Development and Validation of the Marijuana Motives Measure Short Form

Desarrollo y validación de la versión breve del cuestionario de motivos de consumo de marihuana (MMM SF)

Laura Mezquita*,**, Lucía Ruiz-Valero*, Naiara Martínez-Gómez*, Manuel I. Ibáñez*,**, Generós Ortet*,**.

*Department of Basic and Clinical Psychology and Psychobiology, Universitat Jaume I, Castelló, Spain
**Centre for Biomedical Research Network on Mental Health (CIBERSAM), Instituto de Salud Carlos III, Madrid, Spain

Abstract

Marijuana motives are a proximal variable to marijuana use. This research aimed to adapt and validate the short form of the Marijuana Motives Measure (MMM; Simons, Correia, Carey, y Borsari, 1998), the MMM SF, in Spanish.

The sample comprised 232 participants (mean age = 25.11 (7.58), 50.43% males) who had tried marijuana at least once in their lifetime. Item and Rasch analyses were performed to choose the final pool of 15 items. Confirmatory Factor Analysis (CFA) showed an adequate 5-factor structure ($_{S\text{-}B}X^2(80) = 121.30$, $p = .002$; NNFI = .944; CFI = .958; IFI = .959; MFI = .915; RMSEA = .047(0.029, 0.063); AIC = -38.70), and the multi-group CFA between males and females showed acceptable fit indices ($_{S\text{-}B}X^2(160) = 230.01$, $p = .000$; NNFI = .900; CFI = .924; IFI = .927; MFI = .860; RMSEA = .062(.043, .078); AIC = -89.99). The questionnaire indicated metric ($_{S\text{-}B}X^2_{diff}(15) = 13.61$, $p = .556$)), scalar ($_{S\text{-}B}X^2_{diff}(15) = 23.15$, $p = .081$)) and error measurement invariance ($_{S\text{-}B}X^2_{diff}(15) = 8.65$, $p = .895$)) between gender groups. The internal consistencies and ordinal omega of the scales were between .79 and .90. In the regression analysis, enhancement, coping and low conformity motives predicted frequency and quantity of marijuana smoked. The best predictor of frequency and quantity consumed during the heaviest smoking period was enhancement, while coping and, to a lesser extent, low conformity, were the only predictors of cannabis-related problems when marijuana frequency and quantity were controlled for.

The MMM SF shows adequate psychometric properties and is a suitable instrument to assess marijuana motives, especially during time-limited sessions.

Keywords: Marijuana motives; Cannabis; MMM SF; Psychometric properties; Marijuana outcomes.

Resumen

Los motivos de consumo son una variable proximal al uso de marihuana. Este estudio pretende adaptar y validar la versión española breve del Marijuana Motives Measure (MMM; Simons, Correia, Carey, y Borsari, 1998), el MMM SF.

La muestra estaba compuesta por 232 participantes (edad media = 25,11 (7,58), 50,43% hombres) que habían probado la marihuana al menos una vez. Se realizaron análisis de los ítems y de Rasch para seleccionar los 15 ítems. El Análisis Factorial Confirmatorio (AFC) mostró una estructura de cinco factores adecuada ($_{S\text{-}B}X^2(80) = 121{,}30$, $p = ,002$; NNFI = 0,944; CFI = 0,958; IFI = 0,959; MFI = 0,915; RMSEA = 0,047(0,029, 0,063); AIC = -38,70), y el AFC multigrupo entre hombres y mujeres mostró índices de ajuste aceptables ($_{S\text{-}B}X^2(160) = 230{,}01$, $p = ,000$; NNFI = 0,900; CFI = 0,924; IFI = 0,927; MFI = 0,860; RMSEA = 0,062(0,043, 0,078); AIC = -89,99). El cuestionario mostró invarianza métrica ($_{S\text{-}B}X^2_{dif}(15) = 13{,}61$, $p = ,556$)), escalar ($_{S\text{-}B}X^2_{dif}(15) = 23{,}15$, $p = ,081$)) y de los errores de medida ($_{S\text{-}B}X^2_{dif}(15) = 8{,}65$, $p = ,895$)) entre grupos de género. Los alfas de Cronbach y omega ordinal de las escalas fueron de 0,79 a 0,90. Los motivos de animación, afrontamiento y bajos motivos de conformidad predijeron el consumo de marihuana. El mejor predictor durante la época de mayor consumo fueron los motivos de animación, mientras que los motivos de afrontamiento, y en menor medida los bajos motivos de conformidad, fueron los mejores predictores de los problemas derivados una vez se controló el efecto de frecuencia y cantidad fumada.

El MMM SF presenta unas propiedades psicométricas adecuadas y es una medida útil para evaluar los motivos de consumo de marihuana, especialmente durante sesiones de evaluación con tiempo limitado.

Palabras clave: Motivos de consumo de marihuana; Cannabis; MMM SF; Propiedades psicométricas; Variables de consumo de marihuana.

Received: June 2017; Accepted: September 2017

Send correspondence to:
Laura Mezquita. Department of Basic and Clinical Psychology and Psychobiology, Universitat Jaume I, Av. de Vicent Sos Baynat, s/n, 12071 Castelló, Spain. E-mail: lmezquit@uji.es.

Cannabis (marijuana) is the most widely used illicit drug worldwide (UNODC, 2015). In 2013, an estimated 181.8 million people aged 15-64 years used cannabis for nonmedical purposes (uncertainty estimates 128.5–232.1 million) (UNODC, 2015). Cannabis acutely impairs several cognitive function components, and its use is a risk factor for traffic fatalities, cardiovascular and psychotic symptoms, among others (WHO, in press). For these reasons, it is important to prevent and reduce cannabis use and, to do so, it is important to know the reasons why people smoke this drug.

