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Consideration of future consequences as a moderator of the willingness-behavior relationship for young adult marijuana use and consequences

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Abstract

The Prototype Willingness Model is a dual-processing (i.e., intentional and socially reactive) health-risk behavior model. The socially reactive path includes behavioral willingness, descriptive normative perceptions, and favorable images of individuals who engage in health-risk behavior (prototype favorability) as important predictors of health behaviors. Individual differences (such as consideration of future consequences) may potentiate the effects of behavioral willingness on health-risk outcomes, such as marijuana use. Given limited research investigating marijuana use and the Prototype Willingness Model, the goals of the current study were: 1) examine consideration of future consequences and Prototype Willingness Model social reaction pathway variables in relation to behavioral willingness to use marijuana longitudinally; and 2) determine if consideration of future consequences moderated the behavioral willingness-marijuana use relation prospectively. Young adults (N = 769) from a larger longitudinal study completed baseline and 3 follow-up assessments (Months 3, 4, 5). Behavioral willingness was positively related to a higher likelihood of use, more days having used marijuana, and more consequences prospectively, over and above baseline use. Consideration of future consequences moderated the association between behavioral willingness and hours high in a typical week. These findings support the willingness-behavior association of the Prototype Willingness Model and preliminarily demonstrate consideration of future consequences' differential impact on behavioral willingness-future marijuana use relation. Intervention and prevention implications are discussed.

Keywords

Marijuana; Young adults; Prototype willingness model; Behavioral willingness

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.addbeh.2018.06.010.

1. Introduction

In the United States, rates of marijuana use are higher during the early years of young adulthood than at any other point during the life course (Schulenberg et al., 2017). Among young adults in the United States, lifetime rates of marijuana use are at 59.9%, with rates of past 30-day use at 20.6% (Schulenberg et al., 2017). Marijuana is among the most frequently used illicit substances among late adolescents and young adults in the United States, which places them at high risk for a number of acute and long-term negative consequences (e.g., Karila et al., 2014; Maggs et al., 2015; Schulenberg et al., 2017; Volkow, Baler, Compton, & Weiss, 2014). Frequent and long-term marijuana use leads to short-term consequences, including decreased cognitive functioning (Karila et al., 2014), as well as longer-term developmental consequences, including discontinous college enrollment and unemployment (e.g., Arria et al., 2013; Maggs et al., 2015). Given that one of the major goals of Healthy People 2020 is to reduce the proportion of young adults who used any illicit substance, including marijuana, in the last 30 days, research is needed to determine when and why young adults use such substances.

1.1. The prototype willingness model

The Prototype Willingness Model (Gibbons, Gerrard, Blanton, & Russell, 1998; Gibbons, Gerrard, & Lane, 2003) is a modified dual-processing model designed to improve the predictive value of existing health behavior theories for health-risk behaviors. The Prototype Willingness Model was designed to address the social nature of adolescent or young adult risk behaviors by acknowledging that risk behaviors are often reactions to risk-conducive environments one may encounter rather than intentionally planned behaviors (Gibbons et al., 2003). The social reaction pathway of the Prototype Willingness Model pertains to unplanned behaviors, which are posited to follow directly from behavioral willingness (Blanton, Gibbons, Gerrard, Conger, & Smith, 1997; Gerrard, Gibbons, Houlihan, Stock, & Pomery, 2008; Lewis, King, Litt, Swanson, & Lee, 2016; Litt & Lewis, 2016; Litt & Stock, 2011; Pomery et al., 2005; Teunissen et al., 2014). The social reaction pathway relies on behavioral willingness, which varies as a function of perceived vulnerability, descriptive norms, and prototypes. Willingness to use marijuana reflects an openness to use marijuana in situations that are conducive to that behavior. Perceived vulnerability refers to the extent to which individuals perceive themselves to be vulnerable to the various risks associated with the behavior (Gerrard et al., 2008). Descriptive norms refer to the perceived quantity and frequency of peer marijuana behavior. Prototypes are images of the type of person who engages in specific risk behaviors, such as marijuana use.

Previous research on marijuana use under the framework of the Prototype Willingness Model is limited. Studies examining marijuana use and the Prototype Willingness Model have generally examined marijuana use as part of a composite score for health-risk, which often also included alcohol and sexual behavior (e.g., Pomery, Gibbons, Reis-Bergan, & Gerrard, 2009). Because health-risk behaviors are distinct with unique predictors, we aimed to examine behavioral willingness for marijuana as a predictor of future marijuana use independently rather than part of a composite score. Additional research on Prototype Willingness Model constructs and marijuana use has only focused on prototypes in relation

to intention to use marijuana (Comello & Slater, 2010). Thus, little research has examined young adult marijuana use under the social reaction pathway of the Prototype Willingness Model.

