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Developmental Patterns and Social Determinants of Adolescent Polysubstance Use Among Connecticut Youth

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DEVELOPMENTAL PATTERNS AND SOCIAL DETERMINANTS OF ADOLESCENT POLYSUBSTANCE USE AMONG CONNECTICUT YOUTH

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ABSTRACT

DEVELOPMENTAL PATTERNS AND SOCIAL DETERMINANTS OF ADOLESCENT POLYSUBSTANCE USE AMONG CONNECTICUT YOUTH

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Adolescent substance use continues to be a leading health concern in the United States. Although individual substance trends have demonstrated a decrease in use, it seems as if polysubstance use is on the rise among this population. Prior research into adolescent polysubstance use patterns tends to include only commonly used substances (e.g., alcohol, cannabis, tobacco) and neglects prescription drug misuse and illicit substances. Further, subanalyses by grade are typically not completed, leaving a gap in our understanding of developmentally appropriate prevention strategies. The present study utilized 13 substance use indicator variables to estimate substance use patterns among adolescents in grades 7 through 12 through multiple group latent class analysis (LCA) and the socioecological correlates of each class.

Participants included 14,134 adolescents (47.4% male; 45.6% female; 7% gender diverse) drawn from a historical dataset (2021-2024) of Youth Survey questionnaires maintained by a Connecticut nonprofit organization. It was expected that 4 classes would emerge, ranging from nonusers to polysubstance users, and that these classes would differentially relate to socioecological risk and protective factors. Results of the LCA models yielded 4 classes as the best solution for the sample: Nonusers; Alcohol, Cannabis, E-cigarette Experimenters; Prescription Drug and Alcohol Users; and Polysubstance Users. The Prescription Drug and Alcohol Users class emerged as a potentially unique substance using class, capturing a novel

substance use pattern among adolescents. A series of multinomial logistic regressions were completed to assess the odds of belonging to substance using classes based on various levels of risk and protective factors. Results were largely in line with hypotheses, although the Prescription Drug and Alcohol Experimenter class differentially related to the School Domain variables compared to other substance using classes, with only feelings of school safety emerging as a protective factor for this class. Further, parental use of cannabis emerged as a salient risk factor for polysubstance use among youth. The findings highlight the importance of including prescription drugs and illicit substances in investigations of adolescent substance use as well as underscores the importance of preventive strategies to mitigate consequences related to the changing landscape of cannabis legalization.

This dissertation is dedicated to perseverance, resilience, and understanding that you can truly achieve anything you set your mind to as long as you have the tenacity to never give up.

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TABLE OF CONTENTS

Page

Page

LIST OF TABLES

Table Page

LIST OF FIGURES

CHAPTER I

INTRODUCTION

Adolescent substance use is a leading health concern in the United States (National Institute of Drug Abuse [NIDA], 2020). Although alcohol is typically the most reported substance of use among adolescents, emerging trends suggest that polysubstance use is becoming more prevalent. In nationally representative samples, 12-34% of adolescents reported polysubstance use that included combinations of alcohol, cannabis, and tobacco (Moss et al., 2014; Silveira et al., 2019). According to data from the National Survey on Drug Use and Health (NSDUH), the gap between the reported single substance use of alcohol and cannabis has been declining and approaching convergence as there has been about a 57% change in the difference between past month alcohol use and past month cannabis use among youth aged 12 to 17 in the United States from 2017 to 2021 (Substance Abuse and Mental Health Services Administration [SAMHSA], 2023). This observed convergence of substance use may be indicative of higher rates of polysubstance use. Despite the increased risk associated with polysubstance use, most prevention and intervention studies focus on single substance use (Halladay et al., 2020). Although trends over time show a gradual decrease in youth use of individual substances (e.g., Miech et al., 2023), there continues to be a dearth of information regarding national estimates of polysubstance use among adolescents. Given the neurobiological consequences of substance use during adolescence (see Gray & Squeglia, 2018; Meruelo et al., 2017; Newcomb, 1987 for reviews) coupled with data suggesting that adolescents who engage in polysubstance use have a higher likelihood of developing substance use problems, including substance use disorder in adulthood (Moss et al., 2014), there is a significant need to identity determinants of polysubstance use during adolescence. The state of Connecticut is noteworthy for its efforts in

collecting adolescent substance use surveillance data. Consequently, this study will utilize a historical dataset of Connecticut adolescents and aims to expand upon previous research by (a) investigating the polysubstance use patterns among Connecticut students in grades 7-12, including the use of alcohol, cannabis, cigarettes or other tobacco products, e-cigarettes, misuse of prescription drugs (e.g., pain medicine, sedatives or "downers", etc.) and illicit substances (e.g., cocaine, ecstasy, and methamphetamine, etc.) and (b) exploring various socioecological and depressive mental health symptom correlates associated with adolescent substance use.

ADOLESCENCE AS A VULNERABLE DEVELOPMENTAL PERIOD

The developmental period of adolescence is typically understood as a transitional period between childhood and adulthood, incorporating youth aged 12 to 18 (i.e., 7th to 12th grade; Jaworska & MacQueen, 2015) that is marked by an increase in risk-taking behaviors such as substance use initiation. Both risk-taking and sensitivity to reward peaks during adolescence (Braams et al., 2015; Cauffman et al., 2010), particularly between the ages of 15 and 17 years of age (i.e., 10th to 12th grade), making adolescence a vulnerable period for the experimentation and initiation of substance use (Kassel et al., 2005). The initiation of substance use during this period can alter brain and psychosocial development, increasing the susceptibility to experiencing psychopathology and substance use disorders in adulthood (Marshall, 2014; Meruelo et al., 2017; Moise et al., 2020). Spear (2015) asserts that there may be separable vulnerable periods within adolescence, given the timing related to neurobiological development. Specifically, early initiation of alcohol use and high rates of binge drinking in later adolescence are two important behavioral patterns associated with long-term consequences. The developmental trajectory of adolescence includes the maturation of higher-order cognitive functions, such as the delay of gratification and executive decision making (Jaworska & MacQueen, 2015), co-occurring with

immense changes in social and affective processing (Crone & Dahl, 2012). Youth undergo increased independence, emotional reactivity, identity development, shifts in relational prioritization between peers and family, and increased risk taking (Jaworska & MacQueen, 2015; Sales & Irwin, 2009).

A key characteristic of adolescent development is the separation-individuation process from parental figures and the prioritization of peer relationships (Koepke & Denissen, 2012; Prinstein & Giletta, 2016), which can be conceptualized as a form of social exploration to further develop their identity. Substance use research has consistently found that the attitudes and behaviors of peers regarding substance use have the largest effect on self-reported substance use (Connell et al., 2010; Henneberger et al., 2021). Youth tend to select friends whose substance use attitudes and behaviors reflect their own and their association with substance using friends influences their own use. In their systematic review of peer influence on adolescent substance use, Henneberger and colleagues (2021) found that peer selection effects had an important effect on alcohol and tobacco use in adolescence and membership in substance using peer groups may act as a gateway to substance use. However, the interactions between parent and child still exert considerable influence during this process. According to Trucco (2020) in her review of psychosocial factors linked to adolescent substance use, peers and parents are the strongest influences on substance use initiation. Higher parental monitoring, clear family rules, and modeled substance use behaviors all contribute to youth self-reported substance use (Marceau et al., 2020; Pelham et al., 2023). Youth personal substance use norms tend to be stricter than their perceptions of their closest friends' attitudes and more lenient than their perceptions of their parents' attitudes (Field & Prinstein, 2023).

ADOLESCENT SUBSTANCE USE

The initiation of substance use in adolescence can negatively impact neurobiological development, with detrimental consequences to attention, memory, processing speed, and IQ, to name a few, that can persist into adulthood (Gray & Squeglia, 2018). Further, the earlier the age that substance use is initiated, the more likely the adolescent is to experience substance use related problems in adulthood (Behrendt et al., 2009; Halladay et al., 2020; Stamates et al., 2022). According to the Youth Risk Behavior Surveillance Survey (YRBSS; Centers for Disease Control [CDC], 1991-2021), which collects a nationally representative sample of all public and private school students in grades 9-12, about 15% of youth reported using alcohol for the first time prior to the age of 13 (10% of Connecticut youth reported similarly) and 4.9% of youth reported using marijuana for the first time prior to age 13 (2.4% of Connecticut youth reported similarly). Pre-pandemic national estimates of current (i.e., within the past 30 days) youth substance use demonstrated 29% of high schoolers using alcohol, 22% using marijuana, 6% using cigarettes, and 33% using electronic vapor products. Comparatively, among Connecticut high school students, where the current study is based, 26% use alcohol, 22% use marijuana, 4% use cigarettes, and 27% use electronic vapor products. According to the annual Monitoring the Future (MTF) Project (Miech et al., 2023) which collects a nationally representative sample of 8th, 10th, and 12th grade students, lifetime marijuana use among 12th grade students slowly increased from 41.8% in 2007 to 43.7% in 2020, lifetime cigarette use decreased from 46.2% to 24%, lifetime alcohol use decreased from 72.2% to 61.5%, and vaping nicotine increased from 25% in 2017, when they began to collect this measure, to 44.3% in 2020.

Although trends over time indicate that individual substance use is decreasing among substances such as alcohol and tobacco, this is likely due to policy and prevention efforts

associated with these substances. Substances that are relatively new or have changing laws, such as cannabis and electronic cigarettes, have demonstrated an increase in youth use according to the MTF survey. The legalization of cannabis for medical and recreational purposes in some areas of the United States, including Connecticut, has sparked concern that increased accessibility of cannabis to minors and changing perceptions of risk will contribute to observed increases in individual and polysubstance use among adolescents (Hopfer, 2014; Lee et al., 2022; Scheier & Griffin, 2021). In fact, the legalization of recreational cannabis in Washington in 2012 was associated with a higher likelihood of self-reported past-year cannabis use and alcohol use among youth aged 10 to 20 (Bailey et al., 2020), suggesting that youth may be more likely to use these substances post-legalization. Similarly, Maine legalized medical and recreational cannabis in 2016 and has observed increases in cannabis use among youth and young adults since 2017 (Maine Division of Disease Prevention, 2024). Given the focus of this project on substance use among Connecticut adolescents, and that Connecticut legalized recreational marijuana in July of 2021 and began retail sales in January of 2023, it is critical that Connecticut policy makers remain diligent to any unintentional effects on adolescent substance use.

ADOLESCENT POLYSUBSTANCE USE

Adolescent polysubstance use is defined as the use of multiple substances within a specific period of time, either simultaneously or separately (Conway et al., 2013; Connor et al., 2014) and has been on the rise since 2012 (Zuckermann et al., 2019). Most adolescent polysubstance use centers around the concurrent use of cannabis, alcohol, and tobacco (Halladay et al., 2020; Wu et al., 2020), with the most common combinations including alcohol with cannabis, alcohol with tobacco, or the use of alcohol, cannabis, and tobacco. Although cigarette and tobacco use have decreased, e-cigarette use has emerged as a major concern amongst youth

and young adults (Bluestein et al., 2019; Zuckermann et al., 2019). As of 2022, the MTF reported that about 40.7% of 12th grade students reported ever vaping any substance, whereas only 4% reported ever using cigarettes (Miech et al., 2023). Further, Lozano and colleagues (2021) found evidence for a bidirectional association between e-cigarette use and alcohol use in that the use of one substance increased the odds of initiating the use of the other. In their systematic review, Halladay and colleagues (2020) found that adolescents that endorse cannabis or tobacco use typically are engaging in moderate multi-use of substances. In other words, there is a higher likelihood that youth are engaging in polysubstance use if they endorse the use of cannabis or tobacco individually, whereas the use of alcohol is more commonly found among single-substance users. According to Harton and colleagues (2023), adolescents who use cigarettes or e-cigarettes are more likely to misuse opioids and other prescription drugs compared to nonusers. Similarly, Jones et al. (2020) found that youth that reported misusing prescription drugs were more likely to report concurrent use of alcohol and cannabis. Youth who use multiple substances are more likely to continue to use substances as they age, rather than decrease their substance use over time (Choi et al., 2018). However, most adolescent polysubstance use studies typically do not assess for illicit substances. Given the opioid epidemic, it is imperative that investigations into adolescent polysubstance use include illicit substances outside of the typically identified alcohol, cannabis, and tobacco.

Adolescents who engage in polysubstance use increase their risk for negative outcomes in adulthood, including psychosocial outcomes such as lower educational attainment, occupational and financial strain, mental and physical health challenges, and substance use disorder diagnoses (Carbonneau et al., 2023; Conway et al., 2013; Moss et al., 2014). Research into the etiology of polysubstance use suggests that risk factors might be distinct from those that prime individual

substance use. Polysubstance use is uniquely predicted by risk factors such as higher sensation-seeking and impulsivity (Carbonneau et al., 2022; Stamates et al., 2023), low socioeconomic status, and age of onset (Behrendt et al., 2009; Halladay et al, 2020; Stamates et al., 2022). Adolescent polysubstance use is also associated with higher perceptions of parental and peer substance use, poor academic performance, sexual minority status, and tends to occur among older adolescents (Kocojevic et al., 2016; Tomczyk et al., 2016).

Polysubstance Use and Mental Health

Mental health issues and substance use typically co-occur (e.g., Essau & de la Torre-Luque, 2019). Among youth diagnosed with a substance use disorder, an estimated 70% also suffer from a mental health disorder (Hawke et al., 2018). Among a large national sample of adolescents in Canada, it was found that about 20% of students fell into a profile characterized by high substance use and high mental health issues (Halladay et al., 2022). In a longitudinal study, Antti and colleagues (2021) found that adolescents who experience alcohol intoxication before the age of 12 were significantly more likely to develop psychiatric disorders later in life. Although the association between mental health and substance use disorders is widely accepted, the inclusion of mental health correlates in investigations regarding patterns of substance use is relatively uncommon. According to Halladay et al. (2020) in their systematic review of the literature, only 20 studies included mental health correlates, mostly investigating internalizing and externalizing behaviors rather than asking questions related to self-harm and suicide. Across the studies that did include some form of mental health factor, almost all found a combination of co-occurring profiles, such as low substance use, high mental health symptomology and high polysubstance use, high mental health symptomology. Both externalizing and internalizing symptoms were higher among those with high substance and polysubstance use.

Mental health issues such as anxiety, depression, and poor emotional regulation are key precursors to adolescent polysubstance use (Kassel et al., 2005; Maslowsky et al., 2014), but it seems as if the many mental health struggles are moderated by gender. Secades-Villa and colleagues (2024) found that young adults who self-reported an earlier age of onset for alcohol, cannabis, and tobacco use demonstrated poorer psychosocial adjustment and the highest impulsivity traits among all other groups examined; however, females demonstrated poorer psychosocial adjustment compared to males. In their assessment of youth aged 14 to 24, Hawke and colleagues (2018) found that although males were more likely to use cannabis, females were more likely to use a variety of substances and were more likely to experience co-occurring mental health issues. Similarly, Kim observed that gender moderated the association between mental health problems and the use of vaping devices, in that females demonstrated a greater association between the two compared to males (Kim, 2021). Further, Kim observed that males were more likely to use vaping devices given their current use of cigarettes and cannabis compared to females. It seems as if females may be more motivated to use substances based on their mental health struggles compared to males.

Most research on adolescent substance use has focused on investigating the influence of various factors on single substance use (e.g., alcohol use), which allows us to understand what levels of specific factors are correlated with substance use. However, given the number of factors that are associated with substance use and polysubstance use among adolescents, a person-centered approach may offer richer information regarding risky profiles or patterns of substance use among adolescents. Substance use is a behavior that demonstrates a reciprocal relationship with other contextual risk and protective factors (Kassel et al., 2005). In order to understand the complex interrelations of various psychosocial factors with substance use, it is imperative that

we understand the various contexts in which they exert influence over adolescents. The socioecological model offers an excellent scaffolding to facilitate this investigation.

SOCIOECOLOGICAL MODEL

Extensive research supports the use of the socioecological model (e.g., Halladay et al., 2020; Tomcyzk et al., 2016) in understanding the etiology of adolescent substance use, in which proximal and distal environmental factors related to the individual, family, peer, community, and societal domains are considered influential to the developmental trajectory throughout the lifespan (Bronfenbrenner, 1979; Bronfenbrenner, 1992). In his original theory, Bronfenbrenner proposed a series of nested social systems that encompass the ecology of human development: microsystem, mesosystem, exosystem, and macrosystem. Each system is comprised of the unique circumstances that surround a developing individual. The microsystem is the most proximal ecological level and encompasses the genetic and psychobiological factors of an individual as well as the immediate relationships that they navigate, such as with their family and peers. The mesosystem provides the context in which the relations in the microsystem connect (e.g., the relationship between a child's parent and their teacher). The exosystem contains more distal systems within which the individual operates, but does not directly influence themselves, such as the policies of a school board. Finally, the macrosystem is the outermost ecological level that contains overarching attitudes and beliefs that influence the individual, such as societal beliefs, policies, etc. Within this framework, Bronfenbrenner posits that human development contains the components of person, context, process, and time (Bronfenbrenner & Morris, 2006). The person interacts with their context or environment (i.e., the socio-ecological levels), which results in the process (i.e., the reciprocal effects of the interactions on development and behavior) over time. Development is therefore influenced by the complex interplay between the individual

and their social environment. Although the overarching theory of the socioecological model is helpful in organizing psychosocial factors linked to a particular behavior, the broadness of the theory makes it challenging to intervene at any particular level, as factors can encompass several systems (see Figure 1).

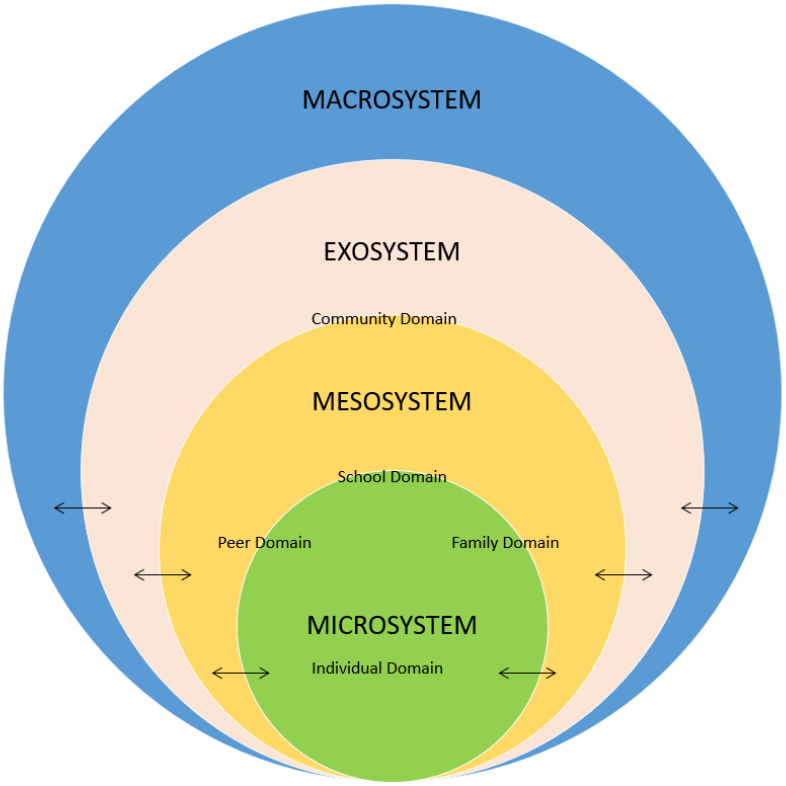

Figure 1. Domains associated with adolescent substance use mapped onto Bronfenbrenner's Socioecological Model

Public health researchers commonly identify key risk and protective factors within particular "domains" of the socioecological model, such as the individual, peer, family, school,

and community domains, to target in preventive interventions (e.g., Connell et al., 2010). Risk variables are empirically investigated adverse experiences or dispositions that increase the likelihood of an individual experiencing negative long-term outcomes. Protective factors are factors that mitigate the likelihood of a negative long-term outcome. They act as a "protective" shield against adverse developmental trajectories and can often seem like the other side of the coin to risk factors. For example, academic engagement is a protective factor if high and a risk factor if low. Effective preventions focus on reducing risk factors and strengthening protective factors. Several risk and protective factors have been identified at each level of the socioecological model when it comes to adolescent substance and polysubstance use.

Individual Domain

The individual domain lies in the microsystem of the socioecological model and includes individual characteristics and personal history factors that contribute to the likelihood of a behavior, such as gender, age, temperament, and other sociodemographic characteristics. This domain also includes key attitudinal influences such as individual perception of harm related to specific substances and the perception of the availability of substances. Significant individual risk factors for substance use initiation include impulsivity, antisocial behavioral problems, academic ability, and mental health.

Gender. Generally, males tend to self-report a higher level of substance use than females. Females are more likely to demonstrate higher mental health symptomology along with low substance use while males typically use more heavily and demonstrate more externalizing problems (Halladay et al., 2020). A more recent study based on data from the YRBSS discovered that adolescent males are more likely to report using illicit substances and cigarette smoking whereas females reported higher binge drinking, recent alcohol use, and prescription opioid

misuse (Bhatia et al., 2023). It seems as if gender differences related to individual substance use have been well documented. However, in their systematic review of latent classes of polysubstance use, Tomczyk and colleagues (2016) found inconsistent gender differences within the literature. Some studies demonstrated that males were more likely to be heavy polysubstance users compared to females, whereas other studies observed no consistent gender effect. Further investigation into potential gender differences in relation to the initiation of polysubstance use is necessary.

Depressive Symptoms. Mental health and substance use typically co-occur, especially within a clinical population (Essau & de la Torre-Luque, 2019; Hawke et al., 2018). Although the association between mental health and substance use disorders is widely accepted, the inclusion of mental health variables in investigations regarding patterns of substance use is relatively uncommon. It is important to include indicators such as self-harm, suicidal ideation, and depressive symptoms, specifically because internalizing symptoms, such as depression, are highly associated with substance use in adolescent females (Kim, 2021). Similarly, among a nationally representative sample of 10th grade students, those who endorsed polysubstance use demonstrated higher levels of somatic and depressive symptoms compared to other classes (Conway et al., 2013).

Individual Perceptions. When making health decisions, individuals typically consider potential risks alongside the benefits of a particular choice (Ferrer & Klein, 2015). Typically, the decision to abstain from a behavior is thought to be influenced by the perception of a negative health outcome, or the perception of risk. Targeting perception of risk regarding substance use is a common prevention technique. Individual perception of risk associated with substances has a direct impact on substance use behavior (Debnam et al., 2018). In a longitudinal study, changes

in risk perception were found to significantly predict changes in self-reported tobacco, alcohol, and cannabis use (Grevenstein et al., 2015). Further, higher perceptions of access to substances among youth are associated with higher likelihood of youth experimentation along with other, more macro consequences, such as increased violence and child maltreatment (Debnam et al., 2018).

Peer Domain

Research has demonstrated that perceived peer disapproval and norms about peer use are highly related to the individual substance use of a person (Marziali et al., 2022; Zimmerman & Vásquez, 2011). An 11 year longitudinal study, following respondents from adolescence to young adulthood, found that although family influence dwindled over time, the influence of substance using peers remained consistent on individual substance use and was the only significant predictor in early adulthood (Van Ryzin et al., 2012). Friends' attitudes around substance use are robust predictors of adolescent risk behaviors. Youth tend to use these perceived norms to justify or normalize their own use. Peer norming is an indirect influence on individual substance use amounts whereas peer pressure is a more direct influence on youth use.

Family Domain

One level out from the individual domain is the family level, where parental attitudes and behaviors influence the adolescent. Within the original socioecological model, this domain is nested in the microsystem as well. The family context and effective parenting is a key protective factor against adolescent substance use (Kumpfer & Alvarado, 2003; Li et al., 2022; Parker & Benson, 2005; Pugh & Richter, 2023). Perceived parental disapproval of substance use, family rules about use, adult use, and parental monitoring are all factors that influence substance use by adolescents. Similarly, experiences of child maltreatment are linked to substance use in

adulthood. High parental warmth and parental monitoring of youth behavior are protective factors (Trucco, 2020).

Family Rules and Parental Monitoring. Clear and consistent family rules as well as higher levels of parental monitoring are associated with lower youth substance use and delayed age of onset. Pelham et al. (2023) found evidence that non-using adolescents are significantly more likely to start using substances when they experience a decrease in parental monitoring and substance-using youth report that they are more likely to stop use when they experienced an increase in parental monitoring. In their longitudinal study, Van Ryzin and colleagues found that parental monitoring was more predictive of substance use in early adolescence rather than in later developmental periods. However, the researchers posit that parental monitoring may indirectly affect later substance use through its influence on peer selection (Van Ryzin et al., 2012). In a sample of Asian adolescents, Fang and colleagues (2011) found that youth that self-reported substance use demonstrated lower parental monitoring, family involvement, and family rules about substance use. Among low-income African American youth, Stewart (2002) found that strong family rules and parental monitoring emerged as significant protective factors against youth use of alcohol, cannabis, and cocaine.

