

ABSTRACT

Title of dissertation: CO-OCCURRING TOBACCO AND MARIJUANA USE
AMONG YOUNG ADULTS: A SEQUENTIAL
EXPLANATORY MIXED METHODS STUDY

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Tobacco use is the greatest cause of preventable death in the United States and an important health behavior to study among young adults. Prior research has suggested that there is an association between tobacco and marijuana use. Studying these two substances together can provide important insight into patterns of young adult tobacco and marijuana initiation and continuation. This dissertation employed a Sequential Explanatory Mixed Methods design to study tobacco and marijuana co-use among young adults 21-30 years old.

Quantitative data analyses used National Health and Nutrition Examination Survey (NHANES) data to assess prevalence of cigarette and marijuana co-use (Aim 1), and characteristics of co-users (Aim 2) over a 10-year period (2005-2014). Prevalence of past-month cigarette use decreased from 30.9% in 2005-2006 to 23.7% in 2013-2014 ($p = 0.024$) while both past-month marijuana use (average 18.0%) and past-month co-use (average 9.8%) remained stable between 2005 and 2014. Prevalence of past-month co-

use differed significantly by gender ($p < 0.001$) and racial and ethnic group ($p < 0.001$). Education level, marital status, race and ethnicity, ratio of income to the poverty level, depressive symptoms, non-marijuana illicit drug use, alcohol use, and household tobacco exposure differentiated co-users from neither users in a multinomial regression.

Results from analyses of NHANES data, prior literature, and theoretical constructs were used to develop a guide for 20 in-depth interviews with young adult co-users living in the state of Maryland (Aim 3). Interviewees reported two modes of co-use: simultaneous and sequential. Participants reporting using tobacco as a replacement for marijuana in situations where they cannot access or use marijuana, suggesting the two products play similar yet distinct roles in co-use. Influences across levels of the Social Ecological Model were salient in young adults' co-use. Quantitative results and qualitative findings were interpreted together, and five mixed methods meta-inferences emerged as important in understanding co-use.

The co-use of tobacco and marijuana is an important behavioral phenomenon to study among young adults. Tobacco and marijuana co-users have unique characteristics compared to tobacco-only and marijuana-only users. Qualitatively, co-users described patterns of product use and replacement that illustrate the complexity of co-use behaviors.

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A SEQUENTIAL EXPLANATORY MIXED METHODS STUDY

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DEDICATION

This dissertation is dedicated to my incredible family.

To my wonderful parents –Marguerite and Kevin Seaman– thank you for encouraging my love of learning and for your constant love and support for the past (almost) three decades. Thank you for showing me the importance of education (both formal and informal) and for helping shape the way I think about and interact with the world. Words cannot describe my gratitude and love!

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"Education consists mainly in what we have unlearned." - Mark Twain

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TABLE OF CONTENTS

DEDICATION.....	ii
ACKNOWLEDGEMENTS.....	iii
TABLE OF CONTENTS	v
LIST OF TABLES AND FIGURES.....	xi
CHAPTER 1: INTRODUCTION	1
a. Background	1
b. Problem Statement	2
c. Conceptual Framework.....	5
d. Research Question, Specific Aims & Hypotheses	10
e. Brief Justification or Rationale	10
f. Dissertation Organization.....	11
g. Definitions of Variables and Terms	12
CHAPTER 2: LITERATURE REVIEW	15
a. Prevalence of Tobacco, Marijuana, and Tobacco and Marijuana Co-use among Young Adults.....	15
b. Changing Marijuana Legislation in the United States.....	16
c. Tobacco Advertising and Flavored Products.....	18
d. Little Cigars and Cigarillos (LCCs), Cigars, and Marijuana Use	20
e. Negative Health Effects of Tobacco and Marijuana	21
i. Health Consequences of Tobacco Use	21
ii. Health Consequences of Marijuana Use.....	23
iii. Compounded Health Effects of Co-use.....	25
f. Potential Mechanisms for Tobacco and Marijuana Co-Use.....	26
g. Young Adults: A Particularly Vulnerable Group.....	29
i. Definitions of Young Adulthood	29
ii. Young Adult Risk Perceptions towards Tobacco and Marijuana.....	30
iii. A Vulnerable Populations Approach.....	31
iv. Tobacco-Related Health Disparities.....	33
h. Current Research on Tobacco and Marijuana Co-Use	34
i. Gender, Sex, and Co-use	34
ii. Employment, Marital Status, and Co-use.....	35
iii. Race, Ethnicity, and Co-use.....	35
iv. Depression and Co-use	36
v. Other Substances and Co-use.....	37
vi. Nicotine Dependence and Co-use	37
i. The National Health and Nutrition Examination Survey	37
CHAPTER 3: Study 1, Examining Prevalence and Predictors of Cigarette and Marijuana Co-Use among Young Adults Using NHANES, 2005-2014	39
a. Introduction.....	39
i. Cigarette and Marijuana Co-Use.....	39
ii. Risk Factors for Co-Use	41
b. Materials and Methods	43
i. The National Health and Nutrition Examination Survey (NHANES) Dataset and Study Population	43

ii. Past-Month Cigarette Use, Past-Month Marijuana Use, and Past Month Co-Use	43
iii. Risk Factors	44
iv. Statistical Analyses	45
c. Results	46
i. Prevalence of Past-Month Cigarette, Marijuana, and Co-Use 2005-2014	46
ii. Associations between Demographic Factors and Co-Use	47
iii. Multinomial Logistic Regression Models	48
iv. Binary Logistic Regression: Past-Month Cigarette-Only vs Co-Use	48
v. Binary Logistic Regression: Past-Month Marijuana-Only vs Co-Use	49
d. Discussion	49
i. Co-Use	49
ii. Strengths and Limitations	52
e. Conclusions	54
CHAPTER 4: Study 2, “If I had more marijuana, I would smoke no tobacco”: Co-Use and Tobacco as a Replacement for Marijuana among Young Adults	64
a. Introduction	64
i. Tobacco and Marijuana Use among Young Adults	64
ii. Theoretical Model	65
b. Methods	67
i. Interview Guide Development	67
ii. Recruitment	67
iii. Interviews	68
iv. Qualitative Coding and Analysis	69
c. Results	69
i. Sample Description	69
ii. Simultaneous and Sequential Co-Use	70
iii. Using Tobacco to Replace Marijuana	70
iv. Individual-Level Influences on Co-Use: Preferences for Blunt Use and Personal Finances	72
v. Interpersonal-Level Influences on Co-Use: Peer Influences	73
vi. Organizational-Level Influences on Co-Use: Drug Tests	74
vii. Community-Level Influences on Co-Use: Physical Environments	75
viii. Policy-Level Influences on Co-Use: Marijuana Policy and Availability	76
d. Discussion	78
e. Conclusions	83
CHAPTER 5: Study 3, A Sequential Explanatory Mixed Methods Study of Young Adult Tobacco and Marijuana Co-Use	91
a. Introduction	91
i. Tobacco and Marijuana Co-Use	91
ii. Health Effects of Co-Use	92
iii. Quantitative, Qualitative and Mixed Methods Research on Co-Use	93
b. Methods	95
i. Defining Co-Use	96
ii. Quantitative Methods: Analysis of NHANES data	96
iii. Qualitative Methods: Semi-Structured In-Depth Interviews	98
iv. Mixed Methods: Integration and Interpretation	100

c. Results.....	101
i. Initiation Experiences of Co-Users and Progression to Regular Use.....	101
ii. Age	103
iii. Gender	104
iv. Employment and School Influences	105
v. Depressive Symptoms	108
vi. Household Exposure.....	109
vii. Alcohol Use	110
viii. Tobacco-Specific Factors	111
ix. Marijuana-Specific Factors.....	113
d. Discussion.....	114
i. <i>Meta-inferences</i>	116
ii. Strengths and Limitations	119
e. Conclusions	121
CHAPTER 6: SUMMARY	130
a. Overview	130
b. Implications for Prevention and Public Health Practice.....	131
c. Strengths	134
d. Limitations.....	135
e. Directions for Future Research	136
APPENDICES	137
Appendix A: Methods	138
Appendix B: Variables from NHANES	147
Appendix C: IRB Initial Application	154
Appendix D: IRB Application: Amendment 1	187
Appendix E: IRB Application: Amendment 2.....	196
Appendix F: IRB Application: Amendment 3.....	206
Appendix G: In-Depth Interview Codebook	211
REFERENCES	215

LIST OF TABLES AND FIGURES

Figure 1.1 Conceptual Framework	9
Figure 1.2 Mixed Methods Study Design	11
Table 3.1 Sample Demographics by Past-Month Smoking Status Across 3 Waves of Weighted NHANES Data (N=124,039,350)	55
Table 3.2 Adjusted Multinomial Logistic Regression Models.....	57
Table 3.3 Adjusted Binary Logistic Regression Predicting Co-Use vs Past-Month Cigarette-Only Use	58
Table 3.4 Adjusted Binary Logistic Regression Predicting Co-Use vs Marijuana-Only Use	59
Figure 3.1 Prevalence of Past Month Cigarette, Marijuana and Cigarette and Marijuana Co-Use among Young Adults 21-30, 2005-2014	60
Figure 3.2 Prevalence of Past Month Cigarette and Marijuana Co-Use among Young Adults 21-30, by Gender 2005-2014.....	61
Figure 3.3 Prevalence of Past Month Cigarette and Marijuana Co-Use among Young Adults 21-30, by Race and Ethnicity 2005-2014.....	62
Figure 3.4 Prevalence of Past Month Cigarette and Marijuana Co-Use among Young Adults 21-30, by Age (21-25 vs 26-30) 2005-2014.....	63
Figure 4.1 Study Theoretical Model	84
Figure 4.2 Study Recruitment.....	85
Table 4.1 Participant Characteristics and Product Use	86
Table 4.2 Overview of Findings and Relations to Theoretical Model.....	88
Table 5.1 Interview Respondent Characteristics	123
Table 5.2 Mixed Methods Findings Joint Display.....	125

CHAPTER 1: INTRODUCTION

a. Background

Tobacco is the leading cause of preventable death in America today and is a priority health behavior to study (Centers for Disease Control and Prevention, 2016c). Young adults are an important group for public health practitioners to study and intervene with; helping young people not initiate tobacco use and helping those who already smoke to quit early can help lead to reductions in the negative health impacts of tobacco. Prior work has demonstrated that young adults and adolescents are particularly susceptible to nicotine addiction (Campaign for Tobacco-Free Kids, 2015; DiFranza et al., 2007); 99% of adult smokers begin smoking by age 26 and many continue to smoke for all or most of their adult lives (Centers for Disease Control and Prevention, 2016c; U.S. Department of Health and Human Services., 2012).

Advances in public health and specific health education campaigns have contributed to declining tobacco smoking prevalence in the past decade, particularly among young adults (Nekvasil & Liu, 2015). In the past decade alone, the prevalence of young adults who smoke cigarettes has dropped 12 percentage points to 22%, meeting the prevalence of adults 30 to 49 years old, 23% (Nekvasil & Liu, 2015). As young adult cigarette use has decreased, marijuana use has increased in this same age group (Martins et al., 2016; Salas-Wright, Vaughn, Todiceanu, Córdova, & Perron, 2015). Concurrently, the rate of marijuana disapproval has significantly decreased among young adults in the US (Salas-Wright et al., 2015) while the perceived availability of marijuana has increased (Martins et al., 2016). With legal recreational marijuana in several US states, increased

availability of medicinal marijuana, and marijuana decriminalization in different states, it is clear that young adults' perceptions of marijuana, ability to access marijuana, and marijuana use are changing rapidly.

Tobacco and marijuana co-users represent a significant number of young people who use tobacco; past studies have found that nearly half of young adults who report using marijuana or tobacco are using both tobacco and marijuana, indicating only about half of young adult smokers only use one product (Ramo, Delucchi, Liu, Hall, & Prochaska, 2014; Ramo, Liu, & Prochaska, 2012; Ramo & Prochaska, 2012). Some groups of young adults, particularly African Americans, may have an increased risk for co-use of both tobacco and marijuana products (Montgomery, 2015). Studying the combined use of tobacco and marijuana among young adults can offer unique insight into the recent trends in decreasing cigarette use and increasing marijuana use among this age group and could help inform public health education and cessation efforts for this group of young people who may be most at-risk due to their dual exposures. Taken together, these points illustrate the critical importance of tobacco and marijuana co-use research and understanding the initiation patterns, predictors, and correlates of this phenomenon, particularly with young adults.

b. Problem Statement

Young adult tobacco smoking is a major public health issue with far-reaching implications. There are a number of negative health outcomes associated with tobacco smoking including the development of lung cancer as well as stroke and coronary heart disease (Centers for Disease Control and Prevention, 2016c). Cigarette smoking has been shown to significantly reduce life expectancy and damage most organs in the body

(Centers for Disease Control and Prevention, 2016c; U.S. Department of Health and Human Services, 2014). Many young adults who begin smoking feel that they will be able to quit smoking before they experience any negative health risks, but the compound damage from decades of smoking can have serious health consequences. Preventing young people from beginning to smoke tobacco and helping young people who do smoke to quit early can have a positive impact on health at the individual and population-level.

More thorough research on the potential health effects of marijuana is still needed, however preliminary data from the past two decades indicates that marijuana use increases the likelihood of other drug use for young adults, even when accounting for a number of covariates (Hall, 2015). About one in ten people who begin using marijuana will develop a dependence disorder and marijuana has been linked to increased risk of developing cardiovascular disease (Hall, 2015). Marijuana has been associated with an increased risk of lung cancer, and a number of other long-term negative respiratory effects like emphysema and COPD (Martinasek, McGrogan, & Maysonet, 2016). Marijuana use has also been associated with shorter-term respiratory effects like wheezing and shortness of breath (Martinasek et al., 2016). Due to marijuana's status as a federally illegal drug, most studies that have assessed the health risks of marijuana in humans are retrospective and associative, so findings are limited. Additionally, there are few studies that examine the long-term health effects of marijuana use. Despite the preliminary evidence that there are negative health consequences associated with marijuana use, research suggests that young adults hold low risk perceptions of marijuana (White, 2015), and are likely to think marijuana is less harmful than tobacco (Kilmer,

Hunt, Lee, & Neighbors, 2007). Among young adults, those who use marijuana are more likely to report lower risk perceptions of marijuana than non-users (Kilmer et al., 2007).

With the decriminalization of marijuana and legalization of recreational and medicinal marijuana in several US states, young adults have not received clear public health messaging regarding the health risks of marijuana use. This lack of education may impact their decisions to use marijuana and the intensity and frequency of their use. There is little causal research on the potential long-term, deleterious health effects from compounded tobacco and marijuana use. However with increasing rates of marijuana use and changing marijuana policies across America, as well as indications that nearly half of young adult smokers are smoking both tobacco and marijuana, it is necessary for future work to explore the health effects from tobacco and marijuana co-use (Ramo, Delucchi, Liu, Hall, & Prochaska, 2014; Ramo, Liu, & Prochaska, 2012; Ramo & Prochaska, 2012).

This dissertation quantitatively and qualitatively explored prevalence of and characteristics associated with tobacco and marijuana co-use among young adults aged 21-30 in order to better understand what is unique about use of both products and the factors that shape co- use among young people. Quantitative data analyses used NHANES data to assess changes in prevalence of co-use and predictors of co-use over a 10-year period (2005-2014).

Results from analysis of NHANES data, a review of the literature and theoretical constructs were used to develop an interview guide to shape qualitative data collection, through in-depth interviews, with young adult tobacco and marijuana co-users who live in the state of Maryland. Recreational marijuana is illegal in the state of Maryland and

medicinal marijuana became available to patients beginning December 1, 2017, during the interview study period (“Maryland Medical Cannabis Commission,” 2018). Results from the quantitative and qualitative phases of this dissertation were interpreted together; qualitative findings help explore and explain quantitative findings. Together, the two phases of this dissertation helped to elucidate the complex, multifaceted phenomena of young adult cigarette and marijuana co-use.

c. Conceptual Framework

This dissertation used one health behavior model, the Social Ecological Model, and constructs from two health behavior theories at different levels, the Theory of Reasoned Action at the individual level and Social Cognitive Theory at the interpersonal level. Very little work with young adult tobacco and marijuana co-use has used health behavior theory, which is a major limitation of the current literature. The qualitative aim of this study sought to investigate the ways that theoretical constructs influence the initiation and continuation of tobacco and marijuana co-use among young adults.

This study was framed within the larger Social Ecological Model, which describes the interplay between various levels of influence for a given health behavior including individual, interpersonal, organizational, community and policy (Bronfenbrenner & Morris, 2007). This model is rooted in studies of human development and was first developed by Urie Bronfenbrenner in the 1970s and underwent major revisions until 2005 (Bronfenbrenner & Morris, 2007). The Social Ecological Model has been used in many prior studies of tobacco use (Fuemmeler et al., 2013; Klein, Bernat, Lenk, & Forster, 2013) and marijuana use (Connell, Gilreath, Aklin, & Brex, 2010) among adolescents and young adults. The multiple levels of influence that shape young adults’

decisions to use both tobacco and marijuana were explored in the qualitative phase of this dissertation. Several individual-level factors including sociodemographic characteristics, depression status and other substance use behaviors were assessed for associations with co-use in quantitative data analysis. Additionally, exposure to household smoking, an interpersonal factor, was explored in the quantitative phase of this dissertation. At the interpersonal level, participants were asked about their friends' use and the social contexts of co-use in the in-depth interviews. Participants were also asked if their friends use tobacco and marijuana. Social contexts of co-use included the situations and settings in which young people report co-use. At the organizational level, participants were asked about how their current occupational status, through a job or enrollment in school, influenced their co-use in the in-depth interviews. At the community level, influences of the physical and social environments were explored in the in-depth interviews. Finally, attitudes towards changing marijuana legislation and perceptions of harm were assessed in the in-depth interviews to address the policy level.

The Theory of Reasoned Action is an individual-level theory that postulates that changing behavioral intention is an effective way to change behavior (Fishbein & Ajzen, 1975). The Theory of Reasoned Action was developed by Martin Fishbein and Icek Ajzen in 1967 (Fishbein & Ajzen, 1975). Theory of Reasoned Action includes the major constructs of Attitudes (comprised of behavioral beliefs and evaluation outcomes) and Subjective Norms (based on normative beliefs and motivation to comply) (Fishbein & Ajzen, 1975). In the Theory of Reasoned Action, Attitudes, and Subjective Norms influence intentions, which are the strongest predictor of behavior (Fishbein & Ajzen, 1975). The Theory of Reasoned Action Behavior is often used for studies of substance

use, including tobacco (Karimy, Niknami, Heidarnia, Hajizadeh, & Montazeri, 2013; Macy, Middlestadt, Seo, Kolbe, & Jay, 2012; Stephens, Ogunsanya, Ford, Bamgbade, & Liang, 2015; Topa & Moriano, 2010), marijuana (Ito, Henry, Cordova, & Bryan, 2015) and the co-use of multiple substances (Kam, Matsunaga, Hecht, & Ndiaye, 2009).

Attitudes towards tobacco and marijuana as well as Subjective Norms were explored in the qualitative phase of the dissertation to gain a better understanding of the experiences of the young adults participating the in-depth interviews. Ajzen built on this theory by adding the construct of perceived behavioral control to develop the Theory of Planned Behavior in 1985 (Ajzen, 1985). For this dissertation, the Theory of Reasoned Action was selected instead of the later Theory of Planned Behavior because the construct of perceived behavioral control was not included in the present study.

Social Cognitive Theory is an interpersonal-level theory that was developed by Albert Bandura initially through his study of Social Learning. The theory was revised throughout the late 1960s and 1970s and was renamed “Social Cognitive Theory” in 1986 (Bandura, 1986). Social Cognitive Theory is based on the triad of reciprocal determinism, which asserts that the person, behavior, and environment all influence each other simultaneously (Bandura, 1986). There are five main components of Social Cognitive Theory: Self-Regulation, Moral Disengagement, Psychological Determinants of Behavior, Environmental Determinants of Behavior and Observational Learning. Observational learning describes the process through which “a person watches the actions of another person and the reinforcements they receive,” (Bandura, 1986). Observational learning is more efficient than operant conditioning for learning complex behaviors because the learner can discover rules and rewards by watching a peer instead of using

trial and error (Bandura, 1986). Observational learning takes places through modelling. This dissertation assessed the role of observational learning in co-use in the in-depth interviews. Because prior research has shown that tobacco and marijuana use are social behaviors among young people (Ramo et al., 2012), it was hypothesized that this social component of learning behavior is a factor in tobacco and marijuana co-use. The following figure (*Figure 1.1*) shows the Conceptual Framework for this dissertation, including the relationship of the three study aims to the framework.

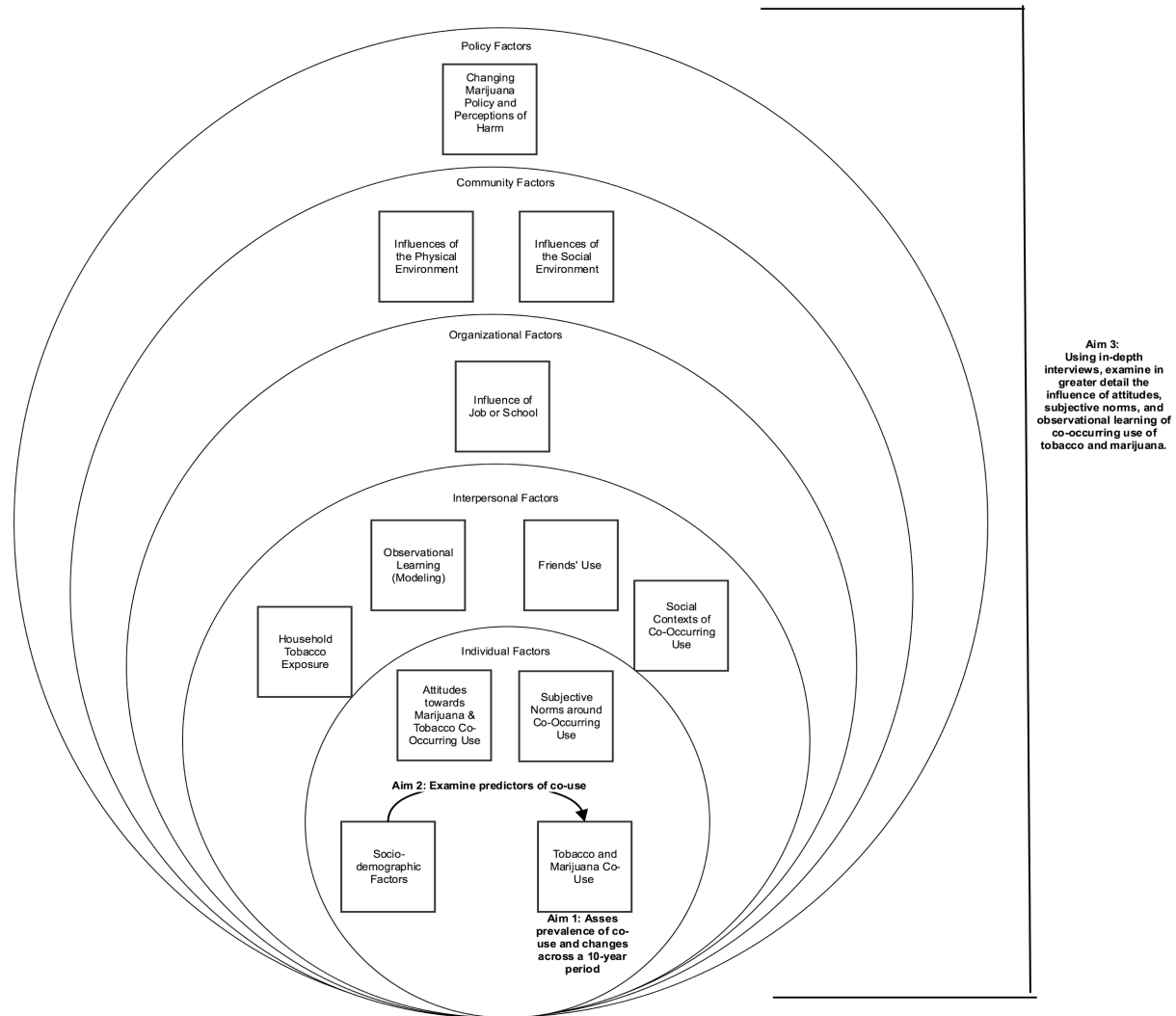


Figure 1.1 Conceptual Framework

d. Research Question, Specific Aims & Hypotheses

Research Questions: How has prevalence of past-month tobacco and marijuana co-use among young adults changed in a 10-year range (2005-2014) and what are the predictors of co-use? What are the experiences of young adults with co-use from their perspectives?

Aim 1: Assess past-month cigarette and marijuana co-use prevalence at 5 waves of NHANES data and changes across these waves over a 10-year period.

Hypothesis 1: Prevalence of past-month cigarette and marijuana co-use among young adults increase across all time points.

Aim 2: Explore predictors of past-month cigarette and marijuana co-use across three waves of NHANES data.

Hypothesis 2: A unique host of sociodemographic variables (gender, race, ethnicity, income, employment status), depression, and behavioral factors predict past month cigarettes and marijuana co-use compared to cigarette-only use, marijuana-only use, and neither marijuana nor tobacco use.

Aim 3: Using in-depth interviews, examine in greater detail the influence of attitudes, subjective norms, and observational learning on tobacco and marijuana co-use.

e. Brief Justification or Rationale

The mixed methods design of this dissertation (see *Figure 1.2*) allowed for rich data collection and analysis that provided a comprehensive picture of tobacco and marijuana co-use. Understanding predictors of tobacco and marijuana co-use and changes in national prevalence of co-use is an important step in assessing the landscape of tobacco and marijuana use among young adults. Additionally, qualitative work with

young adults helped explain quantitative findings and further understand contexts of co-use. Prior research has indicated that life experiences can influence marijuana use continuation or discontinuation (White, Beardslee, & Pardini, 2017) and the qualitative phase of this dissertation allowed for a deeper understanding of participants' experiences as they relate to tobacco use, marijuana use and co-use. Future work can build upon these findings to design effective education and cessation strategies for young people who are exposed to or who currently use both substances, which can improve health and reduce the risk of negative health effects from either substance or from their cumulative effect. This work was important to undertake now as more states are contemplating legislation that makes marijuana more accessible.

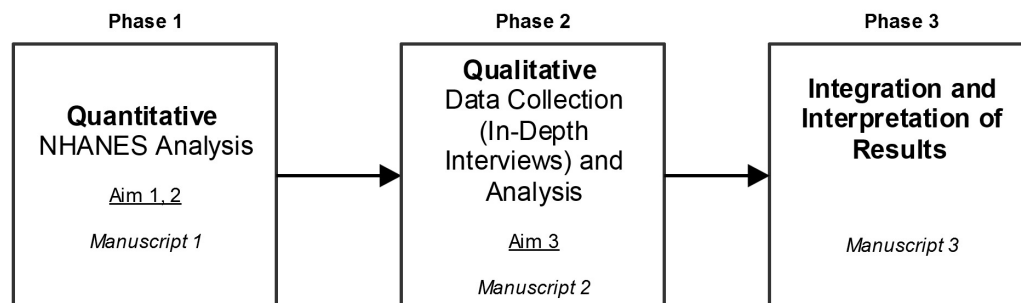


Figure 1.2 Mixed Methods Study Design

f. Dissertation Organization

This dissertation includes an Introduction (Chapter 1) and Literature Review (Chapter 2). This dissertation uses the “three paper option”; three manuscripts developed from this dissertation are presented as individual chapters: Chapter 3 (Study 1), Chapter 4 (Study 2) and Chapter 5 (Study 3). Finally, Chapter 6 includes a summary

of all three studies and a discussion of overarching strengths and limitations of this dissertation.

g. Definitions of Variables and Terms

Co-Occurring Use – Co-occurring use is broadly used in this dissertation to refer to use of both tobacco and marijuana in the past month. This may refer to using both substances at different times in the past month or using both products at the same time, either in one combined product or one directly after the other. Quantitative analyses did not distinguish between these different uses (“co-occurring use” or “co-use” are broadly used to refer to any use of both products in the past month) due to limitations of available data, whereas qualitative analyses collected information about different modes of co-occurring use including using both products at the same time (simultaneous) or at one directly after the other (sequential). Throughout this dissertation the phrase “co-use” has been used interchangeably with “co-occurring use.”

Gender – Gender refers to behavioral and lifestyle roles as well as identity, which contrasts with sex which is a biological classification of anatomy (Prince, 2005). NHANES includes a variable for Gender with responses only coded as “Male,” or “Female.” To authentically reflect the variables in the NHANES dataset, the term “Gender” has been used throughout this dissertation to describe this variable in the quantitative analyses. Recognizing that gender is a social construct, gender is not the same as sex, and that there are more genders than “Male,” and “Female,” however, qualitative data collection and analyses asked participants to self-report their gender identity in an open-ended question. Any findings from prior studies use the term (either

gender or sex) reported in the original publication to honestly and accurately portray empirical findings from past studies.

Marijuana - This dissertation uses the definition of marijuana designed by the National Institute on Drug Abuse, "a greenish-gray mixture of the dried, shredded leaves and flowers of *Cannabis sativa*—the hemp plant," (National Institute on Drug Abuse, 2016). Some users smoke marijuana in hand-rolled cigarettes called joints; many use pipes, water pipes (sometimes called bongs), or marijuana cigars called blunts (made by slicing open cigars and replacing some or all of the tobacco with marijuana)."(National Institute on Drug Abuse, 2016). For the purpose of this dissertation, to reduce variability in participant experiences and to specifically study the co-use of tobacco and marijuana, the term "marijuana use" refers only to combustible marijuana use and does not include edible or drinkable marijuana products. Prior research has shown that combustible marijuana comprises the most prevalent modes of use (Singh, Kennedy, Sharapova, Schauer, & Rolle, 2016).

Mixed Methods – In this dissertation, Mixed Methods refers to "research designs that collect, analyze, and integrate quantitative and qualitative data within a single study or multiple phases of a program of research," based on the definition by Creswell and Plano Clark (Creswell & Plano Clark, 2011). This dissertation used a sequential explanatory mixed methods design where quantitative data collection and analyses preceded qualitative data collection and analyses and quantitative and qualitative findings were integrated and interpreted together.

NHANES – The National Health and Nutrition Examination Survey a nationally-representative survey administered by the Centers for Disease Control and Prevention

(CDC) and the National Center for Health Statistics were used for the analysis in the quantitative phase of this dissertation.

Tobacco – Broadly used to refer to any product with tobacco or nicotine including cigar products. The main outcome for the quantitative phase of this dissertation was cigarette use, however other tobacco products use including cigars were examined quantitatively and qualitatively.

Young Adult – In the scope of this dissertation, the term “young adult” was used to refer to 21-30 year olds. This age range was used in both the qualitative and quantitative phases of this study. Developmental psychologists have proposed different age ranges that best represent “Emerging Adulthood,” however, this dissertation used the age range advocated by Gilmore & Meersand, 21-30 years old (2013).

CHAPTER 2: LITERATURE REVIEW

a. Prevalence of Tobacco, Marijuana, and Tobacco and Marijuana Co-use among Young Adults

Tobacco and marijuana are two substances commonly used by young adults (Ramo et al., 2012). According to the CDC, in 2015 around 13% of young adults between 18 and 24 years old reported smoking cigarettes in the past month, with higher prevalence for several race, ethnicity, education level, and geographic location groups (Centers for Disease Control and Prevention, 2016a; Evans-Polce, Vasilenko, & Lanza, 2015). This number climbs to 17.7% for those aged 25–44, again with higher prevalence for specific subgroups (Centers for Disease Control and Prevention, 2016a). This signifies a decline in cigarette use among young people in the last decade - the smoking prevalence was 24.4% among 18-24 year olds and 24.1% among 25-44 year olds in 2005, representing a 46.6% decline and a 26.2% decline respectively between 2005 and 2015 (Centers for Disease Control and Prevention, 2016a). Specific to young adults, between 32.2% and 29.6% of those ages 21 to 30 reported past month cigarette use according to estimates from the 2015 National Survey on Drug Use and Health (NSDUH) (Substance Abuse and Mental Health Services Administration, 2016).

Although some states have changed their marijuana policies recently, including decriminalization, legalizing medical marijuana and legalizing recreational marijuana, many researchers believe that it is too soon to see the effects these policy changes have had on marijuana use (Hall & Lynskey, 2016). Whether due in part to policy changes or for unrelated reasons, in the midst of decreasing cigarette use prevalence, young adult marijuana use is increasing (Cohn, Johnson, Rath, & Villanti, 2016; Johnson et al.,

2015; Lanza, Vasilenko, Dziak, & Butera, 2015; Martins et al., 2016; Salas-Wright et al., 2015). While earlier studies found that young men had higher prevalence of marijuana use than young women, these differences have decreased over time (Johnson et al., 2015). Estimates from the 2014 NSDUH indicate that between 20.5% and 14.4% of those aged 21-30 used marijuana in the past month, with higher percentages in the younger half of this age range (Substance Abuse and Mental Health Services Administration, 2015). A systematic review of tobacco and marijuana use among young adults and adolescents found that 85% of studies published on the topic from 1999-2009 found a significant association between marijuana use and tobacco use, which underscores the importance of studying these two behaviors together (Ramo et al., 2012). One study of 28 countries found that tobacco and marijuana use decreased between 2002 and 2010, but that their use was related (Hublet et al., 2015). Other studies, however, have found high prevalence of tobacco product and marijuana polyuse among young adults and adolescents in the US, indicating that many young people in America are using both tobacco products and marijuana (Kennedy, Caraballo, Rolle, & Rock, 2016; Moss, Chen, & Yi, 2014). Prior studies have indicated that tobacco and marijuana co-use has been increasing among both adolescents and adults in recent years (Subramaniam, McGlade, & Yurgelun-Todd, 2016).

b. Changing Marijuana Legislation in the United States

In recent decades, many states across America have changed existing marijuana policies to include legalization and decriminalization. Twenty-two states and the District of Columbia have decriminalized marijuana (National Conference of State Legislatures, 2018). Decriminalization laws aim to reduce the legal punishments for

those found possessing a small amount of marijuana, generally defined as a "personal" amount (National Conference of State Legislatures, 2018). In these states, possession of a small amount of marijuana is punished with a local or civil infraction and generally have no jail time (National Conference of State Legislatures, 2018). The specific amount of marijuana that can be considered for "personal consumption" varies from state to state, as do the specifics of the laws.

As of January 2018, over half of the states in America have legalized medicinal marijuana, with nine states (Colorado, Washington, California, Oregon, Alaska, Nevada, Massachusetts, Maine and Vermont) and the District of Columbia having legalized recreational marijuana usage ("Medical Marijuana," 2017, *The health effects of cannabis and cannabinoids*, 2017). The marijuana legislation landscape is rapidly changing in America. States that have approved recreational marijuana have put policies in place to limit access to marijuana, including age limits so no one under 21 can purchase recreational marijuana. Additionally, in states that have legalized recreational marijuana, there are often strict laws limiting advertising and prohibiting stores where marijuana is sold from also legally selling tobacco, such as in Washington state (Washington State Liquor and Cannabis Board, 2016). Due to the differences in policies across the United States, as well as the speed at which these policies have been evolving, issues of legalization and changes in state legislation was not explicitly investigated in quantitative analyses in this dissertation, however qualitative work examined how changes in policy have influenced perceptions and use among young adults who smoke both tobacco and marijuana in Maryland, a state where recreational marijuana is illegal and medicinal marijuana became available to patients on December

1, 2017, during qualitative data collection (“Maryland Medical Cannabis Commission,” 2018).

Prior work has found that people living in states that legalized medical marijuana report changes in marijuana-related attitudes (Khatapoush & Hallfors, 2004; Schuermeyer et al., 2014). Those living in Colorado reported lower risk perceptions of marijuana and greater availability following medical marijuana legalization and generally high levels of acceptability both before and after medical marijuana legalization (Schuermeyer et al., 2014). A study of those living in California found differences in attitudes after legalization of medical marijuana (Khatapoush & Hallfors, 2004). Much more work is needed to fully understand the complexities of how changes in policy influence attitudes and perceptions, and researchers believe it is still too soon to assess the effects of recreational marijuana legalization in the U.S. (Hall & Lynskey, 2016). Studies from other countries, however, have found that decriminalization policies do not influence age of onset of marijuana use (Červený, Chomynová, Mravčík, & van Ours, 2017). Additional work is needed to fully understand the ways that changes in marijuana policy influence attitudes and behaviors.

c. Tobacco Advertising and Flavored Products

The tobacco industry has a long history of pursuing communities through ubiquitous advertising and outreach designed to entice people from those groups into smoking (Ling & Glantz, 2002). The tobacco industry has been particularly interested in marketing to young people, and prior research has shown that youth who are exposed to more tobacco advertising are more likely to begin smoking than their peers (Alpert, Koh, & Connolly, 2008). The Master Settlement Agreement of 1998 banned tobacco

manufacturers from directly advertising to youth, but industry officials have found ways to circumvent these regulations including indirectly advertising to younger customers through flavored products and packaging that appeals to youth (Alpert et al., 2008; Carpenter, Wayne, Pauly, Koh, & Connolly, 2005; Chung et al., 2002). In 2009, the FDA banned the sale of cigarettes with flavors other than menthol with the stated goal of “reducing the number of children who start to smoke, and who become addicted to dangerous tobacco products,” (U.S. Food & Drug Administration, 2016a). On August 8th 2016, the FDA finalized a new policy, known as the “deeming rule” that allows them the ability to regulate all tobacco products (U.S. Food & Drug Administration, 2016b). However, this new rule does not ban flavored cigar products or mentholated cigarettes, leaving these products still unregulated. This rule is also currently being litigated by industry.

Menthol cigarettes are disproportionately marketed in communities with more young people and African Americans (Anderson, 2011; Henriksen, Schleicher, Dauphinee, & Fortmann, 2012) and young smokers are more likely than any other age group to smoke menthol cigarettes (Fernander, Rayens, Zhang, & Adkins, 2010; Lawrence et al., 2010; Villanti et al., 2016). Research has shown increases in the number of cigarette smokers who report past-month smoking of both marijuana and menthol cigarettes in the past decade, with 65.16% of marijuana and menthol cigarette smokers being aged 18 to 34 in 2013-2014, indicating higher use among young smokers (Schauer, Peters, Rosenberry, & Kim, 2017). In 2013-2014, 8.3% of adult past month cigarette smokers reporting smoking both marijuana and menthol cigarettes, compared to 4.6% in 2005–2006, which indicates the trend of menthol cigarette and

marijuana use may be increasing (Schauer, Peters, et al., 2017). Menthol cigarette smoking has been linked to higher levels of dependence (Fagan et al., 2010) as well as more difficulty quitting (Trinidad, Pérez-Stable, Messer, White, & Pierce, 2010). Menthol was explored as a potential factor in co-use in both quantitative analysis of NHANES data and qualitative data collection and analyses in this dissertation.

d. Little Cigars and Cigarillos (LCCs), Cigars, and Marijuana Use

Tobacco companies have added flavored products, including cigars, with names and packaging that appeal to younger customers to increase youth purchasing and use of tobacco (Carpenter et al., 2005). Sale of little cigars and cigarillos (LCCs) has increased in recent years while sales of large cigar sales have decreased, indicating changing patterns in the popularity of cigar products (Kozlowski, Dollar, & Giovino, 2008) which may be due, at least in part, to their lower cost than cigarettes (Gammon et al., 2016). According to estimates from the 2015 NSDUH 7.5% and 10.6% of those 21 to 30 report large cigar, little cigar, or cigarillo use in the past month (Substance Abuse and Mental Health Services Administration, 2016). Little cigar and cigarillos (LCCs) are lower priced and more available in neighborhoods with a high number of young adults (Cantrell et al., 2013). Cigar products also are associated with marijuana use; many young adults report using cutting cigars open, removing all or some of the tobacco inside the cigar and using the wrapper to smoke marijuana, a process known as “blunting,” (Delnevo, Bover-Manderski, & Hrywna, 2011; Giovenco, Miller Lo, Lewis, & Delnevo, 2016; Substance Abuse and Mental Health Services Administration, 2016; Schauer, Rosenberry, & Peters, 2017; Soldz, Huyser, & Dorsey, 2003). There are several features of cigarillos specifically that enable this process including perforated

liners and easily unrolled cigar wrappers (Giovenco et al., 2016). Additionally, many small cigars and cigarillos come in re-sealable, zip-top bags that young adults report using to hold their marijuana, further linking their tobacco and marijuana experiences (Giovenco et al., 2016). Cigar products are taxed at much lower rates than cigarettes, making them more affordable to younger smokers and review of industry documents have shown that RJ Reynolds designed a little cigar “as close to a cigarette as legally possible,” to entice cigarette smokers to begin smoking little cigars (Delnevo & Hrywna, 2014; Delnevo, 2006). Research indicates that most young people consider a “blunt” just marijuana and not a tobacco product, despite the fact that there is tobacco in the cigar wrapper, highlighting gaps in public health knowledge (Delnevo et al., 2011). Blunt users are more likely to experience problematic marijuana use than marijuana users who smoke marijuana through other routes (Fairman, 2015) and many young people report patterns of use of LCCs, blunts, and both LCCs and blunts that may increase risk of negative health effects of tobacco use (Sterling, Fryer, Pagano, & Fagan, 2016).

There is low reported cigar use among young adults in the NHANES dataset, likely due to the wording of the question that does not list brands just the phrase “cigars, or little cigars or cigarillos” which may have led to underreporting. Due to low reported cigar use in NHANES, the main tobacco use outcome for quantitative analyses was cigarette use. However, cigar use was assessed in the quantitative and qualitative phases of this dissertation.

e. Negative Health Effects of Tobacco and Marijuana

i. Health Consequences of Tobacco Use

Tobacco use is the greatest cause of preventable morbidity and mortality and if smoking continues at current rates, 5.6 million youth alive today will die prematurely due to tobacco-related causes (Campaign for Tobacco-Free Kids, 2015; Centers for Disease Control and Prevention, 2016c). Tobacco use is a health problem that is critically important to address during young adult years; up to 90% of adult smokers begin smoking in their teens and 99% of adult smokers began smoking before the age of 26 (U.S. Department of Health and Human Services., 2012).

Tobacco use has a number of well-known, serious negative health effects, including higher risk for heart disease, stroke and lung and other cancers (Centers for Disease Control and Prevention, 2016c; U.S. Department of Health and Human Services., 2012). Additionally, long term damage from smoking can cause lung diseases like COPD, emphysema, bronchitis and asthma attacks (Centers for Disease Control and Prevention, 2016c; U.S. Department of Health and Human Services., 2012). Specifically for young people, smoking has been linked to cough and increased phlegm production, lipid disorders and potential slowing of lung growth and reduction of lung function (Centers for Disease Control and Prevention, 2016c; U.S. Department of Health and Human Services., 2012). There are other negative health effects of tobacco use including decreased night vision, decreased wound healing, and tooth loss (Smokefree.gov, n.d.).

Nicotine is a highly addictive substance (Centers for Disease Control and Prevention, 2016c; U.S. Department of Health and Human Services., 2012) and prior research has indicated that young people may be particularly susceptible; a study of teenagers found that many experienced their first symptom of nicotine dependence

within days of their first use and in extreme cases within 24 hours of their first inhale of tobacco smoke (DiFranza, 2000). In addition to showing clinical signs of nicotine dependence, early tobacco use by young people has been linked to other substance use, such as alcohol, marijuana and other drugs (U.S. Department of Health and Human Services., 2012). Cigarette use has predicted marijuana use among young adults in many prior studies (Lin, Jester, & Buu, 2016; Lipperman-Kreda & Lee, 2011; Moss et al., 2014; Terry-McElrath et al., 2017).

ii. Health Consequences of Marijuana Use

There have been mixed findings regarding the role of marijuana as a potential risk factor in the development of various types of cancers (Hall & Degenhardt, 2009). Prior work has indicated heavy marijuana smokers have twice the risk of developing lung cancer of non-marijuana-smokers, which provides some evidence that marijuana may constitute a risk factor for lung cancer (Callaghan, Allebeck, & Sidorchuk, 2013). Marijuana use has been associated with bronchitis and decreased immune functioning in the lungs which can lead to infections (Hall & Degenhardt, 2009; Tashkin, Baldwin, Sarafian, Dubinett, & Roth, 2002; Tetrault et al., 2007). Marijuana smoke contains many of the same hazardous chemicals as cigarette smoke including ammonia, hydrogen cyanide and polycyclic aromatic hydrocarbons; some of these chemicals are found in higher concentrations in marijuana smoke than they are in cigarette smoke (Hall & Degenhardt, 2009; Moir et al., 2008). Prior studies have shown that marijuana use also has effects on respiratory health including chronic bronchitis, coughing, phlegm production and wheezing (Moore, Augustson, Moser, & Budney, 2005).

There are several major negative mental health effects of marijuana use that have been noted particularly for young adult users including anxiety, panic reactions, and psychotic symptoms (Hall & Degenhardt, 2009). Intense marijuana use in adolescence and early adulthood has been linked to poor cognitive functioning in later life (Lisdahl & Price, 2012). One longitudinal study of black youth found that heavy marijuana use in adolescence was associated with greater anxious mood in midlife, indicating there may be long-term negative mental health effects of heavy marijuana use (Green, Doherty, & Ensminger, 2016).

Studies estimate that about 10% of regular marijuana users show signs of clinical dependence (Hall & Degenhardt, 2009). However, for people who begin smoking marijuana in adolescence, there is a higher risk of developing dependence, roughly 17% (Volkow, Baler, Compton, & Weiss, 2014). The DSM-5 combined the previous diagnoses for cannabis abuse and dependence into one condition, cannabis use disorder in 2013 (American Psychiatric Association, 2013). Cannabis Use Disorder, is described as: "a problematic pattern of cannabis use leading to clinically significant impairment or distress," (American Psychiatric Association, 2013). To meet criteria for diagnosis, a patient must present with two symptoms in the past 12-months including: unsuccessful efforts to cut down, taking larger amounts than intended, craving, spending a great deal of time obtaining marijuana, failure to fulfil major obligations at work, school, or home due to use, tolerance, and withdrawal (American Psychiatric Association, 2013). Research has indicated that young adults who use both tobacco and marijuana show increased symptoms of marijuana dependence (Ream, Benoit, Johnson, & Dunlap, 2008; Richter, Pugh, & Ball, 2016; Richter, Pugh, Smith, & Ball, 2016).

Marijuana use has been established as a risk factor for cigarette smoking among young adults (Scal, Ireland, & Borowsky, 2003). Young adults who smoke marijuana regularly are more likely to initiate tobacco use and eventually become nicotine-dependent than their non-marijuana-smoking peers (Ramo et al., 2012). Marijuana use has also been shown to predict earlier age of cigarette initiation and greater likelihood of developing nicotine dependence (Timberlake et al., 2007). Prior work has indicated that young adults who smoke both tobacco and marijuana show greater symptoms of tobacco dependence than marijuana non-users (Okoli, Richardson, Ratner, & Johnson, 2008; Patton, Coffey, Carlin, Sawyer, & Lynskey, 2005). Additionally, marijuana use, particularly among young adults, may predict non-successful cigarette smoking cessation attempts (Abrantes et al., 2009; Berg, Romero, & Pulvers, 2015; Hindocha, Freeman, Ferris, Lynskey, & Winstock, 2016). Some young adults report smoking a cigarette directly after using marijuana for “boosting” or using cigarettes to enhance the “highs” they feel from alcohol and marijuana use (Lipperman-Kreda & Lee, 2011).

iii. Compounded Health Effects of Co-use

There is a paucity of empirical literature assessing the health consequences of tobacco and marijuana co-use. In addition to the individual negative health effects of each product, it is possible that there are additional health risks of co-use from the same carcinogenic chemicals included, although in different amounts, in both tobacco and marijuana smoke (Hall & Degenhardt, 2009; Moir et al., 2008). Studies have shown that smoking both products at once, as in a blunt, can increase the risk for negative health outcomes because of the dual exposure to tobacco and marijuana (Delnevo et al., 2011).