1.2. Consideration of future consequences

The Prototype Willingness Model posits that with age, decision-making shifts from a more social reaction process to a more reasoned one (Gibbons et al., 2003). Age may play a critical role in decision-making (Steinberg, 2008) as the brain network that relates to planning and self-regulation gradually matures throughout adolescence and into young adulthood (Anderson, Anderson, Northam, Jacobs, & Catroppa, 2001), and the neural system that relates sensitivity to reward and social stimuli peaks in adolescence (Blakemore, 2008; Galvan et al., 2006). Moreover, research on judgement and decision making in teens suggests that in non-emotional contexts, adolescents exhibit much of their adult capacity by mid to late adolescence, but certain emotionally provoking contexts can produce riskier decision making than would be expected among adults (Reyna & Farley, 2006). This suggests that decision-making in adolescence may be particularly moderated by emotion and social factors, such as consideration of future consequences. Research has found that in general, the tendency to be less planful, having lower levels of premeditation, and thinking less about potential consequences is related to the extent to which individuals report being willing to use substances (Gerrard et al., 2008; Vaughn & King, 2016). Related to this notion, the consideration of future consequences is an individual difference generally defined as the extent to which individuals consider the potential future outcomes (or consequences) of their current behavior and the extent to which they are influenced by the imagined outcomes (Strathman, Gleicher, Boninger, & Edwards, 1994). Individuals high in consideration of future consequences typically focus more on the future implications of their behavior and use these long-term possibilities as a guide for their current behaviors. Whereas those low in consideration of future consequences who tend to place less importance on future consequences and are more sensitive to immediate needs and concerns (Joireman, Strathman, & Balliet, 2006; Orbell & Kyriakaki, 2008). High levels of consideration of future consequences have been shown to be positively associated with personality traits related to self-control including conscientiousness and delay of gratification (Daugherty & Brase, 2010; Strathman et al., 1994) and negatively associated with impulsivity (Joireman, Anderson, & Strathman, 2003) and discounting future outcomes (Daly, Harmon, & Delaney, 2009; Joireman, Balliet, Sprott, Spangenberg, & Schultz, 2008).

Greater consideration of future consequences has been associated with less alcohol use, thus indicating its potential utility in health-promotion initiatives (Steiger, Stoddard, & Pierce, 2017); however, we are not aware of any studies that examine consideration of future consequences in relation to marijuana use specifically. Despite harmful consequences (Johnston, O'Malley, Miech, Bachman, & Schulenberg, 2015; Karila et al., 2014; Maggs et al., 2015; Volkow et al., 2014), many individuals continue to use marijuana. One possible explanation of this is that individuals focus on the immediate beneficial consequences of marijuana use while disregarding or discounting the future harmful consequences (Volkow et al., 2016). Given that we know less of how consideration of consequences is related to greater willingness to engage in risk behavior, it is plausible that consideration of future

consequences is an important individual difference that may be related to willingness to use marijuana and actual marijuana use among young adults.

1.3. The present research

The present research will expand the knowledge pertaining to the Prototype Willingness Model by examining the association between behavioral willingness to use marijuana, marijuana use, and negative consequences. This study will also examine whether consideration of future consequences moderates the behavioral willingness-behavior association. The current study may have relevant findings for young adult interventions focused on the social reactive pathway of the Prototype Willingness Model as these interventions may work best for those who have a stronger association between behavioral willingness and a health-risk behavior (i.e., those who do not consider future consequences). Based on the above considerations, the first study aim was to examine the longitudinal associations of consideration of future consequences as well as social reaction pathway variables of the Prototype Willingness Model with behavioral willingness to use marijuana. We expected consideration of future consequences to be negatively associated with behavioral willingness to use marijuana and, as predicted by the social reaction pathway of the Prototype Willingness Model, both perceived descriptive norms and prototype favorability to be positively associated with behavioral willingness to use marijuana. In addition to this aim, we sought to examine the prospective associations of consideration of future consequences and behavioral willingness to use marijuana with marijuana use outcomes and to examine consideration of future consequences as a moderator of the willingness-behavior association. We expected behavioral willingness to use marijuana to predict marijuana use (i.e., hours high per typical week, days used marijuana per typical week, negative consequences), and that this association would be stronger among those who were lower in consideration of future consequences.

2. Method

2.1. Participants

Participants for the present study were 769 young adults who were participating in *Project Transitions*, a larger longitudinal study designed to examine the multitude of social role transitions during young adulthood and the association with alcohol use. *Project Transitions* includes a community sample of 779 young adults (18–23 at time of recruitment) living in the greater Seattle metropolitan area who are assessed monthly for 24 months about social roles, transitions in roles, and alcohol use, as well as a later final assessment. Of participants who met inclusion criteria for *Project Transitions*, participation rates did not vary by age (i.e., 18–20 vs. legal age of 21–23; ($\chi(1) = 0.112$, $p = .738$). *Project Transitions* recruited participants between February 2015 and January 2016. The analytic sample for the present study consists of 769 participants, as 8 had missing data on baseline marijuana use and 2 had extreme outlying scores which produced large changes to model estimates and thus were excluded. Participants were 44% female, with a mean age of 20.5 ($SD = 1.7$). In terms of education, 27% of participants reported having a high school diploma, 37.8% reported “some college”, 10% reported having an Associate’s Degree, and 21% reported a Bachelor’s Degree, with the remaining participants reporting no degrees, vocational or graduate

degrees. The majority of the sample identified as White (59% of the total sample), with the remaining participants Asian (18%), Black (4.8%), more than one race (11.8%) or other ethnicities.

2.2. Procedures

Recruitment procedures utilized a multi-pronged approach including 1) placing ads on online social networking sites (i.e., Facebook), online and print media outlets (e.g., newspapers, community ads), and Craigslist; 2) placing flyers around local area (e.g., coffee shops, public billboards); 3) in-person techniques such as tabling at community college events, and 4) reaching out to community agencies working with or employing young adults. All advertisements and flyers directed potential participants to a website or to call a study number for more information and for directions to complete a brief eligibility survey. Once potential participants go to the online eligibility survey, they are first presented with an information statement briefly describing the eligibility and consent process. If interested, individuals were screened for eligibility.