One of the most widely used questionnaires to assess cannabis smoking motives is the Marijuana Motives Measure (MMM; Simons et al., 1998). The MMM was developed by Simons et al. (1998), and is based on the Drinking Motives Questionnaire-Revised (DMQ-R) developed by Cooper (1994) to assess reasons for alcohol consumption. Consequently, the MMM (Simons et al., 1998) is composed of four marijuana smoking motives based on the (a) type of reinforcement desired (positive or negative reinforcement) and (b) the source of reinforcement (internal or external). Crossing these two dimensions results in four distinct marijuana motives: social motives (external, positive) refer to smoking to facilitate social relationships; enhancement motives (internal, positive) refer to using cannabis to increase positive affect; conformity motives (external, negative) relate to smoking to form part of a group of people; coping motives (internal, negative) relate to smoking cannabis to manage negative affects. Simons et al. (1998) also added a fifth type of marijuana motive, expansion motives, which refer to smoking cannabis to be more creative and original, to understand things differently, or to be more open to experiences. This five-factor questionnaire structure has received support from exploratory (Chabrol, Ducongé, Casas, Roura, & Carey, 2005; Simons et al., 1998) and confirmatory factor analyses (Zvolensky et al., 2007). The resulting five scales showed good internal consistencies with Cronbach's alphas of .70 or higher (Chabrol et al., 2005; Simons et al., 1998; Zvolensky et al., 2007). However, recent studies conducted with the MMM have found that some factor loadings of the original items were inadequate (Benschop et al., 2015). These items (2, 8, 9 and 16) were the same as those removed from the short versions of the DMQ-R (Kuntsche & Kuntsche, 2009; Mezquita et al., 2018).

Regarding sources of evidence for concurrent and predictive validity, and similarly to those found with alcohol, it seems that each marijuana motive type relates differently to cannabis outcomes (Simons et al., 1998). Cross-sectional studies with the MMM (Simons et al., 1998) have found that enhancement motives are related to cannabis use (Buckner, 2013; Foster, Allan, Zvolensky, & Schmidt, 2014; Simons, Simons, & Spelman, 2016), and also with cannabis-related problems through cannabis use (Simons, Gaher, Correia, Hansen, & Christopher, 2005). Coping motives have been related to cannabis use, cannabis-related problems (Buckner, 2013; Buckner & Zvolensky, 2014; Buckner, Zvolensky, & Schmidt, 2012; Foster et al., 2014; Simons et al., 2016) and cannabis dependence (Moitra, Christopher, Anderson, & Stein, 2015). Expansion motives have been associated with cannabis frequency and cannabis dependence in females with borderline symptomatology (Chabrol et al., 2005), and also with cannabis-related problems in a sample of current cannabis users (Buckner & Zvolensky, 2014). Finally, social motives and conformity motives have been negatively related to cannabis frequency (Buckner, 2013; Buckner & Zvolensky, 2014), while only conformity motives have been positively related to cannabis-related problems (Buckner et al., 2012; Foster et al., 2014).

Very few prospective studies about marijuana motives and related outcomes have been conducted. Anderson, Sitney and White (2015) assessed 434 community recruited youths and found that positive reinforcement use motives were associated with increased cannabis use and cannabis-related problems, while negative reinforcement motives predicted cannabis-related problems when controlling for past marijuana use motives and behaviors. Expansion motives in adolescence have been related to lower cannabis use in emerging adulthood. Liebregts et al. (2013) found that coping motives predicted marijuana dependence in a cohort of frequent cannabis users.

The general aim of the present research was to develop a short version of the MMM that may facilitate the inclusion of cannabis-smoking motives in surveys, or in prevention or treatment programs, for which administration time and space are limited (Kuntsche & Kuntsche, 2009). We intended to develop a short version that includes the items that really works properly to assess marijuana motives and to delate others that have been shown to not help assess the construct (Benschop et al., 2015). Specifically, the aims of the present research were to: 1) translate and adapt the MMM into Spanish; 2) create a short version of the measure using Item and Rasch analyses; 3) explore the structure of the short questionnaire version; and 4) study criterion validity sources of evidence of the questionnaire. We hypothesized that in spite of item reduction, MMM SF will show a structure, reliability indices and evidence to predict cannabis outcomes that are at least as good as the original MMM.

Method

Participants

The original sample was composed of 390 participants. However, as in previous studies about motives, we analyzed only the data of those who had tried marijuana at least once in their life. Of the remaining 236 respondents, two did not complete the MMM, and two answered the questionnaires

apparently by chance. The final sample was composed of 232 participants (50.53% males, *M*age= 25.11, *SD* = 7.58), whose age range went from 16 to 58 years. The rest of the descriptive sample data is presented in Table 1.

Table 1. *Descriptive Data of the Final Sample of 232 Participants.*

Descriptive data		% of the total sample
Level of education completed	Elementary school	9.05
	High school	53.02
	University degree	37.98
Level of income	Less than €450	55.17
	€450 to €900	15.52
	€900 to €1500	16.38
	€1500 to €2100	8.19
	€2100 to €2700	4.31
	€2700 to €3600	0.43
Family level of income	Less than €450	14.36
	€450 to €900	21.03
	€900 to €1500	24.10
	€1500 to €2100	21.54
	€2100 to €2700	11.28
	€2700 to €3600	5.13
	€900 to €1500	2.56
Live (with)	Alone	9.48
	Parents or family	58.62
	Partner	20.26
	Others (e.g., roommates)	11.64
Primary occupation	Student	67.10
	Worker	28.57
	Unemployed	4.33

Procedure

We followed the Muñiz, Elosua and Hambleton (2013) recommendations for translating and adapting questionnaires. First after reviewing the literature, we chose the most suitable questionnaire to assess cannabis motives. Second, we requested the permissions to use, translate and adapt the questionnaire. To translate and adapt the questionnaire, two researchers experienced in psychometric test construction, and familiar with cannabis research, translated the MMM items into Spanish. Afterward, an English language teacher, unfamiliar with the inventory, did out a back translation. The analysis of the back translation indicated the Spanish version could be considered comparable to the original scale. We also took into account the differences between the Spanish and American cultures in which the original questionnaire was developed when we adapted the MMM.

Sample recruitment was done following two methods. First, the participants who attended vocational training at different high schools in the province of Castellón (east Spain) were assessed: Politécnico, Matilde Salvador and Salvador Seguí (N= 149). During assessment sessions, trained psychologists followed standard instructions: handed out scales, guaranteed confidentiality, and encouraged participants to provide sincere answers. In this case, the Ministry of Education of the Valencian Government approved the use of the battery of questionnaires in the assessment session. Second, an online survey was devised and participants answered the questionnaires on the Internet (N = 83). They filled in the scales as a response to an announcement displayed in Facebook. In this case, information about the study, including deontological issues, was facilitated on the first questionnaire page after being approved by the Ethical Committee of the Universitat Jaume I.