One additional health concern is the combined effect of tobacco and marijuana exposure on the developing brain. Research has shown that the brain continues to develop and mature well into a young person's twenties (Johnson, Blum, & Giedd, 2009) and the effects of marijuana on the developing brain are still largely unknown (Jacobus & Tapert, 2014). Studies have shown that adolescents and young adults who frequently use marijuana show reductions in brain development and functioning compared to their peers who do not, but the specific mechanisms and ordering of these two outcomes has not been established (Jacobus & Tapert, 2014). Nicotine has also been demonstrated to disrupt brain maturation in adolescents (Dwyer, McQuown, & Leslie, 2009) however the combined effects of tobacco and marijuana on brain development during young adulthood and later on brain functioning and cognition have not been well-studied yet.

f. Potential Mechanisms for Tobacco and Marijuana Co-Use

Qualitative research has documented specific ways in which marijuana use promotes cigarette use for young adults who identify as marijuana only smokers (Hight, 2004). However, most research on patterns of co-use of multiple substances correlates the two product usages and does not offer conclusive evidence towards the most likely patterns of initiation. It is often difficult for researchers to disentangle the initiation and trajectories of use for young adults who use more than one substance, however it is well-established that cigarette use, marijuana use and alcohol use are associated (Ames, Xie, Shono, & Stacy, 2016; Terry-McElrath et al., 2017).

Prior literature has supported four potential mechanisms for tobacco and marijuana initiation among adolescents and young adults, the gateway hypothesis

(Rabin & George, 2015), the reverse gateway hypothesis (Patton et al., 2005), the addiction vulnerability hypothesis, and the shared route of administration hypothesis (Rabin & George, 2015). The gateway hypothesis dates back to 1975, and was the prevalent hypothesis of drug use initiation for years (Kandel, Yamaguchi, & Chen, 1992; Rabin & George, 2015). The gateway hypothesis indicates there's a sequence in which young people initiate substances starting with alcohol and cigarettes and eventually progressing to "harder" drugs (Kandel et al., 1992; Rabin & George, 2015). Specifically relevant for tobacco and marijuana use, the gateway hypothesis could be used to predict that young people who begin using cigarettes are more likely to escalate to marijuana use, whereas young people who do not smoke cigarettes are much less likely to initiate marijuana use without first beginning to use cigarettes as a "gateway" (Kandel et al., 1992; Rabin & George, 2015). There is work that supports this theory (Ellickson, Tucker, & Klein, 2001), however an increasing number of studies in recent years have offered evidence for alternative explanations (Rabin & George, 2015) including the reverse gateway hypothesis. The reverse gateway hypothesis suggests that frequent marijuana use may lead to tobacco use and eventual nicotine dependence, which is the opposite of the gateway hypothesis (Patton et al., 2005). In one study of young adult males, marijuana use was the strongest predictor of cigarette use among a host of potential predictor variables, supporting the reverse gateway hypothesis (Becker, Schaub, Gmel, & Haug, 2015). Other studies have also found that young adults who frequently use marijuana are more likely to initiate cigarette smoking (Patton et al., 2005; Swift et al., 2012).

The addiction vulnerability hypothesis postulates that there are specific genetic, biologic, and environmental factors that predispose some people to be more likely than others to become regular users of more than one substance (Nestler, Barrot, & Self, 2001; Rabin & George, 2015). There is support for this theory; in prior studies genetic variation in the GABAR2 gene has been associated with both nicotine and cannabis dependence (Philibert et al., 2009; Rabin & George, 2015). Additionally, studies have found associations between psychosocial factors and likelihood of tobacco and marijuana co-use (Brook, Lee, Finch, & Brown, 2010). Researchers have hypothesized that this relationship may be complex with multiple genetic factors interacting to produce risk for multiple substance use (Kendler, Myers, & Prescott, 2007) and studies have found that genetic and environmental factors both play a significant role in this phenomena (Agrawal et al., 2016; Xian et al., 2008).

Finally, the shared route of administration hypothesis predicts that the reason tobacco and marijuana are commonly used together is that the main mode of use for both is smoking and inhalation (Rabin & George, 2015). Young people who are smoking and inhaling either marijuana or tobacco may be more likely to begin using another product that they smoke and inhale (Rabin & George, 2015) than they would be to initiate using a product that was injected or administered through another route. Smoking tobacco products has been associated with a significantly increased risk for marijuana use and dependence compared to smokeless tobacco products, even when controlling for covariates, supporting this theory (Agrawal & Lynskey, 2009).

It is possible that all four theories may play a role in different ways and there is preliminary evidence that additional factors may influence this phenomenon. For

example, peer and neighborhood effects influence order of initiation; black youth are more likely to initiate marijuana use before tobacco use compared with white youth (Green, Johnson, et al., 2016) suggesting that the gateway hypothesis and reverse gateway hypothesis may both be true for different demographic groups. Additionally, youth who are exposed to violent victimization initiate marijuana use before tobacco use compared with youth who do not experience violent victimization (Green, Johnson, et al., 2016), indicating life experience may play a role in initiation processes. Research has also found that there are different patterns for trajectories of marijuana use for adolescents and that these trajectories are associated with different health outcomes (Juon, Fothergill, Green, Doherty, & Ensminger, 2011). It is possible that different initiation experiences may play a role in trajectories and later consequences of use.

g. *Young Adults: A Particularly Vulnerable Group*

i. Definitions of Young Adulthood

There is not a clear consensus on “young adulthood” as defined in research, and many different researchers and organizations use different age ranges for this period. This makes research with young adults difficult to identify and interpret because the group included may vary so much from study to study. The U.S. Census uses a definition for Young Adult that includes a larger range and an older upper limit than most other organizations: 18-34 (US Census, 2014).

In the past two decades, developmental psychologists have begun to study and document the period of “Emerging Adulthood,” the time of transition between adolescence and adulthood (Arnett, 2000; Gilmore & Meersand, 2013). This developmental phases is specific to Western societies where young people have

increasingly been delaying the milestones that traditionally accompany adulthood, such as marrying, buying a home and starting a family, and is characterized by a sense of uncertainty and transition (2013). Gilmore & Meersand dub this period “the decade of wandering” because many young people change jobs, locations and long-term goals (Gilmore & Meersand, 2013). While experts have debated the different age ranges that best encompasses this developmental stage, which is particularly difficult because there are not biological indicators that clearly delineate this period, Gilmore & Meersand advocate that 21-30 best captures the unique timeframe of “Emerging Adulthood,” beginning with the time that a young adult is able to legally drink alcohol and continuing into the time where they begin to exhibit increasingly more characteristics of adulthood (2013).

The age range of 21-30 was selected for this dissertation to capture young adults who are in the “Emerging Adulthood,” stage of development. This decision allows for comparison of a relatively robust group of young adults from the NHANES dataset and makes sense in the context of NHANES where most questionnaires are administered in different modes to those 12-19 and those 20 and older, minimizing the potential statistical effects from mode differences in survey methodology (Centers for Disease Control and Prevention, 2016b). This age range aligns with other studies of young adult tobacco and marijuana use (Colby et al., 2004; Crost & Guerrero, 2012; Fallin, Neilands, Jordan, & Ling, 2014) as well as groups and subgroups in psychological and social science studies focusing on emerging adulthood (Bodner, Bergman, & Cohen-Fridel, 2014).

ii. Young Adult Risk Perceptions towards Tobacco and Marijuana

Prior work has indicated that risk perceptions and attitudes may be a predictor in young adult substance use (Bachman, Johnston, & O'Malley, 1990; Berg, Stratton, et al., 2015). One study of young adults in college found that peer effects influence behavior - after their first year of college students had more favorable attitudes towards and higher intentions to use both tobacco and marijuana (Stewart & Moreno, 2013). The study found that intention to use predicted use for both substances, but attitudes towards marijuana also predicted marijuana use, underscoring the importance of studying attitudes in the context of young peoples' marijuana use behavior (Stewart & Moreno, 2013). Recent work has shown that young adult disapproval ratings of marijuana have been decreasing (Salas-Wright et al., 2015) which may influence perceived risk of use among young adults. Marijuana risk perceptions are inversely related to marijuana use, which highlights the importance of assessing risk perceptions among young adults (Holmes, Popova, & Ling, 2016). In the qualitative phase of this dissertation risk perceptions, availability, and approval were discussed to better understand the ways these factor into young adult tobacco and marijuana co-use.

iii. A Vulnerable Populations Approach

First described by Frohlich and Potvin, the Vulnerable Populations Approach suggests that groups of the population who are particularly susceptible to experience negative health outcomes would benefit most from interventions that address the vulnerable group's specific needs (2008). In order to mitigate health disparities, vulnerable groups should be included in research studies in order to better understand and design interventions to lessen the impact of negative health outcomes that influence these groups (Frohlich & Potvin, 2008). Frohlich and Potvin distinguish between "at-

risk” populations and vulnerable populations. “At risk” populations share a “homogeneously high level of exposure to a single risk factor,” (Frohlich & Potvin, 2008). For example, smoking is a risk factor that puts many at-risk for a whole host of negative health outcomes. Conversely, vulnerable populations share social characteristics that make them at a higher “risk of risks,” (Frohlich & Potvin, 2008). The example that Frohlich and Potvin give is that in Canada, people of aboriginal descent, those with low income and those who have not completed secondary education are at significantly higher risk of exposure leading to negative health outcomes than the general population (Frohlich & Potvin, 2008). Frohlich and Potvin continue to explain that while people of aboriginal descent have, on average, higher levels of exposure to risk factors, not everyone in this vulnerable group belongs to the "high-risk population" for any given risk factor (Frohlich & Potvin, 2008). The shared social characteristic of this group can lead to a higher exposure and higher risk, dubbed “risk of risks” by Frohlich and Potvin (2008). In this way, young adults who smoke both tobacco and marijuana have shared characteristics that make them likely to experience negative health effects from their combined smoking and can be considered a vulnerable group. Other factors that may add to young adult co-users’ risk profile include targeted marketing, socioeconomic status, sex, and other substance use including alcohol. Data from the 2014 NSDUH indicates that young adults are more likely than adolescents to have smoked cigarettes, marijuana and cigars in the past-month, demonstrating that young adults are more susceptible than adolescents to marijuana, cigarette and cigar smoking and could benefit from increased research to better understand their unique risk factors and behaviors (Substance Abuse and Mental Health Services

Administration, 2016). This dissertation adds to existing knowledge of the factors that shape the phenomena of co-use among young people, which can lead to a better understanding of intervention components that may reduce tobacco and marijuana use among young adults, working within the Vulnerable Populations Approach.

iv. Tobacco-Related Health Disparities

A growing field of research has been devoted to the study of Tobacco-Related Health Disparities which focus on the disproportionate burden of tobacco use and tobacco-related disease experienced by certain sociodemographic groups. A host of factors including concentrated efforts by industry to reach these populations as well as vulnerabilities that predispose some groups to have a more difficult time quitting tobacco use (Fagan et al., 2004; Moolchan et al., 2007; Okuyemi, Reitzel, & Fagan, 2015). Prior research has indicated that certain age, racial, ethnic and socioeconomic groups disproportionately experience an undue burden of tobacco-related health disparities and these groups are high priority groups to intervene with to reduce the impact of tobacco-related negative health outcomes, particularly under the Vulnerable Populations Approach (Frohlich & Potvin, 2008). While this dissertation does not specifically aim to assess tobacco-related health disparities and does not focus on a population that has been demonstrated to be experiencing tobacco-related health disparities, this dissertation acknowledges the existence of and priority of understanding and eliminating tobacco-related health disparities and findings from this work may be eventually applied to work with groups who experience health disparities.

h. Current Research on Tobacco and Marijuana Co-Use

Due to the number of different product permutations that exist for tobacco and marijuana co-use, it is challenging to comprehensively assess what is known and still unknown with regards to young adults and predictors of tobacco and marijuana co-use. One major systematic review published in 2012 included 163 articles published in a decade (1999 to 2009) on the topic of tobacco and marijuana use (Ramo et al., 2012). However, the systematic review found that few characteristics or predictors were common across a number of studies, underscoring the importance of better understanding this group (Ramo et al., 2012). There are several well-established sociodemographic variables that have been used as predictors of young adult marijuana use initiation and outcomes in prior studies. The quantitative phase of this dissertation assessed a number of potential empirical and theoretical predictors of co-use.

i. Gender, Sex, and Co-use

The evidence of sex as a predictor of co-use is mixed; several studies report males are more likely to demonstrate co-use (Ramo, Delucchi, Hall, Liu, & Prochaska, 2013) while other studies have found non-statistically significant differences by gender or that females were more likely to be co-users than males (Ramo et al., 2012). Prevalence of co-use increased among both males and females over the age of 18 between 2003 and 2012 (Schauer, Berg, Kegler, Donovan, & Windle, 2015). There are differential patterns of intensity of use by gender; males are more likely to consistently increase marijuana and nicotine use between adolescence and young adulthood, while females are more likely to maintain low levels of use of both products, with small increases (Buu, Dabrowska, Heinze, Hsieh, & Zimmerman, 2015). The quantitative

work of this dissertation examined prevalence of co-use by gender. Participants in the interviews were asked to describe their gender identity.

ii. Employment, Marital Status, and Co-use

Prior work has not thoroughly investigated employment status or marital status as predictors of tobacco and marijuana co-use. However, in order to better understand this age range of young adults, this dissertation quantitatively and qualitatively investigated associations between employment status and co-use. Associations between marital status and co-use were assessed in the quantitative phase of this dissertation.

iii. Income and Co-use

Prior work on the link between income and co-use among young adults has reported mixed results. Some research indicates that users of both tobacco and marijuana are more likely to report higher income than tobacco-only smokers (Ramo, Delucchi, Hall, Liu, & Prochaska, 2013), while other studies have found there is not a statistically significant relationship between income and co-use of tobacco and marijuana (Ramo & Prochaska, 2012). The quantitative phase of this dissertation examined the relationship between income and co-use.

iii. Race, Ethnicity, and Co-use

Prior work has found that those who endorse African American race (Ramo et al., 2012) or multiethnic background (Ramo, Delucchi, Hall, Liu, & Prochaska, 2013) have an increased likelihood of reporting co-use. The prevalence of co-use of tobacco and marijuana has increased among both Black and Hispanic populations in the past decade (Schauer et al., 2015), which highlights these groups as priority populations. However, other studies have suggested that the relationship between race and ethnicity

and cigarette and marijuana use may be complicated by age, with trends changing between early adolescence and young adulthood (Keyes et al., 2015). The quantitative phases of this dissertation investigated prevalence of co-use by race and ethnicity.

iv. Depression and Co-use

Depression has been associated with tobacco and marijuana co-use in prior studies (Ramo et al., 2012). Depressive symptoms are independently associated with marijuana use (Patton et al., 2002) and tobacco use (Bonn-Miller, Zvolensky, & Johnson, 2010). Additionally, research supports that there is a link between tobacco and marijuana co-use and depression (Ramo et al., 2012); co-users of tobacco and marijuana are more likely to report depressive symptoms (Lee Ridner, Staten, & Danner, 2005) as well as a clinical diagnosis of depression (Boys et al., 2003; Goodwin et al., 2017; Green & Ritter, 2000) than non-users.

In a study of cigar smokers, blunt smokers, non-blunt marijuana smokers and dual cigar and blunt smokers, major depressive episodes were associated with non-blunt marijuana use indicating young adult marijuana users who don't use cigars as blunts may have unique mental health experiences and needs (Cohn, Johnson, Ehlke, & Villanti, 2016). Other work has suggested that tobacco-only smoking adults may show higher levels of depressive symptoms than marijuana-only smokers, tobacco and marijuana co-users, and non-smokers, which indicates the relationship may be complicated by moderating or mediating variables (Bonn-Miller et al., 2010).

The relationship between depressive symptoms and the co-use of tobacco and marijuana is complex and may be bidirectional. Prior research has shown an association between increased depressive symptoms and increased tobacco and marijuana smoking

frequency, which suggests that young adults who feel depressed may use these substances to self-medicate (Wilkinson, Halpern, & Herring, 2016) whereas other research has found that marijuana use may lead to increased depressive symptoms (Copeland, Rooke, & Swift, 2013). Depression was included in quantitative analyses of the NHANES dataset to further explore this relationship.

v. Other Substances and Co-use

Prior work has established there are relationships between tobacco and marijuana co-use, alcohol use (Ramo et al., 2012; White, Walton, & Walker, 2015), stimulant use (Wagner & Anthony, 2002) and opiate use (Tullis, Dupont, Frost-Pineda, & Gold, 2003) among young people. Measures of use for these substances were included in quantitative analyses in this dissertation.

vi. Nicotine Dependence and Co-use

Prior studies have found that youth who initiate marijuana use are more likely to develop nicotine dependence (Patton et al., 2005; Timberlake et al., 2007). Other work has supported that marijuana use in adolescence predicts tobacco dependence in adulthood (Brook, Lee, & Brook, 2015). Most published work on this topic has focused on marijuana use or the ordering of initiation, not the cumulative effects from the use of both substances. More research is needed to explore the ways in which co-use of both cigarette and marijuana may influence nicotine dependence levels. An item measuring time to first cigarette was used to approximate dependence in NHANES analyses.

i. The National Health and Nutrition Examination Survey

The National Health and Nutrition Examination Survey is a nationally-representative survey administered by the Centers for Disease Control and Prevention

(CDC) and the National Center for Health Statistics to assess a variety of health outcomes among children and adults. NHANES has been administered in several different formats since the 1960s, and in the current format regularly since 1999 (Centers for Disease Control and Prevention, 2016b). NHANES data is collected and released every two years (1999-2000; 2001-2002; 2003-2004; 2005-2006; 2007-2008; 2009-2010; 2011-2012; 2013-2014) (Centers for Disease Control and Prevention, 2016b). Questions about marijuana use were first asked in the 2005-2006 cycle, thus the selection of the five and three data points maximized available data for analysis.

CHAPTER 3: Study 1, Examining Prevalence and Predictors of Cigarette and Marijuana Co-Use among Young Adults Using NHANES, 2005-2014

a. Introduction

i. Cigarette and Marijuana Co-Use

In America in the past decade, cigarette use prevalence among young adults has been decreasing, while young adult marijuana use has been increasing (Johnson et al., 2015; Lanza et al., 2015; Martins et al., 2016; Substance Abuse and Mental Health Services Administration, 2012). According to estimates from the 2016 National Survey on Drug Use and Health (NSDUH), 23.5% of young adults 18-25 smoked cigarettes in the past month, while 20.8% of young adults smoked marijuana in the past month (Substance Abuse and Mental Health Services Administration, 2017). However, due to differing definitions of co-use, different combinations of tobacco products and marijuana, and differences in how questions about substance use are asked in national surveys, there are not well-established national prevalence estimates for cigarette and marijuana co-use among young adults. Kennedy et al (2016) investigated racial differences in tobacco and marijuana trends in a national sample of 18-25 years old and found estimates of co-use between 29.1% and 39.8% among Black and White users of at least one combustible product from 2002-2012, depending on race, year, and tobacco product used (Kennedy et al., 2016). To date, no study has provided estimates of the national trends in co-use of marijuana and cigarettes generally among young adults to assess changes in prevalence over time in this age group, however other studies have

indicated co-use is increasing among adolescents and general adult age groups (see Subramaniam et al., 2016).

It is crucial to understand patterns of co-use among young adults, particularly in the midst of decreasing cigarette use. The context of tobacco and marijuana use has been changing in recent years with young adult disapproval of marijuana decreasing (Salas-Wright et al., 2015) and an increased stigma associated with tobacco use (Castaldelli-Maia et al., 2016). While cigarette use among young adults is becoming less acceptable, marijuana use is becoming more acceptable, which has interesting implications for the study of co-use. One potential mechanism for tobacco and marijuana initiation among adolescents and young adults supported by prior literature, the shared route of administration hypothesis, predicts that the reason tobacco and marijuana are commonly used together is that the main mode of use for both is smoking and inhalation (Rabin and George, 2015). Young adults who are smoking marijuana or tobacco may be more likely to begin using another product that they smoke and inhale than they would be to initiate using a product that was injected or administered through another route. It is important to study co-use behaviors among young adults especially to assess if marijuana may serve as an introduction to cigarettes for young adults, which has implications for long-term health.

This study focuses on co-use among emerging adults, ages 21 to 30, a developmental period describing the transition between adolescence and adulthood (Gilmore and Meersand, 2013). It is critical to focus on young adults as prior work has indicated that young adults in this transition period may be more likely to initiate high-risk behaviors and that this developmental phase may interact with risk and protective

factors in unique ways to influence young adults' tobacco use behaviors long-term (Mermelstein, 2014).

ii. Risk Factors for Co-Use

Our understanding of risk factors for co-use among young adults is limited. This information is critical in order to identify and intervene with young adults at the greatest risk to initiate and continue co-use.

Sociodemographic Risk Factors: Findings on the role of gender as a predictor of co-use are mixed. In a review of the literature on co-use among adolescents and adults, Ramo, Liu and Prochaska (2012) found half of the studies (3 total) reported higher rates of co-use among males a third found higher rates among females, and one reported no association. Thus, while gender may be an important risk factor for co-use, it is unclear the direction of the association, likely due to variability in samples. Similarly, findings on the role of socioeconomic status have been contradictory; some studies have found that co-users earn a higher income than tobacco-only smokers (Ramo, Delucchi, Hall, Liu, and Prochaska, 2013), while other studies have found a lack of relationship between income and co-use (Ramo and Prochaska, 2012). Socioeconomic status may play an important role in co-use as tobacco prices and state taxes have increased in recent years and marijuana's status as a federally illegal substance creates an underground market for its sale and distribution. The amount of discretionary income a young adult has may influence their choice to use tobacco, marijuana, or both depending on actual price and their perception of prices. Years of education, on the other hand, has consistently been found to be a protective factor for both tobacco and marijuana use (Ramo and Prochaska, 2012). Prior studies have found respondents of

African American race (Ramo et al., 2012) or a multiethnic background (Ramo, Delucchi, Hall, Liu, and Prochaska, 2013) have an increased likelihood of co-use, perhaps due to the popularity of blunts, hallowed out cigars used to smoke marijuana (Cohn et al., 2016; Sinclair et al., 2012). The popularity of blunts is influenced by increased availability, more advertising for, and lower prices of little cigar and cigarillos in majority African American communities (Cantrell et al., 2013).

Mental Health and Substance Use Risk Factors: Co-users are more likely to experience depressive symptoms (Lee Ridner et al., 2005) and a clinical depression diagnosis (Boys et al., 2003; Goodwin et al., 2017; Green and Ritter, 2000) than single product users. It is possible that young adults begin using one substance, either tobacco or marijuana, to relieve depression and find that it does not work effectively and begin using a second substance to better alleviate symptoms (Khantzian, 1997). Similarly, prior studies have demonstrated associations between co-use and other substance use including opiates (Tullis et al., 2003), stimulants (Wagner and Anthony, 2002), and alcohol (Ramo et al., 2012; White, Walton, and Walker, 2015).

Social Risk Factors: There are also several social factors that have not been studied as predictors of co-use previously but have been found individually to predict both cigarette and marijuana use or to strongly predict young adults' substance's use, such as marital status and household tobacco exposure. Prior work has found that married young adults are less likely to smoke cigarettes (Terry-McElrath and O'Malley, 2015) and use marijuana (Patrick et al., 2012) than unmarried young adults while, secondhand smoke exposure at home predicts young adult tobacco use (Kalkhoran et al., 2013).

This study used publicly available, nationally representative data to investigate prevalence and predictors of cigarette and marijuana co-use among young adults ages 21-30 between 2005 and 2014.

b. Materials and Methods

i. The National Health and Nutrition Examination Survey (NHANES) Dataset and Study Population

Five waves of NHANES data (2005-2006; 2007-2008; 2009-2010; 2011-2012; 2013-2014; unweighted n=4,948; weighted n=204,669,131) were pooled to analyze prevalence of past-month cigarette, marijuana, and cigarette and marijuana co-use over a 10-year period. Three waves of NHANES data (2005-2006; 2009-2010; 2013-2014; unweighted n=3,073; weighted n=124,039,350) were subsequently used to explore predictors of past-month cigarette and marijuana co-use. These three waves of NHANES data were selected to represent the beginning, mid-point, and end of the 10-year range in assessing predictors of co-use.

ii. Past-Month Cigarette Use, Past-Month Marijuana Use, and Past Month Co-Use

The main outcomes of interest were past-month cigarette-use, past-month marijuana use and past-month co-use. Respondents who had smoked a cigarette on one or more days in the past month were coded as past-month cigarette users. Similarly, participants who had used marijuana or hashish on one or more days in the past month were coded as past-month marijuana users. Respondents who were both past-month cigarette users and past-month marijuana users were coded as past-month co-users. Any participants who were outside of the age range (21-30) or missing data for the main

outcome variables (past-month cigarette use and past-month marijuana use) were not included in analyses.

iii. Risk Factors

Sociodemographic Variables: The NHANES variable for gender included the options “male,” or “female.” Race and ethnicity were assessed as one variable in NHANES with four levels: Hispanic ethnicity, Non-Hispanic White, Non-Hispanic Black and Other or Multi-Racial. Age was assessed both continuously as well as categorically for different analyses. Education level included: less than 12th grade, high school graduate/GED, some college/associates degree, and college graduate or above. Ratio of family income to poverty guidelines is a continuous measure assessed in NHANES.

Mental Health and Substance Use Variables: Depressive symptoms were assessed using the nine-item Patient Health Questionnaire (PHQ-9). After an examination of the skewed distribution of responses, depressive symptoms were recoded as a binary variable where those who experienced no or few depressive symptoms (scores of 0-4) were distinguished from those who experienced depression (scores of 5-27) based on scoring guidelines for the PHQ-9 (Kroenke et al., 2001).

Two drug use questions were used to compute one binary variable to represent ever use of any serious, illegal substance excluding marijuana. Participants who had ever used cocaine, crack cocaine, heroin, or methamphetamine or used a needle to inject a drug not prescribed by a doctor were categorized as ever serious drug users.

A continuous measure to estimate the number of days the respondent had consumed alcohol in the past year was computed by multiplying the average number of drinks a respondent drank per week, month, or year by the respective units. After an

examination of distribution of responses, this variable was categorized into 3 levels: those who did not drink, those who drank less than monthly on average, and those who drank monthly or more on average.

The question to assess household tobacco exposure changed from "Does anyone who lives here smoke cigarettes, cigars, or pipes anywhere inside this home?" in the 2005-2006 and 2011-2012 waves to "How many people who live here smoke cigarettes, cigars, little cigars, pipes, water pipes, hookah, or any other tobacco product?" in the 2013-2014 wave. Any respondent who lived with at least one smoker was coded as having household tobacco exposure.

Social Variables: Marital status included four levels: married, widowed, divorced or separated, never married, and living with partner. The categories for employment status were: working, looking for work, not working - going to school, not working - taking care of house or family, not working other (includes with a job or business but not at work, unable to work, laid off, or disabled).

iv. Statistical Analyses

Analyses were conducted in Stata 15.1 and used svy and svyset commands to account for the complex, multi-stage sampling of NHANES. Weighted estimates for prevalence of past-month cigarette use, marijuana use, and cigarette and marijuana co-use, standard deviation, standard error and sample size were assessed for all waves. Summary ANOVAs were calculated to assess if prevalence of any of the three behaviors significantly changed over time. Secondary analyses included comparing prevalence by demographic groups. Chi-square tests were used to compare prevalence

across groups. However, to properly incorporate weighting factors, Stata calculates a design-based F statistic to determine statistical significance (Heeringa et al., 2010).

Subsequently, three waves of NHANES data representing the beginning (2005-2006), midpoint (2009-2010) and end (2013-2014) of the time period studied were appended into one file to assess predictors of co-use. An adjusted multinomial logistic regression model with year-specific weighting factors was computed to predict past-month co-use, cigarette-only use, and marijuana-only use from neither use. Secondary analyses included binary logistic regression models individually comparing marijuana-only users and co-users and cigarette-only users and co-users to examine the potential influence of tobacco and marijuana-specific variables, such as cigarette and marijuana use frequency and intensity, nicotine dependence, menthol cigarette use and age of initiation. In accordance with NHANES analytic guidelines, prevalence of missing data was examined and since missing data did not exceed 10% for any included variable, no adjustment was completed (Centers for Disease Control and Prevention, 2013).

c. Results

i. Prevalence of Past-Month Cigarette, Marijuana, and Co-Use 2005-2014

As shown in Figure 3.1, past-month cigarette use was 30.85% in 2005-2006, 31.61% in 2007-2008, 28.94% in 2009-2010, 22.57% in 2011-2012 and 23.74% in 2013-2014. A calculated summary ANOVA indicated that the difference in prevalence was statistically significant ($F=2.80, p=0.024$). Past-month marijuana use remained stable: 17.43% in 2005-2006, 17.22% in 2007-2008, 17.11% in 2009-2010, 17.41% in 2011-2012, and 20.58% in 2013-2014. A calculated summary ANOVA indicated that there was not a statistically significant change during this period ($F=0.50, p=0.74$).

Past-month co-use also remained relatively stable: 10.46% in 2005-2006, 10.07% in 2007-2008, 10.66% in 2009-2010, 6.84% in 2011-2012 and 11.02% in 2013-2014 ($F=1.30, p=0.27$).

ii. Associations between Demographic Factors and Co-Use

There was a statistically significant difference in prevalence of past-month co-use by gender at the first three waves: 2005-2006 (14.06% of males, 6.99% of females, $p=0.02$); 2007-2008 (15.12% of males, 5.11% of females, $p=0.0002$); 2009-2010 (12.83% of males, 8.46% of females, $p=0.015$) and a marginally ($p<0.10$) significant difference at the last two waves (8.86% of males, 4.84% of females, $p=0.089$ in 2011-2012 and 13.51% of males, 8.48% of females, $p=0.079$ in 2013-2014, Figure 3.2). Combining across waves, the overall prevalence for past-month co-use was 12.9% for men and 6.8% for women.

There was a statistically significant difference in prevalence of past-month co-use by race and ethnicity overall ($p<.0001$, see Table 3.1). Post-hoc analyses show differences between the first two waves and last wave: 2005-2006 (highest prevalence among Non-Hispanic White respondents 13.16%, lowest among Hispanic respondents 2.88%, $p=0.011$), 2007-2008 (highest among Non-Hispanic Black respondents 13.61%, lowest among other race and multi-racial respondents 2.28%, $p=0.018$); 2013-2014 (highest among Non-Hispanic Black respondents 15.1%, lowest among Hispanic respondents 3.35%, $p=0.0425$), but there were no significant differences in 2009-2010 ($p=0.204$) or 2011-2012 ($p=0.468$). See Figure 3.3.

While co-use varied by mean age overall, ($p<.01$), there was no statistically significant difference in past-month co-use by age category (21-25 vs. 26-30) across

any of the five waves. Co-use was more prevalent in the younger half of the age range for all waves except for 2007-2008 where the prevalence for those 26-30 years old exceeded the prevalence for those 21-25 years old (11.45% and 8.75%, respectively). See Figure 3.4.

Table 3.1 also shows the overall prevalence when pooling waves, as well as differences by risk factors. ANOVA results show statistically significant differences in co-use for each variable examined.

iii. Multinomial Logistic Regression Models

Unadjusted multinomial regression analyses (not shown) indicated that year, gender, age, education, marital status, race and ethnicity, income ratio, depressive symptoms, serious drug use, alcohol use, and household tobacco exposure had $p < .25$ so these variables were included in the adjusted model (see Table 3.2). Several significant differences emerged. The odds of being a past-month co-user versus a past-month neither user were 4.06 times larger for those who drank an average of less than once a month compared to non-drinkers (95% CI [1.97, 8.40]; $p < 0.001$) and 7.59 times larger for those who drank once a month or more (95% CI [4.00, 14.39]; $p < 0.001$). The odds of being a past-month co-user versus a past-month neither user were 1.93 times larger for those who experienced any depressive symptoms (95% CI [1.27, 2.93]; $p = 0.003$), 12.31 times larger for those who had ever used serious drugs (95% CI [8.62, 17.57]; $p < 0.001$) and 13.26 times larger for those who experienced household tobacco exposure (95% CI [7.85, 22.40]; $p < 0.001$).

iv. Binary Logistic Regression: Past-Month Cigarette-Only vs Co-Use

Unadjusted logistic regression indicated that year, age, marital status, race and ethnicity, ever serious drug use, alcohol use, and household tobacco exposure had $p < .25$ so these were included in the adjusted model (see Table 3.3). The odds of being a past-month co-user versus a cigarette-only user were 2.50 times larger for those who endorsed non-Hispanic Black race (95% CI [0.38, 4.50]; $p = 0.003$) and 3.73 times larger for those who had ever used serious drugs (95% CI [2.37, 5.86]; $p < 0.001$). Marital status ($p = 0.003$ for married), age ($p = 0.039$), and alcohol use ($p = 0.031$ for Once a month or more) were also statistically significant in this model.

v. Binary Logistic Regression: Past-Month Marijuana-Only vs Co-Use

Comparing past-month marijuana-only users and past-month co-users with regards to marijuana-specific variables (frequency of use, intensity of use, age first tried marijuana), the unadjusted model indicated that education, marital status, race and ethnicity, depressive symptoms, serious drug use, alcohol use, household tobacco exposure, age first used marijuana, and days used marijuana in past month had $p < .25$ so these were included in the adjusted model (see Table 3.4).

The odds of being a past-month co-user versus a past-month marijuana-only user were 2.01 times larger for those who have ever used serious drugs (95% CI [1.09, 3.68]; $p = 0.024$) and 5.17 times larger for those who experienced household tobacco exposure (95% CI [2.98, 8.95]; $p < 0.001$). Those who had first used marijuana at a younger age were more likely to be current co-users ($p < 0.001$).

d. Discussion

i. Co-Use

While other studies have shown an increase in marijuana use (Johnson et al., 2015; Lanza et al., 2015; Martins et al., 2016; Salas-Wright et al., 2015) and in co-use (Subramaniam et al., 2016) among young adults, this study found stability in both marijuana use and co-use in the time period assessed. These differences are likely because this study included a different age range and time period than prior research. In the context of declining cigarette use among young adults, the stable, relatively high rate of co-use among young adults is concerning and indicates that a significant percent of marijuana users also use cigarettes. As the negative consequences of smoking are well established, this underscores the importance of examining these two behaviors together to better understand patterns and trajectories of use.

This study provides insight into risk factors for co-use. While evidence of gender as a predictor of co-use in prior literature is mixed (Ramo et al., 2012, 2013) with national data, we found co-users were more likely to be male though this difference became less significant over time. In the first two waves, males were 2-3 times as likely as females to engage in past month co-use. By the fifth wave, this difference reduced to 1.6 times as likely with co-use for women slightly increasing from 2005-2006 to 2013-2014 and co-use for men slightly decreasing. One potential explanation for changes in co-use prevalence by gender over time is changing social norms and decreased stigma around marijuana use (Berg et al., 2015; Salas-Wright et al., 2015). With changing marijuana legislation across the United States, young women may find marijuana use more acceptable, potentially leading a group of young women who would have previously been cigarette-only smokers to begin co-use. Within the changing context of

cigarette and marijuana use, it is critical to continue to monitor and investigate gender changes over time.

Demographically, cigarette and marijuana co-users are more similar to marijuana-only users than cigarette-only users. In the adjusted model comparing co-use to marijuana-only use, there were no significant differences in education, marital status, race, ethnicity, or alcohol use. For the adjusted model comparing cigarette-only to co-users, however, age, marital status, race, ethnicity, and alcohol use were all significant predictors, illustrating that demographic factors are better able to distinguish co-users from cigarette-only users than to distinguish co-users from marijuana-only users. This may indicate that cigarette-only users are a distinct group of young adults and are not susceptible to initiate marijuana-use, whereas co-users and marijuana users come from a more similar background.

Interestingly, when examining smoking behavior, co-users behave more like cigarette-only users in their use of cigarettes than like marijuana-only users in their use of marijuana. For example, averages for age of initiating regular cigarette smoking, use of menthol cigarettes, and cigarettes per day are similar for cigarette-only users compared with co-users. The age when a young adult first used marijuana and number of days when marijuana was used in the past month, however, differ for marijuana-only users compared with co-users. This finding may be related to dependence; co-users may display similar levels of nicotine dependence as cigarette-only users. While there is less research on marijuana dependence, it is possible that co-users may experience marijuana and marijuana dependence differently from marijuana-only users. Moreover,

it is possible that the biological propensity for dependence experienced by some young adults may have important implications on co-use.

Lastly, prior work has established there are relationships between tobacco and marijuana co-use and other substance use including alcohol, opiates and stimulants (Ramo et al., 2012; White et al., 2015). In this study, co-users were more likely to use alcohol once a month or more than cigarette-only users, but less likely than marijuana-only users. Co-users were also more likely to have ever used other serious illicit drugs than cigarette-only or marijuana-only users. Taken together, these findings may suggest that co-users are at a higher risk for other comorbid substance use conditions. To this end, primary care physicians and psychiatrists should include screening for marijuana and tobacco with other substances, and give specific consideration to screening for marijuana and tobacco co-use among young adults who respond affirmatively to using either marijuana or tobacco. Additionally, as co-use is related to depressive symptoms, clinicians should consider screening for co-use among young adults reporting depressive symptoms and for depressive symptoms among young adults reporting co-use. Future research can contribute to more effective, tailored prevention strategies and public health messaging specific to this unique group of co-users who have significant health risks from their dual exposures, as well as helping clinicians and public health educators best serve young adults exhibiting these unique risk factors.

ii. Strengths and Limitations

There are notable strengths to this study. Since this study used nationally-representative data across a 10-year range, it's reasonable to postulate that the data accurately reflects the U.S. young adult population and allows for generalization about

this subset of the population. Additionally, the weighted sample size was sufficiently large to allow for meaningful subgroup comparisons, particularly by racial subgroup, and a range of risk factors to be considered.

This study also has limitations to consider. First, because this study was a secondary analysis of pre-existing data, there are questions that were not included in this dataset that may have been important or interesting to study based on prior literature. For example, NHANES includes very little detail about history, frequency and intensity of marijuana use in 2005-2006 and 2009-2010 waves of data collection, which limited comparisons between marijuana-only and co-users. Moreover, NHANES includes no questions that could be used to assess marijuana dependence, and includes questions about depression but no other mental health outcomes (e.g., anxiety). Additionally, co-users of tobacco and marijuana in this study may also be regular users of other substances not assessed such as cigars. NHANES includes a question to assess past 5 day cigar use, but the reported prevalence was very low in this sample (2.41%) so cigar use was not assessed as an outcome. This study examined lifetime serious drug use but was not able to assess current illicit drug use due to limitations of NHANES data available. It is possible that co-users of tobacco and marijuana are also frequent users of other substances not examined in this study and these other substances complicate the relationship between cigarette use and marijuana use. Finally, because this study used multiple, pooled waves of cross-sectional data, there is no way to establish a temporal relationship between cigarette and marijuana initiation, which is critical for intervention.

e. Conclusions

These findings can contribute to public health prevention and educational strategies designed specifically to address the risk of co-use. Factors that predict co-use can be used to tailor education curriculum for young adults to reduce the risk of single product-users initiating a second substance. Additionally, since marijuana and tobacco co-use represents a distinct pattern of behavior, preventing the initiation of one substance may be critical in preventing the other or preventing the transition from one substance to both substances.

Table 3.1 Sample Demographics by Past-Month Smoking Status Across 3 Waves of Weighted NHANES Data (N=124,039,350)

	Neither Cigarette nor Marijuana use in past month (64.54%; n=80,056,251)	Cigarette-Only use in past month (17.07%; n=21,169,082)	Marijuana-Only use in past month (7.68%; n=9,520,873)	Cigarette and Marijuana Co- use in past month (10.72%; n=13,293,144)	
Gender					
Male	58.75%	17.69%	10.11%	13.45%	F=15.96 p<0.001***
Female	70.33%	16.45%	5.24%	7.99%	
Race and Ethnicity					
Hispanic Ethnicity	74.81%	12.04%	7.72%	5.43%	F=7.14 p<0.001***
Non-Hispanic White	60.45%	20.35%	6.87%	12.33%	
Non-Hispanic Black	61.41%	13.96%	11.28%	13.35%	
Other Race/Multi-Racial	75.71%	9.77%	7.58%	6.95%	
Age (mean)	25.57	25.70	24.78	24.93	F=5.72 p<0.01**
Education Level					
Less than 12 th Grade	53.32%	27.59%	4.56%	14.53%	F=12.26 p<0.001***
High School/GED	54.51%	23.58%	8.83%	13.08%	
Some College/ Associates Degree	66.20%	13.56%	9.30%	10.94%	
College Graduate or above	80.16%	8.33%	6.25%	5.26%	
Ratio of income to poverty guideline	2.64	2.33	2.27	2.17	F=7.26 p<0.001***
Depressive Symptoms					
None	67.88%	13.95%	8.51%	9.66%	F=17.81 p<0.001***
Any	50.48%	21.60%	8.58%	19.34%	
Ever Serious Drug Use					
Never	71.57%	13.95%	7.55%	6.93%	F=89.52 p<0.001***
Ever	28.69%	23.75%	13.21%	34.36%	
Alcohol Use					
None	80.49%	16.20%	0.91%	2.39%	

Less than once a month	65.23%	16.84%	8.19%	9.75%	F=24.83 p<0.001***
Once a month or more	53.62%	17.80%	11.71%	16.87%	
Household Tobacco Exposure					
No	75.69%	11.17%	7.70%	5.45%	F=101.29 p<0.001***
Yes	25.93%	37.17%	7.77%	29.12%	
Marital Status					
Married	76.15%	15.38%	4.39%	4.09%	F=12.26 p<0.001***
Widowed, Divorced or Separated	51.37%	25.31%	8.19%	15.13%	
Never Married	61.94%	15.25%	10.19%	12.62%	
Living with Partner	52.66%	23.22%	6.91%	17.21%	
Employment Status					
Working	64.95%	16.93%	7.91%	10.21%	F=9.83 p<0.001***
Looking for Work	58.35%	18.27%	9.98%	13.40%	
Not Working – going to school	75.59%	16.01%	1.82%	6.59%	
Not Working – taking care of house/family	61.17%	6.75%	12.62%	13.46%	
Not Working – other	53.06%	23.28%	7.63%	16.03%	

*The percentages presented are row percentages

Table 3.2 Adjusted Multinomial Logistic Regression Models

	Cigarette-Only vs Neither AOR (95% CI)	Marijuana-Only vs Neither AOR (95% CI)	Co-use vs Neither AOR (95% CI)
Year (ref. 2005 - 2006)			
2009 - 2010	0.83 (0.57, 1.22)	0.81 (0.44, 1.51)	1.24 (0.65, 2.36)
2013 - 2014	0.44 (0.25, 0.78)**	1.03 (0.58, 1.81)	0.79 (0.48, 1.31)
Female Gender (ref. Male)	1.01 (0.74, 1.37)	0.61 (0.45, 0.84)**	0.72 (0.48, 1.08)
Age	1.06 (1.00, 1.11)*	0.95 (0.88, 1.02)	0.97 (0.90, 1.06)
Education (ref. <12th grade)			
HS/GED	0.82 (0.53, 1.27)	1.98 (0.79, 4.98)	0.93 (0.46, 1.89)
Some College/AA degree	0.34 (0.22, 0.53)***	1.35 (0.61, 2.99)	0.54 (0.31, 0.94)*
College Grad or Above	0.18 (0.11, 0.31)***	0.93 (0.39, 2.21)	0.33 (0.17, 0.61)**
Marital Status (ref. Never Married)			
Married	0.92 (0.60, 1.43)	0.50 (0.29, 0.86)*	0.40 (0.23, 0.73)**
Widowed, Divorced, Separated	1.45 (0.82, 2.56)	1.14 (0.49, 2.65)	1.22 (0.52, 2.88)
Living With Partner	1.31 (0.88, 1.94)	0.71 (0.40, 1.26)	1.43 (0.91, 2.26)
Race and Ethnicity (ref. Non-Hispanic White)			
Hispanic Ethnicity	0.38 (0.24, 0.60)***	0.84 (0.50, 1.42)	0.32 (0.18, 0.59)**
Non-Hispanic Black	0.52 (0.33, 0.81)**	1.91 (1.21, 3.00)**	1.24 (0.76, 2.02)
Other Race or Multi-Racial	0.92 (0.52, 1.63)	1.13 (0.60, 2.12)	0.75 (0.32, 1.77)
Income Ratio	0.97 (0.88, 1.07)	0.82 (0.71, 0.96)*	0.88 (0.79, 0.99)*
Any Depressive Symptoms (ref. No Depressive Symptoms)	1.49 (1.14, 1.95)**	1.18 (0.72, 1.93)	1.93 (1.27, 2.93)**
Ever Serious Drug Use (ref. Never)	3.25 (2.12, 4.97)***	3.70 (2.40, 5.69)***	12.31 (8.62, 17.57)***
Days Drink Alcohol per Year (ref. None)			
Less than once per month	2.85 (1.62, 5.04)**	7.29 (2.60, 20.49)***	4.06 (1.97, 8.40)***
More than once per month	4.33 (2.46, 7.63)***	13.00 (4.69, 36.00)***	7.59 (4.00, 14.39)***
Household Tobacco Exposure (ref. No)	9.04 (5.83, 14.02)***	2.23 (1.37, 3.63)**	13.26 (7.85, 22.40)***

*p<0.05; **p≤0.01; ***p≤0.001

Table 3.3 Adjusted Binary Logistic Regression Predicting Co-Use vs Past-Month Cigarette-Only Use

	AOR (95% CI OR)
Year (ref. 2005 - 2006)	
2009 - 2010	1.30 (0.69, 2.42)
2013 - 2014	1.54 (0.80, 2.97)
Age	0.93 (0.86, 0.99)*
Marital Status (ref. Never Married)	
Married	0.38 (0.21, 0.70)**
Widowed, Divorced, or Separated	0.72 (0.34, 1.54)
Living With Partner	0.93 (0.61, 1.42)
Race and Ethnicity (ref. Non-Hispanic White)	
Hispanic Ethnicity	0.80 (0.48, 1.35)
Non-Hispanic Black	2.50 (1.38, 4.50)**
Other Race or Multi-Racial	0.89 (0.35, 2.30)
Ever Serious Drug Use (ref. Never)	3.73 (2.37, 5.86)***
Days Drink Alcohol per Year (ref. None)	
Less than once per month	1.90 (0.82, 4.37)
More than once per month	2.40 (1.09, 5.32)*
Household Tobacco Exposure (ref. No)	1.52 (0.88, 2.63)

*p<0.05; **p≤0.01; ***p≤0.001

Table 3.4 Adjusted Binary Logistic Regression Predicting Co-Use vs Marijuana-Only Use

	AOR (95% CI)
Education (ref. <12th grade)	
HS/GED	0.61 (0.25, 1.50)
Some College/AA degree	0.53 (0.24, 1.15)
College Grad or Above	0.42 (0.15, 1.17)
Marital Status (ref. Never Married)	
Married	0.68 (0.30, 1.54)
Widowed, Divorced, Separated	1.88 (0.68, 5.20)
Living With Partner	1.58 (0.77, 3.27)
Race and Ethnicity (ref. Non-Hispanic White)	
Hispanic Ethnicity	0.49 (0.24, 1.01)
Non-Hispanic Black	0.61 (0.32, 1.16)
Other Race or Multi-Racial	0.56 (0.21, 1.51)
Any Depressive Symptoms (ref. No Depressive Symptoms)	1.77 (1.01, 3.10)*
Ever Serious Drug Use (ref. Never)	2.01 (1.09, 3.68)*
Days Drink Alcohol per Year (ref. None)	
Less than once per month	0.49 (0.19, 1.22)
More than once per month	0.81 (0.31, 2.05)
Household Tobacco Exposure (ref. No)	
Yes	5.17 (2.98, 8.95)***
Age First Used Marijuana	0.83 (0.75, 0.92)***
Days Used Marijuana in Past Month	0.98 (0.96, 1.01)

*p<0.05; **p≤0.01; ***p≤0.001

Figure 3.1 Prevalence of Past Month Cigarette, Marijuana and Cigarette and Marijuana Co-Use among Young Adults 21-30, 2005-2014

