1.43
PBSM12* Comprar cannabis solo a personas/fuentes de confianza [Only purchase marijuana from a trusted source]	4.92	1.35
PBSM15* Llevar la cuenta del dinero que gasto en cannabis para tener una idea exacta de cuánto gasto [Keep track of your costs to get an accurate picture of how much you spend on marijuana]	3.84	1.82
PBSM25* Comprar menos cantidad de cannabis para consumir menos [Buy less marijuana at a time so you smoke less]	3.43	1.56
PBSM26 Marcharme de la habitación si hay gente consumiendo cannabis y no me siento cómodo/a o no quiero que me ofrezcan [Excuse yourself from the room if people are smoking marijuana and you feel uncomfortable or do not wish to be offered marijuana]	2.22	1.55
PBSM28 Consumir cannabis solamente en casa [Use only at home]	3.06	1.66
PBSM30 Usar un vaporizador u otros métodos sin combustión para evitar las sustancias cancerígenas [Use a vaporizer or other smokeless method to avoid carcinogens]	1.56	1.11
PBSM33* Establecer una cantidad de caladas predeterminada (p.ej.. pasando el porro si ya he alcanzado el límite que me había puesto) [Having a set amount of "times" you take a hit (e.g., passing on a shared joint if you have already hit that limit)]	2.90	1.79
PBSM36 Consumir cannabis solo en una propiedad privada [Only use marijuana on private property]	3.54	1.53
PBSM38 Usar colirios para que otras personas no sepan que he consumido cannabis [Use eye drops so others do not know you have used]	1.84	1.39
PBSM44 Consumir solo antes de eventos especiales (por ejemplo. películas o conciertos) o en ocasiones especiales [Only use before special events (e.g., movies, concerts) or on special occasions]	2.77	1.48

Table 2 (continued)

PBSM46 Consumir variedades de mayor potencia para dar menos caladas y evitar los daños en los pulmones [Use higher potency marijuana so you can take less hits and avoid lung damage]	2.75	1.52
PBSM49 Consumir mi propio cannabis (cuando estoy solo o con amigos/as) para saber lo que estoy consumiendo [Use your own marijuana (if alone or sharing with friends) so you know what you are using]	3.44	1.80
Items removed due to factor loading < .40 and/or corrected item-total correlation < .30 (confirmatory sample)		
	Mean	*SD*
PBSM27* Evitar situaciones en las que creo que van a presionarme para que consuma cannabis [Avoid situations that you anticipate being pressured to use marijuana]	2.73	1.76
PBSM42* Si voy a una fiesta u otro evento social (p.ej. un bar), decidir antes si consumiré cannabis o no [If attending a party or going out to a social event (e.g., a bar), decide in advance whether you want to use marijuana or not]	3.79	1.84
Items removed for exhibiting Differential Item Functioning across genders (item 43) and university status (item 14)		
	Mean	*SD*
PBSM14* Evitar consumir cannabis al levantarme o poco después de levantarme [Avoid using marijuana early in the day]	4.57	1.62
PBSM43* Evitar consumir cuando me siento ansioso/a ("p.ej.. evitar consumir para calmarme o dejar de preocuparme") [Avoid using when feeling anxious (e.g., using to calm you down or stop worrying)]	3.44	1.66

The items numbers named with "PBSM" (e.g., PBSM1, PBSM2) correspond with the original item numbers of the initial pool developed by Pedersen et al. (2016). Full versions of the S-PBSC and S-PBSC-SF, including instructions for application, are available in Supplementary Appendix-A

* Asterisk indicates items also retained in the PBSM full length version of Pedersen et al. (2017)

Table 3 Fit Statistics for Confirmatory Factor Models (N = 612). Unidimensional models. Reliability coefficients

Model	χ^2	*df*	*CFI*	*TLI*	*SRMR*	*RMSEA*	*90% RMSEA CI*	α	ω
S-PBSC_31 items	1233.15***	434	.968	.966	.065	.055	.051/.059	.93	.93
S-PBSC_SF_13 items	134.34***	65	.989	.987	.051	.042	.032/.052	.88	.88

S-PBSC = Spanish Protective Behavioral Strategies for Cannabis scale; S-PBSC-SF = Spanish Protective Behavioral Strategies for Cannabis scale- Short Form

