EVALUATION OF COGNITIVE AND BEHAVIORAL EFFECTS OF PERSONALITY-BASED SUBSTANCE USE PREVENTION IN CANADA

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Abstract

This study evaluated the effectiveness of the Preventure program with students in a medium sized school district in Western Canada. Preventure is a selective prevention program that screens students on four distinct personality types: sensation-seeking (SS), anxiety sensitivity (AS), negative thinking (NT), and impulsivity IMP). Each of these traits is linked to both the risk of early substance use and subsequent onset of mental health concerns. The tested program tailors a brief intervention to reduce cognitive and behavioral risks in higher risk students based on their personality.

Method: At the start of the study, 576 grade eight students were screened using the Substance Use Risk Profile scale (SURPS) to assess the four personality traits. Of these students, 268 students (46.2%) exceed risk criteria on one or more of the personality types. For the evaluation, two of the four schools were randomly assigned to receive training immediately (Trained Schools) with the other two schools receiving delayed implementation the following year (Untrained Schools). In the two training schools, 94 students were invited to participate in Preventure training groups with 44 students completing the training. During the following year, all students took part in three health surveys that included questions about substance use and measures of their substance use cognitions (i.e., expectancies and memory associations).

Results: The substance use measures were analyzed over three time points using zero-inflated negative binomial tests. Students who received Preventure training or who attended schools that had the training were significantly less likely to begin using tobacco, vapes, cannabis, and illicit drugs and used cannabis less frequently than those in Untrained Schools. Cannabis cognitive associations were also lower in Trained Schools and fully mediated differences in Trained versus Untrained schools. Past year alcohol use and initiation of alcohol use were unaffected.

Conclusions: These findings support other international findings for the efficacy of Preventure in reducing substance use in teens. Cognitive mediation analysis suggests that reductions in risky associations partially mediate positive treatment effects on Cannabis use. This finding is the first to reveal one possible cognitive mechanism for the effects of Preventure.

Keywords: Substance abuse prevention, adolescents, personality, targeted prevention.

1. Introduction

Substance use in adolescents remains a significant concern with long-term consequences. Many prevention approaches have been tried yet few studies have strong effects or reach more than a portion of students. Recent successful approaches have focused on personality as a risk factor and personality-specific social and cognitive risks as targets for intervention. Personality traits that predict substance use include higher levels of impulsivity, sensation seeking, extraversion, and negative affectivity (e.g. sensitivity to anxiety or depression) as well as lower levels of conscientiousness (Conrod, 2016). Of particular relevance for the present study, the Substance Use Risk Profile Scale (SURPS) was developed using predictive validity against substance use criteria. The SURPS identifies four personality types, impulsivity, sensation seeking, anxiety sensitivity, and negative thinking. All of the SURPS measures predict both concurrent and future substance use in adolescents including problem use (Krank et al., 2011; Woicik et al., 2009). Theoretically, personality traits work as distal risk factors that influence more proximal factors such as social influences (Pilin, et al., 2021) and substance use cognitions (e.g. expectancies and memory associations (Pilin et al., 2022; Krank, & Robinson, 2017). Thus, personality traits should inform intervention approaches to prevention by identifying trait-specific social influences, motives and cognitions. Although personality is hard to change, cognitive-behavioral treatments (CBT) and motivational enhancement (ME) should be able to target trait-specific social influences and cognitions. The

present study was designed to replicate the effectiveness of a personality targeted prevention program, Preventure, and identify whether known mediators of substance use in adolescents (expectancies and memory associations) are changed by this program.

Preventure Effectiveness: Evaluation studies have repeatedly confirmed Preventure's effectiveness in trials including RCTs in a number of countries. Findings indicated that this program has been successful in reducing the rates of alcohol and illicit drug use and substance-related harms by ~50% in high-risk adolescents with the effects last for up to 3 years. These interventions were also associated with a 25% reduction in likelihood of transitioning to mental health problems, such as anxiety, depression, suicidal ideation, and conduct problems. The program is particularly beneficial for youth with more significant risk profiles, such as youth reporting clinically significant levels of externalizing problems, and victimized adolescents. Notably, the program was successful when delivered by school personnel (i.e. teachers, guidance counselors) trained to deliver Preventure. The present study was designed to test the effectiveness of this school-based delivery in a delayed implementation design. In addition, the evaluation was extended to previously unmeasured outcomes, tobacco and vaping. Finally, we assessed changes in substance cognitions as potential mediators of treatment effects.

