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A Cross-National Examination of Cannabis Protective Behavioral Strategies' Role in the

Relationship between Big Five Personality Traits and Cannabis Outcomes

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Abstract

Background: Identifying mediators that elucidate the relationship between risk/protective factors (e.g., personality traits) and negative cannabis consequences is crucial to enhancing the quality of prevention and intervention efforts.

Objective: The present study examined whether the Five-Factor Model of personality (openness, conscientiousness, extraversion, agreeableness, and neuroticism) relates to cannabis outcomes via use of cannabis protective behavioral strategies (PBS) in a cross-national sample of college student cannabis users.

Method: Participants were 1175 students (63.27% female) across five countries (United States, Argentina, Spain, Uruguay, and the Netherlands) who used cannabis in the last 30 days.

Results: PBS use mediated the associations between personality traits and cannabis consequences, such that higher conscientiousness ($\beta=.20$), agreeableness ($\beta=.11$), and lower emotional stability [i.e., higher neuroticism] ($\beta=-.14$) were associated with more PBS use, which was associated with lower frequency of cannabis use ($\beta=-.32$), and lower frequency of use was in turn associated with fewer cannabis consequences ($\beta=.34$). This sequential pathway was invariant across sex, but not countries. Notably, there were a number of differences in links between PBS and cannabis outcomes when comparing countries (e.g., in the USA sample PBS use was negatively associated with consequences, but a positive association was found among students in Argentina).

Conclusions: Our findings suggest that PBS mediates the relationship between personality traits and cannabis outcomes, but that there are nuanced differences across countries. Overall, students that are low in conscientiousness, agreeableness, and neuroticism and/or report low rates of PBS use may benefit from cannabis PBS focused interventions that promote utilization of PBS.

Keywords: Big Five; cannabis; protective behavioral strategies; cross-national; college students

Introduction

Cannabis use and subsequent negative consequences are highest among young adults (1). Young adults who frequently use cannabis are more likely to experience an array of short- and long-term consequences, such as an increase in academic difficulties, motor vehicle crashes, impaired respiratory function, cardiovascular disease, along with decreases in memory, cognitive functioning, and information processing (2-4). Furthermore, despite acknowledgement of potential harms by college students (5), perceived risk of cannabis use is decreasing among young adults (1, 6) and youths (7). Considering cannabis is commonly used by college students in the United States (8), and among young adults from Spain (7), the Netherlands (9) and Argentina (10), there is a need to move beyond prevention. As such, attention might be best served exploring ways to decrease negative consequences of cannabis use (11). Identifying mediators that elucidate the relationship between risk/protective factors and negative cannabis consequences is crucial to enhancing the quality of prevention and intervention efforts, as well as education efforts aimed at harm reduction.

Personality and substance use

The Five-Factor Model (FFM) is a widely used model of human personality (12, 13). This conceptualization of personality refers to the existence of five personality dimensions: openness to experience, conscientiousness, extraversion, agreeableness, and neuroticism (or the positive end of the spectrum, emotional stability). Openness to experience reflects individual differences in creativity, open-mindedness, curiosity, and appreciation of beauty. Conscientiousness refers to individual differences in delaying gratification, adhering to norms and rules, and thinking before acting. Extraversion reflects individual differences in assertiveness, gregariousness, and the experience of being energized around other people.

Agreeableness reflects individual differences in cooperation, sympathy, and altruism. Lastly, neuroticism (or low emotional stability) represents individual differences in experiencing negative emotions such as fear, anger, or irritability, as well as a tendency towards self-consciousness. These five traits have consistently emerged in a variety of studies spanning many languages and cultures (14, 15).

The FFM is closely related to a variety of health outcomes including drug abuse (16). This strong association is reflected in oft-cited meta-analyses on the relationship between personality traits and substance use outcomes. For example, Bogg & Roberts (17) found conscientiousness to be strongly negatively related to drug abuse. Expanding on this finding, Ruiz and colleagues (18) provided evidence for a dimensional personality profile of those at high risk for experiencing problems with substance use. Specifically, individuals possessing low levels of conscientiousness and agreeableness paired with higher levels of impulsivity (a facet of neuroticism in some personality theories; see (19) for an overview) were found to be at greater risk of problematic substance use, including illicit drug use (18). A subsequent meta-analysis corroborated this at-risk personality profile by showing those with substance use disorders were often low in conscientiousness and agreeableness, and high in neuroticism (20). These meta-analyses are crucial to providing context for understanding the relationship between substance use and personality; however, it is also necessary to investigate the nuances of individual substance-personality trait relationships.

