DO NATURAL MENTORS DISRUPT MULTILEVEL

ADOLESCENT RISK FACTORS OF PROBLEMATIC

CANNABIS USE?

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Abstract: There are multilevel factors during adolescence that may contribute to problematic cannabis use; it is crucial to identify these factors and factors that may buffer problematic use. The present study investigated if adolescent risk factors across systems are associated with lifetime history of problematic cannabis use and investigated if having a natural mentor was a protective and/or compensatory factor against problematic use. Individuals from the National Longitudinal Study of Adolescent to Adult Health (Add Health) study were included in the present study (N=2,153). Adolescent risk factors assessed at Wave I (neighborhood poverty and drug exposure, access to illegal drugs at home, peer cannabis use, and delinquency); natural mentorship was assessed at Wave III. Lifetime history of problematic cannabis use was assessed at Wave IV. The main effects of risk factors and natural mentorship on problematic cannabis use were investigated; and the moderating role of natural mentorship on the association between risk factors and problematic cannabis use. Analyses were initially completed with the full sample; additional analyses were conducted on two subsamples: Black and White individuals. Results of the model using the full sample are described first. Those with access to drugs at home were less likely to have a history of problematic use (B=-.812,p=.029). An interaction between access to drugs at home and mentorship emerged (B=.844,p=.038). Follow-up probing indicated for *those with no mentor*, having access to drugs at home was not related to a history of problematic use (OR=.222,p=.148). *Among those with a mentor*, having access to drugs at home during was associated with a *greater* likelihood of having a history of problematic use (OR=1.062,p< .001). Among Black individuals, the peer use*mentorship interaction (B=-.402,p =.056) was marginally significant. Among *Black individuals with no mentor*, exposure to peer use was associated with an *increased* likelihood of problematic use (OR=1.448,p=.009). On the other hand, among *Black individuals with a mentor*, exposure to peer use was associated with a *decreased* likelihood of problematic use in adulthood (OR=0.636,p<.001). No significant predictors or interactions were present for White individuals. Our findings suggest that natural mentorship may be beneficial in some contexts for Black individuals.

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CHAPTER I

INTRODUCTION

Cannabis is the most popular substance used in the western world, and use is

highly prevalent among young adults ages 18-29 (Cohen, Weizman, & Weinstein, 2019;

Substance Abuse and Mental Health Service Adminstation, 2019). In fact, in 2014, daily

or near daily cannabis use (e.g. using cannabis 20 or more occasions in the past 30 days)

reached its highest rate among young adults and college students since 1980 (Carliner,

Brown, Sarvet, & Hasin, 2017; Johnston, O'Malley, Bachman, Schulenberg, & Miech,

2014; Wang, Hoyte, Roosevelt, & Heard, 2019). Problematic cannabis use, which

encompasses patterns of cannabis use associated with abuse and/or dependence

symptoms, has also increased across time (Hasin et al., 2017). Given the rising

prevalence of cannabis use, research is needed to understand early risk and protective

factors associated with cannabis use, especially problematic cannabis use, later in life.

Research on the health effects of cannabis use has increased since the rise in cannabis use

and the rise of legalization of cannabis; several short- and long-term side effects have

been documented (Cousijn, Núñez, & Filbey, 2018). To date, many conclusions about the

potential benefits of cannabis use remain limited due to insufficient methodically strong

research (Cousijn et al., 2018). There are well documented adverse health consequences

associated with *smoking cannabis*, such as respiratory and cardiovascular diseases (e.g.,

myocardial infarction, stroke, and transient ischemic attacks (Thomas, Kloner, & Rezkalla, 2014; Volkow, Baler, Compton, & Weiss, 2014), cognitive impairments (especially with early initiation), psychosis, and addiction (Cohen et al., 2019; Sachs, McGlade, & Yurgelun-Todd, 2015). Additionally, heavy, chronic cannabis smoking is linked to increases chronic bronchitis, frequent phlegm, shortness of breath, wheezing without a cold, and pneumonia (Moore, Augustson, Moser, & Budney, 2005; Volkow et al., 2014). *Cannabis use (not limited to cannabis smoking)* is also associated with numerous cognitive and psychological sequalae. Long-term cannabis use has been linked to changes in the brain that affect memory, learning, and overall cognitive abilities, especially for those who initiated heavy and chronic use before the age of 21 (Volkow et al., 2014; Zalesky et al., 2012). Cannabis use is also associated with increased anxiety and panic symptoms, paranoid thoughts and hallucinations, sensitivity and intensification to certain stimuli (e.g., colors, sound) (Agrawal, Madden, Bucholz, Heath, & Lynskey, 2014), depressive symptoms, and suicidal ideation (Cousijn et al., 2018; National Academies of Sciences, Engineering, 2017). These psychological effects are more deleterious for those who have pre-existing mental health diagnoses (e.g. anxiety, bipolar disorder)(Buckner, Mallott, Schmidt, & Taylor, 2006). Problematic cannabis use is associated with even greater deleterious health consequences (Hall & Degenhardt, 2014).

Problematic Cannabis Use: Abuse and Dependence

The current study will focus specifically on problematic cannabis use (i.e., diagnoses of cannabis abuse or dependence). Diagnostic and Statistical Manual of Mental Disorders Fourth Edition- Text Revision (DSM-IV-TR) differentiated cannabis abuse and cannabis dependence as separate disorders (Hasin et al., 2013), with cannabis abuse

described as a less serious diagnosis relative to cannabis dependence. Cannabis abuse refers to a clinically significant pattern of problems associated with cannabis use without the presence of dependence symptoms (American Psychiatric Association, 2000); cannabis dependence refers to experiencing symptoms of tolerance and withdrawal (American Psychiatric Association, 2000). A recent large, study found that over 34% of lifetime cannabis users will meet the DSM-IV-TR criteria for cannabis dependence or abuse in their lifetime, with half of diagnoses occurring within the first three years of first use (Feingold, Livne, Rehm, & Lev-Ran, 2020). This taken together with the deleterious health effects associated with heavy cannabis use supports the urgent need to identify early risk factors and protective factors associated with problematic cannabis use during adulthood.