In both cases, all the respondents provided informed consent to participate in the study, completed the questionnaires voluntarily and anonymously, and did not receive any compensation for doing so.

Measures

Marijuana use was assessed with the *Cannabis and Other Drugs Intake Scale* (CODIS), which was developed by our research group according to a variety of previous measures. CODIS includes a measure of frequency of cannabis use in one's lifetime (Fq life: *Indicate if you have consumed cannabis from never 0 to daily 5*), frequency of cannabis use during the week (Fq weekdays: *number of days you smoke cannabis from Monday to Thursday: 0 - 4*), and at weekends (Fq weekend: *number of days you smoke cannabis from Friday to Sunday: 0 - 3*), number of joints smoked on weekdays (Qn weekdays) and at weekends (Qn weekend), frequency of use during the heaviest cannabis smoking period (Fq heaviest*: during your heaviest smoking period, what was the frequency you smoked from never 0 to twice a day 6*) and number of joints smoked during the week (Qn heaviest weekdays) and at weekends (Qn heaviest weekend) during a typical week of the heaviest cannabis smoking period. While the questions about the number of joints smoked were open-ended, those about frequency took a Likert scale answer format.

The MMM (Simons et al., 1998) consists of 25 items, and each contributes to one of five subscales: social, coping, enhancement, conformity and expansion. After taking into account all the occasions on which they smoked marijuana, the participants indicated how often they smoked for the reason specified in each item on a 5-point Likert scale that ranged from 1 (almost never/never) to 5 (almost always/always).

The *Cannabis Problems Questionnaire* (CPQ; Copeland, Gilmour, Gates, & Swift, 2005) assesses cannabis-related problems using 27 items. The participants informed if they

had experienced a series of consequences due to their marijuana use in the last 3 months. Items were dichotomous (yes/no). The Cronbach's alpha of the scale in the present sample was .90.

Missing data imputation

The missing values in the MMM in the final sample (N = 232) were .21% of all the data. For this reason, a person mean imputation approach was followed on each scale (Bentler, 2006) in both the CFA and the Item and Rasch analyses. In the regression analysis, pair-wise deletion of missing values was used, although there were only 19 missing values in all in the eight cannabis use measures and descriptive data.

Data analysis

Item selection strategies. The aim was to cut the global scale length by keeping a suitable conceptual breadth. To select items, the classical item analysis and the Rasch measurement procedures were combined (Meyer, 2014). Joint Maximum Likelihood Estimation (JMLE) was used. First, item-total correlations were performed (i.e., classical item discrimination). By taking into account number of points on the Likert scale, the discrimination index should be .60 or higher. Second, the person-item outfit and infit were evaluated with the Unweighted Mean Square (UMS) and the Weighted Mean Square (WMS) fit statistics. In both cases, values between .80 and 1.20 were recommended, and more attention should be paid to high, rather than to low, values (Meyer, 2014). Before running the item analysis, the dimensionality and local independence assumptions were confirmed.

In addition to these statistical considerations, when items showed good indices, the items that measured different aspects of one motive dimension were selected. The items that were a crucial component of a motives scale were not removed (see Mezquita, Camacho, Suso, Ortet, & Ibáñez, 2018, for a similar procedure). All the item analyses were performed with the jMetrik software (Meyer, 2014).

Testing the questionnaire structure. After selecting the final pool of 15 items, and similarly to previous studies done with the MMM (Zvolensky et al., 2007) and the DMQ-R SF (Kuntsche & Kuntsche, 2009; Mezquita et al., 2018), a correlated CFA of five factors was performed. Other competing models derived from the literature with the DMQ-R (Cooper, 1994; Hauck-Filho, Pereira & Cooper, 2012) were also performed: a unidimensional model in which all the items loaded in one single factor; a bifactor model that compared positive (social, enhancement and expansion) and negative (coping and conformity) reinforcement; a bifactor model that compared internal (enhancement, coping and expansion) and external (social and conformity) sources.

For all the structural equation modeling analyses, Satorra-Bentler's robust method was employed since our data were non normally distributed. To consider that a model has an *excellent* fit, the ${}_{S\text{-}B}\chi^2$ must be non significant, but this is uncommon in CFA. So using other fit indices to compare competing models is interesting: Non Normed Fit Index (NNFI), Comparative Fit Index (CFI), Incremental Fit Index (IFI), McDonald's Fit Index (MFI), Root Mean Square Error of Approximation (RMSEA), and Akaike's Information Criterion (AIC). Lower AIC values indicate a better fit. A model with NNFI, CFI, IFI, and MFI ≥ .90, RMSEA ≤ .10 is considered an *acceptable* fit, and NNFI, CFI, IFI and MFI ≥ .95, and RMSEA ≤ .06 an *adequate* fit (Byrne, 2006).

Reliability of scores. To test the reliability of the subscales, the Cronbach's alphas and ordinal omegas (Dunn, Baguley, & Brunsden, 2014) were calculated with 95% CI using the jMetriK software (Meyer, 2014) and the R 3.4.0 (R Core Team, 2013) software, respectively.

Measurement invariance across gender groups. Structural Equation Models (SEM) were performed to determine the measurement invariance of the questionnaire across males and females. In the first step, the model was tested separately for each gender group. Second, configural invariance was explored across groups by performing a multi-group analysis between males and females. Then metric, scalar and error invariances were tested (Milfont & Fischer, 2010). The relative goodness-of-fit between increasingly constrained models was calculated by the scaled ${}_{S\text{–}B}X^2$ difference test (Satorra & Bentler, 2001). All the CFAs were performed with version 6.1 of the EQS software (Bentler & Wu, 2002).

Relation between marijuana motives and marijuana outcomes. Descriptive analyses, Pearson's correlations and regression analyses were performed by SPSS 22 (IBM Corp, 2013). Eight different regression analyses were performed in which the gender and age effect were controlled for. In these analyses, marijuana motives were the independent variables, while marijuana outcomes were the dependent variables. For cannabis-related problems, an additional regression analysis was performed that also controlled for cannabis use frequency and quantity.

