

Highlights

- Evaluated the Perceived Importance of Marijuana to the College Experience Scale
- Found strong measurement (scalar) invariance across countries, sex, and user status
- U.S. college students reported the highest levels of marijuana internalized norms
- Males/marijuana users had higher marijuana internalized norms than females/non-users
- Marijuana internalized norms are an important cross-cultural intervention target

Cross-Cultural Examination of College Marijuana Culture in Five Countries: Measurement
Invariance of the Perceived Importance of Marijuana to the College Experience Scale

Matthew R. Pearson
Center on Alcoholism, Substance Abuse, and Addictions
University of New Mexico

Adrian J. Bravo
Center on Alcoholism, Substance Abuse, and Addictions
University of New Mexico, USA

Melissa Sotelo
Center on Alcoholism, Substance Abuse, and Addictions
University of New Mexico, USA

Cross-Cultural Addictions Study Team**

* Corresponding Author:

**This project was completed by the Cross-Cultural Addictions Study Team (CAST), which includes the following investigators (in alphabetical order): Adrian J. Bravo, University of New Mexico, USA (Coordinating PI); James M. Henson, Old Dominion University, USA; Manuel I. Ibáñez, Universitat Jaume I de Castelló, Spain; Laura Mezquita, Universitat Jaume I de Castelló, Spain; Generós Ortet, Universitat Jaume I de Castelló, Spain; Matthew R. Pearson, University of New Mexico, USA; Angelina Pilatti, National University of Cordoba, Argentina; Mark A. Prince, Colorado State University, USA; Jennifer P. Read, University of Buffalo, USA; Hendrik G. Roozen, University of New Mexico, USA.

Role of Funding Sources

MRP is supported by a career development grant (K01-AA023233) from the National Institute on Alcohol Abuse and Alcoholism (NIAAA). AJB is supported by a training grant (T32-AA018108) from the NIAAA. Data collection was supported, in part, by grant T32-AA018108. NIAAA had no role in the study design, collection, analysis or interpretation of the data, writing the manuscript, or the decision to submit the paper for publication. Data collection in Spain was also supported by grants UJI-A2017-18 and UJI-B2017-74 from the Universitat Jaume I and grant PSI2015-67766-R from the Spanish Ministry of Economy and Competitiveness (MINECO). Data collection in Argentina was also supported by grants from the National Secretary of Science and Technology (FONCYT, grant number #PICT 2015-849) and by grants from the Secretary of Science and Technology- National University of Córdoba (SECyT-UNC).

Abstract

Marijuana internalized norms, measured by the Perceived Importance of Marijuana to the College Experience Scale (PIMCES; 8 items), has been found to be distinct from marijuana descriptive/injunctive norms and to be a unique robust predictor of marijuana-related outcomes among college students, yet the role of these beliefs has not been studied outside the U.S. Using confirmatory factor analysis, the present work examined the level of measurement invariance (i.e., configural, metric, and scalar) of the PIMCES across five different countries with distinct marijuana-related regulations (i.e., U.S., Argentina, Spain, Uruguay, and the Netherlands), sex, and marijuana user status among college students ($n=3,424$) recruited between September 2017 and January 2018. To make valid comparisons across groups, metric invariance is needed to compare correlations and scalar invariance is needed to compare latent means. We found strong measurement invariance (i.e., scalar invariance) for the PIMCES across countries, across males and females, and across marijuana users and non-users. College students in the U.S. reported the highest levels of marijuana internalized norms compared to college students from all other countries. As expected, males and marijuana users showed significantly higher scores on the PIMCES than females and non-users, respectively. Bivariate correlations between PIMCES scores and other marijuana-related variables were remarkably similar across males and females, though differences across countries warrant further exploration. Taken together, the degree to which college students view marijuana use to be an integral part of the college experience may be an important target for college student marijuana interventions across various countries/cultures.

Keywords: marijuana; college norms; measurement invariance; college students; cross-cultural

Introduction

Normative perceptions have been demonstrated to be robust predictors of substance use outcomes. Although most of this research has focused on alcohol (Borsari & Carey, 2003), a burgeoning literature has revealed that normative perceptions play a similar role in predicting other substance use outcomes (Martens et al., 2006), including marijuana-related outcomes (i.e., marijuana use, marijuana-related consequences; Napper, Kenney, Hummer, Fiorot, & LaBrie, 2016). In terms of normative perceptions, the literature has predominantly focused on two distinct norms: descriptive norms and injunctive norms (Borsari & Carey, 2001; 2003; Cialdini, Kallgren, & Reno, 1991). In the case of marijuana, descriptive norms include estimations of others' frequency and/or quantity of marijuana use, whereas injunctive norms include perceptions regarding others' approval of specific marijuana use patterns/behaviors.

Specific to the college population, Osberg et al. (2010) introduced the construct of alcohol internalized norms, or the degree to which college students perceive alcohol to be an important part of the college experience. Compared to descriptive and injunctive norms, alcohol internalized norms (as measured by the College Life Alcohol Salience Scale, CLASS; Osberg et al., 2010) have been shown to be a unique robust predictor of alcohol-related outcomes among college students even when controlling for descriptive/injunctive norms (Hustad, Pearson, Neighbors, & Borsari, 2014; Osberg, Billingsley, Eggert, & Insana, 2012; Osberg, Insana, Eggert, & Billingsley, 2011; Pearson & Hustad, 2014). Modelled after the CLASS, the Perceived Importance of Marijuana to the College Experience Scale (PIMCES) assesses marijuana internalized norms (Pearson, Kholodkov, Gray, & Marijuana Outcomes Study Team, 2017). Similar to what has been found with the CLASS, the PIMCES has been found to be distinct from marijuana descriptive/injunctive

norms and to be a unique robust predictor of marijuana-related outcomes (i.e., marijuana user status, frequency of use, marijuana-related consequences) among U.S. college students, even when controlling for descriptive/injunctive norms (Pearson et al., 2018).