Design: The initial Preventure trial began in two of four participating secondary schools in the school district. The remaining schools were phased in over the following year. This process allowed us to compare students who received Preventure training with similar students who did not. In addition, we also compared students in schools that received Preventure with students in schools where no students had received training. This latter comparison revealed whether there was a beneficial "herd effect" where students who were in training schools, but did not receive training still showed reductions in their substance use. Such an effect is expected to occur from past studies of Preventure effects and has been interpreted as the positive social influence of reducing substance use in at risk individuals who did receive training. We expect that 1) Preventure will reduce substance use in schools that initially were trained in the program, 2) substance use risk will be predicted by personality scores on the SURPS, 3) a latent cognitive construct based on outcome expectancies and memory associations will also precinct risk, and 4) program-based changes in substance use will be mediated by the latent cognitive construct.

2. Method

Participants and Procedures: All students in four schools from a medium sized school district in the Southern Interior of BC Canada participated. Students completed survey responses for screening and demographics (February 2017). Three surveys of substance use were completed: Baseline, immediately after the intervention (May 2017), six months follow-up (November 2017), and one-year follow-up (May 2018). Each survey contained a range of questions about healthy and unhealthy behaviors and thoughts. For program delivery, schools were randomly assigned to *Immediate* program delivery) and *Delayed* implementation (March- May 2018). Preventure training (see https://preventureprogram.com) consisted of two 90-minute group sessions delivered by a trained facilitator from the school. Group facilitators employed motivational enhancement and cognitive behavior training to encourage healthy decision-making. Each manual targets common misperceptions and thought processes present in individuals with high levels of each personality trait. Although some examples were substance related, the focus of the lessons was to identify risky thoughts and actions and encourage prosocial alternatives. In February 2017, 576 grade eight students were screened using the Substance Use Risk Profile scale (SURPS). Of these students, 94 students from the two intervention schools were invited to participate in Preventure training groups. Invitations to participate were determined by relative SURPS scores. Any student who exceeded one standard deviation above the mean for any sub-scale was eligible to participate. Students were asked to join one of four groups corresponding to the highest personality score. By May, 44 students competed the training. Parental consent and student assent were obtained in accordance with the University of British Columbia Okanagan Behavioural Research Ethics Board.

Survey measures: *Demographics*: Age, Sex, income level, parental education were obtained in February, 2017.

Personality screening: Screening consisted of the 23 questions from the Substance Use Risk Profile Scale (SURPS). The SURPS measures levels of four personality traits: sensation-seeking, impulsivity, negative thinking, and anxiety sensitivity. The scale has excellent psychometric properties with strong test-retest reliability, internal consistency, and most importantly, predictive validity.

Substance use: We assessed alcohol, cannabis, tobacco, vaping, and illicit drug use with questions that asked, "When was the last time you _____?" The options were "Never," "More than a year ago," "In the past year," "In the past month," and "In the past week." The question we used is well validated and is a reliable measure of early use. In addition, we assessed days of alcohol and cannabis use in the past 30 as well as problem alcohol (AUDIT) and cannabis (CUDIT).

Cognitions: Memory associations and outcome expectancies were assessed at the six-month follow-up. For memory associations, participants responded with the first word that came to mind in response to a target word that has dual meanings. Words were included based on previous research with alcohol and cannabis (cf Stacy, 1995). Participants were presented with 44 homographs that included alcohol or cannabis-related words (e.g., *draft, mug, weed, pot*). Students subsequently classified their own responses into categories that included alcohol and cannabis use. The memory association scores for alcohol and cannabis were the sum of responses in each category respectively (Frigon & Krank, 2009; Krank et. al, 2010). For the outcome expectancy measure. participants identify four outcomes they would expect to happen when using alcohol or cannabis and then rate how much they would enjoy this outcome on a five-point Likert scale (-2 to 2) (Fulton et al., 2012).

3. Results

Grade eight students were screened in February 2017 and assessments of substance use occurred in May 2017, November 2017, and May 2018. Data was collected from baseline, six-month follow-up, and twelve-month follow-up assessments. Because the program was phased in over time, the effectiveness of the program can be analyzed by comparing students who received the program with similar students and schools that did not receive the program. Although this design has too few schools to meet the rigorous demands of a randomized control trial, the data provide a good indication of whether the program delivered in SD22 had the expected positive effect of reducing problematic substance use.

Growth of current drug and alcohol use: The developmental period from the spring of grade eight to the spring of grade nine reveals a noteworthy increase in use of a variety of substances. Much of this increase occurs over the summer months. Consistent with previous studies, alcohol use increases the most with much lower levels of cannabis and tobacco use. Non-prescription illicit drug use over the past year is low (<4%). A somewhat surprising and concerning finding is the high level of reported use of vapes with one in four students reporting past year vaping at the end of grade nine.