Results

Item selection

The Item and Rasch analyses are presented in Table 2. First by taking into account discrimination indices, items 5 and 16 from the social motives scale, item 9 from the enhancement scale, and item 2 from the conformity scale were deleted. Second by considering the UMS and the WMS indices, item 15 from the coping scale and item 21 from the expansion scale were also removed. Of the remaining items, those crucial for the motive scale and those that presented less overlap in content were chosen (e.g.,

"Because I like the feeling" was kept rather than "Because it gives me a pleasant feeling"). The final pool of 15 items, three per scale, is presented in bold in Table 2.

Sources of validity evidence for the MMM structure

The fit indices of the correlated five-factor model of the MMM and MMM SF scales are presented in Table 3. While the fit indices of the MMM were not acceptable, those presented by the MMM SF were generally adequate. The correlated five-factor model of the MMM SF showed also better fit indices than the unidimensional and bifactor models (see Table 3). The factor loading, standard errors and covariances of the five-factor model of the MMM SF are found in Figure 1.

Measurement invariance of the scale across gender groups

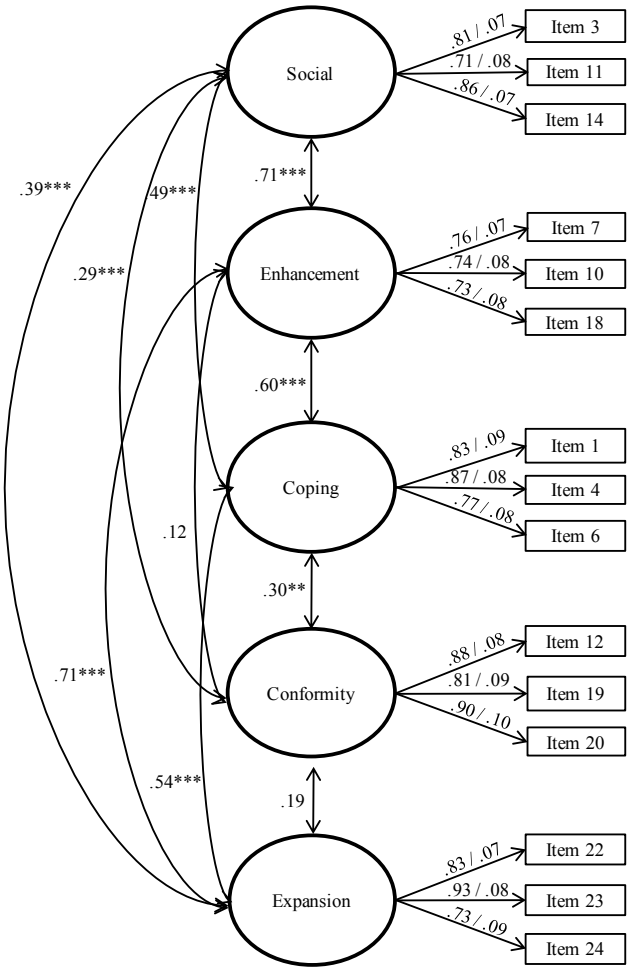
The sample wase split into males and females, and the fit indices of the MMM SF were slightly worse than in the whole sample, but were acceptable (see Table 3). Thus a multi-group analysis was performed to test configural invariance, and the fit indices were also acceptable (see Table 3). The addition of constraints among the factor loading ($_{S\text{-}B}X^2_{diff}$ (15) = 13.61, p = .56), means ($_{S\text{-}B}X^2_{diff}$ (15) = 23.15, p = .08) and measurement errors ($_{S\text{-}B}X^2_{diff}$ (15) = 8.65, p = .90) of males and females did not show significant reductions in fit. This indicated that the MMM SF showed metric, scalar and error measurement invariance between gender groups.

Reliability of scores

Table 2. *Item and Rasch Analysis of the Marijuana Motives Questionnaire.*

Subscale	Items	Discrimination	Difficulty	UMS	WMS
	Item 3	.66	-.19	.81	.85
	Item 5	.42	.87	1.38	1.70
	Item 11	.65	-.20	.92	.90
	Item 14	.74	-.02	.65	.70
Social	Item 16	.57	-.46	1.12	1.21
	Item 7	.74	-.87	.73	.73
	Item 9	.34	1.49	2.23	2.23
	Item 10	.68	-.06	.98	.98
	Item 13	.74	-.68	.71	.71
Enhancement	Item 18	.64	.13	.95	.95
	Item 1	.80	-.14	.76	.86
	Item 4	.78	-.12	.94	.93
	Item 6	.72	-.32	1.07	1.11
	Item 15	.69	.87	1.41	1.37
Coping	Item 17	.80	-.28	.87	.92
	Item 2	.55	-.89	1.43	1.53
	Item 8	.66	1.06	.94	1.18
	Item 12	.79	-.45	.64	.75
	Item 19	.74	-.01	.98	1.05
Conformity	Item 20	.84	.28	.53	.58
	Item 21	.62	.60	1.13	1.37
	Item 22	.76	-.40	.98	.90
	Item 23	.83	-.18	.63	.69
	Item 24	.68	.46	.91	1.11
Expansion	Item 25	.69	-.48	1.09	1.05

Note. The items retained in the MMM SF are shown in bold. The content of the items can be consulted in Simons et al. (1998).



Note. Above unidirectional arrows are factor loadings and standard errors. Above bidirectional arrows are correlations. All factor loadings were significant at p < .001.
*p < .05. **p < .01. ***p < .001. The content of the items can be consulted in Simons et al. (1998).

Figure 1. Correlated CFA of the final 15-items solution of the MMM SF.