Personality and cannabis use across cultural contexts

Research exploring cannabis use has varied in method and cultural context. In alignment with the personality profile identified by Ruiz and colleagues (18), Australian twins and siblings enrolled in a 5-year longitudinal study who possessed the personality profile of low

conscientiousness and agreeableness paired with high neuroticism, were more likely to experience cannabis use disorder (21). Similarly, longitudinal data indicates Chilean youth who scored higher on conscientiousness and agreeableness were less likely to initiate or continue use of cannabis in young adulthood (22), whereas those who scored high in neuroticism were more likely to initiate and continue use. Low conscientiousness and agreeableness were also associated with use and consequences in Canadian undergraduates (23) and community members in the United States (24). In addition, there is evidence linking openness to experience to cannabis outcomes. Specifically, openness to experience has been found to be positively associated with cannabis use longitudinally in Brazil (25) and Belgium (26), prospectively in Australia (27), and cross-sectionally in Switzerland (28), Mexico (29), and the United States (30).

The past literature has repeatedly shown cannabis use to be associated with higher levels of openness to experience and lower levels of conscientiousness and agreeableness. Additionally, negative consequences of cannabis use were found to be associated with lower levels of conscientiousness and agreeableness as well as higher levels of neuroticism. These findings illustrate the robustness of personality as a predictor of cannabis use outcomes. However, despite extensive research illustrating the associations between the Big Five and cannabis outcomes in different populations separately (i.e., North American, Belgian, Brazilian), there is limited research exploring these associations cross-nationally (15). Further, researchers have yet to examine if the associations between the FFM and cannabis outcomes differ across countries from North America (US), South America (Argentina and Uruguay) and Europe (Netherlands and Spain).

Cross-national comparisons are important considering that cultural or regional differences (e.g., access to drugs; cultural attitudes towards drug use) might affect the magnitude

of associations across personality and cannabis use and related negative consequences. For

instance, in the US, cannabis legislation, access to cannabis, and acceptability of use vary across

states (31). Within the present study, college students were recruited in four states with varying

cannabis policies at the time of data collection: Colorado (recreational cannabis is legal for those

aged 21+ and is easily accessible through registered dispensaries, medical cannabis is legal for

Colorado residents aged 18+); New Mexico and New York (medical cannabis is legal and can be

purchased from registered dispensaries with a recommendation from a medical provider); and

Virginia (medical cannabis is legal, but only in more medically severe cases) (31, 32). Whereas,

in Uruguay, the federal government regulates the production, distribution and selling of cannabis

for recreational use and adults have multiple avenues to acquire cannabis (33). In the

Netherlands possession and distribution of cannabis remains illegal, despite cannabis tourism

being popular in Amsterdam (34). However, the Dutch government classifies cannabis as a

"soft" drug, meaning legal penalties for using cannabis are less severe than those associated with

the use of "hard" drugs (34, 35). In Spain, buying, selling, and use of cannabis is illegal in public

areas, however, private use as well as personal growing has been decriminalized (36). As a result

of these discrepancies in public and private policies, non-profit groups that sell to members over

the age of 18 (in some cases 21) in private 'social clubs' are common due to a loophole allowing

"private" sale and use (37). Additionally, Spain has no specific regulations governing its use for

therapeutic purposes. Argentina decriminalized the possession of small amounts of cannabis for

personal use in private locations in 2009. Further, the first national law in Argentina regulating

the use of cannabis for medical and research purposes (approved in 2017) restricts access to

cannabidiol to certain patients and researchers. Given these differences, it is important to

examine whether mechanisms linking personality traits and cannabis outcomes differ across

countries.

Protective behavioral strategies

Protective behavioral strategies (PBS) are behaviors that are used immediately prior to, during, after, and/or instead of substance use that reduce consumption, intoxication, and/or substance-related harm (see (38, 39) for reviews). Use of cannabis PBS is typically assessed using the Protective Behavioral Strategies–Marijuana Scale (PBSM; (40, 41)). Examples of items include, "Only purchase marijuana from a trusted source," "Use a little and then wait to see how you feel before using more," and "Avoid using marijuana before work or school". Recent findings indicate use of cannabis PBS is a robust protective factor associated with lower cannabis use and negative consequences of use (42, 43). Use of cannabis PBS has also been shown to mediate the effects of known risk factors on cannabis outcomes such as gender, specific cannabis use motives, and sensation seeking personality types in youths from the United States (44-46). Increased alcohol PBS use has been shown to mediate the relationship between conscientiousness and alcohol use and related problems in undergraduates from the United States (47, 48). However, research has not yet explored cannabis PBS as a mediator between the Big Five personality traits and cannabis outcomes around the world.