Multilevel Influences on Cannabis Use

Cannabis use, and more specifically problematic cannabis use, is influenced by a variety of biological, socio-cultural, environmental, and/or structural influences (Hayatbakhsh, Najman, Bor, O'Callaghan, & Williams, 2009). Since genetics only account for a portion of influence (Verweij et al., 2010), the identification of multilevel risk factors during adolescence that predict problematic cannabis use in young adulthood/adulthood, and protective factors that may buffer against adolescent risk, is critical to the development of effective prevention and intervention programming. Urie Bronfenbrenner's Social Ecological Model (Bronfenbrenner, 1977) describes how individuals are embedded within numerous, larger systems that are dynamically related, and helps to identify potential risk and protective factors across multiple systems that influence behavior (Bronfenbrenner, 1977; Wilson, Coulon, & Huffman, 2018). These

systems work together to impact individuals' overall outcomes, including problematic

cannabis use. The current study will investigate how adolescent neighborhood factors

(neighborhood poverty; neighborhood drug exposure), family factors (access to illegal

drugs in the home), peer factors (peer cannabis use), and individual factors (delinquency)

predict a lifetime history of problematic cannabis use. These risk factors were chosen

based on Social Ecological Theory and the extant longitudinal research supporting them

as risk factors for cannabis use; notably, there is more limited research focused on

problematic cannabis use. The available longitudinal research on how each of these risk

factors relate to cannabis use are reviewed below, followed by a review of studies that

simultaneously investigated numerous risk factors for problematic cannabis use.

Neighborhood: Drug Exposure and Poverty

Longitudinal studies have documented that neighborhood drug exposure and

neighborhood poverty during adolescence are predictive of subsequent cannabis initiation

and use (Karriker-Jaffe, 2011; Jungeun Olivia Lee et al., 2017; Leifheit et al., 2015).

Neighborhood drug exposure is predictive of *cannabis use initiation* (Karriker-Jaffe,

2011; Leifheit et al., 2015) and more problematic cannabis, alcohol, and nicotine use in

adulthood (Jungeun Olivia Lee et al., 2017). This neighborhood risk does not stand alone

and rather often coincides with other neighborhood risk: Neighborhood poverty is

associated with increased drug exposure opportunities among adolescents and adults

(Storr, Chen, & Anthony, 2004), and both drug exposure opportunities and neighborhood

poverty are associated with drug use (Storr et al., 2004). Neighborhood poverty is a risk

factor cannabis use (Burlew et al., 2009; Karriker-Jaffe, 2011). However, in one of the

few longitudinal studies investigating neighborhood poverty during adolescence as a risk

factor for later problematic cannabis use, neighborhood stability, but poverty, was associated with problematic cannabis use. (J. O. Lee et al., 2018). Overall, there is a paucity of longitudinal research focused on examining how adolescent neighborhood poverty and drug exposure relates to problematic cannabis use.

Family: Access to Illicit Drugs

There are several well-established family level risk factors for problematic cannabis use (Schuler, Tucker, Pedersen, & D'Amico, 2019; Von Sydow, Lieb, Pfister, Höfler, & Wittchen, 2002), including access to products (Swahn & Hammig, 2000). To date, there is limited research focused on cannabis, with only one longitudinal study examining how access to illicit drugs in the home predicts subsequent cannabis use. Using the first two waves from the National Study of Adolescent to Adult Health (Add Health Study; the same sample that will be used for the present study), Bouchard et al. (2017) investigated if numerous adolescent risk factors (Wave I), including individual factors (delinquency), peer substance use and relationships, parental smoking/alcohol use and relationships, school risk factors, and access to illegal drugs, tobacco, or alcohol in the home, predicted cannabis use in later adolescence (Wave II). Having access to illegal drugs, tobacco, and alcohol in the home were not significant predictors of subsequent cannabis use at Wave 2. The current study will add to the literature by using a longer study period and by identifying how access to illicit drugs in the home predicts later problematic cannabis use in adulthood.

Peers: Substance Use

Peer relationships are essential for adolescents to develop appropriate social skills and behaviors; however, peer relationships (Tucker, De La Haye, Kennedy, Green, &

Pollard, 2014) and substance use are also major influences on the development and maintenance of adolescent delinquency and substance use (Allen, Chango, Szwedo, Schad, & Marston, 2012; Moffitt, Caspi, Dickson, Silva, & Stanton, 1996), including problematic cannabis use (Buckner et al., 2006). Longitudinal research has also documented that exposure to peer cannabis use during adolescence is predictive of subsequent personal problematic cannabis use later in life (Piehler, Véronneau, & Dishion, 2012; Von Sydow et al., 2002). These finding were replicated in a methodically rigorous longitudinal study by Johnson and colleagues (2018) that examined the roles of genetics (e.g. genome-wide polygenic risk for substance use (PRS)) and environmental factors (e.g. perceived peer cannabis use) in predicting subsequent cannabis use and cannabis use disorder. This study included a sample of 1,167 European participants taken from a larger longitudinal study (Collaborative Study on genetics and Alcoholism). Participants were 12-26 years old at baseline and were offspring of parents who struggled with addiction (61% had one parent with alcohol use disorder). Participants completed the same semi-structured interview every 2 years; data collection is still on-going. Cannabis use was assessed by the semi-structured Assessment for the Genetics of Alcoholism which included an assessment of life-time cannabis use (yes vs no) and frequency of past year cannabis use. Cannabis use disorder was coded using DSM-IV criteria. To assess perceived peer cannabis use, participants were asked 'When you were 12-17 how many of your best friends used marijuana?'; responses ranged from none to all. Participants also self-reported on externalizing behaviors. Results identified three different classes of cannabis users: 1) No/Low Use: infrequent users or never users; 2) High Use: high frequency of use at baseline that escalated and remained elevated; and 3)

Moderate Use: high frequency of use at baseline that slightly increased throughout follow-up. Next, predictors of class membership and cannabis use disorder were examined. When accounting for the contribution of genetics, peer cannabis use at age 13 was a significant predictor of being in a riskier cannabis use class and cannabis use disorder at age 19. In fact, the authors note that peer cannabis use was a more significant predictor of problematic cannabis use compared to genetics alone (Johnson et al., 2018).