Table 3. *Fit Indices of the Different Structural Models and the Multi-group Analysis between Males and Females of the MMM SF.*

			S-BX^2	g.l.	*p*	NNFI	CFI	IFI	MFI	RMSEA (90%CI)	AIC
MMM	Correlated five-factor model	Whole sample	497.51	265	.000	.837	.856	.859	.606	.062 (.053, .070)	-32.49
MMM SF	Correlated five-factor model	Whole sample	121.30	80	.002	.944	.958	.959	.915	.047 (.029, .063)	-38.70
	Unidimensional model	Whole sample	549.56	90	.000	..450	.528	.535	.371	.149 (.136, .160)	369.56
	Bifactorial model internal *vs.* external source	Whole sample	509.42	89	.000	.491	.568	.575	.404	.143 (.131, .155)	331.42
	Bifactorial model positive *vs.* negative reinforcement	Whole sample	569.69	89	.000	.418	.507	.515	.355	.153 (.141, 165)	391.69
	Correlated five-factor model	Males	119.13	80	.003	.896	.921	.925	.846	.065 (.038, .088)	-40.87
		Females	112.13	80	.010	.900	.924	.923	.870	.059 (.030, .083)	-47.87
	Multi-group analysis of the correlated five-factor model	Configural invariance	230.01	160	.000	.900	.924	.927	.860	.062 (.043, .078)	-89.99
		Metric invariance	239.03	175	.001	.916	.930	.933	.871	.056 (.037, .073)	-110.97
		Scalar invariance	261.06	190	.000	.903	.925	.929	.855	.057 (.038, .073)	-118.94
		Error variance invariance	259.24	205	.006	.929	.944	.946	.994	.051 (.031, .068)	-150.76

Table 4. *Descriptive Analysis for the Whole Sample and Differentiating between Males and Females.*

	Whole sample				Males		Females			
	X	SD	α	Ω	X	SD	X	SD	*t*	*d*
Social	5.75	2.95	.83 (.79, .88)	.82 (.79, .86)	6.03	3.19	5.47	2.68	1.44	.19
Enhancement	7.09	3.41	.79 (.74, .84)	.79 (.73, .83)	7.60	3.80	6.57	2.88	2.33*	.31
Coping	5.05	2.84	.86 (.82, .91)	.86 (.83, .89)	5.23	3.17	4.87	2.45	.97	.13
Conformity	3.68	1.88	.90 (.84, .96)	.89 (.86, .91)	3.52	1.64	3.83	2.10	-1.27	-.16
Expansion	4.65	2.53	.83 (.76, .91)	.86 (.83, .89)	4.86	2.66	4.43	2.38	1.32	.17
Fq weekdays	.67	1.30		-	.90	1.44	.45	1.10	2.66**	.35
Fq weekend	.79	1.12		-	.90	1.18	.68	1.03	1.46	.20
Qn weekdays	1.29	3.27		-	1.67	3.70	.89	2.72	1.80	.24
Qn weekend	1.65	3.16		-	2.09	3.72	1.21	2.37	2.12*	.28
Fq heaviest	3.33	1.99		-	3.54	2.12	3.11	1.83	1.63	.22
Qn heaviest weekdays	4.14	6.74			5.50	7.90	2.76	4.98	3.13**	.41
Qn heaviest weekend	4.77	6.19			5.82	7.05	3.70	4.99	2.63**	.35
Cannabis-related problems	2.51	3.99			3.26	4.66	1.75	3.01	2.92**	.38

Note. Fq weekdays = frequency of cannabis use during the week; Fq weekend = frequency of cannabis use at the weekend; Qn weekdays = number of joints smoked on weekdays; Qn weekend = number of joints smoked at the weekend; Fq heaviest = frequency of use during the heaviest cannabis smoking period; Qn heaviest weekdays = number of joints smoked during the week in a typical week of the heaviest cannabis smoking period; Qn heaviest weekend = number of joints smoked at the weekend in a typical week of the heaviest cannabis smoking period. Cronbach's alphas and ordinal omega coefficients with 95% CI. Cohen's *d* values of 0.20, 0.50, and 0.80 correspond to the small, medium, and large effect sizes, respectively (Cohen, 1992).
*$p<$ .05. **$p<$ .01. ***$p<$ .001.

Table 5. *Pearson's Correlation Analyses Between Cannabis Motives and Cannabis-related Outcomes.*

	Social	Enhancement	Coping	Conformity	Expansion	Fq weekdays	Fq Weekends	Qn weekdays	Qn weekends	Fq heaviest	Qn heaviest weekdays	Qn heaviest weekend	Cannabis-related problems
Social	-	.59***	.44***	.30***	.38***	.12	.20**	.14*	.17**	.24***	.12	.16*	.21**
Enhancement		-	.52***	.10	.62***	.35***	.39***	.31***	.40***	.51***	.33***	.36***	.41***
Coping			-	.27***	.50***	.31***	.38***	.31***	.35***	.36***	.25***	.20**	.43***
Conformity				-	.17*	-.12	-.17*	-.08	-.13	-.13	-.10	-.10	-.12
Expansion					-	.26***	.30***	.24***	.28***	.30***	.17**	.14*	.36***

Note. Fq weekdays = frequency of cannabis use during the week; Fq weekend = frequency of cannabis use at the weekend; Qn weekdays = number of joints smoked on weekdays; Qn weekend = number of joints smoked at the weekend; Fq heaviest = frequency of use during the heaviest cannabis smoking period; Qn heaviest weekdays = number of joints smoked during the week in a typical week of the heaviest cannabis smoking period; Qn heaviest weekend = number of joints smoked at the weekend in a typical week of the heaviest cannabis smoking period.
*p< .05. **p< .01. ***p< .001.