Purpose of present study

The purpose of the present study was to explore the associations between personality traits, cannabis PBS, frequency of cannabis use, and cannabis-related negative consequences among a sample of college students from five countries. To accomplish this, we tested a double mediation model of personality traits on negative consequences of cannabis use via use of PBS and cannabis frequency. Based on past literature we expected to find significant double mediation effects for conscientiousness, such that higher conscientiousness would be associated

with more cannabis PBS use, which in turn would be associated with lower use frequency and consequences. We also expected to find significant double mediation effects for agreeableness, such that higher agreeableness would be associated with more cannabis PBS use, which in turn would be associated with lower use frequency and consequences. However, given the mixed findings for the other three personality dimensions (i.e., openness to experience, extraversion, neuroticism), no specific hypotheses were proposed. We also explored whether findings were the same across countries or country specific by testing the structural invariance of the model among college students from five countries.

Method

Procedures and Participants

Participants were college students recruited from the United States (US; four universities across four states: Colorado, New Mexico, New York Virginia), Argentina (AR; one university located in the Central region), Spain (SP; one university located in the autonomous community of Valencia), Uruguay (UY; one university located in the largest city of the country, situated on the southern coast of Uruguay) and the Netherlands (NL; one university located in the province of North Brabant) to participate in an online survey measuring risk and protective factors of cannabis use and subsequent outcomes. Among all sites, students completed the same core battery translated into the native language (data collected from September 2017 – May 2018).

For the US sites, students were recruited from Psychology Department research pools and received research credit for their participation. In Argentina and Uruguay, students were recruited through online social networks and email listings. In Argentina, participants who completed the survey were entered into a raffle of seven prizes [one stay in a cottage located in a popular destination and six cash prizes (each of ≈US 36 at the time)]. In Uruguay, participants

did not receive compensation for their participation. In Spain, an email was sent to all the students at the university inviting them to participate in the research. Participants who completed the survey received €5 for their participation. In the Netherlands, students were recruited from the School of Social and Behavioral Sciences and received research credit. Study procedures were approved by the institutional review boards (or the international equivalent) for each participating university.

Although 3,482 students were recruited across sites (for specific demographic information of the full sample as well as each data collection site, see (49)), for the purpose of the present study the analytic sample was limited to 1175 students who reported consuming cannabis in the last 30 days [n=698; 64.5% female], SP, [n=178; 54.5% female], AR, [n=153; 60.1% female], UY, [n=79; 81.0% female], NL, [n=67; 60.6% female]). Therefore, 2307 students (US=1109, SP=311, AR=118, UY=34, NL=98) were excluded from analyses as they did not consume cannabis in the last 30 days.

Measures

For all measures (unless specified), composite scores were created by averaging items and reverse-coding items when appropriate such that higher scores indicate higher levels of the construct.

Personality. Personality traits were assessed using the Big Five Personality Trait Short Questionnaire (BFPTSQ; (13)) and its Spanish version (50). The measure was translated into Dutch for the present study. The questionnaire consists of 50 questions rated on a 5-point scale ranging from zero (*disagree strongly*) to four (*agree strongly*). The scale is broken down into the Big Five personality domains consisting of openness (Total α=.81; US=.80; SP=.78; AR=.81; UY=.72; NL=.81), conscientiousness (Total α=.76; US=.76; SP=.84; AR=.69; UY=.80;

NL=.77), extraversion (Total α=.85; US=.87; SP=.84; AR=.83; UY=.86; NL=.85), agreeableness (Total α=.73; US=.73; SP=.75; AR=.69; UY=.78; NL=.80), and emotional stability (Total α=.86; US=.85; SP=.86; AR=.86; UY=.89; NL=.88). The BFPTSQ has been found to be an adequate tool to assess the Big Five personality traits cross-nationally in young adults (15).