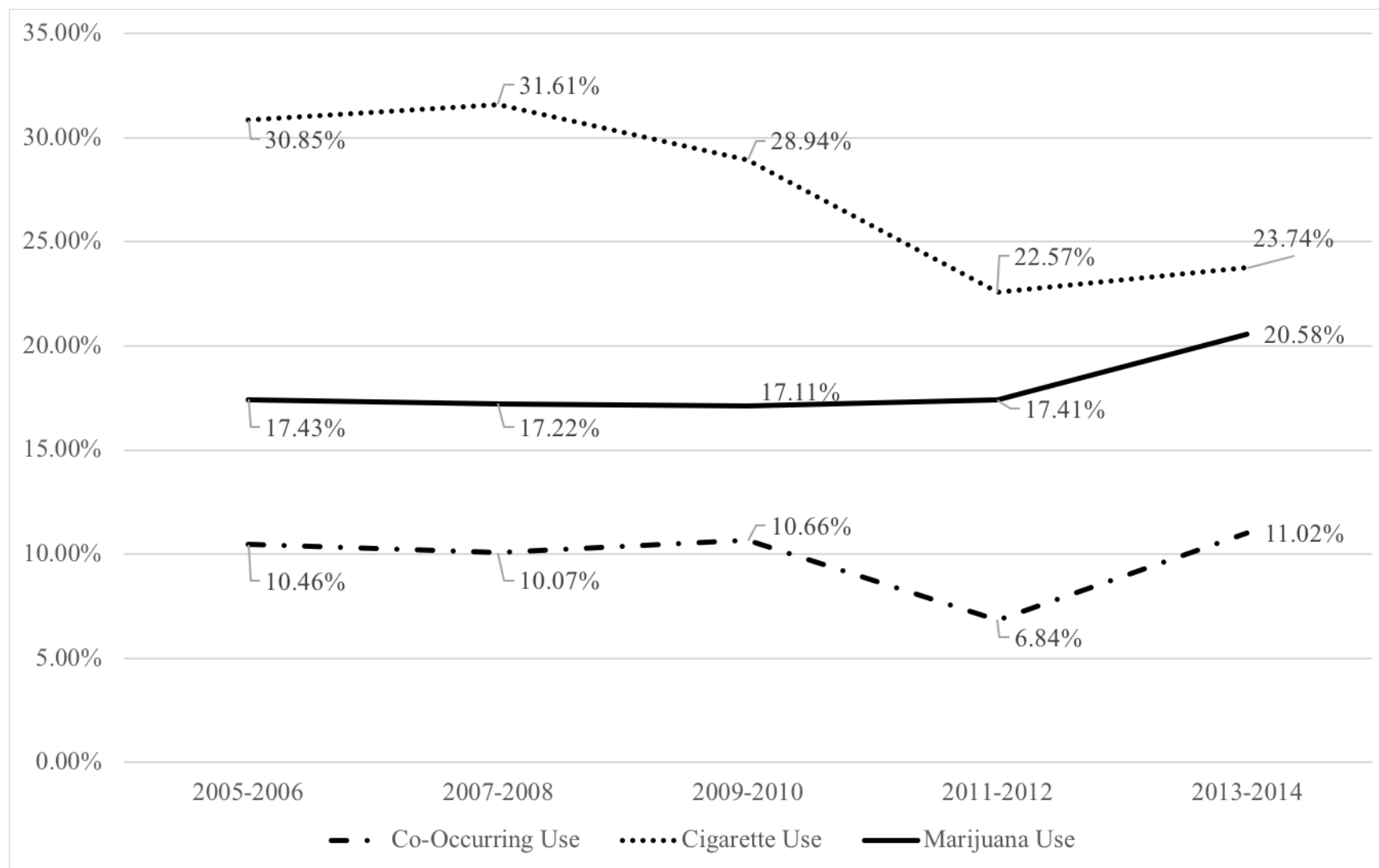


Figure 3.2 Prevalence of Past Month Cigarette and Marijuana Co-Use among Young Adults 21-30, by Gender 2005-2014

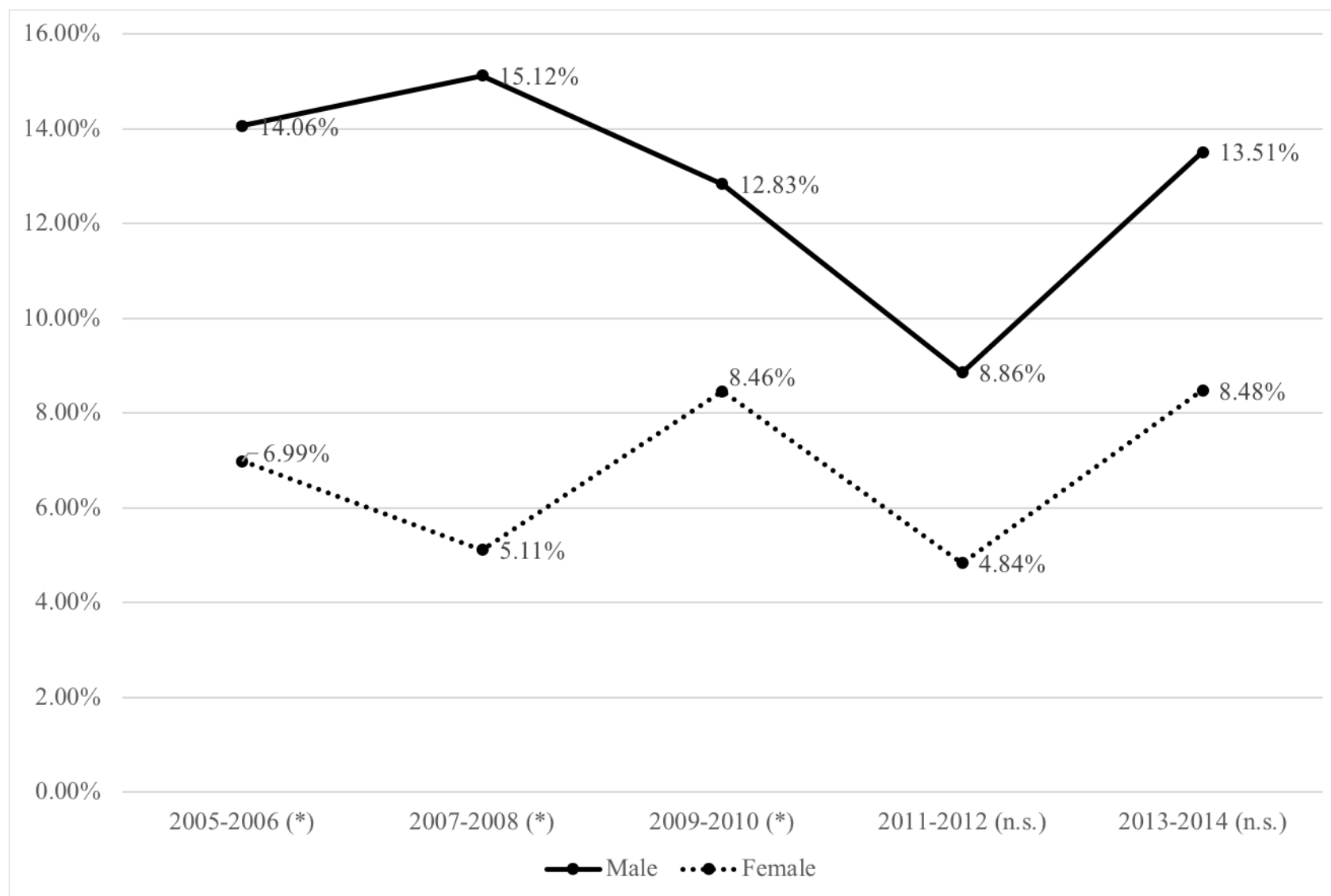


Figure 3.3 Prevalence of Past Month Cigarette and Marijuana Co-Use among Young Adults 21-30, by Race and Ethnicity 2005-2014

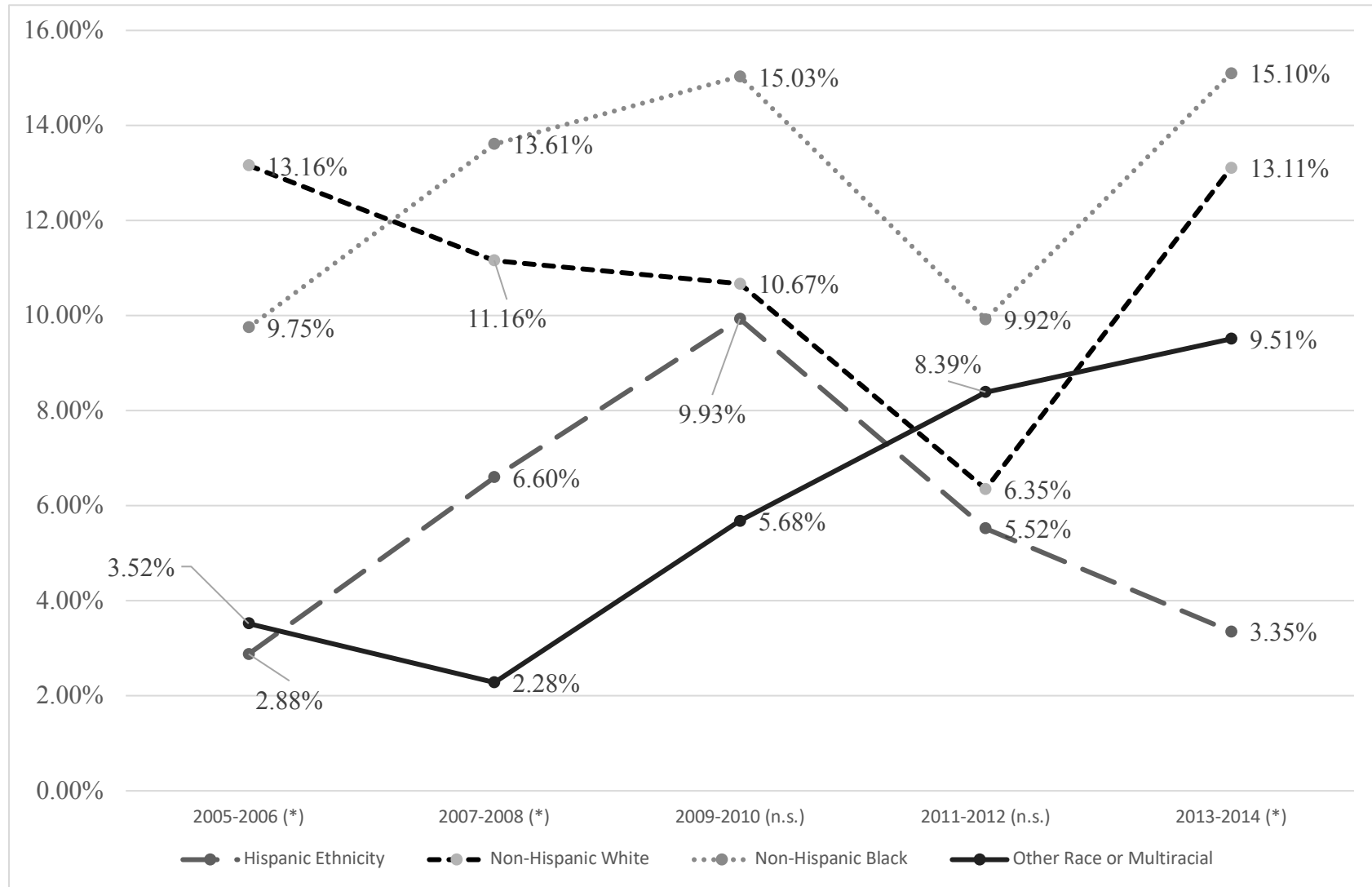
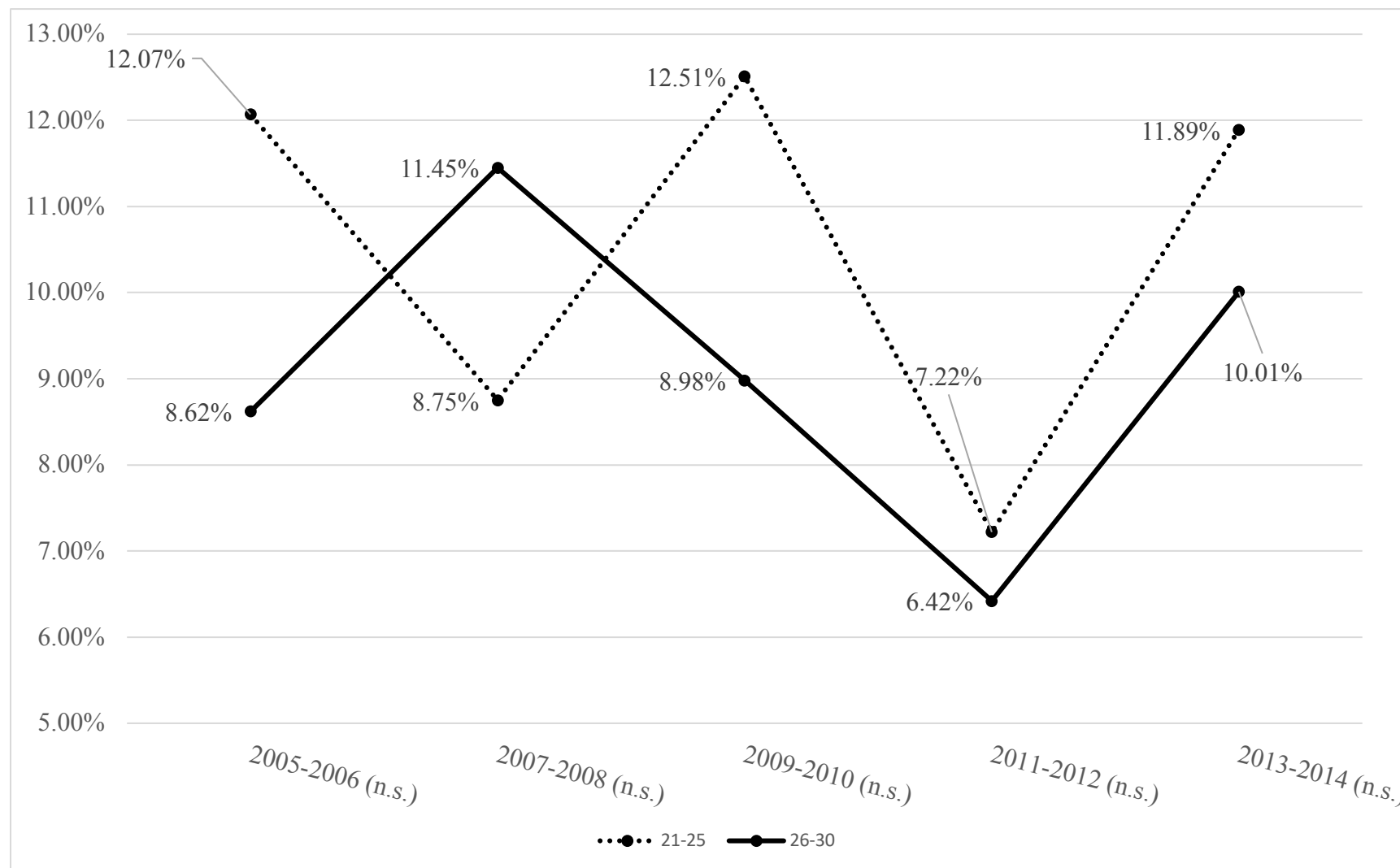


Figure 3.4 Prevalence of Past Month Cigarette and Marijuana Co-Use among Young Adults 21-30, by Age (21-25 vs 26-30) 2005-2014



CHAPTER 4: Study 2, “If I had more marijuana, I would smoke no tobacco”: Co-Use and Tobacco as a Replacement for Marijuana among Young Adults

a. Introduction

i. Tobacco and Marijuana Use among Young Adults

Tobacco use represents the single greatest cause of preventable mortality in the United States and is a critical health behavior for public health efforts, particularly among young adults who may benefit the most from prevention and early cessation (Centers for Disease Control and Prevention, 2016c). It is crucial to understand the contexts in which young adults use tobacco in order to develop effective prevention and cessation strategies. Research indicates that many young people use tobacco and marijuana together and that tobacco and marijuana co-use represents a specific pattern of behavior (Ramo & Prochaska, 2012; Subramaniam, McGlade, & Yurgelun-Todd, 2016). Prior work has documented one popular method of co-use where adolescents and young adults create “blunts” by cutting a cigar or cigar product open, replacing all or some of the tobacco with marijuana, wrapping it back up and smoking it (National Institute on Drug Abuse, 2016).

Studies have found that almost half of young people who use one combustible product, marijuana or tobacco, use both tobacco and marijuana, underscoring the importance of studying this behavioral pattern (Ramo, Delucchi, Liu, Hall, & Prochaska, 2014; Ramo et al., 2012; Ramo & Prochaska, 2012). Studying the combined

use of tobacco and marijuana among young adults may offer unique insight that could inform health education campaigns to address this group of young adults.

Co-use of tobacco and marijuana use has been studied in different age groups, however, due to different products included in definitions of co-use and differences in ages included from study to study, it is difficult to paint a comprehensive picture co-use prevalence. Co-use has been found to be as high as 12% in a sample of middle and high school students (Webster, Chaiton, & Kirst, 2014), 5.2% in a sample of adults over age 18 (Schauer, Berg, Kegler, Donovan, & Windle, 2015), and between 29.1% and 39.8% among 18-25 year old users of at least one combustible product (Kennedy, Caraballo, Rolle, & Rock, 2016). The present study aimed to qualitatively explore co-use among young adults (ages 21-30) to glean a better understanding of behavioral patterns and factors influencing co-use. The age range for this study was selected to encompass “emerging adulthood” (Gilmore & Meersand, 2013), a developmental period marking the time of transition from adolescence to adulthood, from the time a young adult can legally drink to when they begin to exhibit more characteristics of traditional adulthood. Most published research on co-use has focused on high school students, college students, or a general adult sample; “emerging adults” are understudied with regards to their co-use behaviors.

ii. Theoretical Model

A theoretical understanding of young adult tobacco and marijuana co-use is sorely missing from the literature. Most published work on co-use has been atheoretical, focusing instead on an epidemiologic profile of co-use, i.e. estimates of prevalence and associations with other health behaviors, or scale development to assess

expectancies of co-use (Ramo, Liu, & Prochaska, 2013) and reasons for co-use (Berg et al., 2018). One recent study that developed a scale for reasons of co-use was informed by Social Cognitive Theory, but did not explicitly assess the importance of specific theoretical constructs (Berg et al., 2018).

This study aimed to assess the salience of several health behavior theory concepts and constructs in understanding the co-occurring use of marijuana and tobacco among young adults. This study's theoretical model (Figure 4.1) included one health behavior model, the Social Ecological Model, and two constructs and one concept from two health behavior theories at different levels, the Theory of Reasoned Action at the intrapersonal level and Social Cognitive Theory at the interpersonal level.

This study's theoretical model is framed within the larger Social Ecological Model, which has been used in many prior studies of tobacco use (Fuemmeler et al., 2013; Klein, Bernat, Lenk, & Forster, 2013) and marijuana use (Connell, Gilreath, Aclin, & Brex, 2010) behavior among adolescents and young adults (Bronfenbrenner & Morris, 2007).

The theoretical model also includes constructs from the Theory of Reasoned Action (Fishbein & Ajzen, 1975). The Theory of Reasoned Action Behavior is often used for studies of substance use, including tobacco (Karimy, Niknami, Heidarnia, Hajizadeh, & Montazeri, 2013; Macy, Middlestadt, Seo, Kolbe, & Jay, 2012; Stephens, Ogunsanya, Ford, Bamgbade, & Liang, 2015; Topa & Moriano, 2010), marijuana (Ito, Henry, Cordova, & Bryan, 2015) and the co-occurring use of multiple substances (Kam, Matsunaga, Hecht, & Ndiaye, 2009). Attitudes and Subjective Norms towards marijuana and tobacco co-occurring use were explored in this study. The Theory of

Reasoned Action was selected over the more recent Theory of Planned Behavior because the construct of perceived behavioral control is usually applied to cessation in studies of tobacco and was not hypothesized to be a factor in co-use.

Social Cognitive Theory (SCT) is an interpersonal-level theory (Bandura, 1986). Observational learning is a concept in SCT and describes the process through which “a person watches the actions of another person and the reinforcements they receive,” (Bandura, 1986). This study included questions about observational learning in the in-depth interviews. Additionally, based on prior literature, the proposed theoretical model also includes household tobacco exposure, friends’ use, social contexts of use, influence of job/school, influences of the physical and social environment and the influence of changes in marijuana policy.

b. Methods

i. Interview Guide Development

The interview guide was designed to better understand individual, interpersonal, organizational, community and policy influences on young adult co-use experiences. Questions to assess theoretical constructs, specifically attitudes and subjective norms, were adapted from prior studies, to ensure findings from this study could be compared to findings from other studies (Godin, Valois, Lepage, & Desharnais, 1992; Norman, Conner, & Bell, 1999) as well as sample guides for operationalization of theoretical constructs (Ajzen, 2010; Ajzen, 2013).

ii. Recruitment

Young adults were recruited through Craigslist advertisements (posted in Annapolis, Baltimore, Maryland suburbs of DC networks). Participants who read the

advertisement and were interested emailed the PI and scheduled a time to talk on the phone to learn more about the study. After discussing the scope of the in-depth interviews and the goals of the project with the PI, potential participants completed a screening questionnaire over the phone.

To be eligible for the study, participants needed to be between 21 and 30 years of age, live in Maryland and report using both tobacco and marijuana at least once the past month. After participants screened eligible and indicated they were interested in participating, the PI read the Waiver of Consent to participants, emailed them a copy for their records, and obtained verbal consent, as approved by the University of Maryland Institutional Review Board (IRB00000474). The interview guide was pilot tested with 3 participants and was revised for clarity.

iii. Interviews

Interviews were conducted over the telephone to protect participant privacy. Participants were asked to select a pseudonym or nickname to use during the interview, subsequently participants were randomly assigned a set of initials by the PI to use in reporting of the results. Interviews were audio-recorded, transcribed verbatim by Rev.com, an online transcription website, and cleaned by the PI. Participants were emailed a \$40 electronic Amazon gift card to thank them for their time. Additionally, participants were emailed evidence-based factsheets on tobacco and marijuana health effects as well as information for the Maryland Quitline and local cessation resources. Interviews were conducted from November 2017 to December 2017; details on recruitment and eligibility are provided (Figure 4.2). Interviews were completed until thematic saturation was reached, or the interviewer began to hear the same comments

again and again, with twenty interviews completed (Saunders et al., 2017). Interviews lasted between 20 and 60 minutes; the average interview was 30 minutes.

iv. Qualitative Coding and Analysis

NVivo 11 was used for thematic analysis of interview transcripts. Open-coding was used to identify concepts emerging across different interview transcripts. Next, axial coding was used to explore the contexts, precursors, and implications of the open codes in the data. Axial codes were examined to develop an overall understanding of findings. A codebook was developed, with definitions for each key code term. A subset of interview transcripts (15%; n=3 interviews) were double coded by the PI and a trained graduate student to assess the completeness of the data codebook and ensure that the codes were clearly defined. Interrater reliability was assessed ($\kappa = 0.88$) and discrepancies between the two sets of codes were discussed. The codebook was amended, with several codes added and definitions expanded.

c Results

i. Sample Description

Twenty interviews were conducted. Interviewees were asked to describe their gender in an open-ended question; six respondents identified as female and fourteen identified as male. Half of the respondents reported only using one tobacco product in the past month (n=10), with single tobacco product users split evenly between cigarettes (n=5) and cigar products (n=5) (Table 4.1). Half of those interviewed reported using multiple tobacco products in the past month, either two (n = 9) or three (n=1). Cigar products, including cigarillos, little cigars and cigarillo wrapping papers, were relatively commonly used (n = 13 among single and multiple product users),

while other products such as dip (n = 1), snus (n = 1) and electronic nicotine delivery devices (n = 2) were less frequently used. Eight participants indicated that they do not have a preferred method to smoke marijuana and that the method they choose depends on their external factors like how much marijuana they plan to smoke or where they are planning to smoke. Nine participants indicated their preferred method to smoke marijuana involved a tobacco product (blunts, created using a cigar product, and joints, handrolled cigarettes with marijuana and tobacco). Waterpipes, also called “bongs,” (n = 2) and vaporizers (n = 1) were also preferred methods of marijuana use.

ii. Simultaneous and Sequential Co-Use

From the interviews, two modes of tobacco and marijuana co-use emerged: simultaneous and sequential. Simultaneous use involved combining marijuana and tobacco into one product (blunts or joints) to smoke both at the same time. Sequential use involved participants smoking one product first and then the other product directly afterwards in a short time frame and was discussed by 8 respondents. These modes of co-use were not mutually exclusive; respondents reported engaging in both mode of co-use, for example smoking a blunt and then smoking a cigarette directly after.

iii. Using Tobacco to Replace Marijuana

One pattern of behavior that emerged from young adults’ discussion of co-use was that young adults use marijuana separately in social events or recreationally, but will use tobacco separately as a replacement for marijuana when necessary. Young adults prefer marijuana to tobacco use and use tobacco as a substitute when they are in a situation where they cannot obtain or use marijuana. LM, a 29-year-old female, expressed that if she had access to marijuana she would not use tobacco at all, “If I had

more marijuana, I would smoke no tobacco. I wouldn't mix it with the tobacco, I wouldn't smoke a Capone [cigar brand]. Nope.” FR, a 25-year-old male agreed, “If I had the choice, I prefer to smoke marijuana any day over tobacco.” This preference for marijuana only was explicitly expressed by 8 participants. LE, a 25-year-old male, expounded on this relationship and shared how smoking marijuana reduces his likelihood of smoking tobacco:

If I got more marijuana, I'm not gonna nine times outta ten, I'm not gonna really smoke or mess with tobacco, but if I'm just chilling and I don't have none [no marijuana] then I might go for the tobacco product...If I had marijuana throughout the rest of my life, I would never have to touch a tobacco product ever...once I'm smoking weed, I'm not gonna never think about touching tobacco, but if I aint got none [no marijuana], then now, I might get an itch here and there for some tobacco.

When asked about reasons that they would still occasionally “get an itch for tobacco” despite a stated preference for marijuana, most young adults cited addiction to nicotine and stress. DM, a 29 year old male, shared, “Yeah, it's just for stress, and kinda caught up in the, the nicotine addiction right now.” RG, a 24 year old female agreed, “I don't know at this point, I really think I'm just addicted.”

In this way, young adults’ choice of which product to use is determined by their perceptions of availability and the potential risks of using marijuana specific to their present situation. Overwhelmingly, young adults perceived that marijuana was more challenging to obtain than tobacco, likely due to marijuana’s status as illegal.

iv. Individual-Level Influences on Co-Use: Preferences for Blunt Use and Personal Finances

Overwhelmingly, blunts were the most commonly-named way that young adults reported smoking marijuana and tobacco. Personal preference for blunts is an individual-level factor that influenced young adult co-use behaviors (Table 4.2). Eighteen of the twenty interviewees described using blunts, demonstrating the popularity of this method. Four interviewees described their first experience smoking marijuana was a blunt, this early exposure to products that include marijuana and tobacco may shape future use and preferences among young adults. Two participants indicated that the only time they smoke tobacco products is when they're using a blunt to smoke marijuana, including BA, a 28-year-old male who shared, "The only time that I use tobacco is the cigars and it's when I'm smoking weed."

Some participants indicated that they remove all of the cigar tobacco when creating a blunt so the end product is just the tobacco wrapper from the cigar and marijuana. However, some participants indicated that they add some of the cigar tobacco into the blunt, like KB, a 27-year-old male who shared "[Blunts are] my preference, number one. I also sprinkle some tobacco in there as well."

Personal finances were an additional individual-level factor that influenced young adult co-use behaviors and choice of product. Generally, young adults reported that tobacco is less expensive than marijuana, so when they have less money they will smoke more tobacco and less marijuana. EN, a 22 year-old male, explained why adding tobacco back into a blunt is popular, "it kind of saves money to mix your [marijuana with tobacco]... you know what I mean."

Similarly, participants shared that sometimes they are not able to afford marijuana because it is more expensive than tobacco. RG expressed that she would prefer to smoke marijuana, but smoke cigarettes when she cannot afford marijuana, “Smoking weed is more expensive, and it's 20 cigarettes in a pack.” Similarly, AR, a 21-year-old male, indicated that he only smokes tobacco, “on a day where I can't afford marijuana.” For young adults, the cost of marijuana is a barrier to their marijuana use, and they choose to use cheaper tobacco products to replace marijuana when they do not have sufficient funds to purchase marijuana.

v. Interpersonal-Level Influences on Co-Use: Peer Influences

Interviewees indicated that most of their friends used marijuana and that around half of their friends used tobacco products. ET, a 24-year-old male, summed up this sentiment, “I would say maybe 50/50 [of my friends smoke vs do not smoke] for the tobacco, but the marijuana is more like 80 to 90%.” Participants indicated that having friends who smoke made them more likely to smoke because of the access and opportunities to use as well as the social aspect of the behavior. EN shared his experiences, “It’s very social [smoking marijuana] but I mean, I do use it alone sometimes, but more often than not, it’s a social thing.”

Participants reported that they regularly smoke marijuana and tobacco with friends and that friends influence how much they co-use. BF, a 28 year old male, shared that he finds he is more likely to smoke around certain friends. He said, “Yeah, really any one of my friends who smokes I'm more likely to smoke with versus when we're around non-smoking friends, then [my] use definitely falls dramatically.” LS, a 26-year-old female, agreed that she often smokes marijuana with her friends, but suggested

that the preference for marijuana use may have been what initiated these friendships, “I surrounded myself with other stoners. We have this thing of, we know another stoner whether they said it or not. We just know.” It is clear that marijuana and tobacco co-use and particularly marijuana use are strongly tied to peer influences for young adults, however it’s not clear what direction this relationship goes (friends prompting use or use initiating friendships) or if it is bi-directional.

Eight participants shared that they regularly engage in sequential co-use, smoking tobacco and marijuana one directly after the other. Most commonly (n=6 of the 8 participants who reported regularly engaging in sequential co-use) young adults reported that they smoke a cigarette after smoking marijuana. The reason for this specific ordering of product was based on what young adults had seen their friends do and learned from their friends. EQ, a 29-year-old male, shared how he got into the habit of smoking a cigarette after marijuana, explaining “[as] soon as I smoke a blunt, I smoke a cigarette right behind it. Cause my friends just tell me that you get more high if you smoke a cigarette right behind it.” The reasoning shared by EQ (that cigarettes after a blunt will increase the high) was iterated by multiple participants and originated from experiences with friends. There were two ways that interviewees came to endorse the idea that cigarettes increase the high of marijuana, either with friends telling participants that a cigarette “boosts” the high of marijuana or through watching their friends smoke cigarettes directly after marijuana and then replicating this behavior.

vi. Organizational-Level Influences on Co-Use: Drug Tests

Employers conducting random drug tests played a role in several interviewees limiting their marijuana usage or cutting down, leading them to use more tobacco to

replace their marijuana use. EQ shared that recently he's been smoking more tobacco as he tries to cut down on marijuana, "My job's doing random piss tests, so I can't smoke [marijuana] every day."

Employment also influences young adult choice of products. Most interviewees reported that their job does not permit marijuana use. Some interviewees use tobacco at work when they'd prefer to use marijuana. CD, a 21-year-old male, smokes cigarettes at work, although he prefers marijuana over tobacco. CD postulated "If marijuana was legal, I wouldn't be smoking cigarettes on break at my job, I'd be smoking blunts."

However, other young adults indicated that they will smoke marijuana at work, even though it is not permitted, and will use a tobacco product to cover the smell of the marijuana. EH, a 29-year-old male, shared that he would only smoke an unaltered cigar product when he's on a break at work and wants to cover up the smell after he smokes marijuana, "I typically would only choose a tobacco product [without marijuana] such as Black and Mild, if I was at work...because it kind of drowns out the weed scent."

vii. Community-Level Influences on Co-Use: Physical Environments

A major reason for sequential use of a tobacco product after marijuana was using the smell of tobacco to cover the smell of marijuana, as in the above example of EH using tobacco products to cover the smell of marijuana when he is at work. Young adults' discussion of why they would need to conceal the smell of marijuana were strongly tied to different environments. CD shared "I do...smoke a cigarette after a blunt to try to air out the smell. It's only when I have something professional to do." When CD knows he will be in a physical or social environment where he needs to be

“professional” and he doesn’t want to smell like marijuana, he uses a tobacco product after marijuana to conceal the smell of marijuana.

There are certain physical locations where young adults feel like they have to use tobacco instead of marijuana even though they would prefer to smoke marijuana.

MR, a 27-year-old female, shared that the only real risk she perceives to marijuana use is that it is illegal and a police officer lives in the same apartment building as she does,

“The only risky part is that it's not legal. I have a cop in my building, you know?” This makes MR less likely to smoke marijuana at her apartment but she still smokes at her

friends’ houses and apartments or in social situations. Young adults were very

conscious of physical environments where it is unsafe to smoke marijuana and

indicated that when they are in these locations they are more likely to smoke tobacco.

AR said he would, “Never [smoke marijuana in] public places” but he will smoke

tobacco in public. EN, said he only smokes marijuana, “At my house, at my apartment.

Just cause it’s safer.” ET shared that he used to smoke marijuana in his car when he

was younger, however after an incident with the police he stopped smoking marijuana

in his car and now only smokes marijuana in his house. ET reflected, “At my age now,

it's [marijuana use] mainly just in the house. I used to do it [smoke marijuana] in the

car, but I found out that's not a good idea a couple years ago...But I’ll smoke Black and

Milds [brand of cigar product].” ET reported that he still finds the physical environment

of being in a car makes him want to smoke, so he smokes cigars instead of marijuana.

viii. Policy-Level Influences on Co-Use: Marijuana Policy and Availability

Overwhelmingly, when asked to reflect on the ways that changes in marijuana policy across the United States in the past few years have influenced their perceptions

of marijuana risk and use, participants responded that these factors had influenced neither their perceptions nor their use. For example, EN's reaction was, "They've [the changes in policy] more influenced me to the senselessness of the illegality of it." ET expressed a similar opinion, "It didn't really change my opinion on it. I'm happy to see that it got decriminalized in more places. But even if it didn't, I'd probably would still be doing it the same." PS, a 25-year-old male, agreed, stating, "I've always been pro [marijuana]."

Because recreational marijuana is illegal in the state of Maryland, in order to buy marijuana interviewees shared that they had to have social connections to someone who sells marijuana. This reduces young adults' access to marijuana, thereby influencing their choice of product. Young adults shared that they will smoke tobacco products when they are not able to obtain marijuana. RG shared that sometimes she wants to buy marijuana but, "the weed man is not answering the phone...you got to wait and call other people." Waiting for other people can be frustrating and take time. FR shared that he often drives from suburban Maryland into DC to purchase marijuana and the likelihood of him being able to obtain marijuana "depends on what time it is and [if I'm] making it to DC or not." In FR's experience is much more difficult to purchase marijuana in Maryland than in DC, so he is willing to travel to purchase marijuana in DC. NC, a 21-year-old female, reaffirmed that access to marijuana is dependent on social connections for young adults, "I know people, but if I didn't know the people I knew, then it would be pretty hard [to buy marijuana]."

d. Discussion

Findings from this study complement and extended prior work with adolescents and college students related to tobacco and marijuana co-use, illustrating that many of the same factors that influence adolescent and college student co-use continue into young adulthood. While much prior work co-use has focused on high school students, college students, or all adults, this study focused on the under-studied age group of young adults who are between 21 and 30, who may have different experiences, behavioral patterns, and factors influencing their use than younger adolescents or older adults. Literature has extensively documented the process of adolescents using cigars as a method to smoke marijuana through the creation of blunts (Giovenco, Miller Lo, Lewis, & Delnevo, 2016; Lee, Battle, Lipton, & Soller, 2010) and the sequential ordering of smoking a tobacco product after marijuana because young people believe this increases the high they experience (Lipperman-Kreda & Lee, 2011), but the present study suggests these are popular modes of marijuana use among young adults as well. This study also provides context into these behaviors and a consideration of how they relate to the levels of the Social Ecological Model. Related to sequential use, the experience of beginning to use tobacco after marijuana because participants' friends told them it would increase the high represents an influence at the interpersonal level and illustrates the importance of friends in shaping the substance use beliefs and behaviors of young adults. Young adults smoking tobacco after marijuana to cover the smell and conceal that they are using marijuana has implications at the community and policy levels; marijuana's status as federally illegal means that young people go to certain lengths, including using tobacco products directly after, to hide their marijuana

use. Young adults specifically were more likely to use tobacco products after marijuana to hide the marijuana smell in certain physical public locations, underscoring the importance of community and physical locations in determining young adult tobacco and marijuana co-use behaviors.

Prior work has documented that high school students will use blunts to smoke marijuana and will substitute cigarillos when marijuana is “unavailable,” (Antognoli et al., 2018) however, the contexts of this pattern of behavior may differ for high school students, most of whom cannot legally purchase tobacco products. Young adults in this study were legally able to purchase tobacco products and alcohol and still elected to use tobacco products, both cigarettes and cigars, when they cannot obtain marijuana. Taken together, findings indicate that while “emerging adults,” may share the experience using tobacco to replace marijuana with younger age groups, there may also be experiences unique to this group of 21-30 year olds. The reasons shared by young adults in this study for why they would use tobacco instead of marijuana: they cannot afford marijuana, they cannot access marijuana, they are in a physical location where they cannot use marijuana, and being drug tested by their employers represent influences at different levels of the social ecological model. Personal financial is an individual level influence, while not being able to obtain marijuana relates to policy level factors as well, as marijuana being illegal means that young adults rely on social networks to buy marijuana. The consideration of physical locations where marijuana use would be risky, including in cars, in public spaces and at work, highlights the importance of community level influences in young adult tobacco replacement for marijuana. Finally, drug tests at work prompting young adults to use tobacco to cut

down on marijuana use and conceal their marijuana use at work by smoking tobacco products after marijuana is tied to the organizational level of influence.

Recently, researchers used mixed methods to develop a scale to assess reasons for tobacco and marijuana co-use among college students (Berg et al., 2018); findings from the present study underscore the importance of these reasons of young adult co-use. The four main reasons for co-use from Berg et al.'s scale include: instrumentality (one product prompting or preceding the other product), displacement (using one product to reduce or quit the other), social context (use in social settings), and experimentation (2018). Young adults in this study provided examples of instrumentality of co-use, in the sequential use of products, as well as displacement, when using tobacco to reduce marijuana use because of anticipated drug tests at work. The present study also provides context into reasons for and modes of co-use and reasons young adults may choose to use tobacco over marijuana in certain circumstances.

Several factors of this study's theoretical model emerged as less-salient than predicted. Specifically, the construct of observational learning from social cognitive theory was predicted to be important for young adults, however, since marijuana and tobacco use are not complex behaviors, peer influence broadly was found to be important while the specific construct of observational learning was not a major factor in co-use. The one way that observational learning did come up was young adults learning to physically create blunts. Watching friends disassemble cigar products, break up the marijuana and add it to the wrapper and roll it back up was the one example of observational learning that emerged as salient to young adult co-use. Observational

learning plays a specific role in young adults learning to create blunts but is not an important factor in co-use broadly. Additionally, initially the decision to use the Theory of Reasoned Action instead of the Theory of Planned Behavior was made because perceived behavioral control, the construct added to the Theory of Reasoned Action to create the Theory of Planned Behavior, was proposed to not be an important factor driving co-use. In prior studies of tobacco, perceived behavioral control is usually applied to cessation and the role of addiction and since this study did not explicitly assess addiction or cessation, it was initially hypothesized that perceived behavioral control would not play a role in young adult co-use. However, through the interviews, perceived behavioral control emerged as an important theme in young adult co-use related to replacement and choice of product. Young adults' perceptions of access to products influence their perceived behavioral control that does influence their use of both products. Future studies should aim to fully understand the role of perceived behavioral control in young adult marijuana and tobacco co-use behaviors and choice of products.

Additionally, based on preliminary findings from a quantitative study that showed significant differences in the prevalence of co-use among younger (21-25) and older (26-30) young adults in this age range, interviews were segmented by age with half the interviews taking place with young adults in the lower half of the age range and half taking place with young adults in the older half of the age range. However, when qualitative findings were compared across the two age groups, no important differences emerged. It may be that while prevalence of co-use decreases as young adults begin to age out of the "emerging adult" period and move more towards adulthood for young

adults who continue to co-use their motivations, patterns of use, and experiences are largely the same as younger adult co-users.

There are strengths and limitations to consider with this work. First, the semi-structured format of the interview permitted flexibility in the questions asked, including the interviewer being able to probe for more information throughout the interviews, and allowed participants to reflect on their experiences and share their thoughts. This work was able to provide context and add understanding to a multifaceted behavior among young adults. Additionally, since the screening and interviews were conducted entirely over the phone, participants may have been less acutely aware of the interviewer's presence and may have felt like they could be more candid in their answers. There are, however, limitations. First, the age range for this study was selected to represent the developmental period of "emerging adulthood," but since this period is not accompanied by biological markers and different researchers have proposed different age ranges, it is possible that the age range selected did not truly encompass "young adults." Additionally, interviews were conducted until thematic saturation was reached (with the researcher hearing the same comments again and again) with 20 interviews total, but it is possible that this was not enough to fully understand this behavior. Finally, to protect interviewee privacy, minimal personal information was collected from participants. Specifically, participants were not asked about their racial and ethnic identity. Prior studies have documented the role of race and ethnicity in both tobacco and marijuana use, and not having the ability to compare these qualitative results by racial and ethnic group limits conclusions that can be drawn and does not allow for consideration of how experiences differ by race and ethnicity.

e. Conclusions

In-depth interviews with young adults living in the state of Maryland who reported using both tobacco and marijuana in the past month illustrated two modes of co-use, simultaneous and sequential. Additionally, the behavior of replacement, where young adults prefer to smoke marijuana but will use tobacco products as a replacement in situations where they cannot access or cannot use marijuana emerged as an important part of young adults' experiences. Limitations on young adults' access to marijuana, certain physical locations where they cannot openly smoke marijuana, and random drug testing at their places of employment drive them to replace marijuana with tobacco. This study extends findings from prior work to include young adults and includes the experiences and reflections shared by young adults, helping to contextualize co-use behaviors. This study also provides an understanding of how constructs from health behavior theories may help explain co-use behaviors. Insights from this study can help public health professionals gain a better understanding of these behaviors and opportunities to prevent and intervene with young adult co-users. Future work can build upon this understanding of the influences of co-use across different levels of the Social Ecological Model.

Figure 4.1 Study Theoretical Model

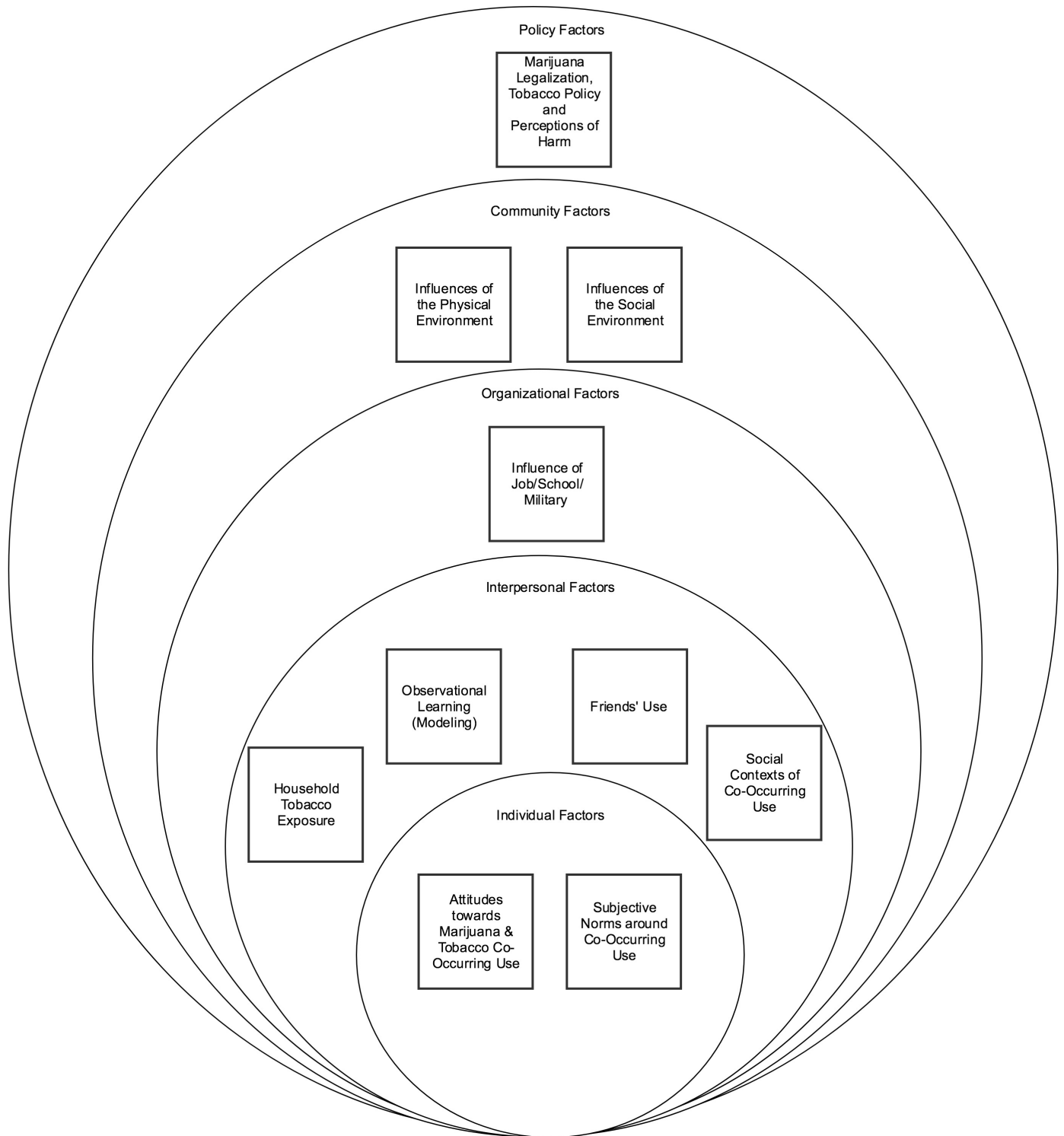


Figure 4.2 Study Recruitment

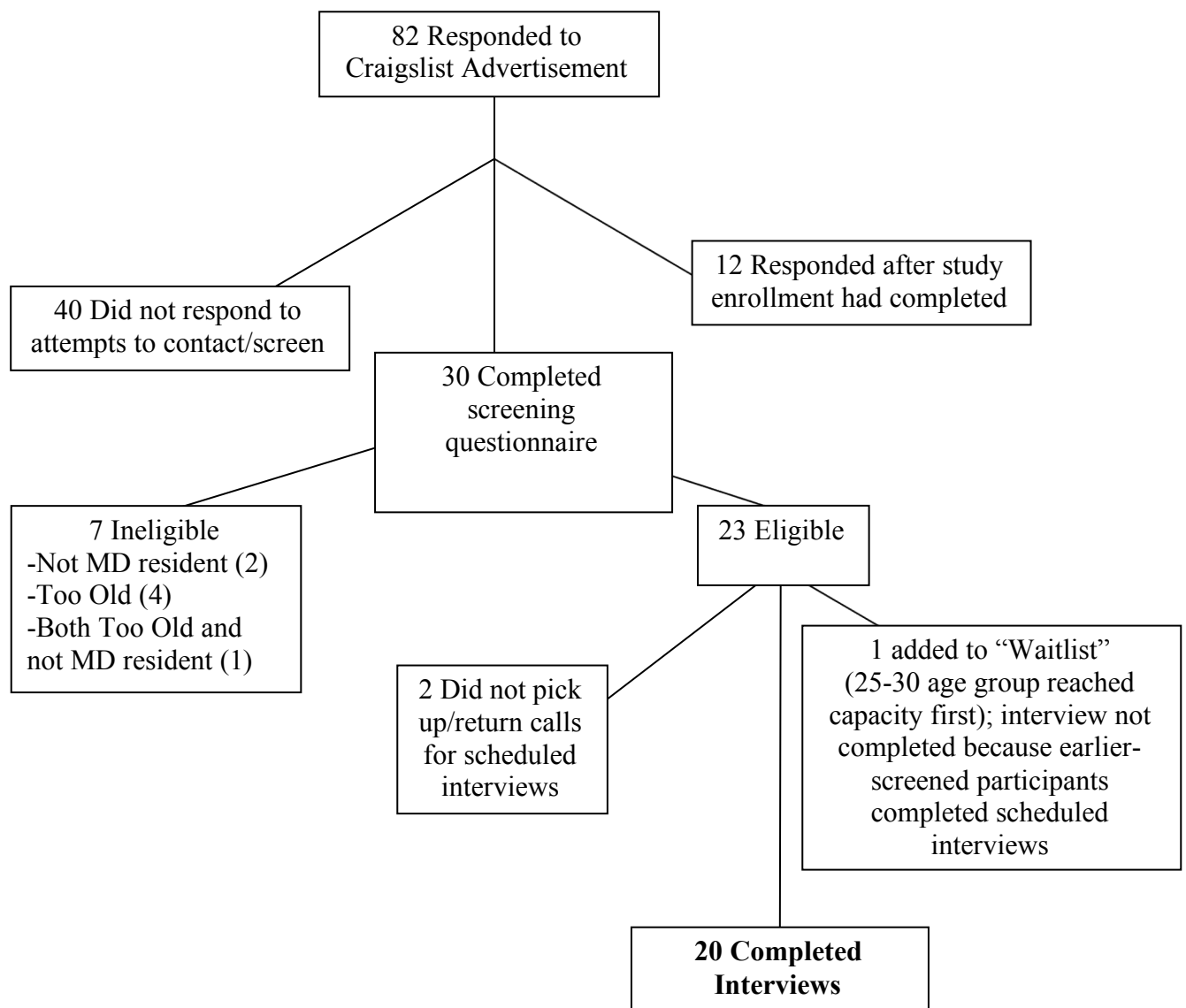


Table 4.1 Participant Characteristics and Product Use

<u>Participant ID</u>	<u>Age</u>	<u>Gender</u>	<u>Tobacco Products Used in Past Month</u>	<u>Preferred Method of Marijuana Use</u>	<u>Current Employment Status</u>
NC	21	Female	Cigars; vaporizer	Vaporizer	Full-Time Student
AR	21	Male	Cigars	Blunt	Full-Time Student
CD	21	Male	Cigarettes; Cigarillo Wrappers; vaporizer	Blunt	Full-Time Student
RQ	22	Female	Cigarettes; Cigars	Blunt	Unemployed
EN	22	Male	Cigarettes; Dip (smokeless tobacco)	Joint	Full-Time Student
RG	24	Female	Cigarettes; Cigarillos	Blunt	Unemployed
ET	24	Male	Cigars	Waterpipe (Bong)	Employed
FR	25	Male	Cigarettes; Cigars	No preferred method	Unemployed
LE	25	Male	Cigarettes; Cigars	Blunt	Employed and taking classes online
PS	25	Male	Cigarettes	No preferred method	Employed
LS	26	Female	Cigarettes	No preferred method	Unemployed
KB	27	Male	Cigarettes; Cigars	Blunt	Employed
WZ	27	Male	Cigarettes; Snus (smokeless tobacco)	No preferred method	Employed

MR	27	Female	Cigarettes	No preferred method	Employed
BA	28	Male	Cigarillos	Blunt	Employed
BF	28	Male	Cigarettes	No preferred method	Employed
DM	29	Male	Cigarettes	Waterpipe (Bong)	Employed
EH	29	Male	Cigars	No preferred method	Employed
EQ	29	Male	Cigarettes; Cigars	Blunt	Employed
LM	29	Female	Cigarillos	No preferred method	Employed

Table 4.2 Overview of Findings and Relations to Theoretical Model

	<u>Co-Use</u>	<u>Sample Quotations</u>
Individual Influences		
Personal Preference	Prefer to smoke blunts	<ul style="list-style-type: none"> • “The only time that I use tobacco is the cigars and it’s when I’m smoking weed.” • “[Blunts are] my preference, number one. I also sprinkle some tobacco in there as well.”
Personal Finances	Adding tobacco back into blunt	<ul style="list-style-type: none"> • “it kind of saves money to mix your [marijuana with tobacco]... you know what I mean.”
	Using tobacco as a replacement for marijuana	<ul style="list-style-type: none"> • “Smoking weed is more expensive, and it's 20 cigarettes in a pack.” • AR only smokes tobacco, “on a day where I can't afford marijuana.”
Interpersonal Influences		
Peer Influences on Co-Use	Friends’ Use	<ul style="list-style-type: none"> • “I would say maybe 50/50 [of my friends smoke vs do not smoke] for the tobacco, but the marijuana is more like 80 to 90%.” • “Yeah, really any one of my friends who smokes I'm more likely to smoke with versus when we're around non-smoking

		<p>friends, then use definitely falls dramatically.”</p> <ul style="list-style-type: none"> • “I surrounded myself with other stoners. We have this thing of, we know another stoner whether they said it or not. We just know.”
	Tobacco Augments Marijuana “High”	<ul style="list-style-type: none"> • “[as] soon as I smoke a blunt, I smoke a cigarette right behind it. Cause my friends just tell me that you get more high if you smoke a cigarette right behind it.”