Table 6. *Regression Analyses: Cannabis Motives as Predictors of Cannabis-related Outcomes.*

IV	Fq weekdays		Fq Weekends		Qn weekdays		Qn weekends		Fq heaviest		Qn heaviest weekdays		Qn heaviest weekend		Cannabis-related problems		IV	Cannabis-related problems	
	β	ΔR^2	β	ΔR^2	β	ΔR^2	β	ΔR^2	β	ΔR^2	β	ΔR^2	β	ΔR^2	β	ΔR^2		β	ΔR^2
Step 1																			
Sex	-.18**	.03*	-.10	.01	-.12	.02	-.14*	.02	-.11	.01	-.21**	.04**	-.17*	.03*	-.19**	.04*	Sex	-.09	.48***
Age	.06		-.01		.03		-.06		-.02		.02		-.01		-.01		Age	-.01	
																	Frequency	.39***	
																	Quantity	.32***	
Step 2																			
Social	-.14	.19***	-.01	.27***	-.08	.15***	-.08	.22***	-.07	.31***	-.11	.14***	-.06	.15***	-.05	.28***	Social	-.00	.05***
Enhancement	.29**		.23**		.22*		.31***		.49***		.34***		.43***		.21*		Enhancement	.05	
Coping	.26***		.32***		.26**		.28***		.23**		.19*		.10		.35***		Coping	.18**	
Conformity	-.20**		-.30***		-.16*		-.21**		-.22***		-.15*		-.13*		-.24***		Conformity	-.11*	
Expansion	.03		.06		.03		.01		-.06		-.07		-.13		.11		Expansion	.09	

Note. Fq weekdays = frequency of cannabis use during the week; Fq weekend = frequency of cannabis use at the weekend; Qn weekdays = number of joints smoked on weekdays; Qn weekend = number of joints smoked at the weekend; Fq heaviest = frequency of use during the heaviest cannabis smoking period; Qn heaviest weekdays = number of joints smoked during the week in a typical week of the heaviest cannabis smoking period; Qn heaviest weekend = number of joints smoked at the weekend in a typical week of the heaviest cannabis smoking period.
*p< .05. **p< .01. ***p< .001.

The Cronbach's alphas and ordinal omega coefficients of the scales with 95%CI are presented in Table 4. The reliability of all the scales went from good to excellent (all the alpha and ordinal omega coefficients were between .79 and .90).

Sources of validity evidence: motives as predictors of different marihuana outcomes

The descriptive analysis of the MMM SF and the marijuana outcomes are presented in Table 4. Males scored significantly higher than females in enhancement motives, smoking frequency during the week, smoking quantity at weekends, the quantity of marijuana smoked during the heaviest smoking period on weekdays and at weekends, and cannabis-related problems. However, the effect of differences was minor. The correlation analyses showed that the strongest correlations were found between the internal marijuana motives (enhancement, coping and expansion) and the marijuana outcomes (see Table 5).

The regression analyses showed that the enhancement, coping and low conformity motives predicted the frequency and quantity of marijuana smoked during the week and at weekends (see Table 6). The best predictor of the frequency and quantity of its use during the heaviest smoking period were enhancement motives, which was a stronger association at weekends than on weekdays. Although the coping, enhancement and low conformity motives predicted cannabis-related problems, the effect of enhancement motives was not significant when the effect of frequency and quantity was controlled for (see Table 6).

Discussion

The aims of the present study were to translate and adapt the MMM SF into Spanish, to explore its factor structure and reliability, and to also evaluate different sources of its criterion validity (predicting marijuana outcomes). The Item and Rasch analyses provided a final pool of 15 items, three per scale, with salient factor loadings (all of which were .71, or higher). Twelve items of the social, enhancement, coping and conformity scales were the same as those previously kept in the short DMQ-R version (Kuntsche & Kuntsche, 2009; Mezquita et al., 2018). This is important for future comparison studies about drug motives. If differences about drug motives are found, these might not be attributed to differences in the measure as the MMM SF and the DMQ-R SF are equivalents. The final 3-item solution of the expansion scale was composed of the three items that showed the highest factor loadings in the original questionnaire validation (Simons et al., 1998). The questionnaire showed also measurement invariance between males and females. Consequently, the MMM SF is an adequate instrument to compare marijuana motives between genders.

Regarding the reliability of scores, Cronbach's alphas were all above the standard cutoff of .70, even though shorter scales usually show lower internal consistencies than larger ones. When the endorsement of marijuana motives was explored in previous studies, enhancement motives were followed by the social, expansion, coping and conformity ones (Buckner et al., 2012; Foster et al., 2014; Simons et al., 2016, 1998; Zvolensky et al., 2007). However in the present research, the participants endorsed coping more than expansion motives. This was not due to a short questionnaire length, but indicated the existence of some cultural differences that could be explored in future cross-cultural studies.

When exploring the intercorrelations between motives scales, the highest correlations were found between enhancement and expansion motives. This result was expected because, as in enhancement motives, the positive reinforcement of marijuana effects was desired in the expansion motives, and the source of reinforcement was also internal. The lowest correlations were observed between conformity motives and the other scales, as in previous studies (Simons et al., 1998; Zvolensky et al., 2007).

Regarding the criterion validity sources, both coping and enhancement motives were similarly associated with smoking frequency and quantity during the week and at weekends. This result differed from those found with alcohol as previous studies have shown that enhancement motives are related mainly to weekend use, while coping motives are associated with alcohol use on weekdays (Mezquita, Ibáñez, Moya, Villa, & Ortet, 2014; Studer et al., 2014). Nevertheless, some similarities between drugs were found. enhancement motives were the best predictor of not only smoking frequency during the heaviest smoking period, but also of the quantity smoked on weekdays and at weekends during the heaviest smoking period. Previous findings on alcohol have also reported that enhancement motives are the best predictor of heavy alcohol use and binge drinking (Cooper, 1994; McCabe, 2002). Finally, the fact that the association between enhancement motives and cannabis-related problems disappeared when controlling for the effect of smoking frequency and quantity suggested that the association was mediated by marijuana use (Simons et al., 2005). In line with this, previous results about motives and alcohol-related problems have offered similar findings (Mezquita et al., 2014). Finally according to previous studies on marijuana (Simons et al., 2005) and alcohol (Mezquita et al., 2018, 2014), coping motives were the best predictor of drug-related problems, even when drug use was controlled for, which suggests that these motives are a vulnerability factor to marijuana use disorders.