Eligibility for inclusion in *Project Transitions* included being 18–23 years of age at screening, residing within the greater Seattle metropolitan areas, having a valid email address, reporting drinking alcohol at least once in the last year, and willing to come to our local Seattle offices for consent, identity/age verification, and to complete a baseline assessment. If participants met criteria, they were asked to schedule an appointment online. Those interested in participating in the longitudinal study, were then asked to complete a baseline assessment conducted online but at our study offices. The baseline assessment included questions pertaining to demographic information, alcohol use and consequences, other substance use, current social role status, and other psychosocial measures relevant to the larger study. The entire session took approximately 1 ½ h and participants were given a $40 Amazon gift card for completion of the baseline assessment. The first monthly online assessment occurred the first day of the following month, with subsequent monthly online assessments following similar procedures for the next 23 months. Participants received electronic Amazon gift cards for their participation.

The present analyses utilized data from the baseline assessment, as well as Months 3, 4 and 5 as those time points included the measures relevant to the present study—marijuana use and consequences (Baseline and Month 5), prototype favorability (Month 3), willingness to use marijuana (Month 4), and consideration of future consequences (Baseline). Incentives for completion of monthly surveys during Year 1 were a $20 Amazon gift card for each monthly assessment completed and a bonus of $20, if all monthly assessments were completed in the first six months.

For the present analyses, we included data from 769 young adults who completed the baseline survey and who had relevant marijuana use data. Of the 769 eligible, 90% completed the Month 3 assessment, 90% completed the Month 4 assessment and 83% completed the Month 5 assessment. At baseline, participants missing data at Month 4 or 5 reported higher peer marijuana use, $t(765) = -3.87$, $p < .001$, more hours high per week, $t(765) = -5.41$, $p < .001$, days of marijuana use, $t(765) = -5.64$, $p < .001$, marijuana-related consequences, $t(765) = -5.60$, $p < .001$, and a lower consideration of future consequences,

$t(765) = -4.69$, $p < .001$. We used listwise deletion for the current analysis, as missing data methods (such as multiple imputation) have not been fully developed for hurdle count models. To check the impact of listwise deletion on our coefficient estimates and inferences, we re-estimated the final models using full-information maximum likelihood estimation in MPlus (version 6.1; Muthén & Muthén, 2012); the final parameter estimates, standard errors and significance tests were nearly identical, and the ultimate inferences were unchanged. Thus, we present our original analyses using listwise deletion.

2.3. Measures

2.3.1. Marijuana use—We used two marijuana use outcomes, both measured at baseline and Month 5. Participants completed a modified Daily Drinking Questionnaire (Collins, Parks, & Marlatt, 1985) for use with marijuana and assessed the typical number of hours high for each day of the week in the last month. From this measure, we also calculated the number of typical days in a given week that participants reported being high (i.e., number of typical days high per week).

2.3.2. Marijuana-related consequences—Developed for the larger study and based on qualitative work from open-ended responses from college students, marijuana-related consequences were assessed at baseline and Month 5. This 26-item measure asked how frequently the young adult experienced each item in the last 30 days (from 0 = *0 times*, to 4 = > *10 times*). Sample items included “had low motivation” and “had trouble remembering things”. A sum score was computed for the present analyses (baseline $\alpha = 0.90$, Month 5 $\alpha = 0.91$), reflecting the “intensity” of consequences (i.e. the variety and frequency of consequences).

2.3.3. Behavioral willingness to use marijuana—In order to measure a participant’s willingness (Gerrard et al., 2002, 2008) to engage in marijuana use, we presented participants with a scenario followed by three questions in Month 4 (Comello & Slater, 2011; Gerrard et al., 2008). Instructions read, “We would like you to think about yourself in certain situations. We are not saying that you would be in these situations. We just want you to think about them and then tell us how you think you would act. We will call these “suppose“ questions. Please read the following scenario and respond to each item accordingly.” The hypothetical scenario was as follows: “How willing would you be to do each of the following?”: “try some of it”, “use enough to get high”, and “not use any” (reverse scored). The mean of the three questions were used to represent a participant’s willingness to use marijuana. Alphas for baseline and Month 4 were 0.80 and 0.79, respectively.

2.3.4. Perceived descriptive marijuana use norms—At baseline, participants were asked their perceived norms for marijuana use modeled after the marijuana use question above. “Participants were asked to consider a typical week during the past 30 days. Over how many hours is the typical person your age high from marijuana?” Responses ranged from 0 = 0 h to 12 = 12 or more hours. For the purposes of this manuscript, we calculated the typical number of hours high the participant perceived the typical person is and the perceived number of days high.

2.3.5. Marijuana user prototypes—Marijuana user prototype favorability was assessed in Month 3 by asking "Please think about the typical male (female) your age who uses marijuana. How much do you think the following words describe your image of that person"? Following the stem were five different adjectives (e.g., smart, popular, attractive, immature, careless). Each adjective was then rated on a scale from (0) *not at all* to (9) *extremely* (α =0.89). Immature and careless were reverse scored. Mean scores were computed. Cronbach's alpha in the current sample was 0.66 at Month 3.