Organizational Influences

Employers’ Drug Testing	Using less marijuana and more tobacco because of drug tests at work	<ul style="list-style-type: none"> • “My job’s doing random piss tests, so I can't smoke [marijuana] every day.”
Using Tobacco to replace Marijuana at work	Using tobacco instead of marijuana at work	<ul style="list-style-type: none"> • “If marijuana was legal, I wouldn't be smoking cigarettes on break at my job, I'd be smoking blunts.”
Concealing Marijuana Use at Work	Smoking a cigarette after marijuana to cover the smell of marijuana	<ul style="list-style-type: none"> • “I typically would only choose a tobacco product such as Black and Mild, if I was at work...because it kind of drowns out the weed scent.”

Community Influences

Physical Environment	Concealing marijuana smell in certain physical locations	<ul style="list-style-type: none"> • “I do...smoke a cigarette after a blunt to try to air out the smell. It's only when I have something professional to do.”
	Use tobacco in locations where it is risky to use marijuana	<ul style="list-style-type: none"> • “I used to do it [smoke marijuana] in the car, but I found out that's not a good idea a couple years ago...But I'll smoke Black and Milds [brand of cigar product].”
Policy Influences		
Changes in marijuana policy	Decriminalization and Legalization of Medicinal Marijuana have not influenced perceptions of marijuana	<ul style="list-style-type: none"> • “They’ve [the changes in policy] more influenced me to the senselessness of the illegality of it.” • “It didn’t really change my opinion on it. I’m happy to see that it got decriminalized in more places. But even if it didn’t, I’d probably would still be doing it the same.” • “I’ve always been pro [marijuana].”
Less Access to Marijuana than Tobacco	Since recreational marijuana is illegal need to rely on personal connections to obtain marijuana	<ul style="list-style-type: none"> • “the weed man is not answering the phone...you got to wait and call other people.” • “I know people, but if I didn't know the people I knew, then it would be pretty hard [to buy marijuana].”

CHAPTER 5: Study 3, A Sequential Explanatory Mixed Methods

Study of Young Adult Tobacco and Marijuana Co-Use

a. Introduction

i. Tobacco and Marijuana Co-Use

Tobacco and marijuana are two of the most commonly-used substances among young adults; however, patterns of their use have been changing recently in the United States (Cohn, Johnson, Rath, & Villanti, 2016; Masters, Haardörfer, Windle, & Berg, 2018; Ramo, Liu, & Prochaska, 2012). Estimates from 2016 National Survey on Drug Use and Health data indicate 23.5% of those 18-25 years old reported smoking cigarettes in the past month compared with 20.2% of adults over 26 years old (Substance Abuse and Mental Health Services Administration, 2017). However, in the midst of declining young adult cigarette use, young adult marijuana use is increasing (Martins et al., 2016; Salas-Wright, Vaughn, Todic, Córdova, & Perron, 2015). In 2016, 20.8% of young adults between 18 and 25 reported smoking marijuana in the past month compared with only 7.2% of adults over 26 years old (Substance Abuse and Mental Health Services Administration, 2017). As young adult marijuana use has increased, disapproval of marijuana has decreased (Salas-Wright et al., 2015) and perceived availability has increased (Martins et al., 2016) among this group.

Co-use of tobacco and marijuana products has been increasing among both adolescents and adults in recent years (Subramaniam et al., 2016). One systematic review found that the vast majority (85%) of studies published on this topic from 1999

to 2009 found a significant association between marijuana use and tobacco use (Ramo et al., 2012). Many prior studies focus on one substance, either tobacco or marijuana, however, since these two substances are often used together by young adults, studying their co-use may provide important and unique insight.

ii. Health Effects of Co-Use

Tobacco use has a number of well-known, serious negative health effects, including heart disease, stroke, lung and other cancers, COPD, emphysema, bronchitis and asthma attacks (Centers for Disease Control and Prevention, 2016c; U.S. Department of Health and Human Services., 2012). While there have been mixed findings regarding the role of marijuana as a potential risk factor in the development of various types of cancers (Hall & Degenhardt, 2009), marijuana use has been associated with bronchitis and decreased immune functioning in the lungs (Tashkin et al., 2002; Tetrault et al., 2007) as well as coughing, phlegm production and wheezing (Martinasek, McGrogan, & Maysonet, 2016; Moore et al., 2005). Though few published studies have directly addressed this issue, there is some evidence that co-use may be particularly harmful (Macleod et al., 2015). The potential cumulative negative effect from co-use may be due to the same route of administration (combustion and inhalation) and the presence of the same carcinogenic chemicals, although in differing amounts, in both tobacco and marijuana smoke (Hall & Degenhardt, 2009; Moir et al., 2008).

There are also concerns about increased risk of drug dependence due to the use of cigarettes and marijuana together. Young adults who use both tobacco and marijuana show increased symptoms of marijuana dependence (Ream et al., 2008; Richter, Pugh,

& Ball, 2016; Richter, Pugh, Smith, et al., 2016), highlighting the potential for multiple dependencies to develop. Moreover, there is a wealth of negative social consequences associated with cigarette (Prochaska et al., 2016) and marijuana (Green, Doherty, et al., 2016) use separately, including an increased risk of lower income, highlighting the importance of preventing these behaviors.

iii. Quantitative, Qualitative and Mixed Methods Research on Co-Use

Quantitative studies of tobacco and marijuana co-use have provided estimates for prevalence of co-use and poly-use in various groups as well as establishing some preliminary risk factors for co-use. There are not well-established national trends for tobacco and marijuana co-use among young adults, due in large part to differing definitions of co-use, however, individual studies have found estimates between 29.1% and 39.8% among 18-25 year old users of tobacco or marijuana (Kennedy et al., 2016). Between 2002 and 2014, daily marijuana use has significantly increased among adult daily and non-daily cigarette smokers, with the majority of daily marijuana users being cigarette users, as compared to former or never smokers (Goodwin et al., 2018). Longitudinal analyses have indicated that the relationship between intensity of tobacco use and marijuana use is reciprocal during transitions in young adulthood; increased cigarette use at 24 years old predicts increased marijuana use at age 27 and increased marijuana use at 24 years old predicts increased cigarette use at 27, even when controlling for other factors (Kristman-Valente et al., 2017). Additionally, a scale to assess nicotine and marijuana interaction expectancies for co-users has been developed and validated (Ramo, Liu, & Prochaska, 2013) and implemented in a diverse sample of African American young adults (Montgomery & Ramo, 2017). Montgomery & Ramo

found that a majority of the sample reported blunt use and that tobacco use increases marijuana use and urges and that they smoke tobacco to cope with marijuana urges (2017).

Much qualitative work addressing tobacco and marijuana co-use has focused on one facet of co-use, such as the co-administration of tobacco and marijuana in one product like a “blunt” where a cigar is emptied and the wrapper is used to smoke marijuana either with or without some of the cigar tobacco added back in (Schauer, Rosenberry, et al., 2017). Qualitative work has provided insight into the social contexts in which adolescents begin smoking blunts and the ways in which marijuana can promote and reinforce tobacco use (Antognoli et al., 2018), as well as patterns of and reasons for co-use (Schauer, Berg, Kegler, Donovan, & Windle, 2016).

Increasingly, there has been an interest in using mixed methods in tobacco control research (Fryer, Seaman, Clark, & Plano Clark, 2017; Huh, Paul Thing, Abramova, Sami, & Beth Unger, 2014; Momin et al., 2017). Mixed methods research designs hold a unique potential to elucidate complex phenomena by combining the strengths of both quantitative and qualitative data collection and analyses as well as new insights gained through their integration. Though several compelling definitions of mixed methods research have been proposed by experts, this study uses the core characteristics set forth by Creswell and Plano Clark (2011). Several published articles have used mixed methods research approaches to study the use of blunts specifically (Schauer, Rosenberry, et al., 2017) and to develop and evaluate a scale to assess reasons for co-use (Berg et al., 2018). The present study is unique in its use of a mixed methods research design to better understand the behavioral factors influencing co-use

in a young adult sample. This present study used mixed methods to investigate factors associated with young adult (ages 21-30) tobacco and marijuana co-use and to gain a better understanding of this phenomenon. The research question for this study was: What demographic and behavioral factors are associated with past-month tobacco and marijuana co-use among young adults and how do the experiences of young adults help contextualize and explain the salience of these factors?

b. Methods

This study employed a Sequential Explanatory design to investigate young adult tobacco and marijuana co-use. The Sequential Explanatory design involves first collecting and analyzing quantitative data, next collecting and analyzing qualitative data and then merging results to interpret findings together (Creswell & Plano Clark, 2011). The value of this design is the ability to use qualitative findings to help interpret quantitative results (Creswell & Plano Clark, 2011). The Sequential Explanatory design is ideal for the present study's research question because it allows for results from quantitative analysis to shape the qualitative data collection, such that qualitative results help explain quantitative findings.

Consistent with the sequential explanatory design, the timing of this study was sequential with the quantitative data analyses preceding qualitative data collection and analyses (Creswell & Plano Clark, 2011). The priority in this study was on the quantitative phase; while both phases address the research question, the priority was on using the quantitative findings to help explore factors associated with tobacco and marijuana co-use in the NHANES dataset and the quantitative findings better answer the research question (Creswell & Plano Clark, 2011).

Quantitative results and qualitative findings were interpreted together and provide a unique perspective on the phenomenon of young adult co-use, addressing questions that neither research methodology could have addressed alone. This study was approved by the University of Maryland College Park Institutional Review Board (IRB00000474).

i. Defining Co-Use

In this study, co-use was defined as self-reported use of both tobacco and marijuana during the past month, however the definition differed slightly between the two phases of the study. Quantitative analyses of NHANES limited co-use to past-month cigarette use and past-month marijuana use, due to low prevalence of other reported tobacco use. However, in order to be eligible for the interviews, participants had to report use of any tobacco product and marijuana in the past month. This broad conception of co-use does not necessitate that participants from either phase were using the two products concurrently (as in one product like a blunt), just that both substances had been used at least once during the past month.

ii. Quantitative Methods: Analysis of NHANES data

The National Health and Nutrition Examination Survey (NHANES) is a nationally-representative survey administered by the Centers for Disease Control and Prevention (CDC) and the National Center for Health Statistics to assess a wide range of health outcomes in adults and children (Centers for Disease Control and Prevention, 2016b). NHANES data is de-identified and publicly-available on the CDC's website (<https://www.cdc.gov/nchs/nhanes/index.htm>). Three waves of NHANES data (2005-2006, 2009-2010; 2013-2014) were used to analyze prevalence and predictors of past-

month cigarette and marijuana co-use over a 10-year period among young adults aged 21 to 30.

The main outcome was past-month cigarette and marijuana co-use. Any respondent who reported smoking a cigarette and marijuana on one or more days in the past month was considered a past-month cigarette and marijuana co-use. Other variables included in quantitative analyses included age within the specified range, gender, race and ethnicity, employment status, depressive symptoms, household tobacco exposure and alcohol use. The categories for employment status included: working, looking for work, not working because going to school, not working because taking care of house or family and not working - other (including unable to work, with a job or business but not at work, laid off, or disabled).

NHANES includes the Patient Health Questionnaire (PHQ-9) as a measure of depression. The PHQ-9 is scored from 0 to 27 and is used to identify different clinical levels of depressive symptoms (Kroenke et al., 2001). Participant-reported average alcohol use in the past year was recoded with three levels: those who had not had a drink in the past year, those who reported drinking less than once a month in the past year and those who reported drinking once a month or more in the past year.

Additionally, cigarette smoking behavior variables (days smoked in past month, cigarettes per day, usual brand menthol or nonmenthol, how soon after waking smoke first cigarette, age began smoking regularly) and marijuana smoking behavior variables (days smoked in past month, joints or pipes smoked per day, age first tried marijuana, age started smoking marijuana at least once a month for a year) were included in analyses.

Quantitative analyses were conducted in Stata 15.1 with svy and svyset commands and appropriate weighting factors to account for the complex survey design of NHANES. Respondents were separated into four categories to facilitate comparisons: neither marijuana nor cigarette use, cigarette-only use, marijuana-only use, and co-use. Missing data was examined and did not exceed 10% for any variable so in accordance with NHANES analytic guidelines no further evaluation of missing data was conducted (Centers for Disease Control and Prevention, 2013). All quantitative analyses were conducted before the qualitative phase of the study began.

iii. Qualitative Methods: Semi-Structured In-Depth Interviews

The interview guide was designed to explore the tobacco and marijuana co-use experiences of young adults. Interview domains included initiation experiences, past substance use behavior, current co-use behavior, and perceptions of marijuana and tobacco. Questions for the interview guide were influenced by findings from the quantitative analysis of NHANES data and the factors that were statistically associated with co-use such as questions about household tobacco exposure and alcohol use. The draft interview guide was pilot tested with three participants to ensure the questions and probes were appropriate and relevant; the interview guide was updated based on findings.

Based on results from analysis of NHANES data that suggested tobacco and marijuana co-use behaviors and patterns may differ by age, the interviews were segmented by age so that half of the interviews were conducted with participants in the younger half of the age range (21-25) and half of the interviews were conducted with older participants (26-30).

Advertisements were posted on three major Maryland Craigslist pages (Annapolis, Baltimore, Maryland Suburbs of Washington, DC) to recruit 21-30 year olds residing in Maryland who had smoked both marijuana and at least one tobacco product in the past month. Maryland and surrounding areas (Washington, DC and Virginia) have different laws governing medicinal and recreational use of marijuana, so one state was selected to ensure differences in participant experiences were not due to different policies alone. In Maryland, recreational marijuana use is illegal but medical marijuana became available on December 1, 2017, during the interview period ("Maryland Medical Cannabis Commission," 2018). Potential participants contacted the first author to discuss the study and complete screening questions over the phone.

Participants who were eligible discussed the study with the PI over the phone, were read and emailed a copy of the Waiver of Consent and verbally agreed to its terms. Participants scheduled a time to complete their telephone interview. To protect participant confidentiality since marijuana use is illegal federally, telephone was selected as the interview mode. Interviews were audio-recorded and transcribed verbatim by Rev.com (www.rev.com), an online audio transcription service.

Interviews were completed until saturation was reached, a total of twenty interviews, which fits with recommendations from prior studies (Crouch & McKenzie, 2006; Guest, Bruce, & Johnson, 2006). This study used the definition of "data saturation," as put forth by Saunders et al., that saturation occurs when the researcher "begins to hear the same comments again and again," (Saunders et al., 2017). After the interview, participants were emailed several resources including evidence-based factsheets about the health effects of tobacco and marijuana use, contact information for

the Maryland Quitline and a list of local tobacco cessation resources. Participants were thanked for their participation with a \$40 electronic Amazon gift card. Interviews took between 20 and 60 minutes, with the average interview lasting 30 minutes.

Interviewees were asked to select a pseudonym or nickname to use during the interview; to protect confidentiality, all respondents were randomly assigned a set of initials to use in publications.

Transcripts were compared with audio recordings to check for accuracy, edited, and cleaned. Transcripts were imported into NVivo11 for thematic analysis. Open-coding was used to identify overarching concepts and domains in the data. Then, axial coding was used to explore the relationships and contextual dynamics of the designated open codes. A codebook was developed to provide a name and description for each code. Fifteen percent (n=3) of the interview transcripts were double coded by the PI and a trained graduate student. Interrater reliability was excellent with a Kappa of 0.88. The codebook was amended to clarify codes where there were discrepancies between the PI and graduate student; the final codebook included 67 codes separated into six thematic sections.

iv. Mixed Methods: Integration and Interpretation

This study used O’Cathain, Murphy and Nicholl’s (2010) guidelines for *following a thread* to integrate quantitative results with qualitative findings because this technique best answered the research questions and aligned with the sequential design of the study. With the *following a thread* technique, integration takes place in the analysis stage (O’Cathain et al., 2010). First, data from each phase were analyzed separately, then themes (or “threads”) were identified from quantitative and qualitative

findings individually (O’Cathain et al., 2010). Threads were then “followed” from their original phase (quantitative or qualitative) to the remaining phase so that quantitative and qualitative findings in the same “thread” could be interpreted together (O’Cathain et al., 2010). *Meta-inferences*, overarching conclusions drawn from the integration of quantitative and qualitative analyses, were then refined from these “threads” (Creswell & Plano Clark, 2011; Curry & Nunez-Smith, 2015; Teddlie & Tashakkori., 2009).

c. Results

Description of the interview participants (age, current tobacco product use, age of initiation for tobacco and marijuana) is included (see Table 5.1). Additionally, Table 5.2 provides an overview of quantitative, qualitative and mixed methods findings by overarching themes in a joint-display format (Guetterman, Feters, & Creswell, 2015).

i. Initiation Experiences of Co-Users and Progression to Regular Use

Past-month co-users in NHANES reported first trying marijuana at age 15.04, 95% CI [14.64, 15.43] and regularly using marijuana by age 16.54, 95% CI [16.09, 16.99]. Similarly, past-month co-users reported progressing from experimental to regular cigarette use by age 16.00, 95% CI [15.23, 16.76]. Taken together, these findings indicate that a typical co-user begins regular use of cigarettes about a year before they report regularly using marijuana.

Overwhelmingly, young adults in the interviews reported beginning tobacco and marijuana at the same age or in a range of ages that could not be explicitly ordered (n=9), with 5 participants reporting that they tried tobacco first and the remaining 6 participants trying marijuana first.

Participants described negative memories of their first tobacco use experience.

LM, a 29-year-old female recalled:

My dad used to smoke KOOLs but I stole one of his cigarettes, and I went outside around the corner with all the little kids. I pretended to smoke that cigarette, and I coughed and choked, and was disgusting, and then I did it again.

Many reported that they didn't enjoy the sensory experiences (taste and smell) of tobacco during their first experience. KB, a 27-year-old male, shared his memories of his first time using tobacco, "I remember the taste wasn't so good...It wasn't something that I really liked that much." Participants reported a relatively long period between their tobacco experimentation and their regular use due to the unpleasantness of their initial experiences with tobacco.

Conversely, many participants expressed that they enjoyed their first time experimenting with marijuana and that they began relatively regular use soon after their first time. LE, a 25-year-old male, shared his reflections on his experience:

I was around my friends when I first did it. At first, I would just be around them: they all smoked before me. Then I wanted to try it one day when we were just sitting there playing cards, and I did, I smoked it, it got me light headed and I started coughing or whatever, but it was cool, it kept me calm, I wasn't all hype or nothing like that. It felt good and ever since then I liked it, and I kept going.

LS, a 26-year-old female, agreed that the first time she used marijuana she knew she would like to use it again, "Yeah. I realized I was missing out [previously not using

marijuana].” Many interviewees reported that their first use of both tobacco and marijuana occurred in a social setting with friends, usually friends who were more experienced or who were already relatively regular users of marijuana or tobacco. Some interviewees struggled to precisely recall the timeline of their marijuana initiation and progression because there was no clear event or demarcation when they became a “regular” or “frequent” user, such as BF, a 28-year-old male, who described his progression, “So it started with that [first time] and then it was sort of infrequent until it became very frequent. I would say I was a habitual pot smoker for probably four years until I went off to college.” This recurring reflection (“it was sort of infrequent until it became very frequent”) was expressed by many interviewees indicating that the changes in their behavior leading to more frequent use were not usually based on some external event or significant moment, but just that their use gradually became more frequent until they were regular users

ii. Age

Co-use was more prevalent in the younger half of the age range for all waves. Across all 3 waves of NHANES, co-use prevalence was 12.15% among 21-25 year olds and 9.21% among 26-30 year olds. The average age of co-users in NHANES was 24.93, 95% CI [24.45, 25.40].

Many of the interviewees in the older half of the age group (26-30) expressed that they had decreased their usage of tobacco, marijuana, or both in the past few years, such as EQ, a 29-year-old male, reflected “It [growing up] slowed me down a lot though, it slowed me down a lot though, it slowed me down 'cause I use to go at it with cigarettes, cigarettes used to be my best friend.” EQ’s experience of smoking less

cigarettes today than he did when he was younger is consistent with other interviewee's experiences. Participants had varied experiences with their marijuana use progression with some indicating they currently smoke more marijuana than they used to and others indicating that their marijuana use has decreased as they have gotten older.

iii. Gender

Analysis of NHANES data revealed statistically significant differences in prevalence of past-month co-use by gender at the first two waves: 2005-2006 (14.06% of males, 6.99% of females, $p = 0.02$); 2009-2010 (12.83% of males, 8.46% of females, $p = 0.02$) but not at the most recent wave (13.51% of males and 8.48% of females, $p = 0.07$ in 2013-2014). Overall, the prevalence for past-month co-use was 13.45% for men and 8.0% for women.

Interviewees were asked in an open-ended question to describe their self-identified gender during screening. Six of the interviewees self-identified as female while the remaining fourteen interviewees identified as male. No explicit questions about the role of gender identity in co-use behaviors were asked as part of the interview, however, several female interviewees detailed the role that gender played in their experiences with marijuana specifically.

Female interviewees indicated that being a female increases their access to marijuana. MR, a 27-year-old female, shared, "It's a perk of being a female because guys will just smoke you up for free, so you don't really have to pay for it." In addition to the experiences unique to being a female that could increase access to marijuana, or make smoking marijuana more affordable, like men giving women marijuana without

asking them to pay for it, MR described her experience of being a mother influencing her marijuana use. MR shared how marijuana helps her deal with the stress of caring for her children and having an overwhelming amount of responsibilities: “Being a female, our minds are like constantly on the go. It’s sometimes so exhausting.” Male interviewees did not explicitly mention the role that their sex identity played in their tobacco and marijuana use. Only three participants reported being parents, but MR was the only participant to directly relate her marijuana use to her experiences of parenting.

iv. Employment and School Influences

In NHANES data, there was a significant difference in co-use prevalence by employment status: the highest prevalence of co-use were among respondents who were actively looking for work (13.40%), those not working because they were in full time students (13.46%) and those not working for other reasons, including being unable to work, laid-off or disabled (16.03%). Those who were working had average prevalence rates (10.21% among those working and 10.72% in the entire sample) and those who were not working because they were taking care of their family was considerably lower than average (6.59%).

Four of the interview participants reported being in school full-time, with a fifth interviewee taking classes part time while working. Participants indicated that the school environment and access to their peers profoundly influenced their tobacco and marijuana use. AR, a 21-year-old male indicated that he did not begin smoking marijuana until college, “It [marijuana use] didn’t start until I got to school.” EN, a 22-year-old male expressed a similar sentiment expressing how being around his peers who were smoking tobacco and marijuana have influenced his own use, “I don’t know,

it's just being on a college campus, it's just more people that like to do those kinds of things and so it makes for the rampant usage to increase a little bit." EN went on to talk about how being in school gives him more freedom and time, which leads to increased use:

I'm just also, a little bit in this carefree spot, part of my life. So I don't really have a serious job, or anything like that so doing all those things together just makes for ... at least, much more than I did in high school, and much more than I anticipate doing in the future.

EN anticipates that while enrolled in college, he will use tobacco and marijuana more than he will later in life. Highlighting a different experience, CD a 21-year-old male, indicated that his friends from college are less likely to use tobacco or marijuana which decreases his usage, "Honestly, the only friends I have who don't use tobacco or marijuana are the ones who are enrolled in college. It's kind of what gives me the insight not to want to smoke."

For interviewees who reported working full time, the ways in which their employment influenced their tobacco and marijuana use varied greatly based on industry and type of job. Those who work in creative and service jobs, including restaurants, the music industry and television production, generally indicated that the work environment, including social climate, positively influenced their usage. BA, a 28-year-old male working in the music industry shared that at work he is exposed to many people using large amounts of marijuana, which has played a role in increasing his own use. BA shared:

Don't get me wrong, I smoked before, but before when I was just by myself, I would probably roll like a gram, a point eight. But then I started getting into the studios and see people roll like, three point five and two and half grams, four grams in a blunt, seventy, eighty dollar blunts.

In this way, being exposed to marijuana at work, particularly people who were smoking large quantities of marijuana increased BA's usage.

On the other hand, most interviewees indicated that working a job decreases their tobacco and marijuana use. Specific to marijuana use, many participants indicated that they would not be able to smoke marijuana at work so having to be out of the house and at work for several hours a day means they were smoking less marijuana than they would be if they were at home. EQ summarized this, "Cause on your day off, you can smoke more weed just 'cause you at the house, maybe bored, few days off and you ain't doing nothing so you got access to it." Interviewees expressed similar sentiments about physically being at work all day decreasing their tobacco use as well. DM, a 29-year-old male, shared how his job has led to a decrease in his tobacco use, because he needs to take a break and go outside anytime he wants to smoke:

During the day, you know, I don't get that many breaks to smoke, so I'd say it [working] tends to, to slow you down just because you know you're inside somewhere where you can't smoke, and the boss man doesn't like you going outside every hour.

Finally, job stress made some participants want to smoke more tobacco and marijuana when they return home from work, indicating that the relationship between

employment status and tobacco and marijuana co-use is complex and may be driven by different factors depending on a young adults' employment industry.

v. Depressive Symptoms

In the NHANES dataset, past-month co-users reported more depressive symptoms than their single-product using or neither product using peers. Co-users reported an average PHQ-9 score of 4.65, 95% CI [4.10, 5.21] compared to average scores of 2.51, 95% CI [2.28, 2.75], for neither product users, 3.67 for cigarette-only users, 95% CI [3.10, 4.24], and 3.08, 95% CI [2.67, 3.50], for marijuana-only users. Responses to the PHQ-9 had a strong positive skew, so a dichotomous variable was created based on PHQ-9 scoring guidelines to separate participants reporting any depressive symptoms (scores 5-27) from those reporting no depressive symptoms (scores 0-4) (Kroenke et al., 2001). More co-users reported depressive symptoms, 36.75%, than neither product users (17.75%), cigarette-only users (31.01%), and marijuana-only users (22.64%).

Many interviewees shared their experiences related to depression and their emotional states when asked about why they use tobacco and marijuana or what life events and situations make them want to use tobacco and marijuana. CD shared that he believes that marijuana changes the way he perceives those around him, helping him be more in-touch with his emotions and that this has been a major reason for his marijuana initiation and continuation:

I know personally when I first started [using marijuana], it was because I was scared of my mind. I just think too analytically, not very emotionally, so I don't empathize with other people as much as I should. I feel like marijuana helped

me more sympathize with my fellow man... can I tack on depression too? I would like to add that.

Echoing a similar experience, MR shared that she finds marijuana use beneficial for her depression, “I have anxiety and depression...sometimes your mind needs a break.” MR also added that she finds tobacco use helps as well in managing her depression, “Because sometimes it neutralizes your mood, you know?” Several other participants discussed their experience of marijuana’s ability to improve their mood without explicitly mentioning clinical depression or depressive symptoms, like PS, a 25-year-old male who shared, “I feel like it [marijuana use] makes me a happier person.” Marijuana, and to a lesser extent, tobacco, were used by interviewees to help manage their clinical depression, as well as a general mood enhancement.

vi. Household Exposure

In the NHANES dataset, more than half of co-users (60.62%) reported living with a tobacco user, compared to cigarette-only users (48.96%), marijuana-only users (22.54%) and neither product users (8.98%). NHANES does not include any questions to assess household marijuana exposure.

Half of the participants (n=10) reported living with a tobacco user, marijuana user or tobacco and marijuana co-user. However, in the interviews, respondents had mixed feelings about whether living with tobacco, marijuana, or tobacco and marijuana co-users influenced their own behavior. ET, a 24-year-old male, expressed this ambivalence, describing how he does not believe living with someone who uses both tobacco and marijuana influences his own use, “Not necessarily. I guess they could. I don’t know. It’s hard to give a solid answer...I want to say no, because if he [my

roommate] wasn't there, I still would be doing it." BF, who lives with four roommates, one of whom regularly uses tobacco and marijuana and three of whom are infrequent marijuana users reflected, "It's nice to have somebody who you can take a break with and smoke with but I don't think ... We're not edging each other on to smoke more."

Young adults also indicated that household exposure influences where they smoke. Many interviewees who do not live with other tobacco or marijuana users reported intentionally smoking in the outdoor spaces directly around their house to avoid smoking in the house and exposing their non-smoking roommates. MR expressed this, responding to what physical locations she usually uses marijuana, "My house and my car...but outside my house not inside...I refuse to do that in my house." Considering the varied role that living with a tobacco or marijuana smoker can have on young adult co-use can provide insight into experiences and perceptions.

vii. Alcohol Use

Alcohol emerged as an important behavior to consider in the contexts of tobacco and marijuana co-use. Co-users were more likely to reporting drinking at least once a month or more (65.57%) than neither users or cigarette-only users (34.65% and 43.52% respectively) but reported similar alcohol use as marijuana-only users (63.62%).

Several different themes related to co-use and alcohol emerged in the interviews. First, many interviewees indicated that drinking alcohol increases the likelihood that they will smoke tobacco as well as the amount of tobacco that they smoke. DM shared that in his experience, "alcohol and cigarettes go hand in hand." LS echoed these thoughts and indicated that although she drinks infrequently, on the rare

occasions where she does drink alcohol, her cigarette use increases, “I smoke like a chimney when I get drunk. It’s awful...alcohol will influence you straight into [using] tobacco.”

On the other hand, respondents indicated that they intentionally do not mix marijuana and alcohol or that they infrequently mix the two substances in social contexts. BF shared, “Marijuana and alcohol aren’t the most compatible except for if you use marijuana in a social setting, you’re usually already inebriated off alcohol.” Another perspective shared by many interviewees was that they use alcohol when they do not have access to marijuana. In this way, smoking marijuana is more desirable, but sometimes difficult because of the legality, so participants will drink alcohol when they do not have marijuana. EH, a 29-year-old male, shared how when he has access to marijuana he drinks less alcohol than when he does not have access to marijuana, “The more marijuana, I guess I am able to get my hands on, the less I have a desire to purchase any alcohol.”

Several participants compared the differing legal status of alcohol and marijuana, expressing that they have lower risk perceptions for marijuana than alcohol despite the fact that alcohol is federally legal and marijuana is federally illegal. PS shared his reflections:

When have you gotten into a fight on weed, you know? And when have you ever got in trouble on weed?... All you do is relax and you eat. But alcohol is one of the worst drugs out there and it's legal.

viii. Tobacco-Specific Factors

According to results from NHANES data, co-users reported smoking cigarettes a similar number of days (average 24.9 days, 95% CI [23.9, 26.1]) in the past month as cigarette-only users (average 24.7 days, 95% CI [23.7, 25.7]). Co-users report smoking slightly fewer cigarettes per day (11.0, 95% CI [9.9, 12.2]) than cigarette-only users (12.3, 95% CI [9.3, 11.2]). A similar percent of co-users (38.6%) indicated that their usual cigarette brand was mentholated as cigarette-only users (37.9%). The percent of co-users who reported that they usually smoke their first cigarette within the first 5 minutes of waking (22.7%) was identical to the percent of cigarette-only users (22.7%). This suggests that co-users have similar tobacco use behaviors as cigarette-only smokers and that marijuana uses does not necessarily influence tobacco intensity, frequency, or preference for mentholated brands.

In the interviews, most participants (n=15) reported regularly using one or more flavored products. Participants used flavored cigar products, both in their creation of blunts to smoke marijuana and separately as an unaltered tobacco product. Participants' favorite flavors were generally sweet, including fruit or alcohol flavored, like NC, a 21-year-old female, who shared, "I was doing mango. I tend to stick to fruitier flavors." AR agreed and shared that he usually selects, "Mostly sweeter flavors like Jazz or cherry." Of the five interviewees who reported that they usually used non-flavored tobacco, the majority (n=3) were cigarette-only smokers, one smoked cigarettes and used chewing tobacco, and only one participant reported regularly using non-flavored cigars. Many participants had tried to quit tobacco in the past. LM indicated that discussing tobacco use during the interview made her want to quit: "I'm telling you

because the way this phone call [interview] went, I will not smoke another Capone [cigarillo brand].”

ix. Marijuana-Specific Factors

In NHANES data, past-month co-users reported smoking marijuana on more days in the past month (average 13.5 days, 95% CI [12.0, 15.0]) than marijuana-only users (average 11.7 days, 95% CI [10.0, 13.4]) though this difference was not statistically significant. Co-users also reported smoking more, an average of 2.2 joints or pipes of marijuana per day, 95% CI [2.0, 2.4], than the average marijuana-only user, average 1.9 per day, 95% CI [1.7, 2.1] although this difference was not statistically significant either.

Several participants indicated that the primary reason they use marijuana is for medicinal benefits, e.g., for managing conditions such as acid reflux, gastrointestinal distress, attention-deficit disorder, anxiety, pain relief and epilepsy. FR, a 25-year-old male, shared that he uses marijuana to medicate his anxiety. FR reflected, “I’d rather smoke a joint any day over taking that medicine... it’s much more effective. It works perfectly fine and it heals it pretty good.” Additionally, many interviewees indicated that marijuana helps them reflect on their lives or helps them get in touch with their spiritual side. KB shared his reflections:

It’s definitely something that allows me to access myself. I can connect with my spirit. I can connect with who I am when smoking marijuana...It allows you to tap into this mental state where you connect with things, and connect with people, and you have a sort of understanding. And during that time when you

read or when you watch a movie or when you watch documentaries and things like that, things you're able to process and understand just go to a different level.

KB's experience was shared by many interviewees who indicated that their marijuana use differed from their tobacco or alcohol use in terms of allowing them to thoughtfully connect with people around them, as well as media including movies and books.

d. Discussion

Taken together, the quantitative and qualitative findings help explain the behavior of young adult tobacco and marijuana co-use and offer a unique perspective into their experiences. Statistically, data from NHANES supported that the co-use of cigarettes and marijuana describes a specific behavioral pattern with a set of unique characteristics, and young people in the interviews discussed their experiences of co-use. Findings related to household exposure underscore the importance of considering environment in contextualizing and understanding health behaviors.

NHANES results indicated that a typical co-user begins the regular use of cigarettes about a year before they report regularly using marijuana whereas more interviewees reported they could not explicitly remember which product they used first or that they had used both products for the first time in the same year. These findings aren't necessarily contradictory – since NHANES does not include age of first cigarette for adults, so it is difficult to directly compare these findings to the interview data about first use of both marijuana and tobacco. These mixed findings may suggest that there are many factors at play, including exposures and social settings, and that the interplay between order of substance initiation may be complex and highly influenced by individual experiences. Additionally, this indicates that there may be different

initiation patterns for co-users: tobacco-first, marijuana-first, and both simultaneously. Patterns of use and behaviors may be different for different subgroups of co-users.

Interestingly, when asked about tobacco products, many young people interviewed only motioned cigarettes and not their use of blunts. This is consistent with the body of literature documenting the popularity of “blunts” (Schauer, Rosenberry, et al., 2017) and that many young adults do not appear to consider cigars and cigar products as “tobacco,” especially when they are only using the cigar wrapper as a method to smoke marijuana. Young adults hold lower risk perceptions for cigars than cigarettes (Amrock, Lee, & Weitzman, 2016). This highlights a gap for future public health educational and messaging campaigns– educating young people about the harms of cigars and cigar products, even when only the wrapper is used since prior work has established that the cigar wrapper contains nicotine (Peters, Schauer, Rosenberry, & Pickworth, 2016). Prior work has demonstrated that adult cigar users often underestimate the risks of cigar use (Bernat, Ferrer, Margolis, & Blake, 2017; Nyman, Sterling, Majeed, Jones, & Eriksen, 2017). The findings of this study bolster these results and suggest a similar pattern exists among young adults specifically.

The role of gender in co-use emerged as an important theme in this work and should be explored in future work. Female interviewees discussed specific experiences and stressors unique to their gender identity and marijuana-use, while men did not bring up male-specific stressors or gender-related reasons for use in the interviews. It is possible that these experiences differ greatly for men and women; future work should explore the relationship between gender and co-use and stress. The generally positive perceptions of marijuana and the negative perceptions of tobacco endorsed by young

adults in the interviews may play a role in young adults' stress coping through substance use and differences between young men and young women.

i. *Meta-inferences*

Through analysis of quantitative and qualitative data, unique features of young adult co-use emerged. These *meta-inferences* are overarching themes present in both the quantitative and qualitative findings, shaped by the integration of the two sets of results. The priority of this mixed methods study was on the quantitative phase, so many of the *meta-inferences* are driven by quantitative threads that were brought together with qualitative findings. In total, 5 *meta-inferences* emerged.

1. Despite different initiation experiences and progression to regular use, for tobacco and marijuana, young adults co-use of both substances is a distinct behavioral pattern.

Both quantitatively and qualitatively, participants reported a relatively similar age for progressing to regular tobacco use and regular marijuana use, yet their initiation experiences were very different. Many interviewees expressed that they did not enjoy their first tobacco use experience but continued to experiment because they were in social situations where tobacco was being used or because they felt symptoms of nicotine withdrawal. On the other hand, most young adults interviewed reported that they did enjoy their first experience using marijuana and began regular use soon after; the only limiting factor being access to marijuana. More work is needed to fully understand how co-users come to use both substances when their initiation, timing, sequencing and progression to regular use experiences appear to be very different. It is possible that experiences may be different for young adults who initiate one substance

(either tobacco or marijuana first) than for those who begin using both substances at the same time.

2. The contexts of co-use differ by age and may have developmental antecedents.

Compared to the older half of the age range (ages 26-30), co-use was more prevalent in the younger half of the age range (ages 21-25). Older interviewees described “slowing down” and decreasing the intensity and frequency of their use as they progressed from their late teens and early twenties into their mid and late twenties. Interestingly, these older participants still reported co-use but their patterns of use and the situations in which they reported smoking, moving from primarily social use in younger years to more individual use in older years. More specific work is needed to understand how life events and transitions the age range of “emerging adulthood” (Gilmore & Meersand, 2013), including birth of children, graduating college, getting married, as well as developmental changes and how they influence changes in co-use behavior. This is consistent with a body of literature that supports that many young adults “age out” of substance use, usually by age 30 (Flora & Chassin, 2005).

3. The institutional affiliations that most young adults engage with (employment and school) influence co-use through access to products, social situations that promote co-use and young adult perceptions of co-use.

School and employment were found to be significant influences in co-use, though the specific effect, increasing or decreasing, depends on the individual and their assessment of their environment. This suggests that prevention and cessation efforts

that take into account the different physical and social environments young adults experience and are tailored to individual factors may be effective.

4. Depressive symptoms, along with other mental health symptoms, should be more thoroughly investigated to assess their association with co-use.

Co-users reported higher levels of depressive symptoms than neither cigarette nor marijuana users, cigarette-only users, and marijuana-only users in NHANES data. Interviewees described using marijuana as self-medication for depression, whether clinically diagnosed or not. Prior studies have found an association between depression and co-use (Ramo et al., 2012). This relationship is complex and may be bidirectional; some work has found that marijuana use can lead to symptoms of depression (Copeland et al., 2013) while other work has suggested that young adults may use marijuana to self-medicate when they experience depressive symptoms (Wilkinson et al., 2016). Further work is needed to explicate this relationship and understand the potential sequencing of these two experiences as well as considering a wider range of mental health symptoms and conditions alluded to but not fully explored in this work, such as anxiety. These findings may have implications on physician prescription of medical marijuana, particularly for patients with pre-existing mental health symptoms and a condition that would qualify them for medical marijuana.

5. Co-users behave more like cigarette-only users in their use of cigarettes than like marijuana users in their use of marijuana.

Co-users reported smoking marijuana on more days in the past month than marijuana-only users but smoking cigarettes a similar number of days as cigarette-only users. Similar percentages of co-users and cigarette-only users reported that their usual

cigarette brand is mentholated and that they usually smoke their first cigarette within the first five minutes after waking up as cigarette-only users. In the interviews, participants described their preference for using marijuana and how their use of tobacco was mainly driven by feelings of addiction whereas their use of marijuana was primarily driven by enjoyment.

Together these findings suggest something about the addictive potential of tobacco; young adults who smoke cigarettes, regardless of if they use marijuana or not, report similar levels of dependence, indicated by a very similar time to first cigarette in NHANES data. There were no measures of marijuana dependence in NHANES and dependence was not explicitly asked about in the interviews, however many interviewees discussed experiences with tobacco addiction (experiencing withdrawal, unsuccessful attempts to quit, continuing to smoke because of the addiction) and did not discuss marijuana addiction. Future work should endeavor to better understand the experiences of dependence, both of tobacco and marijuana, for co-users to assess how experiences of dependence may influence use behaviors.

ii. Strengths and Limitations

There are noteworthy strengths of the present study. This study utilized nationally representative data from NHANES and in-depth interview data from young adults in Maryland in a sequential explanatory mixed methods research design. The study findings provide a deeper understanding of factors associated with co-use and a broader understanding of how young adults' reflections on their own experiences of co-use can explicate the role of these factors. The qualitative phase of this study used well-established methodology and an interview guide developed based on quantitative findings

and pilot tested with participants. The mixed methods research design of this study, including quantitative and qualitative analyses as well as their explicit integration, provided a unique perspective on this phenomenon including findings that neither methodology could reach independently. The qualitative portion of this study allowed for insights from prioritized population to be included in the study. Qualitative findings helped contextualize and explain quantitative findings.

There are also several limitations to this study. First, the quantitative and qualitative phases of this study used data from different samples collected in different years, unlike many mixed methods studies where the two samples are the same or one phase uses a subset of the sample from the other phase. There is the possibility that co-use was experienced differently by young adults in the two samples. Next, in this study the quantitative and qualitative phases used different definitions of co-use. Due to low prevalence of other tobacco products, NHANES analyses only included past-month cigarette and marijuana users as co-users whereas qualitative data collection included any tobacco product use. NHANES includes questions about past 5 day use for non-cigarette tobacco products but prevalence was very low. For this sample, 2.41% reported past 5-day cigar use so cigar was not included as an outcome in NHANES analyses. It is possible that cigar-only or other tobacco product and marijuana co-users differ in important ways from cigarette and marijuana co-users. Additionally, because the quantitative portion included a secondary analysis of pre-existing data, the analyses and interpretation of findings are limited by the available data. Some potential research questions were not able to be assessed because the surveys did not include relevant items. For example, NHANES includes no questions that could be used to assess

household marijuana exposure. To some extent this issue was ameliorated by the qualitative phase; the interview guide was developed to better understand the contextual dynamics of co-use that were unavailable or unable to be assessed in the NHANES data. Finally, in order to protect participant privacy, limited demographic information was collected from interview participants. Racial and ethnic identity were not assessed, which limits conclusions that can be drawn from this work and did not allow for a consideration of how race and ethnicity influence co-use experiences.

e. Conclusions

Much remains to be learned about tobacco and marijuana co-use among young adults. This study illustrated the ways that qualitative research can help elucidate and explain quantitative findings related to young adult co-use. The rich diversity of experiences of participants underscores the importance of exploring a range of personal factors, life experiences, and social contexts to better understand young adult substance use behaviors. While quantitative results from analysis of the NHANES dataset allowed for an initial consideration of factors that may predict and influence co-use, qualitative findings from interviews allowed for an in-depth understanding of how these factors influence tobacco and marijuana use initiation and continuation. The mixed methods design of this study allowed for a deeper understanding of the factors associated with co-use through examination of the experiences and reflections of young adult co-users. This study used the *following a thread* mixed methods integration technique; quantitative and qualitative findings on the same topic were interpreted together to provide a more comprehensive picture of young adult tobacco and marijuana co-use behaviors. Future work, both quantitative and qualitative, should focus on

understanding the mechanisms through which young adults initiate and continue using tobacco and marijuana and finding ways to develop effective preventive and cessation programs to address co-use.