Most research on marijuana norms has been conducted in the United States, and to date, no research has examined marijuana internalized norms outside of the United States. Considering the wide range of distinct laws and regulations pertaining to marijuana across countries, we expect substantial differences across cultures in normative perceptions about marijuana. For example, marijuana is legal for adult use in Uruguay, but federally illegal throughout the United States. The status of marijuana in many countries (and even states within the United States) occupies a legal middle-ground between licit and illicit with varying levels of decriminalization (i.e., reducing criminal penalties for use and/or possession) and/or level of criminal enforcement (i.e., strict vs. laissez-faire). For example, although Spain, Belgium, and Uruguay all have non-profit “cannabis social clubs,” they differ substantially in how they are organized and regulated as well as the methods and limits of distribution (Decorte et al., 2017). Given that prevalence rates do not differ across countries in a strictly linear fashion according to level of legal restrictions (Degenhardt et al., 2008; Simons-Morton, Pickett, Boyce, ter Bogt, & Vollebergh, 2010), it is important to conduct cross-cultural work to examine whether risk/protective factors operate similarly or different in distinct cultural milieu. For example, in both U.S. (Pearson et al., 2017) and Argentine samples (Pilatti, Read, & Pautassi, 2017), injunctive norms have been shown to be associated with marijuana use frequency showing stronger associations for peers/friends’ norms compared to parental norms. Although in separate studies, these norms seem to operate similarly, comparative studies are needed to make stronger conclusions. Similar to cross-cultural work conducted on alcohol internalized norms using the CLASS (Bravo et

al., 2017, 2018), it is important to conduct cross-cultural research to determine the extent to which findings on marijuana internalized norms are culturally-specific or more universal. It is possible that marijuana internalized norms are a proximal risk factor that can help to explain cross-cultural differences on marijuana-related outcomes.

The present study had three primary aims. First, we wanted to determine if the PIMCES can be used to accurately assess marijuana internalized norms across five distinct countries (U.S., Spain, Argentina, Uruguay, and the Netherlands), across males and females, and across marijuana users and non-users. Second, we sought to quantify mean level differences on the PIMCES to determine the degree to which college students perceive marijuana to be an important part of the college experience across these distinct countries, across males and females, and across marijuana users and non-users. Third, we wanted to examine the construct validity of the PIMCES to determine the degree to which the associations between marijuana internalized norms and marijuana-related outcomes are similar/different across countries and across males and females. Based on previous research (Pearson et al., 2017), we expected the PIMCES to be measurement invariant across sex and user status; we expected males and marijuana users to report higher marijuana internalized norms compared to females and marijuana non-users, respectively; and we expected the associations between marijuana internalized norms and marijuana-related outcomes to be similar for males and females. In terms of cross-cultural comparisons, we did not have a strong basis for hypotheses, thus we considered these analyses to be exploratory.

Method

Participants and Procedures

Participants were college students recruited from eight universities across five countries (U.S., Spain, Argentina, Uruguay, and the Netherlands) to participate in a longitudinal online survey study examining antecedents to marijuana outcomes cross-culturally (Bravo et al., 2019). Among many cultural differences, these countries also have a wide range of distinct laws and regulations pertaining to marijuana. Participants were recruited for the baseline survey between September 2017 and January 2018. Although 3,482 students were recruited across sites at baseline, only baseline data from students that completed the PIMCES ($n=3,424$; 68.0% female) were included in the present analyses (U.S., $n=1,916$; 67.3% female; Argentina, $n=375$; 66.7% female, Uruguay, $n=97$; 78.4% female; Spain, $n=736$; 66.7% female; Netherlands, $n=300$; 73.9% female; for demographics, see Bravo et al., 2019). Study procedures were approved by the institutional review boards (or their international equivalent) at the participating universities.

Measurement Translation

The original English version of the PIMCES (Pearson et al., 2017) was translated to Spanish and Dutch by native speakers that are also proficient in English. Then, members of the research team compared the original and translated versions and, after thorough discussion, composed a version of the instrument based on consensus (see Appendix A for Spanish/Dutch versions of the items). Several dimensions of marijuana consumption and use patterns (see below) were assessed via self-report questionnaires (mostly single-item questions) and were also translated into Spanish and Dutch in the same manner.

Measures

PIMCES. Marijuana internalized norms were assessed using the 8-item PIMCES

(Pearson et al., 2017) measured on a 5-point response scale (1=*strongly disagree*, 5=*strongly agree*). Previous psychometric testing has shown a single factor solution of the 8-item PIMCES to demonstrate good model fit (e.g., CFI=.967) in a large sample of college students from the U.S. (Pearson et al., 2017) and excellent internal consistency ($\alpha=.892$). Further, the PIMCES has been shown to have negligible associations with marijuana descriptive norms and moderate associations with marijuana injunctive norms, indicators of marijuana use, and marijuana-related negative consequences.