Perception of Parental Disapproval and Parental Use of Substances. It is well-established that perceived parental disapproval is protective against adolescent substance use and impacts individual perception of harm across various substances (Heerde et al., 2019; Marziali et al., 2022). In fact, adolescent perception of parental disapproval is more impactful on self-reported substance use than parent reports of disapproval (Jaccard et al., 1998). After the COVID-19 pandemic, perception of harm associated with various substance use showed a significant increase, as did the perception of parental disapproval (Rosenthal et al., 2024), which

may indicate that the influence of parents increased during the quarantine period. Concern about parental disapproval is commonly cited as one of the most important reasons that abstaining youth continue to choose not to use (Johnson et al., 2001).

Contrarily, favorable parental attitudes and behaviors towards substance use are positively related to adolescent substance use. Meldrum and colleagues (2023) found evidence that as adolescent perceptions of parental opinions of substances shifted from negative to positive, adolescents are more likely to engage in substance use, which supports the social learning theory whereby youth would model their behavior after their parents.

School Domain

The school domain lies within the mesosystem and exosystem of the socioecological model and exerts more of a distal influence on youth behavior. The school environment can influence adolescent drug use as both a protective and a risk environment, dependent on its overall functionality. Fletcher et al. (2008) found that student disengagement and poor-teacher student relationships were associated with youth substance use while preventions that encourage student engagement and increase a positive school environment can be protective against substance use.

School connectedness encompasses the extent a student feels a sense of commitment, belonging, safety, and support from their school (Osterman, 2000) and has long been identified as a protective factor against adolescent substance use (e.g., Bond et al., 2007). However, Manning and colleagues (2023) demonstrated its limitations when they found that school connectedness was not able to influence adolescent substance use among those who have a history of emotional maltreatment, demonstrating that more proximal influences such as family relationships are more influential on substance use.

Community Domain

Finally, the distal influence of the larger community context also plays a role in attitudes and behaviors towards substance use (e.g., Van Horn et al., 2007). This domain includes settings such as towns and neighborhoods. Characteristics of the community, such as permissive attitudes and behaviors surrounding substance use, high delinquency, and community disorganization (e.g., violence, drug activity) have all been found to be associated with higher adolescent substance use (Connell et al., 2010; Debham et al., 2018; Van Horn et al., 2007). Youth perceptions of neighborhood safety have demonstrated a direct effect on subsequent adolescent substance use (e.g., Lambert et al., 2004). Pederson and colleagues (2022) found that the lack of perceived neighborhood safety is associated with greater substance use among adolescents, but this effect is moderated by support from adults, such as parents or teachers. According to Myers (2013), in a sample of rural African American youth, engagement in extra-curricular activities with local churches was found to be protective against youth substance use.

Other community-level factors, such as poverty, income, unemployment, and crime have yielded inconsistent results with adolescent substance use (e.g., Jackson et al., 2014). While exhaustive investigation of the influence of community-level factors on adolescent substance use is outside the scope of this paper, youth perceptions of community drug use, safety and acceptance, and community activities are investigated.

USING LATENT CLASS ANALYSIS TO EXAMINE ADOLESCENT POLYSUBSTANCE USE

Most research on adolescent substance use has focused on investigating the influence of factors on single substance use (e.g., alcohol use) rather than investigating the complex nature of polysubstance use. Among the research that has investigated polysubstance use, there is a dearth

of information surrounding the patterns of substance use behaviors surrounding adolescent illicit substance use and prescription drug misuse. Given the number of factors that are associated with polysubstance use among adolescents, a person-centered approach may offer richer information regarding risky profiles or patterns of substance use among adolescents. Latent class analysis is a person-centered cluster analytic approach that allows patterns of behavior to emerge for identification based on individual scores relevant to the issue at hand (Collins & Lanza, 2010). LCA is particularly informative when examining substance use because different levels and combinations of substance use warrant different treatment approaches and preventive strategies (Wu et al., 2020). Further, the use of LCA allows researchers to identify patterns and predictors of use within their own sample and apply their strategies to these specific profiles (Tomcyzk et al., 2016), which is extremely useful for prevention specialists, who often are collecting local data to inform said strategies.

Previous research has used LCA to examine substance use patterns among adolescents, but most have not explored subgroup analyses by age (e.g., Halladay et al., 2020), and therefore are limited in their ability to provide developmentally appropriate prevention strategies. On average, studies have found about four classes of substance use related to the amount and type of substance endorsed, specifically (1) low use; (2) single or dual substance use; (3) moderate multi-use; (4) high multi-use. While the first two classes mainly consist of alcohol, cannabis and alcohol, tobacco and alcohol, or tobacco, the latter higher use classes typically include alcohol, cannabis, and tobacco, with or without the endorsement of other substances (Halladay et al., 2020). Outside of these four classes, the addition of a class of abstainers was also common (e.g., Gilreath et al., 2014; Silveira et al., 2019; Wu et al., 2020).

Within the extant literature, most studies include alcohol, cannabis, and tobacco as substances of interest, while fewer include illicit substances or misuse of prescription drugs (Halladay et al., 2020; Wu et al., 2020). The opioid epidemic makes it clear that it is imperative that research investigate illicit and prescription drug misuse among adolescents to better inform preventive interventions. Further, Wu and colleagues (2020) noted that most LCA studies include a minimal number of explanatory variables outside of basic demographic information. LCA research will benefit from the inclusion of more detailed variables to distinguish classes among adolescents.

STUDY PURPOSE

Although researchers typically agree that polysubstance use is an area of concern, most prevention and intervention studies continue to focus on single substances (Halladay et al., 2020). Further, national surveillance surveys, such as MTF, NSDUH, and YRBSS, still do not investigate polysubstance use as part of their reports, so it remains unclear the extent of polysubstance use among adolescents in the United States.

The primary purpose of the proposed research is to utilize advanced multi-group Latent Class Analysis to examine patterns of substance use and polysubstance use among a large sample of adolescents in grades 7-12 across Eastern Connecticut. Although previous work has been done to examine classes of substance use among adolescents (e.g., Connell et al., 2010), it has yet to be examined if these classes remain constant across adolescents of various ages. Emerging trends indicate that marijuana use is rising among adolescents in Connecticut and beginning to approach convergence with rates of reported alcohol use (NSDUH, 2019-2020), which may be indicative of an increase in polysubstance use among youth. This research also aims to investigate the interrelations of class membership on self-reported mental health indicators, such

as suicidal ideation and self-harm, as well as level-specific socioecological outcomes, such as perception of harm, family rules, and parental disapproval.

The current study extends previous research in several ways. Although investigations regarding adolescent substance use have been completed, these usually are comprised of a selection of grades (e.g., 8th and 10th grade) rather than including continuous grades from 7th to 12th (e.g., Tomczyk et al., 2016). Further, if continuous grades are included, subsequent analyses that investigate any potential age differences are absent (Halladay et al., 2020). The inclusion of multiple grades allows developmental comparisons that can inform changes to preventive interventions by age. Further, there is scant research that includes illicit substance use in their investigations of youth substance use. Given the opioid epidemic, it is imperative that research include illicit substances when exploring substance using profiles among adolescents. Further, depressive symptomology associations with classes of substance use were explored, which is an area that needs to be expanded upon in the literature within this population.

The specific aims of this study are:

Aim 1. To determine the patterns of substance use and polysubstance use among adolescents in grades 7-12.

Hypothesis 1a. Given that systematic reviews of the literature cite that the most common combinations of adolescent substance and polysubstance use patterns include single use, dual use, and multi-use combinations (e.g., Halladay et al., 2020; Wu et al., 2020) and that alcohol remains the most commonly used substance among adolescents, it was hypothesized that distinct classes of adolescent substance use would be found, particularly: non-users, alcohol-only users, dual-substance polysubstance users, and multi-substance polysubstance users.

Hypothesis 1b. Risk-taking and sensitivity to reward peak during adolescence, particularly between 15 and 17 years of age (Braams et al., 2015; Cauffman et al., 2010; Kassel et al., 2005) and increasing age has been associated with higher substance use (Wu et al., 2020). Therefore, it was hypothesized that the number of cases within each latent class would significantly vary by grade, such that as grade increases, more youth would populate substance using classes.

Research Question. Would the number of latent classes remain consistent across grade levels?

Aim 2. To investigate the varying influence of level-specific socioecological risk and protective factors among the five domains (i.e., individual, peer, family, school, community) on class membership.

Aim 2.1. To investigate the interrelations between the individual domain and substance use class membership.

Hypothesis 2.1a. It was hypothesized that identifying as male gender would increase the odds of belonging to a substance using class.

Hypothesis 2.1b. It was hypothesized that higher perception of availability of substances would increase the odds of belonging to a substance using class.

Hypothesis 2.1c. It was hypothesized that higher perception of harm would decrease the odds of belonging to a substance using class.

Aim 2.2. To investigate the interrelations between the peer domain and substance use class membership.

Hypothesis 2.2. It was hypothesized that higher perception of peer disapproval would decrease the odds of belonging to a substance using class.

Aim 2.3. To investigate the interrelations between the family domain and substance use class membership.

Hypothesis 2.3a. It was hypothesized that higher parental monitoring would decrease the odds of belonging to a substance using class.

Hypothesis 2.3b. It was hypothesized that youth perceptions of clear family rules discouraging substance use would decrease the odds of belonging to a substance using class.

Hypothesis 2.3c. It was hypothesized that youth perceptions of high parental disapproval would decrease the odds of belonging to a substance using class.

Hypothesis 2.3d. It was hypothesized that parental use of substances would increase the odds of belonging to a substance using class.

Aim 2.4. To investigate the interrelations between the school domain and substance use class membership.

Hypothesis 2.4a. It was hypothesized that higher school commitment would decrease the odds of belonging to a substance using class.

Hypothesis 2.4b. It was hypothesized that higher school safety would decrease the odds of belonging to a substance using class.

Hypothesis 2.4c. It was hypothesized that higher school support would decrease the odds of belonging to a substance using class.

Aim 2.5. To investigate the interrelations between the community domain and substance use class membership.

Hypothesis 2.5. It was hypothesized that positive youth perceptions of community would decrease the odds of belonging to a substance using class.

Aim 3. To examine the association of substance use classes with depressive symptoms.

Hypothesis 3a. Self-reported depressive symptoms in the past 12 months would be positively associated with odds of belonging to a substance using class.

Hypothesis 3b. Self-reported self-harming behavior in the past 12 months would be positively associated with odds of belonging to a substance using class.

Hypothesis 3c. Self-reported thoughts of self-harming behavior in the past 12 months would be positively associated with odds of belonging to a substance using class.

Hypothesis 3d. Thoughts of suicide in the past 12 months would be positively associated with odds of belonging to a substance using class.

CHAPTER II

METHOD

DATA SOURCE AND PARTICIPANTS

Participants were drawn from data gathered through a regional surveillance effort that surveys adolescents in grades 7 through 12 about their behaviors and attitudes regarding substance use, gambling, mental health, and associated risk and protective factors between the years of 2006 to 2024. This data collection effort is hosted by the Southeastern Regional Action Council, Inc. (SERAC), which is a non-profit regional behavioral health action organization (RBHAO), designated by the Department of Mental Health and Addiction Services (DMHAS), that serves eastern Connecticut. SERAC operates largely with the aid of federal grant-funding, but also offers contractual partnerships to aid local substance use prevention coalitions with data collection and analysis. In the collection of these data, SERAC coordinates efforts with local coalitions, school boards, and school staff to design and collect data from youth. The resulting convenience sample of 82,835 youth responses is not the result of a systematic effort to gather a representative sample but are a culmination of SERAC's efforts over time partnering with local towns and coalitions to collect data to inform prevention efforts. The resultant dataset is composed largely of students in the southeastern region of Connecticut and could be considered mostly representative of this area. Although the dataset is a historical source, the collection and analysis of data has been completed by the author since 2021.

Description of the Region

According to the American Community Survey (U.S. Census Bureau, 2021) 5-year estimate, the total population in the towns served by SERAC is approximately 426,026 residents. In Region 3, 77% of the population self-identify as White non-Hispanic, 4% as Black non-

Hispanic, 4% as Asian non-Hispanic, and 11% self-identify as Hispanic or Latino of any race. About 18.9% of the population of this region are youth aged 0-17, 13.2% are 18-24, 23.6% are 25-44, 27.1% are 45-65, and 17.2% are 65+.

When assessing demographics within Windham and New London counties, which are the two largest counties within the area that SERAC serves, we find that about 11.9% (n = 13,871) of Windham County residents and about 12.5% (n = 33,661) of New London County residents are between the ages of 10-19. Windham County is 93.3% rural with 14 out of 15 towns classified as rural areas while New London is about 70% rural with 14 out of 20 towns classified as rural areas. The median household income is about $72,068 in Windham County and $78,828 in New London County. About 12.3% of residents in Windham County are at or below poverty level with an employment rate of about 59.8% compared to 8.6% of residents at or below poverty level and an employment rate of about 57.6% in New London County.

Sample Selection

For inclusion in this study, participants were drawn from years 2021 to 2024, enrolled in grades 7-12 within the DMHAS Region 3 catchment area (i.e., eastern Connecticut). The larger dataset includes a small sample of 6th grade participants, but generally does not seek to collect this grade unless requested by the client, and therefore is not included in the current analysis. The final sample included a total of 14,134 responses (see Figure 1).

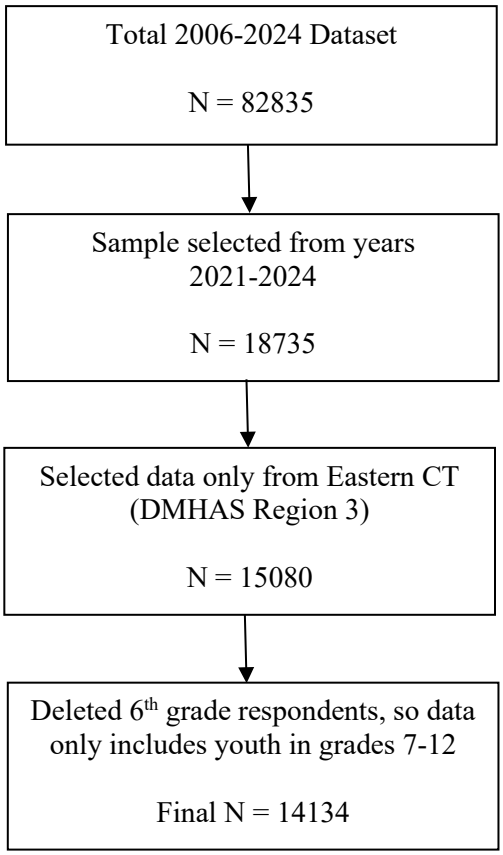

Figure 2. Process of sample selection.

The final dataset included observations from a total of 15 towns and 34 schools in CT DMHAS Region 3. Across the sample, 77.4% participants reside in southeastern Connecticut and 22.6% reside in northeastern Connecticut. According to the "Five Connecticuts" classification system (see Levy & DataHaven, 2015), about 45.6% reside in rural areas (i.e., average income, below average poverty, lowest population density), 45.5% urban periphery (i.e., below average income, average poverty, high population density), and 8.9% suburban (above average income, low poverty, moderate population density). Participant school districts were also classified by District Reference Groups (DRGs) designed to categorize school districts based on

similar socioeconomic status (see Connecticut School Finance Project, 2016). It is from this classification that the average median household incomes were drawn (see Table 1).

Of the 14,134 participants, 45.6% identified as female, 47.4% identified as male, and 7.0% identified as gender diverse, preferred to self-describe, or preferred not to say. Sample ethnicity included Caucasian (56.8%), African American (7.7%), Hispanic (13.7%), Asian (5.5%), Native or Indigenous (1.0%), and Multiracial (14.2%) participants. Class standing was 14.7% 7^{th} graders, 16.9% 8^{th} graders, 19.1% 9^{th} graders, 17.9% 10^{th} graders, 17.8% 11^{th} graders, and 13.5% 12^{th} graders. Detailed demographic characteristics of the sample are reported in Table 1.

Table 1

*Demographic Characteristics of Final Sample (*N = *14,134)*

Variable	N	%
Gender		
Female	6434	45.6
Male	6679	47.4
Transgender Female	21	0.1
Transgender Male	89	0.6
Gender Fluid	109	0.8
Nonbinary/Non-Gender Conforming	241	1.7
I'm not sure right now	26	0.2
I prefer to self-describe	215	1.5
I prefer not to say	285	2.0
Ethnicity		
Caucasian	7039	56.8
African American	950	7.7
Hispanic	1699	13.7
Asian	687	5.5
Native/Indigenous	124	1.0
Multiracial	1761	14.2
Other	132	1.1
Grade Level		
7th Grade	2079	14.7
8th Grade	2389	16.9
9th Grade	2700	19.1
10th Grade	2532	17.9
11th Grade	2519	17.8
12th Grade	1915	13.5
Geographical Area		
Rural	6447	45.6
Suburban	1257	8.9
Urban Periphery	6430	45.5
*Average Median Household Income**		
$49,662	5550	39.3
$71,638	2689	19.0
$73,523	1224	8.7
$92,169	2303	16.3
$94,009	739	5.2
$120,789	1629	11.5

**Note*. Average Median Household Income indicated by DRG as of 2016 estimates.

PROCEDURE

All surveys were approved by school boards prior to collection and passive parental consent procedures were utilized. A passive parental consent letter (see Appendix B) was sent home with students at least one week prior to the administration of the survey and a copy of the survey was held within the front office of the school for parents to review. Parents were able to express their objection to their child completing the survey at any time. Youth were also able to decline participation. If no objection was given by either the parent or the child, the child was permitted to complete the survey. Information about the incidence of refusal was not collected from school officials. Whenever possible, the surveys were administered online during school hours using the SurveyMonkey.com website and software. In some cases, the survey was administered with a specific subject class, such as English, to all students in the class. In other instances, students were asked to participate on a given day rather than in a specific class. Efforts were made to ensure that the students surveyed were representative of the entire school population by calculating a response rate given the current enrollment by grade. At least 50% of the grade needed to participate to allow analyses to be interpreted for that grade. The survey took an average of 16.72 minutes to complete. No incentive was granted for the completion of the survey. All data are anonymous.

OVERVIEW OF SOURCE MEASURES

Survey items were originally derived from several sources, including the Drug Free Communities (DFC) recommended core measures from the Office of National Drug Control Policy (ONDCP; DFC Support Program, 2023) and the Connecticut Governor's Prevention Initiative for Youth (GPIY) survey (Ungemack et al., 2000), which in turn based its questionnaire largely from prior statewide school surveys utilized in New York and Connecticut,

such as the Youth Risk Behavior Surveillance Survey (YRBSS; CDC, 2004) and the Monitoring the Future Survey (MTF; Bachman & Johnston, 1978). All of these measures are briefly described below.

Of note, all the source measures for the current survey are surveillance surveys, which typically utilize one item to assess a health behavior, rather than multiple items to assess a complex psychological construct. This practice of assessing health behaviors with one item is perhaps because health behaviors can be directly observable and therefore multiple items to assess the behavior would be redundant. As a result, the psychometric properties of surveillance surveys are limited in terms of item analysis or reliability. Although it is possible to assess psychometric properties, it is not often done, likely due to the related expense to accommodate methods, such as repeated measures to assess stability over time. It is much more common to assess the validity of surveillance measures, which is usually done by comparing data to national averages from reputable sources such as the National Survey on Drug Use and Health (NSDUH; SAMHSA, 2021) to evaluate whether trends in the data are consistent with those observed at the state or national level.

Drug Free Communities (DFC) Core Measures. Administered by the Office of National Drug Control Policy (ONDCP), the DFC Support Program was created in 1997 to financially support community-based coalitions in their efforts to prevent youth substance use (see The United States Government, 2023; ICF, 2022 for more information). As part of evaluation efforts, the coalitions must gather data from local youth on "core measures," which include past 30-day prevalence of use for selected substances such as alcohol, cigarettes, and marijuana, perception of risk/harm of using substances, perception of parental disapproval for youth using substances,

and perception of peer disapproval for substance use (see ICF, 2022, Appendix A). These measures have commonly been compared to national estimates from the YRBSS.

Governor's Prevention Initiative for Youth (GPIY). The GPIY was given by the Connecticut DMHAS and the University of Connecticut Health Center in 2000 as a part of an effort to address the statewide problem of adolescent substance use (Ungemack et al., 2000). The GPIY targeted youth enrolled in 7^{th} -10^{th} grade classes within 21 school districts and aimed to measure lifetime and recent use of alcohol, tobacco, and other drugs (ATOD) along with risk and protective factors associated with use. The GPIY contains 57 self-report items and was largely based off prior statewide school surveys (e.g., Barnes & Welte, 1986; Kandel et al., 1986), as well as the YRBSS (CDC, 2004) and MTF (Bachman & Johnston, 1978) surveys (Ungemack et al., 1997). The GPIY contains questions about risk and protective factors in 5 domains: individual, peer, family, school, and community.

Youth Risk Behavior Surveillance Survey (YRBSS). The YRBSS was created by the Center for Disease Control (CDC) to monitor the health-risk behaviors in high school students enrolled in grades 9 through 12. The YRBSS has been conducted biennially since 1991 and uses stratified sampling to include representative samples of students at the national, state, and local levels (Furlong et al., 2004; Underwood et al., 2020). Assessments of the test-retest reliability of the YRBSS have demonstrated substantial agreement between the two timepoints, on average (Brener et al., 2002; Zullig et al., 2006), indicating temporal stability. The results of the YRBSS are often quite comparable to those of other national, state, and district surveys conducted on the same subjects, which speaks to the validity of the survey. Similarly, YRBSS results often coincide with health outcomes from other data collection methods. In 2020, Lima and colleagues

evaluated the psychometric properties of the YRBSS among college students in Brazil and found evidence of convergent and criterion validity.

Monitoring the Future (MTF). The MTF project began in 1975 and measures behaviors and attitudes around drug use among other social and ethical issues (see Bachman et al., 2015 for a review) among high school seniors and deploys follow-up questionnaires to assess changes over time. Since 1991, MTF has included youth enrolled in grades 8 and 10 among its respondents. Over the four decades that the MTF has been collected, the results from year to year have been consistent, which suggests that the measure has a high level of reliability and precision in its estimates. Like the YRBSS, the MTF survey has yielded survey results that are parallel to other health outcomes.

OVERVIEW OF THE CURRENT SURVEY

See Appendix A for the current survey. The items of interest are described below. For ease of reference, substance use indicators appear in Table 2 and socioecological variables are organized by specific domain in Table 3.

Self-Reported Substance Use

Self-reported substance use is assessed with 24 total items that ask about various substances (see Table 2). Six items specifically ask about use within the past 30 days regarding cigarettes, other tobacco products, electronic cigarettes, alcohol, cannabis, and an energy drink containing alcohol (e.g. “Think back over the past 30 days. On how many days, if any, did you use electronic cigarettes (ecigs, vapes, JUULs)?”). These 6 items are answered on a categorical scale with the following options: I have never used; not in the past 30 days; occasionally (1-5 days); frequently (6-20 days); and almost every day (21 days or more). Twelve items are used to assess the use of illicit substances, such as cocaine, ecstasy, heroin, and hallucinogens (e.g.,

"Have you ever used any of these drugs?") and 6 items are used to assess prescription drug misuse, including uppers, downers, tranquilizers, pain medications, steroids, and over the counter medicine (e.g., "Which of the following prescription drug(s) have you ever mis-used to get high?"). These 18 items are all answered on a categorical scale that includes: (1) no, never; (2) yes, but not in the past 30 days; and (3) yes, in the past 30 days. All substance use items were treated as categorical and recoded to reflect the following categories: (1) Never used; (2) Ever in lifetime use; (3) Recent (past 30 day) use.

Table 2

Self-Reported Substance Use Items

Substance	Item	Response Scale
Electronic Cigarettes	Think back over the past 30 days. On how many days, if any, did you use electronic cigarettes (ecigs, vapes, JUULs)?	I have NEVER used Not in the past 30 days Occasionally (1-5 days) Frequently (6-20 days) Almost every day (21 days or more)
Cigarettes	Think back over the past 30 days. On how many days, if any, did you use cigarettes?	
Other tobacco products	Think back over the past 30 days. On how many days, if any, did you use other tobacco products (like cigars, snuff, chewing tobacco, smoking tobacco from a pipe)?	
Cannabis / Marijuana	Think back over the past 30 days. On how many days, if any, did you use marijuana, hashish, edibles, vaping marijuana, smoked marijuana, and/or dabbed marijuana?	
Alcohol	During the past 30 days, on how many days (if any) did you drink one or more drinks of an alcoholic beverage (more than a sip, and NOT including religious activities)?	
Energy drinks containing alcohol	During the past 30 days, on how many days (if any) did you drink one or more drinks of an energy drink containing alcohol?	

