ABSTRACT

Changing Patterns in Marijuana Use among High School Seniors:
Latent Modeling of Time-Series Cross-Sections (1976 – 2013)

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Public support for the legalization of marijuana is on the rise. As states are
increasingly passing legislation decriminalizing marijuana possession and consumption, a
great deal of research is needed to inform policy-makers of the patterns and implications
of use. In this project, I work to describe the patterns of perception and use among
adolescent marijuana users, especially in light of this cultural shift over time, by
providing a framework by which researchers might better understand the social contexts
of marijuana use and, by extension, may be better equipped to examine the long-term
implications of widespread use. Data for this project come from the *Monitoring the
Future* study, a series of national random samples of US High School Seniors collected
as time series cross sections since 1976. Utilizing Confirmatory Factor Analysis and
latent mixture modeling techniques I create a framework to typify adolescent marijuana
users into two latent constructs, 'Individualist' and 'Communal' users. Using this
framework, I track identification within these categories over time and examine the
behavioral implications of this identification, vis-à-vis gateway drug use.

Changing Patterns in Marijuana Use among High School Seniors:
Latent Modeling of Time-Series Cross-Sections (1976 - 2013)

by

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A Dissertation

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TABLE OF CONTENTS

## LIST OF FIGURES

# LIST OF TABLES

# ACKNOWLEDGMENTS

This project began as a term paper for an undergraduate research methods course at Mount Vernon Nazarene University. Since then, it had also served as the topic of my first research presentation at the 2010 annual meeting of the Southwestern Social Science Association and is now culminating as the dissertation that you read presently. Along the way, a number of people have contributed in some way to its completion and I would be remiss to fail to acknowledge them here.

Dr. David Caddell was a great undergraduate mentor and continues to be a great friend. Without his help and guidance, I never would have found my way into sociology, nor Baylor University. He continues to be a bridge builder, for the fair-haired youth that follow.

Drs. Kyle Irwin and Lindsay Wilkinson provided continued guidance throughout my time at Baylor. In addition to the collaboration and academic education provided, both assisted in my socialization into academia and professionalization into the larger realm of research.

Each of my committee members have contributed in a significant regard. Their assistance in the final defense is paramount, of course, but their tutelage began much earlier. They have served as instructors, mentors, and collaborators and many of my present successes can be attributed to the work done under their advisement. Thank you Drs. Tolbert, Driskell, Lyon, Mencken and Morgan.

To Erica


Your unfailing love, patience, and encouragement keep me moving forward

CHAPTER ONE

Introduction

In recent polls, Pew Research Center has found that support for marijuana

legalization is rapidly increasing (Pew Research 2015a; Pew Research, 2015b). Recent

estimates place support at 53% of the American population—a significant increase from

the just 12% reported in 1969 and even relative to the 42% reported in 2010 (Pew

Research 2015a). Support for legalization is certainly not uniform among the US

population as significant differences exists among cohorts (with 68% of Millennials

supporting legalization compared to 50% of Boomers), political ideologies (73% of

liberals vs. 31% of conservatives), and geographic regions (57% of Westerners vs. 45%

of Midwesterners) (Pew Research, 2015b). Nonetheless, public support for the

legalization of marijuana is on the rise. As states are increasingly passing legislation

decriminalizing marijuana possession and consumption, a great deal of research is needed

to inform policy-makers of the patterns and implications of use. The present research

aims to address some of these patterns and implications.

Most discussion around mitigating the harms of cannabis use has focused

narrowly on the appropriateness of legal versus criminal regulatory regimes (Room et al.,

2010; Hall, 2007). However, cannabis use is a larger public health issue. It has been

reported that more than 50% of Americans born after 1973 have used marijuana

(Degenhardt et al., 2007) and as legalization occurs and public disapproval continues to

decline, teens report an increased probability to initiate use (Palamar et al., 2014).

Because these statistics are measured from self-reports, estimates are certainly conservative. Discussion of cannabis-related harm tends to be simplified into one of two extremes: that cannabis use is harmless or that it is a source of significant harm (Hall, 2007). As a sociologist, I am not equipped to undertake a biological or biochemical perspective in this examination, however there are a number of significant behavioral health implications of marijuana use (Hyshka, 2013; Hall, 2009). Perhaps the most common visible examples of these are related to accidental injury, especially those associated with auto accidents as individuals who use cannabis before driving are 2-3 times more likely to be involved in an accident (Hyska, 2013; Hall, 2009).

Perhaps more salient are the long-term, and often invisible, effects of use. The lifetime prevalence of dependence is greater for marijuana than for all other illicit drugs (Hyshka, 2013). Because of this, prevention is a major focus of policymakers, rather than the previous standard of incarceration, especially among adolescents (Hyshka, 2013; White House, 2011). Young people are at increased risk of dependence and other marijuana-related harm (Hyshka, 2013; Guxensa et al., 2007; Toumbourou & Catalano, 2005). Early adolescent users are more vulnerable to negative developmental outcomes, longer cannabis use trajectories, earlier transitions to heavier use and dependence (Hyshka, 2013; West & O'Neal, 2004; Sloboda, 2002).

Because of these particular risks, as well as the widespread cost associated with public health concerns such as these, prevention is a major focus, as well documented in the White House National Drug Control Strategy (2011), and prevention programs often begin at an early age. However, prevention strategies that have previously been touted as

the most effective solutions, such as family intervention and the D.A.R.E. programs, are becoming increasingly ineffective (Vermeulen-Smit et al., 2015; West & O'Neal, 2004)

Understanding the patterns of use, as well as the motivations reported for using are important factors in addressing this public health concern (Hemovich & Crano, 2009; McCabe et al., 2009). By using data on adolescents' motivations for marijuana use, researchers are better able to understand and predict patterns of use, and inform policymakers who enact legal and programmatic changes (McCabe et al., 2014; DeWall 2011; Muramoto et al., 2011; Patrick et al., 2011; McCabe et al., 2009; Denham 2009; Monga et al., 2007; Kaplan et al., 1986). As marijuana use among adolescents continues to rise, fueled by changing public perceptions and legal status, the need for further research is pressing (Palamar et al., 2014).

In this project, I work to provide a framework by which researchers might better understand the social contexts of marijuana use and, by extension, may be better equipped to examine the long-term implications of widespread use. In the next chapter, I provide an empirical foundation for my theoretical framework. With Chapter Three, my own empirical work begins as I construct a latent measurement model of motivation and context of marijuana use. In Chapter Four, I examine how these constructs have changed over time, especially relative to specific subpopulations. In Chapter Five, I examine one specific implication of these differences in patterns of use—the probabilities that adolescents escalate their marijuana use to other substances.

CHAPTER TWO

Literature Review

*Introduction*

Support for the legalization of marijuana use has been steadily on the rise since the early 1990s and in recent years 27 states have decriminalized, or indeed legalized, marijuana use (Pew Research, 2015a). Proponents of such a change commonly cite the perceived medicinal benefits which come from regular use (Pew Research 2015b). By all appearances, a large shift is underway in the public perception of a once deviant practice. In this project, I work to describe the patterns of perception and use among marijuana users, especially in light of this cultural shift over time. Because adolescence is among the most common life periods for initiation of drug use and the implications of early initiation are so significant, as detailed below, I focus on examining these patterns among high school seniors. How do teens describe their motivation for using marijuana? How have reports of these motivations changed over the past several generations of students? What behavioral health implications exist as a result of the differing patterns in reported motivations? These are the questions which I seek to answer. First, as with all empirically-based projects, it is helpful to provide context about the present state of research.

*Importance of Motivation and Context of Use*

Previous research has provided substantial evidence that an individual's motivation for substance use, as well as the situational context their use, are significant

factors in understanding the social and medical consequences of their drug use (Hemovich & Crano, 2009; McCabe et al., 2009; Terry-McElrath et al., 2009; Sloboda, 2002). Indeed, research has indicated that motives and patterns of use are largely unique among users of different classes of drugs and may indicate future behavioral patterns, including subsequent abuse and dependence (McElrath et al., 2009; Chung et al., 2006; Hall 2006; Collins 2002). As such, researchers may utilize data regarding individuals' motivations for use to understand and predict present and future patterns of use, including the probability of later escalation (McCabe et al., 2014; DeWall 2011; Muramoto et al., 2011; Patrick et al., 2011; McCabe et al., 2009; Denham 2009; Monga et al., 2007; Kaplan et al., 1986).

While a significant body of research has investigated these motivational and contextual factors, much of it to date has relied on simple quantitative methods (Evans-Whipp et al., 2015; Eisenberg et al., 2014; McCabe et al., 2014; McCabe et al., 2009; Johnston et al., 1986). Eisenberg et al., (2014) utilized logit models to predict the odds of substance use using simple indicators of social norms regarding use. Likewise, McCabe et al., (2009) utilized weighted least squares (WLS) regressions to predict the contexts of use using single-item motivation measures. In one of the largest research projects to-date, Johnston et al., (1986) reported motivations for adolescent substance abuse using simple descriptives among high school seniors between 1976 and 1984. Through each of these projects, the authors suggest that there may be an underlying characteristic of users that influences these single-item responses, however none directly test for such a structure.

Studies that have included multiple substances have provided evidence that unique motivation dimensions accompany different drugs, each with their own

subsequent behavioral outcomes (Terry-McElrath et al., 2009;Simons et al., 2000; Johnston & O'Malley, 1986; O'Malley et al., 1984; Segal, 1983; Segal et al., 1982; Segal et al., 1980). As one important example, a line of research has linked the single-item motivations for different classes of substances into a motivation chain, which works to predict pathways by which individuals move from one substance to the next, or gateway drug use (Collins, 2002; Kirby & Barry, 2002; Yamaguchi & Kandel, 1984). While these descriptive studies, and others, have served as a foundation to understanding the significant role of motivation and context, they have not yet provided a larger framework by which researchers and policy-makers might understand the complex nature of the motivations for, and contexts related to, substance use and abuse.

For several decades, researchers have noted the importance of motivation in understanding the patterns of adolescent substance abuse. One of the core modules of the *Monitoring the Future* (MTF) project, which I utilize as a data source and outline later in this paper, measures the motivations for substance use as reported by its adolescent participants. In 1986, the primary investigators of the project reported that the motivations for use in the sample thus far (since 1976) had indicated patterns which might be conducive to typify (Johnston & O'Malley, 1986). Utilizing exploratory factor analysis, the authors identified several distinct types of motivations, including a 'social/recreational' factor, a 'coping with negative affect' factor, a 'compulsive' factor, and a 'drug effect' factor, which relates to drug interaction effects. While these identified factors continued to be mention by researchers, in concept, they were not widely modeled as such. In more recent studies, researchers have utilized these same motivation questions as single-item measures in their regressions to predict subsequent substance use and

abuse (Patrick et al., 2011; Terry-McElrath et al., 2009). Although these previous studies, and others, have yet to operationalize their measures in a way consistent with their conceptualization, vis-à-vis latent modeling approaches, their results have provided sufficient evidence that by measuring (and typifying) individuals' motivations for use, we might better understand and predict prevalence of use cross-sectionally and longitudinally for a number of drugs (McCabe et al., 2014; DeWall 2011; Patrick et al., 2011; Muramoto et al., 2011; Denham 2009; McCabe et al., 2009; Monga et al., 2007).

In the present research, I work to provide a framework by which we might conceptualize different 'types' of marijuana users in the context of their motivations and patterns of use. While this is the first application of latent methods to typify substance use in relation to motivation and social context, some previous studies have used latent methods to examine 'types' of users in regard to multi-use, or the concurrent use of multiple types of substances (Kuramoto, Bohnert & Latkin, 2011; Heden et al, 2010; Monga et al., 2007; Chung et al., 2006). Previous research has used Latent Class Analysis to typify users in relation to their extent of use and attitudes toward use and examine class prevalence over time (Chung et al., 2006), to compare the mental health statuses and likelihood of subsequent behavioral risks among different classes of multi-drug users (Kuramoto et al., 2011; Siliquini et al., 2001), and to predict the probabilities of other biological health outcomes according to multi-use drug classes (Monga et al., 2007). In each of these studies, researchers argue that our understanding of drug use cannot be summarized by single-item measures, but instead must be operationalized and conceptualized as a complex relationship between multiple factors. In this research

project, I apply the same understanding toward the modeling of marijuana use with regard to motivation and social context.

*'Individualist' and 'Communal' Users: Suggestions from Previous Research*

Beginning in Chapter Three, I utilize a latent modeling framework, operationalizing the patterns of use into an 'Individualist' or 'Communal' type, in accordance with the patterns discovered in the previous studies (Patrick et al., 2011; Terry-McElrath et al., 2009; Johnston & O'Malley, 1986). Johnston & O'Malley (1986) initially identified several factors, however, I focus on only two throughout this project, modifying the previously outlined conceptualizations. I present the statistical justification for this change in Chapter Three, but there is a more salient, theoretical justification as well.

The first reason for this focus relates to evidence from previous research. While Johnston and O'Malley identified five factors within their study, the relationship between these measures has changed since their inception in 1976 and the authors' analysis in 1986. While later researchers utilized the same data source as Johnston & O'Malley and begin with the same conceptualization of the factors, later researchers likewise modify the categories as justified by their data (Patrick, et al., 2011; Terry-McElrath et al., 2009). While factors had changed over time, the presence and measurement of 'individualized' and 'Communal' aspects have remained consistent, specifically in relation to adolescent marijuana use.

Continuing with the evidence from previous studies about the importance of these two types of marijuana users, research has provided evidence of the particular importance of 'Individualist' and 'Communal' or social use. Existing social ties and a desire for

further social connection have been supported as significant motivations for substance use by a number of studies (McCabe, 2014; Hyshka, 2013; DeWall, 2011; Hemovich, 2009; Guxensa et al., 2007; Wallace, 2007; Kandel, 1980). An individual's understanding of the salient norms regarding use, prevalence , and attitudes toward marijuana have been linked to the likelihood and extent of use of the individual (Eisenberg, et al., 2014; Palamar, et al., 2014; Wallace, et al., 2007; Chung, et al., 2006).

My second reason for this focus relates to the public push to legalize the consumption of marijuana. One of the principal uses of marijuana as cited by proponents of such a change is medical, an implicitly individualized motivation (Pew Research, 2015a). It is not my purpose in this research to test the veracity of such claims, however this shift in public perception is interesting in itself. The individualized nature of medical marijuana, consumed alone and for the purposes of self-medication, is a hard contraposition to the paradigm previously espoused by public proponents, which focused on the social consumption of the substance. I will discuss these changing patterns more in the following section and test these ideas fully in Chapter Three.