Estimation Method: Diagonally Weighted Least Squares (DWLS); CFI = Comparative Fit Index; TLI = Tucker Lewis Index; RMSEA = Root Mean Square Error Approximation; SRMR = Standardized Root Mean Square Residual. PBSM_S_31 = 31 items Spanish version of PBSM (Pedersen et al., 2016). NS = -Non significant, *$p < .05$; **$p < .01$; ***$p < .001$. α = Cronbach's alpha; ω = McDonald's omega

Table 4 Means (Standard Deviations) and correlations between the study variables

	1	2	3	4	5	6	7	Mean (*SD*)
1. Age	–							21.04 (2.16)
2. Cannabis consequences[1]	.054	–						7.72 (4.20)
3. Cannabis quantity (grams)[2]	.050	**.274**	–					8.50 (10.46)
4. Time under cannabis effects (minutes)[3]	**.158**	**.221**	**.455**	–				225.77 (210.54)
5. Past-month days of cannabis use	.116	**.372**	**.507**	**.324**	–			18.16 (10.88)
6. S-PBSS-20	-.061	-.053	-.124	**-.146**	-.101	–		3.06 (0.60)
7. S-PBSC	-.017	**-.385**	**-.526**	**-.404**	**-.648**	**.416**	–	3.82 (0.94)
8. S-PBSC-SF	-.012	**-.410**	**-.554**	**-.403**	**-.682**	**.314**	**.938**	3.83 (1.06)

S-PBSS-20 = Spanish Protective Behavioral Strategies Scale (Alcohol); S-PBSC = Spanish Protective Behavioral Strategies for Cannabis scale; S-PBSC-SF = Spanish Protective Behavioral Strategies for Cannabis scale- Short Form

All correlations higher than |.14| are statistically significant ($p < .001$) and bolded for emphasis

[1]Negative cannabis-related consequences experienced in the last month

[2]Quantity (grams) of cannabis used in a typical consumption week of the past month

[3]Time under cannabis effects (measured in minutes) in a past-month typical day of cannabis use. When time is calculated in hours: *M* = 3 h, 45 min, *SD* = 3 h, 30 min

day of use than women ($p < 0.01$; d = 0.241). In contrast, compared to university students, non-college participants reported higher frequency ($p < 0.001$ $d = 0.567$) and quantity ($p < 0.001$; $d = 0.518$) of cannabis use, more time spent under the effects of cannabis during a typical day of consumption ($p < 0.001$; $d = 0.334$) and more cannabis-related consequences ($p < 0.05$, $d = 0.168$).

Discussion

The present study has successfully developed a Spanish-adapted version of the PBSM (Pedersen et al., 2016, 2017), termed the S-PBSC. A rigorous item-selection process, including cross-validation, was employed to identify the most suitable items from the original 50-item pool developed by Pedersen et al. (2016). The criteria for item selection were based on evidence of reliability (corrected total-item correlation), evidence of validity

Table 5 Hierarchical linear regression models examining the associations between sociodemographic data, pattern of cannabis use, cannabis-related consequences, and cannabis-protective behavioral strategies

Cannabis use profile outcomes										Negative cannabis-related consequences[3]			
	Cannabis quantity[1]			*Time under cannabis effects*[2]			*Past-month days of cannabis use*						
	β	R^2	ΔR^2	β	R^2	ΔR^2	β	R^2	ΔR^2		β	R^2	ΔR^2
Step 1		*.07*	*.07***		*.06*	*.06***		*.08*	*.08***	***Step 1***		*.01*	*.01*
Gender	-.05			-.12**			.02			Gender	.05		
Age	.03			.15***			.10*			Age	.05		
Univ. status	-.25***			-.15***			-.27***			Univ. status	-.08*		
Step 2A		*.29*	*.22***		*.19*	*.13***		*.45*	*.37***	***Step 2***		*.16*	*.15***
Gender	-.02			.08*			.07*			Gender	.06		
Age	.02			.15***			.10**			Age	.01		
University	-.13***			-.06			-.12***			University status	.03		
S-PBSC	-.49***			-.38***			-.62***			Cannabis quantity[1]	.10*		
Step 2B		*.32*	*.25*** *(regarding Step1)*		*.19*	*.13*** *(regarding Step1)*		*.49*	*.41*** *(regarding Step1)*	Time under cannabis effects[2]	.10*		
Gender	-.04			.10**			.04			Past-month days of cannabis use[3]	.30***		
Age	.03			.15***			.10***			***Step 3A***		*.19*	*.03***
University	-.12***			-.05			-.10***			Gender	.08*		
S-PBSC-SF	-.52***			-.38***			-.66***			Age	.02		
										University status	.04		
										Cannabis quantity[1]	.05		
										Time under cannabis effects[2]	.06		
										Past-month days of cannabis use[3]	.18***		
										S-PBSC	-.24***		
										Step 3B		*.20*	*.04*** *(regarding Step2)*

