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Reasons for Marijuana and Tobacco Co-use Among Young Adults: A Mixed Methods Scale Development Study

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Abstract

Background—Marijuana-tobacco co-use has increased recently, particularly in young adults.

Objectives—We conducted a mixed-methods study to: (1) examine reasons for co-use; and (2) develop a scale assessing reasons for co-use among participants in a longitudinal cohort study of 3,418 students aged 18-25 from 7 Georgia colleges and universities.

Methods—Phone-based semi-structured interviews were conducted in Summer 2015 among 46 current (past 30-day, $n = 26$) or lifetime ($n = 20$) marijuana users. Subsequently, scale items were developed and included at Wave 3. Participants reporting past 4-month tobacco and marijuana use ($n = 328$) completed the Reasons for Marijuana-Tobacco Co-use section.

Results—Per qualitative data, reasons for marijuana-tobacco co-use included synergistic effects, one triggering or preceding the other's use, using one to reduce the other's use, co-administration, social context, and experimentation. The survey subsample included 37.1% who used cigarettes, 30.4% LCCs, 9.4% smokeless, 23.7% e-cigarettes, and 30.4% hookah. Four subscale factors emerged: (1) Instrumentality, indicating synergistic effects; (2) Displacement, indicating using one product to reduce/quit the other; (3) Social context, indicating use in different settings/social situations; and (4) Experimentation, indicating experimentation with both but no specific reasons for co-use. These subscales demonstrated distinct associations with tobacco type used; nicotine dependence; marijuana and alcohol use frequency; tobacco and marijuana use motives, respectively; perceptions of tobacco and marijuana; and parental and friend use. Including these

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Declaration of interests

The authors declare no conflicts of interest.

subscales in regressions predicting nicotine dependence and days of marijuana use significantly contributed to each model.

Conclusions—These findings might inform theoretical frameworks upon which marijuana-tobacco co-use occurs and direct future intervention studies.

Keywords

Substance use; young adults; risk factors; tobacco use; marijuana use

Introduction

Adult marijuana users have been shown to have a significantly higher prevalence of tobacco use than non-users (Agrawal, Budney, & Lynskey, 2012; Ramo, Liu, & Prochaska, 2012; Richter et al., 2004; Schauer, Berg, Kegler, Donovan, & Windle, 2015); a recent review noted that between 41% and 94% of adult marijuana users also consume tobacco (Peters, Budney, & Carroll, 2012). The term “co-use” has been used to refer to dual use (i.e., use of tobacco and marijuana by the same person) and concurrent use (i.e., use at the same time). Common modes of concurrent use include blunts (i.e., hollowed out cigars filled with marijuana) or spliffs (i.e., joints of marijuana mixed with loose-leaf tobacco) (Golub, Johnson, & Dunlap, 2005; Mariani, Brooks, Haney, & Levin, 2011; Rabin & George, 2015; Soldz, Huyser, & Dorsey, 2003). Most studies use the term co-use, as assessments commonly fail to ascertain if marijuana and tobacco were used concurrently (Meier & Hatsukami, 2016).

Tobacco and marijuana have a complementary and synergistic relationship, wherein the effects of one may reinforce and/or enhance the effects of the other, potentially through psychological and/or physiological mechanisms. For example, one study found that young adults reported using both tobacco and marijuana because marijuana use increased tobacco urges, tobacco use increased marijuana urges, and the act of smoking cigarettes helped cope with marijuana urges (Ramo, Liu, & Prochaska, 2013). Another study of college student co-users found that 65% had smoked both substances in the same hour, with 31% reporting that they smoked tobacco to prolong and sustain the effects of marijuana (Ramo & Prochaska, 2012). While these findings are significant for providing some insight into why individuals engage in dual and concurrent use of tobacco and marijuana, there are potentially additional reasons for this behavior that continued research on this topic could identify. This is especially important to study given that dual and concurrent use may increase the frequency of tobacco use (Patton, Coffey, Carlin, Sawyer, & Lynskey, 2005), as well as risks of nicotine dependence (Ream, Benoit, Johnson, & Dunlap, 2008) and marijuana dependence (Peters et al., 2012; Ream et al., 2008).

Changing marijuana policies may also impact tobacco use. For example, legalization of marijuana may increase the development and marketing of new and existing products that facilitate dual and concurrent use (e.g., cigars, vaporizers or other electronic delivery systems, etc.). Indeed, the same devices are already used to consume marijuana (hash oil) and nicotine liquid (“E-cigarettes make marijuana smoke virtually undetectable,” November 7, 2013). The effect on social acceptability is also important as social context

may influence co-use; a study of co-using college students found that 55% had friends who also engaged in co-use (Ramo & Prochaska, 2012). As policy changes make marijuana more available, visible, and socially acceptable (Gallup, 2013; Hickenlooper, 2014), understanding the motives for co-use with tobacco is critical.

Quantitative research has examined trends in marijuana-tobacco co-use (Schauer et al., 2015), but little research has explored reasons for co-use (Schauer et al., 2016). Additionally, no research to date has examined reasons for co-use among users of non-cigarette tobacco products. Finally, limited prior research has aimed to develop a measure for assessing reasons for marijuana-tobacco co-use. The Nicotine and Marijuana Interaction Expectancy (NAMIE) questionnaire (Ramo, Liu, et al., 2013) assesses expectancies of co-use (i.e., marijuana increases tobacco use and urges, tobacco increases marijuana use and urges, smoking to cope with marijuana urges). Additional factors that have not been considered include the potential experimental nature of use of either, particularly in a young-adult population, or the context of use (e.g., social, location), which is particularly important given the different social acceptability and policy contexts of each. Thus, additional research is needed to further explore the reasons for co-use. This is critical for surveillance and intervention development, especially given the health risks of tobacco and marijuana use either alone or in combination (Patton et al., 2005; Peters et al., 2012; Ream et al., 2008; Sidney, 2002; U.S. Department of Health and Human Services, 2014; Zhang et al., 1999).

Using sequential exploratory mixed-methods design, the current study aimed to: (1) examine reasons for and factors associated with co-use of marijuana and tobacco; and (2) develop a scale that assesses reasons for marijuana-tobacco co-use among college students (ages 18-25) who are co-users.