Marijuana use indicators. Participants across all sites were presented with a visual guide (the same guide in all countries) which depicted different amounts of marijuana labelled in grams. Typical marijuana use frequency and quantity was assessed using the Marijuana Use Grid (MUG, Pearson & Marijuana Outcomes Study Team, 2018), a measure patterned from the Daily Drinking Questionnaire (Collins, Parks, & Marlatt, 1985). The MUG asks participants to indicate their frequency and quantity of marijuana use during a typical week. Each day of the week (Monday-Sunday) was broken down into six 4-hour blocks of time (24:00-04:00, 04:00-08:00, 0800-12:00, 12:00-16:00, 16:00-2000, 20:00-24:00), and participants entered the number of grams they consumed during each time block during a typical use week in the past 30 days. From this measure, we calculated both typical frequency (i.e., counting all non-zero values; hypothetical ranges: 0-42) and typical quantity (i.e., summing number of grams) of marijuana use for a typical week. Scores greater than 3 SDs above the mean for typical quantity were Winsorized to address outliers. To assess subjective intoxication, participants were asked to indicate how high they get on a “typical marijuana use day” (typical subjective intoxication) on a visual analog scale (0=*not at all* to 100=*completely*) and reported the number of hours they typically “stay high” on a typical marijuana use day (length of typical intoxication).

Marijuana norms. All participants (regardless if they have ever used marijuana) answered questions about marijuana norms. Marijuana descriptive norms were assessed using the same marijuana use frequency/quantity measure to assess one's own marijuana use (see MUG above); however, participants also estimated the frequency/quantity of use of their "close friends." Using a similar grid-based measure, marijuana injunctive norms were assessed by asking the amount of marijuana use that "close friends" would approve of in a typical week. Similar to the MUG, indicators of both typical quantity and frequency were calculated for each norm. Moreover, nine additional items (Pearson, Liese, Dvorak, & Marijuana Outcomes Study Team, 2017) were used to assess injunctive norms by asking one's perceptions about others' approval of specific marijuana use behaviors (using marijuana, using marijuana to get high, using marijuana daily) on a 7-point response scale (1=*strongly disapproving* to 7=*strongly approving*) for three reference groups (best friends, college students, parents). We averaged across the three behaviors to create composite scores for each reference group.

Negative marijuana-related consequences. Negative marijuana-related consequences were assessed using the 21-item Brief-MACQ (Simons et al., 2012) measured on a dichotomous response scale (0=*no*, 1=*yes*). By summing these responses, the total score reflects the total number of consequences that the individual had experienced in the past month. Previous psychometric testing has shown a single-factor solution to the B-MACQ to demonstrate good model fit (e.g., CFI=.96) and strong test-retest reliability (intra-class correlation=.80) in a sample of college student marijuana users in the U.S. Further, the B-MACQ has been shown to be weakly correlated with alcohol use, moderately correlated with alcohol consequences and indicators of marijuana use, and strongly correlated with another measure of marijuana-related consequences (Simons et al.,

2012). We have found the MACQ to be scalar invariant across sex and countries using the present sample (Bravo et al., 2019).

Statistical Analysis

To examine the internal structure of the PIMCES across sites and in the total sample, we conducted confirmatory factor analyses (CFA) using a diagonally weighted least squares (WLSMV) estimator in *Mplus* 7.4 (Muthén & Muthén, 1998-2018). To evaluate overall model fit, we used model fit criteria suggested by Marsh, Hau, and Wen (2004). Specifically, a Comparative Fit Index (CFI)/Tucker-Lewis Index (TLI) > .90 is considered acceptable and CFI/TLI > .95 is considered optimal; Root Mean Square Error of Approximation (RMSEA) < .06 is considered acceptable. Upon deciding on the best fitting model across all countries, we calculated Cronbach's alpha to test the internal consistency of the measure across sites. We conducted multi-group CFA to examine factorial invariance (configural, metric, and scalar) of the PIMCES across sex (males vs. females), lifetime user status (yes vs. no) and countries (i.e., U.S., Argentina, Uruguay, Spain, and the Netherlands). Metric invariance (equivalence of item-factor loadings) is necessary to compare associations between the PIMCES and other constructs across different groups, and scalar invariance (equivalence of item thresholds) is necessary to compare mean levels across groups. Since the χ^2 test statistic is sensitive to sample size (Brown, 2015), we used model comparison criteria of $\Delta\text{CFI}/\Delta\text{TFI} \geq .01$ (Cheung & Rensvold, 2002) and $\Delta\text{RMSEA} \geq .015$ (Chen, 2007) to indicate significant decrement in fit when testing for measurement invariance. Finally, evidence of construct validity was assessed using correlation analyses among the PIMCES latent factor with marijuana use indicators and perceived norms.