Table 5 (continued)

Cannabis use profile outcomes			Negative cannabis-related consequences[3]	
Cannabis quantity[1]	*Time under cannabis effects*[2]	*Past-month days of cannabis use*		
			Gender	.07
			Age	.03
			University status	.05
			Cannabis quantity[1]	.04
			Time under cannabis effects[2]	.06
			Past-month days of cannabis use[3]	.15**
			S-PBSC-SF	-.28***

S-PBSC = Spanish Protective Behavioral Strategies for Cannabis scale; S-PBSC-SF = Spanish Protective Behavioral Strategies for Cannabis scale- Short Form

In repeated steps (2A-2B and 3A-3B), S-PBSC and S-PBSC-SF are separately added regarding previous step 1 or 2. Gender: 0 = men, 1 = women; University status: 0 = not studying at university; 1 = studying at university. *$p < .05$; **$p < .01$; ***$p < .001$

[1]Quantity (grams) of cannabis used in a typical consumption week of the past month

[2]Time under cannabis effects (measured in minutes) in a past-month typical day of cannabis use

[3]Negative cannabis-related consequences experienced in the last month

based on internal structure (factor loadings, invariance, and differential item functioning), and evidence of validity based on the relationships between the S-PBSC scores and cannabis outcomes (cannabis use profile and cannabis-related consequences). Our findings support a 31-item unidimensional measure with excellent fit and internal consistency, invariant across genders and college status, and free of DIF based on these two variables. Moreover, correlations between the 31 selected items and two external criteria (cannabis quantity and consequences) were assessed to provide a 13-item short form (S-PBSC-SF). Both the full-length and short-form versions (S-PBSC) have shown evidence of validity according to their relationships with cannabis outcomes and alcohol PBS use.

Given the contextual and cultural differences between the US and Spain, we decided to use the initial pool of 50 items developed by Pedersen et al. (2016) to select the most suitable items for the Spanish PBS measure. As expected, some items of the PBSM (Pedersen et al., 2017) did not show adequate functioning in our Spanish sample and were therefore excluded. Specifically, only 27 of the 36 items proposed by Pedersen et al. (2017) were retained in our 31-item measure. For instance, Pedersen et al. (2017) retained the item "Avoid bringing marijuana into events or venues where you are likely to be searched", but removed it from their short 17-item PBSM due to DIF based on legal status. In contrast, this item has been retained in the 13-item short version developed in Spain, where cannabis is not legal. Similarly, Pedersen et al. (2017) identified DIF according to gender for 13 of their 36 selected items, leading to their removal from the short 17-item PBSC version. In contrast, we only observed DIF for the item "Avoid using when feeling anxious" (also identified by Pedersen et al., 2017), prompting its exclusion from both our full-length and short-form versions. This, together with the fact that gender invariance was demonstrated for both Spanish versions, suggests the adequate psychometric functioning of these measures across genders.

The PBSM was initially developed with university students (Pedersen et al., 2016, 2017), known for their familiarity with and motivation to respond to tests compared with their non-university counterparts, while possessing superior cognitive skills to complete such tasks (Foot & Sanford, 2004; Hooghe et al., 2010). Moreover, as pointed out by Pedersen et al. (2017), non-college young adults may differ substantially in terms of cannabis and PBS use. Consistent with previous research (Patrick et al., 2022), our findings reveal higher cannabis usage rates among non-college young adults compared to their university counterparts. Furthermore, non-college young adults tend to use cannabis-PBS more frequently and experience more negative consequences. Our study offers a PBS measure that is invariant in terms of university status, based on a large sample of Spanish community young adults. This characteristic facilitates its applicability to a broad population of young adults. Interestingly, we identified DIF according to university status for the item "Avoid using marijuana early in the day" (retained by Pedersen et al., 2016, 2017), which may be attributed to the expectation that attending university typically implies high cognitive functioning early in the day.