2.3.6. Considerations of future consequences scale—(Strathman et al., 1994). The consideration of future consequences scale is a 12-item scale assessed at baseline that measures an individual's consideration of distal outcomes of current behaviors, with 5 items focused on future consequences and 7 items focused on immediate consequences. Sample items included "I consider how things might be in the future, and try to influence those things with my day to day behavior" and "I am willing to sacrifice my immediate happiness or wellbeing in order to achieve future outcomes". Item responses range from 1 (i.e., "extremely uncharacteristic of you") to 5 (i.e., "extremely characteristic of you"), with higher scores indicating a greater orientation to the future. Similar to the original Strathman et al. (1994) and based on the findings by McKay, Morgan, van Exel, and Worrell (2015), we have utilized the unidimensional approach to the measure with items averaged across responses. The consideration of future consequences has been found to have strong internal reliability and temporal stability (Strathman et al., 1994; Toepoel, 2010). Cronbach's alpha in the current sample at baseline was 0.83. Items were summed to create an overall score for consideration of future consequences.

2.4. Analytic plan

We used ordinary least squares regression (OLS) to test the first aim of the study, which predicted willingness to use marijuana from consideration of future consequences and the social reaction pathway variables of the Prototype Willingness Model. For the second aim of the study, predicting marijuana use from willingness, consideration of future consequences and the social reaction pathway variables of the Prototype Willingness Model, we compared count, zero-inflated and hurdle count models to test the main hypotheses because marijuana use outcomes were distributed as counts with high proportions of zeros. Zero-inflated models separately predict a count of an outcome (such as number of days smoked marijuana in the past week) from "excess zeros", which are zeros greater than what would be predicted by the distribution of counts. Hurdle models also have two sub-models: a logistic regression predicts zero or not-zero, and a truncated count regression predicts non-zero counts (truncated because it does not include zero; Hilbe, 2011).[1] We used model fit criteria, such as AIC, BIC and the Vuong test (Vuong, 1989) to decide which count distribution (Poisson, which constrains the mean to be equal to the variance, or negative binomial, which does not) best fits the outcome. To test interactions, we centered all variables involved (Aiken & West, 1991). Testing and interpreting interactions in nonlinear models cannot be translated straightforwardly from tests of interactions in linear models (Ai & Norton, 2003; Karaca-

[1]Zero-inflated models are a type of mixture model, in which the distribution of zeroes is a mixture of zeroes from the count regression model and the logit model. See Hilbe (2011) for further details.

Mandic, Norton, & Dowd, 2011). As such, we followed guidelines provided by King, Tomz, and Wittenberg (2000) to create graphical depictions of significant interactions at hypothetical values of interest in our focal predictor, moderator, and covariates, using Monte Carlo procedures to simulate the predicted probabilities and 95% confidence regions of our drinking outcomes across the hypothetical range of a focal predictor based on our model-derived parameter estimates and covariances. We tested separate models for days used marijuana per typical week, typical weekly hours high, and marijuana-related consequences.

We controlled for age, biological sex, and perceived peer marijuana use at baseline and prototypes from Month 3 in all models. To ensure that the main hypothesis tests were not biased by un-modeled dependencies in the data, we tested all covariates by predictor interactions. This is recommended as best practice for model building in regression models (Allison, 1977), and simulations have shown that *not* including or estimating interactions that exist in models can induce substantial bias in the main effects coefficients (Vatcheva, Lee, McCormick, & Rahbar, 2015). To balance the risk of alpha inflation against model mis-specification, we used an a-priori threshold of $p < .01$ to retain significant covariate by predictor interactions and refrained from interpreting any interactions we did retain to avoid speculation about non-hypothesized interactions. Finally, because coefficients from hurdle count models are non-linear, their interpretation depends on the levels of all covariates in the model. Thus, for all significant effects, we report the predicted probability of a non-zero outcome and the predicted count of that outcome when all covariates were at their mean, and for specific values of interest of other significant predictors (King et al., 2000).

3. Results

3.1. Descriptive statistics and correlations

Table 1 provides descriptive statistics and correlations for all variables in the current study. At baseline, 64.2% of the sample reported no hours or days high per week, and 56.6% reported no marijuana-related consequences. Among those who reported marijuana use at baseline, the mean number of hours high per week was 15.78 ($SD = 18.79$), the mean number of days used marijuana was 3.72 ($SD = 2.52$). The mean level of marijuana related consequences was 14.38 ($SD = 11.82$), which could reflect an intensity of ~3.5 consequences reported > 10 times, to more consequences experiences less frequently (~14 consequences experienced around 1 time). At 6 months, 74% reported no hours or days high per week, while 68% reported no marijuana-related consequences. Among those who reported marijuana use at 6 months, the mean number of hours high per week was 16.11 ($SD = 17.11$), the mean number of days used marijuana was 4.25 ($SD = 2.47$). The mean level of marijuana related consequences was 12.09 ($SD = 12.55$), and could be interpreted in the same manner as consequences at baseline. Average consideration of future consequences score for the sample was 42.67 ($SD = 7.38$).

3.2. Prospective prediction of behavioral willingness to use marijuana

Our first study aim was to examine the longitudinal associations of social reaction pathway variables of the Prototype Willingness Model with behavioral willingness to use marijuana using OLS regression. Prototype Willingness Model predictors included past marijuana use

behavior, perceived peer norms for marijuana use (hours high and days high per week) and marijuana prototype favorability. Covariates included biological sex and age. Consideration of future consequences was also included as a predictor. There were no covariate by predictor interactions below our pre-specified threshold. Above and beyond the effects of the covariates, baseline marijuana use (typical number of days high per week, but not hours high per week) was associated with willingness to use marijuana at Month 4, such that a 1 *SD* increase in the number of typical days high per week was associated with a 0.49 *SD* increase in willingness to use marijuana at Month 4. Similarly, those who reported more favorable marijuana related prototypes at Month 3 reported being more willing to use marijuana at Month 4. Finally, consideration of future consequences was slightly negatively associated with willingness, such that a 1 *SD* increase in consideration was associated with a 0.07 *SD* decrease in willingness at Month 4. Table 2 reports results.