Methods

The parent study, Project DECOY (**D**ocumenting **E**xperiences with **C**igarettes and **O**ther Tobacco in **Y**oung Adults) is a two-year, six-wave longitudinal cohort study that involves 3,418 racially/ethnically diverse students (ages 18 to 25) from seven colleges and universities in Georgia, where medicinal marijuana use was legalized in 2015. Schools are located in both rural and urban settings and include two public universities/colleges, two private universities, two community/technical colleges, and one historically black university. Project DECOY was approved by the [omitted for blind review] Institutional Review Boards as well as those of the participating colleges and universities. Data collection began in Fall 2014 and consisted of self-report assessments via an online survey every four months for two years (during Fall, Spring, and Summer).

Detailed information on sampling and recruitment are described elsewhere (Berg et al., 2016) and briefly summarized here. The registrar's office from each campus provided e-mail addresses for English-speaking students ages 18-25. We randomly selected 3,000 email addresses from each of the three largest campuses, and emailed a census of students at the four smaller campuses with fewer than 3,000 students. Response rates at the campuses ranged from 12.0% to 59.4%. The overall response rate of 22.9% ($N = 3,574/15,607$), albeit low, was obtained over a short time frame (24 hours at the private schools to seven days at

the technical colleges) and met the sampling quota targets (Berg et al., 2016). Our intent was to enroll participants who were engaged in email and were potentially more likely to be retained in the subsequent waves of the larger, multi-wave longitudinal project. Our experience using this approach over several studies (An et al., 2009; Berg et al., 2011; Berg et al., 2014), as well as the experiences of others using this approach (An et al., 2007; An et al., 2008; Prokhorov et al., 2003; Sutfin et al., 2012; Sutfin, McCoy, Morrell, Hoeppner, & Wolfson, 2013; Sutfin, Reboussin, McCoy, & Wolfson, 2009), has indicated that it is an effective and cost-effective way to recruit participants. The sociodemographic characteristics of the baseline sample were largely reflective of the student bodies of the college campuses included in this study; however, the sample was disproportionately female (Berg et al., 2016). Current analyses draw from two data sources, described below (see Figure 1 and Table 1 for more detailed information regarding the specific study samples).

Study 1: Qualitative interviews

Participants—We recruited via email users of each tobacco product (cigarettes, little cigar/cigarillos [LCCs], smokeless tobacco, e-cigarettes, hookah) identified at Wave 2 of Project DECOY to participate in semi-structured interviews during Summer 2015 (see Figure 1). Eligibility criteria for the qualitative interviews were based on the distributions of level of use for each product within our larger study cohort. As such, eligibility criteria for use were: (1) used cigarettes, LCCs, smokeless tobacco, or e-cigarettes 15 days out of the past 30 days; or (2) used hookah 10 days out of the past 30 days (due to the lower frequency of use in this product category). We purposively recruited current and lifetime marijuana users within this sampling frame. Of the 99 participants recruited, 80 (80.8%) consented, and 60 (60.6%) actually participated in this portion of the study. A total of 46 (76.7%) of the 60 had experience using marijuana and were included in these analyses. Specifically, 26 (43.3%) were current marijuana-tobacco co-users and an additional 20 were current tobacco users and lifetime but not current marijuana users.

Qualitative semi-structured interviews—Telephone-based interviews that lasted about 30 minutes were facilitated by female MPH graduate students trained in qualitative data collection. They were audio-recorded for subsequent coding. Participants provided verbal consent at the start and were compensated with a \$40 Amazon gift card. The interview guide focused on understanding perceptions, attitudes, and reasons for use of alternative tobacco products and marijuana. Current analyses focused on reasons for co-use of tobacco and marijuana.

Data analysis—Qualitative data were analyzed using MAXQDA 12 (Berlin, Germany: <http://www.maxqda.com/>). Two members of the authorship team (trained MPH-level study personnel) independently reviewed all transcripts, which they then used to generate preliminary codes using deductive and inductive coding methods. Specifically, the interview guide was used to inform deductive codes, and thematic content analyses informed inductive coding methods (Braun & Clarke, 2006). All codes were compiled and developed into a codebook for analysis. Primary (i.e., major topics) and secondary codes (i.e., recurrent themes within primary topics) were established. Then, each transcript was fully and independently analyzed by two additional MPH graduate students and coded using the

preliminary codebook that was developed. All new codes that arose during coding were added to the codebook and applied to all transcripts. Codes were compared, and consensus for coding was reached ($Kappa = 93.3\%$). Final codes were used to identify themes, and relevant and representative quotes were chosen. Descriptive statistics were conducted to characterize the interview sample using SPSS 23.0.

Study 2: Scale development

Participants—Scale development involved data from the Wave 3 survey, which was also conducted in Summer 2015 (retention rate = 83.9%, $n = 2869/3418$). In order to ensure that we had sufficient sample size, all participants who used marijuana and at least one tobacco product in the past 4 months (a time frame selected to cover the period of time between assessments) were instructed to answer a subset of 14 items about reasons for co-use. A total of 500 participants had used marijuana in the past 4 months (17.4%; 221 [7.7%] refused responding), and a total of 1,087 participants (37.9%) used any tobacco in the past 4 months. In the current analysis, we included only participants who used any tobacco and marijuana in the past 4 months and had complete responses to the scale items ($n = 328$, 11.4% of total; see Figure 1). We considered focusing on only past 30-day users, but to increase our power to detect associations, we focused on the larger sample size, which also allowed us to include a broader range of use behaviors. Of note, exploratory analyses focusing on past 30-day users showed similar results, likely because of the representativeness of past 4-month users. (That is, 495 [99.0%] of past 4-month marijuana users used marijuana in the past 30 days; 786 [72.3%] of past 4-month tobacco users used any tobacco in the past 30 days.)