Alcohol use: The results show steady growth in alcohol use, but, in contrast to previous studies, no differential effect of the Preventure training. None of the ordinal regressions were significant at any phase of the study. Trained and untrained schools did not differ at baseline, six-month follow-up, or one-year follow-up. The number of days used as a measure is confounded by the large number of non-drinking students in this age group. To account for non-users, the number of days used was analyzed by zero-inflated Poisson (ZIP) regressions. ZIP regressions estimate both the likelihood of being a user in the past 30 days (inflation coefficient) and the rate of use among users (count coefficient). Differences in each of these statistics are tested separately. ZIP regressions were conducted separately for each time of assessment. There were no significant differences in use or rate of use between trained and untrained schools at baseline or at either of the two follow-up assessments. AUDIT scores contained large numbers of zeros from non-users so the data were analyzed with ZIP regressions. There were no differences at baseline, six months, or one year. Generally, there was no significant effect of Preventure training on early alcohol use detected in this cohort.

Tobacco use: Tobacco use was relatively low throughout the sample with only 9.4% having used tobacco by the end of grade 9. In contrast to most drug use measures, nicotine use was not affected by personality risk, but it was strongly influenced by training, beta =1.21 (SE =0.45), Wald chi square (1) = 7.36, p < .007, OR = 3.368. Students in untrained schools were more than 3 times more likely to smoke (14.3%) than students in trained schools (4.5%). These rates were unaffected by personality risk.

Cannabis use: The results clearly show reduced recency of cannabis use in Preventure schools. Ordinal logistic regressions at each time confirm this observation. Trained and untrained schools did not differ at baseline, beta = 0.41, Wald Chi-square = .679, ns. However, Preventure schools had lower levels of past year and past month use at both six-month follow-up, beta = 1.01, Wald Chi-square (1) = 6.744, p< .009, and twelve-month follow-up, beta = 0.87, Wald Chi-square (1) = 6.356, p< .012. Log likelihood estimates indicate that students in non-trained schools were 2.7 and 2.4 times more likely to have more recent use at six- and twelve-month follow-ups respectively.

Additional evidence for the effectiveness of Preventure on cannabis use is found in the number of days used in the past 30. To account for non-users, the number of days measure was analyzed by zero-inflated Poisson (ZIP) regressions. ZIP regressions estimate both the likelihood of being a user in the past 30 days (inflation coefficient) and the rate of use among users (count coefficient). Differences in each of these statistics are tested separately. ZIP regressions were conducted separately for each time of assessment. There were no differences between trained and untrained schools at baseline in being a user, inflation coefficient = .012, z = .072, ns, or rate of use, count coefficient = -.051, z = -.277, ns. Training condition influenced the ZIP regressions for the two follow-up assessments. At six months, the rate was unaffected, count coefficient = .012, z = .072, ns, but the likelihood of being a user was reduced, inflation

coefficient = 1.151, z= 2.176, p < .03. At the twelve-month follow-up, both the rate of use in users, count coefficient = -.559, z = -2.221, p <. .026 and the likelihood of using, inflation coefficient = 1.151, z= 2.176, p < .03, was higher in students from untrained schools.

Problems associated with cannabis use were assessed with the CUDIT. The CUDIT scores contained large numbers of zeros from non-users so the data were analyzed with ZIP regressions. There were no differences at Baseline, count coefficient = .253, z= 1.059, ns and inflation coefficient = .315, z = .614, ns. CUDIT scores did suggest that students from untrained schools were more likely to experience problems at six months, inflation coefficient = .747, z= 2.200, p < .028, and one year, inflation coefficient = .614, z= 1.937, p < .053. At one year, the number of problems is higher in students from untrained schools, inflation coefficient = -.349, z= -2.605, p < .009.

Illicit drug use: We measured the number of illicit drugs they had used: psilocybin, LSD, inhalants, MDMA, GHB, Rohypnol, methamphetamine, cocaine, and opiates. The variables analyzed were whether the students had ever used any of the illicit drugs and the number of illicit drugs they used. Consistent with previous findings in this age group, the number of students who had used illicit drugs was small. Zip regressions confirmed that students in schools without training were more likely (8.1% vs 3.6%) to have used illicit drugs, zero-inflation coefficient = 1.12, z = 2.31, p < .021 at the six-month follow-up. At twelve months, schools without training were not significantly more likely to have used illicit drugs (7.3% vs 3.4%), zero-inflation coefficient = .172, z = .229, ns, but users used more illicit drugs than those in schools with training, count coefficient = -1.44, z = 2.07, p < .039.