Table 2 Continued

Substance	Item	Response Scale
Illicit substances ("Have you ever used any of these drugs?")	Inhalants (things you sniff or inhale to get high such as glue, paint, whippets, or sprays) Cocaine Crack cocaine (rock) Ecstasy (MDMA, Molly) Hallucinogens (LSD, acid or mushrooms, PCP, Angel Dust) Heroin or Fentanyl Salvia Ketamine (Special K) GHB Methamphetamine (Meth) Synthetic Marijuana (Spice, K2, K3) Bath Salts (Ivorywave, Red Dove)	No, never Yes, but not in the past 30 days Yes, in the past 30 days
Prescription Medication Misuse ("Which of the following prescription drug(s) have you ever mis-used to get high?")	Pain medication (OxyContin, Vicodin, Percodan, Codeine, Fentanyl, or Dilaudid) Steroids (juice, roids) Downers (barbiturates, sleeping pills, sedatives, Quaaludes) Tranquilizers (Valium, Xanax, or Librium) Uppers (Ritalin, Adderall, Amphetamines, or Speed) Over the counter medications to get "high" (cough medicine, mouthwash)	No, never Yes, but not in the past 30 days Yes, in the past 30 days

Psychometric Assessment

Because items from the current survey are derived from a variety of sources, it was necessary to conduct an item analysis for all related socioecological domain variables to determine whether it is more appropriate to treat them as individual indicators of their construct or combine them to create a total score. Item analysis allows the assessment of the quality of items by determining how well the items relate to the construct via Cronbach's alpha and the item-total correlations. Cronbach's alpha allows for an assessment of how well the items in a measure assess the same concept or construct while the item-total correlation demonstrates how well the item correlates with the total score of the test (Tavakol & Dennick, 2011). When conducting the item analysis for each construct, an acceptable alpha value and item-total correlations provided evidence to support the conclusion to create a total score to represent that construct (see Appendix C for detailed statistical tables for all psychometric analyses). Psychometric properties for each measure can be found in Table 4.

Individual Domain Items

Perception of harm of substances. A total of 6 items are used to assess perception of harm across the following substances: cigarettes, electronic cigarettes, binge drinking alcohol, cannabis, drinking alcohol daily, and prescription drugs (e.g., "How much do people risk harming themselves physically or in other ways when they do the following?"). These items are answered on a 5-point scale that includes: (0) don't know; (1) no risk; (2) slight risk; (3) moderate risk; (4) great risk. The item analysis on this scale indicated moderate to strong interitem correlations and excellent reliability, $\alpha = .93$. Therefore, all items were retained and averaged into a total score where higher scores indicate a higher perception of risk associated with using substances.

Depressive Symptoms. Depressive symptoms variables include 4 total items to assess thoughts of self-harm, acts of self-harm, depressive symptoms, and seriously considering attempting suicide (e.g., "In the past 12 months, have you experienced any of the following?"). These items are answered with a dichotomous (0) no or (1) yes response. The results of the item analysis demonstrated good reliability for this scale ($\alpha = .82$) and moderate interitem correlations, therefore these variables were summed to create a total score where higher scores indicate more depressive symptoms experienced within the past year.

Perceived availability of substances. A total of 6 items are included to assess perceived access to various substances, including alcohol, cigarettes, electronic cigarettes, cannabis, illicit drugs, and prescription drugs (e.g., "If you wanted to, how easy would it be for you to get…"). These items are answered on a 4-point scale that ranges from (1) very easy to (4) very hard. The item analysis for this scale indicated moderate interitem correlations and good reliability ($\alpha = .86$). Therefore, all items were retained and averaged to create a total score where higher scores indicate more difficulty to access a substance.

Demographic questions. Demographic questions (4 items) such as grade, gender identity, race, and current town of residence are also included in the survey. Participants were also classified into a school district reference group and geographic area (e.g., rural, suburban, urban).

Peer Domain Items

Perception of Peer Disapproval. Five items were included to assess peer disapproval of various substances, including tobacco, electronic cigarettes, alcohol, cannabis, and prescription drugs (e.g., "How wrong do your friends feel it would be for you to smoke tobacco"). Items are answered on a scale from: (1) not at all wrong, to (4) very wrong. The results of the item analysis

indicated moderate to strong interitem correlations and excellent reliability (α = .93). Thus, all items were retained and averaged into a total score where higher scores indicate higher perceptions of peer disapproval.

Family Domain Items

Perception of Parental Disapproval. A total 5 items assessed perception of parental disapproval across substances, including cigarettes, electronic cigarettes, alcohol, cannabis, and prescription drugs (e.g., "How wrong do your parents feel it would be for you to misuse prescription drugs to get high?"). Items are answered on a 4-point scale that ranges from (1) not at all wrong to (4) very wrong. The results from the item analysis demonstrated good reliability (α = .86) and moderate to strong interitem correlations. All items were retained and averaged to create a total score where higher scores indicate higher perceptions of parental disapproval.

Parental Monitoring. Two items assess parental monitoring, including "On a regular weekday, how many hours do you usually spend after school without an adult present" and "When I am away from home, my parent/guardian(s) know where I am and who I am with." These items have different response scales and therefore cannot be combined to represent parental monitoring together, but rather are two separate variables for parental monitoring. The number of hours item is answered on a 5-point scale that varies from (0) none to (4) more than 4 hours, while the second item is answered on a 4-point scale that ranges from (1) definitely not true to definitely true (4).

Family Rules. Family rules are assessed with 5 items that address rules discouraging the use of cigarettes, electronic cigarettes, alcohol, cannabis, and prescription drugs (e.g., "My family has clear rules discouraging me from smoking cigarettes or using tobacco"). The items are answered on a 4-point scale ranging from (1) definitely not true to (4) definitely true. The

item analysis results indicated strong interitem correlations and excellent reliability for this scale (α = .98), therefore these items were averaged into a total score where higher scores indicate higher endorsement of clear family rules discouraging substance use in the home.

Parent Use of Substances. Four items are included to represent parent use of substances, including cigarettes, electronic cigarettes, alcohol, and cannabis (e.g., "Do either of your parents/guardians smoke cigarettes?"). Items are answered with a dichotomous yes/no response. Item analysis on these items indicated poor interitem correlations and a nonacceptable reliability (α = .54). Therefore, these items were not summed into a total score, but remain individual indicators of parent use of substances in the home.

School Domain Items

An item analysis was completed to assess whether the items below could be combined to create a total score. Results indicated weak interitem correlations and a nonacceptable level of reliability for these items (α = .59). Therefore, these items will remain singular items for their designated constructs.

Commitment to School. A single item is included to represent commitment to school (e.g., "I try to do good work at school"). This item is answered on a 4-point scale that ranges from (1) definitely not true to (4) definitely true.

School Support. One item is included to represent school support: "Teachers/staff at my school encourage and support me to do my best." The item is answered on a 4-point scale where 1 is definitely not true and 4 is definitely true.

School Safety. One item is included to capture the feeling of safety at school (e.g., "I feel safe at school") and is answered on a 4-point scale ranging from (1) definitely not true to (4) definitely true.

Community Domain Items

An item analysis was completed to determine whether the items below could be combined to create a total score. Results of the item analysis seemed to delineate the items into two themes and indicated there might be multidimensionality within the scale. An exploratory factor analysis was completed with all community domain items and found a two-factor solution. The factors will be described below.

Factor 1: Negative Perceptions. Three items loaded onto this factor, including: "In my community, kids are often teased or taunted so much their feelings are hurt," "A lot of drugs are sold in my community," and "A lot of kids in my community are into using marijuana and other drugs." These items are answered on a 4-point scale ranging from (1) definitely not true to (4) definitely true. This scale yielded acceptable reliability ($\alpha = .76$) and therefore will be averaged to create a total score where higher scores indicate higher negative perceptions of community.

Factor 2: Community Support. Three items loaded onto this factor, including: "My community is a safe place," "There are lots of things for young people to do in my community," and "Adults in my town see teenagers as valuable and important members of the community." These items are answered on a 4-point scale ranging from (1) definitely not true to (4) definitely true. This scale yielded acceptable reliability ($\alpha = .63$) and therefore will be averaged into a total score where higher scores indicate higher perceptions of a supportive community.

Table 3

Socioecological Domain Items included in Current Survey

Domain	Construct	# of items	Example Item	Source
Individual	Perception of Risk/Harm of Substances	6	How much do people risk harming themselves physically or in other ways when they drink alcoholic beverages, 5 or more, once or twice a week?	DFC Core Measures (Appendix A, p. 43)
	Perception of Availability of Substances	6	If you wanted to, how easy would it be for you to get marijuana (bud, edibles, vape, concentrates like dab, wax, oils)?	GPIY
	Depressive Symptoms	4	I have felt sad or hopeless almost every day for 2 weeks or more so that it stopped me from doing my usual activities.	YRBSS
Peer	Perception of Peer Disapproval	5	How wrong do your friends feel it would be for you to smoke tobacco?	DFC Core Measures
Family	Perception of Parental Disapproval	5	How wrong do your parents feel it would be for you to use prescription drugs not prescribed to you?	DFC Core Measures
	Parental Monitoring	2	On a regular weekday, how many hours do you usually spend after school without an adult present?	GPIY
	Family Rules	5	My family has clear rules discouraging me from drinking alcoholic beverages.	GPIY
	Adult Use	4	Do either of your parents/guardians smoke cigarettes?	GPIY

Table 3 Continued

Domain	Construct	# of items	Example Item	Source
School	Commitment to School	1	I try hard to do good work at school	GPIY
	Support	1	Teachers/staff at my school encourage and support me to do my best	GPIY
	School Safety	1	I feel safe at school	GPIY
Community	Negative Perceptions	3	A lot of drugs are sold in my community	GPIY
	Supportive Community	3	My community is a safe place	GPIY

Table 4

Scales Constructed for Study and their Psychometric Properties

Domain	Construct	Number of Items	α	*M*	*SD*
Individual	Perception of Harm of Substances	6	.93	16.58	7.35
	Perception of Availability of Substances	6	.86	19.48	4.70
	Depressive Symptoms	4	.82	0.75	1.23
Peer	Perception of Peer Disapproval	5	.93	15.67	4.44
Family	Perception of Parental Disapproval	5	.86	18.37	2.68
	Family Rules	5	.98	15.77	5.95
Community	Negative Perceptions	3	.76	6.56	2.51
	Supportive Community	3	.63	8.39	1.96

Note: Psychometric properties listed here (alpha, mean, standard deviation) are from current study; α = Cronbach's alpha for internal consistency.

CHAPTER III

RESULTS

The final dataset of $N = 14{,}134$ included observations from a total of 15 towns and 34 schools in CT DMHAS Region 3 between the years of 2021 to 2024. In the collection of these data, SERAC coordinated efforts with local coalitions, school boards, and school staff to design and collect data from youth. Each partnership afforded the client the opportunity to make alterations to the overall survey, choosing to include or exclude items given their needs. Because of this, some socioecological domain items included in this study have a lower sample size. These changes in sample size will be notated where appropriate.

PRELIMINARY ANALYSES

All analyses were conducted using IBM SPSS 29 and Mplus version 8.11 (Muthén & Muthén, 1998-2017). Data were first assessed for normality and outliers for all total scores (see Table 5). Boxplots were assessed and only parental disapproval of substance use showed outliers more than 1.5 interquartile ranges away from the median. Upon assessment, the outliers were deemed as legitimate responses within the range of possible values. Given the fact that skewness and kurtosis were acceptable, no action was taken to address the outliers on this variable. Contingency tables comparing substance use by grade were generated to assess issues such as small cell size. Such issues were observed among most of the illicit substance use variables. Therefore, all illicit substance use variables were aggregated into a single indicator of illicit substance use for subsequent analyses. All missing data on substance use indicator variables are considered missing at random (MAR) and addressed with full information maximum likelihood techniques in Mplus, as this has been shown to be the most advantageous approach to achieve less biased and more efficient estimates (Enders & Bandalos, 2001). Missing data on

socioecological domain variables are addressed via listwise deletion for relevant analyses in SPSS.

Table 5

Descriptive Statistics of Socioecological Domain Total Scores

Measure	*N*	*M* (*SD*)	Range [Mix, Max]	Skewness (*SE*)	Kurtosis (*SE*)
Harm	13804	16.58 (7.35)	24.00 [0, 24]	-1.22 (0.02)	0.35 (0.04)
Access	13925	19.48 (4.69)	18.00 [6, 24]	-1.00 (0.02)	0.20 (0.04)
PeerDis	13740	15.67 (4.44)	15.00 [5, 20]	-0.75 (0.02)	-0.45 (0.04)
Mon_Hrs	3118	1.90 (1.20)	4.00 [0, 4]	0.10 (0.04)	-0.72 (0.08)
Mon_Away	4300	3.63 (0.60)	3.00 [1, 4]	-1.75 (0.04)	3.63 (0.08)
Rules	14093	15.77 (5.95)	15.00 [5, 20]	-1.05 (0.02)	-0.66 (0.04)
ParDis	13758	18.37 (2.68)	15.00 [5, 20]	-2.20 (0.02)	5.75 (0.04)
Sch_Hard	5084	3.41 (0.67)	3.00 [1, 4]	-1.03 (0.03)	1.23 (0.07)
Sch_Safe	3893	3.12 (0.70)	3.00 [1, 4]	-0.65 (0.04)	0.80 (0.08)
Sch_Supp	3878	3.22 (0.69)	3.00 [1, 4]	-0.72 (0.04)	0.71 (0.08)
CommNeg	4095	6.56 (2.51)	9.00 [3, 12]	0.27 (0.04)	-0.74 (0.08)
CommSupp	4110	8.39 (1.96)	9.00 [3, 12]	-0.44 (0.04)	0.25 (0.08)
Dep	11915	0.75 (1.23)	4.00 [0, 4]	1.53 (0.02)	1.06 (0.05)

Note. Harm = Perception of Harm of Substances; Access = Perception of Availability of Substances; PeerDis = Perception of Peer Disapproval of Substance Use; Mon_Hrs = Parental Monitoring – Hours without an adult; Mon_Away = Parental Monitoring – parents know where I am when I am away; Rules = Family Rules Discouraging Substance Use; ParDis = Perception of Parental Disapproval; Sch_Hard = Commitment to School; Sch_Safe = School Safety; Sch_Supp = School Support; CommNeg = Negative Perceptions of Community; CommSupp = Perceptions of Community Support; Dep = Depressive Symptoms.

Analyses of potential covariates were not assessed until after Aim 1 hypothesis testing, as it is best to have a clear understanding of what the underlying latent class structure is prior to assessing potential covariates (Collins & Lanza, 2010). The assumption of local independence for latent class models was met.

AIM 1: MULTIPLE GROUP LATENT CLASS ANALYSIS

In order to address aim 1, a multiple group latent class analysis was attempted. In this analysis, a three-step approach is suggested: (1) assess configural similarity (i.e., the same number of latent profiles are extracted in each group) by estimating a latent class solution for each group; (2) assess structural similarity (i.e., measurement invariance) across the profiles by determining whether the item response probabilities for similar profiles are significantly different across groups; (3) assess distributional similarity by determining whether the relative size of the latent classes are the same across groups (Morin et al., 2016; Collins & Lanza, 2010).

Configural Similarity

The presentation of the results of LCAs is divided into two sections. The first section provides evaluative information for the model fit to determine the most appropriate number of classes by grade. This process is aided using information criteria, including the Akaike information criterion (AIC; Akaike, 1987), the Bayesian information criterion (BIC; Schwartz, 1978), the sample adjusted BIC (SABIC), with lower values indicating a better model fit (Ferguson et al., 2020). Further, the Lo Mendell Rubin adjusted likelihood ratio test was used to indicate whether the additional latent profile at each step significantly improved the fit of the model. Theoretical understanding and interpretability of the latent profiles based on investigator judgement was also utilized to pick the overall best model solution for each group. Following the discussion of model fit, the item response patterns and qualitative latent profiles were assessed.

Model Fit. All model fit indices can be found in Table 6. Latent class indicators for all estimated models included 13 substance use variables (i.e., alcohol, cigarettes, tobacco, e-cigarettes, cannabis, energy drinks containing alcohol, illicit substances, pain medications, steroids, downers, tranquilizers, uppers, over the counter medications) with 3 categorical levels: Never, Lifetime, Recent. LCA models for each grade were estimated one at a time with extractions of classes increasing with each iteration, until it became clear that model fit would not be improved with the extraction of additional classes.

Primarily, an LCA was completed for the overall sample to find the most parsimonious model solution across all grades. Fit indices indicated that either a four or five latent class solution was the best fit for the model. Upon reviewing the item response patterns between the four and five class solution, it was determined that the four class solution was the best fit for the overall model due to interpretability. The observed decrease in AIC, BIC, and SABIC was higher between the three class model and the four class model than between the four class and five class model. Although the five class model also demonstrated a significant LMR test, the proportion in the lowest profile decreased to only 1.79% and the additional latent class seemed to delineate a higher-risk polysubstance using class that did not seem to be substantively different from the polysubstance using class observed in the four class solution.

In the 7th grade sample, a series of four LCA models were estimated. Given that the information criterion all increased when a LCA with higher than two classes was estimated, paired with the fact that the LMR test was significant only with a two profile solution, it was determined that the two profile solution was the best fit for this model.

In the 8th grade sample, a series of four LCA models were estimated. Although the information criterion all decreased as more classes were extracted, the overall decrease was not

as substantive as the decrease between the one class and two class model. Further, the LMR test was significant only with the two-class solution and the interpretability of the two class solution was superior to the three class solution. Therefore, this solution was determined to be the best fit for this grade.

In the 9th grade sample, five LCA models were completed. Although the BIC actually increased a bit for the four class solution, the AIC and SABIC all decreased, entropy increased suggesting a better delineation among classes, and the LMR test was significant in the four class solution. These criteria, paired with the interpretability of the profiles, determined that the four class solution was the best fit for this grade.

In the 10th grade sample, five LCA models were estimated. Ultimately, the four class solution was determined the best fit for this model based largely on investigator judgement and interpretability of the profiles. Although the LMR test was not significant for this model, the information criteria all decreased for the four class solution and entropy increased.

In the 11th grade sample, six LCA models were estimated. The four class solution was deemed the best fit in this grade due to it being the best fit indicated by AIC, BIC, and SABIC, significant LMR test, and interpretability.

Finally, five LCA models were estimated in the 12th grade sample. The four class solution was deemed the best fit due to the interpretability of the latent classes and the information criteria demonstrating the best solution. Although the LMR test was not significant, it was nearing significance (p = .064). Further, entropy increased between the three class solution and the four class solution. Therefore, the four class solution was deemed the best fit.

Table 6

Model Fit Statistics for Latent Class Solutions by Grade

Model	# classes	AIC	BIC	SABIC	Entropy	LMR (aLRT) *p*-val	Proportion in lowest profile
All Grades (7-12)	1	82458.49	82654.96	82572.33			
	2	67456.13	67856.61	67688.18	0.93	< .0001	0.13082
	3	65971.81	66576.32	66322.08	0.91	.0032	0.03292
	4	**64769.41**	**65577.93**	**65237.90**	**0.89**	**< .0001**	**0.03096**
	5	64366.02	65378.57	64952.73	0.89	< .0001	0.01786
	6	64030.12	65246.69	64735.04	0.89	.3579	0.01576
	7	63791.26	65211.85	64614.41	0.89	.7620	0.00259
7th Grade	1	6675.75	6822.38	6739.77			
	2	**5891.09**	**6189.99**	**6021.60**	**0.90**	**< .0001**	**0.07862**
	3	5780.01	6231.18	5977.02	0.92	.5482	0.03419
	4	5733.91	6337.36	5997.41	0.89	1.0000	0.00475
8th Grade	1	9451.64	9601.89	9519.28			
	2	**8116.48**	**8422.74**	**8254.35**	**0.92**	**< .0001**	**0.08174**
	3	7937.56	8399.85	8145.67	0.89	.4925	0.04373
	4	7854.98	8473.29	8133.33	0.91	.7609	0.01412
9th Grade	1	13125.040	13278.467	13195.856			
	2	10888.623	11201.376	11032.979	0.928	< .0001	0.10833
	3	10696.556	11168.636	10914.451	0.882	.1247	0.03104
	4	**10549.302**	**11180.710**	**10840.737**	**0.909**	**.0072**	**0.02275**
	5	10512.334	11303.069	10877.309	0.921	.8368	0.01485

Table 6 Continued

Model	# classes	AIC	BIC	SABIC	Entropy	LMR (aLRT) *p*-val	Proportion in lowest profile
10th Grade	1	15876.87	16028.63	15946.22			
	2	13243.23	13552.58	13384.18	0.91	< .0001	0.15602
	3	12987.28	13454.22	13200.04	0.82	.3528	0.06320
	4	**12817.84**	**13442.38**	**13102.41**	**0.84**	**.1839**	**0.03301**
	5	12741.96	13524.09	13098.33	0.87	.6702	0.03119
11th Grade	1	18601.61	18753.24	18670.63			
	2	15056.02	15365.10	15196.70	0.92	< .0001	0.18204
	3	14588.23	15054.76	14800.58	0.90	< .0001	0.05343
	4	**14468.26**	**15092.24**	**14752.28**	**0.87**	**< .0001**	**0.03708**
	5	14373.04	15154.48	14728.73	0.87	.0302	0.03730
	6	14305.76	15244.65	14733.11	0.88	.6993	0.02148
12th Grade	1	15865.99	16010.49	15927.88			
	2	12902.39	13196.94	13028.56	0.91	< .0001	0.22656
	3	12504.57	12949.17	12695.01	0.90	.0268	0.05300
	4	**12349.48**	**12944.13**	**12604.19**	**0.91**	**.0642**	**0.02053**
	5	12269.48	13014.19	12588.47	0.88	.8013	0.02135

Note. AIC = Akaike Information Criterion; BIC = Bayesian Information Criterion; SABIC = Sample-adjusted BIC; LMR = Lo Mendell Rubin; aLRT = adjusted likelihood ratio test. The best fitting model is indicated by bolded font.

Latent Classes. The overall LCA model estimated using all grades yielded a four class solution. Item response probabilities were assessed and classes were identified as Nonusers; Alcohol, Cannabis, E-cigarette Experimenters; Prescription Drug and Alcohol Experimenters; and Polysubstance Users (see Table 7; Figures 3 and 4). Nonusers demonstrated a strong probability to endorse never having used any of the substances listed whereas Alcohol, Cannabis, E-cigarette Experimenters, comparatively, had a higher probability of endorsing ever in lifetime use of substances, particularly alcohol, e-cigarettes, and cannabis. Prescription Drug and Alcohol Experimenters were a surprising group that consistently emerged, demonstrating a higher probability to endorse ever in lifetime use of alcohol, pain medications, and downers specifically. This class differed from Alcohol, Cannabis, E-cigarette Experimenters due to their comparative lack of propensity to experiment with e-cigarettes and cannabis. The Prescription Drug and Alcohol Experimenters very much demonstrated a higher likelihood to use substances in the prescription misuse category as well as alcohol. Finally, the Polysubstance Users had the highest probability to endorse recent use (i.e., past 30 days) of alcohol, e-cigarettes, and cannabis. Further, this class had a higher probability of endorsing ever in lifetime use of illicit substances, cigarettes, and tobacco, and represent the highest risk class extracted. The fact that no class demonstrated a strong propensity for using steroids is likely due to the fact that it is not a drug that is commonly used recreationally, more often seen in attempts to increase athletic performance than with substance use experimentation. Overall, the identified classes were contrary to the expected classes in Hypothesis 1a (nonusers, alcohol-only users, dual-substance polysubstance users, and multi-substance polysubstance users).

Table 7

Item Response Probabilities and Latent Class Prevalences from Overall LCA Model

		Latent Classes			
		Nonusers (*n* = 11451)	Alcohol, Cannabis, E-Cigarette Experimenters (*n* = 1547)	Rx and Alcohol Experimenters (*n* = 698)	Polysubstance Users (*n* = 438)
Latent class prevalences		0.810	0.109	0.049	0.031
Alcohol	Never	**0.940**	0.253	**0.700**	0.082
	Lifetime	0.052	**0.537**	0.242	0.349
	Recent	0.007	0.210	0.057	**0.569**
Cigarettes	Never	**1.000**	**0.852**	**0.989**	0.373
	Lifetime	0.000	0.136	0.011	**0.448**
	Recent	0.000	0.011	0.001	0.179
Tobacco	Never	**0.999**	**0.911**	**0.993**	**0.436**
	Lifetime	0.000	0.080	0.005	0.329
	Recent	0.000	0.009	0.003	0.235
E-Cigarettes	Never	**0.988**	0.378	**0.903**	0.039
	Lifetime	0.011	**0.405**	0.075	0.218
	Recent	0.001	0.217	0.022	**0.743**
Cannabis	Never	**0.991**	**0.388**	**0.943**	0.043
	Lifetime	0.005	0.358	0.031	0.231
	Recent	0.004	0.254	0.026	**0.726**
Energy Drink containing Alcohol	Never	**0.991**	**0.632**	**0.844**	0.308
	Lifetime	0.008	0.307	0.131	**0.369**
	Recent	0.001	0.061	0.024	0.323
Illicit Substances	Never	**0.984**	**0.839**	**0.772**	0.362
	Lifetime	0.013	0.140	0.174	**0.423**
	Recent	0.003	0.021	0.054	0.214
Pain Medications	Never	**0.979**	**0.972**	**0.474**	**0.688**
	Lifetime	0.016	0.023	0.353	0.244
	Recent	0.005	0.004	0.174	0.068
Steroids	Never	**0.999**	**0.997**	**0.932**	**0.949**
	Lifetime	0.000	0.002	0.043	0.031
	Recent	0.000	0.001	0.026	0.019
Downers	Never	**0.986**	**0.953**	**0.451**	**0.623**
	Lifetime	0.011	0.034	0.377	0.237
	Recent	0.002	0.013	0.172	0.140

Table 7 Continued

		Latent Classes			
		Nonusers (n = 11451)	Alcohol, Cannabis, E-Cigarette Experimenters (n = 1547)	Rx and Alcohol Experimenters (n = 698)	Polysubstance Users (n = 438)
Latent class prevalences		0.810	0.109	0.049	0.031
Tranquilizers	Never	**0.999**	**0.991**	**0.915**	**0.774**
	Lifetime	0.001	0.009	0.054	0.166
	Recent	0.000	0.000	0.031	0.060
Uppers	Never	**0.999**	**0.990**	**0.875**	**0.698**
	Lifetime	0.000	0.009	0.079	0.218
	Recent	0.000	0.001	0.046	0.085
Over the Counter	Never	**0.992**	**0.968**	**0.757**	**0.670**
	Lifetime	0.006	0.030	0.150	0.257
	Recent	0.002	0.002	0.093	0.073

Note. Highest endorsed item response probabilities are bolded to facilitate interpretation.