Regardless of the validity of the claims surrounding the medical efficacy of marijuana, it appears that widespread legalization is already underway. While the use, sale, and possession of marijuana in the United States is still illegal under federal law, twenty-seven states, to this point, have passed legislation which legalizes (or decriminalizes) use in some form (Pew Research, 2015b). Indeed, as public support for marijuana legalization continues to rise and the topic continues to gain public and political interest, it appears that full-decriminalization is all-but-inevitable. As marijuana

legalization takes effect and public disapproval continues to decrease, it is expected that prevalence of use will rise, especially among adolescents (Palamar et al., 2014).

Still, this is not to say that usage would not have negative social and biological consequences for users. While the biological components are outside of the scope of this paper, I can certainly address some of the social repercussions of use. Cannabis is a drug of dependence, as previous studies has indicated that regular users develop traditional withdrawal symptoms upon cessation (Hall, 2006; Wiesbeck et al., 1996; Stephens et al., 1994). Additionally, it has been suggested that the likelihood of dependence, as well as the likelihood of escalated use, is inversely correlated with the age of initiation—that is, the younger an individual begins using marijuana, the more likely they are to develop dependence and escalate their use to other substances (Hall, 2006; Wadsworth et al., 2004; Sloboda, 2002; Kaplan et al., 1986).

More specific to the frame of this paper, previous research has provided evidence that the effects of substance use are particularly negative among adolescents who use alone and that solitary use appears to be more indicative of poor psychosocial and behavioral outcomes, including later substance use problems, including dependence and abuse (McCabe et al., 2014; Kaplan et al., 1986; Kaplan et al., 1984). In a following section of this chapter, I will discuss the potential differences between 'Individualist' and 'Communal' use in regard to social consequences and directly test these differences in one specific behavioral outcome—gateway drug use, or the likelihood of transition from marijuana to other illicit substances.

*Changing Patterns in Use and Motivation for Use*

Reports regarding trends in prevalence of use vary according to the contrast with which researchers focus. Overall, prevalence of marijuana use among adolescents appears to be relatively stable over time, with a slight decline through the 1980s and a subsequent increase in the 1990s (Miech & Koester, 2012; Keyes et al., 2011; Bachman et al., 1998; Bachman et al., 1988; O'Malley et al., 1984). However, there are distinct subpopulations (or social characteristics) for which specific trends appear to be clear. That is, the changing rate of change in prevalence of use is not homogenous throughout the US population. For example, previous research has indicated that changes in prevalence vary according to religious commitment and perceived risk of use (Palamar et al., 2014; Bachman et al., 1988). However, some of the starkest patterns in changing rates are demographic.

While early estimates found that marijuana use was most prevalent among white males, more recent studies have indicated that this pattern is changing (Miech & Koester, 2012; Guxensa et al., 2007; Kerr et al., 2007; Wallace et al., 2003). Over the past several decades, marijuana use has been decreasing among men whilst increasing among women, such that there is no longer a significant difference between the prevalence among the two sexes changing (Miech & Koester, 2012; Kerr et al., 2007; Wallace et al., 2003)This is a significant shift, as marijuana use had been relatively rare among young women, with use among men being nearly three times greater in the 1970s (Kerr et al., 2007). Likewise, while marijuana use has remained relatively stable among whites, prevalence has significantly increased among blacks, such that rates of use are similar among the two races (Timberlake, 2013; Miech & Koester, 2012; Wallace et al., 2003). At the same

11

time, the overall percent of adolescents who disapprove of others' marijuana use has been on the decline during this same period (Keyes et al., 2011).

In addition to these overall trends, social researchers have been documenting a shift in motivations for use for several decades. In one of the earliest studies on motivation for marijuana use, Johnston & O'Malley (1986) began to observe some degree of shift away from individuals reporting social/recreational reasons for their marijuana use toward what they had described as "psychological coping" and "functional" reasons (e.g. dealing with anger and frustration, getting away from problems, getting more energy, etc.). Perhaps because this observation was relegated to their discussion section and their statistical methods for making such a claim were simple descriptives, this observation was not elaborated in further studies. More recent studies which utilized the updated data show similar patterns, with decreased reports of socially-oriented motivations such as 'to fit in' and increased reports of individually-focused motivations like 'to relax' and 'to get away from problems'. However, without a framework that is explicitly designed to test for changes in these latent factors, no larger discussion of these patterns emerged (Patrick et al., 2011; Terry-McElrath et al., 2009).

This shift from socially-oriented to individually-focused is not unique to motivations for substance use. Since the early years of sociology, theorists have noted a change in social structure from the collective toward the individual. Durkheim attributed this change from mechanical to organic solidarity to the division of labor in society (1893). Ferdinand Tönnies, likewise, describes the move from gemeinschaft toward gesellschaft as social ties were restructured for an increasing dependence on economic exchange (1887). More recently, modern social theorists have continued to observe this

pattern, even in a post-industrial society. Robert Bellah, in his 1985 book *Habits of the Heart* and 1991 follow-up *The Good Society*, argues that the individualizing shift in social structure has created a self-perpetuating loop by which individuals continue to become more individually-focused, increasingly individualizing the structure of our social institutions. Following this same pattern, Robert Putnam has described a decrease in social capital among Americans as individuals become increasingly disaffiliated from public organizations and opt out of large-scale social interaction (1995).

These patterns have culminated in an emerging generation which has been branded by some as 'Generation Me'. Social psychologist, Jean Twenge, and collaborators argue that these structural changes in society are generating a unique culture among the upcoming 'millennial' generation (Twenge & Campbell, 2010; Twenge, 2008; Twenge, 2006). These highly-individualized, or even narcissistic, ideals which are espoused by the current generation can be attributed to a number of factors, according to these researchers. Many of these factors are largely cultural, such as an increased focus on parenting and the increasingly individualized focus of the media and corporate marketing (Twenge, 2008; Twenge, 2006). Regardless of the attributed causes, Twenge and Campbell provide an analysis of decades of personality inventories of college students, as well as cross-sectional poll statistics, as evidence that Gen Y-ers are significantly and increasingly more self-centered and narcissistic than those in previous generations (Twenge & Campbell, 2010; Twenge 2006).

*What Difference Does it Make?*

What difference does it make if the motivations of adolescents to use marijuana follow the larger cultural trends described by social theorists? That is, if individuals are

13

less likely to attribute their substance use to 'Communal' motivations and increasingly more likely to ascribe to 'Individualist' motivations, what social (and medical) implications might we expect? This question is the focus of Chapter Five as I examine the relationship between these latent factors and an individual's escalation of substance abuse. As this is the first study to typify users in such a manner, these specific questions have not been directly tested in previous studies; however, there is some evidence which might allow us to make predictions.

Research suggests that the context of marijuana use, as well as the motivation to initiate use have significant effects on later patterns of use and subsequent behavioral and health outcomes. Among adolescents, substance dependence and escalated use are always of particular concern, especially because each of these is increasingly common among individuals who initiate their first use at a younger age (Hall, 2006; Kaplan et al., 1986). In addition, though, research has provided evidence that individuals who report individualized motivations for their use, as well as those whose use occurs in isolation, are increasingly likely to develop dependence and escalate their use regarding frequency of marijuana use, but also transitions to use of other substances as well (McCabe et al., 2014; Kaplan et al., 1986).

Previous work has also indicated the importance of social factors as they relate to motivation for use. The initiation of substance use because of psychological distress, as a means of self-medicating, and without peer influence, independent of social pressures, predict escalated use (Kaplan et al., 1986). Some research has suggested that marijuana dependence, as predicted by individualized motivations, may have a causal influence on educational underachievement and diagnosable psychosis (Hall, 2006). Additionally, the

subsequent weakening of social ties and withdrawal from peer networks, which are predicated by this isolated initiation of use, are each associated with later escalation of use (Kaplan et al., 1986). Overall, research suggests that the effects of substance use are particularly negative among adolescents who use alone and solitary use appears to be more indicative of poor psychosocial and behavioral outcomes, including escalation of substance use and subsequent use of other drugs (McCabe, 2014; Tucker et al., 2006).

*Conclusion*

As the American culture shifts its perspective regarding marijuana use and rates of use continue to rise, it becomes increasingly important for social researchers to examine the patterns and implications of such use. At present, it seems all but inevitable that widespread use will soon be legalized. Still, the structures and mechanisms by which legalization occurs and the regulation of use, post-decriminalization, are important issues of public health. This project will certainly not claim to provide all the answers regarding these issues. However, the goal is to provide a context to begin the conversation. How can we begin to understand the patterns of motivation and use among adolescents? This is the topic of the next chapter.

CHAPTER THREE

'Individualist' and 'Communal' Users: Establishing the Constructs

*Abstract*

An adolescent's motivation for substance use and the social contexts in which

they use are significant factors in understanding the social consequences of their drug use

(Hemovich and Crano, 2009; McCabe et al., 2009; Terry-McElrath et al., 2009; Sloboda,

2002). While previous research has examined such effects, relatively few (see Kuramoto,

Bohnert & Latkin, 2011) have provided a framework by which me might typify use and

further develop our understanding of the implications of use. In the present chapter, I

work toward this goal by using Confirmatory Factor Analysis (CFA) to create a

measurement model of two latent factors of context and motivation for adolescent

marijuana use—'Individualist' and 'Communal' factors.

*Introduction*

For several decades, researchers have noted the importance of motivation in

understanding the patterns of adolescent substance abuse. Situational context for

marijuana use, as well as motivation for using, is an important factor in understanding the

behavioral health implications and the social consequences of drug use (McCabe et al.,

2009; Terry-McElrath et al., 2009). Yet to date, little empirical research has been

conducted to examine these effects, beyond providing simple descriptive statistics

(Evans-Whipp et al., 2015; Eisenberg et al., 2014; McCabe et al., 2014; Johnston et al.,

1986). In the present research, I work to provide a framework by which we might

16

conceptualize different 'types' of marijuana users in the context of their motivations and patterns of use. In this chapter, I utilize latent measurement modeling techniques and data from the *Monitoring the Future* study, a national random sample of high school seniors, to describe adolescent marijuana users with two latent constructs. 'Individualist' users are those who use in isolation for the purpose of dealing with difficult life circumstance or negative affect, while 'Communal' users are those whose use is predominantly social and for the purposes of having fun and fitting in.

## *Model Specification*

If motivations may suggest further implications of behavioral outcomes, as outlined in Chapter One, social scientists may do well to establish models which most appropriately measure and operationalize the constructs. While it can be argued that an individual may not always be cognizant of the actual reasons for his or her behavior (Johnston & O'Malley, 1986), self-report data provide the only direct method to access an individual's internal motivations and provide a relatively high degree of reliability and consistency (Cooper, 1994; Barnea et al., 1987). As such, accurate measurement must incorporate several linked measures to provide sufficient construct validity. Further, if we are to allow the measures themselves to dictate the terms of the construct, simply indexing multi-item measures are insufficient, as they constrain the relative effects of measures to be equal.

In this chapter, I offer an alternative perspective. Here, I use latent analytic methods to conduct confirmatory factor analysis to verify the presence of two latent constructs, as suggested by earlier research (Patrick et al., 2011; Terry-McElrath et al., 2009; Johnston & O'Malley, 1986) and as outlined in Chapter One. Relative to previous

research, I focus on what I am labeling 'Individualist' and 'Communal' typologies as these have remained consistent, relative to other suggested usage themes, specifically in relation to adolescent marijuana use (Patrick et al., 2011; Terry-McElrath et al., 2009).

More importantly, I focus on these two typologies for several empirical reasons, detailed in the previous chapter: 1) these frames of use have specifically been suggested to influence social and behavioral outcomes (Eisenberg, et al., 2014; McCabe, 2014; Palamar, et al., 2014; Hyshka, 2013; DeWall, 2011; Hemovich, 2009; Wallace, et al., 2007; Chung, et al., 2006); 2) the public focus on the medicalization of marijuana has reified the transition of the drug's use as medicinal, rather than the previously social image (Pew Research Center 2015a, Pew Research Center 2015b, Palamar et al., 2014); and 3) sociology has long noted the duality of community and the individual, especially as it relates to the modernization of society (Twenge & Campbell, 2010; Bellah, 1985; Durkheim, 1893; Tönnies, 1887). With this framework, I propose a measurement model for these two factors, as specified in Figure 3.1.

The factor parameters specified in Figure 3.1 include measures of both situational context and self-identified reasons for use. Regarding context, the degree to which an individual reports using marijuana when they are alone ($x_1$), their use will be characterized as 'Individualist' in nature. Likewise, the degree to which they report using at parties ($x_6$) or with one or two others ($x_7$), their use is identified as 'Communal'. As situational ideal types, $x_1$ and $x_6$ will serve as marker indicators for the two factors. Regarding reported motivations for use, the 'Individualist' factor is identified with four indicators ["to relax or relieve tension" ($x_2$), "to get away from my problems or troubles" ($x_3$), "because of anger or frustration" ($x_4$), and "to get through the day" ($x_5$)] and the

'Communal' factor by an additional two indicators ["to have a good time with my friends" ($x_8$), and "to fit in with a group I like" ($x_9$)]. These indicators and their respective factors are displayed, along with question wording in Table 3.1.
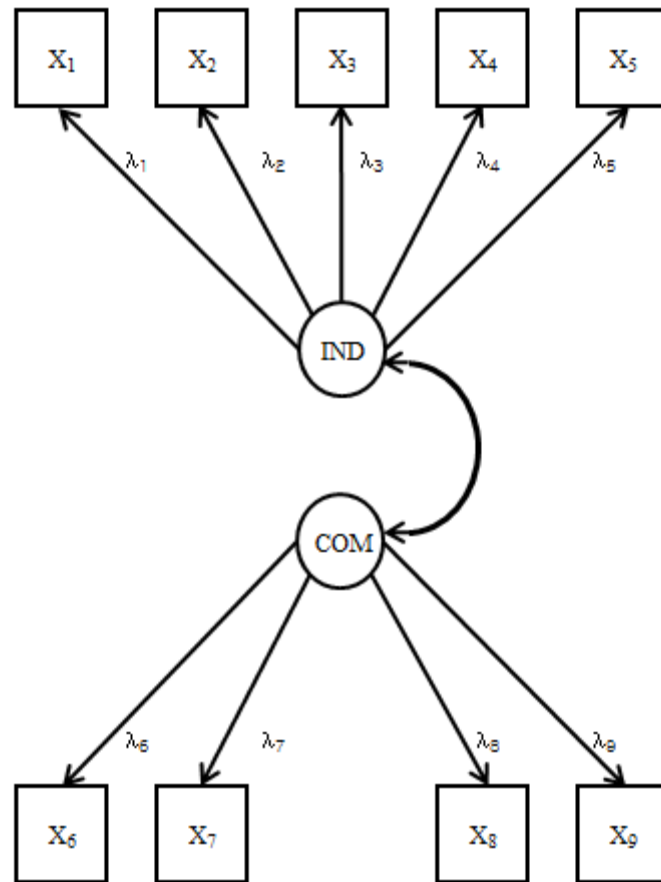


*Figure 3.1 Theoretical Measurement Model*

This model exhibits simple structure. All factors are freely estimated. That is, the loading of each indicator onto its respective factor is entirely determined by the extent to which the indicators covary, using partial covariances. Additionally, the factors are modeled to covary. Because an individual can report using in more than one context (e.g. both at parties and alone) or for more than one reason (e.g. to relax and to have a good time with friends), respondent use may fit, to some degree, into either or both factors.