The existing body of literature on cannabis-PBS consistently indicates that using PBS is associated with a reduction in negative cannabis-related consequences and a decrease in cannabis use in terms of frequency and quantity (Bravo et al., 2017; Côté et al., 2022, Genrich et al., 2021; Jordan et al., 2022). In alignment with these observations, our regression analyses have demonstrated the predictive validity of both the full-length and short-form S-PBSC concerning cannabis use profile and cannabis-related consequences. This was maintained even after controlling for the effect of gender, age, and university status. It is noteworthy that in producing our short S-PBSC form, we used two external criteria, namely cannabis quantity and cannabis-related outcomes, consistent with the intended

purposes of the scale. Thus, unsurprisingly, the correlations between the scores of our short-form and cannabis-related outcomes were found to be stronger than those observed with our full-length scale. This strong correlation may prove advantageous in clinical settings or when PBS are used to educate young adults about potential strategies to reduce their cannabis use and its related consequences. Furthermore, it can be highlighted that in comparison to the work of Pedersen et al. (2017), our S-PBSC and S-PBSC-SF have an item reduction of 13.89% (from 36 to 31) and 25.53% (from 17 to 13), respectively, while maintaining excellent psychometric properties. This reduction may enhance the practicality and applicability of our scales in both clinical and research context.

Limitations and Future Directions

While we used targeted sampling to recruit a heterogeneous sample of young adults who reported cannabis use, our participants may not be fully representative of the broader population of cannabis-using young adults. Future investigations involving Spanish-speaking participants should aim to replicate our findings with other young adult samples across diverse geographical areas. Additionally, while cannabis use is more prevalent among young adults, high rates are also observed in adults (EMCDDA, 2023) and even the elderly (Lee & Palamar, 2019). In this regard, cannabis use patterns, use of PBS, and their efficacy may vary throughout the life span. For example, for adults with children, a typically endorsed and useful strategy may be "Only use marijuana after completing all of the day's responsibilities", a strategy not included in the S-PBSC developed with young adults. Consequently, future studies should explore the utility of the S-PBSC among populations beyond those aged 18–25 years. Furthermore, we used the 50-item pool developed by Pedersen et al. (2016) in the US to select the most suitable items for the S-PBSC. However, this sample of items may not include certain protective behaviors specific to the Spanish context and culture, such as the use of filters to reduce tobacco-related harms, a substance typically mixed with cannabis in Spain (OEDA, 2022). Thus, it would be advisable for future studies to develop new items based on the Spanish context and rigorously test their psychometric properties.

Conclusions

In this study, we followed a rigorous item selection process to develop the Spanish full-length (S-PBSC) and short-form (S-PBSC-SF) versions of the PBSM (Pedersen et al., 2016, 2017). Both versions showed good psychometric properties in a community sample of young adults. To date, studies evaluating cannabis-related PBS have predominantly used the short-form version of the PBSM (Pedersen et al., 2017) with samples of university students (e.g., Livingston et al., 2023; Pearson & Bravo, 2019; Richards et al., 2023). Our Spanish versions, devoid of DIF and showing invariance across genders and university status, include significantly fewer items in comparison to the PBSM and PBSM-SF (Pedersen et al., 2017). This reduction could enhance the practicality of the S-PBSC and S-PBSC-SF for use with broader populations of young adults. The full-length version offers the advantage of providing more reliable measures of PBS, making it particularly suitable for research purposes. Thus, future research may use this measure for testing how cannabis-PBS attenuate the effect of risk factors (e.g., mental health issues, cannabis availability) on cannabis use and its negative consequences. Moreover, the short form of the S-PBSC was

specifically designed to consider the relationship between cannabis-PBS use and cannabis use and its consequences. Consequently, this scale is especially recommended for interventions aimed at fostering behavior change and minimizing cannabis-related consequences among young adults.

Supplementary Information The online version contains supplementary material available at https://doi.org/10.1007/s11469-024-01311-2.

Author Contributions FFC and MSG conceptualized the study and drafted the manuscript. MSG and JCM conducted data analyses. All authors contributed to the interpretation of results, data analyses, writing, editing, and approval of the final manuscript as submitted.

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Data Availability The data necessary to reproduce the findings reported in this manuscript are available at: https://osf.io/u79pr/?view_only=b60b32832def4395bc482f365d387a2b

Declarations

Ethics Approval The study protocol was approved by the Regional Committee for Bioethics Research of Andalusia (Regional Ministry of Health, Andalusia, Spain).

Informed Consent All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2000 (5). Informed consent was obtained from all participants for being included in the study.

Conflict of Interest Author MSG, Author JCM, Author AJB, Author FFC, declare that they have no conflicts of interest to this study.

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