Conceptual framework—The development of the new measure as well as the development of our conceptual framework were informed by Social Cognitive Theory (Bandura, 1998, 2004), which has been broadly applied to substance use literature. We also drew from the literature regarding motives for tobacco and marijuana use, respectively (Piko, Wills, & Walker, 2007; Simons, Correia, & Carey, 2000; Wills, Sandy, & Shinar, 1999), the limited literature regarding reasons for co-use (Ramo, Liu, et al., 2013; Schauer et al., 2016) as well as our qualitative findings, and the literature regarding patterns and trajectories of marijuana-tobacco use and polysubstance use more broadly (Cohn et al., 2015; Haardörfer et al., 2016; Rath, Villanti, Abrams, & Vallone, 2012; Richardson, Williams, Rath, Villanti, & Vallone, 2014; Schauer et al., 2015; Sutfin et al., 2009). In particular, outcome expectancies are a central component of Social Cognitive Theory (Bandura, 1998, 2004). As such, distinct reasons (or outcome expectancies) for co-use may be reflective of those of individual substance use, including social, confidence, boredom, affect regulation, conformity, and expansion (Piko et al., 2007; Simons et al., 2000; Wills et al., 1999). These motives may also be associated with perceived risk of addiction, harmfulness to health, and social acceptability (Berg, Stratton, et al., 2015). Related to the latter, environmental factors, particularly substance use among social influences, are important predictors of use (Berg, Stratton, et al., 2015). In addition, individual psychological and behavioral factors are related to substance use; specifically, the literature suggests that heavier use may be related to greater depressive symptoms (Berg, Buchanan, Grimsley, Rodd, & Smith, 2011; Berg, Wen, Cumming, Ahluwalia, & Druss, 2013) and to higher levels of other substance use, such as alcohol (Cohn et al., 2015; Haardörfer et al., 2016).

Measures—Data collected at Wave 3 included a range of psychosocial and substance use variables, as informed by our conceptual framework. Below we outline our primary measure of focus – the newly developed Reasons for Marijuana-Tobacco Co-use Scale – and the correlates of interest. Specifically, they include level of tobacco and marijuana use, level of nicotine dependence, motives for tobacco use and marijuana use, respectively, social influences using tobacco or marijuana, perceptions of tobacco and marijuana (i.e., in relation to perceived addictiveness, harmfulness to health, and social acceptability), depressive symptoms, and alcohol use.

Tobacco & marijuana use—Participants were first asked to report the number of days they used each product in the past 4 months (to cover the duration of time between each wave of assessment): cigarettes; little cigars/cigarillos [LCCs]; smokeless tobacco; e-cigarettes; hookah; and marijuana (Centers for Disease Control and Prevention, 2014). Those who reported any use in the past 4 months were asked to complete the Reasons for Marijuana-Tobacco Co-Use Scale and are the focus of these analyses. They were also asked to report the number of days they used the respective product in the past 30 days. In addition, marijuana users were asked, “How do you use marijuana *most of the time*? Please choose one answer: smoked in a joint; smoked in a bowl; smoked in a water pipe without tobacco; smoked in a water pipe with tobacco; vaporized it with a vaporizer without tobacco; vaporized it with tobacco mixed with it (for example, with an e-cigarette); rolled in cigar or cigarette papers without tobacco; rolled in cigar or cigarette papers with tobacco; digested with or without food; drank it; or other.”

Reasons for marijuana-tobacco co-use—After reviewing the literature (Berg et al., 2011; Berg et al., 2015; Berg et al., 2013; Cohn et al., 2015; Haardörfer et al., 2016; Piko et al., 2007; Ramo et al., 2013; Rath et al., 2012; Richardson et al., 2014; Schauer et al., 2015; Schauer et al., 2016; Simons et al., 2000; Sutfin et al., 2009; Wills et al., 1999) and the present qualitative findings, a panel of experts that included the current author and other colleagues developed a list of 14 potential reasons for marijuana-tobacco co-use. Participants were asked, “You indicated that you have used at least one *tobacco product* in the past 4 months and have also used *marijuana* in the past 4 months. Below are some reasons for why you might have used both of these products. Please indicate how true each of these reasons are for you using the scale below” (response options of 0 = not at all true to 6 = extremely true).

Nicotine dependence—The Hooked on Nicotine Checklist (HONC) (Wellman et al., 2006; Wellman et al., 2005) is a reliable and valid measure of diminished autonomy over tobacco. It is uniquely suited for use with smokers whose cigarette consumption is low. The verbiage of this scale was adapted in the current study to be applicable to all types of tobacco and nicotine product use (i.e., not only cigarette smoking; e.g., “Have you ever tried to quit using tobacco or nicotine, but couldn’t?”). Cronbachs alpha for this scale in this study was .94.

Tobacco use motives—The Motives for Smoking Scale (Piko et al., 2007; Wills et al., 1999) assesses the extent to which each of 15 smoking-related motives is true for a

participant (1 = not at all true to 5 = very true). The measure contains questions about four common motives: social (4 items, e.g., “Smoking helps you fit in with other people”), self-confidence (4 items, e.g., “Smoking makes you feel more self-confident”), boredom relief (2 items, e.g., “Smoking is something to do when you’re bored”), and affect regulation (5 items, e.g., “Smoking helps you calm down when you’re feeling tense or nervous,” “Smoking cheers you up when you’re in a bad mood”). Higher scores indicate that the motive is more relevant. The verbiage of this scale was adapted in the current study to be applicable to all types of tobacco and nicotine product use (e.g., “Using tobacco or nicotine helps you fit in with other people”). In the current study, alphas for the social subscale, the self-confidence subscale, the boredom relief subscale, and the affect regulation subscale were .89, .86, .94, and .92, respectively.

Marijuana use motives—The Drinking Motives Measure (Simons et al., 2000) is a 25-item questionnaire assessing five motives for drinking and has previously been adapted to assess marijuana use motives (Simons et al., 2000). The five motives include: social (e.g., “I use marijuana to be sociable”), enhancement (e.g., “I use to get high”), coping (e.g., “I use to forget my worries”), conformity (e.g., “I use so that others won’t kid me about not using”), and expansion (e.g., “I use marijuana to be more open to experiences”). Participants are instructed to indicate how often they have used marijuana for each reason (1 = almost never/never to 5 = almost always/always). In the current study, Cronbach’s alpha for marijuana use subscale scores, respectively, were .90, .90, .91, .90, and .93.

Perceptions of tobacco products and marijuana—We also asked about perceptions of tobacco products (i.e., cigarettes, LCCs, smokeless tobacco, e-cigarettes, hookah) and marijuana – specifically addictiveness, harmfulness of use, and social acceptability – on a Likert scale of 1 = not at all to 7 = extremely (Berg et al., 2015).

Social factors—We asked if a parent currently used each tobacco product and marijuana (Berg et al., 2015) and the number of five closest friends using each (Berg et al., 2015). These items were operationalized as dichotomous variables (e.g., at least one friend used versus none).