3.3. Moderation of behavioral willingness and marijuana use outcomes by consideration of future consequences

For count outcomes hours and days high per week, fit indices (AIC, BIC) indicated that hurdle negative binomial models best fit the distributions. Although the AIC and BIC were similar for the zero-inflated and hurdle negative binomial models, in both cases the Vuong test favored the hurdle model ($p < .05$) over the zero-inflated model. For marijuana-related consequences, the hurdle negative binomial model was favored by all fit indices, including the Vuong test ($p < .05$, compared to the zero-inflated model).

Across all models, baseline levels of the outcomes were strongly associated with Month 5 likelihood of any marijuana use (days high per week or hours high per week) as well as the level of use, while other covariates were generally unrelated to use (age, biological sex, and peer use) and the level of marijuana consequences. No covariate by predictor interactions were significant at our pre-specified alpha level.

3.3.1. Days high in a typical week—Table 3 reports the full results. Over and above the effects of baseline levels of marijuana use (OR = 1.88, RR = 1.15), being more willing to use marijuana at Month 4 was positively associated with a higher likelihood (OR = 1.90) of use as well as more days having used marijuana (RR = 1.12) at Month 5. Neither marijuana prototype favorability nor consideration of future consequences were related to the likelihood or level of use. There was no interaction between willingness and consideration of future consequences. A participant at the mean of the covariates, baseline marijuana use and Month 4 willingness had an 18% probability of reporting Month 5 marijuana use, and if they did report using, they reported around 2 days a week of use. For a participant who reported no baseline marijuana use (at the mean of the covariates), the lowest level of willingness at Month 4 predicted a 2% probability of Month 5 marijuana use and 1.27 days high (if they did report using), while the highest level of willingness predicted a probability of Month 5 use of 65% and 2.83 days high. For a participant who reported the highest level of baseline use (7 days a week), the lowest level of willingness predicted a 47% probability of using at Month 5 with 2.91 days of use, while the highest baseline willingness predicted a 99% probability of reporting use with 6.52 expected days of use.

3.3.2. Hours high in a typical week—Over and above the effects of baseline levels of marijuana use (OR = 1.16, RR = 1.03), being more willing to use marijuana at Month 4 was associated with a higher likelihood (OR = 1.96) of reporting any hours high in a typical week at Month 5. Moreover, baseline consideration of future consequences moderated the effects of Month 4 willingness (p = .01) among those who reported any marijuana use; Fig. 1 describes this interaction. When consideration of future consequences was low, the association between Month 4 willingness and the number of hours high per week was strong and positive (RR = 1.38, $p < .001$), such that (at the mean of all covariates), the expected number of hours spent high in the past week rose from around 1.84 (for the lowest level of willingness) to around 12 at the highest level of willingness. As consideration of future consequences increased, the association between willingness and the predicted number of hours high per week was weaker, but still significant, at mean consideration of future consequences levels (RR = 1.25, $p < .001$), such that (at the mean of all covariates), the expected number of hours spent high in the past week rose from around 3.23 (for the lowest level of willingness) to around 12 at the highest level of willingness. The effect was no longer significant at 1 *SD* above the mean of consideration of future consequences (RR = 1.13, $p = .05$). However, those with high consideration of future consequences reported the highest levels of marijuana use regardless of the level of willingness: at the mean of all covariates), the expected number of hours spent high in the past week rose from around 5.66 at the lowest level of willingness) to around 12.5 h for the highest level of willingness. See Table 4. Marijuana prototype favorability was unrelated to this outcome.

3.3.3. Marijuana-related consequences—Over and above the effects of baseline consequences and the covariates, only willingness at Month 4 was related to marijuana-related consequences at Month 5. A participant at the mean of the covariates, baseline marijuana consequences and Month 4 willingness had an 19% probability of reporting any marijuana consequences at Month 5, and those that did reported a level of 6.71 (i.e. 6 consequences once, or fewer more frequently); while low Month 4 willingness predicted a 6.18% probability and intensity of 6.18, and high Month 4 willingness predicted a 24% probability and an intensity of 7.44. For a participant who reported no baseline marijuana consequences and was at the mean of the covariates, there was virtually no probability of reporting any consequences at Month 5 (0.4%), and the intensity among those that did was predicted to be 2.89; even reporting the highest level of willingness did not change these much (0.7% probability and 3.5 expected intensity). Reporting a higher intensity of consequences at baseline strongly influenced the probability of reporting consequences by Month 5, such that the probability reached > 90% once a participant reported a baseline intensity of > 10 (regardless of the level of willingness.

There was no association between prototype favorability or consideration of future consequences with consequences. See Table 5.

4. Discussion

Studies examining marijuana use under the Prototype Willingness Model have generally examined marijuana use as part of a composite score for health-risk, which often also included alcohol and sexual behavior, or limited constructs of the Prototype Willingness

Model (Comello & Slater, 2010; Pomery et al., 2009). Because risk behaviors are distinct with unique predictors, we aimed to examine social reaction pathway constructs as predictors of behavioral willingness to use marijuana and future marijuana use independently rather than part of a composite score. Findings from the present study indicated that, after controlling for biological sex and age, baseline marijuana use (typical number of days high per week) and having favorable images of the typical young adult who uses marijuana were positively associated with willingness to use marijuana at Month 4. Finally, consideration of future consequences was negatively associated with willingness.