Table 5.1 Interview Respondent Characteristics

<u>Participant ID</u>	<u>Age</u>	<u>Gender</u>	<u>Tobacco Products Used in Past Month</u>	<u>Age First Used Tobacco</u>	<u>Age First Used Marijuana</u>
NC	21	Female	Cigars; vaporizer	20	19
AR	21	Male	Cigars	18	18
CD	21	Male	Cigarettes; Cigarillo Wrappers; vaporizer	“I wanna say 14, 15”	“I’d say 16, 17. 16”
RQ	22	Female	Cigarettes; Cigars	16	16
EN	22	Male	Cigarettes; Dip (smokeless tobacco)	“I was young, maybe ten. Maybe ten, I don’t know”	“Like thirteen, fourteen.”
RG	24	Female	Cigarettes; Cigarillos	17	13
ET	24	Male	Cigars	12	12
FR	25	Male	Cigarettes; Cigars	16	15
LE	25	Male	Cigarettes; Cigars	14	14
PS	25	Male	Cigarettes	“Oh, I was young. I was 12... well 13”	“I think I was about 11 or ... Ah, I was 12. Twelve or 13...”
LS	26	Female	Cigarettes	14	13
KB	27	Male	Cigarettes; Cigars	“Between 12 and 13”	12
WZ	27	Male	Cigarettes; Snus (smokeless tobacco)	13	12
MR	27	Female	Cigarettes	14	14
BA	28	Male	Cigarillos	“maybe like sixteen”	“sixteen, at the same time”
BF	28	Male	Cigarettes	16	16

DM	29	Male	Cigarettes	"I'm gonna guess and say 12 or 13"	17
EH	29	Male	Cigars	"I would say 17, 18"	"I would say about 18 to 19. Was I even 18? I would say about 19, 20. I was in the 19, 20 area"
EQ	29	Male	Cigarettes; Cigars	"maybe like 16, 17 years old"	15
LM	29	Female	Cigarillos	13	14

Table 5.2 Mixed Methods Findings Joint Display

<u>Topic/Theme</u>	<u>Quantitative Findings</u>	<u>Qualitative Findings</u>	<u>Integrated Analysis</u>
Initiation Experiences	<p>Past-month co-users in NHANES reported:</p> <ul style="list-style-type: none"> • marijuana initiation at age 15.04 • marijuana regular use 16.54 • regular cigarette use by age 16.00 	<ul style="list-style-type: none"> • Pleasant first marijuana experiences – “it felt good and ever since then I liked it and I kept going” • Unpleasant first tobacco experiences – “I remember the taste wasn’t so good...It wasn’t something that I really liked that much” 	<p>Although co-users’ first experiences with tobacco and marijuana and progression to regular use occur at a similar age for tobacco and marijuana, perceptions of pleasantness and the speed and experiences of progression to regular use varied by product.</p>
Age	<ul style="list-style-type: none"> • Across all 3 waves, co-use prevalence was 12.15% among 21-25 year olds and 9.21% among 26-30 year olds • The average age of co-users was 24.93 	<ul style="list-style-type: none"> • Interviews were segmented by age • Use of marijuana tobacco had decreased from when they were younger to the present day - “It [growing up] slowed me [my marijuana and tobacco use] down a lot” 	<p>Co-use is more prevalent in the younger half of this age group.</p>
Gender	<ul style="list-style-type: none"> • Across three NHANES waves, the prevalence for past-month co-use was 13.45% for men and 8.0% for women 	<ul style="list-style-type: none"> • Interviews: 6 Female, 14 Male • Females spoke about their experiences specific to access to marijuana and having 	<p>Co-use is more common among men than women.</p> <p>Female-specific stressors prompted marijuana use,</p>

		specific stressors related to being a female or a mother that led them to want to use marijuana more	whereas male-specific stressors were not discussed.
Employment and School	<ul style="list-style-type: none"> The highest prevalence of co-use was among those not looking for work because they were in school (13.46%), those not working for other reasons including being unable to work, laid-off or disabled (16.03%), and those actively looking for work (13.4%) 	<ul style="list-style-type: none"> Four of the 20 interviewees were in school full-time, with a fifth interviewee taking classes part time College influenced use – either increasing (“It [marijuana use] didn’t start until I got to school”) or decreasing use (“the only friends I have who don’t use tobacco or marijuana are the ones who are enrolled in college. It’s kind of what gives me the insight not to want to smoke”) Job stress as well as access to marijuana at work and tobacco smoking breaks at work influenced participants use 	The major institutions young people are involved with (school and jobs) can profoundly impact co-use both through the social influence of classmates and coworkers, and through creating stress from which young people use tobacco and marijuana to gain relief.
Depressive Symptoms	<ul style="list-style-type: none"> Co-users reported an average PHQ-9 score 	<ul style="list-style-type: none"> Interviewees reported that marijuana use and 	Mental health symptoms should be investigated as a

	<p>of 4.65, compared 2.51 for neither product users, 3.67 for cigarette-only users, and 3.08, for marijuana-only user</p> <ul style="list-style-type: none"> • More than a third of co-users (36.75%) reported some depressive symptoms 	<p>to a lesser extent tobacco use improve their mood and help them manage their depression (“I have anxiety and depression...sometimes your mind needs a break.”)</p>	<p>potential predictor of co-use (through self-medication). More work is needed in this area to explicate this relationship.</p>
Household Tobacco and Marijuana Exposure	<ul style="list-style-type: none"> • Past-month co-users (60.62%) were more likely to live with a tobacco user than cigarette-only users (48.96%), marijuana-only users (22.54%) or neither product users (8.98%) 	<ul style="list-style-type: none"> • Interviewees had mixed feelings about whether living with tobacco, marijuana, or tobacco and marijuana co-users influenced their own behavior. • “I don’t know. It’s hard to give a solid answer...” • “It’s nice to have somebody who you can take a break with and smoke with” 	<p>Household exposure to tobacco and marijuana may be an important factor in co-use behaviors.</p>
Alcohol Use	<ul style="list-style-type: none"> • Co-users (65.57%) were more likely to reporting drinking at least once a month or more than neither users or cigarette-only users (34.65% and 43.52%) 	<ul style="list-style-type: none"> • Many interviewees indicated that drinking alcohol increases the likelihood that they will smoke tobacco as well as the amount of tobacco that they 	<p>Both qualitatively and quantitatively, alcohol use emerged as an important behavior to consider in the contexts of tobacco and marijuana co-use.</p>

	<p>but had a similar prevalence as marijuana-only users (63.62%)</p>	<p>smoke – “I smoke like a chimney when I get drunk.”</p> <ul style="list-style-type: none"> Interviewees indicated that they intentionally do not mix marijuana and alcohol “Marijuana and alcohol aren’t the most compatible.” 	
Comparing Tobacco and Marijuana Use	<ul style="list-style-type: none"> Co-users reported smoking marijuana on more days in the past month (average 13.5 days) than marijuana-only users (average 11.7 days) but smoking cigarettes a similar number of days (average 24.9 days) in the past month as cigarette-only users (average 24.7 days) Co-users report smoking fewer cigarettes per day (11.0) than cigarette-only users (12.3) A similar percent of co-users (38.6%) indicated that their usual cigarette brand was mentholated as 	<ul style="list-style-type: none"> In the interviews, most participants reported using flavored cigar products, both in their creation of blunts to smoke marijuana and separately as an unaltered tobacco product. – “Mostly sweeter flavors like Jazz or cherry.” Overwhelmingly, participants in the interviews reported that they prefer to smoke marijuana over tobacco Participants reported using marijuana to self-medicate medical conditions - I'd rather smoke a joint any day over taking that medicine... it's much 	<p>Co-users behave more like cigarette-only users in terms of tobacco use than like marijuana-only users in terms of their marijuana use frequency. Future work should endeavor to examine the different factors that distinguish tobacco-only users from co-users to explicate the specific risk factors that can make a young adult more likely to co-use.</p>

	<p>cigarette-only users (37.9%)</p> <ul style="list-style-type: none"> • The percent of co-users who reported that they usually smoke their first cigarette within the first 5 minutes of waking (22.7%) was identical to the percent of cigarette-only users (22.7%). • The average co-user reported smoking 2.2 joints or pipes of marijuana per day (95% CI 2.0, 2.4), which was slightly more than the average marijuana-only user (average 1.9 per day, 95% CI 1.7, 2.1) 	<p>more effective. It works perfectly fine and it heals it pretty good,” or for spiritual experiences – “I can connect with my spirit. I can connect with who I am when smoking marijuana”</p>	
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CHAPTER 6: SUMMARY

a. Overview

This dissertation used a Sequential Explanatory Mixed Methods design to explore young adult tobacco and marijuana co-use and the factors associated with co-use in order to provide a comprehensive picture of this behavioral phenomenon. Study 1 provided an overview of the prevalence of cigarette and marijuana co-use and how it has changed in a 10-year period, between 2005 and 2014. Study 1 also examined the factors that distinguish co-users from neither users, cigarette-only users, and marijuana-only users. Building on results from Study 1, an interview guide was developed for data collection with young adult co-users in the state of Maryland. The interview guide also included theoretical constructs, based on the conceptual framework of this study, and facets of co-use that have emerged as important in prior studies, such as the creation of blunts. Study 2 entailed an examination of experiences of and modes of co-use, as described by young adult interviewees and an examination of how they relate to theoretical constructs across the different levels of the Social Ecological Model. Finally, Study 3 included the explicit integration of results from Study 1 and findings from Study 2 to glean a deeper understanding of the factors that influence co-use. The experiences of young adults, as well as their reflections, helped explain and contextualize quantitative findings and 5 *meta-inferences* related to the role of co-use and the experiences of young adults emerged as important. Taken together, the results from this dissertation help provide insight into the complex behavior of tobacco and

marijuana co-use among young adults, helping to fill a critical gap in the literature, and providing direction for future research.

b. Implications for Prevention and Public Health Practice

This work has implications on prevention – co-users may begin using one product first and then transition to a second or begin both products simultaneously. Due to the different initiation patterns, prevention of co-use requires multifaceted education strategies designed to explain the harms of co-use to young adults.

With changing marijuana policies across the United States, including decriminalization and legalization of medicinal and recreational marijuana in different states, it is of critical importance for lawmakers and public health professionals to understand the risk factors, experiences and potential health risks of marijuana use, particularly among adolescents and young adults especially when combined with tobacco use. Due to marijuana's status as federally illegal, there is a paucity of literature establishing the negative health effects of marijuana in humans, particularly potential long-term effects. Additionally, more work is needed to understand the potential negative synergistic health effects of co-occurring marijuana and tobacco use. Public health education campaigns have not been able to provide clear messaging about the harms and potential dependence potential of marijuana due to a lack of research on this topic.

Findings from this dissertation have implications, especially with the potential for access to marijuana to become more available across America with changes in state policies. First, Study 1 established that certain set of variables and experiences distinguish co-users from single-product users or neither users. In addition to a host of

demographic factors, experiences such as living with a smoker and reporting depressive symptoms, and behaviors, like alcohol use, are also associated with co-use. Due to the cross-sectional nature of NHANES, it is not possible to explore the temporal relationship. It is possible that these experiences and factors predict co-use initiation but also possible that young adults who co-use are more likely to have these experiences or initiate these behaviors. Depression, specifically, was one factor that was associated with co-use in NHANES analyses and may be a consequence of co-use. Future work is necessary to assess the role of depression in co-use, as either a predictor or a consequence. More work is needed to assess the role of these experiences, including alcohol use, non-marijuana illicit drug use and household tobacco exposure. Co-users require different prevention and intervention strategies than single-product users and future public health work needs to consider the unique needs of this group in developing educational and cessation programs.

Future decisions about marijuana policy should take into account the potential effects of increased marijuana access for young adults. When explicitly asked about the influences that changes in policy have had on their marijuana harm perceptions and use the vast majority of interviewees in Study 2 indicated that the changes in policy have not had a conscious influence on their risk perceptions or behavior, however future work is warranted to investigate the ways that changes in policy can subconsciously influence young adults' harm perceptions and behavior related to tobacco and marijuana and marijuana co-use. Young adults' social norms related to tobacco use and marijuana use play an important role in their use. Specifically, most young adults reported strong positive perceptions of marijuana and strong negative perceptions of

tobacco, which may lead them to use more marijuana, because they perceive it is less harmful.

During the interview period of Study 2, medical marijuana became available in the state of Maryland and two of the 20 interview participants shared that they were medical marijuana patients and had visited a dispensary between 12/1/2017 and the date of their interview. Although medical marijuana was not explicitly investigated in this study, the availability of medical marijuana may change perceptions of marijuana use and marijuana use behaviors among young adults. Specifically, the availability of medical marijuana may make young adults more likely to perceive marijuana as less harmful and more likely to use marijuana to self-medicate their own experienced pain and mental health symptoms.

For interviewees who did not disclose that they were medical marijuana patients, many shared the sentiment that they believe if marijuana was more available they would decrease or discontinue their tobacco use entirely. Future work should examine the potential of an inverse relationship between tobacco and marijuana use among co-users when the two products are similarly available to assess the veracity of these predictions of co-users. It is likely that this relationship will be complicated by nicotine dependence; co-users in NHANES data showed similar levels of nicotine dependence (assessed with time to first cigarette in the morning) as cigarette-only users indicating it may be difficult for them to quit tobacco entirely, even with unfettered access to marijuana. As there is a gap in the literature documenting the potential negative long-term health consequences of marijuana use, advocating marijuana use as a replacement for tobacco use among young adults is not warranted and could be very

dangerous. Before instituting policies that would make marijuana more accessible to young adults, lawmakers should consider the unintended consequences that this pattern of co-users switching from tobacco to marijuana may have such as increased young adult marijuana use.

c. Strengths

This dissertation drew on the strengths of quantitative and qualitative research methodologies to gain a deeper understanding of young adult tobacco and marijuana co-use. First, the mixed methods research design of this study allowed for the collection and analysis of more comprehensive data than either methodology alone would allow. The integration of qualitative results and qualitative findings provided an invaluable opportunity to understand how the experiences of young adult co-users can help explain the salience of different sociodemographic factors, experiences and behaviors relate to co-use. Next, the use of U.S. nationally-representative NHANES data in the quantitative phase allowed for generalization of findings to this subset of the population. Due to the rigorous data collection procedures used in NHANES there were low levels of missing data for most variables and no included variable had a prevalence of missing data over 10%. Additionally, the qualitative phase of this dissertation allowed for young adult co-users' experiences and reflections to be included in this study in their own words, which adds considerably to this dissertation's findings. The study included a strong foundation in health behavior theory, which future work can build upon to generate a comprehensive model to describe tobacco and marijuana co-use.

d. Limitations

There are also important limitations to this dissertation. First, because the quantitative phase of this dissertation involves a secondary analysis of pre-existing data, analyses were limited to including questions asked as part of NHANES. There are questions that were not included in NAHNES that may be associated with co-use and thus could not be included such as household marijuana exposure, and age of first cigarette use. Additionally, NHANES includes very little detail about history, frequency and intensity of marijuana use in the 2005-2006 and 2009-2010 waves of data collection. There is no way to obtain this information since it was not part of the original NHANES data collection, which limits analyses and interpretations of results. Next, the sample used for the quantitative and qualitative portions included different groups of young adults assessed at different points in time, young adults responding to the NHANES survey between 2005 and 2014 and young adults in Maryland in 2017-2018. Closely related, co-use was defined differently in the two phases of this study, which may influence conclusions that have been drawn. In analysis of NHANES data, questions about cigar and other tobacco product use are only asked for respondents who report using tobacco in the past 5 days; thus the prevalence of cigar use and other tobacco product use was low. Due to low prevalence of other tobacco products, quantitative analyses only considered cigarette and marijuana use as co-use. It is possible that this definition excluded some young adults in NHANES who had not used cigarettes but had used other tobacco products in the past month. In the qualitative phase, any past-month tobacco and past-month marijuana use determined eligibility, therefore, the qualitative phase included young adults who would have not been

included in NHANES analyses because they reported only non-cigarette tobacco use. Additionally, eligibility in both the quantitative and qualitative phases of the study was based on participant self-report and was not biochemically verified. Finally, the operationalization of “co-use” in this dissertation included any past month use; this does not necessarily mean that all participants were using both products together (either simultaneously or one directly after the other), merely that both products had been used in the past month. It is possible that this broad definition of co-use captured regular users of one product who experimented with the other product during the month preceding NHANES data collection or infrequent users of both products who happened to use both in the month preceding NHANES data collection. Despite the limitations, this dissertation adds to the field of young adult tobacco and marijuana co-use and can help inform future studies and public health practice.

e. Directions for Future Research

There are important directions for future research to advance scientific understanding of co-use behaviors. First, future studies should examine the long-term health consequences of co-use. The long-term health effects of marijuana are not well studied, due to marijuana’s status as federally illegal, and the negative health effects of co-use are not well-established. Gleaning a better understanding of health effects of co-use will bolster prevention strategies. Additionally, future work should examine patterns of initiation of co-use and their potential influence on frequency, intensity and product preference. Similarly, trajectories of co-use and cessation from one of both products over time may be important to study. Finally, research establishing causal mechanisms of co-use is of critical importance for prevention efforts.

APPENDICES

Appendix A: Methods

Appendix B: Variables from NHANES

Appendix C: IRB Initial Application

Appendix D: IRB Application: Amendment 1

Appendix E: IRB Application: Amendment 2

Appendix F: IRB Application: Amendment 3

Appendix G: In-Depth Interview Codebook

Appendix A: Methods

a. Study Design

This dissertation employed a Sequential Explanatory Mixed Methods design, which is one of the five major mixed methods designs detailed by Creswell and Plano Clark (2011, p. 71). The Sequential Explanatory design is represented as QUAN → qual (Creswell & Plano Clark, 2011, p. 71). This design was ideal for this dissertation's research question because it allowed for results from quantitative analysis to shape qualitative data collection and qualitative findings to elucidate quantitative results in ways that would not be possible with either research methodology alone. The timing of this dissertation was sequential with the quantitative data analyses preceding qualitative data collection and analyses, as is characteristic of a sequential explanatory design (Creswell & Plano Clark, 2011, p. 71).

Quantitative results from analysis of the NHANES dataset were used to develop an interview guide for qualitative data collection. The priority in this dissertation was on the quantitative phase, as is standard in a sequential explanatory design (Creswell & Plano Clark, 2011, p. 71). While both phases of the study address the research question, the priority was on using the quantitative findings to help explore prevalence of and characteristics associated with tobacco and marijuana co-use in the NHANES dataset. Mixing refers to the explicit integration of the two strands (Creswell & Plano Clark, 2011, p. 67). The mixing strategy for this dissertation was merged as data from both phases were brought together in the mixed methods analysis phase (Creswell & Plano Clark, 2011, p. 67). This dissertation used the "following a thread" technique for integrating findings from the quantitative and qualitative phases where integration takes

place in the analysis stage (O’Cathain et al., 2010). The Good Reporting of A Mixed Methods Study (GRAMMS) framework was used when reporting mixed methods findings from this dissertation (O’Cathain, Murphy, & Nicholl, 2008). The value of mixing in this dissertation was that this design allowed for qualitative research inquiry to glean a better understanding of findings from the quantitative phase of the study.

b. Phase 1: Quantitative Aims

Aim 1: Assess past-month cigarette and marijuana co-use prevalence at 5 waves of NHANES data and changes across these waves over a 10-year period.

Hypothesis 1: Prevalence of past-month cigarette and marijuana co-use among young adults increase across all time points.

Aim 2: Explore predictors of past-month cigarette and marijuana co-use across three waves of NHANES data.

Hypothesis 2: A unique host of sociodemographic variables (gender, race, ethnicity, income, employment status), depression, and behavioral factors predict past month cigarettes and marijuana co-use compared to cigarette-only use, marijuana-only use, and neither marijuana nor tobacco use.

i. Description of Sample

For the Quantitative portion of analyses, de-identified, publicly-available data from The National Health and Nutrition Examination Survey (NHANES) were used. NHANES collects data from Americans of all ages from birth through adulthood, this study focused on young adults ages 21-30.

ii. Description of Sampling Procedure

For the Quantitative portion analyzing NHANES data, all participants were all recruited by the CDC and data were collected, cleaned, and de-identified by the CDC (Centers for Disease Control and Prevention, 2016b). NHANES uses a four-stage sampling procedure to recruit participants from across the US. First, all counties in the US are divided into 15 groups based on sociodemographic characteristics and other factors (Centers for Disease Control and Prevention, 2016b). Every year, one county is selected from each of the 15 groups - the selected county is used to model data from the other counties in their group (Centers for Disease Control and Prevention, 2016b). In each of the 15 groups, smaller groups of households are formed - all of the houses and apartments within a randomly selected group are invited to participate, with around 30 households in each group (Centers for Disease Control and Prevention, 2016b). For households with more than one adult, interviewers ask for sociodemographic data (age, race, and gender) for each person in the household and a computer algorithm is used to randomly select none, some, or all of the adults in any given household (Centers for Disease Control and Prevention, 2016b). Throughout the 10-year range included in this dissertation (2005-2014) there have been minor changes to the CDC recruitment process for NHANES but the process has remained largely the same (Centers for Disease Control and Prevention, 2016b). The average number of persons selected per eligible household changed from 2.02 in 2005-2006 to 2 in 2009-2010 and 2013-2014, and the number of study locations changed from 117 in 2005-2006 to 60 in 2009-2010 and 2013-2014 (Centers for Disease Control and Prevention, 2016b). In this way, analyses included pooled, cross-sectional survey data across a 10-year range which fit with the goals of this study to assess how national trends have changed over. The

process of pooling data across multiple years of a cross-sectional survey to assess trends over time has frequently been used in epidemiologic studies with NHANES (Casagrande & Cowie, 2017; McGuinn, Ghazarian, Joseph Su, & Ellison, 2015; O'Connor, 2006; Skinner & Skelton, 2014) as well as other complex, nationally-representative datasets.

iii. Measures

For more information about specific variables that were analyzed in the quantitative portion of this dissertation, please see the attached NHANES variables table (Appendix B) that summarize measures, at which time points they were collected, the question text, and response options. Most of the questions asked in NHANES are measures of use and have not formally undergone psychometric validation but have been refined through cognitive testing and prior rounds of data collection. Additionally, many NHANES questions match other national surveys.

The nine-item Patient Health Questionnaire (PHQ-9) is used to assess Depression Status in NHANES and has a sensitivity of 0.88 and a specificity of 0.88 for major depression (Kroenke, Spitzer, & Williams, 2001). Reliability and validity of the PHQ-9 have been established in prior studies (Kroenke et al., 2001; Kroenke & Spitzer, 2002; Pinto-Meza, Serrano-Blanco, Peñarrubia, Blanco, & Haro, 2005).

iv. Data Analysis

NHANES data were downloaded from the CDC website and organized with a date identifier; data from multiple years was appended in one dataset. All statistical analyses were conducted using Stata 15.1. Svy and svyset commands were used to account for the multi-stage sampling design of NHANES. Univariate and bivariate

statistics were run to examine the dataset and characterize the population. Participants who were missing data for the main outcome variables (past-month cigarette use and past-month marijuana use) were not included in analyses. In accordance with NHANES analytic guidelines, prevalence of missing data was examined. Missing data did not exceed 10% for any variable included in analyses; based on analytic recommendations, no further evaluation of or adjustment for missing data was conducted.

Aim 1: Quantitative Analysis: First, weighted estimates for prevalence of past-month cigarette use, marijuana use, and cigarette and marijuana co-use, standard deviation, standard error and sample size (accounting for the complex design of NHANES) were calculated for each NHANES cycle (2005-2006, 2007-2008, 2009-2010, 2011-2012, and 2013-2014). These values were used to calculate summary ANOVAs to assess if prevalence had significantly changed over time. Secondary analyses included comparing prevalence of co-use by covariates to assess potential differences by groups.

Aim 2: Quantitative Analysis: Data from three waves of NHANES (2005-2006, 2009-2010 and 2013-2014) were used. A multinomial logistic regression was calculated. The dependent variable was past month use (neither, cigarette-only, marijuana-only, co-use) and neither users were set as the reference group. The model was adjusted based on fit statistics. A conservative threshold was set; any variables significant at the $p=0.25$ level were retained in the final model. Secondary analyses included binary logistic regressions to examine the potential influence of tobacco and marijuana use frequency and intensity, nicotine dependence, menthol cigarette status,

and other tobacco product use to specifically compare cigarette-only users and co-users and marijuana-only users and co-users, respectively.

c. Phase 2: Qualitative Aim

Aim 3: Using in-depth interviews, examine in greater detail the influence of attitudes, subjective norms, and observational learning on tobacco and marijuana co-use.

i. Measures

Results from analysis of NHANES data, theoretical constructs and findings from published literature were used to develop an interview guide to shape in-depth interviews with young adult tobacco and marijuana co-users. The qualitative data collection was designed to explore 1) current behavioral use patterns, 2) factors influencing co-use and past experiences and 3) attitudes related to tobacco and marijuana co-use. Operationalization from prior literature was used whenever possible. Three pilot interviews were conducted. After the pilot interviews, the interview guide was edited. The revised interview guide was then submitted as an additional IRB amendment. Once the revised interview guide was approved by the IRB it was used for interviews.

ii. Description of Sample

All participants in the in-depth interviews were between 21 and 30 years of age, lived in Maryland and reported using both tobacco and marijuana in the past month. For the qualitative phase, any tobacco use (including cigars, little cigars and cigarillos) and any marijuana use in the past month qualified a potential participant for inclusion. Given the results of Aims 1 and 2, in-depth interviews were stratified by age: 10 interviews were completed with 21 to 25 year olds and 10 interviews were completed

with 26 to 30 year olds in order to better understand the ways that age may influence co-use experiences. Interviews were completed until thematic saturation was reached, with interviews not introducing any new information. Fifteen to twenty interviews were proposed based on recommendations for the ideal number of interviews for thematic saturation from other studies (Crouch & McKenzie, 2006; Guest et al., 2006). In the end, 20 interviews were conducted.

iii. Description of Sampling Procedure

Craigslist was used for recruitment. Craigslist has been found to be an effective way to recruit participants for qualitative interviews (Worthen, 2014), diverse smokers (Brodar et al., 2016), and young smokers (Ramo, Hall, & Prochaska, 2010) in prior studies. Young adults who were interested in the study after reading the advertisement emailed the Principal Investigator (PI, Elizabeth Seaman). The PI scheduled a phone call with each potential participant, using a GoogleVoice number, to discuss the scope of the in-depth interviews and the goals of the project. GoogleVoice is a free service that allows users to receive calls, voicemails and text messages through a free phone number instead of a user's personal phone number. Potential participants had the opportunity to ask questions about the interviews or their role as a participant. Potential participants who indicated they were interested in the study were then screened for eligibility over the phone. The Waiver of Consent was read to participants over the phone and they gave verbal consent. A copy of the Waiver was emailed to participants. Interviews took place on the phone, were audio-recorded and then transcribed verbatim by Rev.com, a transcription service. During the interviews, participants were asked a series of open-ended questions. After the interview, participants had an opportunity to

ask the PI questions, and were provided with several evidence-based factsheets and Maryland tobacco cessation resources. Participants were compensated with a \$40 electronic Amazon gift card.

iv. Data Analysis

Qualitative data analysis included a blend of inductive and deductive methods: theoretical constructs were assessed from participant answers to the questions related to each construct (attitudes, subjective norms, observational learning), however many themes emerged outside of these theoretical questions and were documented. All interviews transcripts were cleaned by the investigator. Transcripts were thematically analyzed in NVivo 11. Thematic analysis is a "foundational method for qualitative analysis," and one of the most flexible qualitative analytic tools (Braun & Clarke, 2006). This form of analysis involved identifying common themes or ideas across different interviews.

First, transcripts were read through several times and open-coding was used to identify domains in the data. Then, axial coding was used to explore the relationships of the open codes. A codebook was developed. A subset of interview transcripts ($n=3$; 15%) were double coded by a trained graduate student to assess completeness and clarity of the codebook ($\kappa = 0.88$). Edits were made to the codebook and all interview transcripts were coded. All narrative passages that had a specific code applied were read together and compared, and the emergence of themes and subthemes was documented.

d. Human Subjects Procedures

Several safeguards were taken to protect the participants in this study. First, all NHANES data downloaded from the CDC website were de-identified and could not be matched to individual participants. There were very few risks to this qualitative portion of this study. Participants were asked to talk about their experiences with tobacco and marijuana; bringing up these memories may have made participants feel emotional or made them crave a cigarette or marijuana. During the waiver of consent process and again before the interview session, participants were reminded that they could choose to not continue with the interview at any point if they felt uncomfortable. Very little personal information was collected from participants (email, telephone number). Participants were asked to pick a nickname to use during the interview. Then, all participants were randomly assigned a set of initials to standardize reporting of participant quotations across manuscripts and to further protect privacy. All materials from the interview sessions (audio recordings, transcripts) were kept in a locked file cabinet and electronic files were saved on a password-protected computer. Interviewees had the opportunity to debrief after the interview and were emailed evidence-based factsheets and cessation resources.

Appendix B: Variables from NHANES

Tobacco Use Variables

		2005-2006 NHANES	2009-2010 NHANES	2013-2014 NHANES
Cigarettes				
smoked at least 100 cigarettes in lifetime	These next questions are about cigarette smoking and other tobacco use. {Have you/Has SP} smoked at least 100 cigarettes in {your/his/her} entire life? i. Yes ii. No	Yes (SMQ020)	Yes (SMQ020)	Yes (SMQ020)
age started smoking regularly	How old {were you/was SP} when {you/s/he} first started to smoke cigarettes fairly regularly?	Yes (SMD030)	Yes (SMD030)	Yes (SMD030)
do you now smoke	{Do you/Does SP} now smoke cigarettes iii. Every day iv. Some days v. Not at all	Yes (SMQ040)	Yes (SMQ040)	Yes (SMQ040)
age smoked first whole cigarette	How old were you when you smoked a whole cigarette for the first time?	Yes (SMD630)	Yes (SMD630)	Yes (SMD630)
# cigarettes smoked per day now	On average, how many cigarettes {do you/does SP} now smoke per day?	Yes (SMD070)	No	No
Usual brand	May I please see the pack for the brand of cigarettes {you usually smoke/SP usually smoke?	Yes (SMD093 and (SMD100BR)	Yes (SMD093 and (SMD100BR)	Yes (SMD093 and (SMD100BR)

	What brand of cigarettes {do you/does SP} usually smoke?			
Usual brand menthol	Cigarette Menthol indicator	Yes (SMD100MN)	Yes (SMD100MN)	Yes (SMD100MN)
Cigarettes smoked in life	<p>The following questions are about cigarette smoking and other tobacco use. Do not include cigars or marijuana. About how many cigarettes have you smoked in your entire life?</p> <ul style="list-style-type: none"> • I have never smoked • not even a puff • 1 or more puffs but never a whole cigarette • 1 cigarette • 2-5 cigarettes • 6-15 cigarettes • 16-25 cigarettes • 15-25 cigarettes • 26-99 cigarettes • 100 or more cigarettes 	No	No	Yes (SMQ621)
Number of days in last month smoked	During the past 30 days, on how many days did {you/SP} smoke cigarettes?	Yes (SMD641)	Yes (SMD641)	Yes (SMD641)
Cigarettes per day in last month	During the past 30 days, on the days that {you/SP} smoked, how many cigarettes did {you/s/he} smoke per day?	Yes (SMD650)	Yes (SMD650)	Yes (SMD650)

How soon after waking	How soon after {you/SP} wake{s} up {do you/does s/he} smoke? Would you say . . . <ul style="list-style-type: none"> • Within 5 minutes • From 6 to 30 minutes • From more than 30 minutes to one hour • More than one hour • Refused • Don't know 	Yes (SMQ077)	Yes (SMQ077)	Yes (SMQ078) More categories (can be collapsed into categories from SMQ077) <ul style="list-style-type: none"> • Within 5 minutes • 6-30 minutes • 30 mins to 1 hour • 1 hour to 2 hours • 2 hours to 3 hours • 3 hours to 4 hours • More than 4 hours
Tried to quit smoking	During the past 12 months, have you stopped smoking for one day or longer because you were trying to quit smoking? <ul style="list-style-type: none"> • Yes • No • Refused • Don't Know 	Yes (SMQ670)	Yes (SMQ670)	Yes (SMQ670)
Cigarette Use Last 5 days	Which of these products did {you/he/she} use?	Yes (SMQ690A)	Yes (SMQ690A)	Yes (SMQ690A)
Days smoked cigarettes in last 5 days	During the past 5 days, including today, on how many days did {you/he/she} smoke cigarettes?	Yes (SMQ710)	Yes (SMQ710)	Yes (SMQ710)

Cigarettes smoked per day in last 5 days	During the past 5 days, including today, on the days {you/he/she} smoked, how many cigarettes did {you/he/she} smoke each day?	Yes (SMQ720)	Yes (SMQ720)	Yes (SMQ720)
Smoked last cigarette?	When did {you/he/she} smoke {your/his/her} last cigarette? Was it... <ul style="list-style-type: none"> • Today • Yesterday • 3-5 days ago • Refused • Don't Know 	Yes (SMQ725)	Yes (SMQ725)	Yes (SMQ725)
Household Tobacco Exposure				
Does anyone smoke in home?	Does anyone who lives here smoke cigarettes, cigars, or pipes anywhere inside this home?	Yes (SMD410)	Yes (SMD410)	No
# of people who live here smoke tobacco?	How many people who live here smoke cigarettes, cigars, little cigars, pipes, water pipes, hookah, or any other tobacco product?	No	No	Yes (SMD460)
Marijuana				
Ever used marijuana	Have you ever, even once, used marijuana or hashish?	Yes (DUQ200)	Yes (DUQ200)	Yes (DUQ200)
Age first tried marijuana	How old were you the first time you used marijuana or hashish?	Yes (DUQ210)	Yes (DUQ210)	Yes (DUQ210)
Used marijuana every month for a year	Used marijuana every month for a year?	No	Yes (DUQ211)	Yes (DUQ211)
Age started regularly using marijuana	How old were you when you started smoking marijuana or	No	Yes (DUQ213)	Yes (DUQ213)

	hashish at least once a month for one year?			
Time since last used marijuana	How long has it been since you last smoked marijuana or hashish at least once a month for one year?	No	Yes (DUQ215Q)	Yes (DUQ215Q)
Time since last used marijuana (unit)	How long has it been since you last smoked marijuana or hashish at least once a month for one year? (UNITS)	No	Yes (DUQ215U)	Yes (DUQ215U)
How often used marijuana	During the time that you smoked marijuana or hashish, how often would you usually use it?	No	Yes (DUQ217)	Yes (DUQ217)
How many joints/pipes a day	During the time that you smoked marijuana or hashish, how many joints or pipes would you usually smoke in a day?	No	Yes (DUQ219)	Yes (DUQ219)
Last time used marijuana	How long has it been since you last used marijuana or hashish?	Yes (DUQ220Q)	Yes (DUQ220Q)	Yes (DUQ220Q)
Last time used marijuana unit	How long has it been since you last used marijuana or hashish? (UNITS)	Yes (DUQ220U)	Yes (DUQ220U)	Yes (DUQ220U)
#days smoked marijuana in last month	How long has it been since you last used marijuana or hashish?	Yes (DUQ230)	Yes (DUQ230)	Yes (DUQ230)

Depression				
Depression	Patient Health Questionnaire (PHQ-9), a nine-item screening instrument that asks questions about the frequency of symptoms of depression over the	Yes (DPQ_D)	Yes (DPQ_F)	Yes (DPQ_H)

	past 2 weeks (score \geq 10 is clinical depression)			
Other Substance Use				
Ever used cocaine/heroin/methamp hetamine	Have you ever used cocaine, crack cocaine, heroin, or methamphetamine?	Yes (DUQ240)	Yes (DUQ240)	Yes (DUQ240)
How often drink alcohol over past 12 mos	In the past 12 months, how often did {you/SP} drink any type of alcoholic beverage?	Yes (ALQ120Q)	Yes (ALQ120Q)	Yes (ALQ120Q)
# days drink alcohol per wk, mo, yr	In the past 12 months, how often did {you/SP} drink any type of alcoholic beverage? UNIT	Yes (ALQ120U)	Yes (ALQ120U)	Yes (ALQ120U)
Age			No	
Age	Age in Years	Yes (RIDAGEYR)	Yes (RIDAGEYR)	Yes (RIDAGEYR)
Gender				
Gender	Gender of participant <ul style="list-style-type: none"> • Male • Female 	Yes (RIAGENDR)	Yes (RIAGENDR)	Yes (RIAGENDR)
Education Level				
Education level - Adults 20+	What is the highest grade or level of school {you have/SP has} completed or the highest degree {you have/s/he has} received?	Yes (DMDEDUC2)	Yes (DMDEDUC2)	Yes (DMDEDUC2)
Marital Status				
Marital status	Marital status	Yes (DMDMARTL)	Yes (DMDMARTL)	Yes (DMDMARTL)
Race and Ethnicity				
Race/Hispanic origin	Recode of Race and Ethnicity <ul style="list-style-type: none"> • Mexican American • Other Hispanic 	Yes (RIDRETH1)	Yes (RIDRETH1)	Yes (RIDRETH1)

	<ul style="list-style-type: none"> • Non-Hispanic White • Non-Hispanic Black • Other Race – Including Multi-Racial 			
Race/Hispanic origin	Recode of race and ethnicity with Non-Hispanic Asian Group <ul style="list-style-type: none"> • Mexican American • Other Hispanic • Non-Hispanic White • Non-Hispanic Black • Non-Hispanic Asian • Other Race (including multi-racial) 	No	No	Yes (RIDRETH3)
Family Income				
Ratio of Family Income to Poverty Guidelines	Ratio (0.00 to 5.00)	Yes (INDFMPIR)	Yes (INDFMPIR)	Yes (INDFMPIR)
Student/Employment Status				
Type of work done last week	In this part of the survey I will ask you questions about {your/SP's} work experience. Which of the following {were you/was SP} doing last week	Yes (OCD150)	Yes (OCD150)	Yes (OCD150)
Main reason didn't work	What is the main reason {you/SP} did not work last week?	Yes (OCQ380)	Yes (OCQ380)	Yes (OCQ380)

Appendix C: IRB Initial Application



1204 Marie Mount Hall
College Park, MD 20742-5125
TEL 301.405.4212
FAX 301.314.1475
irb@umd.edu
www.umresearch.umd.edu/IRB

DATE: August 14, 2017

TO: Elizabeth Seaman, MHS
FROM: University of Maryland College Park (UMCP) IRB

PROJECT TITLE: [1013593-1] Co-Occurring Marijuana and Tobacco Use among Young Adults:
A Sequential Explanatory Mixed Methods Study

REFERENCE #:
SUBMISSION TYPE: New Project

ACTION: APPROVED
APPROVAL DATE: August 14, 2017
EXPIRATION DATE: August 13, 2018
REVIEW TYPE: Expedited Review

REVIEW CATEGORY: Expedited review category # 7

Thank you for your submission of New Project materials for this project. The University of Maryland College Park (UMCP) IRB has APPROVED your submission. This approval is based on an appropriate risk/benefit ratio and a project design wherein the risks have been minimized. All research must be conducted in accordance with this approved submission.

Prior to submission to the IRB Office, this project received scientific review from the departmental IRB Liaison.

This submission has received Expedited Review based on the applicable federal regulations.

This project has been determined to be a Minimal Risk project. Based on the risks, this project requires continuing review by this committee on an annual basis. Please use the appropriate forms for this procedure. Your documentation for continuing review must be received with sufficient time for review and continued approval before the expiration date of August 13, 2018.

Please remember that informed consent is a process beginning with a description of the project and insurance of participant understanding followed by a signed consent form. Informed consent must continue throughout the project via a dialogue between the researcher and research participant. Unless a consent waiver or alteration has been approved, Federal regulations require that each participant receives a copy of the consent document.

Please note that any revision to previously approved materials must be approved by this committee prior to initiation. Please use the appropriate revision forms for this procedure.

All UNANTICIPATED PROBLEMS involving risks to subjects or others (UPIRSOs) and SERIOUS and UNEXPECTED adverse events must be reported promptly to this office. Please use the appropriate reporting forms for this procedure. All FDA and sponsor reporting requirements should also be followed.

All NON-COMPLIANCE issues or COMPLAINTS regarding this project must be reported promptly to this office.

Please note that all research records must be retained for a minimum of seven years after the completion of the project.

If you have any questions, please contact the IRB Office at 301-405-4212 or irb@umd.edu. Please include your project title and reference number in all correspondence with this committee.

This letter has been electronically signed in accordance with all applicable regulations, and a copy is retained within University of Maryland College Park (UMCP) IRB's records.

University of Maryland College Park
Institutional Review Board
IRB Initial Application - Part 1

Last edited by: Elizabeth Seaman

Last edited on: July 12, 2017

[\[click for checklist\]](#)

☐ Full
☒ Expedited
☐ Exempt

[1013593-1] Co-Occurring Marijuana and Tobacco Use among Young Adults: A Sequential Explanatory Mixed Methods Study

Answer all questions on this form completely, include attachments and obtain signatures of Co-Investigators and your department IRB Liaison prior to final submission on IRBNet.

I. Principal Investigator

Name: Elizabeth Seaman, MHS **Status:** Graduate Student
Department: SPHL- Public Health
Phone: 4438524139 **Email:** eseaman@terpmail.umd.edu
Address: 427 Red Birch Rd. Millersville, MD 21108

II. Faculty Advisor

N/A ☐

Note: A faculty advisor is required if the PI is a student resident or fellow and the Faculty Advisor MUST sign this package through IRBNet.

Name: Craig Fryer
Department: SPHL- Public Health
Phone: (301) 405-0818 **Email:** csfryer@umd.edu
Address: 4200 Valley Drive, Office 1234X

III. Co-Investigators

N/A ☒

Note: All co-investigators MUST sign this package through IRBNet.

Name:
Department:
Phone: **Email:**
Address:

IV. Funding Information

N/A ☐

Note: A copy of the awarded grant application (minus budgetary information) must be provided.

Status	Funding Type	Sponsor Name	ORAA #	COI
Awarded	Departmental	UMD BCH Department		No
Funding Title:				
Awarded	Advisor Funding	Dr. Craig S. Fryer		No
Funding Title:				

V. Project Information

Lay Summary:

This study aims to better understand co-occurring use patterns of marijuana and tobacco products among young adults. Utilizing a nationally-representative de-identified dataset to assess changes in prevalence and predictors of co-occurring marijuana and tobacco use and how these factors have changed over a 10-year period (2005-2014). Results from this analysis will be used to develop an interview guide to shape qualitative data collection (through in-depth interviews) with young adult concurrent marijuana and tobacco smokers. The results from each analysis will be interpreted together for a mixed methods design.

Requested Review Path:

- ☐ Full
☒ Expedited
☐ Exempt

Projected Completion Date: 07/01/2018

Research Category:

- ☐ Faculty or Staff Research
☒ Graduate Student Research
☐ Student/Faculty Collaboration
☐ Undergraduate Student Research
☐ Other:

Academic Committee Review:

- ☐ Yes - Masters committee
☒ Yes - Dissertation committee
☐ No additional academic review required

Participant Incentives:

- ☐ Cash
☐ Check
☐ Raffle/ Lottery:

☐ Extra Credit/ Course Credit:

☐ Gift:

☐ Food:

☒ Other:

Each interview participant will receive an electronic \$40 Amazon Gift Card

☐ Not Applicable

VI. Performance Sites

Performance Sites Engaged in Human Subject Research:

(where the research will be conducted)

☐ UMCP - Campus:

☐ University of Maryland - Extension:

☐ Campus Health Center

☐ Universities at Shady Grove:

☐ Schools:

☐ Prison/Jail:

☒ Other:

Phone Calls with Participants (no physical performance site)

Is this an international study?

☐ Yes [complete Section 10 of Initial Application Part 2]

☒ No

If yes: International Sites:

VII. Subject Information

Targeted Populations:

☒ Normal adult/healthy persons

☐ Cognitively impaired persons

☐ Economically disadvantaged persons

☐ Educationally disadvantaged persons

☐ Elderly/aged persons

☐ Hospital patients or outpatients

☐ Illiterate persons

☐ Individuals with physical disabilities

- ☐ Minority group(s)
- ☐ Minors/children
[inclusion of anyone under 18 requires a Parental Consent Form]
- ☐ Non-English speakers
- ☐ Pregnant women
- ☐ Prisoners
- ☐ Students (non-minors)
- ☐ UMCP employees
- ☐ Other special characteristics and special populations:

Informed Consent Process:

- ☐ Informed consent will be obtained from subjects and documented with a signed, written consent form
- ☒ Informed consent will be obtained from subjects, but no signed consent form will be used. This includes oral consent and implied consent (e.g., completing a survey).
[please see the Requesting a Waiver of Informed Consent Guidance]
- ☐ Fully informed consent will not be obtained from all subjects. This includes deception, withholding information, etc.
[please see the Requesting a Waiver of Informed Consent Guidance]

Will health information be collected?

(See the [HIPAA section of the IRB website](#) for more information and additional resources.)

- ☒ No
- ☐ Yes, data are de-identified or constitute a limited data set.
- ☐ Yes, subject's authorization will be obtained or a waiver or alteration of authorization will be requested.
[complete IRB Form HIPAA]

VIII. Research Procedures

Research Procedures:

- ☐ Records review - retrospective
- ☐ Records review - prospective
- ☐ Education research
- ☐ Behavioral experiments
- ☐ Behavioral observation
- ☐ Questionnaires/surveys
- ☒ Interviews
- ☒ Audiotaping/videotaping
- ☐ The Internet
- ☐ Deception
[describe debriefing process in Section 7 of Initial Application Part 2]
- ☐ Cancer Interventions (health promotion, implementation, etc.)

- ☐ None of the above

Biomedical Procedures:

- ☐ Tissue banking
☐ Biopsy
☐ Blood draw:
☐ Use of pre-existing tissues
☐ Clinical tests
☐ Radiology
☐ Radiation/X-ray/DEXA
☐ fMRI
[use IRB fMRI templates]
☐ Pregnancy screening
☐ EKG
☐ EEG
☐ Genetic analysis
☒ None of the above

IX. Assurances and Signatures

Assurances

This research, once approved, is subject to continuing review and approval by the IRB. The principal investigator will maintain records of this research according to IRB guidelines. If these conditions are not met, approval of this research could be suspended or terminated.

Electronic signatures certify that:

- The signatory agrees that he or she is aware of the policies on research involving participants of the University of Maryland College Park and will safeguard the rights, dignity, and privacy of all participants.
- The information provided in this application form is correct.
- The principal investigator will seek and obtain prior written approval from the IRB for any substantive modification in the proposal, including but not limited to changes in cooperating investigators/agencies as well as changes in procedures.
- Unexpected or otherwise significant adverse events in the course of this study which may affect the risks and benefits to participation will be reported to the IRB.
- The research will not be initiated and subjects cannot be recruited until final written approval is granted.

The following signatures are required for new project submissions:

- Principal Investigator
- Research Advisor(s)
- IRB Liaison ([click here for list](#))

INSTRUCTIONS TO RESEARCHERS

[\[top\]](#)

Now that you have completed this document, check your work, attach all appropriate documents, electronically sign and submit your work. Based on your responses, the following additional documentation must be included with this package before submission. Upload additional documentation in the Designer.

Documents available in the IRBNet Forms and Templates Library:

No additional documents from the Library are required for this project.

Additional required documentation:

- Grant application for any awarded funding
- Request for Consent Waiver

If you have any questions, please refer to the guidelines in the IRBNet Forms and Templates Library or contact irb@umd.edu.