Individual: Delinquency

Delinquency, i.e., engagement in illegal activities, is associated with numerous risky health behaviors such as substance use and abuse and risky sexual behaviors in adolescence (Henggeler, 1989). "Delinquency involves learning techniques of committing crimes and motives, drives, rationalizations and attitudes favorable to the violations of the law" (Sykes & Matza, 1957). Research has shown that these delinquent techniques are typically learned within the peer and/ or familial context (Henry, Tolan, & Gorman-Smith, 2001; Hoeben, Meldrum, Walker, & Young, 2016), and that familial and peer influences may also work together to influence individual delinquency, and ultimately substance use (Dishion, Capaldi, Spracklen, & li, 1995). Two international studies that each spanned 25 years identified that early delinquent behaviors were associated with increased risk for developing subsequent problematic cannabis use(Fergusson, Horwood, & Ridder, 2007; Zohsel et al., 2016). In both studies, childhood delinquent behaviors, but not adolescent delinquent behaviors, were associated with subsequent problematic cannabis use(Fergusson et al., 2007; Zohsel et al., 2016).

Multilevel Predictors of Problematic Cannabis Use

Consistent with the Social Ecological Model, several longitudinal studies have simultaneously investigated multiple risk factors for problematic cannabis use across multiple systems. Several key studies, which are described below, have identified numerous multilevel risk factors for problematic cannabis. Yet, to date, there is a paucity of research investigating potential protective factors that may disrupt early multilevel risk for problematic cannabis use.

A longitudinal Australian birth cohort study (N=2,493 pregnant woman and their babies) assessed babies and their mothers 3-5 days after child birth and then 6 months later, and then again when the child was 5, 14, and 21 years old (Hayatbakhsh et al., 2009). Overall, this study investigated numerous potential multilevel influences on offspring cannabis use disorder (i.e., cannabis abuse or dependence) at 21 years of age. At baseline, mothers self-reported on demographic variables and substance use behaviors (e.g. cigarette and alcohol use).When the child was 14 years old, the following constructs were assessed: maternal current drinking habits, paternal criminal behavior, mother and child communication, changes in maternal marital status, gross family income, problems in residential areas (e.g. violence in the streets, drug abuse, and school truancy), and adolescent-reported behavioral problems, tobacco use, and drinking behaviors. At the 21 year follow- up, participants self-reported on lifetime cannabis use and the presence of DSM-IV cannabis abuse or dependence symptoms. Alarmingly, 21.1% of the sample met criteria for cannabis abuse or dependence by age 21. Results indicate that children who experienced more changes in their parents' marital status, exhibited more aggressive/ delinquent behavior, had poor academic performance, had a history of sexual abuse,

smoked cigarettes, had a mother who smoked cigarettes, and who had a father involved in criminal behavior were more likely to develop cannabis abuse or dependence by age 21 (Hayatbakhsh et al., 2009). These results highlight the importance of mitigating childhood adverse experiences to promote better subsequent behavioral health.

von Sydow and colleagues (2002) investigated cannabis use and abuse/dependence across three assessments spanning four years among a German cohort of 1,101 adolescents (14-17 at baseline) and a German cohort of 1, 345 young adults (18-24 at baseline). At baseline, participants completed computer-assisted interviews assessing intrapersonal variables (e.g. behavior during childhood, trauma, self–control), developmental interpersonal family variables (e.g. parent substance use history, divorce or death of parents), current interpersonal family variables (e.g. parent attitude toward legal and illegal drug use, siblings illicit drug use, availability of alcohol and medication at home), socio-environmental variables (e.g. socioeconomic status, place of residence), and substance use variables (frequency and intensity of substance use, DSV-IV and ICD-10 substance abuse and dependence symptoms, availability of drugs, peer drug intake). These substance use variables were also assessed at the follow-assessments. Risk factors for subsequent higher frequency of cannabis use were male gender, maternal affective problems, poor financial status, employment (vs school), peer drug use, easy availability of drugs, and baseline use of other illicit drugs; resources factors included being older, living in a rural place (vs. urban), behavioral inhibition in childhood, positive life events, positive parental attitudes towards drugs, grandparent alcohol use, parental illicit drug use and medication misuse, father affective problems, and maternal anxiety. Clearly, the relationships between family substance use and mental health and offspring substance use

are complex. The pattern of risk and resource factors for cannabis abuse differed between the younger cohort and older cohort. Only being male and having a history of more frequency cannabis use were risk factors for a cannabis abuse diagnosis among the younger cohort; only older age was a resource factor. For the older cohort, male gender, more positive attitude about future drug use, baseline illicit substance abuse or dependence, poor relationships with father, and grandparent alcohol problems were risk factors for cannabis abuse. Resource factors for this older cohort included older age, not living with parents, anxiety, poor relationship with mom, and availability of alcohol at the home. Across the entire sample, risk factors for cannabis dependence included parental death before the age of 15, lower socio-economic status, mental health problems, low self-esteem, poor financial situation, and other illicit substance abuse or dependence at baseline. Resource factors the protected against cannabis dependence were being older and low self-control/coping skills (Von Sydow et al., 2002). This study documents individual, family, and sociocultural risk factors for subsequent problematic cannabis use across four years, and demonstrates a somewhat perplexing pattern of results. More research is needed to help elucidate multilevel prospective risk factors for problematic cannabis use, and how protective factors may buffer against early risk.

In a US-based study, Defoe and colleagues (2018) investigated if adolescent cannabis use, conduct problems, and exposure to peer cannabis use predicted cannabis use disorder in adulthood. This study assessed 364 12-14-year-olds across four waves, with the last wave occurring when participants were 18-21. Across waves, participated self-reported on cannabis use frequency and peer cannabis use, and reported on conduct problems via the Youth Self Report (YSR). At the final time-point, participants self-

reported on DSM-IV cannabis abuse and dependence symptoms. Overall, mediation analyses demonstrated that early conduct problems predicted cannabis use at waves III and IV, which in turn predicted problematic cannabis use in adulthood (wave IV). In addition, increased affiliation with cannabis using peers at baseline was related to subsequent increased personal cannabis use, which in turn predicted problematic cannabis use (Defoe, Khurana, Betancourt, Hurt, & Romer, 2019). This study highlights the importance of investigating conduct problems and peer substance use as risk factors for subsequent problematic cannabis use.