Still, each indicator loads only onto one factor (e.g. a response of using to get away from problems is entirely loaded onto the 'Individualist' factor and not at all onto the 'Communal' factor. Although errors are not shown in Figure 3.1, errors are likewise freely estimated for the two factors and all indicators.

Table 3.1 List of Indicators by Factor

| Individualist Factor | Communal Factor |
|---|---|
| *How often did you use [marijuana]…* | |
| $x_1$ When you were alone | $x_6$ At a party |
| | $x_7$ With just 1 or 2 other people |
| *What have been the most important reasons for your using marijuana?* | |
| $x_2$ To relax or relieve tension | $x_8$ To have a good time with my friends |
| $x_3$ To get away from my problems or troubles | $x_9$ To fit in with a group I like |
| $x_4$ Because of anger or frustration | |
| $x_5$ To get through the day | |

Regarding model identification, there are several things to consider. Errors are freely estimated and not specified to covary, thus each indicator has two parameters being estimated (save the marker indicators), the error and the loading. Each factor has several indicators eliminating any issue of local under-identification. The model is recursive, meaning that all estimations happen in one causal direction. Thus, because 17 parameters are estimated [seven indicator loadings, seven indicator variances, two factor variances, and one factor covariance] from 45 known covariances (among the nine indicators), and thus the model is over-identified. Additional controls (covariates) are included in the full model, and are detailed in the following data section.

*Data*

To test this model, and all models within the project, I utilize data from the *Monitoring the Future* (MTF) study, previously known as the *National High School Senior Survey*, an ongoing study of the social behaviors and beliefs of students in American secondary schools, funded by the National Institutes of Health (NIH) and the National Institute on Drug Abuse (NIDA). While several panels have been constructed for the study, I specifically use data for high schools seniors, as it was the initial panel created for the study. As a part of this panel, more than 16,000 students in approximately 130 public and private high schools were included in a national random sample each year since 1976 with the goal of providing a nationally representative picture of American students (Bachman et al., 2006). For this chapter, all data from 1976 to 2013 have been aggregated into a single file for analysis. In Chapter Four, results are re-specified by year of survey administration.

To gather the data, researchers use a stratified random sampling technique. At the highest stratum, specific geographic areas are selected. Within each area, a number of schools are selected, with a probability proportionate to the population size. Within each school, up to 350 students may be included, with smaller schools attempting 100% response and larger schools utilizing random sampling techniques. Questionnaires are group administered in the schools by researchers from the *Institute for Social Research* at the University of Michigan. While these techniques are quite thorough in their randomization, post-processing weights are created to correct for any unequal probabilities of selection that may have occurred at any stage of sampling.

*Measures*

The indicators outlined above are measured in two ways. Regarding situational context, respondents are asked "When you used marijuana in the last twelve months, how often did you use it in each of the following situations…" and for each situation, respondents may choose: "Not at all", "A few of the times", "Some of the times", "Most of the times", or "Every time", resulting in a 5-point ordinal scale. The three situational indicators that I utilize ("When alone", "When at a party", and "With 1-2 friends") come from this array. Measure descriptives for these questions, and all variables used in the model specified, are detailed in Table 3.2.

Regarding motivational indicators, respondents are asked "What have been the most important reasons for your using marijuana?" and instructed to select all that apply from a list of motivations, including the indicators specified in the model. Thus, each motivational indicator is measured as a simple yes/no binary. Percentages of respondents marking each category are detailed in Table 3.2.

In addition to the factor indicators, a number of demographic covariates are included as statistical controls. Race is measured as a white/non-white binary, with 82% of respondents self-identifying as white. 48% of respondents are male and 2.4% are married. Mother's education is measured on a 6-point ordinal scale, with responses ranging from "completed grade school or less" to "graduate or professional degree". Also included are place characteristics: a binary indicator for MSA status, another to indicate if the MSA is among the nation's largest, and a system of binaries to indicate the region of the country, with South as the reference category. Additionally, a 7-point categorical

measure of annual marijuana use, ranging from 1=0 occasions to 7=40 or more, was

included.

Table 3.2 Sample Descriptives

| Measure | Mean Percent | Min / Max | Std. Dev. |
|---|---|---|---|
| Demographics | | | |
| White | 82.07% | 0 / 1 | |
| Male | 48.38% | 0 / 1 | |
| Married | 2.40% | 0 / 1 | |
| Mother's Education | 3.80 | 1 / 6 | 1.42 |
| Place Characteristics | | | |
| MSA | 78.50% | 0 / 1 | |
| Large MSA | 32.60% | 0 / 1 | |
| Region | | | |
| South | 31.67% | 0 / 1 | |
| Northeast | 22.42% | 0 / 1 | |
| Northcentral | 26.24% | 0 / 1 | |
| West | 19.67% | 0 / 1 | |
| Marijuana Use | | | |
| Annual Use | 2.32 | 1 / 7 | 2.07 |
| IND FACTOR | | | |
| When Alone | 1.56 | 1 / 5 | 0.89 |
| Relax | 50.43% | 0 / 1 | |
| Get Away | 23.23% | 0 / 1 | |
| Anger | 16.85% | 0 / 1 | |
| Get Through | 9.36% | 0 / 1 | |
| COM FACTOR | | | |
| When Party | 2.81 | 1 / 5 | 1.38 |
| When Few | 3.1 | 1 / 5 | 1.18 |
| Good Time | 66.11% | 0 / 1 | |
| To Fit in | 10.27% | 0 / 1 | |

n= 39,032

23

*Model Estimation*

To conduct this analysis, and all latent models within this project, I utilized the CFA function of the lavaan package in R version 3.1.1. With this function, a maximum likelihood (ML) estimator is used on a variance-covariance matrix. In reporting tables and results, I specify unit loading identification of the model, setting the loadings of my marker variables to 1, which allows for all other factor loadings to be interpreted similarly to regression coefficients in 'predicting' their respective factor score. Before estimating the model, the covariances were checked for issues of poor discriminant validity or egregious issues of multivariate normality, but all skew, kurtosis, and covariant measures were within a nominal range.

*Model Evaluation*

Model results are displayed below in Figure 3.2. Generally, indicators load onto their respective factors as expected. Modeling the 'alone use' measure as the marker indicator of the 'Individualist' factor, each of the indicators on the 'Individualist' are positively measured by the factor itself. Because the model is specified with unit loading identification, the absolute scale of the factors cannot be measured, but it can be stated that an increase in the factor score corresponds to an increase in each of the respective indicator measures. That is, the more 'Individualist' a respondent's marijuana use, the more often they are predicted to use alone and the more likely they are to report using 'to relax', 'to get away from problems', 'because of anger', or 'to get through the day'. Each of these are consistent with the hypothesized model.

Modeling the 'party use' measure as the marker indicator of the 'Communal' use factor, three of the indicators are positively measured by the factor. Again, for these

| Controls | Int. | $b_{IND}$ | $b_{COM}$ |
|---|---|---|---|
| white | 0.883 | -0.092 | 0.11 |
| male | 0.52 | -0.015 | 0.022 |
| marmar | 0.016 | 0.017 | -0.028 |
| maeduc | 3.85 | -0.013 | -0.001 |
| msa | 0.796 | -0.01 | 0.01 |
| Lmsa | 0.326 | -0.016 | -0.007 |
| regne | 0.255 | -0.048 | 0.063 |
| regnc | 0.293 | -0.037 | 0.044 |
| regwe | 0.177 | -0.031 | 0.038 |
| mjuseyer | 4.386 | 0.138 | 0.317 |

| Fit Statistics | |
|---|---|
| $\chi 2$ | 33319 |
| df | 141 |
| fmin | 0.589 |
| agfi | 0.965 |
| armr | 0.065 |
| srmr | 0.065 |
| cfi | 0.558 |
| tli | 0.464 |
| rmsea | 0.091 |
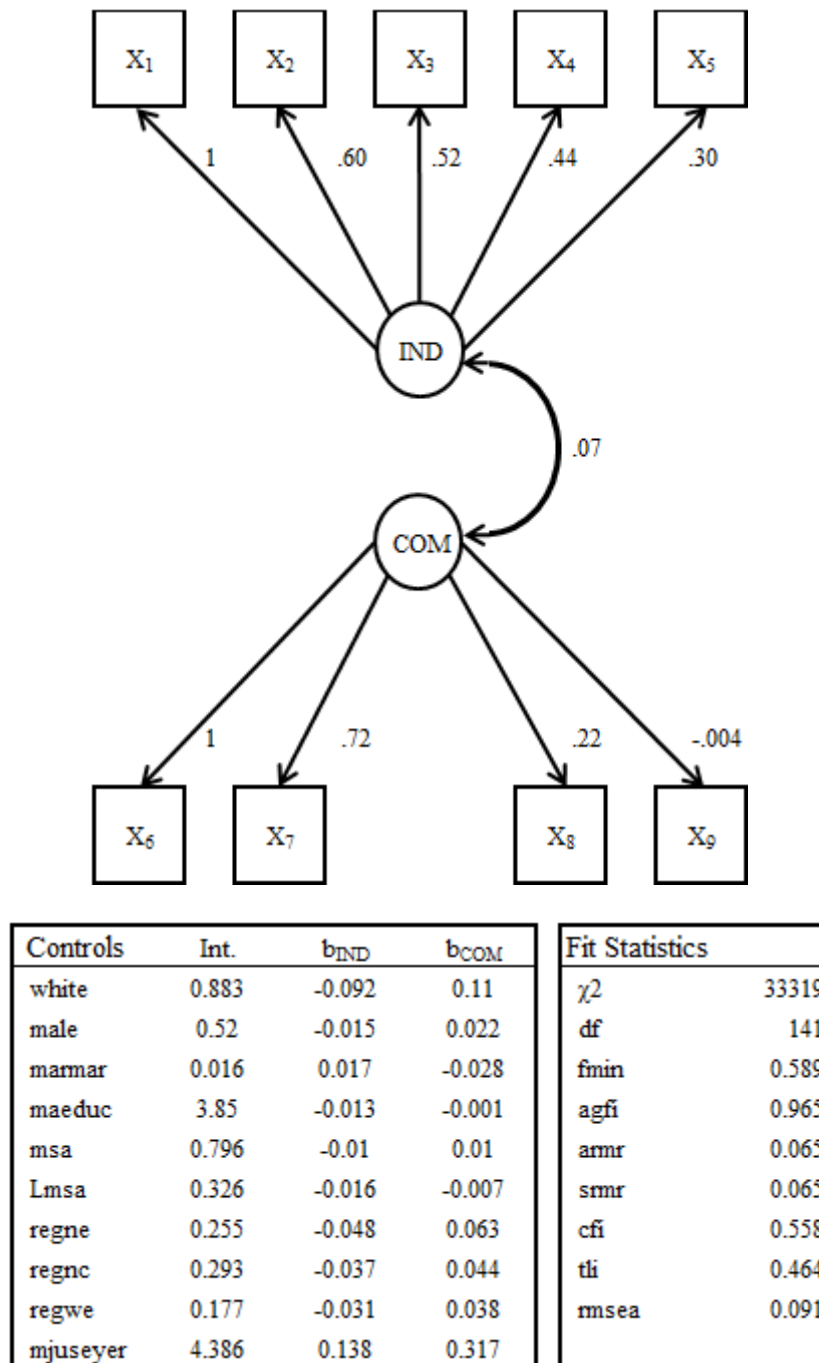
Figure 3.2 Empirical Measurement Model

measures an increase in the 'Communal' factor score corresponds to a predicted increase in the respective measures. The more 'Communal' a respondent's marijuana use, the more often they are predicted to use at a party or with 1-2 friends and the more likely they are

to report using 'to have a good time with friends'. However, a single indicator does not load as expected; 'to fit in' is modeled with a negative (though substantively non-existent) loading on the Communal factor. This finding is discussed later.

With a model $\chi^2$ of 33,319 and 141 degrees of freedom (including those introduced with the covariates), the fit is significant at p<.0001. However, with such a large sample size, (n=39,032), $\chi^2$ is perhaps not the most reliable of fit statistics. A number of fit indices are included in Figure 3.2, but in general, their indication is less optimistic. With a CFI of .558 (less than the ideal .95) and an SRMR of .065 and RMSEA of .091(both greater than the ideal cutoff of .05), the fit of my initial measurement model is less than ideal. Discussion of fit is elaborated in the following section.

*Discussion*

The measurement model in the present chapter provides a good foundation for the continuing work of this project. The model largely behaves as expected. The 'Individualist' factor indicators load positively and with large coefficients. The 'Communal' factor indicators are a bit less consistent, with the motivational measures having smaller effect sizes, and the effect of 'fitting in' item appearing negative. This effect may be a particular area of localized ill fit as adolescents are likely to underreport on this measure due to the low social desirability of conforming (Terry-McElrath et al., 2009). Further, because the present model aggregates data from all years, fit is apt to be negatively influenced. Indeed, the entire premise of the following chapter is that these effects have changed since 1976. Nonetheless, the model is theoretically sound and fits

sufficiently well to continue to Chapter Two as I justify the disaggregation of data to test

the changing patterns in these factors across time.

CHAPTER FOUR

Changing Patterns of Use: Time Series Cross-Sectional Trends

*Abstract*

With the measurement models established in Chapter Three, the focus turns to measuring these factors over time. As outlined in Chapter One and detailed below, if adolescent marijuana use follows the trend of other (formerly) social activities over recent decades, a measurable increase in 'Individualist' use should be observed. However, proportional estimates of use among teens suggest that trends differ among social characteristics. If motivational patterns follow similar distinctions, it is expected that the rates at which adolescents' use may be increasingly characterized as 'Individualist' might also correspond to these same demographic characteristics. Adapting the previous measurement model into a series of latent mixture models, these topics are addressed in the present chapter.