Cannabis PBS. Past month use of cannabis PBS was assessed using the 17-item version of the Protective Behavioral Strategies for Marijuana Scale (PBSM; (41)) and its Spanish and Dutch Version (51). The items were measured on a 6-point scale ranging from 1 (*never*) to 6 (*always*). The Cronbach's alpha for the total scale was .91 (US=.93; SP=.87; AR=.83; UY=.78; NL=.94). The PBSM Scale has been found to be an adequate tool to assess cannabis PBS cross-nationally in young adults (51).

Cannabis use frequency. Typical cannabis use frequency was assessed using the Marijuana Use Grid (52). Each day of the week was divided into six 4-hour blocks of time (12a-4a, 4a-8a, 8a-12p, etc), and students were asked to report at which times they used cannabis during a "typical week" in the past 30 days. A visual guide (the same in all countries) showing different amounts of cannabis in grams was used to help participants estimate cannabis quantity. A total score was calculated by summing the total number of time blocks for which they reported use (ranges: 0-42).

Cannabis consequences. Past 30 days cannabis consequences were assessed using the Brief Marijuana Consequences Questionnaire (53) and its Spanish and Dutch versions (49). The questionnaire consists of 21 yes or no questions and the total score reflects the total number of cannabis-related consequences an individual experienced in the past month. The Cronbach's alpha for the total scale was .86 (US=.87; SP=.86; AR=.80; UY=.84; NL=.83).

Data analysis plan

Study aims were tested using a fully saturated path model that was conducted using

M*plus 8.3* (54), such that double-mediated effects (i.e., sequential indirect effects) were

examined for the associations between personality traits and negative consequences of cannabis

use via use of cannabis PBS and frequency of cannabis use (e.g., conscientiousness → cannabis

PBS → frequency of cannabis use → negative cannabis consequences). Age was included as a

covariate. We examined the total, indirect, and direct effects of each predictor variable on

cannabis outcomes using bias-corrected bootstrapped estimates (55), based on 10,000

bootstrapped samples. Parameters were estimated using maximum likelihood estimation, and

missing data were handled using full information maximum likelihood, which is more efficient

and has less bias than alternative procedures (56, 57). Due to our large sample size, statistical

significance was determined by 99% bootstrapped confidence intervals not containing zero.

Results

Bivariate correlations and descriptive statistics of all study variables among the total

sample are shown in Table 1. Descriptive statistics of study variables across countries are shown

in Supplemental Table 1. The total, total indirect, specific indirect, and direct effects of the

mediation model are summarized in Table 2 and Figure 1.

Mediation Effects

Use of cannabis PBS significantly mediated the associations between three of the Big

Five personality traits and cannabis use outcomes (i.e., cannabis use frequency, and

consequences of cannabis use). Specifically, higher levels of conscientiousness, agreeableness,

and neuroticism (i.e., lower emotional stability) were associated with higher cannabis PBS use,

which in turn was associated with lower frequency of cannabis use, which in turn was associated

with lower negative consequences of use. The associations between openness to experience and

use of cannabis PBS and extraversion and use of cannabis PBS were not significant.

Structural invariance testing across countries and gender

To test whether our mediation model was country specific or universal across countries (i.e., invariant or non-invariant across countries), we conducted χ^2 difference tests comparing a freely estimated multi-group model to a constrained multi-group model (i.e., constraining the paths of the mediation model) to determine whether constraining the paths to be equivalent across countries and gender (separate models) resulted in a worse fitting model. Given the χ^2 test statistics sensitivity to sample size (58), a more stringent alpha level was used (α=.01).

Constrained multi-group models compared to the freely estimated model indicated model invariance across sex [$\chi^2(26)$=26.81, *p*=.42] but not countries [$\chi^2[104]$=273.54, *p*<.001]. To identify where the lack of invariance in the model arose, we identified the paths with the greatest contribution to reducing model fit within the fully constrained model. In the final multi-group model [$\chi^2(92)$=91.08, *p*=.51], all associations were constrained between countries except for three paths: cannabis use frequency→consequences, cannabis PBS use→consequences, and cannabis PBS use→ cannabis use frequency.