Results

CFA and Measurement Invariance of the PIMCES

The 8-item PIMCES showed adequate-to-excellent fit to the data on most indices for the total sample: $\chi^2(20)=424.28, p<.001$, CFI=.984, TLI=.977, RMSEA=.077 (90% CI [.071, .083]) and country subsamples (see Table 1). The standardized loadings (available from the authors upon request) were all salient (i.e., $\geq .30$; Brown, 2015). Internal consistency for the PIMCES was .87 in the total sample and ranged between .81-.88 across countries. Based on the findings reported above, measurement invariance testing was conducted and the PIMCES was found to be invariant across sex, the five countries, and lifetime user status (i.e., configural, metric, and scalar invariance was met; see Table 1).¹

Latent Mean Comparisons

Based on the results of our measurement invariance analyses, we conducted latent mean comparisons to test for latent score mean differences by country, lifetime user status, and sex (controlling for the effects of the other factors). We used dummy-coded indicators for country, lifetime user status (0=no, 1=yes) and sex (0= male, 1=female) as predictors of a latent factor of the PIMCES. A statistically significant result indicates a significant mean difference in the latent factor between the reference group and the predictor group (these results are available upon request).

Independent of country and lifetime user status, females reported significantly lower scores than males on the PIMCES ($b=-.227, p<.001$). Independent of country and sex, lifetime users reported significantly higher scores than non-users on the PIMCES ($b=.510, p<.001$). Using the U.S. as the reference group and controlling for sex and lifetime user

¹ *There were no endorsement of all response options for items 2,5,7, and 13 in the Uruguay sample; thus, measurement invariance of the 8-item version was tested across the U.S., Argentina, Spain, and Netherlands. A 4-item version (no items 2,5,7, and 13) was tested across all five countries. Each of these analyses supported measurement invariance of the measure (see Table 1).

status, we found that college students from all other countries reported significantly lower scores than U.S. college students on the PIMCES: Argentina ($b=-.250, p<.001$), Uruguay ($b=-.220, p=.012$), Spain ($b=-.330, p<.001$), and the Netherlands ($b=-.394, p<.001$). Of all possible mean differences across the other countries, there was only one significant latent mean difference such that Dutch students reported significantly higher scores on the PIMCES than Argentinian students ($b=.144, p=.015$).

Construct Validity

Bivariate correlations were conducted between the latent factor of the PIMCES and other marijuana-related variables among past month marijuana users ($n=1117$) across sex and across countries. In the analyses conducted across sex (see Table 2), the associations between PIMCES scores and marijuana-related variables were small-to-moderate across both males and females, though they tended to be slightly larger among females than males (average $r_{diff}=.03$). The association between PIMCES and best friend injunctive norms was stronger among females ($r=.30$) than males ($r=.14$) and the association between PIMCES and typical frequency was stronger among females ($r=.27$) than males ($r=.16$). All other differences were $|.08|$ or smaller (average $|r_{diff}|=.05, SD=.05$). In the analyses conducted by country (see Table 3), larger differences emerged in the associations between PIMCES and other marijuana-related variables. Across 130 possible comparisons, we found that the average difference in correlations was $|.15|$ ($SD=.12$). The largest correlation differences were between PIMCES and typical quantity injunctive norms in the Netherlands ($r=.41$) vs. Uruguay ($r=-.06$), PIMCES and typical frequency descriptive norms in Argentina ($r=.24$) vs. Uruguay ($r=-.19$), and PIMCES and typical quantity in the U.S. ($r=.24$) vs. Uruguay ($r=-.22$). As demonstrated here, for multiple variables, we observed a mixture of negative, positive, and/or non-significant associations across distinct countries.

Discussion

In the first study of its kind, we examined marijuana internalized norms, or the degree to which college students view marijuana use to be an integral part of the college experience, among college students across five distinct countries (United States, Uruguay, Argentina, Spain, and the Netherlands) spanning three continents (North America, South America, and Europe) with three different languages (English, Spanish, and Dutch). We found strong measurement invariance (i.e., scalar invariance) for the PIMCES across these countries, suggesting that this measure taps into the same construct across these distinct cultures. Consistent with our hypotheses and with previous research (Pearson et al., 2017), we also found the PIMCES to be scalar invariant across sex and user status, suggesting that this measure taps into the same construct across males and females as well as across marijuana users and non-users.

Also consistent with our hypotheses and previous research (Pearson et al., 2017), we found that males reported higher marijuana internalized norms than females, and marijuana users reported higher marijuana internalized norms than non-users. The legal regulatory status of marijuana across these countries are complicated. In Uruguay, marijuana is legal for adult use, but frequent users have been found to circumvent the legal market (Boidi, Queirolo, & Cruz, 2016). In the Netherlands, Spain, and Argentina, marijuana is decriminalized though specific policies, availability, and prevalence rates differ across these countries (Decorte et al., 2017). Despite more legal restrictions regarding marijuana use in the United States compared to these other countries, college students in the United States reported the highest levels of marijuana internalized norms compared to college students in any of the other countries. Just like prevalence rates (Degenhardt et al., 2008), it is important to note that normative perceptions are not strictly (or even strongly)

determined by legal restrictions.

In terms of the relationships between marijuana internalized norms and other marijuana-related constructs across males and females, we observed very similar associations, although these relationships tended to be slightly stronger among females suggesting that PIMCES has similar construct validity among males and females. In terms of the relationships between marijuana internalized norms and other marijuana-related constructs across countries, we observed a rather wide range of differences with an average correlation difference of .15. For example, the associations between marijuana internalized norms and typical quantity descriptive norms ranged from .04 to .14, the associations with past month marijuana use frequency ranged from .10 to .38, and the associations with negative consequences ranged from .18 to .41. The associations with many of these constructs included a mix of positive, negative, and/or non-significant associations. These findings could reflect real cultural differences in how internalized marijuana norms exert effects on outcomes, measurement non-invariance on the outcomes examined, or sample-specific differences. For example, it is plausible that college students in distinct countries differ in their ability to estimate marijuana use in grams based on varied formulations of marijuana products obtained across these countries, leading to large differences across countries in these associations. It must also be noted that the sample sizes of marijuana users in some of these countries were quite small (e.g., $n=43$ in Uruguay), suggesting that some of these differences could be spurious.