Findings from the present study also indicated that behavioral willingness for marijuana use at Month 4 predicted prospectively any marijuana use (i.e., any hours high, any days used marijuana), quantity of marijuana use (i.e., number of hours high, number of days used marijuana), and marijuana-related consequences the following month (Month 5). Thus, findings indicate that being more willing to use marijuana predicts later marijuana use (i.e., one month later), supporting this link from willingness to behavior in the social reaction pathway of the Prototype Willingness Model. In addition to testing the willingness-behavior association for marijuana use, the findings from the present study also show for young adults who were low in consideration of future consequences, the association between Month 4 willingness and the number of hours high per week was strong and positive. As consideration of future consequences increased, the association between willingness and the predicted number of hours high per week was weaker, but still significant, at mean consideration of future consequences levels, disappearing at 1 *SD* above the mean of consideration of future consequences. However, as illustrated, by Fig. 1, those high on consideration of future consequences reported higher levels of marijuana use across all levels of willingness. This finding is similar to recent cross-sectional research showing the association between alcohol cognitions and drinking was stronger among those higher in impulsive traits (i.e., negative urgency, premedication, sensation seeking; Vaughn & King, 2016). Our current study expands the literature by examining personality as a moderator of willingness to use marijuana and subsequent marijuana use within a longitudinal design.

However, consideration of future consequences itself was positively related to the level and likelihood of marijuana use, such that the highest levels of marijuana use were observed among those who reported either higher willingness or higher consideration of future consequences. This finding is counterintuitive, given that consideration of future consequences was negatively associated with baseline levels of marijuana use. It may be that this effect reflects a suppression effect, where controlling for baseline levels of use accounted for so much variance in marijuana use that the association between consideration of future consequences and the rank order change from baseline to the follow up reversed direction.

The current findings have implications for interventions focused on the social reactive pathway of the Prototype Willingness Model as these interventions may work best for those who have a stronger association between behavioral willingness and a health-risk behavior (i.e., those who do not consider future consequences). Moreover, framing of potential consequences of marijuana use might be distinguished between short-term consequences and long-term consequences, as prior research has shown that drinking behavior tends to be

more strongly affected by consideration of short-term consequences, as compared to consideration of long-term consequences, even when the outcomes themselves are objectively the same over time (Chapman, 2005; Gerend & Cullen, 2008). Given that marijuana use is another health-risk behavior, it is plausible that the same patterns found for alcohol use would hold when looking at temporal framing of marijuana consequences.

4.1. Limitations

Although the current study had several considerable strengths (e.g., longitudinal design with a community sample of young adults; specific marijuana behavioral willingness measure; examining consideration of future consequences and marijuana use), there are several limitations to note. The current study examined constructs of the social reaction pathway of the Prototype Willingness Model. Future research is needed to examine the full model as it relates to young adult marijuana use. Moreover, the sample consisted of participants from the Seattle, Washington area (where recreational marijuana use is legal for those 21 years of age and older) and thus findings are not representative of young adults in the United States. While less consideration of consequences is related to greater willingness, it could also be conceptualized to relate to the reasoned pathway in the Prototype Willingness Model; however, the present study did not test if consideration of future consequences moderated the relations between intentions to use marijuana and marijuana use. Moreover, given previous findings that willingness decreases in predictive power and intentions increase in predictive power as individuals age (Pomery et al., 2009), it may be that consideration of future consequences moderates both the reactive and reasoned pathways. Given that the majority of our sample at baseline did not report past hours or days high per week, behavioral willingness still is an important construct to investigate among this group. It should also be noted that measures were assessed at various time points, including marijuana use and consequences at baseline and Month 5, behavioral willingness at Month 4, marijuana user prototypes at Month 3, and descriptive norms and consideration of future consequences at baseline. Despite these limitations, this is the first study to investigate these associations and utilized a community sample with longitudinal follow-ups; thus, the results are important and may shed light on processes that can inform prevention and intervention activities as more states consider moving toward legalization. In the future, replication with a more geographically and ethnically diverse sample is warranted. Additionally, future studies should consider measuring the emotional state of individuals when examining willingness, consideration of future consequences, and marijuana use as previous research has found that negative affect increases the likelihood of accepting immediate rewards over long-term gains (e.g., Tice, Bratslavsky, & Baumeister, 2001) and negative affect may potentiate craving or increase substance use over time (Mason, Hitchings, & Spoth, 2009); thus, the affective state of the individual may influence our findings.