Using data from the Lives Across Time study (LAT), Windle and colleagues (2004) examined eight adolescent multilevel predictors of subsequent problematic cannabis use in young adulthood, including variables at the individual level (e.g. delinquency, alcohol use, depressive symptoms, stressful life events, grade point average), peer-level (e.g. percentage of friends using alcohol and other drugs), and family-level (e.g. perceived familial support). Participants were first assessed in 10th and 11th grade (Wave I), then every 6 months for 2 years (11th and 12th grade; Waves II-IV), and finally in young adulthood (Mage= 23.5; Wave V). Adolescents self-reported on their frequency of cannabis use, current depressive symptoms, perceived social support from family, delinquent activity, peer substance use, and stressful life events across waves. GPA and educational attainment was assessed by school transcripts and self-reported educational completion. Finally, psychiatric and substance abuse disorders in young adulthood were assessed via the World Health Organization (WHO) Composite International Diagnostic Interview (WHO-CIDI). First, semiparametric group-based mixture modeling identified five trajectory groups of cannabis use across middle

adolescence: Abstainers (never used cannabis), Experimental Users (rarely used cannabis during adolescence), Decreasers (gradually decreased cannabis use), Increasers (continuously increased cannabis use), and High Chronic Users (maintained high levels of cannabis use). The High Chronic Users group endorsed the highest levels of involvement in delinquent activity, stressful life events, peer drug use, and lower GPA. The authors then investigated how cannabis use trajectories predicted lifetime cannabis use disorder (assessed in young adulthood): The High Chronic User group exhibited the highest rate of cannabis use disorder (78%) relative to the other groups. Notably, the Increasers (60%), Decreasers (48%), and Experimental Users (43%) also had relatively high rates of cannabis use disorder. This finding highlights the equifinality nature of cannabis use disorder (Windle & Wiesner, 2004).

Overall, longitudinal research to date supports the importance of investigating influences from multiple systems to understand subsequent problematic cannabis use. The current study will investigate how individual (delinquency), family (access to illegal drugs in the home), peer (peer cannabis use), and neighborhood factors (neighborhood poverty; neighborhood drug exposure) during adolescence predict problematic cannabis use in adulthood. Further, this study will expand prior research by investigating the role of natural mentors in mitigating adolescent risk factors for problematic cannabis use in adulthood. Resilience theory is useful for conceptualizing why some youth are able to refrain from adverse health behaviors despite their environmental influences.

Resilience Theory

Resilience theory offers a framework for understanding why some adolescents who are exposed to adverse conditions early in life (e.g. poverty, parental and peer drug

use) do not exhibit the problem behavior associated with that environment (N. Hurd &

Zimmerman, 2010a; Zimmerman, Bingenheimer, & Notaro, 2002). Resilience is a

dynamic process where individuals who have experienced adverse situations exhibit

positive adaptation across development (Luthar & Cicchetti, 2000) thus avoiding the

negative trajectories associated with that risk. One key aspect of resiliency research is

identifying and enhancing protective and promotive factors associated with resiliency

among youth who are exposed to risk factors (Fergus & Zimmerman, 2005a). Promotive

factors are variables associated with positive outcomes for youth exposed to adversity;

promotive factors can be further delineated as having direct effects or as having

protective, or moderating, effects (and thus called protective factors) (Zimmerman et al.,

2013). The more promotive factors an individual has, the more likely they are to be

resilient in the face of adversity or risk. Resiliency theory and further be broken down in

three main models: compensatory, protective, and challenge models. The compensatory

and protective models will be utilized in the current study and are reviewed below. The

challenge model is not used in the present study so it is only briefly defined her. The

challenge model refers to when the impact of risk exposure (e.g., early stress) depends on

the level of exposure: Both high and low exposures to risk may lead to negative

outcomes, but moderate exposure is related to more positive outcomes.

Compensatory Model of Resiliency. The compensatory model of resiliency is

demonstrated when a promotive factor (e.g. adult monitoring) counteracts the effects of a

risk factor (e.g. poverty) via a direct effect of the promotive factor on the outcome

(Fergus & Zimmerman, 2005a). For example, Edari (1998) and colleagues demonstrated

that youth living in poverty were more likely to be involved in violent delinquency than

youth not living in poverty. Yet, among youth experiencing poverty, adult monitoring was associated with lower engagement in delinquent behaviors, thereby counteracting the negative effects of poverty (Edari & McManus, 1998).

Protective Factor Model of Resiliency. The protective factor model states that assets or resources may moderate the effects of risk on future negative outcomes (Luthar & Cicchetti, 2000; Zimmerman et al., 2013). For example, the documented relationship between youth poverty and subsequent violent behavior may be reduced for youth with higher levels of parental support versus lower levels support. Thus, demonstrating that parental support serves as a protective factor by mitigating (i.e., moderating) the influence of poverty on violent behavior. In this model, the protective factor may completely eliminate the negative outcome or it may greatly reduce the negative outcome. In some cases, the presence of a protective factor may enhance the effects of other protective factors resulting in a protective-protective factor (Zimmerman et al., 2013)(e.g. greater parental support strengthens the association of positive appraisal of school on educational success; (Fergus & Zimmerman, 2005a)).

Natural Mentorship as a Compensatory and Protective Factor. The extant literature documents that social support, across multiple levels (e.g. family, peers, neighborhood)(Jaffee, Caspi, Moffitt, Polo-Tomas, & Taylor, 2007), is an important promotive factor (N. Hurd & Zimmerman, 2010a) often associated with improved psychological and physical well-being and has been shown to promote resilience among youth (G. Rhodes & Lakey, 1999). It is hypothesized that social support leads to positive health outcomes by reducing the negative effects of stress (N. Hurd & Zimmerman, 2010a). These supportive relationships may be with peers, parents, nonparental adults,

and non-related adults (N. Hurd & Zimmerman, 2010a). Research has shown that relationships with caring adults are critical promotive resources for adolescents (Zimmerman et al., 2013). Supportive relationships between a nonparental adult and an adolescent are typically referred to as mentoring relationships, and is often characterized as being either formal mentorship or informal mentorship. The current study will utilize the protective and compensatory factor model to investigate if having a natural mentor both 1) directly relates to decreased risk for later problematic cannabis use in adulthood and 2) buffers the influence of multi-level risk during adolescence on later problematic cannabis use in adulthood.