*Introduction*

The findings from Chapter Three provide evidence that, indeed, marijuana use among high school seniors can be typified into two constructs, an 'Individualist' factor and a 'Communal' factor. However, as described in Chapter Two, public perceptions regarding marijuana use have been shifting over the past several decades and it is reasonable to believe that identification within these constructs may likewise be changing. As perceptions of marijuana as a legitimate medical substance become more mainstream, the motivations for use will *de facto* become more individualized—

28

prescription medications are for individual consumption, not to be shared, regardless of the method of administration. This trend toward individualization is not a new concept for sociologists, as it was at the core of the research conducted by several of the early theorists and continues to be a popular notion today. In this chapter section, I lay the theoretical framework by which these ideas are formed and the statistical framework by which they may be tested.

<div align="center"><em>Theoretical Framework</em></div>

*General Trends toward 'Individualist' Use*

As suggested in Chapter One, the extent to which adolescent marijuana users might be typified as either 'Individualist' or 'Communal' is expected to change across time. In concept, this pattern mirrors those which were described by early social theorists. Just as Tönnies (1887) and Durkheim (1893) noted that the industrial revolution and the division of labor in society attributed to a rise in individualism, modern theorists have observed the same patterns, which they have attributed to the changing relationship between society and technology (Putnam, 1995; Bellah, 1991; Bellah, 1985).

Indeed, the upcoming 'millennial' generation has been labeled as 'Generation Me' as a result of the internalization of such social norms (Twenge & Campbell, 2010; Twenge, 2008; Twenge, 2006). If marijuana use has followed the pattern evinced by other previously social activities, it can be expected that a shift from social to individual is well under way. The medicalization of marijuana may be one such example of this. As previous research indicates that the negative effects that adolescents experience as a

result of marijuana use are accentuated among those who use alone and with the intention of psychotropic self-medication (McCabe et al., 2014; Kaplan et al., 1986).

In some regards, social scientists have already begun to take note of this effect. In an early report on the results of the *Monitoring the Future* study (1986), Johnston & O'Malley began to observe some degree of shift away from individuals reporting social/recreational reasons for their marijuana use toward what they had described as "psychological coping" and "functional" reasons. More recently, other studies report similar results with decreased reporting of using marijuana to fit in with peers and increased reporting of self-medication of anxiety (Patrick et al., 2011; Terry-McElrath et al., 2009). As a general pattern, it appears that a shift from 'Communal' to 'Individualist' marijuana use is underway. With this in mind, I introduce the effect of time into my models, as shown in figure 4.1a. Accordingly, I submit the following hypothesis:

> *Since 1976, adolescent marijuana use can increasingly be identified as 'Individualist', while decreasingly being identified as 'Communal'*

*The Case for Diverging Trends*

Still, this effect may not be consistent among all social groups. Regarding general rates of use, research has charted different patterns regarding sex and race. Early estimates found that marijuana use was most prevalent among white males; however this no longer appears to be the case (Colell et al., 2013; Wallace et al., 2003). In recent decades, marijuana use has been decreasing among men whilst increasing among women, closing the gap between the two to the point that any measured difference is not statistically significant (Miech & Koester, 2012; Kerr et al., 2007). Likewise, among Blacks, prevalence has significantly increased, such that rates of use are similar between

the two races (Timberlake, 2013; Miech & Koester, 2012; Wallace et al., 2003). Based

on these diverging trends in overall self-reports of use, I introduce an interaction term

into my models, as shown in Figure 4.1b. With this, I allow models to fit different rates

of change in the factors over time. Using this framework, I submit the following

hypotheses: *The rate at which respondents become increasingly likely to report*
*'Individualist' use will be statistically different between men and women,*
*and whites and Blacks.*

*The rate at which reporting of 'Communal' use changes will be*
*statistically different between men and women, and whites and Blacks.*

### *Data and Methods*

As with the measurement model of Chapter Three,  the data for these models

come from the *Monitoring the Future* (MTF) study. Again, I specifically use the data

collected from the high schools senior panel. However, as a distinct difference in this

chapter, as compared to the data format in Chapter Three, the responses are aggregated

into their respective year of administration and analyzed as a time-series cross-sectional

analysis. Using the same measures specified in the previous chapter, sample descriptives

are listed in Table 4.1, as aggregated into 5-year cohorts, for the sake of simpler display.

These tables are replicated and disaggregated to the annual cross-sections, as modeled in

the following, in Table A of the appendix.
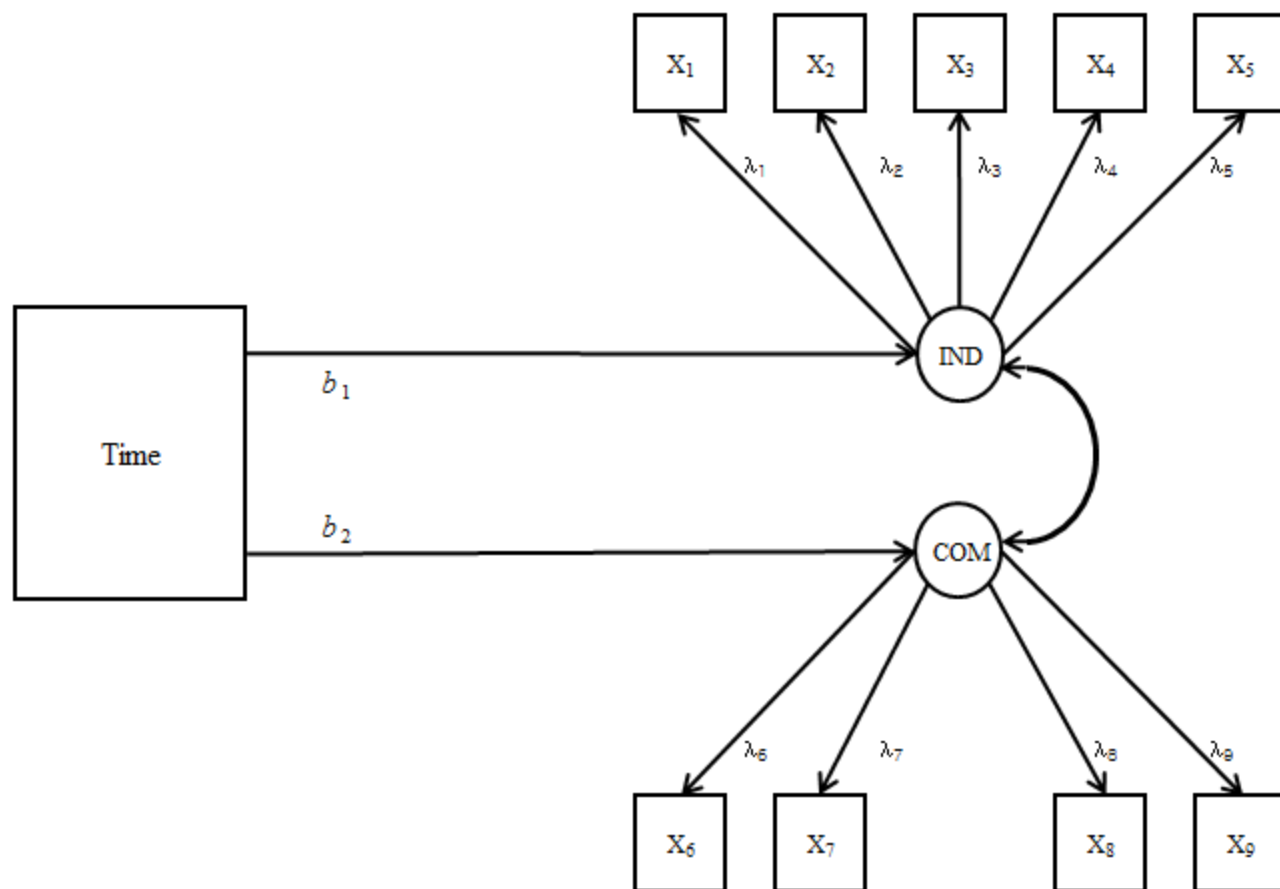
*Figure 4.1a Theoretical Main Effect Model*
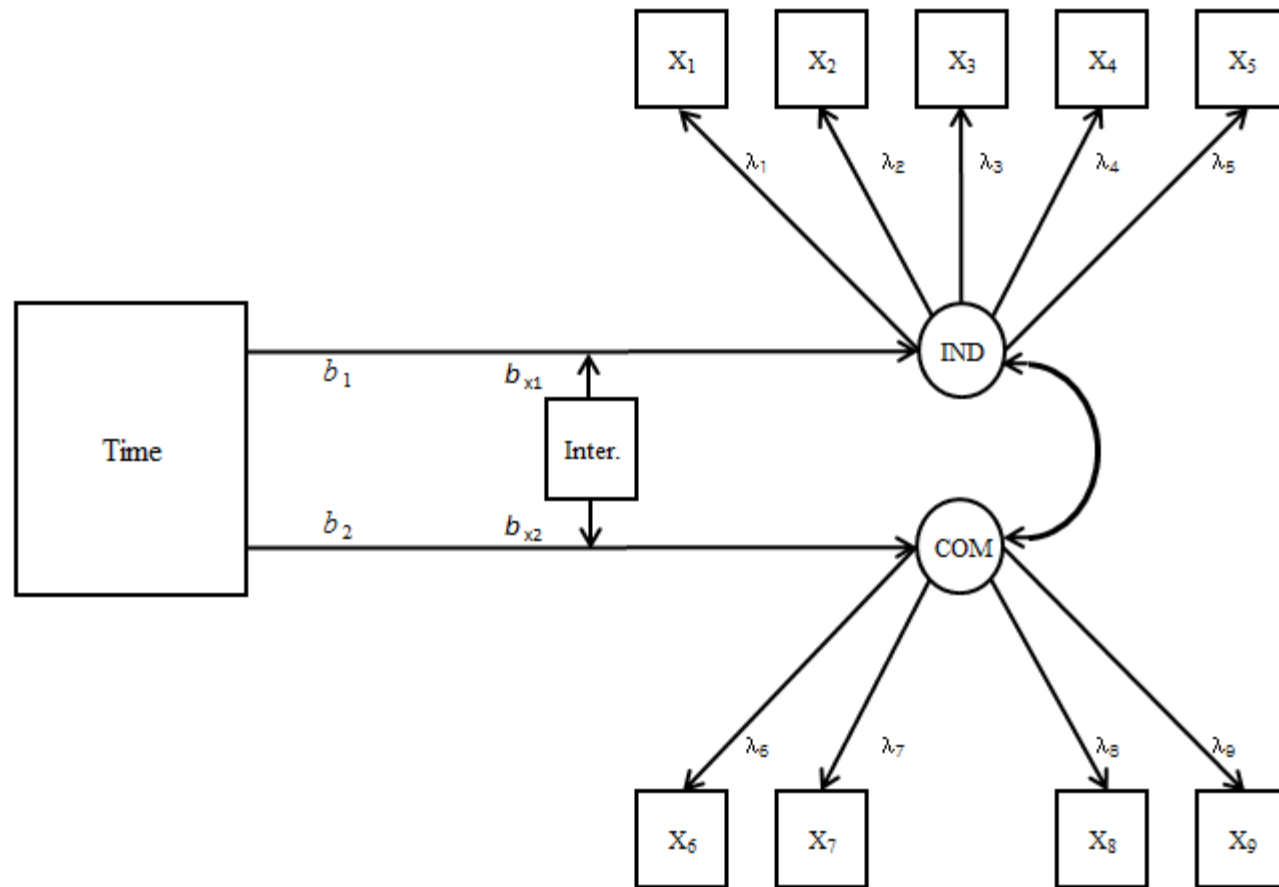
*Figure 4.1b Theoretical Interaction Model*

Table 4.1 Sample Descriptives by Cohort

| Cohort | Cohort 1 (1976-1980) | | Cohort 2 (1981-1985) | | Cohort 3 (1986-1990) | | Cohort 4 (1991-1995) | |
|---|---|---|---|---|---|---|---|---|
| Measure | Mean Percent | Std. Dev. | Mean Percent | Std. Dev. | Mean Percent | Std. Dev. | Mean Percent | Std. Dev. |
| Demographics | | | | | | | | |
| White | 87.35% | | 84.55% | | 86.38% | | 84.55% | |
| Male | 48.86% | | 48.97% | | 49.46% | | 47.69% | |
| Married | 2.26% | | 2.05% | | 1.76% | | 2.02% | |
| Mother's Education | 3.51 | 1.46 | 3.64 | 1.43 | 3.87 | 1.42 | 3.90 | 1.37 |
| Place Characteristics | | | | | | | | |
| MSA | 75.82% | | 74.74% | | 79.98% | | 79.76% | |
| Large MSA | 30.57% | | 30.23% | | 31.64% | | 32.66% | |
| Region | | | | | | | | |
| South | 27.62% | | 31.50% | | 30.36% | | 32.35% | |
| Northeast | 24.97% | | 23.42% | | 21.91% | | 20.60% | |
| Northcentral | 29.93% | | 26.84% | | 27.54% | | 26.19% | |
| West | 17.47% | | 18.24% | | 20.20% | | 20.86% | |
| Marijuana Use | | | | | | | | |
| Annual Use | 2.95 | 2.38 | 2.50 | 2.13 | 2.06 | 1.83 | 1.88 | 1.72 |
| IND FACTOR | | | | | | | | |
| When Alone | 1.61 | 0.85 | 1.54 | 0.84 | 1.43 | 0.78 | 1.43 | 0.80 |
| Relax | 43.11% | | 42.26% | | 42.40% | | 50.22% | |
| Get Away | 18.05% | | 19.82% | | 23.27% | | 23.85% | |
| Anger | 13.11% | | 14.73% | | 16.30% | | 16.78% | |
| Get Through | 7.27% | | 7.36% | | 7.45% | | 7.71% | |
| COM FACTOR | | | | | | | | |
| When Party | 2.98 | 1.38 | 2.79 | 1.36 | 2.68 | 1.36 | 2.72 | 1.37 |
| When Few | 3.14 | 1.10 | 3.09 | 1.16 | 3.04 | 1.22 | 3.00 | 1.24 |
| Good Time | 64.98% | | 65.61% | | 67.21% | | 65.28% | |
| To Fit in | 13.25% | | 13.05% | | 10.54% | | 8.65% | |
| | n= 8,322 | | n= 7,286 | | n= 5,135 | | n= 3,606 | |