Practical and Clinical Implications

The PIMCES appears to have merit from a psychometric perspective as it demonstrates strong psychometric properties for males and females as well as marijuana users and non-users sampled from diverse countries/cultures. The patterns of associations

between marijuana internalized norms with other marijuana norms measures, indicators of marijuana use, and marijuana-related negative consequences continues to support that these internalized norms reflect a construct that is unique from other marijuana norms and is one that plays a unique role in college students' decision whether and how to use marijuana.

Clearly, additional research is needed to examine how marijuana internalized norms develop over time and to determine what factors influence these perceptions. For example, alcohol internalized norms have been shown to be influenced by exposure to alcohol-promoting movies (Osberg et al., 2012).

Despite some differences across countries in terms of correlations with other measures, we found that marijuana internalized norms were robustly related to marijuana-related outcomes across males and females and across the five countries included in the present sample. From a clinical perspective, these findings provide preliminary support for marijuana internalized norms as an intervention target. Although our findings provide limited information regarding specific strategies to modify these beliefs, it is possible that the efficacy of norm-based interventions targeting college student marijuana use (Lee et al., 2010) could be improved through targeting marijuana internalized norms. Perhaps such approaches would be efficacious across distinct cultural contexts, despite large differences in college/campus cultures.

Limitations

The present study had notable limitations that prevent our ability to make stronger inferences. Due to the cross-sectional/non-experimental design, we cannot determine whether marijuana internalized norms are causally related to the marijuana-related outcomes that we examined. Given our convenience sampling approach, we cannot be sure that our subsamples are representative of the college student populations in each country.

Thus, we do not wish to overinterpret differences found between countries as they could have resulted from small differences in sampling strategies (e.g., differential representativeness of college students in each country). Although our overall sample size was large, the sample sizes in some of our subsamples were rather small. Further, our selection of countries was largely opportunistic and did not include any countries in Africa, Asia, or Oceania. Taken together, longitudinal and experimental research that examines these associations prospectively in large, representative samples of college students in a wider selection of countries reflecting the full range of variability in marijuana-related policies, use, and norms would be ideal.

Conclusion

Our results are promising in that the PIMCES appears to assess marijuana internalized norms equally well among males and females, marijuana users and non-users, and across college students in the five countries examined. Now that we have Spanish and Dutch versions of the instrument, we can examine the psychometric properties and construct validity of the PIMCES in English-, Spanish-, and/or Dutch-speaking countries. Given the limitations of the present study, our findings should be considered preliminary; however, our results support further examination of normative perceptions across cultures. Characterizing cultural differences in normative perceptions and their influence on marijuana-related outcomes can inform the etiology of marijuana use as well as development and tailoring of norms-based interventions.

References

- Borsari, B., & Carey, K. B. (2001). Peer influences on college drinking: A review of the research. *Journal of Substance Abuse, 13*(4), 391-424.
- Borsari, B., & Carey, K. B. (2003). Descriptive and injunctive norms in college drinking: A meta-analytic integration. *Journal of Studies on Alcohol, 64*, 331-341. doi: 10.15288/jsa.2003.64.331
- Bravo, A. J., Pearson, M. R., Pilatti, A., Mezquita, L., & Cross-cultural Addictions Study Team. (2019). Negative marijuana-related consequences among college students in five countries: Measurement invariance of the Brief Marijuana Consequences Questionnaire. Under Review.
- Bravo, A. J., Pearson, M. R., Pilatti, A., Read, J. P., Mezquita, L., Ibáñez, M. I., & Ortet, G. (2017). Cross-cultural examination of college drinking culture in Spain, Argentina, and USA: Measurement invariance testing of the College Life Alcohol Salience Scale. *Drug and Alcohol Dependence, 180*, 349-355. doi: 10.1016/j.drugalcdep.2017.08.016
- Bravo, A. J., Pearson, M. R., Pilatti, A., Read, J. P., Mezquita, L., Ibáñez, M. I., & Ortet, G. (2018). Impulsivity-like traits, college alcohol beliefs, and alcohol outcomes: Examination of a prospective multiple mediation model among college students in Spain, Argentina, and USA. *Addictive Behaviors, 81*, 125-133. doi: 10.1016/j.addbeh.2018.02.009
- Brown, T. A. (2015). *Confirmatory factor analysis for applied research* (2nd ed.). New York: Guilford Press.