4.2. Conclusions

As consideration of future consequences is hypothesized to affect the way individuals construe their behavioral options (Joireman et al., 2008), consideration of future consequences may represent an important moderator in the Prototype Willingness Model. Given that the temporal distance between immediate and long-term consequences may affect a person’s present choices by creating a temporal dilemma (i.e., short-term benefits versus

future outcomes), it seems likely that consideration of future consequences may provide buffering (concern for long-term effects) or susceptibility (preference for immediate consequences) effects. Sensitivity to temporal aspects of consequences may modify both the reasoned and social reactive decision making; we provide preliminary evidence that consideration of future consequences differentially impacts the relation between willingness and future marijuana use using a longitudinal design. Although research regarding marijuana's effects on decision making is mixed (see Curran et al., 2016 for review), acute impairment of working memory has been evidenced (Curran et al., 2016), as has the links between recreational marijuana use, impulsivity in daily life, and motivational (i.e., regulation of motivation and affect), but not cognitive (i.e., solving abstract problems) inhibition (Griffith-Lendering, Huijbregts, Vollebergh, & Swaab, 2012). Moreover, the relations between marijuana use and problems from marijuana use have been found to be stronger among individuals who evidenced poor decision-making in situations of uncertain risk (Gonzalez, Schuster, Mermelstein, & Diviak, 2015). Taken together with the current study's findings, it may be that socio-contextual aspects during decision making, which are salient when examining an individual's willingness to engage in a behavior, interact with individual characteristics (e.g., consideration of future consequences) to affect decision making, which in turn, may increase negative consequences from marijuana use. A possible cycle may exist for some individuals who are more sensitive to immediate consequences and thus are more willing to use marijuana, especially in situations involving motivation and affect regulation, which in turn, may lead to increased problems from marijuana use given the valuation of immediate rewards in the face of larger long-term consequences. Understanding how reactive decisions made in social contexts interact with individual temporal preferences may be a promising avenue to pursue for prevention efforts.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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HIGHLIGHTS

- Behavioral willingness was positively related to marijuana use and related consequences.
- Consideration of future consequences moderated willingness-marijuan use association.
- Findings support the willingness-behavior association of the Prototype Willingness Model.
- Intervention and prevention implications are discussed.

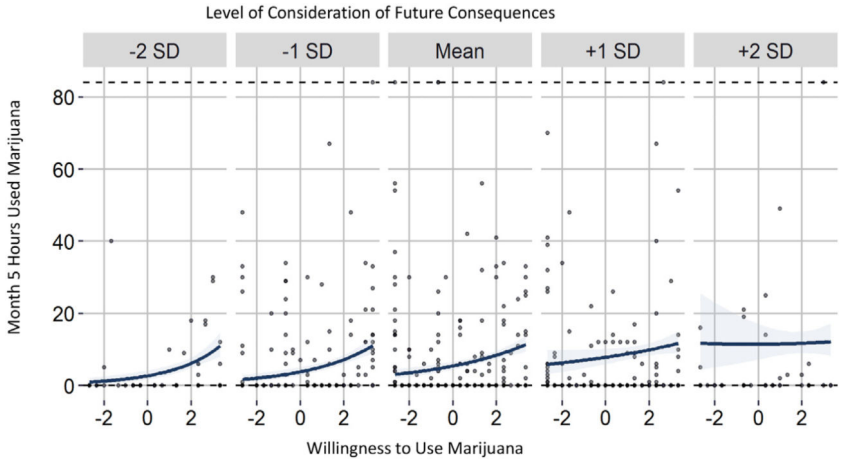

Fig. 1.

Willingness to use marijuana by consideration of future consequences.

Model predicted levels of marijuana use at Month 5 from Month 4 Willingness at −2, −1, mean,+1 and +2 SD of CONSIDERATION OF FUTURE CONSEQUENCES. Confidence intervals and individual predicted levels of use were simulated using the simcf package (Adolph, personal communication).

Table 1

Means, standard deviations, and correlations.

Variable	M	SD	1	2	3	4	5	6	7	8	9	10	11
1. Age	20.59	1.72											
2. Baseline perceived peer use: Hours high per week	10.04	10.20	−0.10**										
3. Baseline perceived peer use: Days high per week	3.53	2.29	−0.06	0.73**									
4. Baseline Hours High Per Week	5.72	13.62	−0.02	0.33**	0.20**								
5. Baseline Days High Per Week	1.34	2.33	0.01	0.26**	0.19**	0.82**							
6. Baseline Marijuana Consequences	5.51	9.75	0.01	0.17**	0.13**	0.65**	0.79**						
7. Consideration of Future Consequences	42.67	7.38	0.03	−0.10**	−0.08*	−0.18**	−0.19**	−0.21**					
8. Month 3 Marijuana Prototype Favorability	4.70	1.20	−0.03	0.12**	0.10*	0.20**	0.26**	0.20**	−0.10*				
9. Month 4 Willingness to Use Marijuana	2.67	1.98	0.01	0.12**	0.07	0.39**	0.50**	0.44**	−0.15**	0.35**			
10. Month 5 Hours High Per Week	1.08	2.23	0.03	0.20**	0.16**	0.67**	0.79**	0.62**	−0.16**	0.25**	0.54**		
11. Month 5 Days High Per Week	4.12	11.15	−0.00	0.25**	0.17**	0.76**	0.68**	0.53**	−0.13**	0.18**	0.44**	0.82**	
12. Month 5 Marijuana Consequences	3.18	7.85	0.00	0.15**	0.10**	0.42**	0.54**	0.58**	−0.10*	0.15**	0.43**	0.70**	0.57**

Note.

* indicates $p < .05$

** indicates $p < .01$.

M and SD are used to represent mean and standard deviation, respectively.

Table 2

Predicting Willingness at Month 4.