Natural Mentorship

A mentoring relationship is a social connection between a more experienced (typically older) mentor and a less experienced (typically younger) mentee (N. Hurd & Zimmerman, 2010a). Today, most people think of more formal mentoring relationships when they hear the term "mentor," programs such as Big Brothers/ Big Sisters or vocational mentoring within a company. However, informal mentoring, or natural mentoring relationships, are often developed organically between youth and nonparental family members or community adults, and are not initiated through a program (Hagler & Rhodes, 2018) and are more common than formal mentoring relationships (DuBois & Silverthorn, 2005b; N. Hurd & Zimmerman, 2010a; McLearn, Colasanto, & Schoen, 1998; Miranda-Chan, Fruiht, Dubon, & Wray-Lake, 2016; Sterrett, Jones, McKee, & Kincaid, 2011). The mutual and organic formation of natural mentoring relationships may contribute to the greater longevity and prevalence over formal mentoring relationships (N. M. Hurd, Stoddard, Bauermeister, & Zimmerman, 2014). This is an

advantage of natural mentoring relationships, given findings that suggest that longer mentoring relationships are linked to more positive outcomes (McLearn et al., 1998).

Natural mentors provide emotional support (i.e. offering comfort), informational support (i.e. providing advice, affirming the mentees value and competence), and instrumental support (i.e. concrete aid) to their mentees (Sterrett et al., 2011). The extant research demonstrates that natural mentorship is associated with better educational outcomes (Kelley & Lee, 2018; Sterrett et al., 2011), less problem behaviors (e.g. non-violent delinquency and substance use) (DuBois & Silverthorn, 2005a; Zimmerman et al., 2002), greater psychological well-being and self-esteem(Ahrens, DuBois, Richardson, Fan, & Lozano, 2008; N. M. Hurd et al., 2014), improved employment rates in young adulthood (Kelley & Lee, 2018), and decreases in risky sexual behavior (N. Hurd & Zimmerman, 2010a). In fact, Van Dam et al. (2018) conducted a meta-analysis that examined the relations between natural mentoring and youth outcomes in four domains: academic and vocational functioning (e.g. high school completion and fulltime employment), social-emotional development (e.g. life- satisfaction and self-regulation), physical health (e.g. body mass index, sexually transmitted disease diagnosis), and psychosocial problems (e.g. depression, delinquency, substance use) (Van Dam et al., 2018). The meta-analysis included 30 studies from 1992-2018 (15 cross-sectional studies; 15 longitudinal studies). Results indicated that the presence of a natural mentor was significantly associated with positive youth outcomes across all domains, including substance use (Van Dam et al., 2018). Of note, only a few studies in this review investigated how the presence of a natural mentor relates to substance use over time (these studies are described in detail in the next section). Importantly, natural mentorship

was associated with positive youth outcomes for all youth, not just youth from at-risk backgrounds.

Compensatory Model: The associations between Natural mentoring and cannabis/substance use. To date, there are few studies examining the prospective associations between having a natural mentor and adolescent/young adult substance use, both demonstrating direct or indirect benefits of natural mentorship. Hurd and colleagues (2010) conducted a longitudinal study with African American adolescents with a lower 8th grade point average to explore how natural mentors impacted the trajectories of health outcomes post high school. African American participants (N=615) completed assessments (i.e., self-report measures; interviews) in their senior year of high school and then at 2, 3, 4, and 5 years post high school. At each assessment, participants reported on depressive symptoms, sexual risk behaviors (e.g. frequency of sexual intercourse, frequency of condom use), substance use (past month alcohol, cigarette and cannabis use), stress, and parental support. To assess for the presence of a natural mentor, participants reported on if they had an adult 25 and older (not an immediate family member) who they went to for support. Importantly, 63% of participants reported had a natural mentor. Hierarchical linear modeling was used to identify psychosocial outcome trajectories. Individuals with a natural mentor had greater decreases in depressive symptoms and sexual risk behavior over time relative to those without a natural mentor (and lower overall sexual risk behaviors). Contrary to the authors' hypothesis, having a natural mentor was not predictive of baseline levels or growth in substance use behaviors over time. Mediation analyses showed that having a natural mentor was associated with a lower likelihood of using cannabis and cigarettes through coping abilities and having a

sense of life purpose; additionally, having a natural mentor was related to less depressive and anxiety symptoms through improved coping abilities and having a sense of life purpose (N. Hurd & Zimmerman, 2010a).

Next, Black and colleagues (2010) explored if school attachment mediated the longitudinal relationships between school-based natural mentors and risk behaviors one year later (substance use and delinquent behavior). Adolescent participants (N=3320; Mage= 14.8) were students in one of the 65 high schools across eight states in the United States that were involved in a larger intervention study (Project toward No Drug Abuse (TND)). At baseline, participants reported on their level of school attachment (e.g., "how interested are you in school now?") and the presence of a natural mentor ("at my school, there is a teacher or other adult… who cares about me; tell me when I do a good job etc."). Participants self-reported on past 30- day cigarette, alcohol, cannabis and hard drug (i.e. cocaine) use and delinquent behavior (e.g., hit, punched kicked or beaten someone up etc.) at baseline and at 1-year follow-up. Mediation analysis showed that there was 1) a direct, negative effect of natural mentorship on subsequent substance use and 2) indirect effect of natural mentorship on reduced substance use through school attachment. Overall, the results of these two studies demonstrate that natural mentorship is associated reduced substance use or time via either direct effects (Black, Grenard, Sussman, & Rohrbach, 2010) and indirectly by enhancing youths' coping abilities, sense of purpose, and school attachment (Black et al., 2010; N. M. Hurd et al., 2014).