- Chen, F. F. (2007). Sensitivity of goodness of fit indexes to lack of measurement invariance. *Structural Equation Modeling, 14*, 464-504.
10.1080/10705510701301834
- Cheung, G. W., & Rensvold, R. B. (2002). Evaluating goodness-of-fit indexes for testing measurement invariance. *Structural Equation Modeling, 9*, 233-255. doi:
10.1207/S15328007SEM0902_5
- Cialdini, R. B., Kallgren, C. A., & Reno, R. R. (1991). A focus theory of normative conduct: A theoretical refinement and reevaluation of the role of norms in human behavior. In *Advances in experimental social psychology* (Vol. 24, pp. 201-234). Academic Press.
- Collins, R. L., Parks, G. A., & Marlatt, G. A. (1985). Social determinants of alcohol consumption: The effects of social interaction and model status on the self-administration of alcohol. *Journal of Consulting and Clinical Psychology, 53*, 189-200. doi: 10.1037/0022-006X.53.2.189
- Decorte, T., Pardal, M., Queirolo, R., Boidi, M. F., Avilés, C. S., & Franquero, Ò. P. (2017). Regulating Cannabis Social Clubs: A comparative analysis of legal and self-regulatory practices in Spain, Belgium and Uruguay. *International Journal of Drug Policy, 43*, 44-56.
- Degenhardt, L., Chiu, W. T., Sampson, N., Kessler, R. C., Anthony, J. C., Angermeyer, M., ... & Karam, A. (2008). Toward a global view of alcohol, tobacco, cannabis, and cocaine use: findings from the WHO World Mental Health Surveys. *PLoS Medicine, 5*(7), e141.

- Hustad, J. T. P., Pearson, M. R., Neighbors, C., & Borsari, B. (2014). The role of alcohol perceptions as mediators between personality and alcohol-related outcomes among incoming college student drinkers. *Psychology of Addictive Behaviors, 28*, 336-347. doi: 10.1037/a0033785
- Lee, C. M., Neighbors, C., Kilmer, J. R., & Larimer, M. E. (2010). A brief, web-based personalized feedback selective intervention for college student marijuana use: A randomized clinical trial. *Psychology of Addictive Behaviors, 24*, 265-273. doi:10.1037/a0018859
- Marsh, H. W., Hau, K.-T., & Wen, Z. (2004). In search of golden rules: Comment on hypothesis-testing approaches to setting cutoff values for fit indexes and dangers in overgeneralizing Hu and Bentler's (1999) findings. *Structural Equation Modeling, 11*, 320-341. doi: 10.1207/s15328007sem1103_2
- Martens, M. P., Page, J. C., Mowry, E. S., Damann, K. M., Taylor, K. K., & Cimini, M. D. (2006). Differences between actual and perceived student norms: An examination of alcohol use, drug use, and sexual behavior. *Journal of American College Health, 54*, 295-300. doi: 10.3200/JACH.54.5.295-300
- Muthén, L.K. and Muthén, B.O. (1998-2018). *Mplus user's guide. Eighth Edition*. Los Angeles, CA: Muthén & Muthén.
- Napper, L. E., Kenney, S. R., Hummer, J. F., Fiorot, S., & LaBrie, J. W. (2016). Longitudinal relationships among perceived injunctive and descriptive norms and marijuana use. *Journal of Studies on Alcohol and Drugs, 77*, 457-463. doi: 10.15288/jsad.2016.77.457

- Osberg, T. M., Atkins, L., Buchholz, L., Shirshova, V., Swiantek, A., Whitley, J., ... & Oquendo, N. (2010). Development and validation of the College Life Alcohol Salience Scale: A measure of beliefs about the role of alcohol in college life. *Psychology of Addictive Behaviors, 24*, 1-12. doi: 10.1037/a0018197.
- Osberg, T. M., Billingsley, K., Eggert, M., & Insana, M. (2012). From animal house to old school: A multiple mediation analysis of the association between college drinking movie exposure and freshman drinking and its consequences. *Addictive Behaviors, 37*, 922–930. doi: 10.1016/j.addbeh.2012.03.030.
- Osberg, T. M., Insana, M., Eggert, M., & Billingsley, K. (2011). Incremental validity of college alcohol beliefs in the prediction of freshman drinking and its consequences: A prospective study. *Addictive Behaviors, 36*, 333-340. doi: 10.1016/j.addbeh.2010.12.004
- Pearson, M. R., & Hustad, J. T. P. (2014). Personality and alcohol-related outcomes among mandated college students: Descriptive norms, injunctive norms, and college-related alcohol beliefs as mediators. *Addictive Behaviors, 39*, 879-884. doi: 10.1016/j.addbeh.2014.01.008
- Pearson, M. R., Hustad, J. T., Neighbors, C., Conner, B. T., Bravo, A. J., & Marijuana Outcomes Study Team. (2018). Personality, marijuana norms, and marijuana outcomes among college students. *Addictive Behaviors, 76*, 291-297. doi: 10.1016/j.addbeh.2017.08.012
- Pearson, M. R., Liese, B. S., Dvorak, R. D., & Marijuana Outcomes Study Team (2017). College student marijuana involvement: Perceptions, use, and consequences across 11 college campuses. *Addictive Behaviors, 66*, 83-89. doi: 10.1016/j.addbeh.2016.10.019