Depressive symptoms—We assessed depressive symptoms using the Patient Health Questionnaire – 9 item (PHQ-9) (Kroenke, Spitzer, & Williams, 2003). The nine items were summed; Cronbach’s alpha was .86.

Alcohol use—Participants were asked to report the number of days they used alcohol in the past 4 months, and if they reported one day or more, they were asked to report the number days used in the past 30 days (Centers for Disease Control and Prevention, 2014).

Data analysis—We conducted an exploratory factor analysis of the Reasons for Marijuana-Tobacco Co-Use items. We used principal components extraction and Promax rotation. We used eigenvalues of greater than 1 as the criterion for number of factors. Then, we examined the content and internal consistency of the factors. We then conducted bivariate analyses examining subscale scores in relation to these correlates of interest to examine convergent and discriminant validity. Next, to examine the independent predictive

validity of the Reasons for Marijuana-Tobacco Co-Use subscales, we conducted multivariable regressions identifying correlates of 1) nicotine dependence per the HONC; and 2) number of days of marijuana use. Controlling for age, sex, race/ethnicity, and school type, we entered other correlates in a step-wise manner to examine the contribution of groups of variables. Step 1 included parental and friend use of marijuana or tobacco, respectively; perceived addictiveness, harm to health, and social acceptability of marijuana or tobacco, respectively; and days of alcohol use and depressive symptoms. In Step 2, we included marijuana or tobacco use motives, respectively. Finally, in Step 3, we included the Reasons for Marijuana-Tobacco Co-use subscales. Analyses were conducted in SPSS 23.0, and alpha was set at .05.

Results

Study 1: Qualitative interviews

Participant characteristics—Table 1 presents data regarding participant characteristics. Our sample was 21.0 years old on average ($SD = 2.1$), 56.5% female, and 34.8% Black.

Reasons for co-use of marijuana and tobacco—Table 2 presents themes and selected quotes regarding reasons for co-use of marijuana with each tobacco product. In terms of cigarettes, many indicated that they smoked cigarettes after smoking marijuana because it enhanced the effect of the marijuana. Conversely, some reported that marijuana enhanced the effects of nicotine from cigarettes. Others indicated that they experienced no synergistic effects. Some indicated that marijuana use heightened cravings for nicotine, which triggered tobacco use. In addition, a few participants indicated that they used cigarettes to reduce their use of marijuana in situations when they could not use marijuana, such as in public settings. Others reported using cigarettes to eliminate the taste of marijuana. Finally, many reported that social context influenced their use of both cigarettes and marijuana.

Regarding LCCs, participants commonly reported buying them to use the papers for marijuana, with many reporting that they try to eliminate all of the tobacco from the papers. Those who chose to leave the tobacco in the LCCs and used them in conjunction with marijuana felt that the nicotine enhanced the effects of the marijuana. Social context was also mentioned in relation to LCC and marijuana co-use. In addition, experimentation was mentioned such that the way that one was exposed to using marijuana influences their mode of use. For example, one participant indicated that they first used marijuana by using LCC papers to smoke it and thus continued use in this way.

E-cigarettes were mainly used by those who were using them as a replacement for cigarettes or as a means of lessening their marijuana use. Few participants reported co-use of marijuana and smokeless tobacco, suggesting that participants may not have perceived a synergistic effect between these two products.

Those reporting marijuana and hookah co-use also indicated that hookah enhanced the psychological effects of marijuana (e.g., relaxation, buzz). They also reported that using

marijuana and hookah were social activities that occurred in different places due to the illegal nature of recreational marijuana in Georgia.

Study 2: Scale development

Participant characteristics—The sample was an average age of 20.5 (SD = 1.8), 40.8% male, 58.2% White, 27.4% Black, and 10.1% Hispanic (Table 1). It included 37.1% cigarette users, 30.4% LCC users, 9.4% smokeless tobacco users, 23.7% e-cigarette users, and 30.4% hookah users. Average number of days of alcohol use in the past 30 days was 7.34 (SD = 6.89). Notably, only 4.3% reported that their most common mode of marijuana use was in the same device with tobacco (3.3% rolled in papers; 1.0% in a waterpipe). Average PHQ-9 scores were 11.72 (SD = 72.64).

Factor analysis—Factor analysis identified four factors (see Table 3): 1) Instrumentality, indicating the functions that co-use served related to physical sensations (e.g., enhancing the buzz of using either product) and using tobacco for a buzz when marijuana was not allowed or available; 2) Displacement, indicating use of one product to reduce or quit the use of another or using marijuana when tobacco was not available; 3) Social context, indicating use of different products in different social contexts; and 4) Experimentation, indicating experimental use of these products but no specific link between the their use. Three items were deleted (*I get a different kind of buzz off of tobacco versus marijuana, I typically use marijuana and follow it up with tobacco when I use them on the same occasion, I typically use tobacco and follow it up with marijuana when I use them on the same occasion*), as these items were deemed to tap similar factors to other items (e.g., enhancing the effects of one another) or did not assess specific reasons for use in retrospect. Further, these three items did not clearly fit specifically with any of the four factors identified (i.e., they had factor loading roughly equivalent with at least two factors). These four factors accounted for 68.7% of the variance (component 1: 33.2%, 2: 17.4%, 3: 9.4%, 4: 8.7%). Cronbach's alphas for each subscale were: .81, .72, .80, and .55, respectively. The correlations ranged from $-.04$ between Displacement and Experimentation to $.50$ between Instrumentality and Displacement (Table 3).

Convergent and discriminant validity—Table 4 provides data regarding convergent and discriminant validity. Scores on the Instrumentality subscale were positively associated with past 30-day cigarette, LCC, and hookah use, nicotine dependence, frequency of marijuana use, each of the tobacco use motives, each of the marijuana use motives except conformity, perceived social acceptability of marijuana use, parental use of tobacco and marijuana, and friend use of marijuana. Scores on the Displacement subscale were positively associated with past 30-day cigarette, LCC, and hookah use, nicotine dependence, frequency of marijuana use, each of the tobacco use motives, each of the marijuana use motives, perceived social acceptability of marijuana and negatively associated with perceived addictiveness of tobacco, and parental and friend marijuana use. Scores on the Social context subscale were positively associated with nicotine dependence, frequency of marijuana use, each of the tobacco use motives, perceived social acceptability of tobacco, friend marijuana use, and number of days of alcohol use. Scores on the Experimentation subscale were negatively associated with past 30-day use of cigarettes, LCCs, and hookah, level of

marijuana use, and perceived addictiveness of marijuana, and positively with perceived addictiveness and harm of tobacco and number of days of alcohol use.