Although, cannabis use frequency was significantly positively associated with consequences in all countries, the magnitude of the effect was greater in Spain (β=.633 [.45, .77]), Netherlands (β=.661 [.44, .84]), Argentina (β=.486 [.30, .66]), and Uruguay (β=.577 [.13, .90]) compared to the U.S. (β=.195 [.08, .32]). Findings were more mixed with regards to associations with cannabis PBS use. Cannabis PBS use was significantly negatively associated with cannabis use frequency in four countries, Spain (β=-.295 [-.50, -.07]), Argentina (β=-.343 [-.50, -.17]), Uruguay (β=-.411 [-.71, -.05]), and U.S. (β=-.415 [-.52, -.30]); but was non-significantly positively associated with cannabis use frequency in the Netherlands (β=.182 [-.06,

.41]). For negative consequences, cannabis PBS use was significantly negatively associated with consequences in the U.S. (β=-.284 [-.40, -.17]), significantly positively associated with consequences in Argentina (β=.193 [.02, .37]), and was not statistically significantly associated with consequences in Spain (β=-.076 [-.26, .09]), the Netherlands (β=.115 [-.08, .35]), and Uruguay (β=-.121 [-.58, .26]).

Discussion

Past studies exploring the relationship between personality and substance use reported an association between several personality traits and cannabis outcomes. However, there is limited research examining potential mediators of these relationships. In this study, we built upon past research and examined associations between the FFM personality traits and cannabis outcomes. Specifically, we explored using cannabis PBS as a mediator between personality traits and cannabis outcomes. In doing so, we found students who were higher in conscientiousness, neuroticism (i.e., lower in emotional stability), and agreeableness were more likely to use PBS, which in turn was related to lower frequency of cannabis use and cannabis-related negative consequences. Of note, use of cannabis PBS did not mediate the relationships between openness to experience/extraversion and cannabis outcomes. Although it was unexpected that higher neuroticism was associated with higher PBS use, recent research has identified conditions where neuroticism is associated with positive health outcomes (59). Specifically, research has suggested that "healthy neuroticism" may be a result of vigilance (60). It may be that in our sample, students higher in neuroticism were more likely to be hyper-aware of their bodily state and therefore more likely to use PBS.

These findings help to create a clearer conceptualization of the previously established associations between personality traits and cannabis outcomes. Additionally, understanding how

personality traits relate to PBS use provides further information on when to promote these behaviors to students via cannabis PBS focused interventions. For example, by elucidating the direction of these associations, college health professionals can tailor interventions based off of personality assessments (i.e., identify who would most benefit from information on utilizing PBS). Moreover, given the significant relationship between three of the five traits, our result provide support for the broad appeal of PBS focused interventions. The present findings suggest alternatives for interventions, such as actively teaching and promoting the use of PBS, may be effective at reducing cannabis use and negative consequences. Findings from the alcohol literature suggest that interventions aimed at increasing the knowledge and use of PBS are promising at reducing substance use and negative consequences (61). According to our results, these PBS-centered interventions could be particularly helpful for those students with low levels of conscientiousness and agreeableness, as they are less likely to implement these behaviors. Another possibility corresponds to personality-based interventions (e.g., Preventure Programme) that target individuals with a high-risk personality profile (62). These interventions, aimed at modifying cognitions and behaviors related to certain personality profiles or traits (e.g., sensation seekers, high anxiety sensitivity individuals), even when the drug use has not started yet, have provided satisfactory results for avoiding, reducing, or delaying alcohol and cannabis use behaviors (62).

In exploring the invariance of our mediation model, we found invariance across gender but not across countries. Even when cannabis frequency was significantly related to the negative consequences in the five countries, the magnitude of these associations differs, being higher among European countries, followed by countries from South America and lastly the United States (49). The differences in the magnitude of this association could reflect cultural differences

among countries from different continents. In the case of the associations between PBS and frequency of cannabis use, this association was significant and negative in all countries as expected based on previous research (44-46) besides the Netherlands, in which the association was not significant. The lack of a negative association between PBS use and cannabis outcomes in the Netherlands was unexpected and could be influenced by differences in the cannabis use regulation of the Netherlands (e.g., cannabis is sold in coffee shops in Amsterdam, no penalty for possession if the amount is less than 5 grs, etc.; see (34, 35)) compared with the rest of the countries. Moreover, harm reduction has been a cornerstone of the Dutch drug policy, with efforts concentrated in reducing the negative consequences of substance use, for instance via adoption of protective strategies, instead of punishing or prohibiting use (63). Therefore, the lack of an association between PBS and frequency of cannabis use found in the Netherlands may reflect the implementation of more PBS in the context of substance use. In other words, these Dutch college students may be using similar levels of PBS when they are planning to use cannabis (regardless of use frequency), a behavior probably fueled by years of exposure to harm reduction policies. Noteworthy, this positive association between PBS and substance use has been reported in the alcohol literature. Lewis et al. (64) found that US college students reported increasing their PBS use when they had planned to engage in heavy drinking patterns (e.g., those associated with the 21st birthday). However, because the sample size of the Netherlands is smaller than in the rest of the countries, this result should be interpreted with caution.