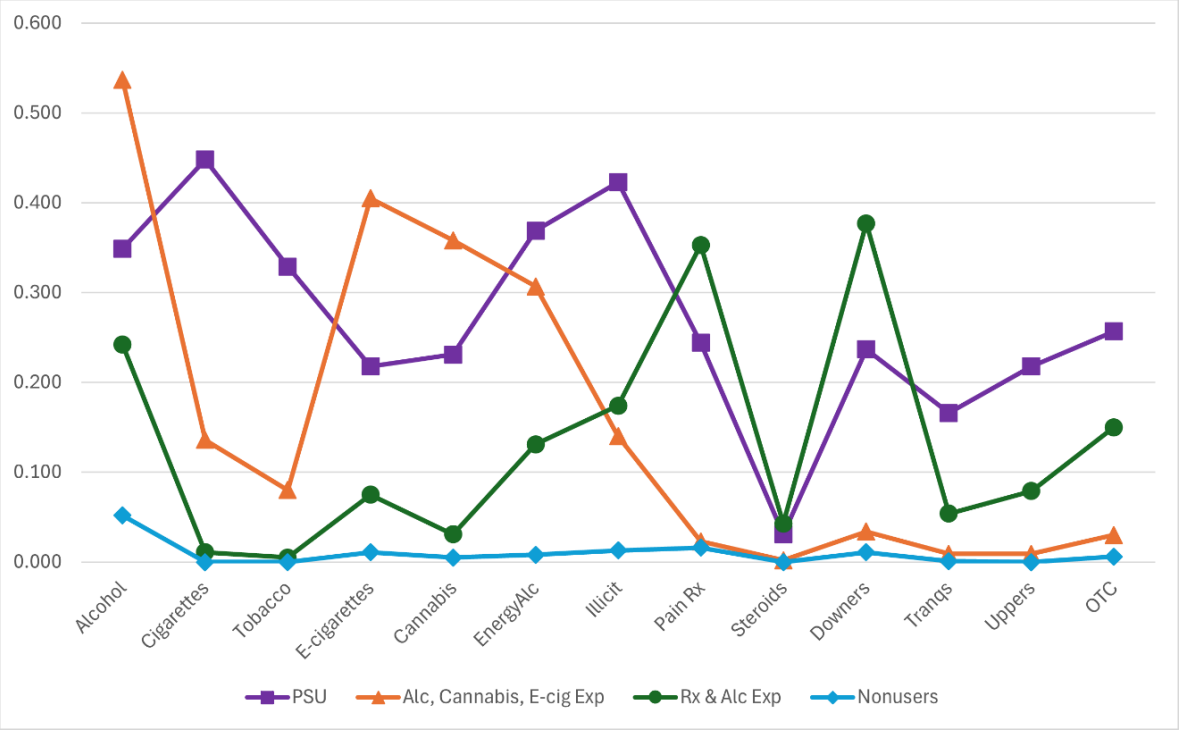

Figure 3. Probability of endorsing lifetime use of substances among classes in overall LCA model (all grades)

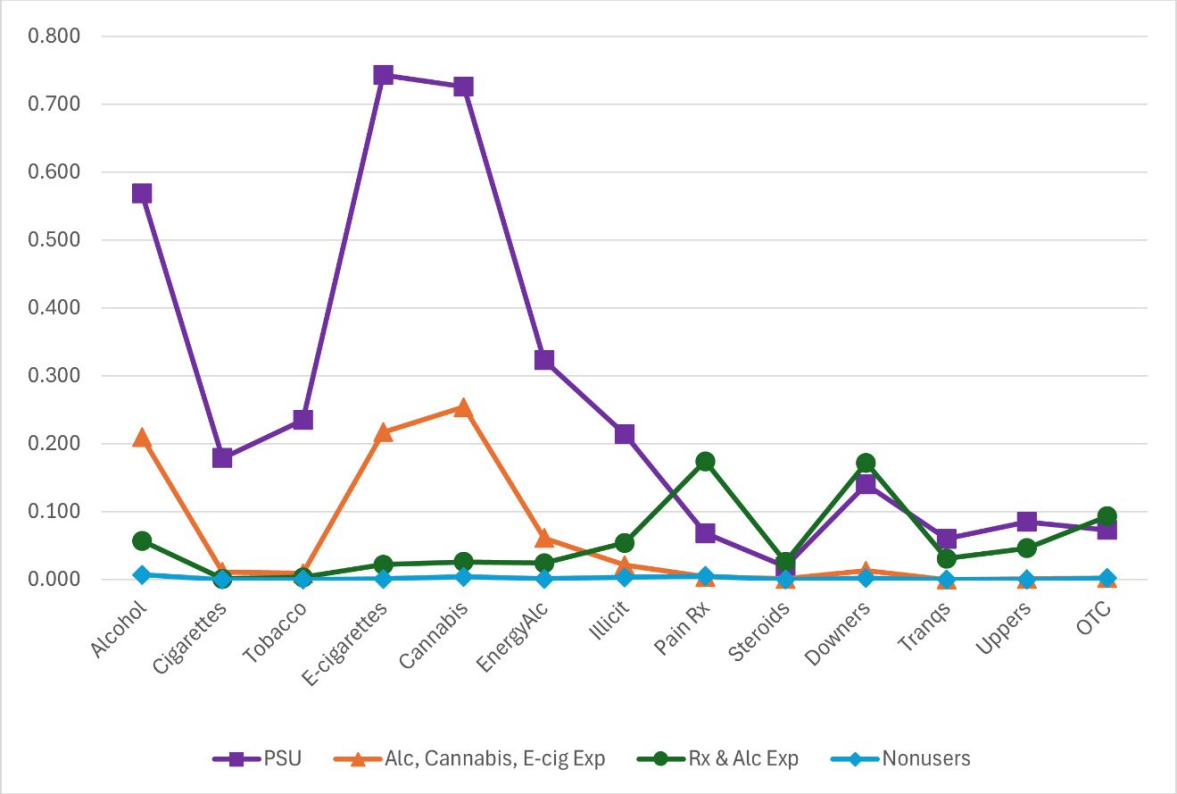

Figure 4. Probability of endorsing recent use of substances among classes in overall LCA model (all grades)

Middle school grades (grades 7 and 8) and high school grades (grades 9-12) separately demonstrated configural similarly by yielding the same number of latent classes. These results address my research question regarding whether the number of latent classes remains consistent across grades. It seems as if the middle grades only include the latent classes of Nonusers and Experimenters, while the high school includes the classes of Nonusers, Alcohol, Cannabis, E-cigarette Experimenters, Prescription Drug and Alcohol Experimenters, and Polysubstance Users, so the latent class solution is not consistent across all grades (see Appendix D for item response probabilities by grade). However, given the fact that the latent classes seem qualitatively similar across grades, it could be that a four class solution is the best solution for the

overall multigroup LCA, but that 7th and 8th grades only yield the developmentally appropriate classes of Nonusers and Experimenters, as we know that substance use experimentation tends to increase as age increases. In order to assess this possibility, structural similarity would need to be investigated to determine if the latent profiles are qualitatively the same across grades.

Structural Similarity

In order to assess structural similarity, first a multiple group LCA including grade as a known categorical group needs to be estimated. Then, the item response probabilities parameters need to be constrained to be equal across all similar profiles across groups and the model estimated again. If the constrained model demonstrates about the same fit as the unconstrained model, then measurement invariance has been demonstrated and the latent profiles can be regarded as qualitatively equal across groups (Collins & Lanza, 2010). Configural similarity is a requirement to assess structural similarity (Morin et al., 2016) and so structural similarity can only be assessed among the middle school and high school grades separately. It is possible to complete advanced analyses of partial structural similarity, but such analyses were deemed outside of the scope of this project. Therefore, structural similarity was assessed for the middle school grades (grades 7 and 8) and high school grades (grades 9-12).

Model fit statistics for the structural similarity of the middle school grades can be seen in Table 8. The constrained model fit the data about as well as the unconstrained model. Therefore, the latent profile interpretations can be considered to be equivalent across groups and directly comparable.

Table 8

Structural Similarity Model Fit Statistics for Middle School Grades (Grades 7-8)

Model	# classes	AIC	BIC	SABIC	loglikelihood
Unconstrained	2	20180.06	20858.96	20522.13	-9984.03
Constrained	2	20163.31	20682.09	20424.71	-10000.66

Structural similarity assessments were attempted within the high school sample. The multiple group LCA with four known classes (grades 9-12) and four latent classes extracted was too complex for the model to converge. Analyses were attempted in a stepwise fashion, comparing 9th grade to 10th grade, collapsing 9th and 10th grade and comparing to 11th grade, and then collapsing 9th, 10th, and 11th grade to compare to 12th grade. The unconstrained models for these analyses were able to be estimated; however, any attempt to constrain the item response probability parameters to equal led to extended hours of processing time for the Mplus software and the models were not able to be estimated. The model non-convergence was due to the maximum number of iterations being met prior to replicating the log-likelihood value for the model, which is a common issue among multiple group LCA (Muthén & Muthén,1998-2017). Although starting values were increased to address this issue, the model processing time was extensive. The non-convergence could also be a limitation of the machine on which analyses were run. Perhaps a more powerful machine would be able to successfully complete all necessary iterations to converge the model. This difficulty is likely due to the complexity of the model (i.e., estimating four known classes along with 4 latent classes) along with the large sample size.

Because structural similarity could not be assessed for the high school grades, the multiple group LCA analyses were abandoned and all subsequent analyses were completed with

the overall LCA model (including all grades) with the four class solution, detailed above. Class membership for each participant was saved and imported into SPSS for Aim 2 and 3 hypothesis testing.

Hypothesis 1b. Due to unforeseen issues surrounding model convergence, hypothesis 1b regarding the expectation of increasing prevalence in substance using classes as grade increases was not able to be assessed via multiple group LCA methods (i.e., distributional similarity assessments). To address this hypothesis, a chi-square analysis was completed in SPSS using class membership to determine whether more youth populate substance using classes as grade increases. Analyses demonstrated that the observed cell distribution was significantly different from chance, χ^2 (15, N = 14,134) = 766.83, $p < .001$. When evaluating the percentage within grade level across latent classes (Table 9), we can see that as grade increases, the percentage of individuals classified as Nonusers decreases, the percentage of classified Alcohol, Cannabis, E-Cigarette Experimenters and Polysubstance Users increases, and Prescription Drug and Alcohol Experimenters is shown to decrease slightly among 11th and 12th graders.

Table 9

Percent Within Grade Level Across Latent Classes

	Latent Class Profiles			
	Nonusers	Alcohol, Cannabis, E-cigarette Experimenters	Rx and Alcohol Experimenters	Polysubstance Users
7th	1920 (92.35%)	70 (3.37%)	80 (3.85%)	9 (0.43%)
8th	2149 (89.95%)	110 (4.60%)	108 (4.52%)	22 (0.92%)
9th	2364 (87.56%)	190 (7.04%)	93 (3.44%)	53 (1.96%)
10th	2040 (80.57%)	314 (12.40%)	95 (3.75%)	83 (3.28%)
11th	1934 (76.78%)	398 (15.80%)	67 (2.66%)	120 (4.76%)
12th	1370 (71.54%)	388 (20.26%)	38 (1.98%)	119 (6.21%)

AIM 2 & 3: MULTINOMIAL LOGISTIC REGRESSIONS

Prior to assessing hypotheses for Aim 2 and 3, the assumptions of multinomial logistic regression were evaluated. Multicollinearity was assessed with Spearman rank correlations between all independent variables and no evidence of multicollinearity was found (Table 10). All assumptions for multinomial logistic regression were met.

Table 10

Spearman Rank Correlations among Socioecological Variables

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13
1. Perception of Harm	1.00												
2. Perception of Availability	.06**	1.00											
3. Peer Disapproval	.13**	.49**	1.00										
4. Parental Monitoring Hours	-.06**	-.21**	-.15**	1.00									
5. Parental Monitoring Knowledge	.14**	.28**	.30**	-.19**	1.00								
6. Family Rules	.17**	.11**	.14**	-.10**	.18**	1.00							
7. Parental Disapproval	.16**	.40**	.50**	-.17**	.26**	.25**	1.00						
8. School Commitment	.15**	.16**	.21**	-.13**	.29**	.15**	.19**	1.00					
9. School Safety	.05**	.14**	.16**	-.09**	.16**	.11**	.14**	.22**	1.00				
10. School Support	.11**	.20**	.21**	-.10**	.24**	.11**	.18**	.30**	.41**	1.00			
11. Negative Community Perceptions	.02	-.34**	-.32**	.16**	-.18**	.00	-.20**	-.03	-.16**	-.21**	1.00		
12. Perceptions of Community Support	.12**	.23**	.28**	-.09**	.21**	.12**	.21**	.21**	.35**	.36**	-.22**	1.00	
13. Depressive Symptoms	-.03**	-.27**	-.25**	.12**	-.15**	-.09**	-.19**	-.11**	-.26**	-.15**	.22**	-.20**	1.00

Note. *$p < .05$, **$p < .01$

Next, several chi-square analyses were completed to investigate any potential covariates with class membership. Specifically, survey year, geographical area, and race were assessed (Table 11). Analyses demonstrated that the observed cell distribution was significantly different from chance for both survey year, χ^2 (9, N = 14,134) = 28.59, p < .001, and for geographic area, χ^2 (6, N = 14,134) = 71.91, p < .001, and therefore these variables were inserted into all subsequent analyses as covariates. Survey year was included as a continuous covariate. Geographic area was dummy coded into two variables, with rural (n = 6447) as the reference group, compared to urban periphery (n = 6430) and suburban (n = 1257).

As seen in Table 11, there is missing data on the race variable and issues with small cell size exist with the Native/Indigenous and Other racial categories. Due to cell size counts less than 5, Fisher's exact test of independence was conducted as an alternative to Chi-square tests for these two racial categories. The "other" racial category was found to not significantly relate to class membership (p = .371) and the "Native/Indigenous" racial category was found to significantly relate to class membership (p = .048). Further analyses revealed that all participants labeled as "suburban" contained missing data on the racial variable. Because of issues with missingness and small cell size, race was not included as a covariate in analyses.

Table 11

Contingency Table of Potential Covariates and Class Membership

		Latent Class Profiles				
		Nonusers	Alcohol, Cannabis, E-cigarette Experimenters	Rx and Alcohol Experimenters	Polysubstance Users	Total
Year (n = 14134)	2021	1777 (81.70%)	242 (11.13%)	63 (2.90%)	93 (4.28%)	2175
	2022	5324 (84.04%)	630 (9.94%)	204 (3.22%)	177 (2.79%)	6335
	2023	3616 (82.94%)	472 (10.83%)	166 (3.81%)	106 (2.43%)	4360
	2024	1060 (83.86%)	126 (9.97%)	48 (3.80%)	30 (2.37%)	1264
Geography (n = 14134)	Rural	5422 (84.10%)	680 (10.55%)	178 (2.76%)	167 (2.59%)	6447
	Suburban	1101 (87.59%)	102 (8.11%)	11 (0.88%)	43 (3.42%)	1257
	Urban Periphery	5254 (81.71%)	688 (10.70%)	292 (4.54%)	196 (3.05%)	6430
Race (n = 12392)	White	5799 (82.38%)	773 (10.98%)	242 (3.44%)	225 (3.20%)	7039
	Black	803 (84.53%)	92 (9.68%)	42 (4.42%)	13 (1.37%)	950
	Asian	616 (89.67%)	46 (6.70%)	20 (2.91%)	5 (0.73%)	687
	Native/Indigenous	93 (75.00%)	22 (17.74%	4 (3.23%)	5 (4.03%)	124
	Hispanic	1487 (87.52%)	116 (6.83%)	68 (4.00%)	28 (1.65%)	1699
	Other	115 (87.12%)	8 (6.06%)	5 (3.79%)	4 (3.03%)	132
	Multiracial	1373 (77.97%)	249 (14.14%)	80 (4.54%)	59 (3.35%)	1761

Due to missingness on socioecological variables, hypotheses were assessed with a series of multinomial logistic regressions, rather than one overall model. Sample sizes utilized will be notated with results. For all multinomial logistic regressions, Nonusers was utilized as the reference group for the dependent variable.

Aim 2.1 Individual Domain Hypothesis Testing

Prior to analyses, gender was dummy coded into two variables to represent the comparison of males (n = 6679; coded 0) to females (n = 6434; coded 1) and males (coded 0) to gender diverse participants (n = 986; coded 1). The gender diverse category included those who identified as transgender male, transgender female, gender fluid, nonbinary/non-gender conforming, not sure right now, prefer to self-describe, and prefer not to say, as these individuals are thought to represent alternatives to the binary response option.

In order to assess hypotheses 2.1a to 2.1c, a multinomial logistic regression was performed regressing class membership on gender, perception of availability of substances, perception of harm, survey year, and geographic variables (Table 12). When assessing predictor variables on class membership, results indicated that identifying as female or gender diverse significantly increased the odds of belonging to a substance using class, which is contrary to hypothesis 2.1a. Further, identifying as gender diverse more than doubled the odds of belonging to the PSU class (odds ratio = 2.33, $p < .001$) or Prescription Drug and Alcohol Experimenters class (odds ratio = 2.83, $p < .001$). Identifying as gender diverse was significantly more influential for classification into the Prescription Drug and Alcohol Experimenters class, 95% CI [2.12, 3.77] compared to the Alcohol, Cannabis, E-cigarette Experimenter class, 95% CI [1.34, 2.08], as the confidence intervals do not overlap, demonstrating a statistical significance at the .05 level.

Table 12

Multinomial Logistic Regression Results of Class Membership on Individual Domain

Regression and Predictors	*B*	*SE*	Wald	df	*p*	*Odds Ratio*	*95% CI*
PSU							
Female	0.36	0.12	8.90	1	.003**	1.43	[1.13, 1.81]
Gender Diverse	0.85	0.19	19.83	1	< .001**	2.33	[1.61, 3.39]
Access	-0.34	0.01	824.51	1	< .001**	0.71	[0.69, 0.73]
Harm	-0.02	0.01	4.18	1	.041*	0.98	[0.97, 0.99]
Survey Year	-0.11	0.07	2.47	1	.116	0.89	[0.78, 1.03]
Urban Periphery	0.21	0.12	3.15	1	.076	1.24	[0.98, 1.56]
Suburban	0.18	0.20	0.81	1	.367	1.20	[0.81. 1.76]
Alc, Cannabis, E-cig Experimenters							
Female	0.43	0.06	46.77	1	< .001**	1.54	[1.36, 1.74]
Gender Diverse	0.51	0.11	20.85	1	< .001**	1.67	[1.34, 2.08]
Access	-0.19	0.01	1008.63	1	< .001**	0.83	[0.82, 0.84]
Harm	-0.01	0.00	1.18	1	.277	1.00	[0.99, 1.00]
Survey Year	0.03	0.04	0.81	1	.367	1.03	[0.96, 1.11]
Urban Periphery	0.10	0.06	2.71	1	.100	1.11	[0.98, 1.25]
Suburban	-0.28	0.12	5.38	1	.020*	0.76	[0.60, 0.96]
Rx, Alc Experimenters							
Female	0.25	0.10	6.14	1	.013*	1.29	[1.05, 1.58]
Gender Diverse	1.04	0.15	50.42	1	< .001**	2.83	[2.12, 3.77]
Access	-0.13	0.01	200.10	1	< .001**	0.88	[0.86, 0.89]
Harm	0.01	0.01	1.24	1	.265	1.01	[0.99, 1.02]
Survey Year	0.14	0.06	4.98	1	.026*	1.15	[1.02, 1.30]
Urban Periphery	0.64	0.10	41.79	1	< .001**	1.90	[1.57, 2.31]
Suburban	-1.10	0.32	11.86	1	< .001**	0.33	[0.18, 0.62]

Note. $N = 13696$, *$p < .05$, **$p < .01$. Access = Perception of Availability of Substances; Harm = Perception of Harm of Substances.

Similarly, perception of the difficulty associated with accessing substances (higher scores indicate more difficulty accessing substances) significantly decreased the odds of belonging to a substance using class, which supports hypothesis 2.1.b. The perceived availability of substances was more influential on the PSU class, 95% CI [0.69, 0.73], than any other substance using class. Finally, higher perception of harm associated with using substances significantly decreased the

odds of belonging to the PSU class (odds ratio = 0.98, p = .041), but was not associated with the Alcohol, Cannabis, E-cigarette Experimenter class or the Prescription Drug and Alcohol Experimenter class, which provides partial support for hypothesis 2.1.c. However, this finding was only marginally significant for the PSU class, given the upper limit of the confidence interval close to 1.

Aim 2.2 Peer Domain Hypothesis Testing

To assess the Aim 2.2 hypothesis, a multinomial logistic regression was performed, regressing class membership on the perception of peer disapproval, survey year, and geographical variables (Table 13). Higher perceptions of peer disapproval significantly decreased the odds of belonging to a substance using class, providing support for hypothesis 2.2. Peer disapproval demonstrated significantly different effects between substance using classes. Comparatively, perception of peer disapproval was strongest on the odds of belonging to the PSU class, 95% CI [0.69, 0.73], followed by the Alcohol, Cannabis, E-cigarette Experimenters class, 95% CI [0.80, 0.82], and least effective on the Prescription Drug and Alcohol Experimenters class, 95% CI [0.86, 0.90].

Table 13

Multinomial Logistic Regression Results of Class Membership on Peer Domain

Regression and Predictors	*B*	*SE*	Wald	df	*p*	*Odds Ratio*	*95% CI*
PSU							
Peer Disapproval	-0.34	0.01	671.99	1	< .001**	0.71	[0.69, 0.73]
Survey Year	-0.17	0.07	5.48	1	.019*	0.85	[0.74, 0.97]
Urban Periphery	0.09	0.12	0.58	1	.447	1.09	[0.87, 1.37]
Suburban	0.06	0.19	0.10	1	.758	1.06	[0.73, 1.55]
Alc, Cannabis, E-cig Experimenters							
Peer Disapproval	-0.21	0.01	1053.16	1	< .001**	0.81	[0.80, 0.82]
Survey Year	0.03	0.04	0.46	1	.496	1.03	[0.95, 1.10]
Urban Periphery	-0.01	0.06	0.01	1	.933	1.00	[0.88, 1.12]
Suburban	-0.32	0.12	7.15	1	.007**	0.73	[0.57, 0.92]
Rx, Alc Experimenters							
Peer Disapproval	-0.13	0.01	166.26	1	< .001**	0.88	[0.86, 0.90]
Survey Year	0.14	0.06	5.43	1	.020*	1.15	[1.02, 1.30]
Urban Periphery	0.55	0.10	31.35	1	< .001**	1.74	[1.43, 2.11]
Suburban	-1.10	0.32	11.95	1	< .001**	0.33	[0.18, 0.62]

Note. N = 13740, *p < .05, **p < .01. Peer Disapproval = Perception of Peer Disapproval.

Aim 2.3 Family Domain Hypothesis Testing

To assess the Aim 2.3 hypotheses, a series of multinomial logistic regressions were performed due to changing sample sizes. Specifically, the parental monitoring variables (n = 3103) and parental use of substances (n = 2728) models had substantially lower sample sizes than the model that contains clear family rules and parental disapproval (n = 13729). Because of these issues, several multinomial logistic regressions were completed rather than one overall model.

Primarily, class membership was regressed on the variables associated with parental monitoring, survey year, and geographical variables (Table 14). Youth who reported higher

parental knowledge regarding where they are and who they are with when away from home (i.e., Mon_Away) were significantly less likely to belong to any substance using class. Further, the impact of parental knowledge was significantly more influential on the odds of belonging to the PSU class, 95% CI [0.14, 0.25], compared to the other substance using classes.