UNIVERSITY OF MARYLAND COLLEGE PARK
Institutional Review Board
Initial Application Part 2

- **Abstract:**

Tobacco use is the greatest cause of preventable death in the United States and an important health behavior to study among young adults. One step towards ending tobacco use is understanding the contexts and situations in which young adults begin and continue smoking tobacco. Prior research has suggested that there is an association between marijuana and tobacco smoking. While the specific mechanism through which young adults initiate and maintain co-occurring marijuana and tobacco use is not fully understood, reviews of published literature have found that 85% of studies on the relationship between marijuana and tobacco use have found a significant association between these two behaviors, indicating that studying these two behaviors together may provide important insight into the initiation and continuation of these two behaviors, particularly among young adults.

This dissertation will employ a Sequential Explanatory Mixed Methods design to glean a deeper understanding of the co-occurring use of marijuana and tobacco products among young adults. Quantitative data analyses will utilize NHANES data to assess changes in prevalence (Aim 1), and predictors (Aim 2) of co-occurring marijuana and tobacco use and how these factors have changed over a 10-year period (2005-2014). Results from quantitative analyses of NHANES data and theoretical constructs will be used to develop an interview guide to shape qualitative data collection (through in-depth interviews) with young adult co-occurring marijuana and tobacco users (Aim 3).

- **Subject Selection:**

1. **Recruitment:**

For the Quantitative Study: All data will come from the NHANES survey. Participants were all recruited by the CDC and data has all been collected and de-identified. All NHANES data used in this dissertation is publicly-available and will be downloaded from the CDC website.

For the Qualitative Study: Participants (21-30 years of age) will be recruited through advertisements posted on Craigslist (see attached draft of advertisement). Potential participants will email the PI and set up a time to discuss the study. Potential participants will be screened (see attached draft of Screener) over the phone to ensure they're between 21 and 30 years old, are current marijuana and tobacco users and live in the state of Maryland. Once participants have been deemed eligible for the study by the PI and indicate they are still interested in participating, the PI will read through the Consent Form (see attached draft) and ask participants to verbally

indicate if they agree to participate or not. The PI will email the participants a copy of the Consent Form (see attached draft) for their records. Email has been selected as the format to share the consent form with participants to protect confidentiality. Once participants have verbally indicated that they agree to participate, the one-hour interview will be scheduled for the following week. Participants will provide a telephone number for the PI to call for the interview. When the PI calls the participant back for the interview, they will confirm that they are still interested in participating and that the scheduled time of the call is still a good time to talk.

2. Eligibility Criteria:

For the Quantitative Study: Participants were systematically sampled by the CDC to meet sampling specifications. This dissertation will analyze data from participants between 21 and 30 years old.

For the Qualitative Study: All participants must be between 21 and 30 years of age, must have smoked both marijuana and tobacco in the past month, and must live in the state of Maryland.

3. Rationale:

For the Quantitative Study: The National Health and Nutrition Examination Survey (NHANES) is a survey assessing health of adults in the United States including substance use, physical activity, nutrition and a variety of health outcomes. This project will include the analysis of data from 5 waves (2005-2006; 2007-2008; 2009-2010; 2011-2012; 2013-2015) of the NHANES survey to assess how prevalence of co-occurring marijuana and tobacco use have changed over time. This project will also use 3 waves of NHANES data (2005-2006; 2009-2010; 2013-2014) to assess how predictors of co-occurring use have changed over time. This dataset includes a host of tobacco and marijuana use questions, which makes it ideal for these analyses.

For the Qualitative Study: In-depth interviews will be conducted with young adult co-occurring marijuana and tobacco smokers. This project will aim to better understand how and why young adults have co-occurring (marijuana and tobacco) use behavior.

4. Enrollment Numbers:

For the Quantitative Study: All participants from the NHANES study datasets who are between 21 and 30 years old will be included. Given the type of analysis, the sample size will range from 3,073 to 4,948.

For the Qualitative Study: First, the interview protocol will be pilot tested with 3 to 5 participants. Data collected during the pilot interviews will only be used for piloting purposes and will not be used in final data analysis. From previous work, we estimate we will conduct 15 to 20 interviews.

a. **Rationale for Enrollment Numbers:**

For the Quantitative Study: All NHANES respondents who met inclusion criteria for age will be included. The total sample size is sufficient to address the research aims of the study with adequate statistical power.

For the Qualitative Study: Interviews will be completed until thematic saturation is reached, based on prior research we estimate this will be between 15 and 20 interviews.

- **Procedures:**

For the Quantitative Study: Publicly-available NHANES data will be downloaded from the CDC website. SAS will be used for all statistical procedures. Data will be cleaned and stored on the PI's password protected laptop. Only the PI will have access to this data file. A variable will be created for co-occurring use by using the variables for past-month marijuana and past-month cigarette use. All statistical analyses will use SURVEY procedures in SAS to account for the complex, multi-stage sampling design of the NHANES. Univariate and bivariate statistics will be run to examine the dataset and characterize the sample. Weighted estimates for prevalence of past month co-occurring marijuana and tobacco use, standard deviation, standard error and sample size will be calculated for five waves of NHANES data (2005-2006, 2007-2008, 2009-2010, 2011-2012, and 2013-2014). These values will be used to calculate an ANOVA model to see if prevalence has significantly changed across time. Secondary analyses will include comparing prevalence of co-occurring use by all covariates to look for potential differences by groups. Next, predictors of co-occurring use will be assessed using data from three waves of NHANES (2005-2006, 2009-2010 and 2013-2014).

For the Qualitative Study: The in-depth interview guide will be developed based on findings from the quantitative portion of this dissertation (the analysis of NHANES), theoretical constructs, and empirical findings from the literature. Once the interview guide is developed, an amendment will be submitted and once approval is granted the guide will be pilot tested with 3 to 5 participants to ensure the questions and probes are appropriate and relevant and to address issues of clarity and interpretation. After pilot testing, the interview guide will be finalized. Then, after the interview guide is finalized, another amendment will be submitted before recruitment begins for the qualitative phase. The qualitative data collection will be designed to explore 1) current behavioral use patterns, 2) predictors of use and past experiences and 3) attitudes related to marijuana and tobacco co-occurring use. The PI will call participants for the interview during the scheduled time discussed during the screening and consent call and will confirm that the participant is still interested in participating and this is still a good time to talk. Interviews will all be conducted on the phone. All interviews will be audio recorded, which participants will be reminded of during the screening call and

before the interview begins. Interview participants will be asked a series of open-ended questions about their marijuana and tobacco use (please see attached draft of Interview Domains). An amendment will be submitted when we finalize the interview protocol. No data will be collected until we receive IRB approval on the amendment. We expect interviews to last up to 60 minutes. Once the interview is complete, the PI will confirm the current email address for the participant to send the \$40 electronic Amazon gift card.

- **Risks:**

For the Quantitative Study: There are very few risks involved. The publicly-available data from the CDC website has already been de-identified, cleaned and stripped of any potentially identifiable information.

For the Qualitative Study: Participants will be asked to talk about their experiences with marijuana and tobacco so it is possible that bringing up these memories may make participants feel uncomfortable. If a participant becomes uncomfortable they have the right to skip a question or choose to discontinue the interview. Participants will receive an evidence-based factsheet about the harms of marijuana and tobacco and cessation resources in the state of Maryland after the interview concludes. All potential participants who respond to the Craigslist Advertisement, whether they are deemed eligible or ineligible for the study, will receive an evidence-based factsheet about the harms of marijuana and tobacco and cessation resources in the state of Maryland. Copies of these factsheets and cessation resources are included (Tobacco Health Effects Factsheet.pdf, Marijuana Health Effects Factsheet.pdf, Maryland Tobacco Resources.pdf, Maryland Quitline Flyer.pdf). If a person skips a question or two they will still receive the incentive, however, if a person discontinues participation after little to no data has been collected they will not receive the incentive. Participants will be informed that they may not be compensated if they decide to skip multiple questions. The potential risk of breach of confidentiality is low since minimal personal information will be collected from participants (specifically: phone number and email address). Several steps have been taken to mitigate the potential risk of breach of confidentiality. First, interviews will take place over the phone in an effort to protect participant identity. Second, the spreadsheet where participant phone numbers and email addresses are stored will not include participant names and will instead be linked to a participant ID number. This spreadsheet will be stored on a password-protected laptop and the PI will be the only person with access to this information. All interview materials (audio recordings and transcripts) will use participant ID number as the only identifier.

- **Benefits:**

This study has the potential to enhance the scientific community's understanding of the initiation and continuation of marijuana and tobacco co-occurring use among young people as well as factors that influence patterns of co-occurring use. This information could be used to help design effective preventive and cessation interventions designed for young adults, which could help reduce the burden of tobacco-related morbidity and mortality.

For the Quantitative Study: There are no direct benefits from participating in this research.

For the Qualitative Study: There are no specific direct benefits from participating in this research beyond contributing to our understanding of the co-occurring use of marijuana and tobacco.

- **Confidentiality:**

For the Quantitative Study: All NHANES data available on the CDC website is publicly-available and de-identified, so risks to confidentiality are minimal.

For the Qualitative Study: Confidentiality is critically important to this study; efforts have been made to protect participant confidentiality. Risks to confidentiality are minimal. Very little personal information will be collected from participants (specifically: phone number and email address). Participant information (phone number and email address) will be saved on the PI's password-protected laptop and the PI will be the only person with access to this information. This spreadsheet will only include participant phone number, email address and participant identification number, participant name will not be included in this file to guard against a potential breach of confidentiality. Participants will be asked to pick a nickname or initials to use during the interview so that nothing they say during the interview will be connected to their identity. Participants will be reminded that the interview will be confidential during the screening and consent process and then again before the interview begins. Interviews will be transcribed verbatim by a third-party transcription service such as Rev.com or Scribie individually directly after each interview is conducted. All materials from the interview sessions (audio recordings, transcripts) will be kept in a locked file cabinet at the University of Maryland and any electronic folders will be saved on the PI's password-protected laptop that can only be accessed by the PI and the Faculty Advisor. All research records including original data (audio files and transcripts of interviews) will be destroyed at the completion of the data analysis phase.

- **Consent Process:**

For the Quantitative Study: All participants have already been recruited and provided informed consent to the CDC.

For the Qualitative Study: Potential participants will email the PI. The PI will respond via email to set up a time to talk with the potential participant. The PI will share information about the project with the potential participant and explain what the interviews will entail. Potential participants will have the opportunity to ask questions and voice concerns if there are any to the PI. The PI will then read the Waiver of Consent to participants, and participants will verbally indicate if they choose to participate in the study or not. The PI will email a copy of the Waiver of Consent to participants for their records. So participants have a better understanding of the types of questions that will be asked, sample questions will be added to the Consent Form via an amendment once the interview guide is created.

This project requests a waiver of written consent so that verbal consent may be obtained from participants. This project meets the 4 criteria outlined for waiver of written consent:

1. This research poses no more than minimal risk to the subjects. As outlined in section 4, this study poses minimal risk to participants.
2. The waiver will not adversely affect the rights and welfare of the subjects. Potential participants will discuss the project with the PI during the screening call and will have the opportunity to ask questions. The PI will read the Waiver of Consent to potential participants, and participants will verbally indicate if they choose to participate or not. During the screening call and before the interview begins, participants will be reminded that if they become uncomfortable they have the right to skip a question or choose to discontinue the interview at any point.
3. The research (specifically the privacy that the telephone interviews and verbal consent afford participants) could not practicably be carried out without the waiver of written consent. Minimal personal information will be collected from participants (specifically: phone number and email address) to protect participant confidentiality. Since marijuana use is illegal in the state of Maryland, participants may feel uncomfortable sharing their full legal name or providing personal information. If a traditional Informed Consent document was used and participants needed to print and sign their full legal name participants may become uncomfortable and not choose not to participate. The screening as well as the interview will take place over the phone to protect participant privacy.
4. Participants will be provided with an evidence-based factsheet about the harms of marijuana and tobacco and tobacco cessation resources in Maryland via email after the interview concludes. These materials are included (Tobacco Health Effects Factsheet.pdf, Marijuana Health Effects Factsheet.pdf, Maryland Tobacco Resources.pdf, Maryland Quitline Flyer.pdf).

- **Conflict of Interest:**

The research team reports no conflicts of interest.

- **HIPAA Compliance:**

Not applicable – this research will only involve interviews and will not record any medical information about participants. Very minimal personal information about participants will be recorded.

- **Research Outside of the United States:**

Not applicable – this research will involve young adults living in Maryland.

- **Research Involving Prisoners:**

Not applicable – this research will involve young adults living in Maryland.

- **SUPPORTING DOCUMENTS**

Your Initial Application must include a **completed Initial Application Part 1 (On-Line Document)**, the information required in items 1-11 above, and all relevant supporting documents including: consent forms, letters sent to recruit participants, questionnaires completed by participants, and any other material that will be presented, viewed or read to human subject participants.

For funded research, a copy of the Awarded Grant Application (minus the budgetary information) must be uploaded. If the Grant has not been awarded at the time of submission of this Initial Application, a statement must be added to the Abstract Section stating that an Addendum will be submitted to include the Grant Application once it has been awarded.

THE IRB OFFICE WILL NO LONGER STAMP CONSENT FORMS. THE CONSENT FORMS IN YOUR APPROVED IRBNET PACKET MUST BE USED. THESE ARE YOUR APPROVED CONSENT FORMS.

Sample Craigslist Advertisement

To be posted in Annapolis, Baltimore, and MD suburbs of DC Craigslist Networks

Subject: Do you smoke marijuana and tobacco?

Body: Are you are an adult between the ages of 21 and 30 who lives in the state of Maryland and has smoked both marijuana and tobacco in the last month? You may qualify to take part in a study being conducted at the University of Maryland. The study involves completing a 1 hour interview. The study is confidential – you will speak to a member of the research team on the phone about your experiences and will use a nickname or pseudonym to protect your identity and any information you provide in the screening call (telephone number, email address) and interview will be kept confidential.

If interested please contact: *[study gmail address]* for more information about the study or to determine if you are eligible

Thanks!

Interview Screener

Thank you for reaching out to us and for your interest in the study. The goal of this study is to better understand young adult marijuana and tobacco use. If you choose to participate, you will complete a one hour interview with our research team where you'll be asked questions about your marijuana and tobacco use and experiences. The interview will be recorded, but everything you say will be kept confidential and your name or identity will not be associated with anything you say. If you are uncomfortable answering a question you do not have to answer it. You will receive an electronic \$40 Amazon Gift Card at the completion of the 1 hour interview. If you are eligible and interested the interview will be scheduled sometime in the next week. Today's call is to get some basic information from you and to verify your eligibility. Are you ready?

☐ No

☐ Yes

How old are you? _____

☐ under 21 or over 30

☐ between 21 and 30

When is the last time you smoked marijuana? _____

☐ more than 30 days

☐ less than 30 days

When is the last time you smoked a tobacco product? _____

☐ more than 30 days

☐ less than 30 days

What was the tobacco product? _____

What is the zip code where you reside? _____

☐ if not in Maryland

☐ if in Maryland

If screened '**NO**' for any questions: Unfortunately you do not meet the criteria to enroll in our study. We appreciate your time, have a great day.

If screened '**YES**' for all questions: You meet the criteria to participate in our study. Now that you are eligible, do you think you are still interested in participating? ☐ No ☐ Yes
If Yes: Now I'm going to provide you with some information about our informed consent process.

Waiver of Consent

You are invited to participate in an interview to be conducted by Elizabeth Seaman at the University of Maryland, School of Public Health. You have been invited to participate in this interview because you are between the ages of 21 and 30, live in the state of Maryland and report using both marijuana and tobacco during the past month. The purpose of this interview is to better understand young adult marijuana and tobacco use. This interview will be audio recorded and transcribed.

Although there may be some risks from participating in this research study the risks are considered to be minimal. You will be asked to discuss smoking experiences in the interview which may be uncomfortable. There are no direct benefits to study participants, however you will be contributing to our understanding of the co-occurring use of marijuana and tobacco. Only your phone number and email address will be collected and this information will be stored on a secure, password-protected laptop that only the principal investigator can access. To prevent loss of confidentiality, materials from your interview (audio recordings and transcripts) will be kept in a locked file cabinet at the University of Maryland and electronic files will be saved on the principal investigator's password-protected laptop that only the principal investigator and faculty advisor can access. Your participation is completely voluntary – if you feel uncomfortable or uneasy you may skip a question or discontinue the interview at any time.

If you have questions, concerns, or complaints, or if you need to report an injury related to the research, please contact the investigator, Elizabeth Seaman at eseaman@terpmail.umd.edu or (443) 292-2185. This interview will take up to 60 minutes and you will receive a \$40 electronic Amazon Gift Card for your time and participation. If you discontinue participation after not responding to 3 or more interview questions, you will not receive the incentive.

Do you provide consent for participating in this research study and for your responses to the interview questions to be used in the study?

Email: _____

☐ YES

☐ NO

Draft In-Depth Interview Domains

The specific In-Depth Interview Guide will be developed based on findings from Aims 1 and 2. Below are some topics that are anticipated to be included in the In-Depth Interview Guide and sample introductory text.

Hi [Name], this is Elizabeth. As you recall we spoke about a week ago and you agreed to participate in an interview to discuss tobacco and marijuana use among 21 to 30 year olds.
[wait for participant to indicate they remember]

Thank you for agreeing to talk with me. We had initially picked this time for your interview, is this still a good time to talk? *[wait for affirmation that this is still a good time to talk]*

As you recall, we will have a conversation that will last up to an hour which will be audiorecorded so I can make sure I capture your thoughts verbatim. Before we start I would like to remind you that there are no right or wrong answers for this interview. I am interested in learning about your experiences and hearing your opinions. Your interview will be kept confidential – you may select a nickname or a set of initials to use during this interview so that what you say will not be connected to your identity. If at any point you feel uncomfortable, you can choose to not answer a question or to end our interview.

1) Current Behavioral use patterns

- Frequency of Tobacco Use; Frequency of Marijuana Use
- Availability and Use
- Modes of Co-occurring Use

2) Predictors of use and past experiences

- Usual Brand/Type of Cigarette (to assess for Menthol Cigarette smoking), use of LCCs/Cigars
- First Tobacco Experience; First Marijuana Experience; Order of Initiation
- Progression from First Use to Regular Use (Tobacco); Progression from First Use to Regular Use (Marijuana)

3) Social Ecological Model Influences (Theoretically-based)

- Social Contexts of Co-Occurring Use
- Friends' Use
- Household Tobacco Exposure
- Influence of Job/School/Military
- Influence of Physical and Social Environment
- Has decriminalization and legalization of medicinal and recreational marijuana in several states influenced thoughts about the potential harms of marijuana?

4) Attitudes towards Behavior (Theoretically-based)

- Attitudes towards marijuana; Attitudes towards tobacco; Attitudes towards marijuana and tobacco among your friends; Behavioral Beliefs and Evaluation of Outcomes; Risk Perceptions; Approval/Disapproval
- 5) Subjective Norms towards Behavior (Theoretically-based)
- Normative Beliefs
 - Motivation to Comply
- 6) Observational Learning (Modeling) (Theoretically-based)
- Attention
 - Retention/Memory
 - Indication/Motor
 - Motivation



UNIVERSITY OF
MARYLAND

SCHOOL OF PUBLIC HEALTH

Department of Behavioral and Community Health

1234X 4200 Valley Drive
College Park, Maryland 20742-2611
301.405.0818 TEL 301.314.9167 FAX

June 15, 2017

Dear Graduate Program Committee,

I am writing in support of Elizabeth Seaman's application for the BCH Graduate Student Dissertation Fund Match program. Ms. Seaman has successfully defended her proposed research titled, *Co-occurring Marijuana and Tobacco Use among Young Adults: a Sequential Explanatory Mixed Methods Study*.

As Ms. Seaman's academic advisor and dissertation chair, I can attest that the funds requested will directly support the qualitative data collection phase of her research. To this end, I have committed \$500 of support to her dissertation work. Additionally, I encouraged Ms. Seaman's request for the department to match these monies to extend the total funding for her research to \$1,000.

If you have any questions, please do not hesitate to contact me.

Thank you for your consideration,

Craig S. Fryer, DrPH, MPH
Associate Professor, Behavioral and Community Health
Associate Director, Maryland Center for Health Equity
University of Maryland, School of Public Health
csfryer@umd.edu

Application for BCH Graduate Student P/T/D Support

Please fill out all sections below, obtain required signatures and submit to your advisor who will then submit the BCH Graduate Program Committee (GPC) to approve/deny. If approved, GPC will forward to BCH Business Office to process. Applicants will be notified of GPC decision by Dr. Sharp within 10 business days of submission of the complete application form.

Contact Information:

Last name: Seaman
First name: Elizabeth
Address: 427 Red Birch Road Millersville MD 21108
UMD e-mail address: eseaman@terpmail.umd.edu
UID: 113145988
MPH or PhD student: PhD
If PhD, have you advanced to candidacy? Yes
Year in program: rising 5th
Expected semester/year of graduation: December 2017 or May 2018
Faculty advisor's name: Dr. Craig S. Fryer

P/T/D Information:

Title of P/T/D: Co-occurring Marijuana and Tobacco Use Among Young Adults: a Sequential Explanatory Mixed Methods Study
Date of proposal defense: 5/15/2017
Amount requested from BCH dept (MPH maximum = \$250; PhD maximum = \$500): \$500

Materials and Signatures:

Application form
Copy of P/T/D abstract, proof of matching funds, and statement of what funds will be spent on

Advisor's signature and date: Craig S. Fryer 6-15-17

Applicant's signature and date: Elizabeth Y Seaman 6/15/17

GPC approval/denial:

Approve (Amount approved \$ 500.00) K. Champ 7/6/17
Deny

Smoking & Tobacco Use

Health Effects of Cigarette Smoking

Cigarette smoking harms nearly every organ of the body, causes many diseases, and reduces the health of smokers in general.^{1,2}

Quitting smoking lowers your risk for smoking-related diseases and can add years to your life.^{1,2}

Smoking and Death

Cigarette smoking is the leading preventable cause of death in the United States.¹

- Cigarette smoking causes more than 480,000 deaths each year in the United States. This is nearly one in five deaths.^{1,2,3}
- Smoking causes more deaths each year than the following causes combined:⁴
 - Human immunodeficiency virus (HIV)
 - Illegal drug use
 - Alcohol use
 - Motor vehicle injuries
 - Firearm-related incidents
- More than 10 times as many U.S. citizens have died prematurely from cigarette smoking than have died in all the wars fought by the United States.¹
- Smoking causes about 90% (or 9 out of 10) of all lung cancer deaths.^{1,2} More women die from lung cancer each year than from breast cancer.⁵
- Smoking causes about 80% (or 8 out of 10) of all deaths from chronic obstructive pulmonary disease (COPD).¹
- Cigarette smoking increases risk for death from all causes in men and women.¹
- The risk of dying from cigarette smoking has increased over the last 50 years in the U.S.¹

On This Page

- [Smoking and Death](#)
- [Smoking and Increased Health Risks](#)
- [Smoking and Cardiovascular Disease](#)
- [Smoking and Respiratory Disease](#)
- [Smoking and Cancer](#)
- [Smoking and Other Health Risks](#)
- [Quitting and Reduced Risks](#)
- [References](#)

Smoking and Increased Health Risks

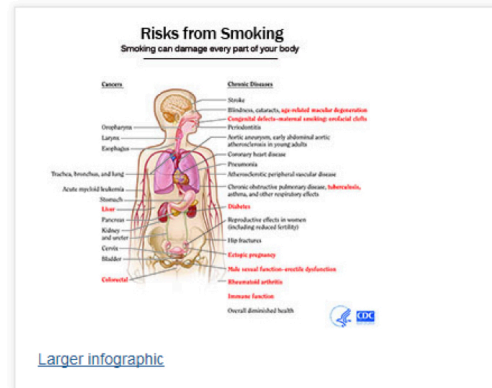
Smokers are more likely than nonsmokers to develop heart disease, stroke, and lung cancer.¹

- Estimates show smoking increases the risk:
 - For coronary heart disease by 2 to 4 times^{1,6}
 - For stroke by 2 to 4 times¹
 - Of men developing lung cancer by 25 times¹
 - Of women developing lung cancer by 25.7 times¹
- Smoking causes diminished overall health, increased absenteeism from work, and increased health care utilization and cost.¹

Smoking and Cardiovascular Disease

Smokers are at greater risk for diseases that affect the heart and blood vessels (cardiovascular disease).^{1,2}

- Smoking causes stroke and coronary heart disease, which are among the leading causes of death in the United States.^{1,3}
- Even people who smoke fewer than five cigarettes a day can have early signs of cardiovascular disease.¹
- Smoking damages blood vessels and can make them thicken and grow narrower. This makes your heart beat faster and your blood pressure go up. Clots can also form.^{1,2}
- A stroke occurs when:
 - A clot blocks the blood flow to part of your brain;
 - A blood vessel in or around your brain bursts.^{1,2}
- Blockages caused by smoking can also reduce blood flow to your legs and skin.^{1,2}



[Larger infographic](#)

Smoking and Respiratory Disease

Smoking can cause lung disease by damaging your airways and the small air sacs (alveoli) found in your lungs.^{1,2}

- Lung diseases caused by smoking include COPD, which includes emphysema and chronic bronchitis.^{1,2}
- Cigarette smoking causes most cases of lung cancer.^{1,2}
- If you have asthma, tobacco smoke can trigger an attack or make an attack worse.^{1,2}
- Smokers are 12 to 13 times more likely to die from COPD than nonsmokers.¹

Smoking and Cancer

Smoking can cause cancer almost anywhere in your body:^{1,2} (See figure above)

- Bladder
- Blood (acute myeloid leukemia)
- Cervix
- Colon and rectum (colorectal)
- Esophagus
- Kidney and ureter
- Larynx
- Liver
- Oropharynx (includes parts of the throat, tongue, soft palate, and the tonsils)
- Pancreas
- Stomach
- Trachea, bronchus, and lung

Smoking also increases the risk of dying from cancer and other diseases in cancer patients and survivors.¹

If nobody smoked, one of every three cancer deaths in the United States would not happen.^{1,2}

Smoking and Other Health Risks

Smoking harms nearly every organ of the body and affects a person's overall health.^{1,2}

- Smoking can make it harder for a woman to become pregnant. It can also affect her baby's health before and after birth. Smoking increases risks for:^{1,2,5}
 - Preterm (early) delivery
 - Stillbirth (death of the baby before birth)
 - Low birth weight
 - Sudden infant death syndrome (known as SIDS or crib death)
 - Ectopic pregnancy
 - Orofacial clefts in infants
- Smoking can also affect men's sperm, which can reduce fertility and also increase risks for birth defects and miscarriage.²
- Smoking can affect bone health.^{1,5}
 - Women past childbearing years who smoke have weaker bones than women who never smoked. They are also at greater risk for broken bones.
- Smoking affects the health of your teeth and gums and can cause tooth loss.¹
- Smoking can increase your risk for cataracts (clouding of the eye's lens that makes it hard for you to see). It can also cause age-related macular degeneration (AMD). AMD is damage to a small spot near the center of the retina, the part of the eye needed for central vision.¹
- Smoking is a cause of type 2 diabetes mellitus and can make it harder to control. The risk of developing diabetes is 30–40% higher for active smokers than nonsmokers.^{1,2}
- Smoking causes general adverse effects on the body, including inflammation and decreased immune function.¹
- Smoking is a cause of rheumatoid arthritis.¹

Quitting and Reduced Risks

- Quitting smoking cuts cardiovascular risks. Just 1 year after quitting smoking, your risk for a heart attack drops sharply.²
- Within 2 to 5 years after quitting smoking, your risk for stroke may reduce to about that of a nonsmoker's.²
- If you quit smoking, your risks for cancers of the mouth, throat, esophagus, and bladder drop by half within 5 years.²
- Ten years after you quit smoking, your risk for lung cancer drops by half.²

References

1. U.S. Department of Health and Human Services. [The Health Consequences of Smoking—50 Years of Progress: A Report of the Surgeon General](#). Atlanta: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, Office on Smoking and Health, 2014 [accessed 2017 Apr 20].
2. U.S. Department of Health and Human Services. [How Tobacco Smoke Causes Disease: What It Means to You](#). Atlanta: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, Office on Smoking and Health, 2010 [accessed 2017 Apr 20].
3. Centers for Disease Control and Prevention. [QuickStats: Number of Deaths from 10 Leading Causes—National Vital Statistics System, United States, 2010](#). Morbidity and Mortality Weekly Report 2013;62(08):155. [accessed 2017 Apr 20].
4. Mokdad AH, Marks JS, Stroup DF, Gerberding JL. Actual Causes of Death in the United States. JAMA: Journal of the American Medical Association 2004;291(10):1238–45 [cited 2017 Apr 20].
5. U.S. Department of Health and Human Services. [Women and Smoking: A Report of the Surgeon General](#). Rockville (MD): U.S. Department of Health and Human Services, Public Health Service, Office of the Surgeon General, 2001 [accessed 2017 Apr 20].
6. U.S. Department of Health and Human Services. [Reducing the Health Consequences of Smoking: 25 Years of Progress. A Report of the Surgeon General](#) [↗](#). Rockville (MD): U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control, National Center for Chronic Disease Prevention and Health Promotion, Office on Smoking and Health, 1989 [accessed 2017 Apr 20].

For Further Information

Centers for Disease Control and Prevention

National Center for Chronic Disease Prevention and Health Promotion

Office on Smoking and Health

E-mail: tobaccoinfo@cdc.gov

Phone: 1-800-CDC-INFO

Media Inquiries: Contact CDC's Office on Smoking and Health press line at 770-488-5493.

https://www.cdc.gov/tobacco/data_statistics/fact_sheets/health_effects/effects_cig_smoking/index.htm

Marijuana and Public Health

Learn more about how marijuana affects the brain and body.

Addiction

Some people think that marijuana is not truly “addictive” or that people can’t become “hooked” on the drug, but research shows that about 1 in 10 marijuana users will become addicted. For people who begin using before the age of 18, that number rises to 1 in 6.^[1, 2, 3]

Some of the signs that someone might be addicted include:

- Unsuccessful efforts to quit using marijuana.
- Giving up important activities with friends and family in favor of using marijuana.
- Using marijuana even when it is known that it causes problems fulfilling everyday jobs at home, school or work.^[4]

People who are addicted to marijuana may also be at a higher risk of other negative consequences of using the drug, such as problems with attention, memory, and learning.

It is also important to be aware that the amount of tetrahydrocannabinol (THC) in marijuana (i.e., marijuana potency) has increased over the past few decades. The higher the THC content, the stronger the effects on the brain. In addition, newly popular methods of using marijuana (e.g., dabbing, edibles) may deliver very high levels of THC to the user.^[5]

Researchers do not yet know the full extent of the consequences when the body and brain (especially the developing brain) are exposed to high concentrations of THC or how recent increases in potency affect the risk of someone becoming addicted.^[5]

Brain Health

Marijuana use directly affects the brain — specifically the parts of the brain responsible for memory, learning, attention, decision making, coordination, emotions, and reaction time.^[6, 7]

Short-term effects of marijuana on the brain

Heavy users of marijuana can have short-term problems with attention, memory, and learning, which can affect relationships and mood.

Long-term effects of marijuana on the brain

Marijuana also affects brain development. When marijuana users begin using as teenagers, the drug may reduce attention, memory, and learning functions and affect how the brain builds connections between the areas necessary for these functions.^[8-9]

Marijuana's effects on these abilities may last a long time or even be permanent. This means that someone who uses marijuana may not do as well in school and may have trouble remembering things.^[8, 7]

The impact depends on many factors and is different for each person. It also depends on the amount of tetrahydrocannabinol (THC) in marijuana (i.e., marijuana potency), frequency, age of first use, and whether other substances (e.g., tobacco and alcohol) are used at the same time.

Marijuana and the developing brain

Developing brains, like those in babies and children, are especially susceptible to the adverse effects of marijuana. Although scientists are still learning about these effects of marijuana on the developing brain, studies show that marijuana use by mothers during pregnancy may be linked to problems with attention, memory, problem-solving skills, and behavior problems in their children.^[8-12]

Find Help and Treatment

If you or a loved one use marijuana often and feel that it is causing problems, talk to your doctor or click on the following links:

- [Behavioral Health Treatment Locator](#) ↗
- [Substance Abuse and Mental Health Services Administration's \(SAMHSA\) National Helpline](#) ↗
- [National Suicide Prevention Helpline](#) ↗
- [The Surgeon General's Report: Facing Addiction in America](#) ↗
- [The National Institute on Drug Abuse \(NIDA\)](#) ↗

Cancer

There is mixed evidence about whether marijuana can cause cancer, partly because most people who use marijuana also use tobacco, a substance that does cause cancer.^[13] Researchers have found an association between current, frequent, or chronic marijuana smoking and testicular cancer (non-seminoma-type).^[15] More research is needed to understand the full impact of marijuana use on cancer.

Heart Health

The compounds in marijuana can affect the circulatory system and may increase the risk of heart attacks and strokes.

Studies have shown smoking marijuana can have a big effect on heart rate and blood pressure, including:

- High heart rate and blood pressure.^[16]
- An increase in the report of chest pains when exercising among people with existing chest pain.^[17]

Previous research has found a significant increase in the risk of heart attack in the hours after marijuana use.^[18] Additional research is needed to confirm the total risk. Smoking marijuana can harm lung tissues and cause scarring and damage to small blood vessels. It could also lead to increased risk for stroke, mini-stroke, and heart disease.^[19-23] More research is needed to understand the full impact of marijuana use on the circulatory system to determine if marijuana use leads to higher risk of death from these causes.

Lung Health

Smoke is harmful to lung health. Toxins and carcinogens are released when marijuana is burned. When these toxins and carcinogens are smoked, they are inhaled into the lungs, increasing health risks. Smoke from marijuana contains many of the same toxins, irritants, and carcinogens as tobacco smoke.^[24, 25] Smoking marijuana can lead to a greater risk of bronchitis, cough, and phlegm production.^[26-31] These symptoms generally improve when marijuana smokers quit.^[32, 33]

Secondhand Marijuana Smoke

Secondhand marijuana smoke contains tetrahydrocannabinol (THC), the chemical responsible for most of marijuana's psychological effects, and many of the same toxic compounds in smoked tobacco. Therefore, breathing it could affect the health and behavior of nonsmokers, including babies and children who are exposed.^[28, 34, 35]

Mental Health

There is still a lot to learn about whether marijuana use may lead to mental health problems or if having a mental illness makes people more likely to use marijuana. And as with other drugs, factors like the age of users, how early they start, the amount of the drug they used, and their genetics all could make a difference in whether or not long-term problems develop.^[42] But current research shows:

- Marijuana users are significantly more likely than nonusers to develop chronic mental disorders, including schizophrenia. Schizophrenia is a type of mental illness where people might see or hear things that aren't really there (hallucinations).
- Some marijuana users have an increased risk for psychosis (loss of reality), a serious mental disorder where people have false thoughts (delusions).
- Marijuana use has also been linked with depression and anxiety, and with suicidal thoughts among teens. However, it is not known whether this is a causal relationship or simply an association.
- Marijuana use can trigger psychosis in people with schizophrenia.^[39-41]

Poisoning

Eating foods or drinking beverages that contain marijuana have some different risks than smoking marijuana, including a greater risk of poisoning. These "edibles" are products such as cookies, sodas, brownies, and candies that have been made with THC—the active ingredient in marijuana.^[43-46]

Unlike smoked marijuana, edibles can:

- Take from 30 minutes to 2 hours to take effect.
- Cause effects that last longer than expected depending on the amount, the last food eaten, and medications or alcohol used at the same time.

The amount of THC, the main psychoactive ingredient in marijuana, can vary in edible marijuana products. This makes it harder to control how much THC is consumed. For example, in states where recreational marijuana use is legal, one cookie or brownie might contain multiple “servings” in the product or package. That means a single marijuana cookie or brownie, or any other marijuana edible, might contain as much as 100 mg of THC. So if someone ate an entire cookie or brownie—each one a single “serving”—it would be like taking many hits of a marijuana cigarette at one time. The amount of THC in homemade marijuana edibles can vary even more. Many users can be caught off-guard by the stronger potency and long-lasting effects of edibles.^[46, 47]

The effects of THC also take longer to feel when it is eaten instead of smoked. So some people eat too much, which can lead to poisoning and/or serious injury.^[48-50]

It is also important to remember that marijuana affects children differently than adults. Since marijuana has become legal in some states, children have accidentally eaten marijuana products that looked like candy and treats, which made them sick enough to need emergency care.^[43-45, 51]

If you use marijuana products, keep them in childproof containers and out of the reach of children. For additional questions, you can contact your health care provider, the [Poison Helpline](#) at 1-800-222-1222, or your health department.










Risk of Using Other Drugs

The concept of marijuana as a “gateway drug”—where using marijuana leads a person to use other drugs—generates a lot of controversy. Researchers haven’t found a definite answer yet.^[52, 53]

It is important to remember that people of any age, sex, or economic status can become addicted to marijuana or other drugs. Things can affect the likelihood of substance use include:

- Family history.
- Having another mental health illness (such as anxiety or depression).
- Peer pressure.
- Loneliness or social isolation.
- Lack of family involvement.
- Drug availability.
- Socioeconomic status.^[52, 53]

Related Links

- [Marijuana: Facts Parents Need to Know](#)  [PDF – 454 KB] 
- [Tips for Teens: The Truth About Marijuana](#) 
- [DrugFacts: Marijuana](#) 
- [Marijuana’s Lasting Effects on the Brain](#) 
- [Facts for Families: Marijuana and Teens](#) 
- [NIDA for Teens: Marijuana](#) 
- [Marijuana: Facts for Teens](#) 
- [Drugs: Shatter the Myths](#) 

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Content source: National Center for Chronic Disease Prevention and Health Promotion | Centers for Disease Control and Prevention

<https://www.cdc.gov/marijuana/health-effects.htm>

MARYLAND TOBACCO RESOURCES

Below are links to other websites offering additional information for providers and professionals:

Smoking Stops Here

<http://www.smokingstopshere.com> ☎ **PHONE:** 1-800-QUIT-NOW (1-800-784-8669)

Maryland County Health Departments

<http://mdquit.org/maryland-county-health-departments> ☎

Maryland Department of Health and Mental Hygiene

<http://www.dhmh.state.md.us> ☎ **EMAIL:** webadministrator@dhmh.state.md.us ☎ **PHONE:** 1-877-463-3464 TTY Number: 1-800-735-2258

Maryland Community Services Locator (MDCSL)

<http://www.mdcsf.org> ☎ **EMAIL:** mdcsf@umd.edu ☎ **PHONE:** 301-405-9796

University of Maryland School of Law Legal Resource Center for Public Health Policy

<http://www.law.umaryland.edu/programs/publichealth/> ☎ **EMAIL:** publichealth@law.umaryland.edu ☎ ☎

PHONE: 410-706-1129 **FAX:** 410-706-1128

American Lung Association® of Maryland, Inc.

www.marylandlung.org ☎ **PHONE:** 410-560-2120 **EMAIL:** info@marylandlung.org ☎

American Cancer Society (ACS)

<http://www.cancer.org/healthy/index> ☎ : To find a local ACS office in your area

Campaign for Tobacco Free Kids

<http://www.tobaccofreekids.org> ☎ **PHONE:** 202-296-5469

Maryland TRASH

<http://www.marylandtrash.com> ☎ Maryland Teens Rejecting Abusive Smoking Habits

Maryland STOPS

<http://marylandstops.com> ☎ Students Together Organizing Prevention Strategies

American Academy of Family Physicians

<http://www.aafp.org/> ☎

Become An Ex

<http://www.becomeanex.org/> (national, online program; free)

Smokefree.gov

<https://www.breathebetter.me/> (national, online program; free)

Quit Tobacco – Ucanquit2.org

<http://ucanquit2.org/> (online program for United States Military Service Members; free)

Nicotine Anonymous Mid-Atlantic Region (NicAMAR)

nicamar.homestead.com (Free in person, online, and phone meetings available to everyone).

PHONE: 410-964-2180.

Green & Healthy Homes Initiative (GHHI) Asthma Program

Qualifications for program services include Baltimore City residents with children diagnosed with asthma between 2-14 years of age. To refer a family, please contact GHHI.

PHONE: 410-534-6447 EMAIL: info@ghhi.org



[Sitemap](#) | [About Us](#) | [Privacy Policy](#) | [Terms of Use](#) | [Contact Us](#) © Maryland Resource Center for Quitting Use & Initiation of Tobacco

<http://mdquit.org/maryland-tobacco-resources>

WHY SHOULD YOU USE THE MARYLAND TOBACCO QUITLINE, 1-800-QUIT-NOW?

It's **FREE**.
It's **CONFIDENTIAL**.
It **WORKS**.

- All services and materials provided by the Quitline are **FREE**.
- We respect your privacy and won't judge you. Many of our Quit Coaches™ have used tobacco themselves. We are here to support your choice to live healthier.
- We can help you quit any kind of tobacco use – cigarettes, cigars, or smokeless. We can even give you information to help someone you care about to quit.
- We're here whenever you need us. A real person will always answer the phone.
- We really **can** help you. People who call us are more successful in quitting.

OUR QUIT COACHES CAN HELP YOU
ON YOUR PATH TO A HEALTHIER,
TOBACCO-FREE LIFE TODAY!

CALL —
the Maryland Tobacco Quitline today.

GET HELP —
you need to make a change.

24 hours a day. **7** days a week.

QUIT NOW —
and start enjoying a healthier you.

Maryland's
1-800  **QUIT NOW**
SmokingStopsHere.com

1-800-QUIT-NOW
1-800-784-8669
TTY: 1-877-777-6534
Servicios tambien en Español
(Services also available in Spanish)



Scan this code
to visit us online.



Maryland's
1-800  **QUIT NOW**
SmokingStopsHere.com

YOU

CAN

QUIT

MARYLAND TOBACCO QUITLINE





"WE QUIT, SO CAN YOU!"

VISIT WWW.SMOKINGSTOPHERE.COM TO HEAR OUR STORIES.

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The Maryland Tobacco Quitline
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- Find out about the benefits of quitting.
- Set a quit date and make a plan just for you.
- Stick to your plan by giving you tips to help with cravings.
- Learn more about medicines that can help you quit.
- Find local classes or other support.

When you sign-up, you can schedule
times that are good for **you** to talk with
a Quit Coach™.

FREE WAYS TO HELP YOU QUIT



Call 1-800-784-8669 to talk to a live
Quit Coach™ 24/7! Counseling is
provided in English, Spanish, and
other languages.



Go to www.SmokingStopsHere.com
to learn more. Click on the "ENROLL
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support, encouragement, and tips.*

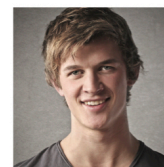


Mail – We will send guides with
helpful advice for you or someone
you care about who is trying to quit.



And More – While supplies last,
we may be able to send the nicotine
patch or gum directly to your home!*

*Services available for Marylanders 18 years and older



ARE YOU 13-17 YEARS OLD? —

**FREE Services are
available by calling
1-800-QUIT-NOW.**

- Our Youth Quit Coaches™ will help you
make a plan to quit and stay tobacco-free.
- All calls are private. If you'd like, guides to help
you quit can be sent to you.



PREGNANT? —

**We will help you quit
while you're pregnant
and stay tobacco-free
after your baby is born.**

- Our free program includes counseling with
our Quit Coaches™, mailed guides, and
online* and text support.*

WE KNOW THAT QUITTING ISN'T EASY.
HELP IS JUST A CALL OR CLICK AWAY.
CHOOSE A COMBINATION OF SERVICES
THAT WORKS BEST FOR YOU.

Appendix D: IRB Application: Amendment 1



UNIVERSITY OF
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INSTITUTIONAL REVIEW BOARD

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College Park, MD 20742-5125
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irb@umd.edu
www.umresearch.umd.edu/IRB

DATE: November 7, 2017

TO: Elizabeth Seaman, MHS
FROM: University of Maryland College Park (UMCP) IRB

PROJECT TITLE: [1013593-2] Co-Occurring Marijuana and Tobacco Use among Young Adults:
A Sequential Explanatory Mixed Methods Study

REFERENCE #:
SUBMISSION TYPE: Amendment/Modification

ACTION: APPROVED
APPROVAL DATE: November 7, 2017
EXPIRATION DATE: August 13, 2018
REVIEW TYPE: Expedited Review

REVIEW CATEGORY: Expedited review category # 7

Thank you for your submission of Amendment/Modification materials for this project. The University of Maryland College Park (UMCP) IRB has APPROVED your submission. This approval is based on an appropriate risk/benefit ratio and a project design wherein the risks have been minimized. All research must be conducted in accordance with this approved submission.

Prior to submission to the IRB Office, this project received scientific review from the departmental IRB Liaison.

This submission has received Expedited Review based on the applicable federal regulations.

This project has been determined to be a Minimal Risk project. Based on the risks, this project requires continuing review by this committee on an annual basis. Please use the appropriate forms for this procedure. Your documentation for continuing review must be received with sufficient time for review and continued approval before the expiration date of August 13, 2018.

Please remember that informed consent is a process beginning with a description of the project and insurance of participant understanding followed by a signed consent form. Informed consent must continue throughout the project via a dialogue between the researcher and research participant. Unless a consent waiver or alteration has been approved, Federal regulations require that each participant receives a copy of the consent document.

Please note that any revision to previously approved materials must be approved by this committee prior to initiation. Please use the appropriate revision forms for this procedure.

All UNANTICIPATED PROBLEMS involving risks to subjects or others (UPIRSOs) and SERIOUS and UNEXPECTED adverse events must be reported promptly to this office. Please use the appropriate reporting forms for this procedure. All FDA and sponsor reporting requirements should also be followed.

All NON-COMPLIANCE issues or COMPLAINTS regarding this project must be reported promptly to this office.

Please note that all research records must be retained for a minimum of seven years after the completion of the project.

If you have any questions, please contact the IRB Office at 301-405-4212 or irb@umd.edu. Please include your project title and reference number in all correspondence with this committee.

This letter has been electronically signed in accordance with all applicable regulations, and a copy is retained within University of Maryland College Park (UMCP) IRB's records.

AMENDMENT APPLICATION

To ensure an accurate and streamlined review of your Amendment Application, please provide the following information:

- 1. Provide a brief explanation stating what is being proposed and where in the protocol and/or consent changes were made.**

This amendment is to submit the Interview Guide and the updated Waiver of Consent. The initial application included a list of interview domains, which has been expanded to include a full set of questions and probes to be used for 3-5 pilot interviews. After pilot interviews, the questions will be updated and the revised interview questions will be submitted as a second amendment. The Waiver of Consent has been updated to include an example question (“An example of a question you may be asked as part of the interview is: How old were you the first time you used tobacco?”). These are the only changes that have been made.

- 1. Explain the rationale/justification for the change.**

When the original application was submitted, a list of interview domains was included but since the quantitative analyses of the NHANES dataset had not yet begun, interview questions had not been developed. This amendment includes the full list of interview questions and probes to be used for 3-5 pilot interviews. The questions and probes will be updated after these pilot interviews and a second amendment will be submitted with the finalized interview questions and probes. The Waiver of Consent has been updated to include a sample question from the interview questions so that potential participants can understand the type of questions they will be asked – this was recommended during the initial IRB application.

- 2. State what impact the change has on risks to participants. Please state the number of CURRENTLY ENROLLED participants and if the changes will require re-consent. If the changes will not require re-consent, please state why. If the changes present no additional risks to participants, please provide a statement to indicate so.**

These changes have no impact on risk to participants. This study has not yet begun recruiting or enrolling. These changes will not require re-consent.

- 3. Clearly state whether the change has an impact on the scientific integrity of the study, (i.e. decreases, increases, no impact).**

These changes have no impact on the scientific integrity of the study.

- 4. List the documents included with the application that have been modified (consent forms, flyers, data collection forms, surveys). State what has been changed in each modified document.**

A modified Interview Guide and a modified Waiver of Consent are included.

The Interview Guide has been expanded from the set of domains included with the original IRB submission to include full questions and probes.

One sentence has been added to the Waiver of Consent (“An example of a question you may be asked as part of the interview is: How old were you the first time you used tobacco?”) based on suggestion from the initial application and so participants can understand the type of questions asked during the interview.