There have been several cross-sectional studies that demonstrated having a natural mentor was associated with decreased substance use (Van Dam et al., 2018). Other cross-sectional studies have analyzed data from the Add Health Study, the same sample that

will be used for the present study, to examine how natural mentorship related to cannabis use. Hackshaw (2017) examined the cross-sectional associations between natural mentorship and past year substance use (excessive alcohol use, illicit drug use, and cannabis use) during young adulthood, finding that youth with community natural mentors were less likely to have used cannabis during the past year (Hackshaw, 2017). In another study utilizing Wave III Add Health data, Ahrens et al. (2007) found that among youth in foster care, having a natural mentor was associated with greater perceived general health, higher education attainment, lower risk for suicidal ideation and having a diagnosis of an STD, and physical fighting; however, it was not associated with cannabis use (Ahrens et al., 2008). The present study will extend these Add Health studies by capturing problematic substance use in adulthood and investigating both the main effects of mentorship (and multilevel risk factors) on subsequent substance use and the moderating role of Wave III mentorship on the association between adolescent risk factors and lifetime history of problematic cannabis use (i.e., cannabis abuse or dependence).

Protective Model: The Moderating Role of Natural Mentorship on the Associations between Adolescent Risk Factors and Adult Problematic Cannabis use. The above literature largely supports natural mentorship as a promotive or a compensatory factor. To date, only one study has investigated the protective role of mentorship on youth substance use. In a cross-sectional study, Zimmerman and colleagues (2002) used a primarily African American sample of adolescents (N=770) with low GPAs to investigate if having a natural mentor fits the compensatory and/or protective factor model of resiliency when examining youth problem behaviors (cannabis use, non-violent

delinquent behavior) and school attitudes; the authors also examined if natural

mentorship affects youth outcomes by leading to less exposure to risk factors.

Participants participated in a 1 hour interview that assessed the following constructs:

presence of a natural mentor (e.g. is there an adult 25 or older who you consider to be

your mentor), problem behaviors (e.g. substance use, non-violent and violent behaviors),

school attitudes (e.g. most mornings I look forward to school), friend problem behaviors

(e.g. how many friends smoked cannabis in the past month) and problem school

behaviors (e.g. how many friends 'cut class'), and norms regarding friend school

perceptions (e.g. would your friends think it's cool or uncool if you had very good

grades) and friend perceptions about problem behaviors (e.g. do your friends think it's

cool to drink alcohol). To test if having a natural mentor fits the compensatory and/or

protective favor of resiliency, the authors conducted a set of hierarchical linear

regressions and moderation analyses. Results indicated that having a natural mentor had

both compensatory and protective factor qualities. Having a natural mentor was

associated with more positive school attitudes and lower levels of problem behaviors

(less cannabis use and fewer nonviolent delinquent behaviors), supporting that having a

natural mentor was a compensatory factor. When examining school attitudes, having a

natural mentor also demonstrated protective factor qualities. There was an interaction

between natural mentorship and friend's problem school behaviors and friend negative

school norms such that having a natural mentor buffered against these risk factors in

predicting positive school attitudes. Finally, this study also used mediation analyses to

identify if natural mentorship affected youth outcomes by leading to less exposure to risk

factors. Results indicated that having a natural mentor directly affected all outcomes (e.g.,

less problem behaviors, more positive school attitudes), with larger effects of school attitudes than problem behaviors. In addition, results showed that natural mentorship was associated with more positive outcomes by reducing youth's exposure to friend-related risk factors (Zimmerman et al., 2002). Overall, this study highlights a range of positive outcomes due to having a supportive natural mentor for at risk youth. To date, there have been no longitudinal studies that explored how natural mentorship buffers adolescent risk factors in predicting cannabis use, including *problematic cannabis use*.

Relatedly, a study by DuBois et al. (2005) investigated the differential impact of mentorship on adolescent outcomes depending on individual and environmental risk (i.e., the moderating role of risk exposure on the relations between mentorship and youth outcomes). This differs from the present study that aims to identify if mentorship buffers against adolescent risk in predicting Wave IV problematic cannabis use (i.e., the moderating role of mentorship on the relations between risk exposure and youth outcomes). DuBois and Silverthorn (2005) utilized waves I and III of Add Health to examine the association between natural mentorship and adolescent education and health outcomes at Wave III. Additionally, the authors investigated if the relationship between natural mentorship and adolescent outcomes differed based on individual and environmental risk. Data came from participants (N=3,187) who were randomly selected from a larger sample of Add Health (N=15,197). The analyses controlled for numerous baseline risk variables that were assessed at Wave I: individual risk (e.g. past year counseling or substance abuse treatment) and environmental risk (e.g. parent receiving public assistance, adolescents not feeling safe in the neighborhood, not feeling connected to home or school). At Wave III, participants self-reported on education and work

outcomes (e.g. completion of school, employment), problem behavior (e.g. past year and month binge drinking, drug use, smoking), psychological well-being (e.g. depression and self-esteem), and physical health (e.g. diagnosis of STD, perceived general health). Controlling for Wave I risk variables and Wave I assessments of the variables of interest, logistic regressions indicated that having a natural mentor was associated with completing high school and attending college, higher levels of physical activity, regular use of birth control, higher levels of self-esteem and life satisfaction, and decreased likelihood of being a gang member and risk taking. Natural mentorship did not have a main effect on Wave III substance use. Regarding the moderating role of individual/environmental risk on the association between mentorship and outcomes, there was no significant interaction for substance use; however, other interactions emerged indicating a complex pattern of relations where the association between mentorship and fighting, depressive symptoms, and physical activity depended on adolescents' Wave I risk exposure. Taking the results of these two studies together, one study supported that mentorship was a moderator of the association between risk and subsequent cannabis use (i.e., as a protective factor (Zimmerman et al., 2013); however, moderation was not found when risk was examined as the moderator between mentorship and drug use(DuBois & Silverthorn, 2005a).