Similar to those found in previous studies, higher PBS use was negatively associated with consequences in the United States (44-46) but positively in the case of Argentina. However, in Spain, the Netherlands, and Uruguay the direct relationship between PBS use and consequences was not significant. This could be due to the sample sizes in these countries; however, an

examination of the effect sizes indicates that the standardized βs were much smaller in these countries, making it unlikely to be a Type II error. More likely, are unexplored cultural differences in how PBS are implemented in these countries compared to the US. Further, the positive association between PBS use and negative consequences in the Argentinean sample was unexpected, yet it could be related to a disconnection between perceived and actual risk (65). Previous work, within the alcohol field, found that the use of PBS was associated with lower perception of sexual-related risks (65). The authors suggested that, for some specific subpopulations, PBS may have the paradoxical effect of promoting the idea that their use provides complete protection against the negative consequences of drug use. It is possible that Argentinean college students who implement the use of PBS when using cannabis tend to develop a sense of security or "inoculation" against the negative consequences of its use, which in turns reduces risk perception but does not affect the actual risk. Noteworthy, perceived risk associated with regular use of cannabis is much greater among Argentinean (66) than US youth (8). Future studies should explore whether perceived risk mediates or moderates the association between PBS and cannabis-related negative consequences.

Limitations and future research

It is important to mention the limitations of the current study. First, the cross-sectional design of this study does not allow us to make causal inferences based on this data. Instead, experimental or longitudinal designs would be needed in order to assess possible causal relationships. However, there is value in atemporal mediations to help differentiate the effects due to the predictors from those due to the mediators, as well as to highlight sequential pathways (67). Moreover, given that personality traits are established before college age, it is reasonable to assume some temporal sequencing at least between our predictors and outcomes, and the links

between PBS use and cannabis use likely co-occur in time. Second, despite obtaining a large

sample size from eight universities, we did not take steps to ensure our sample was

representative; therefore, our generalizability to other college students is limited. Future research

is also needed to examine these associations among non-college young adults and community

members. Although limited, insights gained by comparing effects across countries elucidates

potential areas for future research. Another limitation of this study is the reliance on

retrospective self-report measures. Past research has demonstrated significant recall biases (68),

which must be considered when interpreting our results.

Conclusions

In this study, cannabis PBS use mediated the relationship between many personality

traits and cannabis outcomes. Based on our results, findings generalized across sex but not across

countries. Thus, while PBS use has been shown to be a robust predictor of better cannabis

outcomes consistently in the US, more work needs to be done to identify how PBS use (as

measured with the PBSM) relates to cannabis use and outcomes outside the US. It is possible

that students in countries outside of the US utilize different strategies to keep themselves safe or

reduce their risk of cannabis-related harm, or that cultural factors that were not measured in the

current study impacted our findings. Cannabis remains a global concern and more research is

needed to understand how to best prevent cannabis use and intervene on problematic use across

contexts.

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Table 1

Bivariate correlations among study variables in total sample

	1	2	3	4	5	6	7	8	9	M	SD
1. Openness to Experience	--									3.80	0.64
2. Extraversion	**.32**	--								3.61	0.74
3. Agreeableness	**.32**	**.20**	--							3.59	0.58
4. Conscientiousness	**.15**	**.23**	**.30**	--						3.31	0.61
5. Emotional Stability	.03	**.33**	**.25**	**.30**	--					2.95	0.78
6. Cannabis PBS use	**.09**	**.11**	**.15**	**.20**	-.03	--				4.38	1.12
7. Cannabis Frequency	-.00	-.03	-.07	-.05	.04	**-.33**	--			6.10	7.97
8. Cannabis Consequences	-.00	**-.09**	**-.09**	**-.18**	**-.09**	**-.27**	**.39**	--		3.63	3.92
9. Age	**.13**	-.06	**.08**	.06	.04	**-.12**	.07	.06	--	20.96	3.95

Note. Significant correlations ($p < .01$) are bolded for emphasis.

Table 2.