5. **If adding a student and their project (in the domain of the currently approved project), please request the addition of their name to the Approval Letter. If adding a student, faculty, or staff member to your application, please be sure to have this person link a valid, CITI Training record to the submission.**

N/A

NOTE (1): Upload any modified documents with this amendment application.

NOTE (2): The consent forms in your approved IRBNet PACKAGE must be used. When creating or editing your consent form, please provide the most recent IRBNet package number at the bottom, right corner of the consent form. This ensures you are using the most “up-to-date” version of the form.

To find your IRBNet package number, go to the MY PROJECTS tab and click on the title of your project. In the PROJECT OVERVIEW page, your IRBNet package number will be listed at the top, next to your project title.

NOTE (3): NIH Funding - Any change in research activities that would result in an increased risk to human subjects will require prior NIH approval before implementation. Please speak to your program officer.

Waiver of Consent

You are invited to participate in an interview to be conducted by Elizabeth Seaman at the University of Maryland, School of Public Health. You have been invited to participate in this interview because you are between the ages of 21 and 30, live in the state of Maryland and report using both marijuana and tobacco during the past month. The purpose of this interview is to better understand young adult marijuana and tobacco use. This interview will be audio recorded and transcribed.

Although there may be some risks from participating in this research study the risks are considered to be minimal. You will be asked to discuss smoking experiences in the interview which may be uncomfortable. There are no direct benefits to study participants, however you will be contributing to our understanding of the co-occurring use of marijuana and tobacco. Only your phone number and email address will be collected and this information will be stored on a secure, password-protected laptop that only the principal investigator can access. To prevent loss of confidentiality, materials from your interview (audio recordings and transcripts) will be kept in a locked file cabinet at the University of Maryland and electronic files will be saved on the principal investigator's password-protected laptop that only the principal investigator and faculty advisor can access. Your participation is completely voluntary – if you feel uncomfortable or uneasy you may skip a question or discontinue the interview at any time. An example of a question you may be asked as part of the interview is: How old were you the first time you used tobacco?

If you have questions, concerns, or complaints, or if you need to report an injury related to the research, please contact the investigator, Elizabeth Seaman at eseaman@terpmail.umd.edu or (443) 292-2185. This interview will take up to 60 minutes and you will receive a \$40 electronic Amazon Gift Card for your time and participation. If you discontinue participation after not responding to 3 or more interview questions, you will not receive the incentive.

Do you provide consent for participating in this research study and for your responses to the interview questions to be used in the study?

Email: _____

☐ YES

☐ NO

In-Depth Interview Guide

Hi [Name], this is Elizabeth, with the University of Maryland tobacco and marijuana study. As you recall we spoke about a week ago and you agreed to participate in an interview to discuss tobacco and marijuana use among 21 to 30 year olds. *[wait for participant to indicate they remember]*

Thank you for agreeing to talk with me. We had initially picked this time for your interview, is this still a good time to talk? *[wait for affirmation that this is still a good time to talk]*

As you recall, we will have a conversation that will last up to an hour which will be audiorecorded so I can make sure I capture your thoughts verbatim. Before we start I would like to remind you that there are no right or wrong answers for this interview. I am interested in learning about your experiences and hearing your opinions. Your interview will be kept confidential – you may select a nickname or a set of initials to use during this interview so that what you say will not be connected to your identity. If at any point you feel uncomfortable, you can choose to not answer a question or to end our interview.

1) Current Behavioral Use Patterns

- What tobacco product or products do you currently use? (**Examples/Prompts** if interviewee asks for examples: cigarettes, cigars, little cigars or cigarillos, pipes, smokeless tobacco, e-cigarettes, other)
- How frequently do you currently use tobacco? (**Examples/Prompts** if interviewee asks for examples: how many times a day? days a week?)
- How frequently do you currently use marijuana? (**Examples/Prompts** if interviewee asks for examples: how many times a day? days a week?)
- How available is marijuana to you? Comparatively, how available are tobacco products?
- Do you usually use marijuana and tobacco together (either combined in one product or one directly after the other)? Can you tell me more about when you would want to use marijuana and when you would want to use tobacco?

2) Predictors of use and past experiences

- What is your usual brand of tobacco product? (If cigarette: Is your usual brand mentholated?; If Cigar Product: Is your usual brand flavored? What type of flavor?)
- How old were you the first time you used tobacco? Can you tell me a little bit about your first experience using tobacco?
- How old were you when you progressed to regular tobacco use? Can you describe for me your progression to regular tobacco use?
- How old were you the first time you used marijuana? Can you tell me a little bit about your first experience using marijuana?
- How old were you when you progressed to regular marijuana use? Can you describe for me your progression to regular marijuana use?
- How has your use of marijuana influenced how much tobacco you use?

- How has your use of tobacco influenced how much marijuana you use?
- 3) Social Ecological Model Influences (Theoretically-based)
- Are there certain people with whom you are more likely to use marijuana, tobacco or marijuana and tobacco together?
 - Do your friends use marijuana? Do your friends use tobacco?
 - Does anyone you live with use marijuana? Does anyone you live with use tobacco?
 - Are you currently employed, in school or serving in the military? Has your Job/School/Military Service (as appropriate) influenced your tobacco use? Has your Job/School/Military Service (as appropriate) influenced your marijuana use?
 - Are there certain physical locations where you are more likely to use marijuana? Are there certain physical locations where you are more likely to use tobacco?
 - Are there certain social events or settings where you are more likely to use marijuana? Are there certain physical locations where you are more likely to use tobacco?
 - **Examples** (if interviewee asks for examples): Parties, Concerts, at School, at Work
 - Has the decriminalization and legalization of medicinal and recreational marijuana in several states influenced your thoughts about the potential harms of marijuana?
- 4) Attitudes towards Behavior (Theoretically-based)
- What are your thoughts about cigarettes?
 - Probes
 - bad--neutral--good
 - harmful--neutral--beneficial
 - pleasant--neutral—unpleasant
 - What are your feelings about cigarettes?
 - Probes
 - bad--neutral--good
 - harmful--neutral--beneficial
 - pleasant--neutral--unpleasant
 - What are your thoughts about marijuana?
 - Probes
 - bad--neutral--good
 - harmful--neutral--beneficial
 - pleasant--neutral—unpleasant
 - What are your feelings about marijuana?
 - Probes
 - bad--neutral--good
 - harmful--neutral--beneficial
 - pleasant--neutral--unpleasant
 - Do you believe your friends hold similar attitudes towards marijuana and tobacco as you do?

- I'm going to ask you to react to the following statements by telling me how much you agree or disagree with them
 - Marijuana use helps me relieve stress
 - Why?
 - Marijuana use helps me have fun and unwind
 - Why?
 - Tobacco use helps me relieve stress
 - Why?
 - Tobacco use helps me have fun and unwind
 - Why?
 - It is important for me to relieve stress
 - Why?
 - It is important for have fun and unwind
 - Why?
 - Are there reasons other than stress relief and recreation that you use marijuana? (if yes: How important are these reasons?)
 - Are there reasons other than stress relief and recreation that you use tobacco? (if yes: How important are these reasons?)
- How risky do you perceive marijuana use to be? How risky do you perceive tobacco use to be?
- Overall, do you approve or disapprove of marijuana use? Overall, do you approve or disapprove of tobacco use?

5) Subjective Norms towards Behavior (Theoretically-based)

- I'm going to ask you a series of statements and I'm going to ask that you describe your perceptions of the each of the following statements using the scale likely—neutral--unlikely:
 - Do you think your parents approve of your use of tobacco? Why?
 - Do you think your parents approve of your use of marijuana? Why?
 - Do you think your peers approve of your use of tobacco? Why?
 - Do you think your peers approve of your use of marijuana? Why?
 - Do you think your close friends approve of your use of tobacco? Why?
 - Do you think your close friends approve of your use of marijuana? Why?
- Now I'm going to ask you about a few more statements, and I will ask that you reply using the scale not at all—a little—neutral—some—very much:
 - Generally speaking, how much do you care what your parents think you should do?
 - Generally speaking, how much do you care what your peers think you should do?
 - Generally speaking, how much do you care what your close friends think you should do?

6) Observational Learning (Modeling) (Theoretically-based)

- Do you feel like your use of tobacco has been influenced by watching other people (friends or family members) use tobacco?
 - If Yes: In what ways has watching others use tobacco influenced your own youth?
- Do you feel like your use of marijuana has been influenced by watching other people (friends or family members) use tobacco?
 - If No: In what ways has watching others use tobacco influenced your own youth?

7) Are there any other things you'd like to share with me?

8) Do you have any questions for me?

Thank you so much for your time today and for sharing your experiences and reflections with me. I emailed you a copy of the consent form we talked through last time we spoke on the phone – that includes my contact information if you have any questions or need to contact me.

Turn off recording I want to confirm that I have the correct email address so I can send you a \$40 electronic Amazon gift card to thank you for your time. Is _____(email address) the correct email address to send your giftcard to?

Appendix E: IRB Application: Amendment 2



UNIVERSITY OF
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INSTITUTIONAL REVIEW BOARD

1204 Marie Mount Hall
College Park, MD 20742-5125
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www.umresearch.umd.edu/IRB

DATE: November 30, 2017

TO: Elizabeth Seaman, MHS
FROM: University of Maryland College Park (UMCP) IRB

PROJECT TITLE: [1013593-3] Co-Occurring Marijuana and Tobacco Use among Young Adults:
A Sequential Explanatory Mixed Methods Study

REFERENCE #:
SUBMISSION TYPE: Amendment/Modification

ACTION: APPROVED
APPROVAL DATE: November 30, 2017
EXPIRATION DATE: August 13, 2018
REVIEW TYPE: Expedited Review

REVIEW CATEGORY: Expedited review category # 7

Thank you for your submission of Amendment/Modification materials for this project. The University of Maryland College Park (UMCP) IRB has APPROVED your submission. This approval is based on an appropriate risk/benefit ratio and a project design wherein the risks have been minimized. All research must be conducted in accordance with this approved submission.

Prior to submission to the IRB Office, this project received scientific review from the departmental IRB Liaison.

This submission has received Expedited Review based on the applicable federal regulations.

This project has been determined to be a Minimal Risk project. Based on the risks, this project requires continuing review by this committee on an annual basis. Please use the appropriate forms for this procedure. Your documentation for continuing review must be received with sufficient time for review and continued approval before the expiration date of August 13, 2018.

Please remember that informed consent is a process beginning with a description of the project and insurance of participant understanding followed by a signed consent form. Informed consent must continue throughout the project via a dialogue between the researcher and research participant. Unless a consent waiver or alteration has been approved, Federal regulations require that each participant receives a copy of the consent document.

Please note that any revision to previously approved materials must be approved by this committee prior to initiation. Please use the appropriate revision forms for this procedure.

All UNANTICIPATED PROBLEMS involving risks to subjects or others (UPIRSOs) and SERIOUS and UNEXPECTED adverse events must be reported promptly to this office. Please use the appropriate reporting forms for this procedure. All FDA and sponsor reporting requirements should also be followed.

All NON-COMPLIANCE issues or COMPLAINTS regarding this project must be reported promptly to this office.

Please note that all research records must be retained for a minimum of seven years after the completion of the project.

If you have any questions, please contact the IRB Office at 301-405-4212 or irb@umd.edu. Please include your project title and reference number in all correspondence with this committee.

This letter has been electronically signed in accordance with all applicable regulations, and a copy is retained within University of Maryland College Park (UMCP) IRB's records.

AMENDMENT APPLICATION

To ensure an accurate and streamlined review of your Amendment Application, please provide the following information:

2. Provide a brief explanation stating what is being proposed and where in the protocol and/or consent changes were made.

This second amendment is to submit the revised Interview Guide, Screening Form and Craigslist advertisement after the pilot testing phase. The initial application included a list of interview domains, which was expanded to include a full set of questions and probes approved as the first amendment which were used for 3 pilot interviews. After pilot interviews, the questions have been updated and minor changes have been made to the wording of the Screening Form and Advertisement. These are the only changes that have been made – there have been no changes to the Waiver of Consent.

6. Explain the rationale/justification for the change.

When the original application was submitted, a list of interview domains was included but since the quantitative analyses of the NHANES dataset had not yet begun, interview questions had not been developed. The first amendment included a list of interview questions and probes which were approved and then used for 3 pilot interviews.

Based on experiences with the pilot interviews, the questions and probes have been updated and expanded to be more clear and comprehensive. The Screening form has been updated to ask for participant birthyear (to verify age) to determine eligibility and to include a question to ask if the participant has used more than one tobacco product in the past 30 days. The Craigslist Advertisement has been updated to remove the study email address (since Craigslist flags posts that include contact information) and to include the compensation (\$40 electronic Amazon.com Gift Card).

7. State what impact the change has on risks to participants. Please state the number of CURRENTLY ENROLLED participants and if the changes will require re-consent. If the changes will not require re-consent, please state why. If the changes present no additional risks to participants, please provide a statement to indicate so.

These changes have no impact on risk to participants. The 3 pilot interviews used the previously approved study materials (Advertisement, Screening Form, Waiver of Consent, Interview Guide). All data from the pilot interviews were used for revising the questions and will not be reported in final study data.

These changes will not require re-consent. Once these changes have been approved, the 15-20 interviewees will all use the updated materials (Advertisement,

Screening Form, Interview Guide) as well as the previously-approved and unchanged Waiver of Consent.

8. **Clearly state whether the change has an impact on the scientific integrity of the study, (i.e. decreases, increases, no impact).**

These changes have no impact on the scientific integrity of the study.

9. **List the documents included with the application that have been modified (consent forms, flyers, data collection forms, surveys). State what has been changed in each modified document.**

A finalized Interview Guide, Screening Form and Craigslist Advertisement are included.

The Interview Guide has been updated based on the pilot interviews.

Minor changes have been made to the Screening Form to ensure all respondents meet study criteria (asking for Year of Birth to verify Age) and to clarify respondent behavior (asking what tobacco product or products the respondent has used in the past month). The Craigslist Advertisement has been updated to remove the study email address (since Craigslist flags posts that include contact information) and to include the compensation (\$40 electronic Amazon.com Gift Card).

10. **If adding a student and their project (in the domain of the currently approved project), please request the addition of their name to the Approval Letter. If adding a student, faculty, or staff member to your application, please be sure to have this person link a valid, CITI Training record to the submission.**

N/A

NOTE (1): Upload any modified documents with this amendment application.

NOTE (2): The consent forms in your approved IRBNet PACKAGE must be used. When creating or editing your consent form, please provide the most recent IRBNet package number at the bottom, right corner of the consent form. This ensures you are using the most “up-to-date” version of the form.

To find your IRBNet package number, go to the MY PROJECTS tab and click on the title of your project. In the PROJECT OVERVIEW page, your IRBNet package number will be listed at the top, next to your project title.

NOTE (3): NIH Funding - Any change in research activities that would result in an increased risk to human subjects will require prior NIH approval before implementation. Please speak to your program officer.

Craigslist Advertisement

To be posted in Annapolis, Baltimore, and MD suburbs of DC Craigslist Networks

Subject: Do you smoke marijuana and tobacco?

Body: Are you are an adult between the ages of 21 and 30 who lives in the state of Maryland and has smoked both marijuana and tobacco in the last month? You may qualify to take part in a study being conducted at the University of Maryland. The study involves completing a 1 hour interview. The study is confidential – you will speak to a member of the research team on the phone about your experiences and will use a nickname or pseudonym to protect your identity and any information you provide in the screening call (telephone number, email address) and interview will be kept confidential.

If interested, please contact us for more information about the study or to determine if you are eligible

Thanks!

Compensation: \$40 electronic Amazon.com Gift Card

Interview Screener

Thank you for reaching out to us and for your interest in the study. The goal of this study is to better understand young adult marijuana and tobacco use. If you choose to participate, you will complete a one hour interview with our research team where you'll be asked questions about your marijuana and tobacco use and experiences. The interview will be recorded, but everything you say will be kept confidential and your name or identity will not be associated with anything you say. If you are uncomfortable answering a question you do not have to answer it. You will receive an electronic \$40 Amazon Gift Card at the completion of the 1 hour interview. If you are eligible and interested the interview will be scheduled sometime in the next week. Today's call is to get some basic information from you and to verify your eligibility.

When is the last time you smoked marijuana? _____

☐ more than 30 days

☐ less than 30 days

When is the last time you smoked a tobacco product? _____

☐ more than 30 days

☐ less than 30 days

What tobacco product or products have you smoked in the past 30 days?

What is the zip code where you reside? _____

☐ if not in Maryland

☐ if in Maryland

What is your year of birth? _____

How old are you? _____

☐ under 21 or over 30

☐ between 21 and 30

If screened '**NO**' for any questions: Unfortunately you do not meet the criteria to enroll in our study. We appreciate your time, have a great day.

If screened '**YES**' for all questions: You meet the criteria to participate in our study. Now that you are eligible, do you think you are still interested in participating? ☐ No ☐ Yes
If Yes: Now I'm going to provide you with some information about our informed consent process.

In-Depth Interview Guide

Hi [Name], this is Elizabeth, with the University of Maryland tobacco and marijuana study. As you recall we spoke about a week ago and you agreed to participate in an interview to discuss tobacco and marijuana use among 21 to 30 year olds. *[wait for participant to indicate they remember]*

Thank you for agreeing to talk with me. We had initially picked this time for your interview, is this still a good time to talk? *[wait for affirmation that this is still a good time to talk]*

As you recall, we will have a conversation that will last up to an hour which will be audiorecorded so I can make sure I capture your thoughts verbatim. Before we start I would like to remind you that there are no right or wrong answers for this interview. I am interested in learning about your experiences and hearing your opinions. Your interview will be kept confidential – you may select a nickname or a set of initials to use during this interview so that what you say will not be connected to your identity. If at any point you feel uncomfortable, you can choose to not answer a question or to end our interview.

1) Current Behavioral Use Patterns

- What tobacco product or products do you currently use? (**Examples/Prompts** if interviewee asks for examples: cigarettes, cigars, little cigars or cigarillos, pipes, smokeless tobacco, e-cigarettes, other)
 - What brand is that?
 - What is your usual brand of tobacco product? (If cigarette: Is your usual brand mentholated?; If Cigar Product: Is your usual brand flavored? What type of flavor?)
- How frequently do you currently use tobacco? (**Examples/Prompts** if interviewee asks for examples: how many times a day? days a week?)
- How frequently do you currently use marijuana? (**Examples/Prompts** if interviewee asks for examples: how many times a day? days a week?)
- How available is marijuana to you? Comparatively, how available are tobacco products?
- Do you usually use marijuana and tobacco together (either combined in one product or one directly after the other)?
- Can you tell me more about when you would want to use marijuana?
- Can you tell me more about when you would want to use tobacco?
- How does your marijuana use compare to your tobacco use?
 - Prompts: which product do you use more frequently? Are there differences in when you'd use each product?

2) Predictors of use and past experiences

- How old were you the first time you used tobacco? Can you tell me a little bit about your first experience using tobacco?

- How old were you when you progressed to regular tobacco use? Can you describe for me your progression to regular tobacco use?
- How old were you the first time you used marijuana? Can you tell me a little bit about your first experience using marijuana?
- How old were you when you progressed to regular marijuana use? Can you describe for me your progression to regular marijuana use?
- How has your use of marijuana influenced how much tobacco you use?
- How has your use of tobacco influenced how much marijuana you use?
- Does alcohol use influence your tobacco and/or marijuana use?

3) Social Ecological Model Influences (Theoretically-based)

- Are there certain people with whom you are more likely to use marijuana, tobacco or marijuana and tobacco together?
- Do your friends use marijuana? Do your friends use tobacco?
- Does anyone you live with use marijuana? Does anyone you live with use tobacco?
- Are you currently employed, in school or serving in the military?
 - Has your Job/School/Military Service (as appropriate) influenced your tobacco use?
 - Has your Job/School/Military Service (as appropriate) influenced your marijuana use?
- Are there certain physical locations where you are more likely to use marijuana? Are there certain physical locations where you are more likely to use tobacco?
- Are there certain social events or settings where you are more likely to use marijuana? Are there certain physical locations where you are more likely to use tobacco?
 - **Examples** (if interviewee asks for examples): Parties, Concerts, at School, at Work
- Has the decriminalization and legalization of medicinal and recreational marijuana in several states influenced your thoughts about the potential harms of marijuana?

4) Attitudes towards Behavior (Theoretically-based)

- What are your thoughts about cigarettes?
 - Probes
 - bad--neutral--good
 - harmful--neutral--beneficial
 - pleasant--neutral—unpleasant
- What are your feelings about cigarettes?
 - Probes
 - bad--neutral--good
 - harmful--neutral--beneficial
 - pleasant--neutral--unpleasant
- What are your thoughts about marijuana?
 - Probes
 - bad--neutral--good

- harmful--neutral--beneficial
 - pleasant--neutral—unpleasant
- What are your feelings about marijuana?
 - Probes
 - bad--neutral--good
 - harmful--neutral--beneficial
 - pleasant--neutral--unpleasant
- Do you believe your friends hold similar attitudes towards marijuana and tobacco as you do?
- I'm going to ask you to react to the following statements by telling me how much you agree or disagree with them
 - Marijuana use helps me relieve stress
 - Why?
 - Marijuana use helps me have fun and unwind
 - Why?
 - Tobacco use helps me relieve stress
 - Why?
 - Tobacco use helps me have fun and unwind
 - Why?
 - It is important for me to relieve stress
 - Why?
 - It is important for have fun and unwind
 - Why?
 - Are there reasons other than stress relief and recreation that you use marijuana? (if yes: How important are these reasons?)
 - Are there reasons other than stress relief and recreation that you use tobacco? (if yes: How important are these reasons?)
- How risky do you perceive marijuana use to be? How risky do you perceive tobacco use to be?
- Overall, do you approve or disapprove of marijuana use? Overall, do you approve or disapprove of tobacco use?

5) Subjective Norms towards Behavior (Theoretically-based)

- I'm going to ask you a series of statements and I'm going to ask that you describe your perceptions of the each of the following statements using the scale likely—neutral--unlikely:
 - Do you think your parents approve of your use of tobacco? Why?
 - Do you think your parents approve of your use of marijuana? Why?
 - Do you think your peers approve of your use of tobacco? Why?
 - Do you think your peers approve of your use of marijuana? Why?
 - Do you think your close friends approve of your use of tobacco? Why?
 - Do you think your close friends approve of your use of marijuana? Why?

- Now I'm going to ask you about a few more statements, and I will ask that you reply using the scale not at all—a little—neutral—some—very much:
 - Generally speaking, how much do you care what your parents think you should do?
 - Generally speaking, how much do you care what your peers think you should do?
 - Generally speaking, how much do you care what your close friends think you should do?

6) Observational Learning (Modeling) (Theoretically-based)

- Do you feel like your use of tobacco has been influenced by watching other people (friends or family members) use tobacco?
 - If Yes: In what ways has watching others use tobacco influenced your own use?
- Do you feel like your use of marijuana has been influenced by watching other people (friends or family members) use marijuana?
 - If Yes: In what ways has watching others use marijuana influenced your own use?

7) Are there any other things you'd like to share with me?

8) Do you have any questions for me?

Thank you so much for your time today and for sharing your experiences and reflections with me. I emailed you a copy of the consent form we talked through last time we spoke on the phone – that includes my contact information if you have any questions or need to contact me.

Turn off recording I want to confirm that I have the correct email address so I can send you a \$40 electronic Amazon gift card to thank you for your time. Is _____ (email address) the correct email address to send your giftcard to?

Appendix F: IRB Application: Amendment 3



1204 Marie Mount Hall
College Park, MD 20742-5125
TEL 301.405.4212
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irb@umd.edu
www.umresearch.umd.edu/IRB

DATE: December 17, 2017

TO: Elizabeth Seaman, MHS
FROM: University of Maryland College Park (UMCP) IRB

PROJECT TITLE: [1013593-4] Co-Occurring Marijuana and Tobacco Use among Young Adults:
A Sequential Explanatory Mixed Methods Study

REFERENCE #:
SUBMISSION TYPE: Amendment/Modification

ACTION: APPROVED
APPROVAL DATE: December 17, 2017
EXPIRATION DATE: August 13, 2018
REVIEW TYPE: Expedited Review

REVIEW CATEGORY: Expedited review category # 7

Thank you for your submission of Amendment/Modification materials for this project. The University of Maryland College Park (UMCP) IRB has APPROVED your submission. This approval is based on an appropriate risk/benefit ratio and a project design wherein the risks have been minimized. All research must be conducted in accordance with this approved submission.

Prior to submission to the IRB Office, this project received scientific review from the departmental IRB Liaison.

This submission has received Expedited Review based on the applicable federal regulations.

This project has been determined to be a Minimal Risk project. Based on the risks, this project requires continuing review by this committee on an annual basis. Please use the appropriate forms for this procedure. Your documentation for continuing review must be received with sufficient time for review and continued approval before the expiration date of August 13, 2018.

Please remember that informed consent is a process beginning with a description of the project and insurance of participant understanding followed by a signed consent form. Informed consent must continue throughout the project via a dialogue between the researcher and research participant. Unless a consent waiver or alteration has been approved, Federal regulations require that each participant receives a copy of the consent document.

Please note that any revision to previously approved materials must be approved by this committee prior to initiation. Please use the appropriate revision forms for this procedure.

All UNANTICIPATED PROBLEMS involving risks to subjects or others (UPIRSOs) and SERIOUS and UNEXPECTED adverse events must be reported promptly to this office. Please use the appropriate reporting forms for this procedure. All FDA and sponsor reporting requirements should also be followed.

All NON-COMPLIANCE issues or COMPLAINTS regarding this project must be reported promptly to this office.

Please note that all research records must be retained for a minimum of seven years after the completion of the project.

If you have any questions, please contact the IRB Office at 301-405-4212 or irb@umd.edu. Please include your project title and reference number in all correspondence with this committee.

This letter has been electronically signed in accordance with all applicable regulations, and a copy is retained within University of Maryland College Park (UMCP) IRB's records.

AMENDMENT APPLICATION

To ensure an accurate and streamlined review of your Amendment Application, please provide the following information:

- 3. Provide a brief explanation stating what is being proposed and where in the protocol and/or consent changes were made.**

This third amendment is to add a question about Gender to the Screening Form. This is the only change that has been made – there have been no changes to the Waiver of Consent.

- 11. Explain the rationale/justification for the change.**

During the pilot interview process, gender and the different experiences of young men and women emerged as an important part of this work. When I submitted the second amendment, I neglected to add a question about Gender to the Screening Form. This third amendment is to rectify that oversight.

- 12. State what impact the change has on risks to participants. Please state the number of CURRENTLY ENROLLED participants and if the changes will require re-consent. If the changes will not require re-consent, please state why. If the changes present no additional risks to participants, please provide a statement to indicate so.**

These changes have no impact on risk to participants. The 3 Pilot Interviewees and 1 Interviewee who have already completed the study will not be re-contacted and will not require to be re-consented. The Gender question will not be used for study inclusion/exclusion – it will only be used to contextualize responses provide during the interview. Once this amendment has been approved, future interviews will use the updated Screening Form as well as the previously approved materials (Advertisement, Waiver of Consent, and Interview Guide).

- 13. Clearly state whether the change has an impact on the scientific integrity of the study, (i.e. decreases, increases, no impact).**

These chances have no impact on the scientific integrity of the study.

- 14. List the documents included with the application that have been modified (consent forms, flyers, data collection forms, surveys). State what has been changed in each modified document.**

An updated Screening Form is included. The only change to the Screening Form is the addition of a question about gender.

- 15. If adding a student and their project (in the domain of the currently approved project), please request the addition of their name to the Approval Letter. If adding a student, faculty, or staff member to your application, please be sure to have this person link a valid, CITI Training record to the submission.**

N/A

NOTE (1): Upload any modified documents with this amendment application.

NOTE (2): The consent forms in your approved IRBNet PACKAGE must be used. When creating or editing your consent form, please provide the most recent IRBNet package number at the bottom, right corner of the consent form. This ensures you are using the most “up-to-date” version of the form.

To find your IRBNet package number, go to the MY PROJECTS tab and click on the title of your project. In the PROJECT OVERVIEW page, your IRBNet package number will be listed at the top, next to your project title.

NOTE (3): NIH Funding - Any change in research activities that would result in an increased risk to human subjects will require prior NIH approval before implementation. Please speak to your program officer.

Interview Screener

Thank you for reaching out to us and for your interest in the study. The goal of this study is to better understand young adult marijuana and tobacco use. If you choose to participate, you will complete a one hour interview with our research team where you'll be asked questions about your marijuana and tobacco use and experiences. The interview will be recorded, but everything you say will be kept confidential and your name or identity will not be associated with anything you say. If you are uncomfortable answering a question you do not have to answer it. You will receive an electronic \$40 Amazon Gift Card at the completion of the 1 hour interview. If you are eligible and interested the interview will be scheduled sometime in the next week. Today's call is to get some basic information from you and to verify your eligibility.

When is the last time you smoked marijuana? _____

☐ more than 30 days

☐ less than 30 days

When is the last time you smoked a tobacco product? _____

☐ more than 30 days

☐ less than 30 days

What tobacco product or products have you smoked in the past 30 days?

What is the zip code where you reside? _____

☐ if not in Maryland

☐ if in Maryland

What is your year of birth? _____

How old are you? _____

☐ under 21 or over 30

☐ between 21 and 30

What is your Gender? (open ended) _____

If screened '**NO**' for any questions: Unfortunately you do not meet the criteria to enroll in our study. We appreciate your time, have a great day.

If screened '**YES**' for all questions: You meet the criteria to participate in our study. Now that you are eligible, do you think you are still interested in participating? ☐ No ☐ Yes
If Yes: Now I'm going to provide you with some information about our informed consent process.

Appendix G: In-Depth Interview Codebook

Young Adult Co-occurring Marijuana and Tobacco Use

In-depth Interview Codebook

Notes to Coders:

- Code the entire paragraph related to the code (only participant response; not interviewer question unless otherwise noted in codes)
- If one paragraph reflects more than one code, mark/highlight all relevant codes
- Depending on participant responses and behavioral patterns not all codes may be used in all transcripts

Code	Definition
5. Current Behavioral Use Patterns	
Tobacco Product Currently Use 1	First-listed currently used Tobacco Product
<ul style="list-style-type: none"> • Tobacco Product Currently Use 1: Flavor 	Is first-listed currently used Tobacco Product flavored (menthol for cigarettes or other flavors for cigars/pipes/other tobacco products). Code includes if the currently used Tobacco Product is flavored and what the usual flavor(s) are. If the participant indicates their tobacco product is NOT flavored please use this code.
<ul style="list-style-type: none"> • Tobacco Product Currently Use 1: Frequency 	How frequently does the participant report using first-listed currently used Tobacco Product
Tobacco Product Currently Use 2	Second-listed currently used Tobacco Product; this code is for when a participant reports using more than one tobacco product in the past month
<ul style="list-style-type: none"> • Tobacco Product Currently Use 2: Flavor 	Is second-listed currently used Tobacco Product flavored (menthol for cigarettes or other flavors for cigars/pipes/other tobacco products). Code includes if the currently used Tobacco Product is flavored and what the usual flavor(s) are. If the participant indicates their tobacco product is NOT flavored please use this code.
<ul style="list-style-type: none"> • Tobacco Product Currently Use 2: Frequency 	How frequently does the participant report using second-listed currently used Tobacco Product

Usual mode of marijuana use	How does the participant usually smoke marijuana (bong, pipe, vaporizer, blunt, spliff)
Marijuana Use Frequency	How frequently does the participant report using marijuana
Marijuana Availability	How available is marijuana to participant
Comparative Availability	Is it easier for the participant to obtain marijuana or tobacco
Co-Occurring Use	Does the participant usually smoke tobacco and marijuana together in one product or one after the other
<ul style="list-style-type: none"> Co-Occurring Use: Together 	Does the participant usually smoke tobacco and marijuana together in one product (like a blunt or spliff) **Please include question and answer in code**
<ul style="list-style-type: none"> Co-Occurring Use: Sequential 	Does the participant usually smoke tobacco and marijuana one directly after the other) **Please include question and answer in code**
When Use Marijuana	Participant's description of when they'd use marijuana
When Use Tobacco	Participant's description of when they'd use tobacco
Comparative Frequency	Does participant use marijuana or tobacco more frequently
6. Predictors of Use and Past Experiences	
Age First Use Tobacco	Age participant first used a tobacco product
Description First Use Tobacco	Participant's description of their first use of tobacco
Tobacco Progression	Participant's description of their progress from experimentation to regular tobacco use
Age First Use Marijuana	Age participant first used marijuana
Description First Use Marijuana	Participant's description of their first use of marijuana
Marijuana Progression	Participant's description of their progress from experimentation to regular tobacco use
Marijuana Influence Tobacco	Participant's description of if/how their marijuana use influences their tobacco use
Tobacco Influence Marijuana	Participant's description of if/how their tobacco use influences their marijuana use
Alcohol	Participant's description of if/how alcohol use influences tobacco and marijuana use
7. Social Ecological Model Influences (Theoretically-Based)	
Personal Influences	Are there certain people the participant is more likely to use marijuana or tobacco with
<ul style="list-style-type: none"> Personal Influences: Marijuana 	Are there certain people the participant is more likely to use marijuana with
<ul style="list-style-type: none"> Personal Influences: Tobacco 	Are there certain people the participant is more likely to use tobacco with

Friends Use Marijuana	Do participants' friends use marijuana
Friends Use Tobacco	Do participants' friends use tobacco
Household Influences	Does the participant live with anyone who uses marijuana, tobacco, or both
Job Influences	Does the participant's employment influence marijuana use, tobacco use or both
School Influences	Does the participant's student status/experience in school influence marijuana use, tobacco use, or both
Physical Location Influences	Are there physical locations where participant is more likely to use marijuana or tobacco or both
Social Setting Influences	Are there social events or social settings where participant is more likely to use marijuana or tobacco or both
Policy Influences	Have national discussions/changes in policy related to the decriminalization and legalization of medicinal and/or recreational marijuana influenced participant
8. Attitudes towards Behavior (Theoretically-Based)	
Tobacco Good_Bad	Participant description of tobacco product on a scale from good to bad
Tobacco Harmful_Beneficial	Participant description of tobacco product on a scale from harmful to beneficial
Tobacco Pleasant_Unpleasant	Participant description of tobacco product on a scale from pleasant to unpleasant
Marijuana Good_Bad	Participant description of marijuana on a scale from good to bad
Marijuana Harmful_Beneficial	Participant description of marijuana on a scale from harmful to beneficial
Marijuana Pleasant_Unpleasant	Participant description of marijuana on a scale from pleasant to unpleasant
Friends Attitudes Marijuana	Participant description of friends attitudes towards marijuana
Friends Attitudes Tobacco	Participant description of friends attitudes towards tobacco products
Marijuana Stress	Participant agreement/disagreement to the statement "Marijuana use helps me relieve stress"
Marijuana Fun	Participant agreement/disagreement to the statement "Marijuana use helps me have fun and unwind"
Tobacco Stress	Participant agreement/disagreement to the statement "Tobacco use helps me relieve stress"
Tobacco Fun	Participant agreement/disagreement to the statement "Tobacco use helps me have fun and unwind"
Importance Stress	Participant agreement/disagreement to the statement "It is important for me to relive stress"

Importance Fun	Participant agreement/disagreement to the statement “It is important for me to have fun and unwind”
Other Reasons Marijuana Use	Any reasons other than stress relief and recreation that participant uses marijuana
Other Reasons Tobacco Use	Any reasons other than stress relief and recreation that participant uses tobacco
Risk Perceptions Marijuana	Participant overall risk perceptions of marijuana
Risk Perceptions Tobacco	Participant overall risk perceptions of tobacco
Approval Marijuana	Participant overall approval/disapproval of marijuana
Approval Tobacco	Participant overall approval/disapproval of tobacco
9. Subjective Norms towards Behavior (Theoretically-Based)	
Parents Approve Tobacco	Participant reaction to if parents approve of their tobacco use
Parents Approve Marijuana	Participant reaction to if parents approve of their marijuana use
Peers Approve Tobacco	Participant reaction to if peers approve of their tobacco use
Peers Approve Marijuana	Participant reaction to if peers approve of their marijuana use
Close Friends Approve Tobacco	Participant reaction to if close friends approve of their tobacco use
Close Friends Approve Marijuana	Participant reaction to if close friends approve of their marijuana use
Parents Care	Participant’s description of how much they care what their parents think they should do
Peers Care	Participant’s description of how much they care what their peers think they should do
Close Friends Care	Participant’s description of how much they care what their close friends think they should do
10. Observational Learning (Modeling) (Theoretically-Based)	
Observational Learning Tobacco	Has watching others use tobacco influenced participant’s use
Observational Learning Marijuana	Has watching others use marijuana influenced participant’s use

REFERENCES

- Abrantes, A. M., Lee, C. S., MacPherson, L., Strong, D. R., Borrelli, B., & Brown, R. A. (2009). Health risk behaviors in relation to making a smoking quit attempt among adolescents. *Journal of Behavioral Medicine*, 32(2), 142–149.
<https://doi.org/10.1007/s10865-008-9184-1>
- Agrawal, A., Grant, J. D., Lynskey, M. T., Madden, P. A. F., Heath, A. C., Bucholz, K. K., & Sartor, C. E. (2016). The genetic relationship between cannabis and tobacco cigarette use in European- and African-American female twins and siblings. *Drug and Alcohol Dependence*, 163, 165–171. <https://doi.org/10.1016/j.drugalcdep.2016.04.011>
- Agrawal, A., & Lynskey, M. T. (2009). Tobacco and cannabis co-occurrence: Does route of administration matter? *Drug and Alcohol Dependence*, 99(1–3), 240–247.
<https://doi.org/10.1016/j.drugalcdep.2008.08.007>
- Ajzen, I. (2010). *Constructing a Theory of Planned Behavior Questionnaire*. Retrieved from <https://people.umass.edu/aizen/pdf/tpb.measurement.pdf>
- Ajzen, I. (2013). *Theory of Planned Behaviour Questionnaire* (Measurement Instrument Database for the Social Science). Retrieved from http://www.midss.org/sites/default/files/tpb.questionnaire_sample.pdf
- Ajzen, I. (1985). From Intentions to Actions: A Theory of Planned Behavior. In J. Kuhl & J. Beckmann (Eds.), *Action Control* (pp. 11–39). Berlin, Heidelberg: Springer Berlin Heidelberg. https://doi.org/10.1007/978-3-642-69746-3_2

- Alpert, H. R., Koh, H. K., & Connolly, G. N. (2008). After The Master Settlement Agreement: Targeting And Exposure Of Youth To Magazine Tobacco Advertising. *Health Affairs*, 27(6), w503–w512. <https://doi.org/10.1377/hlthaff.27.6.w503>
- American Psychiatric Association. (2013). *Diagnostic and Statistical Manual of Mental Disorders*. Washington, DC.
- Ames, S. L., Xie, B., Shono, Y., & Stacy, A. W. (2016). Adolescents at Risk for Drug Abuse: A 3-Year Dual Process Analysis. *Addiction*. <https://doi.org/10.1111/add.13742>
- Amrock, S. M., Lee, L., & Weitzman, M. (2016). Perceptions of e-Cigarettes and Noncigarette Tobacco Products Among US Youth. *Pediatrics*, 138(5), e20154306. <https://doi.org/10.1542/peds.2015-4306>
- Anderson, S. J. (2011). Marketing of menthol cigarettes and consumer perceptions: a review of tobacco industry documents. *Tobacco Control*, 20(Supplement 2), ii20-ii28. <https://doi.org/10.1136/tc.2010.041939>
- Antognoli, E., Koopman Gonzalez, S., Trapl, E., Cavallo, D., Lim, R., Lavanty, B., & Flocke, S. (2018). The Social Context of Adolescent Co-Use of Cigarillos and Marijuana Blunts. *Substance Use & Misuse*, 53(4), 654–661. <https://doi.org/10.1080/10826084.2017.1355388>
- Arnett, J. J. (2000). Emerging adulthood: A theory of development from the late teens through the twenties. *American Psychologist*, 55(5), 469–480. <https://doi.org/10.1037//0003-066X.55.5.469>
- Bachman, J. G., Johnston, L. D., & O'Malley, P. M. (1990). Explaining the recent decline in cocaine use among young adults: further evidence that perceived risks and disapproval lead to reduced drug use. *Journal of Health and Social Behavior*, 31(2), 173–184.

- Bandura, A. (1986). *Social foundations of thought and action: a social cognitive theory*. Englewood Cliffs, N.J: Prentice-Hall.
- Becker, J., Schaub, M. P., Gmel, G., & Haug, S. (2015). Cannabis use and other predictors of the onset of daily cigarette use in young men: what matters most? Results from a longitudinal study. *BMC Public Health*, *15*(843). [https://doi.org/DOI 10.1186/s12889-015-2194-3](https://doi.org/DOI%2010.1186/s12889-015-2194-3)
- Berg, C. J., Payne, J., Henriksen, L., Cavazos-Rehg, P., Getachew, B., Schauer, G. L., & Haardörfer, R. (2018). Reasons for Marijuana and Tobacco Co-use Among Young Adults: A Mixed Methods Scale Development Study. *Substance Use & Misuse*, *53*(3), 357–369. <https://doi.org/10.1080/10826084.2017.1327978>
- Berg, C. J., Romero, D. R., & Pulvers, K. (2015). Perceived Harm of Tobacco Products and Individual Schemas of a Smoker in Relation to Change in Tobacco Product Use Over One Year Among Young Adults. *Substance Use & Misuse*, *50*(1), 90–98. <https://doi.org/10.3109/10826084.2014.958858>
- Berg, C. J., Stratton, E., Schauer, G. L., Lewis, M., Wang, Y., Windle, M., & Kegler, M. (2015). Perceived Harm, Addictiveness, and Social Acceptability of Tobacco Products and Marijuana Among Young Adults: Marijuana, Hookah, and Electronic Cigarettes Win. *Substance Use & Misuse*, *50*(1), 79–89. <https://doi.org/10.3109/10826084.2014.958857>
- Bernat, J. K., Ferrer, R. A., Margolis, K. A., & Blake, K. D. (2017). US adult tobacco users' absolute harm perceptions of traditional and alternative tobacco products, information-seeking behaviors, and (mis)beliefs about chemicals in tobacco products. *Addictive Behaviors*, *71*, 38–45. <https://doi.org/10.1016/j.addbeh.2017.02.027>

- Bodner, E., Bergman, Y. S., & Cohen-Fridel, S. (2014). Do Attachment Styles Affect the Presence and Search for Meaning in Life? *Journal of Happiness Studies*, 15(5), 1041–1059. <https://doi.org/10.1007/s10902-013-9462-7>
- Bonn-Miller, M. O., Zvolensky, M. J., & Johnson, K. A. (2010). Uni-Morbid and Co-Occurring Marijuana and Tobacco Use: Examination of Concurrent Associations with Negative Mood States. *Journal of Addictive Diseases*, 29(1), 68–77. <https://doi.org/10.1080/10550880903435996>
- Boys, A., Farrell, M., Taylor, C., Marsden, J., Goodman, R., Brugha, T., ... Meltzer, H. (2003). Psychiatric morbidity and substance use in young people aged 13-15 years: results from the Child and Adolescent Survey of Mental Health. *The British Journal of Psychiatry: The Journal of Mental Science*, 182, 509–517.
- Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. In *Qualitative Research in Psychology* (Vol. 2, pp. 77–101).
- Brodar, K., Hall, M., Butler, E., Parada, H., Stein-Seroussi, A., Hanley, S., & Brewer, N. (2016). Recruiting Diverse Smokers: Enrollment Yields and Cost. *International Journal of Environmental Research and Public Health*, 13(12), 1251. <https://doi.org/10.3390/ijerph13121251>
- Bronfenbrenner, U., & Morris, P. A. (2007). The Bioecological Model of Human Development. In W. Damon & R. M. Lerner (Eds.), *Handbook of Child Psychology*. Hoboken, NJ, USA: John Wiley & Sons, Inc. <https://doi.org/10.1002/9780470147658.chpsy0114>

- Brook, J. S., Lee, J. Y., Finch, S. J., & Brown, E. N. (2010). Course of comorbidity of tobacco and marijuana use: Psychosocial risk factors. *Nicotine & Tobacco Research*, 12(5), 474–482. <https://doi.org/10.1093/ntr/ntq027>
- Brook, J. S., Lee, J. Y., & Brook, D. W. (2015). Trajectories of Marijuana Use Beginning in Adolescence Predict Tobacco Dependence in Adulthood. *Substance Abuse*, 36(4), 470–477. <https://doi.org/10.1080/08897077.2014.964901>
- Buu, A., Dabrowska, A., Heinze, J. E., Hsieh, H.-F., & Zimmerman, M. A. (2015). Gender differences in the developmental trajectories of multiple substance use and the effect of nicotine and marijuana use on heavy drinking in a high-risk sample. *Addictive Behaviors*, 50, 6–12. <https://doi.org/10.1016/j.addbeh.2015.06.015>
- Callaghan, R. C., Allebeck, P., & Sidorchuk, A. (2013). Marijuana use and risk of lung cancer: a 40-year cohort study. *Cancer Causes & Control*, 24(10), 1811–1820. <https://doi.org/10.1007/s10552-013-0259-0>
- Campaign for Tobacco-Free Kids. (2015). Smoking and Kids. Retrieved January 30, 2017, from www.tobaccofreekids.org/research/factsheets/pdf/0001.pdf
- Cantrell, J., Kreslake, J. M., Ganz, O., Pearson, J. L., Vallone, D., Anesetti-Rothermel, A., ... Kirchner, T. R. (2013). Marketing Little Cigars and Cigarillos: Advertising, Price, and Associations With Neighborhood Demographics. *American Journal of Public Health*, 103(10), 1902–1909. <https://doi.org/10.2105/AJPH.2013.301362>
- Carpenter, C. M., Wayne, G. F., Pauly, J. L., Koh, H. K., & Connolly, G. N. (2005). New Cigarette Brands With Flavors That Appeal To Youth: Tobacco Marketing Strategies. *Health Affairs*, 24(6), 1601–1610. <https://doi.org/10.1377/hlthaff.24.6.1601>

Casagrande, S. S., & Cowie, C. C. (2017). Trends in dietary intake among adults with type 2 diabetes: NHANES 1988-2012. *Journal of Human Nutrition and Dietetics*.

<https://doi.org/10.1111/jhn.12443>

Castaldelli-Maia, J. M., Ventriglio, A., & Bhugra, D. (2016). Tobacco smoking: From “glamour” to “stigma”. A comprehensive review: Smoking: From “glamour” to “stigma.” *Psychiatry and Clinical Neurosciences*, 70(1), 24–33.