- Pearson, M. R., Kholodkov, T., Gray, M. J., & Marijuana Outcomes Study Team (2017). Perceived Importance of Marijuana to the College Experience (PIMCES): Initial Development and Validation. *Journal of Studies on Alcohol and Drugs*, 78, 319-324. doi: 10.15288/jsad.2017.78.319
- Pearson, M. R., & Marijuana Outcomes Study Team. (2018). Marijuana Use Grid: A brief, comprehensive measure of marijuana use. *Manuscript submitted for publication*.
- Pilatti, A., Read, J. P., & Pautassi, R. M. (2017). ELSA 2016 cohort: Alcohol, tobacco, and marijuana use and their association with age of drug use onset, risk perception, and social norms in Argentinean college freshmen. *Frontiers in Psychology*, 8, 1452.
- Queirolo, R., Boidi, M. F., & Cruz, J. M. (2016). Cannabis clubs in Uruguay: The challenges of regulation. *International Journal of Drug Policy*, 34, 41-48.
- Simons-Morton, B., Pickett, W., Boyce, W., Ter Bogt, T. F., & Vollebergh, W. (2010). Cross-national comparison of adolescent drinking and cannabis use in the United States, Canada, and the Netherlands. *International Journal of Drug Policy*, 21(1), 64-69.
- Simons, J. S., Dvorak, R. D., Merrill, J. E., & Read, J. P. (2012). Dimensions and severity of marijuana consequences: Development and validation of the Marijuana Consequences Questionnaire (MACQ). *Addictive Behaviors*, 37, 613-621. doi: 10.1016/j.addbeh.2012.01.008

Table 1. Model fit and test of measurement invariance of the PIMCES

Overall Fit Indices for 8-Item PIMCES									
	n	χ^2	df	CFI	TLI	RMSEA			
1. United States	1916	282.23	20	.985	.978	.083 (.074, .091)			
2. Argentina	375	62.96	20	.975	.966	.076 (.055, .097)			
3. Uruguay	97	32.92	20	.983	.977	.082 (.022, .130)			
4. Spain	736	146.10	20	.978	.969	.093 (.079, .107)			
5. Netherlands	300	47.00	20	.982	.975	.067 (.042, .092)			
6. Total Sample	3424	424.28	20	.984	.977	.077 (.071, .083)			
<i>Measurement Invariance Test of the 8-Item PIMCES Across U.S., Argentina, Spain, and Netherlands</i>									
Overall Fit Indices						Comparative Fit Indices			
	χ^2	df	CFI	TLI	RMSEA	Model Comparison	Δ CFI	Δ TLI	Δ RMSEA
1. Configural	473.51	80	.986	.981	.077 (.070, .084)				
2. Metric	753.42	101	.977	.975	.088 (.082, .094)	1 vs 2	-.009	-.006	.011
3. Scalar	829.61	170	.977	.985	.068 (.064, .073)	2 vs 3	.000	.010	-.020
<i>*Measurement Invariance for a 4-item version (no items 2,5,7 and 13) Across All Countries</i>									
Overall Fit Indices						Comparative Fit Indices			
	χ^2	df	CFI	TLI	RMSEA	Model Comparison	Δ CFI	Δ TLI	Δ RMSEA
1. Configural	107.55	10	.991	.973	.119 (.100, .140)				
2. Metric	218.46	22	.982	.976	.114 (.101, .128)	1 vs 2	-.009	.003	-.005
3. Scalar	335.78	66	.976	.989	.077 (.069, .086)	2 vs 3	-.006	.013	-.037
<i>Measurement Invariance Test of the 8-Item PIMCES Across Marijuana Lifetime User Status</i>									
Overall Fit Indices						Comparative Fit Indices			
	χ^2	df	CFI	TLI	RMSEA	Model Comparison	Δ CFI	Δ TLI	Δ RMSEA
1. Configural	488.10	40	.981	.973	.081 (.075, .087)				
2. Metric	568.53	47	.978	.973	.081 (.075, .087)	1 vs 2	-.003	.000	.000
3. Scalar	591.48	70	.978	.982	.066 (.061, .071)	2 vs 3	.000	.000	-.015
<i>Measurement Invariance Test of the 8-Item PIMCES Across Sex</i>									
Overall Fit Indices						Comparative Fit Indices			
	χ^2	df	CFI	TLI	RMSEA	Model Comparison	Δ CFI	Δ TLI	Δ RMSEA
1. Configural	467.28	40	.983	.976	.079 (.073, .086)				
2. Metric	503.58	47	.981	.978	.075 (.070, .081)	1 vs 2	-.002	.002	-.004
3. Scalar	390.81	70	.987	.990	.052 (.047, .057)	2 vs 3	.006	.012	-.023

Note. We relied on the model comparison criteria of Δ RMSEA \leq .015 (increase indicates worse fit; Chen, 2007) and Δ CFI/ Δ TLI \leq .01 (decrease indicates worse fit; Cheung & Rensvold, 2002) to test for measurement invariance. *In the Uruguay sample, items 2, 5, 7 and 13 did not contain all values and thus measurement invariance was tested without these items.

Table 2
Correlations between the latent PIMCES factor and composite scores of marijuana use variables across sex

	Females	Males	Females – Males Difference
<i>Marijuana Use Indicators</i>	n=695	n=416	
Use Frequency Past 30 Days	.22	.19	.03
Typical Quant.	.20	.14	.06
Typical Freq.	.27	.16	.11
Typical Subjective Intox.	.24	.20	.04
Length of Typical Intox. (hours)	.13	.13	-.00
Negative Consequences	.21	.17	.04
<i>Marijuana Use Norms</i>			
Descript. Norms Typ. Quant.	.06	.13	-.07
Descript. Norms Typ. Freq.	.11	.12	-.01
Inj. Norms Typ. Quant.	.11	.08	.03
Inj. Norms Typ. Freq.	.09	.08	.01
<i>Injunctive Norms of Others</i>			
Inj. Norms – Best Friend	.30	.14	.16
Inj. Norms – College Student	.22	.21	.01
Inj. Norms – Parents	.16	.08	.08