Predicting levels of marijuana use and nicotine dependence—Table 5 presents the final regression models (including all factors) and highlights as footnotes the adjusted R-squareds for each step in the model. In the final regression model predicting HONC scores, tobacco boredom and affect regulation motives scores were significantly associated with higher HONC scores ($p < .001$ and $p = .003$, respectively; Table 5). Lower scores on the Reasons for Marijuana-Tobacco Co-use subscale for Experimentation was associated with higher HONC scores ($p < .001$). In the regression model predicting number of days of marijuana use, lower marijuana coping motives scores were significantly associated with higher number of days of marijuana use ($p = .01$). Higher scores on the Reasons for Marijuana-Tobacco Co-use subscales for Instrumentality and Social context ($p = .05$ and $p = .002$, respectively) and lower scores for Experimentation were associated with more days of marijuana use. The contribution of the Reasons for Marijuana-Tobacco Co-use subscales to each equation was significant (p 's $< .001$, respectively).

Discussion

The current study is one of the few studies that used a qualitative approach to examine reasons for marijuana-tobacco co-use and the first study aimed at quantitatively assessing a range of reasons for co-use. Our qualitative findings identified specific themes regarding reasons for co-use, which informed our scale development efforts. The four factors that emerged from the scale reflected Instrumentality, Displacement, Social context, and Experimentation. The items demonstrate face validity, and these subscales demonstrated convergent and discriminant validity, which is further elaborated upon below. The new measure largely reflects the literature that informed our conceptual framework (Cohn et al., 2015; Haardörfer et al., 2016; Piko et al., 2007; Ramo et al., 2013; Rath et al., 2012; Richardson et al., 2014; Schauer et al., 2015; Schauer et al., 2016; Simons et al., 2000; Sutfin et al., 2009; Wills et al., 1999), as well as the constructs and associations involved in the Social Cognitive Theory (Bandura, 1998, 2004). Moreover, it is important to note that the addition of these subscales to the regression models predicted nicotine dependence and days of marijuana use, respectively. Specifically, higher Experimentation subscale scores were associated with lower levels of dependence and use, and higher scores on the Instrumentality and Social context subscales predicted more days of marijuana use, which are intuitive findings based on the existing literature. Thus, the resulting scale may be useful for understanding how and why young adults are co-using and for informing interventions to reduce co-use or promote cessation.

Convergent and discriminant validity were demonstrated across subscales and correlates of interest. Relating to the diversity of tobacco products represented in this study, the four factors that emerged demonstrated interesting associations with the types of tobacco products used. It is interesting to note that LCC and hookah use was positively correlated with Instrumentality and Displacement scores. Prior research has indicated that LCC, hookah, and marijuana use cluster among college students (Haardörfer et al., 2016), which might suggest users of these three products desire a specific effect – perhaps a buzz

alongside enjoying flavors – and transition from use of one to the other when needed. Social context was not associated with use of a specific tobacco product, which might indicate that type of product used is dependent on what is available or acceptable within given contexts. Interestingly, Experimentation was negatively associated with cigarettes and LCCs, as well as nicotine dependence and frequency of marijuana use, likely reflecting that experimenters of the two products together are not likely to be regular users of either tobacco or marijuana. Instrumentality, Displacement, and Social context scores were each associated with nicotine dependence and frequency of marijuana use, reflecting that those more frequently using either may be co-using for each of these reasons. Greater alcohol consumption was associated with higher Social context and Experimentation scores, which might suggest that contextual factors (e.g., going out, socializing with friends) play a more significant role in co-use among those using in specific social contexts or experimenting with marijuana and tobacco.

A particularly relevant previous study examined marijuana-tobacco co-use among young adults (Schauer et al., 2016) and found the following patterns of and reasons for use: sequential use (e.g., using within short succession; due to addiction/habit, to enhance the high, or to counteract the effects of one of the substances), substitution (e.g., using in different times/places; due to liking the general act of smoking, limitations on when/where they could use a substance, or as a way to quit or reduce one of the substances), or co-administration (e.g., simultaneous use; to modulate the high or improve the flavor). However, this prior study included marijuana users who mainly used cigarettes and LCCs; the current study included users of a broad range of tobacco products, with several being polytobacco users (Schauer et al., 2016). As such, this study provides a more comprehensive lense regarding co-use of marijuana with the broader range of tobacco products, which is necessary given the distinct associations of type of tobacco product used in relation to reasons for co-use.

In terms of motives for tobacco and marijuana use, respectively, Instrumentality and Displacement were largely associated with each of the use motives, while Experimentation was not, likely reflecting that reasons for co-use are associated with reasons for individual product use. Interestingly, Social context was associated with each of the tobacco use motives but none of the marijuana use motives. Additionally, only Instrumentality and Displacement scores were associated with motives for using marijuana. The strong associations between Displacement and marijuana use motives may reflect a high level of use of tobacco and/or marijuana. The lack of significant associations with the Social context subscale may reflect that Social context (e.g., choosing to use one or the other around different people or in different places) is distinct from the instrumental uses of marijuana and the social influences and pressures that might be involved.

Social context was associated with having friends who use marijuana but no other social influence factors. Parental and friend use of marijuana, as well as greater perceived social acceptability of marijuana use, was associated with Instrumentality and Displacement as well, which may indicate that the environment may have an impact on reasons for use and the potential for a genetic predisposition to substance use and dependence. In addition, Displacement was negatively associated with perceived addictiveness of tobacco, while

Experimentation was positively associated with perceived addictiveness and harm of tobacco use. Also of note, Experimentation was the only subscale negatively associated with perceived addictiveness of marijuana. This might suggest that those who perceive marijuana to be more addictive are less likely to experiment with marijuana and/or tobacco; however, those co-using for other reasons are not impacted by perceived addictiveness of marijuana, which may put them at risk for more regular co-use.

An interesting distinction regarding item loadings on the subscales occurred in relation to the items “I use tobacco when I can’t use marijuana” (Instrumentality) and “I use marijuana when I can’t use tobacco” (Displacement). This might reflect that, in environments where marijuana is not allowed (public places) or otherwise inappropriate (e.g., around family), tobacco might be used in place of marijuana in order to stimulate a physiological effect, even though the effects may differ. However, it is likewise possible that when tobacco is not available, tobacco users might use marijuana to simulate the process of smoking. These findings warrant additional examination.