Youth who reported more hours spent alone after school (Mon_Hrs) were significantly more likely to belong to the Alcohol, Cannabis, E-cigarette Experimenter group (odds ratio = 1.33, $p < .001$), but did not demonstrate a statistically significant relationship with any other substance using class. These results provide partial support for hypothesis 2.3a.

Table 14

Multinomial Logistic Regression Results of Class Membership on Monitoring

Regression and Predictors	*B*	*SE*	Wald	df	*p*	*Odds Ratio*	*95% CI*
PSU							
Mon_Hrs	0.16	0.10	2.78	1	.095	1.18	[0.97, 1.42]
Mon_Away	-1.68	0.15	127.42	1	< .001**	0.19	[0.14, 0.25]
Survey Year	-0.07	0.12	0.32	1	.574	0.93	[0.73, 1.19]
Urban Periphery	-0.52	0.31	2.88	1	.090	0.59	[0.33, 1.08]
Alc, Cannabis, E-cig Experimenters							
Mon_Hrs	0.29	0.05	29.31	1	< .001**	1.33	[1.20, 1.48]
Mon_Away	-0.91	0.10	86.20	1	< .001**	0.40	[0.33, 0.49]
Survey Year	0.05	0.07	0.49	1	.483	1.05	[0.92, 1.19]
Urban Periphery	-0.15	0.14	1.05	1	.305	0.86	[0.65, 1.14]
Rx, Alc Experimenters							
Mon_Hrs	0.19	0.10	3.51	1	.061	1.21	[0.99, 1.47]
Mon_Away	-0.73	0.19	14.36	1	< .001**	0.48	[0.33, 0.70]
Survey Year	0.61	0.14	17.86	1	< .001**	1.83	[1.38, 2.43]
Urban Periphery	1.32	0.27	24.16	1	< .001**	3.74	[2.21, 6.33]

Note. $N = 3103$, *$p < .05$, **$p < .01$, no observations included the suburban geographical area; Mon_Hrs = Parental Monitoring – Hours unsupervised without an adult; Mon_Away = Parental Monitoring – parents know where I am when I am away.

In order to assess hypotheses 2.3b and 2.3c, another multinomial logistic regression was completed using family rules, perception of parental disapproval, survey year, and geographical variables as predictors of class membership (Table 15). Contrary to hypothesis 2.3b, youth who endorse more clear family rules discouraging substance use show a slightly higher likelihood of belonging to the PSU (odds ratio = 1.03, $p = .016$) and the Alcohol, Cannabis, E-cigarette Experimenters class (odds ratio = 1.01, $p = .010$). However, these results are only marginally significant, as the confidence interval is very close to or contains 1 in both of these estimates, which would indicate no effect. Clear family rules were not significantly associated with the Prescription Drug and Alcohol Experimenters. In support of hypothesis 2.3c, higher perception of parental disapproval significantly decreased the odds of belonging to a substance using class. Of note, perception of parental disapproval was significantly more influential on the odds of belonging to the PSU class, 95% CI [0.70, 0.74], followed by the Alcohol, Cannabis, E-cigarette Experimenters class, 95% CI [0.78, 0.81], and finally the Prescription Drug and Alcohol Experimenters class, 95% CI [0.83, 0.88].

Table 15

Multinomial Logistic Regression Results of Class Membership on Family Rules and Perceptions of Parental Disapproval

Regression and Predictors	*B*	*SE*	Wald	df	*p*	*Odds Ratio*	*95% CI*
PSU							
Rules	0.03	0.01	5.76	1	.016*	1.03	[1.01, 1.05]
Parent Disapproval	-0.33	0.01	565.54	1	< .001**	0.72	[0.70, 0.74]
Survey Year	-0.18	0.07	6.35	1	.012*	0.84	[0.73, 0.96]
Urban Periphery	0.14	0.11	1.42	1	.233	1.15	[0.92, 1.43]
Suburban	0.02	0.19	0.02	1	.899	1.02	[0.71, 1.48]
Alc, Cannabis, E-cig Experimenters							
Rules	0.01	0.01	6.63	1	.010*	1.01	[1.00, 1.02]
Parent Disapproval	-0.23	0.01	646.46	1	< .001**	0.79	[0.78, 0.81]
Survey Year	0.01	0.04	0.05	1	.821	1.01	[0.94, 1.08]
Urban Periphery	0.03	0.06	0.22	1	.637	1.03	[0.91, 1.16]
Suburban	-0.35	0.12	8.69	1	.003**	0.71	[0.56, 0.89]
Rx, Alc Experimenters							
Rules	-0.01	0.01	2.16	1	.142	0.99	[0.97, 1.00]
Parent Disapproval	-0.16	0.02	114.55	1	< .001**	0.85	[0.83, 0.88]
Survey Year	0.13	0.06	4.46	1	.035*	1.14	[1.01, 1.29]
Urban Periphery	0.57	0.10	32.59	1	< .001**	1.76	[1.45, 2.14]
Suburban	-1.11	0.32	12.04	1	< .001**	0.33	[0.18, 0.62]

Note. $N = 13729$, *$p < .05$, **$p < .01$. Rules = Family Rules Discouraging Substance Use; Parent Disapproval = Perception of Parent Disapproval.

A final multinomial logistic regression model was completed to assess hypothesis 2.3d, with parent use of cigarettes, parent use of e-cigarettes, parent use of alcohol, and parent use of cannabis, survey year, and geographical variables as predictors (Table 16). The sample size for this regression model was $N = 2728$. No parent use variables were significantly related to the Prescription Drug and Alcohol Experimenters class. Parent use of cigarettes was not significantly related to any substance using class. Parent use of e-cigarettes (odds ratio = 1.92, $p = .001$), parent use of alcohol (odds ratio = 2.32, $p < .001$), and parent use of cannabis (odds ratio = 2.66,

$p < .001$) all significantly increased the odds of belonging to the Alcohol, Cannabis, E-cigarettes Experimenters class. Only parent use of alcohol (odds ratio = 1.95, $p = .033$) and parent use of cannabis (odds ratio = 6.49, $p < .001$) significantly increased the odds of belonging to the PSU class, with parental use of cannabis being significantly more influential on belonging to the PSU class than parent use of alcohol. These results provide partial support for hypothesis 2.3d.

Table 16

Multinomial Logistic Regression Results of Class Membership on Parent Substance Use

Regression and Predictors	*B*	*SE*	Wald	df	*p*	*Odds Ratio*	*95%CI*
PSU							
Par_cigs	0.00	0.29	0.00	1	.994	1.00	[0.56, 1.78]
Par_ecigs	0.24	0.34	0.51	1	.478	1.28	[0.65, 2.50]
Par_alc	0.67	0.31	4.54	1	.033*	1.95	[1.06, 3.62]
Par_MJ	1.87	0.28	44.91	1	< .001**	6.49	[3.76, 11.22]
Survey Year	-0.78	0.29	7.44	1	.006**	0.46	[0.26, 0.80]
Urban Periphery	-0.20	0.32	0.40	1	.527	0.82	[0.44, 1.52]
Alc, Cannabis, E-cig Experimenters							
Par_cigs	0.22	0.17	1.71	1	.192	1.25	[0.90, 1.74]
Par_ecigs	0.65	0.20	10.62	1	.001**	1.92	[1.30, 2.84]
Par_alc	0.84	0.18	22.48	1	< .001**	2.32	[1.64, 3.29]
Par_MJ	0.98	0.18	30.50	1	< .001**	2.66	[1.88, 3.76]
Survey Year	-0.54	0.17	10.75	1	.001**	0.58	[0.42, 0.80]
Urban Periphery	-0.15	0.17	0.72	1	.398	0.86	[0.61, 1.21]
Rx, Alc Experimenters							
Par_cigs	0.58	0.32	3.38	1	.066	1.79	[0.96, 3.32]
Par_ecigs	-0.16	0.45	0.12	1	.732	0.86	[0.35, 2.08]
Par_alc	0.10	0.29	0.12	1	.730	1.10	[0.63. 1.93]
Par_MJ	0.33	0.39	0.71	1	.398	1.39	[0.65, 2.97]
Survey Year	-0.72	0.52	1.89	1	.169	0.49	[0.18, 1.36]
Urban Periphery	1.89	0.42	20.78	1	< .001**	6.65	[2.95, 15.01]

Note. $N = 2728$, *$p < .05$, **$p < .01$, no observations included the suburban geographical area. Par_cigs = Parental use of cigarettes; Par_ecigs = Parental use of e-cigarettes; Par_alc = Parental use of alcohol; Par_MJ = Parental use of cannabis.

Aim 2.4 School Domain Hypothesis Testing

To assess the Aim 2.4 hypotheses, a multinomial logistic regression was completed regressing class membership on school commitment (Sch_hard), school safety (Sch_safe), school support (Sch_support), survey year, and geographical variables (Table 17). Of note, this model was completed with a sample size of 3861 individuals. Providing partial support for hypothesis 2.4a, school commitment significantly decreased the odds of belonging to the PSU (odds ratio = 0.46, $p < .001$) and Alcohol, Cannabis, and E-cigarettes Experimenters (odds ratio = 0.60, $p < .001$) classes, but was not significantly related to the Prescription Drug and Alcohol Experimenters class. Higher perceptions of school safety were not significantly related to the PSU or the Alcohol, Cannabis, and E-cigarette Experimenters class, but did significantly decrease the odds of belonging to the Prescription Drug and Alcohol Experimenters class (odds ratio = 0.52, $p < .001$), providing partial support for hypothesis 2.4b. Finally, higher perceptions of school support significantly decreased the odds of belonging to the PSU class (odds ratio = 0.56, $p < .001$) and the Alcohol, Cannabis, and E-cigarettes Experimenter class (odds ratio = 0.71, $p < .001$), but was not significantly related to the Prescription Drug and Alcohol Experimenters class, providing partial support for hypothesis 2.4c. No predictor demonstrated a significantly stronger influence on one group compared to another.

Table 17

Multinomial Logistic Regression Results of Class Membership on School Domain

Regression and Predictors	*B*	*SE*	Wald	df	*p*	*Odds Ratio*	*95% CI*
PSU							
Sch_hard	-0.77	0.15	28.40	1	< .001**	0.46	[0.35, 0.61]
Sch_safe	-0.22	0.15	2.19	1	.139	0.80	[0.60, 1.07]
Sch_support	-0.58	0.15	15.81	1	< .001**	0.56	[0.42, 0.75]
Survey Year	-0.16	0.11	2.28	1	.131	0.85	[0.69, 1.05]
Urban Periphery	-0.58	0.29	3.81	1	.051	0.56	[0.32, 1.00]
Alc, Cannabis, E-cig Experimenters							
Sch_hard	-0.51	0.08	37.98	1	< .001**	0.60	[0.51, 0.70]
Sch_safe	-0.03	0.08	0.14	1	.709	0.97	[0.82, 1.14]
Sch_support	-0.34	0.08	16.94	1	< .001**	0.71	[0.60, 0.84]
Survey Year	-0.01	0.06	0.02	1	.879	0.99	[0.89, 1.11]
Urban Periphery	-0.22	0.14	2.55	1	.110	0.80	[0.61, 1.05]
Rx, Alc Experimenters							
Sch_hard	-0.24	0.16	2.29	1	.130	0.79	[0.58, 1.07]
Sch_safe	-0.66	0.14	22.50	1	< .001**	0.52	[0.39, 0.68]
Sch_support	-0.20	0.15	1.84	1	.175	0.82	[0.61, 1.09]
Survey Year	0.25	0.12	4.77	1	.029*	1.28	[1.03, 1.61]
Urban Periphery	0.78	0.22	12.75	1	< .001**	2.18	[1.42, 3.35]

Note. $N = 3861$, *$p < .05$, **$p < .01$, no observations included the suburban geographical area. Sch_hard = Commitment to School; Sch_safe = School Safety; Sch_support = School Support.

Aim 2.5 Community Domain Hypothesis Testing

To assess the Aim 2.5 hypotheses, a multinomial logistic regression was completed with negative perceptions of community (CommNeg), community support (CommSupp), survey year, and geographical variables as predictors of class membership (Table 18). The sample for analyses consisted of 4094 youth. Providing support for hypothesis 2.5, higher negative perceptions of community significantly increased the odds of belonging to all substance using classes and higher perceptions of community support significantly decreased the odds of belonging to all substance using classes. Negative perceptions of community were significantly

more predictive of belonging to the PSU class, 95% CI [1.28, 1.53], compared to the Prescription Drug and Alcohol Experimenters class, 95% CI [1.07, 1.23].

Table 18

Multinomial Logistic Regression Results of Class Membership on Community Domain

Regression and Predictors	*B*	*SE*	Wald	df	*p*	*Odds Ratio*	*95% CI*
PSU							
CommNeg	0.34	0.05	51.09	1	< .001**	1.40	[1.28, 1.53]
CommSupp	-0.28	0.06	24.20	1	< .001**	0.75	[0.67, 0.84]
Survey Year	0.24	0.16	2.13	1	.145	1.27	[0.92, 1.74]
Urban Periphery	-0.26	0.29	0.82	1	.366	0.77	[0.44, 1.35]
Suburban	0.02	0.33	0.00	1	.963	1.02	[0.53, 1.95]
Alc, Cannabis, E-cig Experimenters							
CommNeg	0.23	0.02	87.66	1	< .001**	1.25	[1.20, 1.31]
CommSupp	-0.16	0.03	27.12	1	< .001**	0.85	[0.80, 0.90]
Survey Year	0.14	0.09	2.26	1	.132	1.15	[0.96, 1.38]
Urban Periphery	-0.11	0.15	0.62	1	.433	0.89	[0.67, 1.19]
Suburban	-0.21	0.19	1.26	1	.262	0.81	[0.57, 1.17]
Rx, Alc Experimenters							
CommNeg	0.14	0.04	14.31	1	< .001**	1.15	[1.07, 1.23]
CommSupp	-0.21	0.05	19.87	1	< .001**	0.81	[0.74, 0.89]
Survey Year	0.76	0.19	15.93	1	< .001**	2.13	[1.47, 3.09]
Urban Periphery	1.60	0.33	24.16	1	< .001**	4.96	[2.62, 9.40]
Suburban	-0.54	0.59	0.84	1	.360	0.58	[0.19, 1.85]

Note. $N = 4094$, *$p < .05$, **$p < .01$. CommNeg = Negative Perceptions of Community; CommSupp = Perceptions of Community Support.

Aim 3 Depressive Symptoms Hypothesis Testing

To assess the Aim 3 hypotheses, a multinomial logistic regression was completed with class membership regressed onto depressive symptoms, survey year, and geographical variables (Table 19). In support of all original hypotheses, higher endorsement of depressive symptoms in

the last year significantly increased the odds of belonging to all substance using classes. Depressive symptoms were significantly more influential on predicting the odds of belonging to the PSU class, 95% CI [1.81, 2.09], compared to the Alcohol, Cannabis, E-cigarette Experimenters class, 95% CI [1.55, 1.69], but not compared to the Prescription Drug and Alcohol Experimenters class, 95% CI [1.63, 1.85].

Table 19

Multinomial Logistic Regression Results of Class Membership on Depressive Symptoms

Regression and Predictors	*B*	*SE*	Wald	df	*p*	*Odds Ratio*	*95% CI*
PSU							
Depressive	0.67	0.04	321.38	1	< .001**	1.95	[1.81, 2.09]
Survey Year	-0.20	0.08	6.78	1	.009**	0.82	[0.71, 0.95]
Urban Periphery	0.29	0.12	5.40	1	.020*	1.33	[1.05, 1.70]
Suburban	0.63	0.20	9.66	1	.002**	1.87	[1.26, 2.78]
Alc, Cannabis, E-cig Experimenters							
Depressive	0.48	0.02	515.34	1	< .001**	1.62	[1.55, 1.69]
Survey Year	-0.02	0.04	0.38	1	.540	0.98	[0.90, 1.06]
Urban Periphery	0.10	0.07	2.46	1	.117	1.11	[0.98, 1.26]
Suburban	-0.05	0.13	0.15	1	.697	0.95	[0.75, 1.22]
Rx, Alc Experimenters							
Depressive	0.55	0.03	294.10	1	< .001**	1.74	[1.63, 1.85]
Survey Year	0.05	0.07	0.63	1	.426	1.06	[0.93, 1.20]
Urban Periphery	0.51	0.11	23.10	1	< .001**	1.67	[1.35, 2.05]
Suburban	-0.95	0.34	7.87	1	.005**	0.39	[0.20, 0.75]

Note. $N = 11915$, *$p < .05$, **$p < .01$. Depressive = Depressive Symptoms.

CHAPTER IV

DISCUSSION

The present study sought to (1) investigate the substance and polysubstance use patterns among Connecticut adolescents in grades 7-12 as well as (2) explore the various socioecological and depressive mental health symptom correlates associated with adolescent substance use. While previous research has investigated patterns of substance use among adolescents, studies typically do not include indicators of illicit and prescription drug use or correlates outside of standard demographic variables (Halladay et al., 2020; Wu et al., 2020), which limits our understanding of the trajectories of substance use into adulthood. Further, previous research tends to include samples from a selection of grades (e.g., 8th and 10th grade) rather than include continuous grades from 7th to 12th, when substance use onset usually occurs (Tomczyk et al., 2016). Studies that do include continuous grades do not typically include differences in use by age (Hallday et al., 2020). The current study sought to add to the literature by including key substance use indicators, investigating the developmental patterns of adolescent substance use, and determining the influence of various socioecological predictors in the odds of belonging to substance using classes.

PATTERNS OF SUBSTANCE AND POLYSUBSTANCE USE AMONG ADOLESCENTS

The first aim of this study was to identify the patterns of substance use and polysubstance use among Connecticut adolescents in grades 7-12. Specifically, it was expected that the substance using classes that emerged would be best described as nonusers, alcohol-only users, dual-substance polysubstance users, and multi-substance polysubstance users. In contrast to expectations, the substance using classes that emerged in this study included: (1) Nonusers, (2)

Alcohol, Cannabis, E-cigarette Experimenters, (3) Prescription Drug and Alcohol Experimenters, and (4) Polysubstance Users.

Nonusers. Nonusers demonstrated the highest probability to endorse never having used any substances and were the highest populated class across all grades, with about 81% of youth classified as Nonusers. This class was aligned with expectations and provided partial support for hypothesis 1a. The identification of this class and its prevalence highlights that the majority of adolescents report that they abstain from all substance use, which is consistent with national estimates of adolescent substance use as well.

Alcohol, Cannabis, E-cigarette Experimenters. Alcohol, Cannabis, E-cigarette Experimenters were more likely to endorse ever using alcohol, cannabis, or e-cigarettes. This class was the second most prevalent, with about 11% of the sample falling within this classification. Although there was some potential for these individuals to have used these substances recently (i.e., within the past 30 days), this group was better characterized by having ever used these substances rather than using recently (see Table 7). While I expected to find a single substance experimenter class (i.e., alcohol-only users), the discovery of this substance using class was in line with previous research suggesting that adolescents most commonly experiment with alcohol, cannabis, and tobacco (Halladay et al., 2020; Wu et al., 2020); although, results from the current study suggest that the use of e-cigarettes has replaced tobacco in recent years. It seems as if this class captured experimentation with multiple substances rather than delineating only those that have ever used alcohol. This class is theoretically aligned with common substance experimentation trajectories for youth (e.g., Lynne-Landsman et al., 2010).

Polysubstance Users. The Polysubstance Users (PSU) class was characterized by a strong probability of endorsement of recent (past 30 days) use of cannabis and e-cigarettes,

followed by the recent use of alcohol. This class was the least prevalent, with about 3% of the sample classified as PSU. Across all classes, the PSU class demonstrated a higher likelihood to endorse ever in lifetime use of cigarettes, tobacco, and illicit substances. These findings corroborate previous research indicating that adolescents who endorse current cannabis or tobacco use are typically engaging in moderate multi-use of substances (Halladay et al., 2020) of note, polysubstance using adolescents are at a higher risk for continuing to increase the number of substances they use.

Prescription Drug and Alcohol Experimenters. The Prescription Drug and Alcohol Experimenters was an unexpected class that demonstrated a higher probability of ever in lifetime use of pain medications and downers along with a slightly increased probability of lifetime use of alcohol. This class had the third highest prevalence with about 5% of the sample classified as Prescription Drug and Alcohol Experimenters. This class demonstrated the highest likelihood to misuse prescription drugs across all classes, a unique characteristic potentially reflecting a novel substance use pattern emerging in youth. In contrast to previous research, youth in this study who were more likely to misuse prescription drugs were not more likely to report concurrent use of alcohol or cannabis (e.g., Jones et al., 2020) or to use cigarettes or e-cigarettes (e.g., Harton et al., 2023). The youth in the Prescription Drug and Alcohol Experimenters class were more likely to have endorsed lifetime use of pain medications and downers than they were to endorse lifetime use of alcohol. Further, this class included more younger grades than older, as the percentage within grade level was highest for 8th graders and decreased between 10th to 12th grade (see Table 9). Each of the other substance using classes demonstrated an increase in percentage as grade increases, whereas the Prescription Drug and Alcohol Experimenters is unique in showing a decrease as grade increases. This class also contained a higher prevalence

among the urban periphery areas than in suburban and rural areas, which may influence their psychosocial stress levels and increase their likelihood for substance use (Galea et al., 2005). Taken together, the Prescription Drug and Alcohol Experimenters group seem to capture a distinct pattern of substance use that stands apart from the other classes. Perhaps motives for substance use differ in this class compared to the other substance using classes. Youth may have easier access to prescription drugs within the home or perhaps are influenced by parental misuse of prescription drugs. It is also possible that this class captures an emerging pattern of substance use related to the concurrent opioid epidemic in the United States. Further exploration is necessary to deduce key characteristic and developmental differences.

Multiple Group Latent Class Analysis

Although aim 1 was originally intended to be assessed with multiple group LCA to capture the effect of grade level when assessing substance use patterns among adolescents, the complexity of a model that attempted to compared fixed and free parameters across six grades and four classes would not converge, leading to an alternative approach to this analysis. In examining class solutions across grades, I was able to demonstrate that middle versus high school grades extracted different numbers of latent classes. Grades 7 and 8 yielded a two class solution that included Nonusers and Experimenters while grades 9-12 all yielded four class solutions that seemed to mirror the classes described previously: Nonusers; Alcohol, Cannabis, E-cigarette Experimenters; Prescription Drug and Alcohol Experimenters; Polysubstance Users (see Appendix D). Although the middle school grades included only two classes, it is still possible that the most parsimonious model for all grades is a four class solution, as it is possible that youth in middle school grades have yet to engage with substance experimentation to the level of their older peers and yield only the developmentally appropriate classes of Nonusers and

Experimenters. This assertion is aligned with previous research that substance experimentation peaks around 10th to 12th grade (Jordan & Andersen, 2017; Kassel et al., 2005). Analyses of partial structural stability between middle and high school grades would elucidate the best model for describing substance use patterns across all grades. Although this study is limited by not using a quantitative comparison of classes across grades, alternatives to estimating these complex models may become available in future. At present, the current study provides evidence that the latent structure of substance using classes is not similar across all grades.

Due to the need to discontinue the multiple group LCA, the expectation regarding that more youth would populate substance using classes as grade increases was supported by a chi-square analysis (see Table 9). The finding aligns with existing research regarding sensitive periods of substance use experimentation in adolescence (e.g., Jordan & Andersen, 2017) and reaffirms the established understanding that older youth are more likely to have experimented with various substances. Taken together, these results highlight the importance of understanding the developmental trajectory of adolescent substance use and supporting the implementation of developmentally appropriate prevention strategies by grade. Specifically, middle school grades are likely to benefit from primary prevention strategies to discourage the initiation of substance use, while high school grades are likely to benefit from both primary prevention and harm reduction strategies to mitigate substance use experimentation and potential escalation to substance use disorder.

SOCIOECOLOGICAL RISK AND PROTECTIVE FACTORS AND CLASS MEMBERSHIP

The second aim of this study was to investigate the varying influences of level-specific socioecological risk and protective factors on class membership. It was expected that factors in

each of the five domains would differentially predict the odds of belonging to each substance use class. Results are discussed by socioecological domain.

Individual Domain

Gender. Primarily, it was expected that identifying as a male would increase the odds of belonging to a substance using class. This hypothesis was not supported. Compared to Nonusers, membership in all substance using classes was more likely among youth identifying as female. This finding is aligned with research indicating gender differences are inconsistent among latent classes of polysubstance use (e.g., Tomczyk et al., 2016) and provides evidence for emerging trends that suggest female substance use is converging with and at times even surpassing male substance use (e.g., Charrier et al., 2024). According to Cosma and colleagues (2022), the gender convergence might be related to societal gender inequality that socializes females to display internalized behaviors rather than externalized behaviors which are more often associated with males, such as substance use. In Western countries, the gender convergence in substance use may indicate a shift in the gender norms and expectations at a societal level and consequently result in more female substance use. According to McHugh and colleagues (2018), the gender gap in SUDs can largely be attributed to social and cultural factors, such as shifting away from traditional gender roles, rather than biological sex differences. However, further research needs to investigate the underlying determinants of this observed change in substance use among youth identifying as female, including deviations in the gap by age and by substance.