<https://doi.org/10.1111/pcn.12365>

Centers for Disease Control and Prevention. (2013). National Health and Nutrition Examination Survey: Analytic Guidelines, 2011-2012. Retrieved from:
https://wwwn.cdc.gov/nchs/data/nhanes/2011-2012/analytic_guidelines_11_12.pdf

Centers for Disease Control and Prevention. (2016a). *Cigarette Smoking Among Adults—United States, 2005–2015*. (Morbidity and Mortality Weekly Report No. 65(44)) (pp. 1205–11). 2016. Retrieved from
https://www.cdc.gov/mmwr/volumes/65/wr/mm6544a2.htm?s_cid=mm6544a2_w

Centers for Disease Control and Prevention. (2016b). National Health and Nutrition Examination Survey (NHANES) [National Center for Health Statistics]. Retrieved from
<https://www.cdc.gov/nchs/nhanes/>

Centers for Disease Control and Prevention. (2016c). Health Effects of Cigarette Smoking. Retrieved from
https://www.cdc.gov/tobacco/data_statistics/fact_sheets/health_effects/effects_cig_smoking/

- Červený, J., Chomynová, P., Mravčík, V., & van Ours, J. C. (2017). Cannabis decriminalization and the age of onset of cannabis use. *International Journal of Drug Policy*, 43, 122–129. <https://doi.org/10.1016/j.drugpo.2017.02.014>
- Chung, P. J., Garfield, C. F., Rathouz, P. J., Lauderdale, D. S., Best, D., & Lantos, J. (2002). Youth targeting by tobacco manufacturers since the Master Settlement Agreement. *Health Affairs (Project Hope)*, 21(2), 254–263.
- Cohn, A., Johnson, A., Ehlke, S., & Villanti, A. C. (2016). Characterizing substance use and mental health profiles of cigar, blunt, and non-blunt marijuana users from the National Survey of Drug Use and Health. *Drug and Alcohol Dependence*, 160, 105–111. <https://doi.org/10.1016/j.drugalcdep.2015.12.017>
- Cohn, A. M., Johnson, A. L., Rath, J. M., & Villanti, A. C. (2016). Patterns of the co-use of alcohol, marijuana, and emerging tobacco products in a national sample of young adults: Substance Co-Use in Young Adults. *The American Journal on Addictions*, 25(8), 634–640. <https://doi.org/10.1111/ajad.12456>
- Colby, S. M., Rohsenow, D. J., Monti, P. M., Gwaltney, C. J., Gulliver, S. B., Abrams, D. B., ... Sirota, A. D. (2004). Effects of tobacco deprivation on alcohol cue reactivity and drinking among young adults. *Addictive Behaviors*, 29(5), 879–892. <https://doi.org/10.1016/j.addbeh.2004.03.002>
- Connell, C. M., Gilreath, T. D., Aklin, W. M., & Brex, R. A. (2010). Social-Ecological Influences on Patterns of Substance Use Among Non-Metropolitan High School Students. *American Journal of Community Psychology*, 45(1–2), 36–48. <https://doi.org/10.1007/s10464-009-9289-x>

- Copeland, J., Rooke, S., & Swift, W. (2013). Changes in cannabis use among young people: impact on mental health. *Current Opinion in Psychiatry*, 26(4), 325–329.
<https://doi.org/10.1097/YCO.0b013e328361eae5>
- Creswell, J. W., & Plano Clark, V. L. (2011). *Designing and Conducting Mixed Methods Research* (2nd ed.). Thousand Oaks, CA: Sage.
- Crost, B., & Guerrero, S. (2012). The effect of alcohol availability on marijuana use: Evidence from the minimum legal drinking age. *Journal of Health Economics*, 31(1), 112–121.
<https://doi.org/10.1016/j.jhealeco.2011.12.005>
- Crouch, M., & McKenzie, H. (2006). The logic of small samples in interview-based qualitative research. *Social Science Information*, 45(4), 483–499.
<https://doi.org/10.1177/0539018406069584>
- Curry, L., & Nunez-Smith, M. (2015). *Mixed methods in health sciences research: a practical primer*. Los Angeles, Calif.: Sage Publ.
- Delnevo, C. D., Bover-Manderski, M. T., & Hrywna, M. (2011). Cigar, marijuana, and blunt use among US adolescents: Are we accurately estimating the prevalence of cigar smoking among youth? *Preventive Medicine*, 52(6), 475–476.
<https://doi.org/10.1016/j.ypmed.2011.03.014>
- Delnevo, C. D., & Hrywna, M. (2014). Clove cigar sales following the US flavoured cigarette ban. *Tobacco Control*. <https://doi.org/10.1136/tobaccocontrol-2013-051415>
- Delnevo, C. D. (2006). Smokers' choice: what explains the steady growth of cigar use in the U.S.? *Public Health Reports (Washington, D.C.: 1974)*, 121(2), 116–119.
<https://doi.org/10.1177/003335490612100203>

- DiFranza, J. R. (2000). Initial symptoms of nicotine dependence in adolescents. *Tobacco Control*, 9(3), 313–319. <https://doi.org/10.1136/tc.9.3.313>
- DiFranza, J. R., Savageau, J. A., Fletcher, K., O’Loughlin, J., Pbert, L., Ockene, J. K., ... Wellman, R. J. (2007). Symptoms of Tobacco Dependence After Brief Intermittent Use: The Development and Assessment of Nicotine Dependence in Youth–2 Study. *Archives of Pediatrics & Adolescent Medicine*, 161(7), 704. <https://doi.org/10.1001/archpedi.161.7.704>
- Dwyer, J. B., McQuown, S. C., & Leslie, F. M. (2009). The dynamic effects of nicotine on the developing brain. *Pharmacology & Therapeutics*, 122(2), 125–139. <https://doi.org/10.1016/j.pharmthera.2009.02.003>
- Ellickson, P. L., Tucker, J. S., & Klein, D. J. (2001). High-risk behaviors associated with early smoking: results from a 5-year follow-up. *Journal of Adolescent Health*, 28(6), 465–473. [https://doi.org/10.1016/S1054-139X\(00\)00202-0](https://doi.org/10.1016/S1054-139X(00)00202-0)
- Evans-Polce, R. J., Vasilenko, S. A., & Lanza, S. T. (2015). Changes in gender and racial/ethnic disparities in rates of cigarette use, regular heavy episodic drinking, and marijuana use: Ages 14 to 32. *Addictive Behaviors*, 41, 218–222. <https://doi.org/10.1016/j.addbeh.2014.10.029>
- Fagan, P., King, G., Lawrence, D., Petrucci, S. A., Robinson, R. G., Banks, D., ... Grana, R. (2004). Eliminating tobacco-related health disparities: directions for future research. *American Journal of Public Health*, 94(2), 211–217.
- Fagan, P., Moolchan, E. T., Hart Jr., A., Rose, A., Lawrence, D., Shavers, V. L., & Gibson, J. T. (2010). Nicotine dependence and quitting behaviors among menthol and non-

- menthol smokers with similar consumptive patterns: Nicotine dependence and menthol smokers. *Addiction*, 105, 55–74. <https://doi.org/10.1111/j.1360-0443.2010.03190.x>
- Fairman, B. J. (2015). Cannabis problem experiences among users of the tobacco–cannabis combination known as blunts. *Drug and Alcohol Dependence*, 150, 77–84. <https://doi.org/10.1016/j.drugalcdep.2015.02.014>
- Fallin, A., Neilands, T. B., Jordan, J. W., & Ling, P. M. (2014). Secondhand Smoke Exposure Among Young Adult Sexual Minority Bar and Nightclub Patrons. *American Journal of Public Health*, 104(2), e148–e153. <https://doi.org/10.2105/AJPH.2013.301657>
- Fernander, A., Rayens, M. K., Zhang, M., & Adkins, S. (2010). Are age of smoking initiation and purchasing patterns associated with menthol smoking?: Menthol initiation and purchasing. *Addiction*, 105, 39–45. <https://doi.org/10.1111/j.1360-0443.2010.03188.x>
- Frohlich, K. L., & Potvin, L. (2008). Transcending the Known in Public Health Practice: The Inequality Paradox: The Population Approach and Vulnerable Populations. *American Journal of Public Health*, 98(2), 216–221. <https://doi.org/10.2105/AJPH.2007.114777>
- Fryer, C. S., Seaman, E. L., Clark, R. S., & Plano Clark, V. L. (2017). Mixed methods research in tobacco control with youth and young adults: A methodological review of current strategies. *PloS One*, 12(8), e0183471. <https://doi.org/10.1371/journal.pone.0183471>
- Fishbein, M., & Ajzen, I. (1975). Belief, attitude, intention, and behavior: an introduction to theory and research. Reading, Mass: Addison-Wesley Pub. Co.
- Flora, D. B., & Chassin, L. (2005). Changes in Drug Use During Young Adulthood: The Effects of Parent Alcoholism and Transition Into Marriage. *Psychology of Addictive Behaviors*, 19(4), 352–362. <https://doi.org/10.1037/0893-164X.19.4.352>

- Fuemmeler, B., Lee, C.-T., Ranby, K. W., Clark, T., McClernon, F. J., Yang, C., & Kollins, S. H. (2013). Individual- and community-level correlates of cigarette-smoking trajectories from age 13 to 32 in a U.S. population-based sample. *Drug and Alcohol Dependence*, 132(1–2), 301–308. <https://doi.org/10.1016/j.drugalcdep.2013.02.021>
- Gammon, D. G., Loomis, B. R., Dench, D. L., King, B. A., Fulmer, E. B., & Rogers, T. (2016). Effect of price changes in little cigars and cigarettes on little cigar sales: USA, Q4 2011–Q4 2013. *Tobacco Control*, 25(5), 538–544. <https://doi.org/10.1136/tobaccocontrol-2015-052343>
- Gilmore, K., & Meersand, P. (2013). *Normal child and adolescent development: a psychodynamic primer* (1st ed). Washington, D.C: American Psychiatric Pub.
- Giovenco, D. P., Miller Lo, E. J., Lewis, M. J., & Delnevo, C. D. (2016). “They’re Pretty Much Made for Blunts”: Product Features That Facilitate Marijuana Use Among Young Adult Cigarillo Users in the United States. *Nicotine & Tobacco Research: Official Journal of the Society for Research on Nicotine and Tobacco*. <https://doi.org/10.1093/ntr/ntw182>
- Godin, G., Valois, P., Lepage, L., & Desharnais, R. (1992). Predictors of smoking behaviour: an application of Ajzen’s theory of planned behaviour. *Addiction*, 87(9). <https://doi.org/10.1111/j.1360-0443.1992.tb02742.x>
- Goodwin, R. D., Pacek, L. R., Copeland, J., Moeller, S. J., Dierker, L., Weinberger, A., ... Hasin, D. S. (2018). Trends in Daily Cannabis Use Among Cigarette Smokers: United States, 2002–2014. *American Journal of Public Health*, 108(1), 137–142. <https://doi.org/10.2105/AJPH.2017.304050>

- Goodwin, R. D., Wall, M. M., Garey, L., Zvolensky, M. J., Dierker, L., Galea, S., ... Hasin, D. S. (2017). Depression among current, former, and never smokers from 2005 to 2013: The hidden role of disparities in depression in the ongoing tobacco epidemic. *Drug and Alcohol Dependence*, 173, 191–199. <https://doi.org/10.1016/j.drugalcdep.2016.11.038>
- Green, B. E., & Ritter, C. (2000). Marijuana use and depression. *Journal of Health and Social Behavior*, 41(1), 40–49.
- Green, K. M., Doherty, E. E., & Ensminger, M. E. (2016). Long-term consequences of adolescent cannabis use: Examining intermediary processes. *The American Journal of Drug and Alcohol Abuse*, 1–9. <https://doi.org/10.1080/00952990.2016.1258706>
- Green, K. M., Johnson, R. M., Milam, A. J., Furr-Holden, D., Ialongo, N. S., & Reboussin, B. A. (2016). Racial differences and the role of neighborhood in the sequencing of marijuana and tobacco initiation among urban youth. *Substance Abuse*, 37(4), 507–510. <https://doi.org/10.1080/08897077.2016.1178680>
- Guest, G., Bruce, A., & Johnson, L. (2006). How Many Interviews Are Enough?: An Experiment with Data Saturation and Variability. *Field Methods*, 18(1), 59–82. <https://doi.org/10.1177/1525822X05279903>
- Guetterman, T. C., Fetters, M. D., & Creswell, J. W. (2015). Integrating Quantitative and Qualitative Results in Health Science Mixed Methods Research Through Joint Displays. *The Annals of Family Medicine*, 13(6), 554–561. <https://doi.org/10.1370/afm.1865>
- Hall, W. (2015). What has research over the past two decades revealed about the adverse health effects of recreational cannabis use?: Cannabis health effects. *Addiction*, 110(1), 19–35. <https://doi.org/10.1111/add.12703>

- Hall, W., & Degenhardt, L. (2009). Adverse health effects of non-medical cannabis use. *The Lancet*, 374(9698), 1383–1391. [https://doi.org/10.1016/S0140-6736\(09\)61037-0](https://doi.org/10.1016/S0140-6736(09)61037-0)
- Hall, W., & Lynskey, M. (2016). Why it is probably too soon to assess the public health effects of legalisation of recreational cannabis use in the USA. *The Lancet. Psychiatry*, 3(9), 900–906. [https://doi.org/10.1016/S2215-0366\(16\)30071-2](https://doi.org/10.1016/S2215-0366(16)30071-2)
- Heeringa, S., West, B. T., & Berglund, P. A. (2010). *Applied survey data analysis*. Boca Raton, FL: Chapman & Hall/CRC.
- Henriksen, L., Schleicher, N. C., Dauphinee, A. L., & Fortmann, S. P. (2012). Targeted Advertising, Promotion, and Price For Menthol Cigarettes in California High School Neighborhoods. *Nicotine & Tobacco Research*, 14(1), 116–121. <https://doi.org/10.1093/ntr/ntr122>
- Hightet, G. (2004). The role of cannabis in supporting young people's cigarette smoking: a qualitative exploration. *Health Education Research*, 19(6), 635–643. <https://doi.org/10.1093/her/cyg089>
- Hindocha, C., Freeman, T. P., Ferris, J. A., Lynskey, M. T., & Winstock, A. R. (2016). No Smoke without Tobacco: A Global Overview of Cannabis and Tobacco Routes of Administration and Their Association with Intention to Quit. *Frontiers in Psychiatry*, 7. <https://doi.org/10.3389/fpsyt.2016.00104>
- Holmes, L. M., Popova, L., & Ling, P. M. (2016). State of transition: Marijuana use among young adults in the San Francisco Bay Area. *Preventive Medicine*, 90, 11–16. <https://doi.org/10.1016/j.ypmed.2016.06.025>
- Hublet, A., Bendtsen, P., de Looze, M. E., Fotiou, A., Donnelly, P., Vilhjalmsen, R., ... ter Bogt, T. F. M. (2015). Trends in the co-occurrence of tobacco and cannabis use in 15-

year-olds from 2002 to 2010 in 28 countries of Europe and North America. *The European Journal of Public Health*, 25(suppl 2), 73–75.

<https://doi.org/10.1093/eurpub/ckv032>

Huh, J., Paul Thing, J., Abramova, Z. S., Sami, M., & Beth Unger, J. (2014). Place Matters in Perceived Tobacco Exposure Among Korean American Young Adults: Mixed Methods Approach. *Substance Use & Misuse*, 49(8), 1054–1063.

<https://doi.org/10.3109/10826084.2014.850277>

Ito, T. A., Henry, E. A., Cordova, K. A., & Bryan, A. D. (2015). Testing an expanded theory of planned behavior model to explain marijuana use among emerging adults in a promarijuana community. *Psychology of Addictive Behaviors: Journal of the Society of Psychologists in Addictive Behaviors*, 29(3), 576–589.

<https://doi.org/10.1037/adb0000098>

Jacobus, J., & Tapert, S. F. (2014). Effects of cannabis on the adolescent brain. *Current Pharmaceutical Design*, 20(13), 2186–2193.

Johnson, R. M., Fairman, B., Gilreath, T., Xuan, Z., Rothman, E. F., Parnham, T., & Furr- Holden, C. D. M. (2015). Past 15-year trends in adolescent marijuana use: Differences by race/ethnicity and sex. *Drug and Alcohol Dependence*, 155, 8–15.

<https://doi.org/10.1016/j.drugalcdep.2015.08.025>

Johnson, S. B., Blum, R. W., & Giedd, J. N. (2009). Adolescent Maturity and the Brain: The Promise and Pitfalls of Neuroscience Research in Adolescent Health Policy. *Journal of Adolescent Health*, 45(3), 216–221. <https://doi.org/10.1016/j.jadohealth.2009.05.016>

Juon, H.-S., Fothergill, K. E., Green, K. M., Doherty, E. E., & Ensminger, M. E. (2011). Antecedents and consequences of marijuana use trajectories over the life course in an

- African American population. *Drug and Alcohol Dependence*, 118(2–3), 216–223.
<https://doi.org/10.1016/j.drugalcdep.2011.03.027>
- Kalkhoran, S., Neilands, T. B., & Ling, P. M. (2013). Secondhand Smoke Exposure and Smoking Behavior Among Young Adult Bar Patrons. *American Journal of Public Health*, 103(11), 2048–2055. <https://doi.org/10.2105/AJPH.2013.301287>
- Kam, J. A., Matsunaga, M., Hecht, M. L., & Ndiaye, K. (2009). Extending the Theory of Planned Behavior to Predict Alcohol, Tobacco, and Marijuana Use Among Youth of Mexican Heritage. *Prevention Science*, 10(1), 41–53. <https://doi.org/10.1007/s11121-008-0110-0>
- Kandel, D. B., Yamaguchi, K., & Chen, K. (1992). Stages of progression in drug involvement from adolescence to adulthood: further evidence for the gateway theory. *Journal of Studies on Alcohol*, 53(5), 447–457.
- Karimy, M., Niknami, S., Heidarnia, A. R., Hajizadeh, I., & Montazeri, A. (2013). Prevalence and determinants of male adolescents' smoking in iran: an explanation based on the theory of planned behavior. *Iranian Red Crescent Medical Journal*, 15(3), 187–193.
<https://doi.org/10.5812/ircmj.3378>
- Kendler, K. S., Myers, J., & Prescott, C. A. (2007). Specificity of Genetic and Environmental Risk Factors for Symptoms of Cannabis, Cocaine, Alcohol, Caffeine, and Nicotine Dependence. *Archives of General Psychiatry*, 64(11), 1313.
<https://doi.org/10.1001/archpsyc.64.11.1313>
- Kennedy, S. M., Caraballo, R. S., Rolle, I. V., & Rock, V. J. (2016). Not Just Cigarettes: A More Comprehensive Look at Marijuana and Tobacco Use Among African American and White Youth and Young Adults. *Nicotine & Tobacco Research: Official Journal of*

the Society for Research on Nicotine and Tobacco, 18 Suppl 1, S65-72.

<https://doi.org/10.1093/ntr/ntv202>

Keyes, K. M., Vo, T., Wall, M. M., Caetano, R., Suglia, S. F., Martins, S. S., ... Hasin, D.

(2015). Racial/ethnic differences in use of alcohol, tobacco, and marijuana: Is there a cross-over from adolescence to adulthood? *Social Science & Medicine*, 124, 132–141.

<https://doi.org/10.1016/j.socscimed.2014.11.035>

Khantzian, E. J. (1997). The Self-Medication Hypothesis of Substance Use Disorders: A

Reconsideration and Recent Applications. *Harvard Review of Psychiatry*, 4(5), 231–

244. <https://doi.org/10.3109/10673229709030550>

Khatapoush, S., & Hallfors, D. (2004). “Sending the Wrong Message”: Did Medical Marijuana

Legalization in California Change Attitudes about and use of Marijuana? *Journal of Drug Issues*, 34(4), 751–770. <https://doi.org/10.1177/002204260403400402>

Kilmer, J. R., Hunt, S. B., Lee, C. M., & Neighbors, C. (2007). Marijuana use, risk perception,

and consequences: is perceived risk congruent with reality? *Addictive Behaviors*,

32(12), 3026–3033. <https://doi.org/10.1016/j.addbeh.2007.07.009>

Klein, E. G., Bernat, D. H., Lenk, K. M., & Forster, J. L. (2013). Nondaily smoking patterns in

young adulthood. *Addictive Behaviors*, 38(7), 2267–2272.

<https://doi.org/10.1016/j.addbeh.2013.03.005>

Kozlowski, L. T., Dollar, K. M., & Giovino, G. A. (2008). Cigar/Cigarillo Surveillance.

American Journal of Preventive Medicine, 34(5), 424–426.

<https://doi.org/10.1016/j.amepre.2007.12.025>

Kristman-Valente, A. N., Hill, K. G., Epstein, M., Kosterman, R., Bailey, J. A., Steeger, C. M.,

... David Hawkins, J. (2017). The Relationship Between Marijuana and Conventional

- Cigarette Smoking Behavior from Early Adolescence to Adulthood. *Prevention Science*, 18(4), 428–438. <https://doi.org/10.1007/s11121-017-0774-4>
- Kroenke, K., Spitzer, R. L., & Williams, J. B. (2001). The PHQ-9: validity of a brief depression severity measure. *Journal of General Internal Medicine*, 16(9), 606–613.
- Kroenke, K., & Spitzer, R. L. (2002). The PHQ-9: A New Depression Diagnostic and Severity Measure. *Psychiatric Annals*, 32(9), 509–515. <https://doi.org/10.3928/0048-5713-20020901-06>
- Lanza, S. T., Vasilenko, S. A., Dziak, J. J., & Butera, N. M. (2015). Trends Among U.S. High School Seniors in Recent Marijuana Use and Associations With Other Substances: 1976–2013. *Journal of Adolescent Health*, 57(2), 198–204. <https://doi.org/10.1016/j.jadohealth.2015.04.006>
- Lawrence, D., Rose, A., Fagan, P., Moolchan, E. T., Gibson, J. T., & Backinger, C. L. (2010). National patterns and correlates of mentholated cigarette use in the United States: Mentholated cigarette use in the United States. *Addiction*, 105, 13–31. <https://doi.org/10.1111/j.1360-0443.2010.03203.x>
- Lee, J. P., Battle, R. S., Lipton, R., & Soller, B. (2010). “Smoking”: use of cigarettes, cigars and blunts among Southeast Asian American youth and young adults. *Health Education Research*, 25(1), 83–96. <https://doi.org/10.1093/her/cyp066>
- Lee Ridner, S., Staten, R. R., & Danner, F. W. (2005). Smoking and depressive symptoms in a college population. *The Journal of School Nursing: The Official Publication of the National Association of School Nurses*, 21(4), 229–235. <https://doi.org/10.1177/10598405050210040801>

- Lin, H. C., Jester, J. M., & Buu, A. (2016). The Relationships of Cigarette and Alcohol Use With the Initiation, Reinitiation, and Persistence of Cannabis Use. *Journal of Studies on Alcohol and Drugs*, 77(1), 113–120.
- Ling, P. M., & Glantz, S. A. (2002). Why and how the tobacco industry sells cigarettes to young adults: evidence from industry documents. *American Journal of Public Health*, 92(6), 908–916.
- Lipperman-Kreda, S., & Lee, J. P. (2011). Boost Your High: Cigarette Smoking to Enhance Alcohol and Drug Effects among Southeast Asian American Youth. *Journal of Drug Issues*, 41(4), 509–522.
- Lisdahl, K. M., & Price, J. S. (2012). Increased marijuana use and gender predict poorer cognitive functioning in adolescents and emerging adults. *Journal of the International Neuropsychological Society: JINS*, 18(4), 678–688.
<https://doi.org/10.1017/S1355617712000276>
- Macleod, J., Robertson, R., Copeland, L., McKenzie, J., Elton, R., & Reid, P. (2015). Cannabis, tobacco smoking, and lung function: a cross-sectional observational study in a general practice population. *British Journal of General Practice*, 65(631), e89–e95.
<https://doi.org/10.3399/bjgp15X683521>
- Macy, J. T., Middlestadt, S. E., Seo, D.-C., Kolbe, L. J., & Jay, S. J. (2012). Applying the theory of planned behavior to explore the relation between smoke-free air laws and quitting intentions. *Health Education & Behavior: The Official Publication of the Society for Public Health Education*, 39(1), 27–34.
<https://doi.org/10.1177/1090198111404702>

- Martinasek, M. P., McGrogan, J. B., & Maysonet, A. (2016). A Systematic Review of the Respiratory Effects of Inhalational Marijuana. *Respiratory Care*, 61(11), 1543–1551. <https://doi.org/10.4187/respcare.04846>
- Martins, S. S., Mauro, C. M., Santaella-Tenorio, J., Kim, J. H., Cerda, M., Keyes, K. M., ... Wall, M. (2016). State-level medical marijuana laws, marijuana use and perceived availability of marijuana among the general U.S. population. *Drug and Alcohol Dependence*, 169, 26–32. <https://doi.org/10.1016/j.drugalcdep.2016.10.004>
- Maryland Medical Cannabis Commission. (2018). Retrieved from <http://mmcc.maryland.gov/>
- Masters, M. N., Haardörfer, R., Windle, M., & Berg, C. (2018). Psychosocial and cessation-related differences between tobacco-marijuana co-users and single product users in a college student population. *Addictive Behaviors*, 77, 21–27. <https://doi.org/10.1016/j.addbeh.2017.09.007>
- McGuinn, L. A., Ghazarian, A. A., Joseph Su, L., & Ellison, G. L. (2015). Urinary bisphenol A and age at menarche among adolescent girls: evidence from NHANES 2003-2010. *Environmental Research*, 136, 381–386. <https://doi.org/10.1016/j.envres.2014.10.037>
- Medical Marijuana. (2017). Retrieved from <https://medicalmarijuana.procon.org/view.resource.php?resourceID=000881&print>
- Mermelstein, R. J. (2014). Adapting to a Changing Tobacco Landscape. *American Journal of Preventive Medicine*, 47(2), S87–S89. <https://doi.org/10.1016/j.amepre.2014.04.015>
- Moir, D., Rickert, W. S., Levasseur, G., Larose, Y., Maertens, R., White, P., & Desjardins, S. (2008). A comparison of mainstream and sidestream marijuana and tobacco cigarette smoke produced under two machine smoking conditions. *Chemical Research in Toxicology*, 21(2), 494–502. <https://doi.org/10.1021/tx700275p>

- Momin, B., Neri, A., Zhang, L., Kahende, J., Duke, J., Green, S. G., ... Stewart, S. L. (2017). Mixed-Methods for Comparing Tobacco Cessation Interventions. *Journal of Smoking Cessation*, 12(1), 15–21. <https://doi.org/10.1017/jsc.2015.7>
- Montgomery, L. (2015). Marijuana and tobacco use and co-use among African Americans: Results from the 2013, National Survey on Drug Use and Health. *Addictive Behaviors*, 51, 18–23. <https://doi.org/10.1016/j.addbeh.2015.06.046>
- Montgomery, L., & Ramo, D. (2017). What did you expect?: The interaction between cigarette and blunt vs. non-blunt marijuana use among African American young adults. *Journal of Substance Use*, 22(6), 612–616. <https://doi.org/10.1080/14659891.2017.1283452>
- Moolchan, E. T., Fagan, P., Fernander, A. F., Velicer, W. F., Hayward, M. D., King, G., & Clayton, R. R. (2007). Addressing tobacco-related health disparities. *Addiction*, 102, 30–42. <https://doi.org/10.1111/j.1360-0443.2007.01953.x>
- Moore, B. A., Augustson, E. M., Moser, R. P., & Budney, A. J. (2005). Respiratory effects of marijuana and tobacco use in a U.S. sample. *Journal of General Internal Medicine*, 20(1), 33–37. <https://doi.org/10.1111/j.1525-1497.2004.40081.x>
- Moss, H. B., Chen, C. M., & Yi, H. (2014). Early adolescent patterns of alcohol, cigarettes, and marijuana polysubstance use and young adult substance use outcomes in a nationally representative sample. *Drug and Alcohol Dependence*, 136, 51–62. <https://doi.org/10.1016/j.drugalcdep.2013.12.011>
- National Conference of State Legislatures. (2018, August 30). Marijuana Overview. Retrieved February 22, 2018, from <http://www.ncsl.org/research/civil-and-criminal-justice/marijuana-overview.aspx>

- Nekvasil, N., & Liu, D. (2015, December 10). In U.S., Young Adults' Cigarette Use Is Down Sharply. Retrieved from <http://www.gallup.com/poll/187592/young-adults-cigarette-down-sharply.aspx>
- Nestler, E. J., Barrot, M., & Self, D. W. (2001). FosB: A sustained molecular switch for addiction. *Proceedings of the National Academy of Sciences*, 98(20), 11042–11046. <https://doi.org/10.1073/pnas.191352698>
- National Institute on Drug Abuse. (2016). What is marijuana? [drugabuse.gov]. Retrieved from <https://www.drugabuse.gov/publications/research-reports/marijuana/what-marijuana>
- Norman, P., Conner, M., & Bell, R. (1999). The theory of planned behavior and smoking cessation. *Health Psychology : Official Journal of the Division of Health Psychology, American Psychological Association*, 18(1), 89–94.
- Nyman, A. L., Sterling, K. L., Majeed, B. A., Jones, D. M., & Eriksen, M. P. (2017). Flavors and Risk: Perceptions of Flavors in Little Cigars and Cigarillos Among U.S. Adults, 2015. *Nicotine & Tobacco Research*. <https://doi.org/10.1093/ntr/ntx153>
- O’Cathain, A., Murphy, E., & Nicholl, J. (2008). The quality of mixed methods studies in health services research. *Journal of Health Services Research & Policy*, 13(2), 92–98. <https://doi.org/10.1258/jhsrp.2007.007074>
- O’Cathain, A., Murphy, E., & Nicholl, J. (2010). Three techniques for integrating data in mixed methods studies. *BMJ*, 341(sep17 1), c4587–c4587. <https://doi.org/10.1136/bmj.c4587>
- O’Connor, R. J. (2006). Changes in Nicotine Intake and Cigarette Use Over Time in Two Nationally Representative Cross-Sectional Samples of Smokers. *American Journal of Epidemiology*, 164(8), 750–759. <https://doi.org/10.1093/aje/kwj263>

- Okoli, C. T. C., Richardson, C. G., Ratner, P. A., & Johnson, J. L. (2008). Adolescents' self-defined tobacco use status, marijuana use, and tobacco dependence. *Addictive Behaviors*, 33(11), 1491–1499. <https://doi.org/10.1016/j.addbeh.2008.05.008>
- Okuyemi, K. S., Reitzel, L. R., & Fagan, P. (2015). Interventions to Reduce Tobacco-Related Health Disparities. *Nicotine & Tobacco Research*, 17(8), 887–891. <https://doi.org/10.1093/ntr/ntv096>
- Patrick, M. E., Wightman, P., Schoeni, R. F., & Schulenberg, J. E. (2012). Socioeconomic Status and Substance Use Among Young Adults: A Comparison Across Constructs and Drugs. *Journal of Studies on Alcohol and Drugs*, 73(5), 772–782.
- Patton, G. C., Coffey, C., Carlin, J. B., Degenhardt, L., Lynskey, M., & Hall, W. (2002). Cannabis use and mental health in young people: cohort study. *BMJ (Clinical Research Ed.)*, 325(7374), 1195–1198.
- Patton, G. C., Coffey, C., Carlin, J. B., Sawyer, S. M., & Lynskey, M. (2005). Reverse gateways? Frequent cannabis use as a predictor of tobacco initiation and nicotine dependence. *Addiction (Abingdon, England)*, 100(10), 1518–1525. <https://doi.org/10.1111/j.1360-0443.2005.01220.x>
- Peters, E. N., Schauer, G. L., Rosenberry, Z. R., & Pickworth, W. B. (2016). Does marijuana “blunt” smoking contribute to nicotine exposure?: Preliminary product testing of nicotine content in wrappers of cigars commonly used for blunt smoking. *Drug and Alcohol Dependence*, 168, 119–122. <https://doi.org/10.1016/j.drugalcdep.2016.09.007>
- Philibert, R. A., Gunter, T. D., Beach, S. R. H., Brody, G. H., Hollenbeck, N., Andersen, A., & Adams, W. (2009). Role of GABRA2 on risk for alcohol, nicotine, and cannabis

dependence in the Iowa Adoption Studies: *Psychiatric Genetics*, 19(2), 91–98.

<https://doi.org/10.1097/YPG.0b013e3283208026>

Pinto-Meza, A., Serrano-Blanco, A., Peñarrubia, M. T., Blanco, E., & Haro, J. M. (2005).

Assessing depression in primary care with the PHQ-9: can it be carried out over the telephone? *Journal of General Internal Medicine*, 20(8), 738–742.

<https://doi.org/10.1111/j.1525-1497.2005.0144.x>

Prince, V. (2005). Sex vs. Gender. *International Journal of Transgenderism*, 8(4), 29–32.

https://doi.org/10.1300/J485v08n04_05

Prochaska, J. J., Michalek, A. K., Brown-Johnson, C., Daza, E. J., Baiocchi, M., Anzai, N., ...

Chieng, A. (2016). Likelihood of Unemployed Smokers vs Nonsmokers Attaining Reemployment in a One-Year Observational Study. *JAMA Internal Medicine*, 176(5), 662. <https://doi.org/10.1001/jamainternmed.2016.0772>

Rabin, R. A., & George, T. P. (2015). A review of co-morbid tobacco and cannabis use disorders: Possible mechanisms to explain high rates of co-use: A Review of Co-morbid Tobacco and Cannabis Use. *The American Journal on Addictions*, 24(2), 105–116. <https://doi.org/10.1111/ajad.12186>

Ramo, D. E., Delucchi, K. L., Hall, S. M., Liu, H., & Prochaska, J. J. (2013). Marijuana and tobacco co-use in young adults: patterns and thoughts about use. *Journal of Studies on Alcohol and Drugs*, 74(2), 301–310.

Ramo, D. E., Delucchi, K. L., Liu, H., Hall, S. M., & Prochaska, J. J. (2014). Young adults who smoke cigarettes and marijuana: Analysis of thoughts and behaviors. *Addictive Behaviors*, 39(1), 77–84. <https://doi.org/10.1016/j.addbeh.2013.08.035>

- Ramo, D. E., Liu, H., & Prochaska, J. J. (2012). Tobacco and marijuana use among adolescents and young adults: A systematic review of their co-use. *Clinical Psychology Review*, 32(2), 105–121. <https://doi.org/10.1016/j.cpr.2011.12.002>
- Ramo, D. E., Liu, H., & Prochaska, J. J. (2013). Validity and reliability of the nicotine and marijuana interaction expectancy (NAMIE) questionnaire. *Drug and Alcohol Dependence*, 131(1–2), 166–170. <https://doi.org/10.1016/j.drugalcdep.2012.12.018>
- Ramo, D.E., Hall, S. M., & Prochaska, J. J. (2010). Reaching young adult smokers through the Internet: Comparison of three recruitment mechanisms. *Nicotine & Tobacco Research*, 12(7), 768–775. <https://doi.org/10.1093/ntr/ntq086>
- Ramo, D.E., & Prochaska, J. J. (2012). Prevalence and co-use of marijuana among young adult cigarette smokers: An anonymous online national survey. *Addiction Science & Clinical Practice*, 7(1), 5. <https://doi.org/10.1186/1940-0640-7-5>
- Ream, G. L., Benoit, E., Johnson, B. D., & Dunlap, E. (2008). Smoking tobacco along with marijuana increases symptoms of cannabis dependence. *Drug and Alcohol Dependence*, 95(3), 199–208. <https://doi.org/10.1016/j.drugalcdep.2008.01.011>
- Richter, L., Pugh, B. S., & Ball, S. A. (2016). Assessing the risk of marijuana use disorder among adolescents and adults who use marijuana. *The American Journal of Drug and Alcohol Abuse*, 1–14. <https://doi.org/10.3109/00952990.2016.1164711>
- Richter, L., Pugh, B. S., Smith, P. H., & Ball, S. A. (2016). The co-occurrence of nicotine and other substance use and addiction among youth and adults in the United States: implications for research, practice, and policy. *The American Journal of Drug and Alcohol Abuse*, 1–14. <https://doi.org/10.1080/00952990.2016.1193511>

- Salas-Wright, C. P., Vaughn, M. G., Todic, J., Córdova, D., & Perron, B. E. (2015). Trends in the disapproval and use of marijuana among adolescents and young adults in the United States: 2002–2013. *The American Journal of Drug and Alcohol Abuse*, 41(5), 392–404. <https://doi.org/10.3109/00952990.2015.1049493>
- Saunders, B., Sim, J., Kingstone, T., Baker, S., Waterfield, J., Bartlam, B., ... Jinks, C. (2017). Saturation in qualitative research: exploring its conceptualization and operationalization. *Quality & Quantity*. <https://doi.org/10.1007/s11135-017-0574-8>
- Scal, P., Ireland, M., & Borowsky, I. W. (2003). Smoking among American adolescents: a risk and protective factor analysis. *Journal of Community Health*, 28(2), 79–97.
- Schauer, G. L., Berg, C. J., Kegler, M. C., Donovan, D. M., & Windle, M. (2015). Assessing the overlap between tobacco and marijuana: Trends in patterns of co-use of tobacco and marijuana in adults from 2003–2012. *Addictive Behaviors*, 49, 26–32. <https://doi.org/10.1016/j.addbeh.2015.05.012>
- Schauer, G. L., Berg, C. J., Kegler, M. C., Donovan, D. M., & Windle, M. (2016). Differences in Tobacco Product Use Among Past Month Adult Marijuana Users and Nonusers: Findings From the 2003–2012 National Survey on Drug Use and Health. *Nicotine & Tobacco Research*, 18(3), 281–288. <https://doi.org/10.1093/ntr/ntv093>
- Schauer, G. L., Peters, E. N., Rosenberry, Z., & Kim, H. (2017). Trends in and characteristics of marijuana and menthol cigarette use among current cigarette smokers, 2005-2014. *Nicotine & Tobacco Research*, ntw394. <https://doi.org/10.1093/ntr/ntw394>
- Schauer, G. L., Rosenberry, Z. R., & Peters, E. N. (2017). Marijuana and tobacco co-administration in blunts, spliffs, and mulled cigarettes: A systematic literature review. *Addictive Behaviors*, 64, 200–211. <https://doi.org/10.1016/j.addbeh.2016.09.001>

- Schuermeyer, J., Salomonsen-Sautel, S., Price, R. K., Balan, S., Thurstone, C., Min, S.-J., & Sakai, J. T. (2014). Temporal trends in marijuana attitudes, availability and use in Colorado compared to non-medical marijuana states: 2003–11. *Drug and Alcohol Dependence, 140*, 145–155. <https://doi.org/10.1016/j.drugalcdep.2014.04.016>
- Sinclair, C. F., Foushee, H. R., Pevear, J. S., Scarinci, I. C., & Carroll, W. R. (2012). Patterns of Blunt Use Among Rural Young Adult African-American Men. *American Journal of Preventive Medicine, 42*(1), 61–64. <https://doi.org/10.1016/j.amepre.2011.08.023>
- Singh, T., Kennedy, S. M., Sharapova, S. S., Schauer, G. L., & V. Rolle, I. (2016). Modes of ever marijuana use among adult tobacco users and non-tobacco users— *Styles 2014. Journal of Substance Use, 21*(6), 631–635. <https://doi.org/10.3109/14659891.2015.1122100>
- Skinner, A. C., & Skelton, J. A. (2014). Prevalence and Trends in Obesity and Severe Obesity Among Children in the United States, 1999-2012. *JAMA Pediatrics, 168*(6), 561. <https://doi.org/10.1001/jamapediatrics.2014.21>
- Smokefree.gov. (n.d.). Health Effects. Retrieved June 8, 2017, from <https://smokefree.gov/quitting-smoking/reasons-quit/health-effects>
- Soldz, S., Huyser, D. J., & Dorsey, E. (2003). The cigar as a drug delivery device: youth use of blunts. *Addiction (Abingdon, England), 98*(10), 1379–1386.
- Stephens, M., Ogunsanya, M. E., Ford, K. H., Bamgbade, B. A., & Liang, M.-C. (2015). Little Cigar and Cigarillo Beliefs and Behaviors among African-American Young Adults. *American Journal of Health Behavior, 39*(4), 519–528. <https://doi.org/10.5993/AJHB.39.4.8>

- Sterling, K. L., Fryer, C. S., Pagano, I., & Fagan, P. (2016). Little Cigars and Cigarillos Use Among Young Adult Cigarette Smokers in the United States: Understanding Risk of Concomitant Use Subtypes. *Nicotine & Tobacco Research: Official Journal of the Society for Research on Nicotine and Tobacco*, 18(12), 2234–2242.
<https://doi.org/10.1093/ntr/ntw170>
- Stewart, M. W., & Moreno, M. A. (2013). Changes in Attitudes, Intentions, and Behaviors toward Tobacco and Marijuana during U.S. Students' First Year of College. *Tobacco Use Insights*, 6, 7–16. <https://doi.org/10.4137/TUI.S11325>
- Subramaniam, P., McGlade, E., & Yurgelun-Todd, D. (2016). Comorbid Cannabis and Tobacco Use in Adolescents and Adults. *Current Addiction Reports*, 3(2), 182–188.
<https://doi.org/10.1007/s40429-016-0101-3>
- Substance Abuse and Mental Health Services Administration. (2015). *Results from the 2014 National Survey on Drug Use and Health: Detailed Tables*. Retrieved from <https://www.samhsa.gov/data/sites/default/files/NSDUH-DetTabs2014/NSDUH-DetTabs2014.pdf>
- Substance Abuse and Mental Health Services Administration. (2016). *Results from the 2015 National Survey on Drug Use and Health: Detailed Tables*. Retrieved from <https://www.samhsa.gov/data/sites/default/files/NSDUH-DetTabs-2015/NSDUH-DetTabs-2015/NSDUH-DetTabs-2015.pdf>
- Substance Abuse and Mental Health Services Administration. (2017). *Results from 2016 National Survey on Drug Use and Health: Detailed Tables*. Retrieved from <https://www.samhsa.gov/data/sites/default/files/NSDUH-DetTabs-2016/NSDUH-DetTabs-2016.pdf>

- Substance Abuse and Mental Health Services Administration (2012). Trends in Cigarette Use among Adolescents and Young Adults, The NSDUH Report.
<https://www.samhsa.gov/data/sites/default/files/NSDUH047/NSDUH047/SR047CigaretteTrends2012.htm>
- Swift, W., Coffey, C., Degenhardt, L., Carlin, J. B., Romaniuk, H., & Patton, G. C. (2012). Cannabis and progression to other substance use in young adults: findings from a 13-year prospective population-based study. *Journal of Epidemiology and Community Health*, 66(7), e26. <https://doi.org/10.1136/jech.2010.129056>
- Tashkin, D. P., Baldwin, G. C., Sarafian, T., Dubinett, S., & Roth, M. D. (2002). Respiratory and immunologic consequences of marijuana smoking. *Journal of Clinical Pharmacology*, 42(11 Suppl), 71S–81S.
- Teddlie, C., & Tashakkori, A. (2009). *Foundations of Mixed Methods Research, Integrating Quantitative and Qualitative Approaches in the Social and Behavioral Sciences*. Thousand Oaks, CA: Sage.
- Terry-McElrath, Y. M., & O'Malley, P. M. (2015). Trends and Timing of Cigarette Smoking Uptake among U.S. Young Adults: Survival Analysis Using Annual National Cohorts from 1976-2005. *Addiction (Abingdon, England)*, 110(7), 1171–1181.
<https://doi.org/10.1111/add.12926>
- Terry-McElrath, Y. M., O'Malley, P. M., Johnston, L. D., Bray, B. C., Patrick, M. E., & Schulenberg, J. E. (2017). Longitudinal patterns of marijuana use across ages 18–50 in a US national sample: A descriptive examination of predictors and health correlates of repeated measures latent class membership. *Drug and Alcohol Dependence*, 171, 70–83. <https://doi.org/10.1016/j.drugalcdep.2016.11.021>

- Tetrault, J. M., Crothers, K., Moore, B. A., Mehra, R., Concato, J., & Fiellin, D. A. (2007). Effects of marijuana smoking on pulmonary function and respiratory complications: a systematic review. *Archives of Internal Medicine*, 167(3), 221–228.
<https://doi.org/10.1001/archinte.167.3.221>
- The health effects of cannabis and cannabinoids: the current state of evidence and recommendations for research.* (2017). Washington, DC: National Academies Press.
- Timberlake, D. S., Haberstick, B. C., Hopfer, C. J., Bricker, J., Sakai, J. T., Lessem, J. M., & Hewitt, J. K. (2007). Progression from marijuana use to daily smoking and nicotine dependence in a national sample of U.S. adolescents. *Drug and Alcohol Dependence*, 88(2–3), 272–281. <https://doi.org/10.1016/j.drugalcdep.2006.11.005>
- Topa, G., & Moriano, J. A. (2010). Theory of planned behavior and smoking: meta-analysis and SEM model. *Substance Abuse and Rehabilitation*, 1, 23–33.
<https://doi.org/10.2147/SAR.S15168>
- Trinidad, D. R., Pérez-Stable, E. J., Messer, K., White, M. M., & Pierce, J. P. (2010). Menthol cigarettes and smoking cessation among racial/ethnic groups in the United States: Menthol and cessation across ethnic groups. *Addiction*, 105, 84–94.
<https://doi.org/10.1111/j.1360-0443.2010.03187.x>
- Tullis, L. M., Dupont, R., Frost-Pineda, K., & Gold, M. S. (2003). Marijuana and Tobacco: A Major Connection? *Journal of Addictive Diseases*, 22(3), 51–62.
https://doi.org/10.1300/J069v22n03_05
- U.S. Census. (2014). New Census Bureau Statistics Show How Young Adults Today Compare With Previous Generations in Neighborhoods Nationwide. Retrieved January 30, 2017, from <http://www.census.gov/newsroom/press-releases/2014/cb14-219.html>

- U.S. Department of Health and Human Services. (2012). *Preventing Tobacco Use Among Youth and Young Adults: A Report of the Surgeon General*. Retrieved from <http://www.surgeongeneral.gov/library/reports/preventing-youth-tobacco-use/full-report.pdf>
- U.S. Department of Health and Human Services. (2014). *The Health Consequences of Smoking: 50 Years of Progress. A Report of the Surgeon General*. Atlanta, G: Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, Office on Smoking and Health,.
- U.S. Food & Drug Administration. (2016a). Flavored Tobacco. Retrieved from <https://www.fda.gov/TobaccoProducts/Labeling/ProductsIngredientsComponents/ucm2019416.htm>
- U.S. Food & Drug Administration. (2016b). FDA's New Regulations for E-Cigarettes, Cigars, and All Other Tobacco Products. Retrieved April 21, 2017, from <https://www.fda.gov/TobaccoProducts/Labeling/RulesRegulationsGuidance/ucm394909.htm>
- Villanti, A. C., Mowery, P. D., Delnevo, C. D., Niaura, R. S., Abrams, D. B., & Giovino, G. A. (2016). Changes in the prevalence and correlates of menthol cigarette use in the USA, 2004–2014. *Tobacco Control*, 25(Suppl 2), ii14-ii20. <https://doi.org/10.1136/tobaccocontrol-2016-053329>
- Volkow, N. D., Baler, R. D., Compton, W. M., & Weiss, S. R. B. (2014). Adverse Health Effects of Marijuana Use. *New England Journal of Medicine*, 370(23), 2219–2227. <https://doi.org/10.1056/NEJMr1402309>

- Wagner, F. A., & Anthony, J. C. (2002). Into the world of illegal drug use: exposure opportunity and other mechanisms linking the use of alcohol, tobacco, marijuana, and cocaine. *American Journal of Epidemiology*, 155(10), 918–925.
- Washington State Liquor and Cannabis Board. (2016). Frequently Asked Questions About Marijuana Advertising. Retrieved from http://lcb.wa.gov/mj2015/faq_i502_advertising
- Webster, L., Chaiton, M., & Kirst, M. (2014). The co-use of tobacco and cannabis among adolescents over a 30-year period. *The Journal of School Health*, 84(3), 151–159. <https://doi.org/10.1111/josh.12137>
- White, H. R., Beardslee, J., & Pardini, D. (2017). Early predictors of maturing out of marijuana use among young men. *Addictive Behaviors*, 65, 56–62. <https://doi.org/10.1016/j.addbeh.2016.09.007>
- White, J., Walton, D., & Walker, N. (2015). Exploring comorbid use of marijuana, tobacco, and alcohol among 14 to 15-year-olds: findings from a national survey on adolescent substance use. *BMC Public Health*, 15(1). <https://doi.org/10.1186/s12889-015-1585-9>
- White, M. D. (2015). Perceptions of the Harmful Effects of Marijuana Use: A Comparison Between Graduate and Undergraduate College Students. *Journal of Human Behavior in the Social Environment*, 25(4), 333–343. <https://doi.org/10.1080/10911359.2014.969128>
- Wilkinson, A. L., Halpern, C. T., & Herring, A. H. (2016). Directions of the relationship between substance use and depressive symptoms from adolescence to young adulthood. *Addictive Behaviors*, 60, 64–70. <https://doi.org/10.1016/j.addbeh.2016.03.036>

Worthen, M. G. (2014). An invitation to use craigslist ads to recruit respondents from stigmatized groups for qualitative interviews. *Qualitative Research*, 14(3), 371–383.
<https://doi.org/10.1177/1468794113481791>

Xian, H., Scherrer, J. F., Grant, J. D., Eisen, S. A., True, W. R., Jacob, T., & Bucholz, K. K. (2008). Genetic and environmental contributions to nicotine, alcohol and cannabis dependence in male twins. *Addiction*, 103(8), 1391–1398.
<https://doi.org/10.1111/j.1360-0443.2008.02243.x>