Summary of total, indirect, and direct effects of comprehensive mediation path model

Cannabis Outcome Variables:	Use Frequency		Negative Consequences	
Predictor Variable: *Openness to Experience*	β	99% CI	β	99% CI
Total	.028	-0.05, 0.11	.043	-0.05, 0.14
Total indirect[a]	-.008	-0.04, 0.02	.006	-0.03, 0.04
PBS use	-.008	-0.04, 0.02	-.003	-0.02, 0.01
Cannabis Use Frequency	----	----	.012	-0.01, 0.04
PBSM – Cannabis Use Frequency	----	----	-.003	-0.01, 0.01
Direct	.036	-0.05, 0.12	.037	-0.05, 0.12
Predictor Variable: *Conscientiousness*	β	99% CI	β	99% CI
Total	-.057	-0.13, 0.02	**-.161**	**-0.24, -0.08**
Total indirect[a]	**-.062**	**-0.10, -0.03**	**-.046**	**-0.08, -0.01**
PBS use	**-.062**	**-0.10, -0.03**	**-.027**	**-0.05, -0.01**
Cannabis Use Frequency	----	----	.002	-0.03, 0.03
PBS use – Cannabis Use Frequency	----	----	**-.021**	**-0.04, -0.01**
Direct	.005	-0.07, 0.08	**-.115**	**-0.19, -0.04**
Predictor Variable: *Extraversion*	β	99% CI	β	99% CI
Total	-.037	-0.12, 0.04	-.051	-0.14, 0.04
Total indirect[a]	-.023	-0.05, 0.003	-.022	-0.06, 0.01
PBS use	-.023	-0.05, 0.003	-.010	-0.03, 0.001
Cannabis Use Frequency	----	----	-.004	-0.03, 0.02
PBS use – Cannabis Use Frequency	----	----	-.008	-0.02, 0.001
Direct	-.013	-0.09, 0.06	-.029	-0.10, 0.05
Predictor Variable: *Agreeableness*	β	99% CI	β	99% CI
Total	**-.085**	**-0.15, -0.02**	-.043	-0.12, 0.04
Total indirect[a]	**-.035**	**-0.07 -0.01**	**-.043**	**-0.07, -0.01**
PBS use	**-.035**	**-0.07, -0.01**	**-.015**	**-0.04, -0.004**
Cannabis Use Frequency	----	----	-.017	-0.04, 0.01
PBS use – Cannabis Use Frequency	----	----	**-.012**	**-0.03, -0.003**
Direct	-.049	-0.11, 0.02	.001	-0.07, 0.07
Predictor Variable: *Emotional Stability*	β	99% CI	β	99% CI
Total	**.088**	**0.002, 0.17**	-.019	-0.10, 0.07
Total indirect[a]	**.045**	**0.02, 0.08**	**.048**	**0.01, 0.09**
PBS use	**.045**	**0.02, 0.08**	**.019**	**0.01, 0.04**
Cannabis Use Frequency	----	----	.015	-0.01, 0.04
PBS use – Cannabis Use Frequency	----	----	**.015**	**0.01, 0.03**
Direct	.043	-0.04, 0.12	-.068	-0.14, 0.01
Predictor Variable: PBS	β	99% CI	β	99% CI
Total	**-.317**	**-0.41, -0.22**	**-.241**	**-0.32, -0.16**
Total indirect	----	----	**-.106**	**-0.16, -0.06**
PBS use	----	----	----	----
Cannabis Use Frequency	----	----	**-.106**	**-0.16 -0.06**
PBS use – Cannabis Use Frequency	----	----	----	----
Direct	**-.317**	**-0.41, -0.22**	**-.135**	**-0.22, -0.05**

Note. Significant associations are in bold typeface for emphasis and were determined by a 99% bias-corrected standardized bootstrapped confidence interval (based on 10,000 bootstrapped samples) that does not contain zero. [a] Reflects the combined indirect associations within the model.