This study has implications for research and practice. First, it is important to note that this research was conducted in Georgia, where medicinal marijuana was only recently legalized and recreational marijuana remains illegal. As such, examining reasons for marijuana-tobacco co-use in states that have legalized recreational marijuana would expand the literature. In addition, we found that Instrumentality, Displacement, and Social context were associated with nicotine dependence and frequency of marijuana use, highlighting the need to address these phenomena in marijuana-tobacco co-use prevention and intervention strategies. It is important to further understand quit attempts, barriers, and unmet needs to cessation service provision for marijuana-tobacco co-users. Moreover, anti-smoking campaigns have traditionally focused on messaging targeted to cigarette smokers, but young adults use a variety of alternative products as well as co-use tobacco and marijuana (Berg et al., 2016; Haardörfer et al., 2016; Ramo, Delucchi, Hall, Liu, & Prochaska, 2013; Ramo & Prochaska, 2012; Schauer et al., 2015), indicating the high need to expand our prevention and cessation messaging strategies. Finally, further examination of the biological mechanisms that might play a role in co-use and difficulty with cessation is critical in addressing this growing public health issue.

Limitations

The following limitations should be considered when interpreting results from this study. First, findings from this sample of marijuana and tobacco co-users in Georgia aged 18 to 25 years are not intended to be generalizable but rather to inform future generalizable studies (Hennink, Hutter, & Bailey, 2011). Second, our scope of scale items may not be inclusive of all potentially important reasons for co-use; however, the items developed and included here were drawn from the literature related to co-use in this population and from our qualitative findings. The Experimentation subscale also demonstrated low internal consistency. However, given the nature of young adult substance use and rapidly changing patterns of use over time (Berg, Romero, & Pulvers, 2015; Haardörfer et al., 2016), we felt that retaining this scale despite challenges with internal consistency was justified. Additional research can build on current findings to determine if additional or revised items might demonstrate

stronger internal consistency. Additionally, the cross-sectional design does not allow us to draw causal attributions or determine intra-individual trajectories of substance use over time. These analyses are also limited by the self-report nature of the assessments. Finally, whether or not participants were aware of the substance use of others (e.g., parents or friends) is a limitation of the data.

Conclusions

Findings from the current study can be used to inform future research aimed at further expanding on or replicating the validity of this tool for assessing reasons for marijuana-tobacco co-use. Furthermore, these mixed-methods findings might inform sociocontextual theoretical frameworks regarding how and why marijuana-tobacco co-use occurs.

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Figure 1.

Participant flowchart. Note: The Study 2 N of 328 included those reporting past 4-month use of marijuana and at least one tobacco product and also had complete data regarding reasons for marijuana-tobacco co-use.

Table 1

Sociodemographic and substance use characteristics of semi-structured interview participants (Study 1) and scale development participants (Study 2).

Variable	Study 1: Qualitative Interviews			Study 2: Scale Development
	Current & Lifetime Users N = 46 M (SD) or N (%)	Current Users N = 26 M (SD) or N (%)	Lifetime Users N = 20 M (SD) or N (%)	N = 328 M (SD) or N (%)
Age (SD)	21.0 (2.1)	20.9 (2.0)	21.1 (2.2)	20.5 (1.8)
Sex (%)				
Female	26 (56.5)	16 (61.5)	10 (50.0)	177 (59.2)
Male	19 (41.3)	10 (38.5)	9 (45.0)	122 (40.8)
Race (%)				
Black	16 (34.8)	9 (34.6)	7 (35.0)	82 (27.4)
White	30 (65.2)	17 (65.4)	13 (65.0)	174 (58.2)
Other	0 (0.0)	0 (0.0)	0 (0.0)	43 (14.4)
Hispanic (%)	0 (0.0)	0 (0.0)	0 (0.0)	30 (10.0)
School Type (%)				
Public university	12 (26.0)	7 (26.9)	5 (25.0)	80 (26.8)
Private college/university	10 (21.7)	6 (23.1)	4 (20.0)	128 (42.8)
HBCU	6 (13)	5 (19.2)	1 (5.0)	49 (16.4)
Technical college	18 (39.1)	8 (30.8)	10 (50.0)	42 (14.0)
Residence Type (%)				
University-affiliated housing	10 (21.7)	7 (26.9)	3 (15.0)	106 (35.5)
Other	36 (78.3)	19 (73.0)	17 (85.0)	222 (64.5)
Past 30-day Substance Use (%)				
Cigarettes	27 (58.6)	17 (65.4)	10 (50.0)	111 (37.1)
LCCs	23 (50.0)	15 (57.7)	8 (40.0)	91 (30.4)
Smokeless tobacco	11 (23.9)	5 (19.2)	6 (30.0)	28 (9.4)
E-cigarettes	23 (50.0)	10 (38.5)	13 (65.0)	71 (23.7)
Hookah	20 (43.5)	12 (46.2)	8 (40.0)	91 (30.4)
Marijuana	26 (56.5)	26 (100.0)	0 (0.0)	229 (76.6)
Alcohol, number of days (SD)	8.0 (7.9)	7.9 (7.1)	8.2 (9.3)	7.3 (6.9)
Most Common Mode of Marijuana Use (%)				
Smoked in a joint	—	—	—	74 (24.7)
Smoked in a bowl	—	—	—	99 (33.1)
Smoked in a waterpipe without tobacco	—	—	—	27 (9.0)
Smoked in a waterpipe with tobacco	—	—	—	3 (1.0)
Vaporized it without tobacco	—	—	—	15 (5.0)
Vaporized it with tobacco	—	—	—	0 (0.0)
Rolled in cigar/cigarette papers without tobacco	—	—	—	57 (19.1)
Rolled in cigar/cigarette papers with tobacco	—	—	—	10 (3.3)
Digested with or without food	—	—	—	4 (1.3)

Variable	Study 1: Qualitative Interviews			Study 2: Scale Development
	Current & Lifetime Users N = 46 M (SD) or N (%)	Current Users N = 26 M (SD) or N (%)	Lifetime Users N = 20 M (SD) or N (%)	N = 328 M (SD) or N (%)
Drank it	—	—	—	2 (0.7)

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Table 2

Themes and sample responses regarding reasons for marijuana-tobacco co-use among young adult co-users participating in semi-structured interviews (Study 1).