Table 3
Correlations between the latent PIMCES factor and composite scores of marijuana use variables across countries

	PIMCES Latent Factor					Correlation differences across countries									
	USA	AR	UY	ES	NL	USA -AR	USA - UY	USA -ES	USA -NL	AR - UY	AR - ES	AR - NL	UY - ES	UY - NL	ES - NL
<i>Marijuana Use Indicators</i>															
Use Frequency Past 30 Days	.24	.10	.24	.10	.38	.14	.00	.14	.14	.14	.00	.28	.14	.14	.28
Typical Quant.	.24	.13	-.22	.10	-.02	.11	.46	.14	.26	.35	.03	.15	.32	.20	.12
Typical Freq.	.23	.23	.10	.09	.29	.00	.13	.14	.06	.13	.14	.06	.01	.19	.20
Typical Subjective Intox.	.21	-.03	-.02	.36	.11	.24	.23	.15	.10	.01	.39	.14	.38	.13	.25
Length of Typical Intox. (hours)	.04	.08	-.07	.39	.13	.04	.11	.35	.09	.15	.31	.05	.46	.20	.26
Negative Consequences	.18	.25	.21	.18	.41	.07	.03	.00	.23	.04	.07	.16	.03	.20	.23
<i>Marijuana Use Norms</i>															
Descript. Norms Typ. Quant.	.14	.07	.06	.05	.10	.07	.08	.09	.04	.01	.02	.03	.01	.04	.05
Descript. Norms Typ. Freq.	.14	.24	-.19	.10	.12	.10	.33	.04	.02	.43	.14	.12	.29	.31	.02
Inj. Norms Typ. Quant.	.13	-.01	-.06	.06	.41	.14	.19	.07	.28	.05	.07	.42	.12	.47	.35
Inj. Norms Typ. Freq.	.08	.12	-.03	.06	.27	.04	.11	.02	.19	.15	.06	.15	.09	.30	.21
<i>Injunctive Norms of Others</i>															
Inj. Norms – Best Friend	.24	.13	.44	.22	.15	.11	.20	.02	.09	.31	.09	.02	.22	.29	.07
Inj. Norms – College Student	.23	.04	.26	.05	.14	.19	.03	.18	.09	.22	.01	.10	.21	.12	.09
Inj. Norms – Parents	.15	.08	.16	.13	-.13	.07	.01	.02	.28	.08	.05	.21	.03	.29	.26

Note. USA =United States ($n = 696$); AR=Argentina ($n = 153$), UY = Uruguay ($n = 43$), ES=Spain ($n = 160$), NL=Netherlands ($n = 65$). Due to no convergence in the Uruguay sample, all correlations were conducted with a MLR estimator. Medium correlation differences are *italicized* ($.15 < r_{diff} < .27$), large differences are **bolded** ($.28 < r_{diff} < .39$), and substantial difference are **bolded and underlined** ($r_{diff} > .40$).

Appendix A
Items for the Spanish and Dutch Versions of the PIMCES

Item #	Items- Spanish Version	Items- Dutch Version
2	"Colocarse" con marihuana forma parte de convertirse en universitario	High worden van marihuana is onderdeel van het studenten inwijdingsritueel.
4	La recompensa después de una dura semana de estudiar debería ser un fin de semana de "colocarse" con marihuana.	De beloning aan het einde van een harde week van hard studeren zou een weekend van marihuana gebruik moeten zijn.
5	Pienso que los estudiantes que no salen para "colocarse" con marihuana no disfrutan de su experiencia universitaria.	Ik denk dat de studenten die niet er op uit zijn om high van marihuana te worden niet genieten van hun studententijd
7	Una fiesta universitaria no es realmente una fiesta universitaria si no hay marihuana.	Een studentenfeest is geen echt feest zonder marihuana
9	Asistir a fiestas donde hay marihuana es la manera más fácil de hacer amigos.	Een feestje vieren met marihuana is de gemakkelijkste manier om vrienden te maken
10	Consumir marihuana es un acontecimiento social en el que todos los universitarios participan.	Marihuana gebruiken is een sociale situatie waar elke student aan mee doet
11	La universidad es una época para experimentar con la marihuana	Het studentenleven is de tijd voor het experimenteren met marihuana
13	Las oportunidades de "colocarse" con marihuana y salir de fiesta en la universidad son tan importantes como la experiencia académica.	De beleving om high van marihuana te worden en te feesten als student is net zo belangrijk als de academische ervaring

Note. Item numbers refer to the item number of the English PIMCES.

Author Disclosures

Role of Funding Sources

There was no direct funding for this study. However, Dr. Pearson is supported by a career development grant (K01-AA023233) from the National Institute on Alcohol Abuse and Alcoholism (NIAAA) and Dr. Bravo is supported by a training grant (T32-AA018108) from the NIAAA. NIAAA had no role no role in the study design, collection, analysis or interpretation of the data, writing the manuscript, or the decision to submit the paper for publication.

Contributors

Dr. Pearson conceptualized the research questions and drafted the manuscript. Dr. Bravo coordinated data collection, conducted the analyses and prepared the results and tables. Melissa Sotelo conducted literature searches and assisted with writing and editing portions of the manuscript. Cross-Cultural Addictions Study Team collected the data. All authors contributed to and approved of the final manuscript.

Conflict of Interest

No conflict declared.

Acknowledgments

None.