Figure 1. *Standardized effects of mediation model in total sample.*
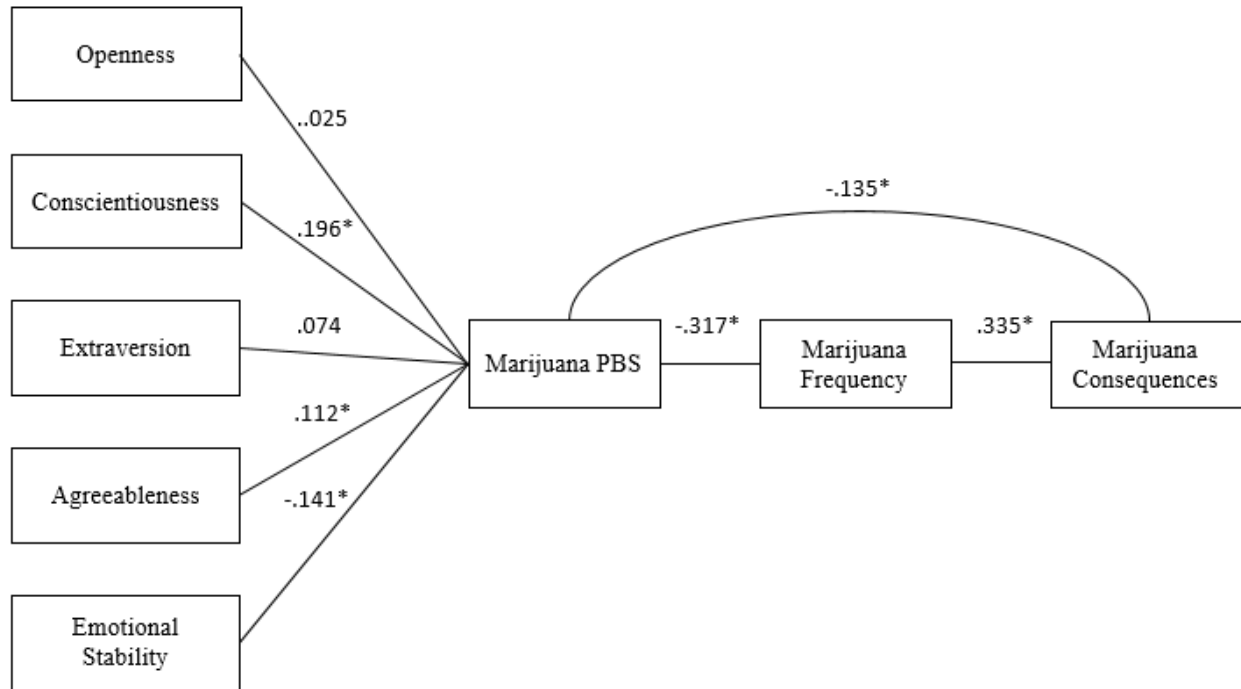
Note: This figure shows the standardized effects of the mediation model in the total sample. *Reflects significant associations determined by a 99% bias-corrected standardized bootstrapped confidence interval (based on 10,000 bootstrapped samples) that do not contain zero. The direct effects of personality traits on cannabis outcomes are not shown in this figure but are shown in Table 2.

Supplemental Table 1. *Descriptive statistics of study variables across countries.*

	United States[a] N=698		Argentina[b] N=153		Uruguay[c] N=79		Spain[d] N=178		Netherlands[e] N=67	
	M	SD	M	SD	M	SD	M	SD	M	SD
PBSM Frequency	4.54	1.11	4.01	0.91	4.16	0.8	4.48	0.95	3.46	1.47
Cannabis Use	6.77	8.91	6.28	6.44	4.96	5.81	4.85	6.58	3.25	4.37
Cannabis Consequences	3.51	4.01	3.48	3.38	3.58	3.7	4.38	4.15	3.26	3.33
Openness to Experience	3.74	0.62	4.02	0.64	4.04	0.5	3.82	0.68	3.82	0.69
Extraversion	3.61	0.75	3.57	0.73	3.58	0.75	3.62	0.69	3.66	0.72
Agreeableness	3.55	0.57	3.77	0.51	3.64	0.59	3.62	0.58	3.55	0.66
Conscientiousness	3.38	0.6	3.22	0.53	3.55	0.65	3.11	0.62	3.13	0.67
Emotional Stability	2.92	0.76	3.02	0.8	2.95	0.77	3.05	0.78	2.93	0.88
Age	19.53	2.72	24.58	4.60	25.86	5.10	21.23	3.43	20.83	2.41

Note: Cohen's d values were conducted for all contrasts. Large effect sizes were found for PBSM frequency between a-e (d = .83) and d-e (d = .82). Large effect sizes were found for Age between a-b (d = 1.34), a-c (d = 1.55), b-d (d = .83), b-e (d = 1.02), c-d (d = 1.07), and c-e (d = 1.26). Cohen's d values of .20, .50, and .80 correspond to small, medium, and large effect sizes, respectively (Cohen, 1992).