A negative association between conformity motives and all the marijuana outcomes appeared in the regression analyses (Buckner & Zvolensky, 2014; Simons et al., 1998; Zvolensky et al., 2007). Previous studies that included drinking motives found similar results and offered different interpretations of these findings (e.g., Grant, Stewart, O'Connor, Blackwell, & Conrod, 2007; Mezquita, Stewart, Grant, & Kuntsche, 2016; Kuntsche, Wiers, Janssen, & Gmel, 2010). On the one hand, this result could be due to a suppression effect (Grant et al., 2007). The classical definition of the suppression effect in a regression analysis is that a potential covariate that is unrelated to the outcome variable (i.e. has a bivariate correlation of zero) increases the overall model fit within regression when this covariate (i.e., conformity motives) is added to the model (Tu, Gunnell, & Gilthorpe, 2008). However, this explanation is unlikely because even when some correlations between conformity and marijuana outcomes were not significant, they showed a negative association with a tendency to significance in most cases. On the other hand, it makes sense that people who report conformity motives indicate low smoking frequency and smoke small quantities of marijuana. As for fitting in with a group, a couple of puffs could be enough to achieve this aim; i.e., getting stoned might be even counterproductive for their aim of not feeling left out (Kuntsche et al., 2010).

Finally, expansion motives were not significantly associated with marijuana outcomes in the regression analysis. These results could be due to the high correlations found between expansion and enhancement motives, but could also be due to their association with coping motives (see Figure 1 and Table 5). The high intercorrelations between the motives scales could overshadow the influence of expansion motives on marijuana outcomes (Studer et al., 2014).

The present research has its limitations. First its sample size is modest, which also occurred in previous studies (Simons et al., 1998; Zvolensky et al., 2007). This is partly due to the fact that the questionnaire was designed to be

used with participants who had tried cannabis at least once in their life, and that cannabis use is not as frequent as alcohol or tobacco use. However, if we consider that the questionnaire is composed of only 15 items, our sample size may be considered adequate. Second, the study design is cross-sectional, and this was why it was not possible to explore the test-retest reliability of the scores and the sources of validity of the motives scales to predict marijuana outcomes. Third, drinking motives are not the only proximal variable to the cannabis used to be taken into account (Lloret Irles, Morell-Gomis, Laguía, and Moriano, 2018). Other variables should be studied to depict a complete view of cannabis use among smokers. Finally, the use of cannabis could be assessed more objectively rather than with only self-reports (Casajuana et al., 2017).

In short, the results support the notion that the MMM SF is better (in structure validity terms), or at least as good (in terms of its reliability of the scores and capability to predicting marijuana outcomes), as the MMM. The questionnaire appears a useful tool to assess reasons for smoking marijuana when administrations' time is limited, especially when various assessment instruments are being used.

Acknowledgement

Funding for this study was provided by research projects PSI2015-67766-R from the Spanish Ministry of Economy and Competitiveness, and GV/2016/158 from the Regional Valencian Government.

Conflicts of interest

The authors declare no conflict of interest.

References

Anderson, K. G., Sitney, M. & White, H. R. (2015). Marijuana motivations across adolescence: Impacts on use and consequences. *Substance Use & Misuse, 50*, 292–301. doi: 10.3109/10826084.2014.977396.

Benschop, A., Liebregts, N., van der Pol, P., Schaap, R., Buisman, R., van Laar, M., … Korf, D. J. (2015). Reliability and validity of the Marijuana Motives Measure among young adult frequent cannabis users and associations with cannabis dependence. *Addictive Behaviors, 40*, 91–95. doi:10.1016/j.addbeh.2014.09.003.

Bentler, P. M. (2006). *EQS 6 structural equations program manual*. Encino, CA: Multivariate Software.

Bentler, P. M., & Wu, E. J. C. (2002). EQS 6 for Windows User's Guide [Computer software]. Software, Inc.

Buckner, J. D. (2013). College cannabis use: The unique role of social norms, motives, and expectancies. *Journal of Studies on Alcohol and Drugs, 74*, 720–726. doi:10.15288/jsad.2013.74.720.

Buckner, J. D. & Zvolensky, M. J. (2014). Cannabis and related impairment: The unique roles of cannabis use to cope with social anxiety and social avoidance. *The American Journal on Addictions, 23*, 598–603. doi:10.1111/j.1521-0391.2014.12150.x.

Buckner, J. D., Zvolensky, M. J. & Schmidt, N. B. (2012). Cannabis-related impairment and social anxiety: The roles of gender and cannabis use motives. *Addictive Behaviors, 37*, 1294–1297. doi:10.1016/j.addbeh.2012.06.013.

Byrne, B. M. (2006). *Structural equation modeling with EQS: Basic concepts, applications, and programming, 2nd ed.* Mahwah, NJ: Erlbaum.

Casajuana, C., López-Pelayo, H., Balcells, M.M., Miquel, L., Teixidó, L.,Colom, J. & Gual, A. (2017). Working on a Standard Joint Unit: A pilot test. *Adicciones*, 29, 227-232. doi:10.20882/adicciones.721.

Chabrol, H., Ducongé, E., Casas, C., Roura, C. & Carey, K. B. (2005). Relations between cannabis use and dependence, motives for cannabis use and anxious, depressive and borderline symptomatology. *Addictive Behaviors, 30*, 829–840. doi:10.1016/j.addbeh.2004.08.027.

Cooper, M. L. (1994). Motivations for alcohol use among adolescents: Development and validation of a four-factor model. *Psychological Assessment, 6*, 117–128. doi:10.1037/1040-3590.6.2.117.

Copeland, J., Gilmour, S., Gates, P. & Swift, W. (2005). The Cannabis Problems Questionnaire: Factor structure, reliability, and validity. *Drug and Alcohol Dependence, 80*, 313–319. doi:10.1016/j.drugalcdep.2005.04.009.

Dunn, T. J., Baguley, T. & Brunsden, V. (2014). From alpha to omega: A practical solution to the pervasive problem of internal consistency estimation. *British Journal of Psychology, 105*, 399–412. doi:10.1111/bjop.12046

Foster, D. W., Allan, N. P., Zvolensky, M. J. & Schmidt, N. B. (2014). The influence of cannabis motives on alcohol, cannabis, and tobacco use among treatment-seeking cigarette smokers. *Drug and Alcohol Dependence, 146*, 81–88. doi:10.1016/j.drugalcdep.2014.11.013.

Grant, V. V, Stewart, S. H., O'Connor, R. M., Blackwell, E. & Conrod, P. J. (2007). Psychometric evaluation of the five-factor Modified Drinking Motives Questionnaire–Revised in undergraduates. *Addictive Behaviors, 32*, 2611–2632.