Note: Sample descriptives by year are listed in Appendix Table A

Table 4.1 Sample Descriptives by Cohort (continued)

| Cohort | Cohort 5 (1996-2000) | | Cohort 6 (2001-2005) | | Cohort 7 (2006-2010) | | Cohort 8 (2011-2013) | |
|---|---|---|---|---|---|---|---|---|
| Measure | Mean Percent | Std. Dev. | Mean Percent | Std. Dev. | Mean Percent | Std. Dev. | Mean Percent | Std. Dev. |
| Demographics | | | | | | | | |
| White | 81.42% | | 82.20% | | 69.53% | | 69.72% | |
| Male | 48.01% | | 46.61% | | 47.72% | | 49.29% | |
| Married | 2.13% | | 2.67% | | 3.50% | | 3.93% | |
| Mother's Education | 3.98 | 1.37 | 3.94 | 1.39 | 3.89 | 1.39 | 3.89 | 1.37 |
| Place Characteristics | | | | | | | | |
| MSA | 78.66% | | 80.56% | | 80.99% | | 80.57% | |
| Large MSA | 33.62% | | 35.07% | | 34.70% | | 35.78% | |
| Region | | | | | | | | |
| South | 35.61% | | 32.50% | | 33.44% | | 32.27% | |
| Northeast | 23.47% | | 21.74% | | 21.58% | | 18.99% | |
| Northcentral | 23.11% | | 24.13% | | 24.84% | | 24.40% | |
| West | 17.81% | | 21.63% | | 20.14% | | 24.34% | |
| Marijuana Use | | | | | | | | |
| Annual Use | 2.25 | 2.02 | 2.21 | 2.02 | 2.15 | 1.98 | 2.3 | 2.09 |
| IND FACTOR | | | | | | | | |
| When Alone | 1.55 | 0.90 | 1.60 | 0.95 | 1.65 | 1.01 | 1.75 | 1.07 |
| Relax | 57.47% | | 60.16% | | 63.41% | | 67.60% | |
| Get Away | 26.07% | | 28.20% | | 27.75% | | 29.63% | |
| Anger | 19.53% | | 19.81% | | 20.39% | | 21.96% | |
| Get Through | 10.16% | | 12.59% | | 14.01% | | 14.67% | |
| COM FACTOR | | | | | | | | |
| When Party | 2.89 | 1.36 | 2.80 | 1.36 | 2.71 | 1.41 | 2.69 | 1.41 |
| When Few | 3.02 | 1.20 | 3.10 | 1.20 | 3.18 | 1.23 | 3.23 | 1.21 |
| Good Time | 67.95% | | 65.40% | | 66.82% | | 67.11% | |
| To Fit in | 8.16% | | 8.12% | | 6.28% | | 7.25% | |
| | n= 4,312 | | n= 4,014 | | n= 3,903 | | n= 2,454 | |

Note: Sample descriptives by year are listed in Appendix Table A

Examining the sample descriptives across time, it appears that the demographics remain largely consistent, save a few particular effects. Over time, the percent of the sample that is white drops from 87% in the earliest cohort to about 70% in the most recent. This shift reflect the larger population trends, as 87% of the 1970 decennial census was white, while only 72% of the US was in 2010. Likewise, as cities expanded into suburbs, the approximately 76% of the sample residing in an MSA in the earliest cohort rises above 80% in the more recently. Likewise, specific social changes are reflected too in these trends as the percentage of students who are married increases from 2% in 1976 to nearly 4% in 2013 and the mean education reported for respondents' mothers increases over the same period.

Paying particular attention to the factor indicators, as they are the focus of this project, distinct trends may be noted as well. Among the 'Individualist' indicators, there is a general trend toward the positive, with each measure increasing between 1976 and 2013. This effect is not, however, directly linear for all measures, as there is a decline before a rebound among the contextual measure, dropping from a mean of 1.61 in the earliest cohort to 1.43 in 1995 and rebounding to 1.75 in 2013. Among the 'Communal' indicators, a consistent and distinct pattern does not immediately appear to exist. Each measure varies from cohort to cohort, as can be expected with most variables, and the proportions among the most recent cohort are quite proximal to those in the earliest cohort.

To better visualize these patterns over time, I have created several growth charts and compiled them into Figure 4.2. The data in Figures 4.2a and 4.2b are reported as they exist in Table 4.1 for the motivational factors and the contextual factors have been
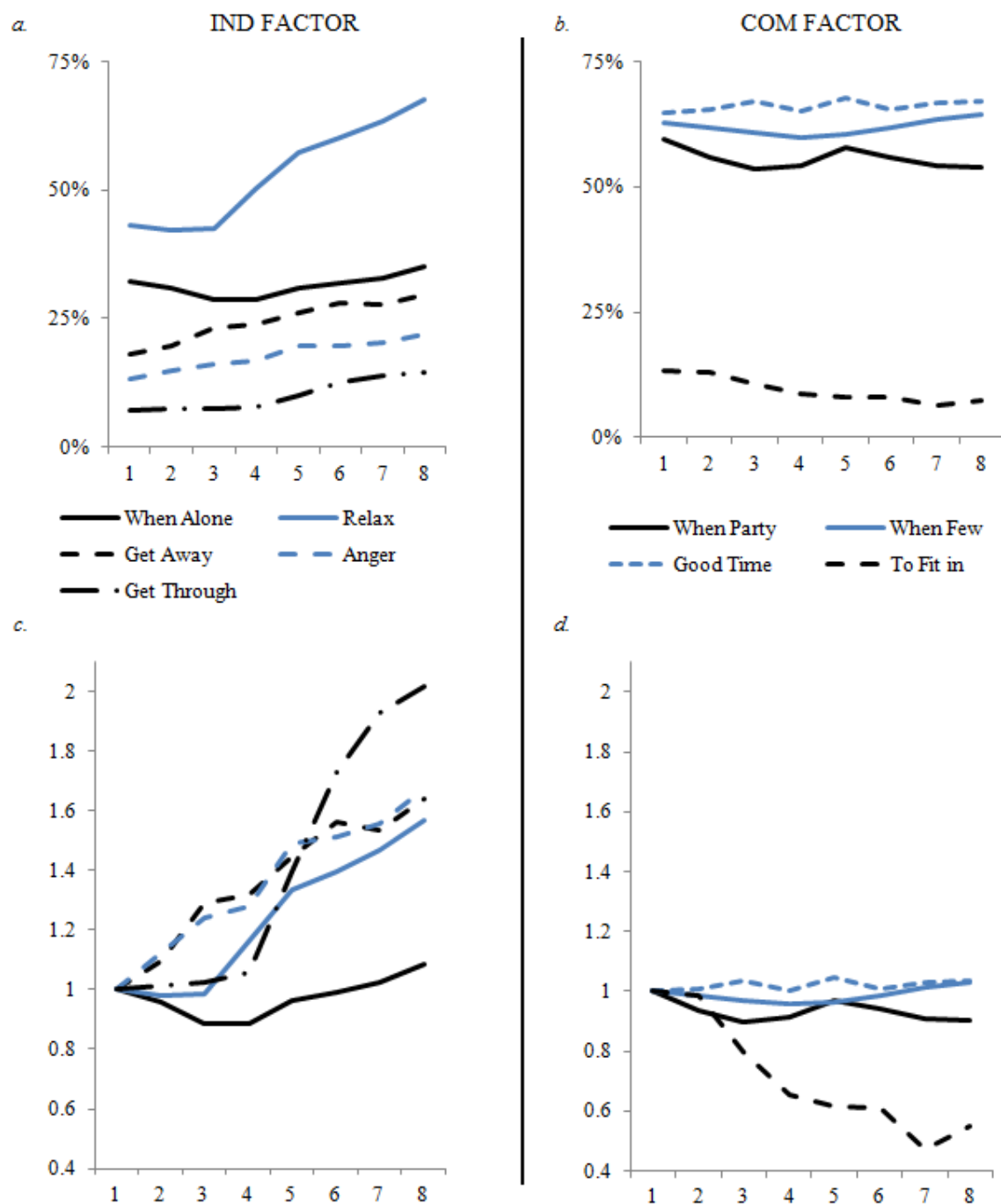
*Figure 4.2 Change in Factor Indicators Over Time:*

These figures show the change in factor indicators over time, as specified by the cohorts listed in Table 4.1. Figures 4.2a and 4.2b show Individualist factor indicators while Figures 4.2b and 4.2d show Communal factor indicators. In Figures 4.2a and 4.2b, binary measures are listed as percents and ordnal measures as standardized means. Figures 4.2c and 4.2d show measures as percent growth, compared to the respective values at cohort 1.

standardized to a 1-point scale, for consistency of display. Here, the effects are as described previously; the 'Individualist' indicators show a general trend toward the positive while the 'Communal' indicators remain largely consistent. In Figures 4.2c and 4.2d, I have standardized all measures with respect to their initial values. Accordingly, these charts indicate proportional growth, with the vertical axes indicating the ratio the measure at any given cohort to its respective starting value in the 1976-1980 cohort.

Figures 4.2c and d more appropriately show the true growth in these measures as a 7%[+] change in those reporting using 'to get through the day' is a significant growth, more than doubling since the earliest cohort. In these charts, the univariate patterns become more apparent--each of the 'Individualist' indicators show positive growth over time, with the largest growth doubling the proportion of respondents reporting using 'to get through the day. Conversely, the 'Communal' indicators remain largely consistent, with declines among two of the measures, and a nearly 50% decrease in the proportion reporting using 'to fit in'.

*Model Results*

The statistical models in this chapter follow a similar structure to the one used in Chapter Three, employing a mixture model framework to incorporate time as a regressive predictor of latent construct scores. However, to fully tell the story from these data, the models take several forms. First, because the simple descriptive analyses indicate that the progression of the latent indicators were not purely linear, I introduce time as a non-linear exogenous predictor. The empirical path model, as well as regression coefficients for this model are listed in Figure 4.3. Compared to the factor loadings first modeled in Chapter Three, all indicators load identically onto their respective factors when accounting for

Figure 4.3 Empirical Model: Nonlinear Time Effect

| Controls | Int. | $b_{IND}$ | $b_{COM}$ |
|---|---|---|---|
| white | 0.883 | -0.053 | 0.123 |
| male | 0.520 | -0.013 | 0.022 |
| marmar | 0.016 | 0.004 | -0.03 |
| maeduc | 3.850 | -0.02 | -0.006 |
| msa | 0.796 | -0.013 | 0.008 |
| Lmsa | 0.326 | -0.017 | -0.007 |
| regne | 0.255 | -0.04 | 0.068 |
| regnc | 0.293 | -0.027 | 0.05 |
| regwe | 0.177 | -0.031 | 0.039 |
| mjuseyer | 4.386 | 0.143 | 0.319 |

| Fit Statistics | |
|---|---|
| chi2 | 231700 |
| df | 1492 |
| fmin | 4.097 |
| agfi | 0.969 |
| srmr | 0.032 |
| cfi | 0.157 |
| tli | 0.098 |
| rmsea | 0.074 |

| Time | Int. | $b_{IND}$ | $b_{COM}$ |
|---|---|---|---|
| 1976 | 0.032 | - | - |
| 1977 | 0.048 | 0.019 | 0.030 |
| 1978 | 0.052 | 0.017 | -0.002 |
| 1979 | 0.048 | 0.057 | 0.020 |
| 1980 | 0.044 | 0.050 | 0.039 |
| 1981 | 0.046 | 0.051 | 0.056 |
| 1982 | 0.045 | 0.066 | 0.065 |
| 1983 | 0.038 | 0.089 | 0.036 |
| 1984 | 0.035 | 0.119 | 0.105 |
| 1985 | 0.035 | 0.122 | 0.077 |
| 1986 | 0.033 | 0.133 | 0.159 |
| 1987 | 0.033 | 0.134 | 0.093 |
| 1988 | 0.032 | 0.171 | 0.134 |
| 1989 | 0.023 | 0.149 | 0.141 |
| 1990 | 0.019 | 0.161 | 0.151 |
| 1991 | 0.015 | 0.174 | 0.151 |
| 1992 | 0.015 | 0.185 | 0.096 |
| 1993 | 0.017 | 0.151 | 0.079 |
| 1994 | 0.020 | 0.164 | 0.121 |
| 1995 | 0.022 | 0.176 | 0.135 |
| 1996 | 0.019 | 0.196 | 0.127 |
| 1997 | 0.022 | 0.218 | 0.192 |
| 1998 | 0.020 | 0.192 | 0.103 |
| 1999 | 0.019 | 0.189 | 0.126 |
| 2000 | 0.017 | 0.231 | 0.109 |
| 2001 | 0.017 | 0.199 | 0.100 |
| 2002 | 0.018 | 0.222 | 0.117 |
| 2003 | 0.019 | 0.222 | 0.102 |
| 2004 | 0.019 | 0.277 | 0.087 |
| 2005 | 0.022 | 0.255 | 0.137 |
| 2006 | 0.021 | 0.274 | 0.109 |
| 2007 | 0.020 | 0.261 | 0.145 |
| 2008 | 0.019 | 0.304 | 0.079 |
| 2009 | 0.019 | 0.313 | 0.185 |
| 2010 | 0.019 | 0.286 | 0.229 |
| 2011 | 0.020 | 0.287 | 0.142 |
| 2012 | 0.020 | 0.312 | 0.133 |
| 2013 | 0.018 | 0.329 | 0.093 |

39

time. The stability of these loadings lends itself toward the validity of the earlier measurement model.

In this model, as suggested by the univariate descriptives and consistent with the proposed theoretical framework, there is a net positive growth in the 'Individualist' factor over time. Indeed, even allowing for a nonlinear effect, there is relatively little noise in the positive trend. Regarding the 'Communal' factor, the trend is less clear. As with the 'Individualist' factor, there is a net positive trend, however there is a significant amount of noise in the pattern, with some year-over-year declines in the interim.

Examining model fit, this framework provides a marked improvement over the simple measurement model of Chapter Three. With a model $\chi^2$ of 231,700 and 1,492 degrees of freedom (including those introduced with the covariates and the non-linear time measure), the fit is significant at p<.0001. As noted earlier, with such a large sample size, (n=39,032), $\chi^2$ is not the most reliable of fit statistics. Still, the fit indices shown in Figure 4.3 display a clear improvement over the simple measurement model. With a CFI of .157, an SRMR of .032 and RMSEA of .074, this model certainly provides a better fit to the data, however it is still less than perfect.