Herd effects: One of the more interesting effects of Preventure training reported in the literature is the "herd" effect. The positive benefits of Preventure training extend to students who were not in the trained groups. We analyzed the herd effect by comparing the impact of training on those students at higher personality risk with students at low levels of personality risk. There were two main effects: 1) the anticipated large effect of personality risk, (Wald chi square = 10.0, df=1 p> .002) and 2) confirmation of the effect of training in both risk conditions (Wald chi square = 8.4, df=1 p> .004). The herd effect is shown by the big impact of training on students with low personality risk. None of these students received direct training in the groups, but benefit by being in the same school with those who were trained (see Figure 1).

Mediation Effects: Cognitive mediation of personality and training effects: Structural equation modelling was used to test for mediation of a) personality effects (SURPS subscales) and b) training effect (Trained versus Untrained) on cannabis use by a cognitive construct of cannabis use associations. Cannabis use was measured by frequency of use at six-months. Initial tests revealed significant direct effects of each personality subtype and training on cannabis use. The cognitive latent construct loading on outcome expectancy liking and memory associates provided a strong fit and a strong direct effect on cannabis use. The final model tested all direct and indirect paths through the cognitive construct to cannabis use for both personality subtytpes and training. Including the cognitive mediator in the model elimanated all significant direct effects on cannabis use except for the cogntive mediator. Significant direct effects from impulsivity, sensation seeking, negative thinking, and training effects on the cognitive latent variable and significant indirect effects on cannabis use (see Figure 2).

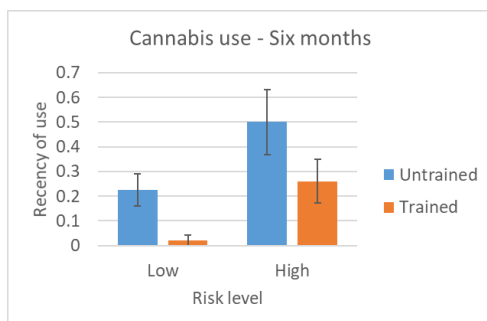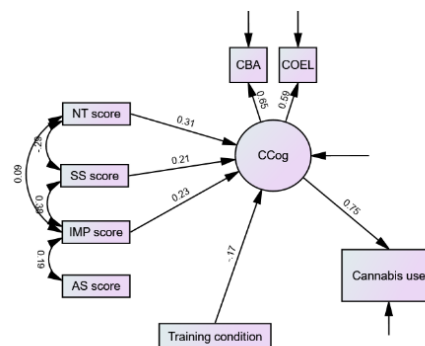|	
Figure 1. This figure shows the impact of Preventure on cannabis use at the six-month follow-up in students from trained versus untrained schools as a function of personality risk.	*Figure 2. This figure shows the final iteration of the the full mediation model including significant paths. Final model fit: Chi square = 22.5,df =14; CFI =.984; NFI =.960; RMSEA , .039*

4. Discussion

The present study had three main findings. First, it replicated previous findings showing the effectiveness of Preventure, an established personality targeted prevention program on reducing substance use in early adolescence. Second, it replicated the cognitive mediation of the effects of personality subtypes on cannabis use. In addition, this study represents the first to provide support for a cognitive mechanism for treatment effects on cannabis use.

Trained schools had fewer cannabis users, less frequent cannabis use, and fewer cannabis related problems. Also students in trained schools used fewer illicit drugs and tobacco products including vapes. The study also replicated the herd effect reported in previous studies. Although based on only four schools and do not fully allow us to account for school level variability, these observations are consistent previous studies supporting Preventure effects. One notable difference is the lack of significance in the measures of alcohol use. One explanation is that the measures used here differed from the binge drinking measures previously used in published studies. It is also possible that as the students get older the effect on drinking problems will emerge as a sleeper effect.

The present study also replicated the value of an associative cognitive latent construct based on outcome expectancies and memory associations as a mediator of cannabis use in early adolescence. The study replicated the mediation of personality effects revealing full mediation. Most importantly, the study shows that differences in cognitive associations fully mediate the impact of Preventure training on cannabis use. This finding suggests a plausible mechanism consistent with the CBT focus of the Preventure program.

Conclusions: These findings support other international findings for the efficacy of Preventure in reducing substance use in teens. Cognitive mediation analysis suggests that reductions in risky associations partially mediate positive treatment effects on Cannabis use. This finding is the first to reveal one possible cognitive mechanism for the effects of Preventure.

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