Hauck-Filho, N., Teixeira, M. A. P. & Cooper, M. L. (2012). Confirmatory factor analysis of the Brazilian version of the Drinking Motives Questionnaire-Revised (DMQ-R). *Addictive Behaviors, 37*, 524–527. doi:10.1016/j.addbeh.2011.11.023.

IBM Corp. (2013). IBM SPSS Statistics for Windows, Version 22.0 [Computer software]. Armonk, NY: IBM Corp.

Kuntsche, E. & Kuntsche, S. (2009). Development and validation of the Drinking Motive Questionnaire Revised Short Form (DMQ-R SF). *Journal of*

Clinical Child and Adolescent Psychology, *38*, 899–908. doi:10.1080/15374410903258967.

Kuntsche, E., Wiers, R. W., Janssen, T. & Gmel, G. (2010). Same wording, distinct concepts? Testing differences between expectancies and motives in a mediation model of alcohol outcomes. *Experimental and Clinical Psychopharmacology*, *18*, 436–444. doi:10.1037/a0019724.

Liebregts, N., van der Pol, P., de Graaf, R., Korf, D. J., van den Brink, W. & van Laar, M. (2013). Predicting the transition from frequent cannabis use to cannabis dependence: a three-year prospective study. *Drug and Alcohol Dependence*, *133*, 352–359. doi:10.1016/j.drugalcdep.2013.06.009.

Lloret Irles, D., Morell-Gomis, R., Laguía, A. & Moriano, J.A. (2018). Design and validation of a Cannabis Use Intention Questionnaire (CUIQ) for adolescents. *Adicciones*, *30*, 54-65. doi:10.20882/adicciones.865.

McCabe, S. E. (2002). Gender differences in collegiate risk factors for heavy episodic drinking. *Journal of Studies on Alcohol*, *63*, 49–56.

Meyer, J. P. (2014). *Applied Measurement with JMetrik*. New York: Taylor & Francis.

Mezquita, L., Camacho, L., Suso, C., Ortet, G. & Ibáñez, M.I. (2018). Development and validation of the alcohol Expectancy Questionnaire Short Form (EQ-SF). *Adicciones*, *30*, 271-281. doi:10.20882/adicciones.920.

Mezquita, L., Ibáñez, M. I., Moya, J., Villa, H., Arias, B., Fañanás, L. & Ortet, G. (2018). Psychometric Properties of Drinking Motives Questionnaire-Revised (DMQ-R) in Spanish Adolescents. *European Journal of Psychological Assessment*, *34*, 145-153. doi:10.1027/1015-5759/a000319.

Mezquita, L., Ibáñez, M. I., Moya, J., Villa, H. & Ortet, G. (2014). A longitudinal examination of different etiological pathways to alcohol use and misuse. *Alcoholism, Clinical & Experimental Research*, *38*, 1770–1779. doi:10.1111/acer.12419.

Mezquita, L., Stewart, S. H., Kuntsche, E. & Grant, V. V. (2016). Cross-cultural examination of the five-factor model of drinking motives in Spanish and Canadian undergraduates. *Adicciones*, *28*, 215–220. doi:10.20882/adicciones.822.

Milfont, T. L. & Fischer, R. (2010). Testing measurement invariance across groups: Applications in cross-cultural research. *International Journal of Psychological Research*, *3*, 111–121. doi:10.21500/20112084.857.

Moitra, E., Christopher, P. P., Anderson, B. J. & Stein, M. D. (2015). Coping-motivated marijuana use correlates with DSM-5 cannabis use disorder and psychological distress among emerging adults. *Psychology of Addictive Behaviors*, *29*, 627–632. doi:10.1037/adb0000083.

Muñiz, J., Elosua, P. & Hambleton, R. K. (2013). Directrices para la traducción y adaptación de los tests: segunda edición. *Psicothema, 25*, 151–157. doi:10.7334/psicothema2013.24

R Core Team (2013). R: A language and environment for statistical computing [Computer Software]. R Foundation for Statistical Computing, Vienna, Austria.

Satorra, A. & Bentler, P. M. (2001). A scaled difference chi-square test statistic for moment structure analysis. *Psychometrika*, *66*, 507–514.

Simons, J. S., C., J. C., Simons, R. M. & Spelman, P. J. (2016). Marijuana consequences in a motivational context: Goal congruence reduces likelihood of taking steps toward change. *Addictive Behaviors*, *52*, 83–90. doi:10.1016/j.addbeh.2015.08.010.

Simons, J. S., Correia, C. J., Carey, K. B. & Borsari, B. E. (1998). Validating a five-factor marijuana motives measure: Relations with use, problems, and alcohol motives. *Journal of Counseling Psychology*, *45*, 265–273. doi:10.1037/0022-0167.45.3.265.

Simons, J. S., Gaher, R. M., Correia, C. J., Hansen, C. L. & Christopher, M. S. (2005). An affective-motivational model of marijuana and alcohol problems among college students. *Psychology of Addictive Behaviors*, *19*, 326–334. doi:10.1037/0893-164X.19.3.326.

Studer, J., Baggio, S., Mohler-Kuo, M., Dermota, P., Daeppen, J.-B. & Gmel, G. (2014). Differential association of drinking motives with alcohol use on weekdays and weekends. *Psychology of Addictive Behaviors*, *28*, 651–658. doi:10.1037/a0035668.

Tu, Y.-K., Gunnell, D. & Gilthorpe, M. S. (2008). Simpson's Paradox, Lord's Paradox, and Suppression Effects are the same phenomenon–the reversal paradox. *Emerging Themes in Epidemiology*, *5*, 2. doi:10.1186/1742-7622-5-2.

UNODC (2015). *World drug report 2015*. Vienna: United Nations Office on Drugs and Crime.

WHO (in press). *The health and social effects of nonmedical cannabis use*. Retrieved at goo.gl/ozDftX.

Zvolensky, M. J., Vujanovic, A. a, Bernstein, A., Bonn-Miller, M. O., Marshall, E. C. & Leyro, T. M. (2007). Marijuana use motives: A confirmatory test and evaluation among young adult marijuana users. *Addictive Behaviors*, *32*, 3122–3130. doi:10.1016/j.addbeh.2007.06.010.