Given the sample of gender diverse youth (i.e., transgender male, transgender female, gender fluid, non-binary/non-gender conforming, not sure right now, prefer to self-describe, and prefer not to say) within this dataset, exploratory analyses were completed assessing the probability of membership in a substance using class based on gender diversity. Results indicated

that identifying as gender diverse significantly increased the odds of belonging to any substance using class, which is aligned with previous research demonstrating the increased risk for substance use in this population (e.g., Fahey et al., 2023; Newcomb et al., 2020). Specifically, it doubled the odds of belonging to the PSU class and almost tripled the odds of belonging to the Prescription Drug and Alcohol Experimenter class. Further, identifying as gender diverse was significantly more influential for belonging in the Prescription Drug and Alcohol Experimenter class compared to the Alcohol, Cannabis, E-cigarette Experimenter class, which may indicate that the circumstances associated with being gender diverse may predispose individuals for this substance use pattern.

According to Siste and colleagues (2019), identity crisis and role confusion are predisposing factors to prescription drug misuse. Additionally, gender diverse individuals are more likely to engage with substance use due to experiences of discrimination in their daily lives, such as microaggressions (e.g., comments or jokes that invalidate their identity) or blatant bullying and exclusion from peers. According to the minority stress theory, the repeated exposures to these stressors may contribute to health disparities within this subpopulation and lead to using substances to treat any mental distress (Rosenthal et al., 2023). This study contributes to the growing body of evidence indicating the gender diverse adolescents face a heightened risk for substance use. These findings highlight the importance of considering gender diversity in substance use prevention efforts. Addressing the unique challenges and risk factors for this subpopulation is crucial for developing effective strategies that promote well-being and mitigate risks.

Availability of Substances. As expected, higher perceptions of the difficulty of accessing substances decreased the odds of belonging to all substance using classes. Of note, the

perception of availability of substances was significantly more influential on the odds of belonging to the PSU class compared to the other substance using classes, highlighting a key protective factor against adolescent PSU. Overall, these findings corroborate previous research demonstrating the critical role of perceived substance availability in the initiation and escalation of substance use during adolescence (e.g., Debnam et al., 2018). Understanding the impact of perceived availability is crucial for developing effective prevention and intervention strategies. Interventions aimed at reducing substance use among adolescents may benefit from addressing and altering these perceptions through community-based programs, policy changes, and education campaigns. By targeting factors that influence perceived availability, such as restricting access, promoting healthy norms, and providing accurate information about substance use risks, it may be possible to mitigate the initiation and escalation of substance use among youth (Jones et al., 2020; Stockings et al., 2016).

Given the recent legalization of recreational cannabis in Connecticut, it is crucial to examine how the changing landscape may affect adolescent perceptions. While the establishment of a legal retail market might reduce the perceived availability of cannabis due to increased regulatory oversight (Salas-Wright et al., 2017), studies suggest that exposure to advertising and proximity to dispensaries are positively associated with the intention to use cannabis among adolescents (Hust et al., 2020). Further, increased access to cannabis by adults over the age of 21 may indirectly increase the exposure to the drug by adolescents, thereby increasing the perception of availability as well. Therefore, it is essential to monitor potential shifts in adolescent perceptions as these changes unfold in communities.

Perception of Harm. Surprisingly, compared to the Nonuser class, perception of harm only significantly decreased the odds of belonging to the PSU class but demonstrated no

relationship with either Experimenter classes. These results suggest that perception of harm may not function as prominently as a protective factor as previously thought. Leban and Griffin (2020) propose that the diminished predictive power of perception of harm could be attributed to the oversaturation of prevention campaigns that rely on "scare tactics" aimed at youth. In their assessment of the relations between risk factors and adolescent substance use, they found that perception of harm was only significantly associated with powdered cocaine use, but that availability of substances was the most influential factor associated with the use of crack cocaine and powdered cocaine while cannabis was most affected by perceptions of peer use (Leban & Griffin, 2020).

It may be that the perception of harm is protective against regular use of substances or polysubstance use, which is why harm perceptions significantly decreased the odds of belonging only to the PSU class. Further, it may be possible that perception of harm is associated with the frequency of use, rather than the choice to abstain from substance use. Ambrose and colleagues (2014) found that youth perceive tobacco use on a continuum of harm, often endorsing "dose dependent" perception of harm associated with cigarettes. Perhaps the PSU class in the current study also includes youth that are heavily using multiple substances and therefore the perception of harm is significantly capturing a sense of danger associated with this behavior that does not exist in either of the Experimenter classes. This nuanced understanding of harm perceptions may be occurring in the current sample, but the measurement of perception of harm may be not sensitive enough to capture these subtleties. Future research should investigate this phenomenon to clarify the implications.

Conclusions. Although males have historically been more likely to engage in substance use behavior (e.g., Halladay et al., 2020), the current study found that females and gender diverse

individuals were all significantly more likely to belong to substance using classes compared to males. While no significant differences were observed between classes for females, gender diverse individuals were significantly more likely to belong to the Prescription Drug and Alcohol Experimenters class compared to the Alcohol, Cannabis, E-cigarette Experimenters class. This finding may speak to different underlying motives for use based on gender identity. Further research is needed to adequately elucidate these findings.

The finding that perception of availability of substances is more influential on class membership than perception of harm was unexpected. However, this finding could be reflective of the propensity to engage in risk-taking behaviors within this developmental period (Braams et al., 2015; Cauffman et al., 2010), which would naturally emphasize the opportunity to use substances rather than the ability to adequately assess harms associated with substance use. These results indicate that preventive interventions that target the environment (i.e., school, community, family) might be more effective than youth-focused substance use harm education campaigns.

Peer Domain

Peer Disapproval. As expected, higher perception of peer disapproval significantly decreased the odds of belonging to all substance using classes compared to Nonusers. This effect was significantly different by class, demonstrating the strongest effect the PSU class, followed by the Alcohol, Cannabis, E-cigarette class, and finally the Prescription Drug and Alcohol Experimenter class. The fact that peer disapproval was the least influential on the Prescription Drug and Alcohol Experimenter class may further highlight that youth populating this class are more alienated from their social environment than typical adolescents. Overall, these findings underscore the influential role of perceived peer disapproval in shaping substance use behaviors

among adolescents. Adolescents who perceive stronger disapproval from their peers are less likely to engage in substance use, suggesting that social norms and peer influence play pivotal roles in substance use initiation and maintenance (Marziali et al., 2022; Zimmerman & Vásquez, 2011). The negative association between perceived peer disapproval and substance use across all classes highlights the potential effectiveness of interventions targeting peer norms and social contexts in mitigating substance use among youth.

Family Domain

Parental Monitoring. Upon investigation of the impact of parental monitoring on class membership, it was found that parental knowledge of their children's whereabouts and companions when away from home was far more predictive of the probability of belonging to a substance using class than the amount of time spent unsupervised after school. Parental knowledge significantly decreased the odds of belonging to all substance using classes compared to Nonusers, showing a significantly stronger impact on the PSU class. The number of hours unsupervised after school was not significantly related to the Prescription Drug and Alcohol Experimenter class or the PSU class, but higher hours unsupervised did significantly increase the probability of belonging to the Alcohol, Cannabis, E-cigarette Experimenter class. This finding is aligned with research that demonstrates that non-using youth are significantly more likely to start using substances when they experience a decrease in parental monitoring (e.g., Pelham et al., 2023), as the Alcohol, Cannabis, E-cigarette substance using group seems to capture the typical pattern of adolescent substance use experimentation. Regarding the disparity between parental knowledge and hourly monitoring, Pelham and colleagues (2024) found that adolescents are more discouraged from using substances due to the fear that their parents would find out,

rather than a concern for punishment. Taken together, these findings indicate that parental knowledge is a key protective factor against the initiation of substance use in adolescents.

Family Rules. Surprisingly, higher endorsement of clear family rules discouraging substance use significantly increased the odds of belonging to the Alcohol, Cannabis, E-cigarette Experimenter class and the PSU class, but was not related to the Prescription Drug and Alcohol Experimenter class; although these findings were only marginally significant. Perhaps this finding is reflective of a family environment wherein parents might know of youth substance use and increase family rules as attempt to mitigate this behavior. This finding may also highlight an important distinction between understanding rules or expectations around substance use versus the influences of parental disapproval and monitoring on youth. It suggests that while clear rules may exist, parental behaviors related to substance use and perceptions of disapproval could potentially undermine the effectiveness of these rules. Meldrum and colleagues (2023) found that as adolescents' perceptions of parental opinions about substances shifted from negative to positive, they were more likely to engage in substance use. Future research that investigates the interplay between these factors could provide valuable insights into how family dynamics influence adolescent substance use behaviors.

Parental Disapproval. Perceptions of parental disapproval significantly decreased the odds of belonging to all substance using classes and differentially related to each class. Parental disapproval was the most influential on the odds of belonging to the PSU class, followed by the Alcohol, Cannabis, E-cigarette Experimenter class, and finally the Prescription Drug and Alcohol Experimenter class. These findings highlight the crucial role that parental influence has in shaping adolescent substance use behavior and is consistent with the literature that parental disapproval remains one of the most influential protective factors against adolescent substance

use initiation (e.g., Marziali et al., 2022; Johnson et al., 2001). By emphasizing the significance of parental disapproval, this study underscores the need for preventions that aim to strengthen parental influence and promote effective communication between parents and adolescents regarding substance use risks and expectations. Understanding these dynamics is essential for developing comprehensive approaches to substance use prevention that leverage the protective influence of parental attitudes and behaviors.

Parental Substance Use. Finally, the role of parental substance use influencing the probability of adolescents belonging to a substance using class was examined, albeit with a smaller sample size. The findings revealed notable associations, particularly highlighting the influential role of parental cannabis use. Specifically, adolescents were over six times more likely to belong to the PSU class compared to Nonusers if youth were aware of parental cannabis use in their household. While parental alcohol use also increased the odds of adolescents belonging to the PSU class, parental use of cannabis was significantly more influential. This suggests that while multiple substances used by parents may contribute to increased risk, cannabis use by parents stands out as particularly influential in shaping adolescent substance use patterns. Given the legalization of cannabis in Connecticut, this finding underscores the importance of substance use prevention education for parents.

Additionally, results indicate that parental use of e-cigarettes, alcohol, and cannabis all significantly increased the odds of adolescents belonging to the Alcohol, Cannabis, E-cigarette Experimenter group, which coincides with the key substances adolescents are experimenting with in this class. Overall, these findings are aligned with literature that has found adolescents are more likely to model parental behavior when it comes to substance use (Trucco 2020), both with substance-specific behavior (i.e., parental alcohol use influencing adolescent alcohol use)

and cross-substance behavior (e.g., Capaldi et al., 2016). Evidence shows that adolescent propensity to use substances increases in relation to the number of parents that use substances within the household and the extent of exposure to parental substance use (Gilman et al., 2009; Smit et al., 2018). Particularly, parental cannabis use has been found to increase the risk of cannabis, alcohol, tobacco, and opioid misuse by adolescents (Madras et al., 2019), highlighting this as a key risk factor for the use of a variety of substances among adolescents.

Interestingly, no significant relationships were found between parental substance use and the Prescription Drug and Alcohol Experimenters class. This suggests that while parental substance use influences certain types of substance use behaviors among adolescents, its influence may not be consistent across all substance use patterns. Further, the lack of relationship found between parental substance use and the Prescription Drug and Alcohol Experimenter class may further speak to the uniqueness of this class and calls for further research to understand the development of this substance use pattern.

Conclusions. Overall, findings indicate that youth perception of parental disapproval remains one of the most influential protective factors against substance use. Further, parental knowledge of youth's whereabouts when away from home emerged as a particularly salient protective factor. Taken together, these findings suggest that parental involvement and a parent-child relationship characterized by clear expectations is pivotal for adolescent substance use prevention. Parental modeling of permissive attitudes towards substance use via their personal substance use increases the odds of their children using substances themselves. Parental use of cannabis seems to demonstrate a particularly strong influence on adolescent substance use behaviors. Among adults, a common motive for using cannabis includes coping with stress, which ultimately may compound feelings of depression and anxiety (Glodosky & Cuttler, 2020).

It is possible that parental use of cannabis emerged as a particularly salient risk factor for adolescent PSU due to comorbid mental health struggles. However, this assessment is outside of the scope of the current project. Future research should investigate the family dynamics that co-occur among families with parental cannabis use.

School Domain

School Commitment. Commitment to school was a significant protective factor against membership in the PSU class and the Alcohol, Cannabis, E-cigarette Experimenters class. This finding emphasizes the role of academic engagement as a protective factor against the initiation of substance use (Lee & Henry, 2022). However, school commitment did not show a significant relationship with the Prescription Drug and Alcohol Experimenters class, providing partial support for hypothesis 2.4a. The absence of a significant relationship suggests that other contextual factors may play a more prominent role in shaping the substance use behaviors within this class.

School Safety. Perceptions of feeling safe at school significantly decreased the odds of belonging to the Prescription Drug and Alcohol Experimenters but demonstrated no relationship with any other substance using class. The fact that this protective factor was only significantly related to the Prescription Drug and Alcohol Experimenter class, coupled with the finding that identifying as gender diverse almost tripled the odds of belonging to this class, suggests that adolescents in this substance using category may be characterized as using substances to cope with anxiety, perhaps due to feelings of threat or discrimination at school. Among a sample of youth from grades 7-12, Boyd and colleagues (2006) found that the most common reasons for misusing opioid pain medication among adolescents included sleeping, anxiety, and as stimulants. Similarly, among adults, the most endorsed motivations for misusing prescription

drugs are to get high, to sleep, or for anxiety/stress (Rigg & Ibañez, 2010). Taken together, these findings may provide insight into the unique experience among adolescents categorized within this class. Further research to elucidate the characteristics of this substance use pattern is needed.

School Support. Perceptions of school support significantly decreased the odds of belonging to the Alcohol, Cannabis, and E-cigarette Experimenters and the PSU classes. This finding corroborates research that has identified school support as a protective factor against substance use in adolescence (e.g., Bond et al., 2007; Osterman, 2000). However, school support demonstrated no significant relationship with the Prescription Drug and Alcohol Experimenters class, which may speak to an attitude of ambivalence or a lack of relationship towards teachers and staff, further highlighting the potential for social alienation among individuals in this substance use class. Again, the lack of relationship observed here highlights the importance of further research to understanding this unique substance using class.

Conclusions. Overall, these results highlight the unique characteristics of the Prescription Drug and Alcohol Experimenters class, suggesting that this class may be described by a lack of school connectedness and safety while at school. The Alcohol, Cannabis, E-cigarette Experimenters and PSU classes demonstrated a similar pattern of related to the school domain factors, which may support the notion that they fall along the same substance use trajectory. The school environment is a key area for substance use prevention initiatives, as opportunities for prosocial activities and feelings of belonging can act as a buffer for the intention to use substances (e.g., Frank & Fiegel, 2020). These findings. coupled with the finding that access to substances is a particularly prominent risk factor for adolescent substance use, it is imperative that the school environment is shaped as a safe and protective environment for youth.

Community Domain

Negative Community Perceptions. Higher negative perceptions of community significantly increased the odds of belonging to all substance using classes. This finding provides further support for the fact that negative characteristics of communities can increase the likelihood of engaging in substance use behavior in adolescents, such as permissive attitudes and behaviors around substance use, high delinquency, violence, and drug activity (e.g., Connell et al., 2010; Debnam et al., 2018; Van Horn et al., 2007). Particularly, these findings provide support that the perception of drug use in the community is influential on adolescent substance use, as this factor was heavily influenced by variables related to drug use in the community (see Appendix C). Negative community perceptions were significantly more predictive of belonging to the PSU class compared to the Prescription Drug and Alcohol Experimenters class, which aligns with other findings in this study that suggest that individuals in the Prescription Drug and Alcohol Experimenters class are differentially affected by risk and protective factors compared to the other classes.

Community Support. Community support emerged as a protective factor against substance use, as higher perceptions of community support significantly decreased the odds of belonging to all substance using classes, providing support for hypothesis 2.5. This finding supports previous research demonstrating that perceived support in the community can act as a buffer against other negative community factors (e.g., Pederson et al., 2022). Although the influence of community support was not significantly different between substance using classes, the results indicate that bolstering community support would be a worthwhile area for preventive interventions.

Conclusions. Overall, these findings highlight that risk and protective factors in more distal, macro levels of the socioecological model can still significantly influence adolescent substance use. Historically, prevention has typically targeted individuals and social groups in order to influence the decision-making process around health behaviors (Burkhart et al., 2022). However, the gap between health intentions and actual behaviors (e.g., Faires, 2016; Frank & Fiegel, 2020) shows that this approach may not be the most efficacious. Further, adolescence is a developmental period that is marked by increased risk-taking and the development of higher-order cognitive functions, such as executive decision making (Jaworska & MacQueen, 2015). Therefore, reliance on the ability of an adolescent to make adequate risk assessments and control risky behaviors is a imperfect strategy. Prevention strategies that target policy and decision makers to alter the environment in order to promote health and wellness are needed now more than ever (Burkhart et al., 2022) and are likely to prove more effective in achieving more positive long-term outcomes.

DEPRESSIVE SYMPTOMS AND CLASS MEMBERSHIP

The final aim of this study was to assess the association between depressive symptoms and substance use. Although originally four hypotheses were made regarding this aim, the results of the psychometric analyses led to the integration of the four depressive symptom variables into one total score. In essence, it was expected that higher levels of depressive symptoms would result in higher odds of belonging to substance using classes. While depressive symptoms technically fall under the individual domain of the socioecological model, the inclusion of them as a separate aim was motivated by the limited research that included mental health correlates within substance use LCA studies. By establishing a separate aim, we can highlight the influence of depressive symptoms on patterns of substance use among adolescents.

Results supported hypotheses that higher endorsement of depressive symptoms significantly increased the odds of belonging to all substance using classes. Specifically, adolescents reporting depressive symptoms in the past year were nearly twice as likely to belong to the PSU class compared to Nonusers. Further, higher depressive symptoms were significantly more predictive of belonging to the PSU class compared to the Alcohol, Cannabis, E-cigarette Experimenter class, which may indicate adolescent mental health struggles underlie the propensity for polysubstance use.

Research consistently indicates that depressive symptoms can contribute to increased susceptibility to using substances to cope, which can increase their overall risk for developing more severe disorders, such as major depression and substance use disorder. Wu and colleagues (2008) found that depressive symptoms were able to significantly predict changes in substance use, in particular the use of illicit drugs and polysubstance use, among a sample of youth with severe emotional disturbance. Further, comorbid substance use and depressive symptoms in adolescence is a major risk factor for adult major depressive disorder (Xu et al., 2024). Incorporating mental health as a part of prevention efforts is imperative to a holistic wellness approach for adolescents.

PRACTICAL IMPLICATIONS

The results of this study provide valuable theoretical and practical insights for understanding patterns of adolescent substance use and developing appropriate preventive interventions to deter substance use initiation, minimize harm, and inhibit progression to substance use disorder. Primarily, this study furthered our understanding of patterns of substance use among adolescents by utilizing a large sample of youth in grades 7-12 living in Eastern Connecticut. The substance use patterns that emerged characterized Nonusers, Alcohol,

Cannabis, E-cigarette Experimenters, Polysubstance Users, and Prescription Drug and Alcohol Experimenters. The fact that no single substance experimentation class was identified may be indicative of an emerging trend of adolescents experimenting with several substances rather than just alcohol, although alcohol remains the most commonly used substance among adolescents (e.g., Miech et al., 2023). While the other classes were aligned with previous research on patterns of substance use in adolescents (e.g., Halladay et al., 2020), the Prescription Drug and Alcohol Experimenters seemed to describe a substance use pattern not previously identified. This prescription drug class may capture an alternate trajectory into substance use experimentation among adolescents and therefore further investigation of motives for substance use and unique risk factors is imperative to effectively intervene with this class.

Within the PSU class, recent use of cannabis and e-cigarettes had the highest probability of endorsement among all substances and parental use of cannabis made it six time more likely for individuals to be classified into the PSU class. These findings support the notion that the new and changing laws around cannabis and e-cigarettes may inadvertently lead to increases in use among youth. Connecticut policy makers must remain diligent to the effects of changing laws on adolescent substance use and develop environmental prevention strategies and an education plan targeting parents to mitigate negative consequences. In particular, a parental education plan should include information regarding how their personal substance use behavior can in turn shape youth substance use behavior, how important it is to keep their substances safely locked away due to the fact that easy access to substances significantly increases youth likelihood to use, and how maintaining a strong relationship with their child via discouraging substance use and keeping apprised of youth activities when away from home can be key protective factors for

preventing youth substance use. Further, emphasizing youth coping skills and mental wellness are also important for a holistic approach to youth substance use prevention.

The finding that identifying as female or gender diverse significantly increased the odds of using substances compared to identifying as male supports emerging research that highlights the historic gender gap in substance use is converging (e.g., Charrier et al., 2024). Although investigators posit that this convergence is likely due to changing societal gender roles that allow women more autonomy, research should investigate how substance use differentially affects females versus males and how to treat SUDs efficaciously.

FUTURE RESEARCH

Future research investigating the developmental underpinnings of the Prescription Drug and Alcohol Experimenter class is warranted. Primarily, future research should aim to replicate this class in other samples to determine if this class is indeed a unique pattern in adolescent substance use or if it is simply unique to the current sample. Further research illuminating the trajectory specific to this substance using class will be helpful in informing preventive interventions.

Similarly, research aimed to adequately assess the effect of grade on substance use patterns via multiple group LCA would further our understanding of the development of substance use patterns and allow us to investigate the differential effects of risk and protective factors by grade. The incorporation of grade into the estimation of substance use patterns would allow us to tailor substance use prevention strategies to increase overall efficacy. Perhaps future endeavors will have access to the resources to estimate such complex models.

Research aimed to explore the predictive power of socioecological factors on LCA class membership in a hierarchical or multi-level assessment would further our understanding of the

relative importance of each risk and protective factor across substance use patterns. Specifically, investigating the interplay between parental knowledge and monitoring, clear family rules, and parental disapproval will elucidate how family dynamics impact substance use class membership. Results of this study yielded counterintuitive results regarding clear family rules, therefore further research investigating this phenomenon is warranted. Further, research on the development and efficacy of community-level prevention strategies for adolescent substance use would serve to empower local communities to make evidence-based programs to affect change.

STRENGTHS AND LIMITATIONS

Certain limitations need to be accounted for when interpreting these results. Although we are discussing the predictive power of the socioecological variables on substance use class membership, there is no way to determine causality within this sample. Bidirectional effects may be present, which is common within substance use research (Kassel et al., 2005). For example, the experience of depressive symptoms may lead to using substances, or the use of substances may lead to the experience of depressive symptoms, or both could simultaneously be true via a reciprocal relationship. The cross-sectional nature of this study precludes the ability to establish directionality of effects. Further, this study was conducted with a convenience sample of adolescents collected within Connecticut DMHAS Region 3. No specific sampling method to ensure representation of the region and therefore the results of this study may not be generalizable outside the southeastern region of Connecticut.

Analyses associated with aims 2 and 3 were limited by issues of missingness on socioecological variables, which made it impossible to estimate one overall model. The fact that models were estimated in a piecemeal fashion inherently biases the estimates by increasing overall error in the model related to variance explainable by the omitted variables. This results in

model specification issues wherein the model attributes the effect of the missing variables to the variables that were included, which may overestimate their true effect. Although the results generated are able to give us an idea of what the main effects of these variables are on substance use classes, a more precise model would include all socioecological variables. Further, issues with small cell size on the race variable prohibited it from being inserted as a covariate in analyses. Race and ethnicity have shown consistent effects on substance use behavior in the literature (e.g., Shih et al., 2010). The exclusion of the variable into model estimation also may yield biased results.

The survey measure itself is composed of largely single item indicators for constructs rather than psychometrically sound questionnaires. Although a psychometric assessment was conducted on these items to create total scores, a stronger methodology would include more nuanced construct measures with strong reliability and validity. However, these single item indicators are commonly used in national epidemiological and surveillance surveys (e.g., YRBSS, MTF, NSDUH) and have demonstrated validity and stability over time. Although the utilization of larger measures to capture the nuance of a construct would be helpful to investigate the underlying determinants of substance use, single indicator items are an efficient methodology for surveillance efforts to monitor use over time, which is the primary purpose for these types of assessments.

Although the study contains limitations, it also contains considerable strengths. Primarily, the particularly large sample size of adolescents enrolled in grades 7-12 in Eastern Connecticut allowed us to be confident that the study is sufficiently powered to detect small effects in the latent classes that emerged. The inclusion of 13 substance use indicators into analyses also allowed us to generate comprehensive latent classes that explore the propensity to use a wide

variety of substances across all classes, including prescription drug misuse and illicit substances. The inclusion of these substances allowed for a novel substance use pattern to emerge unique from typical adolescent substance use. Although this study was not able to incorporate grade into all analyses, it did find that middle school grades yielded a different number of latent classes compared to high school grades, which provides support for the implementation of developmentally appropriate prevention techniques.