Theme	Sample quote
<i>Cigarettes</i>	
Cigarettes enhance effect of marijuana	Once I came to college, they told me that if you smoke a cigarette after you smoke weed it makes you higher, so I started smoking cigarettes, and I haven't been able to quit them since. – <i>White female, current marijuana user</i> Smoking a cigarette after weed definitely makes you a lot higher because you get the nicotine high as well. All of my friends started smoking cigarettes to enhance the effect of weed. That's how they all started. – <i>White female, current marijuana user</i> I think if you smoke weed and then smoke a cigarette, the cigarette it feels like enhances the high from the weed. – <i>White female, current marijuana user</i> I was at a party, a small party with my friends, and we were all smoking weed and drinking, and they just told me, 'try this - it'll make you higher.' I tried a little bit. It felt like a really nice mixture with the marijuana, so it used to be that I would only smoke cigarettes if I was only smoking weed. Just for the effect of it, and then now that I stopped smoking weed, I still can't get rid of the cigarettes. – <i>White female, current marijuana user</i>
Marijuana enhances the effects of cigarettes	After using [marijuana], you feel euphoric, so using tobacco while you feel euphoric would make that tobacco better than in general if you weren't feeling euphoric already. – <i>White male, lifetime marijuana user</i> That's probably a little bit more enjoyable, the cigarette is more enjoyable, yeah. – <i>White male, current marijuana user</i>
No synergistic effect	I don't feel that they have any effect on each other, not in my case. – <i>White female, current marijuana user</i> Some people say that it does if they smoke marijuana and then they smoke cigarettes that it kind of enhances it, it makes them feel a little bit more buzzed, but I haven't noticed anything personally. – <i>White male, lifetime marijuana user</i>
Marijuana triggers cigarette use	It kind of triggers the desire to smoke a cigarette and my electronic cigarette, but I'm not sure if it would ever do that if I never started smoking marijuana, picked it up in the first place. It's kind of just I associate one with the other. – <i>White female, current marijuana user</i>
Cigarettes displace marijuana	We're always hiding because it's illegal, and then we always had cigarettes on us in case. – <i>White female, current marijuana user</i>
Cigarettes taste better than marijuana	I don't like marijuana. I don't like the taste of it. I would always smoke a cigarette right after to get rid of the taste. – <i>White female, lifetime marijuana user</i>
Social context for using cigarettes and marijuana	No one in my life really smoked alone, so the social part really has a lot to do with it. – <i>White male, current marijuana user</i>
<i>Little cigars and cigarillos (LCCs)</i>	
Papers used to roll marijuana	I use them to roll the marijuana with, just take the tobacco out and then put the marijuana in it and just roll it back up. – <i>Black female, current marijuana user</i> Honestly in my opinion that's the only reason people buy [little cigars and cigarillos]. – <i>White male, current marijuana user</i>
LCCs enhance effect of marijuana	I used marijuana to relax myself, and if I felt as though it wasn't working, I used to always go smoke a Black behind it to make sure that I get the effect. – <i>Black female, current marijuana user</i>
Social context of using LCCs and marijuana	Usually marijuana is only done social with a couple of friends here and there. But that's usually at somebody's house. It's not in public. It's not at a bar. It's nothing like that. Our marijuana strictly stays where we are at a friends' house, and that's usually with game nights or having a little party get together kind of thing or sitting by the bonfire. – <i>White female, current marijuana user</i>
Experimentation	I started using it out of curiosity because I had heard so much about like the experience and stuff like that and decided to try it. That's how I learned [by using LCC papers]. – <i>African American male, lifetime marijuana user</i>
<i>E-cigarettes</i>	
Marijuana triggers e-cigarette use	I associate one with the other because I would smoke a cigarette after I finished smoking marijuana or now I will smoke my electronic cigarette. – <i>White female, current marijuana user</i>
E-cigarettes displace marijuana	I feel the e-cigarette will kind of help me to keep from smoking marijuana again, because I'm still going to have that urge to smoke something. – <i>Black female, lifetime marijuana user</i>
<i>Smokeless</i>	

Theme	Sample quote
Smokeless has no effect on marijuana use	I don't think the marijuana had anything to do with me using chew. I think it was just because I use smokeless tobacco every day, and it was just kind of like another day. – <i>White male, current marijuana user</i>
<i>Hookah</i>	
Hookah enhances effect of marijuana	Well, I hear the hookah helps the marijuana high, makes it better or something, so I've heard a couple people who smoke hookah after they smoke marijuana. – <i>Black male, current marijuana user</i>
Social context of using hookah and marijuana	I would say not every time a party happens or a celebration, but I would say all of them have been used in a celebration in the past. – <i>White male, current marijuana user</i> The social setting has everything to do with it. – <i>White male, current marijuana user</i>

Table 3

Marijuana-Tobacco Co-use Scale items and factor loadings (Study 2).

Factors and Items	1	2	3	4
<i>Instrumentality:</i>				
Using marijuana increases the buzz I get from tobacco.	.94	– .04	– .08	.04
Using tobacco increases the buzz I get from marijuana.	.90	– .08	.07	– .14
I use tobacco when I can't use marijuana.	.56	.27	.14	– .04
<i>Displacement:</i>				
I use marijuana when I can't use tobacco.	– .06	.82	.02	– .01
I've tried to reduce my use of tobacco by replacing it with marijuana.	– .07	.81	.18	– .05
I've tried to reduce my use of marijuana by replacing it with tobacco.	.32	.61	– .11	.23
<i>Social Context:</i>				
I use marijuana or tobacco in different places (home, school, work, bars, parties).	– .05	.16	.88	– .05
I use marijuana or tobacco around different people (friends, peers at school, family).	.09	– .02	.84	– .06
<i>Experimentation:</i>				
I like to experiment with different products but do not use any regularly.	.07	.08	– .15	.84
I don't use marijuana and tobacco in any sort of sequence.	– .20	.10	.06	.72
The use of one product had nothing to do with the use of the other.	.05	– .38	.32	.50

Note: Extraction Method: Principal Component. Rotation Method: Promax with Kaiser Normalization. Rotation converged in 6 iterations.