Summary of Literature

Overall, prior literature on adolescent and young adult cannabis use has largely focused on only one or two predictors of substance use or cannabis use (e.g. parent use, peer use), with very few studies investigating multi-level risk factors for cannabis use or problematic cannabis use in adulthood (Burlew et al., 2009; Johnson et al., 2018; Storr et

al., 2004). Regarding natural mentorship, some studies found that natural mentors have a compensatory role on substance use trajectories such that it decreases risk of cannabis use (i.e., demonstrated a main effect on cannabis use among those exposed to risk;(Black et al., 2010; Zimmerman et al., 2002); others demonstrated that natural mentorship is associated reduced substance use over time by enhancing youths' coping abilities, sense of purpose, and school attachment (Black et al., 2010; N. Hurd & Zimmerman, 2010a). In fact, Hurd et al. (2010) identified that natural mentorship only affected later substance via enhancing youths' coping abilities, sense of purpose and was not directly related to substance use over time. On the other hand, some cross-sectional research failed to demonstrate that mentorship is association with subsequent substance use (Ahrens et al., 2008; DuBois & Silverthorn, 2005b). Explanations for these mixed results may be related to methodological differences. Alternatively, the mixed results could be related to the fact substance use is a highly normative aspect of adolescence and young adulthood (Ahrens et al., 2008), and as such mentorship may be less influential on reducing risk against normative adolescent cannabis experimentation (and yet it hypothesized mentorship will be important for problematic cannabis use). Another explanation may be related to differences in the nature of the mentorship relationship; for example, natural mentors' modeling of substance use behavior may increase the likelihood of the young adult substance use. Despite the mixed results of the compensatory role of mentorship on substance use, there is both cross-sectional and longitudinal data supporting this role for substance use (Black et al., 2010; N. Hurd & Zimmerman, 2010a) and overall positive outcomes for youth (Ahrens et al., 2008). To date, only one cross-sectional study has

examined the protective role of mentorship on cannabis use, with findings supporting it as a protective factor (Zimmerman et al., 2013).

The current study will extend the prior literature by utilizing a longitudinal, nationally representative sample to investigate 1) the main effects of multi-level adolescent risk factors and natural mentorship (as a compensatory factor) on lifetime history of problematic cannabis use (assessed in adulthood) and 2) if natural mentoring has a protective effect against problematic cannabis use such that it moderates the association between adolescent multi-level risk factors and problematic cannabis use. This study will be the first to investigate both the compensatory role of mentorship against problematic cannabis use in adulthood and the protective role of natural mentorship against the association between adolescent multilevel risk factors influence and problematic cannabis use in adulthood. The results of this study will support the identification of early risk factors for problematic cannabis, thereby illuminating possible points of early prevention and intervention. Furthermore, the outcomes surrounding natural mentorship as a compensatory and protective factor may inform the development of future interventions that include natural mentorship as a mechanism for reducing problematic cannabis use.

The Current Study

The present study will utilize data from Waves I (1994-1995; 7th-12th grade), III (2001-2002; ages 18-26), and IV (2007-2009; ages 24-32) from the National Longitudinal Study of Adolescent Health (Add Health), a nationally representative longitudinal study. The present study has the following aims: 1) Identify the associations between multi-level risk factors during adolescence (Wave I) and problematic cannabis

use assessed in adulthood (i.e., lifetime history of DSM-IV-TR cannabis abuse or dependence as assessed at Wave IV; 2) investigate if having a natural mentor after the age of 14 (as assessed at Wave III) is a compensatory factor against problematic cannabis use; and 3) investigate if having a natural mentor is a protective factor that buffers the relationships between adolescent multilevel risk factors (Wave I) and problematic cannabis use. Overall, this entire study was informed by social ecological theory (Bronfenbrenner, 1977) and prior literature, and the examination of mentorship as a compensatory and protective factor was informed by resiliency theory and prior literature (Luthar & Cicchetti, 2000). Informed by these theories and research the following Wave I risk factors will be examined: neighborhood poverty and neighborhood drug exposure, access to illegal drugs in the home, peer cannabis use, and delinquency.

Regarding Aim 1, it is hypothesized that adolescents with more risk (more involvement in delinquency, friends and caregivers who use substances; live in disadvantaged neighborhoods) will be more likely to develop problematic cannabis use by adulthood. Regarding Aim 2, it is hypothesized that those who have a natural mentor in adolescence will be less likely to develop problematic cannabis use by adulthood. Regarding Aim 3, it is hypothesized that natural mentorship will buffer the association between adolescent risk factors and lifetime history of problematic cannabis use such that relationship between adolescent risk factors and lifetime history of problematic cannabis use will be diminished or nonexistent for individuals with natural mentors. Overall, the present study will expand upon prior literature by 1) utilizing a nationally representative sample, 2) assessing the relationships between adolescent risk factors, mentorship, and adult problematic cannabis use across multiple developmental periods (e.g. ages 12-32),

3) using a social ecological approach to simultaneously investigate numerous, multilevel adolescent risk factors for problematic cannabis use in adulthood, and 4) using a longitudinal design to simultaneously explore the protective and compensatory role of having a natural mentor on problematic cannabis use in adulthood.

CHAPTER II

REVIEW OF LITERATURE

The current chapter will review the literature pertinent to the proposed study. The first section will provide an overview of cannabis use, including health effects of cannabis use, and problematic cannabis use. The second section will discuss multilevel predictors of cannabis use and problematic cannabis use. The third section will provide an overview of resilience theory. The fourth section will focus on natural mentorship. The final section will be a detailed overview of the proposed study.

Cannabis Use

Cannabis is the most popular substance used in the western world, and use is highly prevalent among young adults ages 18-29 (Cohen et al., 2019; Substance Abuse and Mental Health Service Adminstation, 2019). In fact, in 2014, daily or near daily cannabis use (e.g. using cannabis 20 or more occasions in the past 30 days) reached its highest rate among young adult college students since 1980 (Carliner et al., 2017; Johnston et al., 2014; Wang et al., 2019). In 2019, past year and 30-day cannabis use was the highest among those in their early to mid-20s relative to other older age groups, with similar trends in daily or near-daily cannabis use and past year and past 30-day cannabis vaping (Schulenberg JE, Johnston L, O'Malley PM, Bachman JG, Miech RA, 2020).

More specifically, a nationally representative study found that near-daily cannabis use was highest among 21-22-year olds (11%), leveled off amongst 23-28-year olds (10%), and was much lower among 45-60-year olds (2-3%). In 2019, men reported more past month cannabis use relative to women (30% vs. 24%, respectively). Given the prevalence of cannabis use among young adults and adults, it is important to know the health effects associated with use and understand risk and protective factors that are predictive of adulthood use.