The inclusion of gender diverse youth contributes to the emerging literature regarding the substance and polysubstance use patterns among this subpopulation (e.g., Fahey et al., 2023), which is a crucial step towards a more inclusive and accurate understanding of these behaviors within different demographic groups. Moreover, the inclusion of gender diverse youth addresses disparities and gaps in understanding due to underrepresentation or exclusion in previous studies.

Similarly, the investigation of several socioecological risk and protective factors helps us to understand how these substance using classes function in relation to their environment. Including factors from a variety of socioecological levels allows us to have a more comprehensive picture of how the environment impacts substance use behavior. Although the factors largely functioned similarly across classes, significant differences in the magnitude of the effect were found between substance using groups. These findings may delineate factors that are particularly influential for specific substance use patterns, such as polysubstance use, which may allow for more targeted and effective prevention strategies.

Finally, the inclusion of depressive symptoms, specifically related to suicidal ideation and self-harm, adds to the literature regarding mental health and substance use among youth. According to Halladay et al. (2020), very few cluster-based analysis studies included any mental health correlates and fewer still included suicidal thoughts and behaviors. The current study

underscores the urgent need for integrated approaches that incorporate both mental health concerns and substance use prevention into a holistic wellness approach.

CHAPTER V

CONCLUSIONS

The present study conducted an LCA on adolescent substance and polysubstance use patterns including several substance use indicators in order to expand our understanding of current and emerging substance use patterns. Results indicated that the inclusion of prescription drug misuse and illicit substance use allowed for a unique substance use pattern to emerge regarding the experimentation with pain medication, downers, and alcohol specifically. This Prescription Drug and Alcohol Experimenter class may indicate a novel trajectory of adolescent substance use behavior that merits further investigation. The three other classes of Nonusers, Alcohol, Cannabis, E-cigarette Experimenters, and Polysubstance Users captured a substance use trajectory more commonly observed within this population. The finding that identifying as female or gender diverse significantly increased the odds of belonging to a substance using class compared to males supports emerging trends that the historic gender gap in substance use behavior is converging and highlights the importance of investigating the determinants underlying this change. The differential influence of various socioecological risk and protective factors across classes allows for a better understanding of how to prevent substance and polysubstance use; specifically highlighting the potential strength of environmental prevention strategies targeting family, school, and community domains.. Further research investigating the impact of grade level across these classes is recommended.

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APPENDIX A

SERAC YOUTH SURVEY

Youth Survey Template

This survey is sponsored by [COALITION NAME] in partnership with [INSERT SCHOOL(S)]. We are conducting the survey to learn about your experiences and feelings regarding tobacco, alcohol, drugs, and various activities. This is NOT a test. There are no right or wrong answers.

This survey is completely CONFIDENTIAL and ANONYMOUS.
Your school has no way to access your individual answers.
Your responses go DIRECTLY to SERAC and are *password protected*. Feel free to email data@seracct.org if you have any questions.

NO IDENTIFYING INFORMATION IS COLLECTED.

Please answer honestly based on your OWN opinions and experiences. If you have questions while taking the survey, feel free to ask your teacher or survey administrator for help.

When you have completed the survey, click Done>> and wait for instructions from your teacher.

Youth Survey Template

* 1. What grade are you in now?

◯ 6 ◯ 7 ◯ 8 ◯ 9 ◯ 10 ◯ 11 ◯ 12

2. What is your gender?

◯ Female
◯ Male
◯ Non-binary
◯ Gender Fluid
◯ I prefer to self-describe (please specify)
◯ Transgender male
◯ Transgender female
◯ I'm not sure right now
◯ I prefer not to say

3. How do you describe yourself? (Mark all that apply)

☐ White or Caucasian
☐ Black or African American
☐ Asian or Pacific Islander
☐ Native/Indigenous
☐ Hispanic or Latino

Other (please specify)

4. What town do you currently live in?

5. On a regular *weekday*, how many *hours* do you usually spend after school *without* an adult present?

◯ None
◯ Less Than 1 Hour
◯ 1 To 2 Hours
◯ Up To 4 Hours
◯ More Than 4 Hours

6. Please choose how true the following statements are for you:

	Definitely NOT True	Mostly NOT True	Mostly True	Definitely True
I try hard to do good work at school.	○	○	○	○
I feel safe at school.	○	○	○	○
Teachers/Staff at my school encourage and support me to do my best.	○	○	○	○
When I am away from home, my parent/guardian(s) know where I am and who I am with.	○	○	○	○
I share my thoughts and feelings with my parent/guardian(s).	○	○	○	○
My parent/guardian(s) participates in activities at my school, including attendance at school events.	○	○	○	○
I feel very close to my parent/guardian(s).	○	○	○	○
I feel loved and valued by my family.	○	○	○	○
If I break one of my parent/guardian(s) rules, I am usually disciplined.	○	○	○	○

7. Please choose how true this statement is for you:
My family has clear rules discouraging me from the following:

	Definitely NOT True	Mostly NOT True	Mostly True	Definitely True
Smoking cigarettes or using tobacco.	○	○	○	○
Using electronic cigarettes (ecigs, vaping, JUULs).	○	○	○	○
Drinking alcoholic beverages.	○	○	○	○
Using marijuana.	○	○	○	○
Using a prescription drug that is not prescribed to me.	○	○	○	○
Gambling (scratch tickets, online, sports, casino, etc).	○	○	○	○
Online gaming.	○	○	○	○
Internet access.	○	○	○	○

8. Do either of your parents/guardians:

	NO	YES
Smoke cigarettes?	◯	◯
Use electronic cigarettes (ecigs, vapes, JUULs)?	◯	◯
Drink alcoholic beverages?	◯	◯
Use marijuana recreationally?	◯	◯
Use marijuana medically?	◯	◯
Gamble (scratch tickets, online, sports, casino, etc)?	◯	◯

* 9. Think back over the *past 30 days*. On how many days, if any, did you use electronic cigarettes (ecigs, vapes, JUULs))?

◯ I have **NEVER** used. ◯ Not in the past 30 days ◯ Occasionally (1 - 5 days) ◯ Frequently (6 - 20 days) ◯ Almost every day (21 days or more)

10. Think back over the *past 30 days*. On how many days, if any, did you use cigarettes?

◯ I have **NEVER** used. ◯ Not in the past 30 days ◯ Occasionally (1 - 5 days) ◯ Frequently (6 - 20 days) ◯ Almost every day (21 days or more)

11. Think back over the *past 30 days*. On how many days, if any, did you use other tobacco products (like cigars, snuff, chewing tobacco, smoking tobacco from a pipe)?

◯ I have **NEVER** used. ◯ Not in the past 30 days ◯ Occasionally (1 - 5 days) ◯ Frequently (6 - 20 days) ◯ Almost every day (21 days or more)

Youth Survey Template

* 12. Think back over the *past 30 days*. On how many days, if any, did you use marijuana, hashish, edibles, vaping marijuana, smoked marijuana, and/or dabbed marijuana?

◯ I have **NEVER** used. ◯ Not in the past 30 days ◯ Occasionally (1 - 5 days) ◯ Frequently (6 - 20 days) ◯ Almost every day (21 days or more)

Youth Survey Template

* 13. *During the past 30 days,* on how many days (if any) did you have an energy drink containing alcohol?

- ◯ I have NEVER used.
- ◯ Not in the past 30 days
- ◯ Occasionally (1 - 5 days)
- ◯ Frequently (6 - 20 days)
- ◯ Almost every day (21 days or more)

* 14. *During the past 30 days,* on how many days (if any) did you drink one or more drinks of an alcoholic beverage (more than a sip, and NOT including religious activities)?

- ◯ I have NEVER used.
- ◯ Not in the past 30 days
- ◯ Occasionally (1 - 5 days)
- ◯ Frequently (6 - 20 days)
- ◯ Almost every day (21 days or more)

Youth Survey Template

Recent Alcohol Use

15. *In the past 30 days,* did you drink alcoholic beverages in any of the following places:

	Never	Sometimes	Often
At your home?	○	○	○
On the street, in the woods, or in parks or fields?	○	○	○
At the homes of other people?	○	○	○
At school activities, like dances or sporting events?	○	○	○
While you were driving a car, truck, or motorcycle?	○	○	○
At a party with an adult (21 or older) present?	○	○	○
At a party **without** an adult (21 or older) present?	○	○	○

Youth Survey Template

Lifetime Alcohol Use

16. What was your age (in years) when you FIRST used alcoholic beverages (more than a sip, and NOT including religious activities)?

17. How often do you get alcohol from:

	Never	Sometimes	Often
Your parents, with their permission?	◯	◯	◯
Your parents, without their permission?	◯	◯	◯
Your friends?	◯	◯	◯
Your brother(s) or sister(s)?	◯	◯	◯
Other people who buy it for you?	◯	◯	◯
A party with an adult's permission?	◯	◯	◯
A party without an adult's permission?	◯	◯	◯
A store or bar (you buy it)?	◯	◯	◯
A restaurant ?	◯	◯	◯

18. How often have you drank 4 or more alcoholic drinks (beer, wine, wine coolers, mixed drinks, hard liquor etc.) during a single occasion?

◯ I have NEVER drank 4 or more drinks in a single occasion. ◯ Not in the past 30 days

◯ Occasionally (1 - 5 days) ◯ Frequently (6 - 20 days) ◯ Almost every day (21 days or more)

Youth Survey Template

19. If you wanted to, how easy would it be for you to get:

	Very Easy	Sort Of Easy	Sort Of Hard	Very Hard
Beer, wine, wine coolers, or hard liquor?	○	○	○	○
Cigarettes?	○	○	○	○
Electronic cigarettes (ecigs, vapes, JUULs)?	○	○	○	○
Marijuana for smoking?	○	○	○	○
High concentrate THC for dabbing?	○	○	○	○
Marijuana edibles?	○	○	○	○
Marijuana for vaping?	○	○	○	○
Illicit drugs like cocaine, heroin, LSD, or amphetamines?	○	○	○	○
A prescription drug without your own prescription (such as OxyContin, Vicodin, or Ritalin)?	○	○	○	○
A gun?	○	○	○	○

Youth Survey Template

Perceptions

20. How much do people risk harming themselves physically or in other ways when they do the following:

	No Risk	Slight Risk	Moderate Risk	Great Risk	I Don't Know.
Smoke cigarettes, 1 or more packs a day?	○	○	○	○	○
Use electronic cigarettes (ecigs, vapes, JUULs)?	○	○	○	○	○
Vape/JUUL flavored liquids?	○	○	○	○	○
Vape/JUUL tobacco or nicotine?	○	○	○	○	○
Vape/JUUL marijuana or THC?	○	○	○	○	○
Drink alcoholic beverages, 5 or more, once or twice a week?	○	○	○	○	○
Take 1 or 2 drinks of an alcoholic beverage nearly every day?	○	○	○	○	○
Use marijuana 1 or 2 times a week?	○	○	○	○	○
Dab marijuana or THC?	○	○	○	○	○
Eat marijuana edibles?	○	○	○	○	○
Mis-use prescription drugs to get high?	○	○	○	○	○

21. How wrong do your *parents* feel it would be for you to do the following:

	Not At All Wrong	A Little Bit Wrong	Wrong	Very Wrong
Smoke tobacco products?	○	○	○	○
Use electronic cigarettes (ecigs, vapes, JUULs)?	○	○	○	○
Drink alcohol?	○	○	○	○
Drink one or two alcoholic beverages (beer, wine, or liquor) nearly everyday?	○	○	○	○
Drink alcoholic beverages, 5 or more, once or twice a week?	○	○	○	○
Use marijuana?	○	○	○	○
Mis-use prescription drugs to get high?	○	○	○	○
Gamble (scratch tickets, online, sports, casino, etc)?	○	○	○	○

22. How wrong do your *friends* feel it would be for you to do the following:

	Not At All wrong	A Little Bit Wrong	Wrong	Very Wrong
Smoke tobacco?	○	○	○	○
Use electronic cigarettes (ecigs, vapes, JUULs)?	○	○	○	○
Drink alcohol?	○	○	○	○
Drink one or two alcoholic beverages (beer, wine, or liquor) nearly everyday?	○	○	○	○
Drink alcoholic beverages, 5 or more, one or twice a week?	○	○	○	○
Use marijuana?	○	○	○	○
Mis-use prescription drugs to get high?	○	○	○	○
Gamble (scratch tickets, online, sports, casino, etc)?	○	○	○	○

23. Have you EVER used any of these drugs?

	NO, Never	YES, But **NOT** in the past 30 days	YES, In the past 30 days
Inhalants (things you sniff or inhale to get high such as glue, paint, whippets, or sprays)	○	○	○
Cocaine	○	○	○
Crack cocaine (rock)	○	○	○
Allovites (vites)	○	○	○
Ecstasy (MDMA, Molly)	○	○	○
Hallucinogens (LSD, acid or mushrooms, PCP or Angel Dust)	○	○	○
Heroin or Fentanyl	○	○	○
Salvia	○	○	○
Ketamine (Special K)	○	○	○
GHB	○	○	○
Methamphetamine (Meth)	○	○	○
Synthetic marijuana (Spice, K2, K3)	○	○	○
Bath Salts (Ivorywave, Red Dove)	○	○	○

Youth Survey Template

24. Which of the following PRESCRIPTION drug(s) have you EVER mis-used to get high?

	NO, Never	Yes, But **NOT** in the past 30 days	Yes, In the past 30 days
Pain medication (OxyContin, Vicodin, Percodan, Codeine, Fentanyl, or Dilaudid)	○	○	○
Steroids (juice, roids)	○	○	○
Downers (barbiturates, sleeping pills, sedatives, Quaaludes)	○	○	○
Tranquilizers (Valium, Xanax, or Librium)	○	○	○
Uppers (Ritalin, Adderall, Amphetamines, or Speed)	○	○	○
Over the counter medications to get "high" (cough medicine, mouthwash)	○	○	○

25. When you have mis-used PRESCRIPTION drugs to get high, from where did you get them? (Please choose all that apply)

- ☐ Your home
- ☐ Someone else's home
- ☐ Your brother or sister gave it to you
- ☐ A friend gave it to you
- ☐ Someone at a party gave it to you
- ☐ You bought it
- ☐ You bought it online

Youth Survey Template

26. Please choose how true each of the following statements is for you.

	Definitely NOT True	Mostly NOT True	Mostly True	Definitely True
My community is a safe place.	○	○	○	○
In my community, kids are often teased or taunted so much their feelings are hurt.	○	○	○	○
A lot of drugs are sold in my community.	○	○	○	○
There are lots of things for young people to do in my community.	○	○	○	○
A lot of kids in my community are into using marijuana and other drugs.	○	○	○	○
Adults in my town see teenagers as valuable and important members of the community.	○	○	○	○

27. In the past 12 months, have you experienced any of the following?

	Yes	No
I have had thoughts about hurting myself.	○	○
I have hurt myself on purpose.	○	○
I have had a boyfriend/girlfriend/romantic partner hit, slap, or physically hurt me on purpose.	○	○
I have felt sad or hopeless almost every day for 2 weeks or more so that it stopped me from doing my usual activities.	○	○
I have seriously considered attempting suicide.	○	○

Youth Survey Template

28. Gambling is risking money or something of value on an activity that has an uncertain outcome.
How often do you gamble for money or possessions (such as poker, lottery, sports betting, online betting, fantasy sports)?

◯ Daily ◯ Weekly ◯ Monthly ◯ Less than monthly ◯ Never

29. Please choose a response for each question below:

	Yes, in the past 12 months	Yes, but not in the past 12 months	Never
Have you tried to cut back on your gambling?	◯	◯	◯
Has a family member expressed concern about the amount of time you gamble or the amount of money you spend gambling?	◯	◯	◯
Have you ever missed work, school, or other important social activities because you were gambling?	◯	◯	◯
Do you think you have a gambling problem?	◯	◯	◯

Thank you for completing our survey.
Please click DONE below

APPENDIX B

PASSIVE PARENTAL CONSENT LETTER

(Date)

Dear Parent or Guardian:

Our local prevention coalition **(insert coalition name)**, is the recipient of a grant to assist the community in identifying current factors that influence the healthy and positive development of our children and youth. A variety of community resources have joined together to form **(insert coalition name)** with the goal of reducing substance use among the youth of **(insert town).**

To move forward in addressing the needs of our community, we need better information about our youth and their attitudes and behaviors regarding substance use and abuse. The **(insert town name)** Survey is a computer-driven survey intended to provide **(insert coalition name)** with data about the youth in our community and the factors that influence them. With this information, our community can plan strategies and programs that strive to increase protective factors, and decrease risk factors.

The survey will be administered to students in **(insert grades and dates).** Students will be asked to voluntarily participate in this brief survey during one class period at school. The survey is both anonymous and confidential and students will not be asked for their names or any identifying information. Results will be provided only as a summary of responses. A copy of the survey is available for you to review at your principal's office. If you would like your child excluded from the survey, please contact your principal in writing on or before **(insert date).**

Thank you for your support of this important community initiative. Should you have any questions about the survey, please feel free to contact me.

Sincerely,

Contact Name
Director

APPENDIX C

PRELIMINARY PSYCHOMETRIC ANALYSES

INDIVIDUAL DOMAIN

Table C1

Interitem Correlations for Perception of Harm of Substances

Item	Cigs	E-Cigs	Alc_Binge	MJ	Alc_Daily	Rx
	1.00	.804	.729	.587	.713	.701
		1.00	.720	.642	.703	.688
			1.00	.628	.781	.690
				1.00	.652	.595
					1.00	.687
						1.00
Mean	3.06	2.81	2.83	2.23	2.71	2.95
SD	1.452	1.423	1.408	1.439	1.410	1.554

N = 11896, α_c = .929

Table C2

Item-Level Statistics for Perception of Harm of Substances

Item	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	R^2	Cronbach Alpha if Item Deleted
Cigs	13.53	38.836	.820	.716	.913
Ecigs	13.77	39.060	.826	.715	.912
Alc_Binge	13.75	39.272	.824	.697	.912
MJ	14.36	40.775	.704	.510	.928
Alc_Daily	13.87	39.302	.820	.691	.913
Rx	13.63	38.470	.773	.600	.919

N = 11896, Scale Mean = 16.58, Scale Variance = 55.782, α_c = .929

Table C3

Interitem Correlations for Depressive Symptoms

Item	Thoughts	Hurt	Sad	Suicide
	1.00	.645	.564	.570
		1.00	.484	.549
			1.00	.484
				1.00
Mean	0.25	0.16	0.26	0.12
SD	0.433	0.366	0.436	0.321

N = 10636, α_c = .824

Table C4

Item-Level Statistics for Depressive Symptoms

Item	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	R^2	Cronbach Alpha if Item Deleted
Thoughts	.53	.846	.723	.532	.743
Hurt	.62	.989	.671	.474	.770
Sad	.53	.917	.602	.368	.805
Suicide	.66	1.083	.633	.405	.792

N = 10636, Scale Mean = .782, Scale Variance = 1.610, α_c = .824

Table C5

Interitem Correlations for Perceptions of Availability of Substances

Item	Alc	Cig	Ecig	MJ	Illicit	Rx
	1.00	.528	.551	.523	.362	.427
		1.00	.661	.603	.493	.424
			1.00	.771	.488	.399
				1.00	.516	.382
					1.00	.537
						1.00
Mean	2.78	3.29	3.09	3.21	3.77	3.50
SD	1.144	1.025	1.141	1.117	0.641	0.889

N = 12189, α_c = .858

Table C6

Item-Level Statistics for Perceptions of Availability of Substances

Item	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	R^2	Cronbach Alpha if Item Deleted
Alc	16.86	14.745	.616	.395	.843
Cigs	16.35	14.832	.708	.515	.824
Ecigs	16.55	13.692	.766	.667	.811
MJ	16.43	14.044	.738	.633	.817
Illicit	15.87	17.816	.599	.423	.850
Rx	16.13	16.852	.524	.359	.855

N = 12189, Scale Mean = 19.64, Scale Variance = 21.468, α_c = .858

PEER DOMAIN

Table C7

Interitem Correlations for Perception of Peer Disapproval Items

Item	Cig	Ecig	Alc	MJ	Rx
	1.00	.805	.756	.742	.697
		1.00	.756	.819	.624
			1.00	.745	.634
				1.00	.576
					1.00
Mean	3.23	3.01	3.09	2.98	3.42
SD	0.941	1.082	1.016	1.128	0.855

N = 12588, α_c = .925

Table C8

Item-Level Statistics for Perception of Peer Disapproval Items

Item	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	R^2	Cronbach Alpha if Item Deleted
Cigs	12.51	12.938	.854	.739	.900
Ecigs	12.72	11.980	.862	.768	.897
Alc	12.65	12.659	.818	.671	.906
MJ	12.75	11.946	.820	.713	.907
Rx	12.31	14.391	.692	.515	.929

N = 12588, Scale Mean = 15.73, Scale Variance = 19.607, α_c = .925

FAMILY DOMAIN

Table C9

Interitem Correlations for Perception of Parental Disapproval

Item	Cig	Ecig	Alc	MJ	Rx
	1.00	.786	.573	.619	.560
		1.00	.546	.660	.515
			1.00	.510	.433
				1.00	.402
					1.00
Mean	3.74	3.70	3.58	3.58	3.82
SD	0.577	0.627	0.746	0.803	0.515

N = 12620, α_c = .864

Table C10

Item-Level Statistics for Perception of Parental Disapproval

Item	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	R^2	Cronbach Alpha if Item Deleted
Cigs	14.68	4.644	.792	.677	.799
Ecigs	14.72	4.480	.783	.675	.797
Alc	14.84	4.443	.620	.387	.842
MJ	14.85	4.124	.669	.481	.832
Rx	14.61	5.353	.559	.342	.853

N = 12620, Scale Mean = 18.42, Scale Variance = 6.950, α_c = .864

Table C11

Interitem Correlations for Family Rules

Item	Cig	Ecig	Alc	MJ	Rx
	1.00	.946	.881	.898	.921
		1.00	.888	.921	.919
			1.00	.885	.867
				1.00	.875
					1.00
Mean	3.22	3.21	3.06	3.13	3.20
SD	1.230	1.233	1.209	1.244	1.254

N = 13055, α_c = .978

Table C12

Item-Level Statistics for Family Rules

Item	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	R^2	Cronbach Alpha if Item Deleted
Cigs	12.60	22.427	.951	.916	.971
Ecigs	12.62	22.316	.960	.929	.969
Alc	12.77	23.001	.910	.831	.977
MJ	12.70	22.507	.929	.871	.974
Rx	12.62	22.399	.930	.875	.974

N = 13055, Scale Mean = 15.83, Scale Variance = 35.012, α_c = .978

Table C13

Interitem Correlations for Parental Use of Substances

Item	Cigs	Ecigs	Alc	MJ
	1.00	.367	.182	.286
		1.00	.145	.361
			1.00	.161
				1.00
Mean	0.20	0.10	0.61	0.13
SD	0.403	0.301	0.488	0.335

N = 2728, α_c = .537

Table C14

Item-Level Statistics for Parental Use of Substances

Item	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	R^2	Cronbach Alpha if Item Deleted
Cigs	0.84	.609	.378	.174	.414
Ecig	0.94	.714	.402	.209	.423
Alc	0.43	.605	.220	.049	.594
MJ	0.92	.695	.363	.165	.440

N = 2728, Scale Mean = 1.05, Scale Variance = 1.005, α_c = .537

Table C15

Interitem Correlations for Parental Use of Substances, deleted Parental Use of Alcohol

Item	Cigs	Ecigs	MJ
	1.00	.367	.286
		1.00	.359
			1.00
Mean	0.20	0.10	0.13
SD	0.403	0.301	0.335

N = 2736, α_c = .594

Table C16

Item-Level Statistics for Parental Use of Substances, deleted Parental Use of Alcohol

Item	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	R^2	Cronbach Alpha if Item Deleted
Cigs	0.23	.276	.393	.162	.526
Ecig	0.33	.353	.452	.205	.439
MJ	0.31	.343	.382	.156	.521

N = 2736, Scale Mean = 0.43, Scale Variance = 0.778, α_c = .594

SCHOOL DOMAIN

Table C17

Interitem Correlations for School Domain Items

Item	Commit	Support	Safety
	1.00	.298	.238
		1.00	.419
			1.00
Mean	3.39	3.22	3.12
SD	0.637	0.694	0.695

N = 3861, α_c = .586

Table C18

Item-Level Statistics for School Domain Items

Item	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	R^2	Cronbach Alpha if Item Deleted
Commitment	6.34	1.370	.318	.104	.591
Support	6.51	1.101	.459	.217	.384
Safety	6.61	1.150	.413	.190	.458

N = 3861, Scale Mean = 9.73, Scale Variance = 2.250, α_c = .586

COMMUNITY DOMAIN

Of note, the items related to being teased, drugs being sold in the community, and kids being interested in using marijuana in the community were all reverse coded for the purposes of this item analysis, so that higher scores could indicate positive perceptions of community.