More importantly with regard to my interaction hypotheses, a non-linear time effect does not allow for a simple interpretation for moderated effects. To this end, Table 4.2 lists a series of models which measure time as a linear effect. Model 1 mirrors the path model displayed in Figure 4.3, with only a change to the nature of the time measure. Again, the factor loadings remain consistent with earlier models, providing further evidence for the validity of the measurement model. Similar to the effects measures in

*Table 4.2 Mixture Model Results of Linear Time: Main Effects and Interactions*

| | Model 1: Main Effects | | | Model 2: White * Time Interaction | | | Model 3: Male * Time Interaction | | |
|---|---|---|---|---|---|---|---|---|---|
| | Estimate | Std. Err. | p | Estimate | Std. Err. | p | Estimate | Std. Err. | p |
| **REGRESSION** | | | | | | | | | |
| IND_FACTOR | | | | | | | | | |
| mjuseyer | 0.142 | 71.272 | 0.00 | 0.142 | 0.002 | 0.00 | 0.142 | 0.002 | 0.000 |
| white | -0.051 | -5.661 | 0.00 | -0.013 | 0.009 | 0.14 | -0.051 | 0.009 | 0.000 |
| male | -0.013 | -2.206 | 0.03 | -0.013 | 0.006 | 0.03 | -0.034 | 0.006 | 0.000 |
| marmar | 0.001 | 0.036 | 0.97 | 0.001 | 0.023 | 0.97 | 0.000 | 0.023 | 0.985 |
| maeduc | -0.019 | -9.134 | 0.00 | -0.019 | 0.002 | 0.00 | -0.019 | 0.002 | 0.000 |
| msa | -0.013 | -1.800 | 0.07 | -0.013 | 0.007 | 0.07 | -0.013 | 0.007 | 0.070 |
| Lmsa | -0.018 | -2.930 | 0.00 | -0.018 | 0.006 | 0.00 | -0.018 | 0.006 | 0.003 |
| regne | -0.041 | -6.107 | 0.00 | -0.041 | 0.007 | 0.00 | -0.041 | 0.007 | 0.000 |
| regnc | -0.027 | -4.239 | 0.00 | -0.027 | 0.006 | 0.00 | -0.027 | 0.006 | 0.000 |
| regwe | -0.031 | -4.041 | 0.00 | -0.032 | 0.008 | 0.00 | -0.031 | 0.008 | 0.000 |
| wave | 0.008 | 30.479 | 0.00 | 0.010 | 0.000 | 0.00 | 0.007 | 0.000 | 0.000 |
| whitewave | - | - | - | -0.002 | 0.000 | 0.00 | - | - | - |
| malewave | - | - | - | - | - | - | 0.001 | 0.000 | 0.000 |
| | | | | | | | | | |
| COM_FACTOR | | | | | | | | | |
| mjuseyer | 0.317 | 87.029 | 0.00 | 0.317 | 0.004 | 0.00 | 0.317 | 0.004 | 0.000 |
| white | 0.126 | 7.938 | 0.00 | 0.13 | 0.016 | 0.00 | 0.126 | 0.016 | 0.000 |
| male | 0.022 | 2.146 | 0.03 | 0.022 | 0.010 | 0.03 | 0.014 | 0.010 | 0.165 |
| marmar | -0.035 | -0.856 | 0.39 | -0.035 | 0.040 | 0.39 | -0.035 | 0.040 | 0.390 |
| maeduc | -0.004 | -1.101 | 0.27 | -0.004 | 0.004 | 0.27 | -0.004 | 0.004 | 0.269 |
| msa | 0.009 | 0.703 | 0.48 | 0.009 | 0.013 | 0.48 | 0.009 | 0.013 | 0.484 |
| Lmsa | -0.008 | -0.694 | 0.49 | -0.008 | 0.011 | 0.49 | -0.008 | 0.011 | 0.486 |
| regne | 0.066 | 5.622 | 0.00 | 0.066 | 0.012 | 0.00 | 0.066 | 0.012 | 0.000 |
| regnc | 0.048 | 4.331 | 0.00 | 0.048 | 0.011 | 0.00 | 0.048 | 0.011 | 0.000 |
| regwe | 0.038 | 2.853 | 0.00 | 0.038 | 0.013 | 0.00 | 0.038 | 0.013 | 0.004 |
| wave | 0.003 | 7.465 | 0.00 | 0.004 | 0.000 | 0.00 | 0.003 | 0.000 | 0.000 |
| whitewave | - | - | - | 0.000 | 0.000 | 0.63 | - | - | - |
| malewave | - | - | - | - | - | - | 0.000 | 0.000 | 0.279 |
| | | | | | | | | | |
| **COVARIANCES** | | | | | | | | | |
| IND_FACTOR ~~ | | | | | | | | | |
| COM_FACT | 0.07 | 26.309 | 0.00 | 0.07 | 0.003 | 0.00 | 0.07 | 0.003 | 0.000 |
| | | | | | | | | | |
| **INTERCEPTS** | | | | | | | | | |
| mjuseyer | 4.386 | 379.8 | 0.00 | 4.386 | 0.012 | 0.00 | 4.386 | 0.012 | 0.000 |
| white | 0.883 | 462.5 | 0.00 | 0.883 | 0.002 | 0.00 | 0.883 | 0.002 | 0.000 |
| male | 0.520 | 175.2 | 0.00 | 0.520 | 0.003 | 0.00 | 0.520 | 0.003 | 0.000 |
| marmar | 0.016 | 21.5 | 0.00 | 0.016 | 0.001 | 0.00 | 0.016 | 0.001 | 0.000 |
| maeduc | 3.850 | 468.4 | 0.00 | 3.850 | 0.008 | 0.00 | 3.850 | 0.008 | 0.000 |
| msa | 0.796 | 331.8 | 0.00 | 0.796 | 0.002 | 0.00 | 0.796 | 0.002 | 0.000 |
| Lmsa | 0.326 | 116.9 | 0.00 | 0.326 | 0.003 | 0.00 | 0.326 | 0.003 | 0.000 |
| regne | 0.255 | 98.3 | 0.00 | 0.255 | 0.003 | 0.00 | 0.255 | 0.003 | 0.000 |
| regnc | 0.293 | 108.3 | 0.00 | 0.293 | 0.003 | 0.00 | 0.293 | 0.003 | 0.000 |
| regwe | 0.177 | 77.9 | 0.00 | 0.177 | 0.002 | 0.00 | 0.177 | 0.002 | 0.000 |
| wave | 15.938 | 238.0 | 0.00 | 15.938 | 0.067 | 0.00 | 15.938 | 0.067 | 0.000 |
| whitewave | - | - | - | 13.581 | 0.068 | 0.00 | - | - | - |
| malewave | - | - | - | - | - | - | 8.232 | 0.068 | 0.000 |

41

*Table 4.2 Mixture Model Results of Linear Time: Main Effects and Interactions (continued)*

| | Model 1: Main Effects | | | Model 2: White * Time Interaction | | | Model 3: Male * Time Interaction | | |
|---|---|---|---|---|---|---|---|---|---|
| | Estimate | Std. Err. | p | Estimate | Std. Err. | p | Estimate | Std. Err. | p |
| LOADINGS | | | | | | | | | |
| IND_FACTOR | | | | | | | | | |
| mjwhenalon | 1 | 0.571 | | 1 | 0.481 | | 1 | 0.477 | |
| mjuserelax | 0.619 | 69.45 | 0.00 | 0.620 | 0.009 | 0.00 | 0.619 | 0.009 | 0.000 |
| mjusegtawy | 0.511 | 69.282 | 0.00 | 0.512 | 0.007 | 0.00 | 0.511 | 0.007 | 0.000 |
| mjuseanger | 0.434 | 68.074 | 0.00 | 0.434 | 0.006 | 0.00 | 0.433 | 0.006 | 0.000 |
| mjusegtthru | 0.296 | 63.664 | 0.00 | 0.297 | 0.005 | 0.00 | 0.296 | 0.005 | 0.000 |
| | | | | | | | | | |
| COM_FACTOR | | | | | | | | | |
| mjwhenprty | 1 | 0.451 | | 1 | 0.614 | | 1 | 0.614 | |
| mjwhenfew | 0.725 | 55.289 | 0.00 | 0.725 | 0.013 | 0.00 | 0.725 | 0.013 | 0.000 |
| mjusegdtim | 0.220 | 44.829 | 0.00 | 0.220 | 0.005 | 0.00 | 0.220 | 0.005 | 0.000 |
| mjusefitin | -0.005 | -1.734 | 0.08 | -0.005 | 0.003 | 0.08 | -0.005 | 0.003 | 0.082 |
| | | | | | | | | | |
| Fit Statistics | | | | | | | | | |
| chi2 | 35112 | | | 95457 | | | 75051 | | |
| df | 158 | | | 176 | | | 176 | | |
| fmin | 0.621 | | | 1.688 | | | 1.327 | | |
| agfi | 0.966 | | | 0.944 | | | 0.944 | | |
| srmr | 0.064 | | | 0.084 | | | 0.083 | | |
| cfi | 0.551 | | | 0.310 | | | 0.364 | | |
| tli | 0.460 | | | 0.177 | | | 0.241 | | |
| rmsea | 0.088 | | | 0.138 | | | 0.123 | | |

Figure 4.3, time has a net positive effect on both the 'Individualist' and 'Communal' factors, with the effect on the 'Individualist' factor being nearly three times as large.

Models 2 and 3 introduce interaction terms for the moderated effect of time with regard to race and sex. Each model indicates that white respondents are less likely to report 'Individualist' use, compared to minorities, and more likely to report 'Communal' use. In addition to this, Model 2 suggests that the positive trends in the 'Individualist' factor are stronger among minorities than among whites. However, whites are reported to be more likely to experience 'Communal' use and the differences in factor growth over time are negligible between whites and minorities.

Model 3 measures the differences in factor growth among men and women. In all models, the general pattern is that adolescent men are more 'Communal' than women in their marijuana use and less *'Individualist'*. However, the trend toward increasingly Individualist use is stronger among men, such that any differences are non-significant by 2013. With regard to the 'Communal' factor, however, men consistently score higher, and any differences in factor growth are negligible between men and women.

*Discussion*

The results of the models estimated in the present chapter provide three main findings: 1) since 1976, the extent to which adolescent marijuana use can be identified as 'Individualist' has been consistently on the rise while the rate of change in the 'Communal' factor is less clear; 2) this shift toward increasingly 'Individualist' marijuana use is more pronounced among racial minorities than among the white population and this difference is increasing across time ; and 3) the shift toward increasingly 'Individualist' marijuana use is more pronounced among adolescent women than among men, although the gap is closing.

Each of these findings has significant implications with respect to adolescent drug prevention programming. A full discussion of implications from this project is included in the final chapter, but a concise summary is warranted here. 'Red Ribbon Week' is widely observed across the country sometime every October. The notion of the campaign is that students publicly identify that they are drug-free, relying on the bandwagon effect to maintain abstinence from drugs. However, if marijuana use among adolescents is increasingly characterized as 'Individualist', these programs may be losing their effectiveness. Moreover, the inability of programs to reduce use will be heterogeneously

distributed, as they are increasingly less likely to be effective among young white men, compared to minorities and young women. In the next chapter, we will also see that these diverging motivations have serious implications on other behavioral health outcomes—specifically related to the probability of a teen transitioning to using other substances.

CHAPTER FIVE

Predicting Gateway Use

*Abstract*

What difference do motivation and social context of use have on the behavioral health implications of marijuana use? In this chapter, I utilize the previously established statistical frameworks to test this question. Previous research has suggested that individuals who use marijuana as a means to cope with difficult life circumstance are more likely to suffer from a number of negative health consequences (McCabe et al., 2014; Tucker et al., 2006; Kaplan et al., 1986). Again using data from the *Monitoring the Future* (MTF) study and a latent mixture model, I use my latent constructs, 'Individualist' and 'Communal' use, to predict the likelihood that an individual will have transitioned from marijuana use to other substances.

*Introduction*

In Chapters Three and Four, I have provided evidence for the presence of my hypothesized latent constructs and modeled the change in these measures across time. With this, it appears that there is sufficient evidence to conclude that not only are these constructs measuring real social phenomena, but that the nature of these traits have significantly shifted in recent years. The precision of these measures are not simply mathematic benefits. Rather, they allow for increased precision in modeling behavioral implications, and the social implications associated with adolescent marijuana use in the context of the two factors, 'Individualist' and 'Communal' use. In this chapter, I build and

45

test a theoretical framework which investigates the connection between patterns in use, vis-à-vis my two factors, and the probability of gateway drug use.

*Theoretical Framework*

What difference does it make if high school seniors are increasingly likely to ascribe their marijuana use to 'Individualist' motivations? This question is at the core of the present chapter as I examine the relationship between the latent factors, which were established in Chapter Three, and an individual's escalation of substance abuse, or gateway drug use. Stated differently, how do the motivations and situational context of an adolescent's drug use relate to the likelihood that they will subsequently use other, 'harder', drugs after beginning using marijuana?

As these latent constructs have not previously been measured as such, these specific questions have not been previously tested. However, some work has investigated the link between context of use and subsequent behavioral health outcomes. Substance dependence and escalated use are of particular concern, especially in regard to adolescents, because the likelihood of these behaviors are inversely correlated with the age of first use (Hall, 2006; Kaplan et al., 1986). That is, the younger a person is when they begin using marijuana, the more likely they will develop dependence and escalate their use in frequency and the types of substances abused. Additionally, individuals who use outside of social settings, and with individualized motivation, are increasingly likely to develop dependence and escalate their use in the same capacities (McCabe et al., 2014; Kaplan et al., 1986).

