**Moderation – Type II (multi-group analysis)**

File name: moderation mg ex\_nouse.out

**Analysis Plan**

A multi-group path analysis was conducted to test the following study hypotheses:

H1: Students’ beliefs about others marijuana use (i.e., Descriptive Norms) and acceptability of marijuana use (Injunctive Norms) predict the number of marijuana related consequences they personally experience.

H2: The effect of normative beliefs impacts consequences via perceived harm. (Mediation)

H3: The pattern of findings is different between males and females. (Moderation)

All variables were scored on a continuous scale and were normally distributed, apart from biological sex which was coded (0 = males, 1 = females). A path model is presented in Figure 1. Analyses were conducted using Mplus 7.4 (Muthén & Muthén, 1998–2012).

The primary challenge in making appropriate determinations regarding the strength of an indirect effect is that the product of two regression slopes is not normally distributed. The violation of the normality assumption results in a loss of statistical power for many traditional approaches to testing mediation (e.g., the Sobel Test). In order, to circumvent this issue the best practices approach is to assess asymmetrical confidence intervals (ACIs) that best represent the true distribution of the product of coefficients. ACIs that do not contain zero are considered to be statistically significant. We examined the indirect effects of each predictor variable on outcomes using bias-corrected bootstrapped estimates (Efron & Tibshirani, 1993) based on 1,000 bootstrapped samples, which provides a powerful test of mediation (Fritz & MacKinnon, 2007) and are asymmetrical. Statistical significance was determined by 95% bias-corrected bootstrapped confidence intervals that do not contain zero. We further evaluated the effect size of our indirect effects using the ratio of the indirect to the total effect (Pm) using the mediation function in the MBESS (Kelley & Lai, 2010) R (R Development Core Team, 2010) package, which is appropriate when the direct effect is not close to 0.

The moderation hypothesis (i.e., H3) was tested using a multi-group analysis by sex. All paths in Figure 1 were allowed to freely vary across groups with the exception of the path from Perceived Harm to Marijuana Related Consequences (i.e., path b), which was constrained to be equal across groups.

To evaluate overall model fit, we used model fit criteria suggested by Hu and Bentler (1999) including the comparative fit index (CFI) > .95, Tucker–Lewis Index (TLI) > .95, root mean square error of approximation (RMSEA) < .06, and standardized root mean square residual (SRMR) < .08. In addition, we evaluated the Chi-Square test of model fit, where a non-significant test indicates perfect fit of the model to the data.

We tested 3 nested models and compared the results (i.e., all parameters constrained to be equal across groups, all parameters free to vary across groups, and all paths free to vary with the exception of the path from Perceived Harm to Marijuana Related Consequences). The best fitting model was selected using the model fit indices described above and we only report on the best fitting model.

**Results**

*Overall Model Fit.* Table 1 presents the fit indices for the three models we compared. The best fitting model was the model with all paths allowed to vary besides the b-path which was held constant across groups. The final multi-group path analysis resulted in excellent model fit. The Chi-Square test of model fit was not significant (χ2(1) = .48, p = .49). Overall fit indices were all in the excellent range (RMSEA = .00 [.00, .04], p = .96; CFI = 1.00; TLI = 1.00; SRMR < .01).

*Males*

*Direct Effects.* Among males, Descriptive Norms, Injunctive Norms, and Perceived Harm significantly predicted Marijuana Related consequences. Specifically, Descriptive and Injunctive Norms significantly and positively predicted Marijuana Related Consequences (Descriptive Norms: b = .49, SE = .06, p < .001; Injunctive Norms: b = .24, SE = .08, p < .01), and Perceived Harm negatively predicted Marijuana Related Consequences, b = -.35, SE = .04, p < .001. Further, both Descriptive and Injunctive Norms negatively predicted Perceived Harm (Descriptive Norms: b = -.09, SE = .02, p < .001; Injunctive Norms: b = -.29, SE = .02, p < .01).

*Indirect Effects.* Among males, examination of the bias-corrected bootstrapped confidence intervals revealed that both indirect effects were statistically significant (Descriptive Norms🡪Perceived Harm🡪Marijuana Related Consequences = .03 [.02, .05]; Injunctive Norms 🡪 Perceived Harm 🡪 Marijuana Related Consequences = .10 [.08, .13]).

We examined the ratio of the indirect effect to the total effect as an index of effect size Pm = ab/c (Alwin & Hauser, 1975) for both indirect effects. The ratio of the indirect to total effect for the Descriptive Norms 🡪 Perceived Harm 🡪 Marijuana Consequences path was Pm = .06, and, Pm for the Injunctive Norms 🡪 Perceived Harm 🡪 Marijuana Consequences was .29 this indicates that the indirect effect from injunctive norms to marijuana consequences is nearly five times the size of the indirect effect from descriptive norms to marijuana consequences relative to their respective direct effects.

*Females*

*Direct Effects.* Among females, Descriptive Norms, Injunctive Norms, and Perceived Harm significantly predicted Marijuana Related consequences. Specifically, Descriptive and Injunctive Norms significantly and positively predicted Marijuana Related Consequences (Descriptive Norms: b = .32, SE = .06, p < .001; Injunctive Norms: b = .19, SE = .09, p = .03), and Perceived Harm negatively predicted Marijuana Related Consequences, b = -.35, SE = .04, p < .01. Further, both Descriptive and Injunctive Norms negatively predicted Perceived Harm (Descriptive Norms: b = -.10, SE = .02, p < .001; Injunctive Norms: b = -.29, SE = .02, p < .01).

*Indirect Effects.* Among females, examination of the bias-corrected bootstrapped confidence intervals revealed that both indirect effects were statistically significant (Descriptive Norms🡪Perceived Harm🡪Marijuana Related Consequences = .03 [.02, .05]; Injunctive Norms 🡪 Perceived Harm 🡪 Marijuana Related Consequences = .10 [.08, .14]).

We examined the ratio of the indirect effect to the total effect as an index of effect size Pm = ab/c (Alwin & Hauser, 1975) for both indirect effects. The ratio of the indirect to total effect for the Descriptive Norms 🡪 Perceived Harm 🡪 Marijuana Consequences path was Pm = .01, and, Pm for the Injunctive Norms 🡪 Perceived Harm 🡪 Marijuana Consequences was .34. This indicates that the indirect effect from injunctive norms to marijuana consequences is much larger than the indirect effect from descriptive norms to marijuana consequences relative to their respective direct effects.

**Discussion**

The present study showed that Descriptive Norms, Injunctive Norms, and Perceived Harm significantly predict Marijuana Related Consequences among High School Students, regardless of biological sex. Specifically, the more a student believes his or her peers are using and the more a student believes his or her peers approves of using marijuana the more consequences he or she reports experiencing. In contrast, the more harmful a student believes marijuana use to be the less consequences he or she reports experiencing. Further, perceived harm mediates the relationship between both types of normative beliefs and marijuana related consequences. The ratio of the indirect effects to the total effects were bigger for females compared to males. This suggests that bolstering efforts for students to understand the potential harms of marijuana is a potentially useful intervention target, and that for females, interventions targeting perceived harms of marijuana may be more effective than for males. Comparing the magnitude and direction of effects across sex, revealed a strikingly similar pattern of findings. While the relationship between normative perceptions and Marijuana Related Consequences was stronger for males compared to females, results from this study suggest that normative re-education efforts should be applied similarly for males and females.