Table C19

Interitem Correlations for Community Domain Items

Item	Safe	Teased_R	Drugs_R	Activities	Kids_Drugs_R	Adults
	1.00	.202	.234	.303	.197	.349
		1.00	.430	-.030	.398	.052
			1.00	.003	.719	.060
				1.00	.048	.434
					1.00	.098
						1.00
Mean	3.06	2.61	2.84	2.71	2.70	2.52
SD	0.744	0.891	0.988	0.943	1.036	0.879

N = 3198, α_c = .646

Table C20

Item-Level Statistics for Community Domain Items

Item	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	R^2	Cronbach Alpha if Item Deleted
Safe	13.38	8.599	.412	.210	.595
Teased_R	13.83	8.366	.347	.217	.613
Drugs_R	13.60	7.290	.503	.550	.550
Activities	13.73	8.868	.213	.224	.662
Kids_Drugs_R	13.73	7.094	.505	.530	.548
Adults	13.91	8.641	.298	.242	.630

N = 3198, Scale Mean = 16.44, Scale Variance = 10.950, α_c = .646

Table C21

Interitem Correlations for Community Domain Items, Deleted Activities Item

Item	Safe	Teased_R	Drugs_R	Kids_Drugs_R	Adults
	1.00	.202	.237	.199	.348
		1.00	.426	.397	.050
			1.00	.718	.060
				1.00	.100
					1.00
Mean	3.06	2.61	2.84	2.71	2.53
SD	0.744	0.891	0.988	1.036	0.880

N = 3219, α_c = .662

Table C22

Item-Level Statistics for Community Domain Items, Deleted Activities Item

Item	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	R^2	Cronbach Alpha if Item Deleted
Safe	10.68	6.938	.351	.178	.638
Teased_R	11.13	6.247	.411	.209	.612
Drugs_R	10.90	5.224	.592	.547	.517
Kids_Drugs_R	11.03	5.105	.575	.529	.524
Adults	11.21	7.276	.173	.127	.710

N = 3219, Scale Mean = 13.74, Scale Variance = 8.872, α_c = .662

Table C23

Interitem Correlations for Community Domain Items, Deleted Activities and Adults Items

Item	Safe	Teased_R	Drugs_R	Kids_Drugs_R
	1.00	.201	.238	.201
		1.00	.424	.398
			1.00	.718
				1.00
Mean	3.06	2.61	2.84	2.71
SD	0.743	0.890	0.988	1.036

N = 3241, α_c = .711

Table C24

Item-Level Statistics for Community Domain Items, Deleted Activities and Adults Items

Item	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	R^2	Cronbach Alpha if Item Deleted
Safe	8.16	5.792	.258	.069	.764
Teased_R	8.611	4.730	.451	.208	.675
Drugs_R	8.38	3.727	.673	.545	.527
Kids_Drugs_R	8.51	3.681	.632	.527	.555

N = 3241, Scale Mean = 11.22, Scale Variance = 7.27, α_c = .711

Table C25

Interitem Correlations for Community Domain Items, Deleted Activities, Adults, and Safe Items

Item	Teased_R	Drugs_R	Kids_Drugs_R
	1.00	.425	.398
		1.00	.718
			1.00
Mean	2.61	2.84	2.71
SD	0.890	0.988	1.036

N = 3243, α_c = .764

Table C26

Item-Level Statistics for Community Domain Items, Deleted Activities, Adults, and Safe Items

Item	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	R^2	Cronbach Alpha if Item Deleted
Teased	5.55	3.521	.444	.198	.836
Drugs	5.32	2.602	.696	.539	.565
Kids_Drugs	5.45	2.515	.671	.527	.594

N = 3243, Scale Mean = 8.16, Scale Variance = 5.796, α_c = .764

COMMUNITY DOMAIN: EXPLORATORY FACTOR ANALYSIS

The previous item analyses suggested that there may be multidimensionality in the scale. Therefore, an exploratory factor analysis (EFA) was conducted in order to assess the factor structure of the scale. An EFA was completed with the principle axis extraction method. The number of factors was determined by assessing the unrotated scree plot (Figure C1) and the eigenvalues for the factors that were generated (Table C27), yielding a total of two factors. A promax rotation was completed to increase the interpretability of the factors. Factor loadings were assessed (Table C28) and described as "Negative Perceptions" and "Supportive Community." Subsequent reliability analyses determined that Cronbach's alpha for both factors were acceptable and therefore all items were retained and averaged to create two total scores.

Table C27

Correlation Matrix Eigenvalues and Factor Correlation Matrix

Factor	Eigenvalue	% of Variance	Cumulative %	F1	F2
F1	2.244	0.3740	0.3740	1.00	-.174
F2	1.583	0.2640	0.6379		1.00

N = 3198

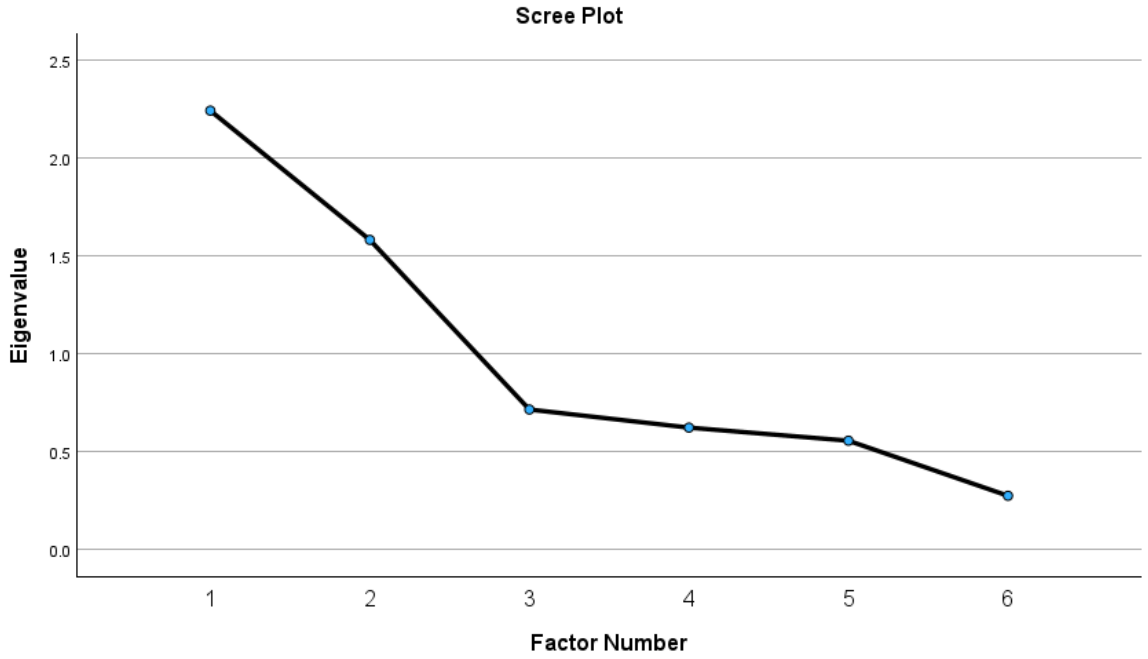

Figure C1. Scree plot of the unrotated factors.

Table C28

Factor Loadings of Items

Item	Factors	
	Negative Perceptions	Supportive Community
My community is a safe place	-.197	**.477**
In my community, kids are often teased or taunted so much their feelings are hurt	**.501**	-.006
A lot of drugs are sold in my community	**.893**	.031
There are lots of things for young people to do in my community	.093	**.642**
A lot of kids in my community are into using marijuana and other drugs	**.795**	-.021
Adults in my town see teenagers as valuable and important members of the community.	.024	**.694**
Cronbach's Alpha	.764	.628

APPENDIX D

SUPPLEMENTARY LCA TABLES BY GRADE

Table D1

Item Response Probabilities and Latent Class Prevalences for the 7th Grade Sample

		Latent Classes	
		Nonusers	Experimenters
Latent class prevalences		0.921	0.786
Alcohol	Never	**0.973**	**0.586**
	Lifetime	0.025	0.378
	Recent	0.002	0.036
Cigarettes	Never	**1.000**	**0.865**
	Lifetime	0.000	0.098
	Recent	0.000	0.037
Tobacco	Never	**1.000**	**0.885**
	Lifetime	0.000	0.073
	Recent	0.000	0.041
E-Cigarettes	Never	**0.996**	**0.614**
	Lifetime	0.004	0.269
	Recent	0.001	0.117
Cannabis	Never	**0.999**	**0.784**
	Lifetime	0.001	0.130
	Recent	0.000	0.085
Energy Drink containing Alcohol	Never	**0.991**	**0.730**
	Lifetime	0.009	0.211
	Recent	0.000	0.059
Illicit Substances	Never	**0.978**	**0.713**
	Lifetime	0.017	0.210
	Recent	0.004	0.077
Pain Medications	Never	**0.960**	**0.661**
	Lifetime	0.030	0.184
	Recent	0.010	0.155
Steroids	Never	**0.998**	**0.940**
	Lifetime	0.001	0.034
	Recent	0.001	0.026
Downers	Never	**0.981**	**0.637**
	Lifetime	0.016	0.245
	Recent	0.003	0.118
Tranquilizers	Never	**1.000**	**0.932**
	Lifetime	0.000	0.041
	Recent	0.000	0.027

Table D1 Continued

		Latent Classes	
		Nonusers	Experimenters
Latent class prevalences		0.921	0.786
Uppers	Never	**1.000**	**0.918**
	Lifetime	0.000	0.055
	Recent	0.000	0.027
Over the Counter	Never	**0.987**	**0.791**
	Lifetime	0.008	0.121
	Recent	0.005	0.089

Note. Highest endorsed item response probabilities are bolded to facilitate interpretation.

Table D2

Item Response Probabilities and Latent Class Prevalences for the 8th Grade Sample

		Latent Classes	
		Nonusers	Experimenters
Latent class prevalences		0.918	0.082
Alcohol	Never	**0.959**	0.407
	Lifetime	0.038	**0.472**
	Recent	0.003	0.122
Cigarettes	Never	**1.000**	**0.783**
	Lifetime	0.000	0.185
	Recent	0.000	0.032
Tobacco	Never	**1.000**	**0.834**
	Lifetime	0.000	0.134
	Recent	0.000	0.033
E-Cigarettes	Never	**0.990**	**0.445**
	Lifetime	0.010	0.375
	Recent	0.000	0.180
Cannabis	Never	**0.996**	**0.639**
	Lifetime	0.004	0.205
	Recent	0.000	0.156
Energy Drink containing Alcohol	Never	**0.986**	**0.640**
	Lifetime	0.012	0.303
	Recent	0.002	0.057
Illicit Substances	Never	**0.978**	**0.692**
	Lifetime	0.020	0.220
	Recent	0.002	0.088
Pain Medications	Never	**0.960**	**0.739**
	Lifetime	0.030	0.152
	Recent	0.010	0.109
Steroids	Never	**0.999**	**0.937**
	Lifetime	0.001	0.034
	Recent	0.000	0.029
Downers	Never	**0.969**	**0.668**
	Lifetime	0.028	0.196
	Recent	0.003	0.136
Tranquilizers	Never	**0.998**	**0.940**
	Lifetime	0.002	0.037
	Recent	0.000	0.023

Table D2 Continued

		Latent Classes	
		Nonusers	Experimenters
Latent class prevalences		0.918	0.082
Uppers	Never	**0.999**	**0.909**
	Lifetime	0.001	0.044
	Recent	0.000	0.046
Over the Counter	Never	**0.980**	**0.807**
	Lifetime	0.010	0.120
	Recent	0.010	0.073

Note. Highest endorsed item response probabilities are bolded to facilitate interpretation.

Table D3

Item Response Probabilities and Latent Class Prevalences for the 9th Grade Sample

		Latent Classes			
		Nonusers	Alcohol, Cannabis, E-Cigarette Experimenters	Rx and Alcohol Experimenters	Polysubstance Users
Latent class prevalences		0.857	0.071	0.049	0.023
Alcohol	Never	**0.955**	0.367	**0.639**	0.097
	Lifetime	0.042	**0.533**	0.299	0.448
	Recent	0.004	0.100	0.062	**0.455**
Cigarettes	Never	**1.000**	**0.861**	**0.964**	**0.420**
	Lifetime	0.000	0.133	0.036	0.413
	Recent	0.000	0.005	0.000	0.167
Tobacco	Never	**0.999**	**0.938**	**1.000**	**0.450**
	Lifetime	0.001	0.062	0.000	0.308
	Recent	0.000	0.000	0.000	0.242
E-Cigarettes	Never	**0.988**	0.321	**0.898**	0.152
	Lifetime	0.009	**0.436**	0.102	0.181
	Recent	0.003	0.243	0.000	**0.666**
Cannabis	Never	**0.992**	**0.429**	**0.921**	0.142
	Lifetime	0.003	0.388	0.046	0.270
	Recent	0.005	0.183	0.033	**0.588**
Energy Drink containing Alcohol	Never	**0.994**	**0.643**	**0.801**	0.227
	Lifetime	0.004	0.302	0.188	0.378
	Recent	0.002	0.056	0.012	**0.396**
Illicit Substances	Never	**0.984**	**0.823**	**0.799**	0.350
	Lifetime	0.012	0.161	0.169	**0.390**
	Recent	0.005	0.016	0.031	0.260
Pain Medications	Never	**0.981**	**0.985**	0.410	**0.538**
	Lifetime	0.011	0.000	**0.446**	0.300
	Recent	0.008	0.015	0.144	0.162
Steroids	Never	**0.999**	**1.000**	**0.934**	**0.979**
	Lifetime	0.000	0.000	0.047	0.021
	Recent	0.001	0.000	0.019	0.000
Downers	Never	**0.983**	**0.906**	**0.426**	**0.464**
	Lifetime	0.014	0.064	0.350	0.309
	Recent	0.003	0.030	0.224	0.227
Tranquilizers	Never	**1.000**	**0.973**	**0.904**	**0.894**
	Lifetime	0.000	0.027	0.049	0.046
	Recent	0.000	0.000	0.047	0.060

Table D3 Continued

		Latent Classes			
		Nonusers	Alcohol, Cannabis, E-Cigarette Experimenters	Rx and Alcohol Experimenters	Polysubstance Users
Latent class prevalences		0.857	0.071	0.049	0.023
Uppers	Never	**1.000**	**1.000**	**0.848**	**0.833**
	Lifetime	0.000	0.000	0.079	0.126
	Recent	0.000	0.000	0.072	0.041
Over the Counter	Never	**0.991**	**0.947**	**0.771**	**0.516**
	Lifetime	0.008	0.053	0.190	0.346
	Recent	0.001	0.000	0.040	0.137

Note. Highest endorsed item response probabilities are bolded to facilitate interpretation.

Table D4

Item Response Probabilities and Latent Class Prevalences for the 10th Grade Sample

		Latent Classes			
		Nonusers	Alcohol, Cannabis, E-Cigarette Experimenters	Rx and Alcohol Experimenters	Polysubstance Users
Latent class prevalences		0.763	0.096	0.108	0.033
Alcohol	Never	**0.932**	0.257	**0.516**	0.142
	Lifetime	0.062	**0.534**	0.355	0.258
	Recent	0.007	0.209	0.130	**0.601**
Cigarettes	Never	**0.999**	**0.804**	**0.990**	**0.563**
	Lifetime	0.001	0.188	0.010	0.251
	Recent	0.001	0.008	0.000	0.186
Tobacco	Never	**1.000**	**0.867**	**1.000**	**0.610**
	Lifetime	0.000	0.117	0.000	0.172
	Recent	0.000	0.016	0.000	0.218
E-Cigarettes	Never	**0.976**	0.162	**0.888**	0.015
	Lifetime	0.020	**0.556**	0.068	0.072
	Recent	0.004	0.282	0.044	**0.912**
Cannabis	Never	**0.988**	0.259	**0.910**	0.062
	Lifetime	0.007	**0.456**	0.069	0.111
	Recent	0.005	0.286	0.021	**0.827**
Energy Drink containing Alcohol	Never	**0.996**	**0.657**	**0.695**	0.353
	Lifetime	0.004	0.305	0.247	0.289
	Recent	0.000	0.038	0.058	**0.358**
Illicit Substances	Never	**0.989**	**0.798**	**0.819**	**0.414**
	Lifetime	0.007	0.184	0.155	0.321
	Recent	0.004	0.017	0.026	0.265
Pain Medications	Never	**0.986**	**0.966**	**0.708**	**0.641**
	Lifetime	0.012	0.000	0.199	0.294
	Recent	0.002	0.005	0.093	0.066
Steroids	Never	**0.999**	**0.995**	**0.982**	**0.916**
	Lifetime	0.000	0.000	0.018	0.050
	Recent	0.001	0.005	0.000	0.034
Downers	Never	**0.990**	**0.934**	**0.702**	**0.603**
	Lifetime	0.007	0.041	0.231	0.203
	Recent	0.003	0.025	0.067	0.194
Tranquilizers	Never	**0.999**	**0.981**	**0.970**	**0.826**
	Lifetime	0.000	0.019	0.025	0.157
	Recent	0.001	0.000	0.005	0.017

Table D4 Continued

		Latent Classes			
		Nonusers	Alcohol, Cannabis, E-Cigarette Experimenters	Rx and Alcohol Experimenters	Polysubstance Users
Latent class prevalences		0.763	0.096	0.108	0.033
Uppers	Never	**0.999**	**1.000**	**0.931**	**0.681**
	Lifetime	0.000	0.000	0.058	0.220
	Recent	0.001	0.000	0.011	0.099
Over the Counter	Never	**0.995**	**0.965**	**0.879**	**0.614**
	Lifetime	0.005	0.029	0.076	0.333
	Recent	0.000	0.006	0.044	0.053

Note. Highest endorsed item response probabilities are bolded to facilitate interpretation.

Table D5

Item Response Probabilities and Latent Class Prevalences for the 11th Grade Sample

		Latent Classes			
		Nonusers	Alcohol, Cannabis, E-Cigarette Experimenters	Rx and Alcohol Experimenters	Polysubstance Users
Latent class prevalences		0.735	0.175	0.037	0.053
Alcohol	Never	**0.917**	0.202	**0.814**	0.076
	Lifetime	0.075	**0.596**	0.146	0.373
	Recent	0.009	0.201	0.040	**0.551**
Cigarettes	Never	**1.000**	**0.890**	**1.000**	0.365
	Lifetime	0.000	0.102	0.000	**0.479**
	Recent	0.000	0.008	0.000	0.156
Tobacco	Never	**0.999**	**0.916**	**0.986**	**0.438**
	Lifetime	0.001	0.075	0.014	0.407
	Recent	0.000	0.009	0.000	0.155
E-Cigarettes	Never	**0.988**	**0.429**	**1.000**	0.043
	Lifetime	0.011	0.402	0.000	0.283
	Recent	0.001	0.169	0.000	**0.674**
Cannabis	Never	**0.982**	**0.365**	**0.965**	0.029
	Lifetime	0.011	0.340	0.035	0.242
	Recent	0.008	0.295	0.000	**0.728**
Energy Drink containing Alcohol	Never	**0.990**	**0.595**	**1.000**	0.284
	Lifetime	0.010	0.360	0.000	**0.392**
	Recent	0.001	0.056	0.000	0.323
Illicit Substances	Never	**0.983**	**0.850**	**0.879**	0.320
	Lifetime	0.014	0.116	0.084	**0.495**
	Recent	0.004	0.034	0.037	0.185
Pain Medications	Never	**0.990**	**0.957**	**0.470**	**0.715**
	Lifetime	0.009	0.035	0.406	0.247
	Recent	0.001	0.008	0.124	0.038
Steroids	Never	**0.999**	**0.994**	**0.953**	**0.958**
	Lifetime	0.001	0.006	0.034	0.024
	Recent	0.000	0.000	0.013	0.019
Downers	Never	**0.986**	**0.958**	**0.573**	**0.607**
	Lifetime	0.010	0.042	0.238	0.238
	Recent	0.005	0.000	0.188	0.155
Tranquilizers	Never	**0.999**	**0.994**	**0.925**	**0.673**
	Lifetime	0.001	0.003	0.075	0.238
	Recent	0.000	0.003	0.000	0.094

Table D5 Continued

		Latent Classes			
		Nonusers	Alcohol, Cannabis, E-Cigarette Experimenters	Rx and Alcohol Experimenters	Polysubstance Users
Latent class prevalences		0.735	0.175	0.037	0.053
Uppers	Never	**1.000**	**0.992**	**0.837**	**0.610**
	Lifetime	0.000	0.005	0.137	0.250
	Recent	0.000	0.003	0.026	0.141
Over the Counter	Never	**0.994**	**0.963**	**0.801**	**0.732**
	Lifetime	0.006	0.037	0.141	0.170
	Recent	0.000	0.000	0.058	0.098

Note. Highest endorsed item response probabilities are bolded to facilitate interpretation.

Table D6

Item Response Probabilities and Latent Class Prevalences for the 12th Grade Sample

		Latent Classes			
		Nonusers	Alcohol, Cannabis, E-Cigarette Experimenters	Rx and Alcohol Experimenters	Polysubstance Users
Latent class prevalences		0.717	0.210	0.021	0.052
Alcohol	Never	**0.875**	0.155	**0.476**	0.028
	Lifetime	0.097	**0.521**	0.263	0.170
	Recent	0.028	0.324	0.262	**0.802**
Cigarettes	Never	**0.997**	**0.813**	**1.000**	0.193
	Lifetime	0.003	0.171	0.000	**0.562**
	Recent	0.000	0.016	0.000	0.245
Tobacco	Never	**0.998**	**0.917**	**0.945**	0.237
	Lifetime	0.001	0.072	0.055	0.381
	Recent	0.001	0.011	0.000	**0.382**
E-Cigarettes	Never	**0.981**	**0.354**	**0.765**	0.000
	Lifetime	0.018	0.344	0.000	0.208
	Recent	0.001	0.302	0.235	**0.792**
Cannabis	Never	**0.975**	0.238	**0.787**	0.019
	Lifetime	0.014	**0.392**	0.104	0.237
	Recent	0.011	0.370	0.108	**0.744**
Energy Drink containing Alcohol	Never	**0.987**	**0.636**	**0.845**	0.297
	Lifetime	0.009	0.288	0.000	**0.370**
	Recent	0.004	0.075	0.155	0.333
Illicit Substances	Never	**0.984**	**0.838**	**0.659**	0.369
	Lifetime	0.014	0.145	0.203	**0.444**
	Recent	0.002	0.017	0.138	0.188
Pain Medications	Never	**0.982**	**0.986**	0.259	**0.751**
	Lifetime	0.016	0.014	**0.536**	0.228
	Recent	0.002	0.000	0.205	0.021
Steroids	Never	**1.000**	**1.000**	**0.780**	**0.960**
	Lifetime	0.000	0.000	0.094	0.027
	Recent	0.000	0.000	0.126	0.013
Downers	Never	**0.985**	**0.976**	0.265	**0.723**
	Lifetime	0.015	0.023	**0.450**	0.250
	Recent	0.000	0.002	0.285	0.026
Tranquilizers	Never	**0.999**	**0.991**	**0.653**	**0.779**
	Lifetime	0.001	0.009	0.218	0.169
	Recent	0.000	0.000	0.129	0.052

Table D6 Continued

		Latent Classes			
		Nonusers	Alcohol, Cannabis, E-Cigarette Experimenters	Rx and Alcohol Experimenters	Polysubstance Users
Latent class prevalences		0.717	0.210	0.021	0.052
Uppers	Never	**0.996**	**0.970**	**0.750**	**0.695**
	Lifetime	0.004	0.030	0.154	0.252
	Recent	0.000	0.000	0.097	0.052
Over the Counter	Never	**0.997**	**0.984**	**0.688**	**0.666**
	Lifetime	0.003	0.013	0.170	0.312
	Recent	0.001	0.003	0.141	0.022

Note. Highest endorsed item response probabilities are bolded to facilitate interpretation.

VITA

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Education

Ph.D.	Applied Experimental Psychology (*expected August 2024*) Department of Psychology Old Dominion University
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Background

Jennika K. Jenkins is a doctoral candidate in the Applied Experimental Psychology doctoral program at Old Dominion University. Jennika's research interests include the study of early family dynamics, with emphasis on developmental psychopathology, emotional coping, and transgenerational trauma. She is interested in the determinants of parenting that may be identified as key risk or protective factors to prevent patterns of stress and abuse within families. Jennika is currently employed as the Epidemiologist at the Connecticut Department of Mental Health and Addiction Services' (DMHAS) Regional Behavioral Health Action Organization for Eastern Connecticut.

Selected Publications

Jenkins, J. K. & Duhaime, A. R. (2023). *Region 3 Priority Report 2022-2023.* Norwich, Connecticut: Southeastern Regional Action Council for the Connecticut Department of Mental Health and Addiction Services, Prevention and Health Promotion Division. https://portal.ct.gov/-/media/dmhas/publications/r3_serac_2023_priority_report_final_111423.pdf

Long, M. M., Cramer, R.J., **Jenkins, J. K.**, Bennington, L., Paulson, J. F. (2019). A systematic review of interventions for healthcare professionals to improve screening and referral for perinatal mood and anxiety disorders. *Archives of Women's Mental Health, 22*, 25-36. https://doi.org/10.1007/s00737-018-0876-4