For example, the initiation of substance use because of psychological distress or as a means of self-medicating have successfully been modeled to predict escalated use

(Kaplan et al., 1986). Likewise, those who initiate use independent of social pressures and without peer influence, have been suggested to fare worse because of their use ( Bisset et al, 2007; Kaplan, 1986). Subsequently, as dependent users withdraw from peer networks and social ties weaken, their marijuana use inevitably becomes more isolated and escalation of use grows significantly more likely (Kaplan et al., 1986; Kaplan et al., 1984). In sum, research suggests that the effects of substance use are particularly negative among adolescents whose use is characterized by individualized motivations and is experienced in isolation, specifically as it relates to escalation of substance use and subsequent use of other drugs (McCabe, 2014; Tucker et al., 2006). Considering this evidence, I submit the following hypothesis, in conjunction with the model specified in Figure 5.1:

> *Adolescent marijuana users whose use is characterized as 'Individualist' will be significantly more likely to begin subsequently using other drugs, especially as compared to users whose use is characterized as 'Communal'.*

## *Data and Methods*

To test this hypothesis, I created a binary indicator for gateway drug use. To code this measure, I utilized an array of questions regarding when the respondent began using a specific class of substance. For each of these questions, the student was asked "When, if ever, did you firs do each of the following things?", with the possible response options given in years. The substances in this array include: marijuana, alcohol, and tobacco cigarettes, as well as LSD, psychedelics, amphetamines, Quaaludes, tranquilizers, barbiturates, cocaine, heroin, and a general response for "other narcotics". If a respondent indicates that they had used multiple substances from this array and that marijuana was
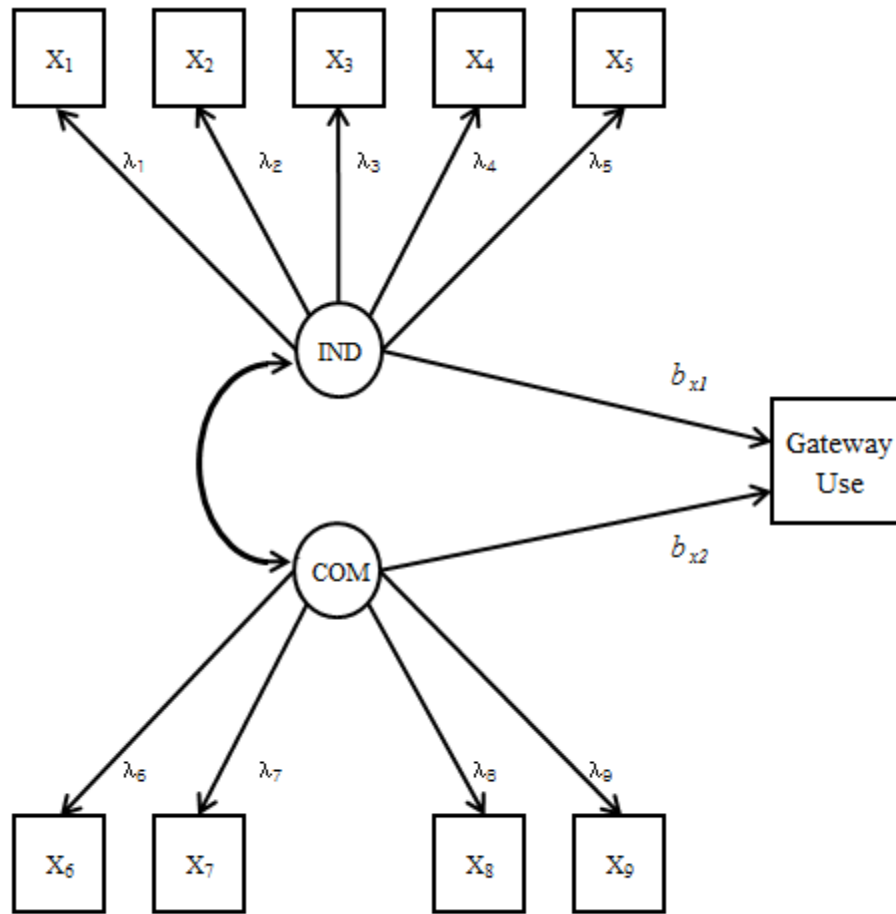
*Figure 5.1 Theoretical Implication Model*

the chronologically the first of the substances to be used, they were coded positive for

gateway use, while all others were coded negative. This is a conservative estimate of

gateway status, as individuals who initiated a subsequent substance within the same year

as beginning their marijuana use will not be coded as a gateway user. While this measure

is less-than-perfect, it is the best means of measuring the concept available within the

given data.

Within the overall sample of marijuana users, 25 percent are identified as gateway

users, having initiated use of other substances at least one year after first trying

marijuana. Table 5.1 displays, the descriptive statistics of the factor indicators among

both gateway users and non-gateway users. Additionally, correlation coefficients are listed for each indicator to show the extent to which they covary with gateway status in a bivariate fashion. These coefficients indicate that there is a modest correlation between each indicator and the gateway binary. However, the effect sizes are small as there is a sizable percentage of both gateway and non-gateway users who mark each of the indicators. To help untangle the relationship between the factors and gateway drug use.

*Model Results*

As with the models tested in Chapter Four, this model makes use of latent mixture modeling techniques, incorporating the measurement model from Chapter Three, and regressive predictors as in earlier chapters, and new to this chapter, a regression on the endogenous gateway use binary. The results of this model are displayed below in Figure 5.2.

Table 5.1 Indicator Descriptives by Gateway Drug Status

| Measure | Corr. w/ Gateway Use | Gateway User | | Not Gateway User | |
|---|---|---|---|---|---|
| | | Mean / Percent | Std. Dev. | Mean / Percent | Std. Dev. |
| IND FACTOR | | | | | |
| When Alone | 0.291 | 1.79 | 0.92 | 1.29 | 0.66 |
| Relax | 0.195 | 60.45% | | 39.37% | |
| Get Away | 0.091 | 26.24% | | 18.27% | |
| Anger | 0.098 | 19.66% | | 12.18% | |
| Get Through | 0.144 | 12.45% | | 4.52% | |
| COM FACTOR | | | | | |
| When Party | 0.237 | 3.16 | 1.27 | 2.47 | 1.32 |
| When Few | 0.159 | 3.32 | 1.01 | 2.91 | 1.24 |
| Good Time | 0.118 | 74.39% | | 62.29% | |
| To Fit in | -0.026 | 9.76% | | 11.56% | |

Note: All correlations significant at p<.001

Generally, the indicator loadings are identical to their counterparts in earlier chapters, again reinforcing the validity evidence for the measurement model. Similar, too, is the story told by the fit indices: with a χ2 of 7415 and 111 degrees of freedom, the model fit is significant at <.0001. The other fit statistics, listed in Figure 5.2, show are likewise similar to their earlier counterparts, even those which described the nonlinear-time-effect model in Chapter Four. The regression coefficients predicting gateway use from the latent constructs are the main addition to this model and as such, are the primary focus of the results. While both latent factors positively predict the likelihood of gateway use, the effect of the 'Communal' factor is five times the size of the effect of the 'Individualist' factor. This finding is discussed at length in the following section.

*Discussion*

What are the implications of these results? The extent to which a teen identifies their marijuana use within the realm of 'Individualist' or 'Communal' has significant consequences on the likelihood that they may later use other substances. A portion of each of these effects is likely due to the response options of the situational measures. If a student indicates that they use 'most of the time' at a party or while alone, it implies that they use more than 'some of the time' or 'never'. Simply because extent of use is included in these constructs, although as a tertiary intention, it is logical that some degree of positive influence on the probability of gateway use will exist. However, a measure of extent of use, directly reported from the respondent, is included as a control and yet this effect remains robust.
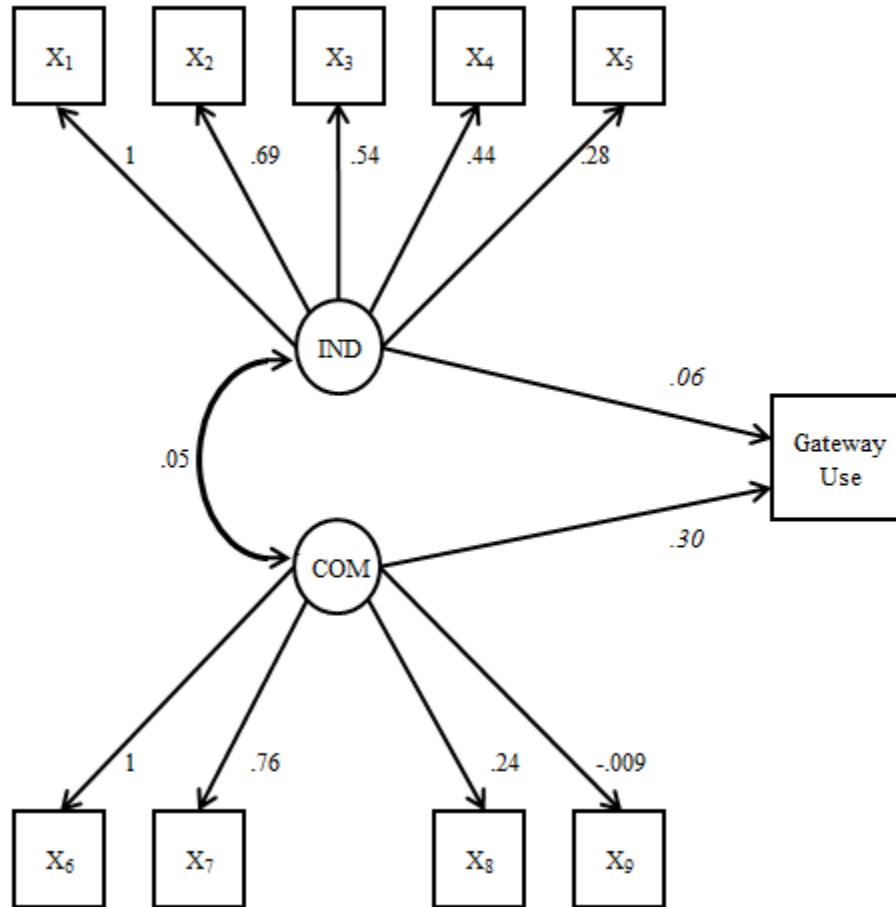
| Controls | $b_{IND}$ | $b_{COM}$ | $b_{gate}$ | Fit Statistics | |
|----------|-----------|-----------|------------|----------------|-----|
| white    | -0.047    | 0.111     | 0.134      | $\chi 2$       | 7415 |
| male     | -0.014    | 0.021     | -0.026     | df             | 111 |
| marmar   | 0.018     | -0.022    | -0.024     | fmin           | 0.230 |
| maeduc   | -0.016    | 0.001     | -0.001     | agfi           | 0.974 |
| msa      | -0.014    | 0.022     | 0.013      | srmr           | 0.036 |
| Lmsa     | -0.020    | -0.021    | 0.016      | cfi            | 0.782 |
| regne    | -0.045    | 0.060     | -0.037     | tli            | 0.696 |
| regnc    | -0.028    | 0.044     | -0.014     | rmsea          | 0.064 |
| regwe    | -0.030    | 0.017     | 0.055      |                | |
| mjuseyer | 0.129     | 0.304     | -          |                | |
| Wave     | 0.007     | 0.005     | -0.007     |                | |

*Figure 5.2 Empirical Implications Model*

51

The differences in effect size of each of these constructs, however, seems to be a more telling matter. The extent to which an individual's marijuana use can be characterized as 'Communal' is six-times more influential on the probability that they will transition to using other substances as the extent to which their use can be characterized as 'Individualistic'. Using only this gateway measure as a benchmark and a detrimental behavioral health outcome, it appears that 'Communal' marijuana use is more dangerous for the individual than 'Individualist' use. While a statistically significant finding, what substantive implications does this reveal. Further, what can be done, from a public health perspective, to curb this negative effect? The implications for this project as a whole are discussed in the final chapter.

CHAPTER SIX

Conclusion

Previous research had suggested that there exist certain 'classes' or 'types' of marijuana use among high school students. In Chapter Three, I had tested a measurement model to confirm the presence of two such constructs, using Confirmatory Factor Analyses. In Chapter Four, I described the overall shift in these types of adolescent marijuana users since 1976, and tested the hypothesis that these changes occur at different rates among the different subpopulations in the US. Then, in Chapter Five, I tested the notion that the degree of measurement within these latent factors contribute to the likelihood that an individual will transition from marijuana, as their first drug experience, to using other substances.

*Reviewing the Findings*

The measurement model in Chapter Three provided a sufficient, though less than ideal, fit. As the model was amended in later chapters, fit improved. Likewise, indicator loadings remained consistent, suggesting that the measurement model is stable and a good description of patterns within the data. While researchers had previously discussed measures related to motivation and situational context for marijuana use as if there were some underlying factor, this initial test was a necessary model to confirm that such a pattern exists within the data.

Chapter Two contained a series of models to test the introduction of a time component in several ways. First, I tested time as a non-linear predictor of factor scores,

allowing for changes in effect size to differ from year to year. In this model, there was certainly a linear trend that described a steady increase in the rate for which the marijuana use of high school students could be described as 'Individualist'; however, irregular patterns existed in the trend for the 'Communal' factor, suggesting that there may not be a linear function to the change in that factor. Nonetheless, I tested a linear effect of time, first as a main effect, then as an interaction term, with race and sex acting as independent mediators of the time effect. These interaction models suggested two key findings: 1) In addition to the notion that racial minorities are more likely to use marijuana in such a manner that it could be described as 'Individualist', marijuana use among non-white students is becoming more 'Individualist' at a much higher rate than that of white students; and 2)the shift toward increasingly 'Individualist' marijuana use is more pronounced among adolescent women than among men, although the gap is not as large as it once was.

In the final empirical chapter, I tested for differences in the impact of these latent factors on the probability that a student will progress from marijuana use onto other substances. Surprisingly, both factors has a significant positive effect on the probability that a student had transitioned to other substance use. Regardless of *why* students use, and the situations in which they use, the likelihood that they begin using other substances correlates, to some extent, with the mere fact that they justify their use with a motivation. Perhaps more surprising, the effect of the 'Communal' factor on gateway use was much larger, than the effect of the 'Individualist' factor—more than size times the size.

*Possible Implications*

When considered in sum, what implications might these findings have for future social research related to marijuana use and for the policies which might stem from such research? First, regarding the notion that the patterns and characteristics of an individual's drug use might be typified: future researchers should examine other ways to measure and categorize drug use. Further, how do these patterns differ among different subpopulations or geographies or among users of different classes of substances?

Second, regarding the evidence that the nature of marijuana use among adolescents is becoming increasingly 'Individualistic': Prevention programming should carefully consider the evidence presented supporting the fact that motivations for substance use appear to change over time. It's beyond the scope of this project to examine these changes for other substances, but in regard to marijuana, there is significant evidence that high school students are increasingly using marijuana as a means to cope with negative emotions and negative life circumstance. Considering the extant literature which states that individuals who use with such intentions have worse repercussions because of their use, these types of users should be a particular focus for counselors and policymakers. Because there appears to be patterns in these motivations related to demographics, particular care should be given in locating and addressing users properly.

There is evidence that 'Communal' marijuana users are significantly more likely to transition to using other substances. Perhaps the idea here is that users may become bored with familiar substances and look for new experiences. Perhaps they are simply more likely to encounter users of other substances through their social networks.