Cronbach's $\alpha = .75$; Subscale Cronbach's α : Instrumentality: .81; Displacement: .72; Sociocontextual: .80; Experimentation: .55.

Average subscale scores: Instrumentality 1.90 (SD = 1.32); Displacement 1.48 (SD = 0.93); Social Context 2.57 (SD = 1.65); and Experimentation 3.63 (SD = 1.20).

Table 4

Correlations among Reasons for Marijuana-Tobacco Co-use subscales and related factors (Study 2).

Variable	Instrumentality	Displacement	Social Context	Experimentation
<i>Reasons for Marijuana-Tobacco Co-use</i>				
Instrumentality	—	.56***	.32***	-.10
Displacement		—	.37***	-.07
Social Context			—	.22***
Experimentation				—
<i>Types of Tobacco Used</i>				
Cigarettes [‡]	.12*	.06	.06	-.16**
LCCs [‡]	.25***	.24***	.07	-.17**
Smokeless tobacco [‡]	.04	-.02	.01	-.09
E-cigarettes [‡]	.03	.02	.06	-.05
Hookah [‡]	.16**	.28***	.11	-.10
Nicotine Dependence ^a	.31***	.18**	.14*	-.19**
Marijuana Use, Number of Past 30 Days	.28***	.24***	.20***	-.16**
<i>Tobacco Use Motives^b</i>				
Social	.30***	.19**	.21***	-.05
Self-enhancement	.32***	.27***	.21***	-.05
Boredom	.35***	.20**	.12*	-.10
Affect regulation	.45***	.29***	.17**	-.06
<i>Marijuana Use Motives^c</i>				
Social motives	.11*	.18**	.02	-.06
Enhancement	.11*	.14*	.07	-.01
Coping	.14*	.20**	.05	-.05
Conformity	.07	.20**	.01	-.05
Expansion	.16**	.19***	.02	-.08
<i>Attitudinal Factors</i>				
Addictiveness of tobacco	.01	-.19***	-.02	.17**
Harmfulness of tobacco	-.05	-.04	.05	.14*
Social acceptability of tobacco	.02	.01	.12*	.04
Addictiveness of marijuana	.05	.02	.03	-.16**
Harmfulness of marijuana	-.10	-.05	-.05	-.04
Social acceptability of marijuana	.16**	.13*	.08	.08
<i>Social Factors</i>				
Parental use of tobacco [‡]	.14*	.06	.01	-.09
Friend use of tobacco [‡]	.04	.01	.03	-.03

Variable	Instrumentality	Displacement	Social Context	Experimentation
Parental use of marijuana [†]	.26 ***	.15 *	.04	.01
Friend use of marijuana [†]	.20 ***	.13 *	.16 **	.05
<i>Substance Use & Mental Health</i>				
Number of days of alcohol use, past 30 days	– .01	– .02	.11 *	.11 *
Depressive symptoms ^d	.02	.06	– .02	– .08

[†]Point biserial correlations; all others are Pearson correlations.

Note:

*
 $p < .05$;

**
 $p < .01$;

 $p < .001$.

^aPer the Hooked on Nicotine Checklist

^bPer the Tobacco Use Motives Scale;

^cPer the Marijuana Use Motives Scale;

^dPer PHQ-9. Abbreviations: HBCU = Historically Black College or University; LCC = little cigars or cigarillos.

Table 5

Reasons for Marijuana-Tobacco Co-use subscales in relation to HONC scores and days of marijuana use (Study 2).

Variable	HONC Scores		Days of Marijuana Use	
	OR (CI)	<i>p</i>	OR (CI)	<i>p</i>
Step 1				
<i>Attitudinal Factors</i>				
Addictiveness of tobacco/marijuana	0.17 (−0.01, 0.34)	.06	0.00 (−0.03, 0.02)	.73
Harmfulness of tobacco/marijuana	− 0.16 (−0.39, 0.07)	.17	0.00 (−0.03, 0.03)	.98
Social acceptability of tobacco	0.04 (−0.15, 0.23)	.71	0.04 (0.02, 0.07)	.003
<i>Social Factors</i>				
Parental use of tobacco/marijuana	0.49 (−0.18, 1.16)	.15	0.06 (−0.10, 0.21)	.46
Friend use of tobacco/marijuana	0.12 (−0.91, 1.15)	.81	0.00 (−0.17, 0.17)	.98
<i>Substance Use & Mental Health</i>				
Days of alcohol use, past 30 days	0.01 (−0.04, 0.05)	.83	0.01 (0.00, 0.01)	.11
Depressive symptoms	− 0.01 (−0.01, 0.01)	.82	0.00 (0.00, 0.01)	.17
Step 2				
<i>Tobacco Use Motives</i>				
Social	− 0.08 (−0.21, 0.04)	.19	—	—
Self-enhancement	0.02 (−0.14, 0.18)	.82	—	—
Boredom	0.31 (0.13, 0.49)	.001	—	—
Affect regulation	0.14 (0.05, 0.23)	.003	—	—
<i>Marijuana Use Motives</i>				
Social motives	—	—	0.01 (−0.01, 0.03)	.20
Enhancement	—	—	0.01 (0.00, 0.02)	.14
Coping	—	—	− 0.03 (−0.05, −0.01)	.01
Conformity	—	—	0.00 (−0.01, 0.01)	.94
Expansion	—	—	0.00 (−0.01, 0.01)	.49
Step 3				
<i>Reasons for Marijuana-Tobacco Co-use</i>				
Instrumentality	0.17 (−0.13, 0.48)	.26	0.05 (0.00, 0.09)	.05
Displacement	0.03 (−0.40, 0.44)	.90	− 0.02 (−0.08, 0.04)	.55
Social Context	0.19 (−0.02, 0.41)	.07	0.05 (0.02, 0.09)	.002
Experimentation	− 0.56 (−0.83, −0.28)	<.001	− 0.05 (−0.09, −0.01)	.02

Note: Controlling for age, sex, race/ethnicity, and school type.

Tobacco: Adjusted R-squareds for Steps 1, 2, and 3: 0.063 ($p = .002$), 0.264 ($p < .001$), and 0.306 ($p < .001$), respectively.

Marijuana: Adjusted R-squareds for Steps 1, 2, and 3: 0.040 ($p = .02$), 0.042 ($p = .35$), and 0.104 ($p < .001$), respectively.