Predictor	*b*	95% CI *b* [LL, UL]	*beta*	Fit
(Intercept)	1.34	[−0.46, 3.13]		
Biological sex	−0.18	[−0.44, 0.09]	−0.04	
Age	0.00	[−0.07, 0.07]	0.00	
Consideration of Future Consequences	−0.02 *	[−0.04, −0.00]	−0.07	
Perceived Peer Use Hours High Per Week	0.01	[−0.01, 0.03]	0.03	
Perceived Peer Use Days High Per Week	−0.06	[−0.15, 0.02]	−0.07	
Baseline Hours High Per Week	−0.01	[−0.02, 0.01]	−0.04	
Baseline Days High Per Week	0.44 **	[0.34, 0.54]	0.49	
Month 3 Marijuana Prototype Favorability	0.39 **	[0.28, 0.50]	0.24	
				$R^2 = 0.335$ **
				95% CI[0.27,0.38]

Note.

* indicates $p < .05$

** indicates $p < .01$.

A significant *b*-weight indicates the beta-weight and semi-partial correlation are also significant. *b* represents unstandardized regression weights; *beta* indicates the standardized regression weights; LL and UL indicate the lower and upper limits of a confidence interval, respectively.

Table 3

Results from hurdle negative binomial models for number of days high a typical week.

Days high per typical week: Count	*b*	RR	LL	UCL
Intercept	−0.33	–	–	–
Willingness	0.12***	1.12	1.04	1.21
Consideration of Future Consequences	0.01	1.01	0.98	1.04
Prototype Favorability	−0.03	0.97	0.89	1.06
Baseline level of outcome	0.14***	1.15	1.11	1.19
Baseline perceived peer use: Days high per week	0.02	1.02	0.99	1.06
Biological sex	0.02	1.02	0.86	1.22
Age	0.06*	1.06	1.00	1.11
Willingness*Consideration of Future Consequences	0.00	1.00	0.99	1.01
Days high per week: Likelihood	b	RR	LCL	UCL
Intercept	−2.35	–	–	–
Willingness	0.64***	1.90	1.58	2.29
Consideration of Future Consequences	−0.02	0.98	0.94	1.03
Prototype Favorability	0.24	1.27	0.95	1.69
Baseline level of outcome	0.63***	1.88	1.59	2.23
Baseline perceived peer use: Days high per week	0.01	1.01	0.89	1.15
Biological sex	0.34	1.41	0.79	2.52
Age	−0.02	0.98	0.84	1.14
Willingness*Consideration of Future Consequences	0.00	1.00	0.98	1.03

* $p < .05$

*** $p < .001$

OR = Odds Ratio; RR = Risk Ratio; LCL = 95% Lower confidence limit, UCL = 95% Upper confidence limit.

Table 4

Results from hurdle negative binomial models for number of hours high in a typical week.

Number of hours high per week: Count	b	RR	LCL	UCL
Intercept	0.94	–	–	–
Willingness	0.22***	1.25	1.14	1.37
Consideration of Future Consequences	0.05***	1.05	1.02	1.08
Prototype Favorability	−0.10	0.90	0.81	1.01
Baseline level of outcome	0.03***	1.03	1.02	1.04
Baseline perceived peer use: Hours high per week	0.02***	1.02	1.01	1.03
Biological sex	0.11	1.12	0.88	1.41
Age	0.05	1.05	0.98	1.13
Willingness*Consideration of Future Consequences	−0.01**	0.99	0.98	1.00
Number of hours high per week: Likelihood	b	RR	LCL	UCL
Intercept	−2.98	–	–	–
Willingness	0.67***	1.96	1.63	2.34
Prototype Favorability	−0.02	0.98	0.94	1.02
Consideration of Future Consequences	0.31*	1.36	1.04	1.80
Baseline level of outcome	0.15***	1.16	1.10	1.22
Baseline perceived peer use: Hours high per week	0.00	1.00	0.97	1.03
Biological sex	0.44	1.55	0.89	2.68
Age	0.00	1.00	0.86	1.16
Willingness*Consideration of Future Consequences	0.00	1.00	0.98	1.03

* $p < .05$

*** $p < .001$

OR = Odds Ratio; RR = Risk Ratio; LCL = 95% Lower confidence limit, UCL = 95% Upper confidence limit.

Table 5

Results from hurdle negative binomial models predicting marijuana consequences.

Intensity of consequences: Likelihood	b	RR	LL	UL
Intercept	−3.42	–	–	–
Willingness	0.70***	2.02	1.70	2.41
Consideration of Future Consequences	−0.04	0.96	0.93	1.00
Prototype Favorability	0.09	1.09	0.85	1.40
Baseline level of outcome	0.09*	1.09	1.06	1.13
Baseline perceived peer use: Hours high per week	0.00	1.00	0.95	1.04
Baseline perceived peer use: Days high per week	−0.07	0.93	0.79	1.11
Biological sex	0.30	1.35	0.82	2.24
Age	0.06	1.06	0.92	1.21
Willingness*Consideration of Future Consequences	0.01	1.01	0.99	1.03
Intensity of consequences: Likelihood	b	RR	LL	UL
Intercept	2.44	–	–	–
Willingness	0.16***	1.17	1.06	1.29
Consideration of Future Consequences	−0.02	0.98	0.94	1.01
Prototype Favorability	0.00	1.00	0.86	1.16
Baseline level of outcome	0.03***	1.04	1.02	1.05
Baseline perceived peer use: Hours high per week	0.00	1.00	0.97	1.02
Baseline perceived peer use: Days high per week	0.06	1.06	0.96	1.16
Biological sex	−0.08	0.93	0.70	1.23
Age	−0.05	0.95	0.88	1.03
Willingness*Consideration of Future Consequences	0.01	1.01	0.99	1.02

*** $p < .001$

RR = Risk Ratio; LCL = 95% Lower confidence limit, UCL = 95% Upper confidence limit.