Regardless of the mechanisms by which this divergent probability occurs, it appears to be a specific need that needs addressed by educators and policymakers. Research on the effects of anti-tobacco messages has shown that the most powerful prevention messages may be those that accurately and directly address the harms associated with use (Terry-McElrath et al., 2005; Biener et al., 2004; Wakefield et al., 2003). Likewise, drug education might take a similar approach. Rather than the all-or-nothing perspective associated with 'Red Ribbon Week', programs might focus on educating students to the specific dangers associated with different classes of drugs. In this way, users may be more likely to consider the escalated risks associated with 'harder' drugs.

## *What's Next*

This project is the beginning of a conversation. It's a necessary contribution to the discussion regarding marijuana legalization. My intention is to prepare the document and package it for distribution in an appropriate capacity, whether through an academic journal or an applied report. In either situation, the discussion does not end with submission to the Baylor Graduate School.

APPENDIX

Sample Characteristics by Year

| Measure | 1976 | 1977 | 1978 | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 | 1988 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Demographics* | | | | | | | | | | | | | |
| White | 87.64% | 86.44% | 86.97% | 89.07% | 86.75% | 84.61% | 85.98% | 84.28% | 83.06% | 84.69% | 85.95% | 87.55% | 84.94% |
| Male | 50.00% | 48.06% | 48.04% | 48.36% | 50.06% | 48.93% | 50.82% | 49.74% | 48.23% | 46.90% | 48.35% | 48.68% | 49.50% |
| Married | 2.92% | 1.89% | 2.12% | 2.31% | 2.15% | 2.04% | 2.12% | 1.76% | 2.22% | 2.11% | 2.00% | 1.80% | 1.42% |
| Mother's Education | 3.38 | 3.47 | 3.45 | 3.56 | 3.68 | 3.64 | 3.61 | 3.65 | 3.60 | 3.70 | 3.81 | 3.90 | 3.94 |
| *Place Characteristics* | | | | | | | | | | | | | |
| MSA | 76.01% | 77.31% | 76.18% | 74.32% | 75.07% | 75.08% | 77.29% | 74.60% | 73.37% | 73.04% | 78.67% | 81.87% | 79.44% |
| Large MSA | 30.89% | 32.18% | 31.07% | 28.17% | 30.29% | 31.62% | 32.15% | 30.81% | 29.47% | 26.69% | 28.67% | 30.10% | 32.72% |
| Region | | | | | | | | | | | | | |
| South | 24.17% | 26.04% | 25.53% | 23.21% | 25.72% | 23.34% | 25.56% | 24.09% | 21.97% | 21.86% | 21.80% | 23.17% | 21.91% |
| Northeast | 30.71% | 30.68% | 29.81% | 32.42% | 25.93% | 27.19% | 29.00% | 25.14% | 24.78% | 27.87% | 27.95% | 27.82% | 29.27% |
| Northcentral | 20.11% | 16.52% | 15.54% | 15.84% | 19.75% | 19.02% | 17.21% | 17.75% | 18.85% | 18.45% | 19.07% | 19.64% | 20.97% |
| West | 25.01% | 26.76% | 29.12% | 28.53% | 28.61% | 30.45% | 28.23% | 33.02% | 34.40% | 31.82% | 31.18% | 29.36% | 27.85% |
| *Marijuana Use* | | | | | | | | | | | | | |
| Annual Use | 2.82 | 2.90 | 3.05 | 3.01 | 2.94 | 2.75 | 2.65 | 2.42 | 2.34 | 2.32 | 2.23 | 2.19 | 2.08 |
| IND FACTOR | | | | | | | | | | | | | |
| When Alone | 1.60 | 1.58 | 1.61 | 1.63 | 1.61 | 1.56 | 1.52 | 1.54 | 1.53 | 1.52 | 1.48 | 1.45 | 1.39 |
| Relax | 39.55% | 43.72% | 42.82% | 44.42% | 44.70% | 44.88% | 41.52% | 41.45% | 41.26% | 41.75% | 40.62% | 43.92% | 41.91% |
| Get Away | 17.81% | 17.71% | 17.33% | 19.44% | 18.02% | 17.42% | 20.10% | 19.04% | 21.63% | 21.53% | 23.79% | 22.69% | 23.44% |
| Anger | 11.14% | 12.86% | 12.82% | 14.73% | 13.81% | 14.68% | 14.48% | 12.67% | 15.63% | 16.42% | 16.16% | 16.33% | 17.71% |
| Get Through | 6.12% | 6.84% | 7.79% | 7.57% | 7.85% | 6.64% | 6.16% | 7.23% | 9.16% | 8.13% | 8.29% | 7.10% | 7.76% |
| COM FACTOR | | | | | | | | | | | | | |
| When Party | 3.00 | 2.98 | 2.98 | 2.93 | 2.99 | 2.92 | 2.88 | 2.69 | 2.75 | 2.67 | 2.74 | 2.65 | 2.67 |
| When Few | 3.13 | 3.12 | 3.16 | 3.15 | 3.14 | 3.08 | 3.08 | 3.09 | 3.12 | 3.08 | 3.06 | 3.07 | 3.00 |
| Good Time | 63.20% | 66.04% | 63.80% | 66.13% | 65.66% | 65.90% | 66.81% | 65.07% | 64.36% | 65.53% | 69.51% | 66.94% | 65.60% |
| To Fit in | 12.45% | 14.14% | 12.51% | 14.31% | 12.81% | 13.70% | 13.82% | 13.60% | 11.93% | 11.77% | 12.48% | 8.90% | 11.38% |
| *n=* | 1454 | 1711 | 1887 | 1677 | 1593 | 1642 | 1657 | 1397 | 1299 | 1291 | 1194 | 1225 | 1186 |

Table A. Sample Characteristics by Year (continued)

| Measure | 1989 | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Demographics* | | | | | | | | | | | | | |
| White | 85.44% | 88.32% | 84.38% | 82.23% | 83.32% | 85.90% | 87.12% | 81.12% | 79.39% | 83.11% | 83.28% | 80.11% | 81.35% |
| Male | 50.45% | 50.69% | 50.33% | 47.52% | 47.21% | 46.08% | 47.39% | 47.43% | 47.30% | 48.09% | 48.22% | 49.21% | 45.35% |
| Married | 1.63% | 2.02% | 2.07% | 1.73% | 2.11% | 1.90% | 2.32% | 2.08% | 1.96% | 2.04% | 2.11% | 2.49% | 2.75% |
| Mother's Education | 3.89 | 3.82 | 3.77 | 3.89 | 3.90 | 3.94 | 3.98 | 3.99 | 3.93 | 3.94 | 4.04 | 3.99 | 3.93 |
| *Place Characteristics* | | | | | | | | | | | | | |
| MSA | 78.83% | 81.06% | 81.54% | 78.85% | 78.65% | 80.08% | 79.80% | 75.98% | 77.72% | 80.56% | 78.43% | 80.73% | 79.21% |
| Large MSA | 33.95% | 33.32% | 33.36% | 30.39% | 31.71% | 34.41% | 33.48% | 29.51% | 34.43% | 35.25% | 35.93% | 32.78% | 32.02% |
| Region | | | | | | | | | | | | | |
| South | 21.80% | 20.53% | 21.83% | 21.33% | 19.62% | 19.40% | 20.92% | 27.20% | 24.52% | 21.24% | 21.27% | 23.06% | 25.01% |
| Northeast | 25.63% | 26.53% | 26.74% | 28.91% | 27.97% | 25.38% | 21.82% | 21.06% | 23.21% | 22.49% | 23.87% | 25.20% | 20.70% |
| Northcentral | 20.09% | 21.40% | 20.86% | 18.41% | 23.04% | 23.00% | 18.92% | 16.91% | 16.77% | 20.19% | 18.33% | 16.68% | 20.30% |
| West | 32.49% | 31.54% | 30.57% | 31.35% | 29.37% | 32.22% | 38.34% | 34.84% | 35.51% | 36.08% | 36.53% | 35.06% | 33.99% |
| *Marijuana Use* | | | | | | | | | | | | | |
| Annual Use | 1.89 | 1.83 | 1.71 | 1.64 | 1.83 | 2.04 | 2.18 | 2.22 | 2.29 | 2.25 | 2.27 | 2.25 | 2.28 |
| IND FACTOR | | | | | | | | | | | | | |
| When Alone | 1.40 | 1.42 | 1.42 | 1.37 | 1.43 | 1.42 | 1.49 | 1.54 | 1.53 | 1.55 | 1.58 | 1.53 | 1.56 |
| Relax | 42.75% | 43.16% | 46.71% | 46.48% | 49.14% | 53.35% | 53.02% | 55.04% | 57.66% | 57.13% | 59.36% | 58.18% | 57.05% |
| Get Away | 21.68% | 24.96% | 23.27% | 24.16% | 21.57% | 25.43% | 24.37% | 25.80% | 27.74% | 25.94% | 25.83% | 24.68% | 26.28% |
| Anger | 15.35% | 15.23% | 15.51% | 17.95% | 16.57% | 16.50% | 17.23% | 19.29% | 20.19% | 19.40% | 19.22% | 19.44% | 18.97% |
| Get Through | 6.70% | 7.05% | 6.58% | 6.71% | 5.43% | 11.41% | 7.57% | 9.83% | 9.83% | 9.54% | 10.77% | 11.00% | 10.77% |
| COM FACTOR | | | | | | | | | | | | | |
| When Party | 2.66 | 2.69 | 2.64 | 2.50 | 2.74 | 2.81 | 2.83 | 2.93 | 2.91 | 2.94 | 2.87 | 2.79 | 2.80 |
| When Few | 3.05 | 2.98 | 2.98 | 2.99 | 2.94 | 3.02 | 3.03 | 3.01 | 3.03 | 2.98 | 3.08 | 3.01 | 3.06 |
| Good Time | 67.60% | 66.01% | 66.61% | 64.09% | 63.86% | 66.63% | 65.09% | 68.06% | 70.70% | 66.13% | 68.54% | 65.98% | 61.41% |
| To Fit in | 10.35% | 8.89% | 9.61% | 8.56% | 9.14% | 7.44% | 8.78% | 9.21% | 8.59% | 8.15% | 6.24% | 8.57% | 7.44% |
| *n*= | 821 | 709 | 593 | 596 | 700 | 806 | 911 | 814 | 966 | 933 | 817 | 782 | 780 |

Table A. Sample Characteristics by Year (continued)

| Measure | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Demographics* | | | | | | | | | | | | |
| White | 85.32% | 84.65% | 85.27% | 75.58% | 73.66% | 70.47% | 68.19% | 68.07% | 67.05% | 68.29% | 73.05% | 67.73% |
| Male | 47.25% | 45.34% | 47.91% | 47.07% | 47.52% | 47.85% | 48.65% | 47.39% | 47.21% | 49.53% | 49.66% | 48.62% |
| Married | 2.43% | 2.44% | 3.07% | 2.63% | 3.31% | 3.95% | 3.14% | 3.68% | 3.43% | 3.86% | 4.40% | 3.48% |
| Mother's Education | 3.95 | 3.91 | 3.94 | 3.98 | 3.95 | 3.93 | 3.91 | 3.84 | 3.82 | 3.87 | 3.94 | 3.85 |
| *Place Characteristics* | | | | | | | | | | | | |
| MSA | 80.59% | 80.52% | 82.29% | 80.05% | 78.38% | 79.97% | 82.06% | 82.53% | 82.07% | 80.51% | 79.78% | 81.48% |
| Large MSA | 40.69% | 35.33% | 34.30% | 33.28% | 34.67% | 34.44% | 33.76% | 36.20% | 34.48% | 36.08% | 38.59% | 32.41% |
| Region | | | | | | | | | | | | |
| South | 23.85% | 19.37% | 20.33% | 20.84% | 21.29% | 21.05% | 20.07% | 24.16% | 21.42% | 18.72% | 18.24% | 20.10% |
| Northeast | 26.02% | 25.20% | 24.58% | 23.94% | 26.59% | 25.34% | 23.60% | 24.29% | 24.35% | 25.91% | 23.20% | 23.99% |
| Northcentral | 19.59% | 21.67% | 23.61% | 22.55% | 18.79% | 17.36% | 23.06% | 20.99% | 20.63% | 22.92% | 26.73% | 23.36% |
| West | 30.54% | 33.76% | 31.49% | 32.66% | 33.33% | 36.25% | 33.27% | 30.56% | 33.61% | 32.45% | 31.82% | 32.55% |
| *Marijuana Use* | | | | | | | | | | | | |
| Annual Use | 2.27 | 2.21 | 2.20 | 2.11 | 2.19 | 2.07 | 2.16 | 2.13 | 2.20 | 2.32 | 2.30 | 2.26 |
| IND FACTOR | | | | | | | | | | | | |
| When Alone | 1.59 | 1.62 | 1.61 | 1.59 | 1.63 | 1.65 | 1.66 | 1.65 | 1.63 | 1.68 | 1.75 | 1.81 |
| Relax | 59.35% | 61.60% | 62.58% | 59.98% | 61.17% | 60.99% | 65.67% | 63.47% | 65.63% | 66.86% | 67.62% | 68.44% |
| Get Away | 27.06% | 28.35% | 30.69% | 28.43% | 26.34% | 25.30% | 30.04% | 28.93% | 28.13% | 29.79% | 28.32% | 30.89% |
| Anger | 19.74% | 17.70% | 23.10% | 19.45% | 20.47% | 17.18% | 21.72% | 21.60% | 20.91% | 22.06% | 21.98% | 21.84% |
| Get Through | 12.16% | 12.44% | 14.56% | 12.84% | 13.61% | 13.45% | 14.30% | 14.67% | 14.06% | 13.97% | 14.70% | 15.45% |
| COM FACTOR | | | | | | | | | | | | |
| When Party | 2.89 | 2.81 | 2.82 | 2.69 | 2.73 | 2.71 | 2.65 | 2.71 | 2.75 | 2.71 | 2.74 | 2.61 |
| When Few | 3.09 | 3.07 | 3.12 | 3.15 | 3.12 | 3.19 | 3.17 | 3.23 | 3.20 | 3.24 | 3.20 | 3.27 |
| Good Time | 66.93% | 66.87% | 63.78% | 67.96% | 66.29% | 66.84% | 65.41% | 67.87% | 67.67% | 67.21% | 67.26% | 66.84% |
| To Fit in | 8.37% | 8.13% | 7.58% | 9.10% | 7.87% | 6.52% | 6.11% | 5.20% | 5.65% | 6.70% | 7.65% | 7.46% |
| *n*= | 765 | 836 | 831 | 802 | 801 | 751 | 769 | 750 | 832 | 866 | 837 | 751 |

60

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