Health Effects of Cannabis Use. Since the rise in cannabis smoking, several short- and long-term side effects have been documented. This literature is growing due to the increases in the number of states where cannabis is legal for medical and recreational use. A brief review of the potential benefits of medical marijuana are described below; to date, many conclusions that can be drawn about the potential benefits of cannabis use remain limited due to insufficient research. There are well documented adverse health consequences associated with smoking cannabis, such as respiratory and cardiovascular diseases, cognitive impairments (especially with early initiation), psychosis, and addiction(Cohen et al., 2019; Sachs et al., 2015). More specifically, heavy, chronic cannabis smoking is linked to increases in the following symptoms: chronic bronchitis, frequent phlegm, shortness of breath, wheezing without a cold, and pneumonia (Moore et al., 2005; Volkow et al., 2014). Smoking cannabis is also associated with increased risk of myocardial infarction, stroke, and transient ischemic attacks (Thomas et al., 2014; Volkow et al., 2014). A longitudinal study that assessed cannabis use and lung functioning in adults at ages 18, 21, and 26 years found that increases in cannabis

smoking across time were associated with decreases in lung functioning across time (Taylor et al., 2002).

Cannabis use (not limited to cannabis smoking) is also associated with numerous cognitive and psychological sequalae. Long-term cannabis use has been linked to changes in the brain that affect memory, learning, and overall cognitive abilities, especially for those who initiated heavy and chronic use before the age of 21 years old (Volkow et al., 2014; Zalesky et al., 2012). Cannabis use is also associated with increased anxiety and panic symptoms, paranoid thoughts and hallucinations, sensitivity and intensification to certain stimuli (e.g., colors, sound) (Agrawal et al., 2014), depressive symptoms, and suicidal ideation (Cousijn et al., 2018; National Academies of Sciences, Engineering, 2017). These psychological effects are more deleterious for those who have pre-existing mental health diagnoses (e.g. anxiety, bipolar disorder)(Buckner et al., 2006). Regular cannabis use among individuals who are genetically predisposed to schizophrenia is associated with an earlier onset of schizophrenia, and regular use is also correlated with a poorer course of psychotic symptoms among those with schizophrenia (Cousijn et al., 2018). Regular cannabis users are at increased risk for short-term adverse experiences such as dry mouth, drowsiness, impaired ability to drive a car, and over all impairment of cognitive functioning (Cousijn et al., 2018; Whiting et al., 2015). Importantly, the negative health effects are more pronounced for individuals who start using cannabis during adolescence: Cannabis use during adolescence is associated with adverse effects on the developing brain and increased risk for dependence throughout life(Cousijn et al., 2018).

Medical Cannabis. Medical marijuana is now legal in 37 states, with the current literature on the health effects of cannabis use being mixed (*States with Leagalized Marijuana*, 2021). On the one hand, recent reviews on the health effects of cannabis use have demonstrated strong evidence for the potential positive outcomes for some health conditions (e.g. chronic pain, multiple sclerosis) and some psychiatric disorders (e.g. tourette's syndrome) (Cohen et al., 2019; Cousijn et al., 2018). Overall, there is a shortage of high quality randomized controlled trials and longitudinal studies examining health effects of medical cannabis, therefore conclusions that can be drawn are limited (Gillman, Hutchison, & Bryan, 2015). The current study will specifically investigate problematic cannabis use, and how multilevel adolescent risk factors predict problematic use in adulthood, and how having natural mentors during adolescence and young adulthood may mitigate multilevel risks.

Problematic Cannabis Use: Abuse and Dependence. The current study will focus specifically on problematic cannabis use (i.e., diagnoses of cannabis abuse or dependence). A recent study found that over 34% of lifetime cannabis users will meet the Diagnostic and Statistical Manual of Mental Disorders Fourth Edition- Text Revision (DSM-IV-TR) criteria for cannabis dependence or abuse with half the instances occurring within the first three years of first use (Feingold et al., 2020). The DSM-IV-TR differentiated cannabis abuse and cannabis dependence as separate disorders (Hasin et al., 2013). In DSM-IV-TR, cannabis abuse was described as a less serious diagnosis relative to cannabis dependence; cannabis abuse refers to a clinically significant pattern of problems associated with cannabis use without the presence of dependence symptoms (American Psychiatric Association, 2000). In DSM-IV-TR, cannabis dependence refers

to experiencing symptoms of tolerance and withdrawal (American Psychiatric

Association, 2000). In a study with 200,000 participants, it was identified that this

classification approach was failing to identify many individuals with significant

impairments associated with their cannabis use (Hasin et al., 2013). Given these findings,

cannabis abuse and cannabis dependence were combined into a single diagnosis for

Diagnostic and Statistical Manual of Mental Disorders Fifth Edition (DSM-5), allowing

for a more accurate diagnosis to capture problematic cannabis use (Feingold et al., 2020).

In addition, DSM-5 removed legal problems as a criterion, and added craving and

withdraw symptoms as criteria to better align with the current tobacco use disorder

criteria (Hasin et al., 2013). Under the DSM-5, individuals meet diagnostic criteria for

Cannabis Use Disorder if they experience at least two criteria under the following areas

within the past 12 months: impaired control, social impairment, risky behavior, or

physiological adaptation. The current study will use data from the National Study of

Adolescent to Adult Health (Add Health) (Harris, 2012); given that the DSM-5 was not

published yet, the DSM-IV-TR criteria for cannabis abuse and dependence will be used

to capture differential levels of problematic cannabis use.

Social Ecological Theory

Problematic cannabis use is influenced by numerous biological and multilevel

contextual factors. According to a 2010 meta-analysis on twins and cannabis use, genes

accounted for about 48% of the variance in problematic cannabis use among twin males

and 40% in twin females (Verweij et al., 2010). Since genetics only account for a portion

of influence, the identification of multilevel risk factors during adolescence that predict

problematic cannabis use in young adulthood/adulthood, and protective factors that may

buffer against adolescent risk, is critical to the development of effective prevention and

intervention programming. Urie Bronfenbrenner's Social Ecological Model

(Bronfenbrenner, 1977) describes how individuals are embedded within numerous, larger

systems that are dynamically related, and helps to identify potential risk and protective

factors across multiple systems that influence behavior (Bronfenbrenner, 1977; Wilson et

al., 2018). The Social Ecological Model describes four larger systems that individuals are

embedded in and that encompass correlates of cannabis use: Microsystem: the immediate

environment (e.g. family and peer cannabis use); Mesosystem: the interactions of family

and institutions (e.g. family affecting the peer group); Exosystem: aspects of the

environment that the individual is not directly involved in (e.g. parents' workplace,

school, neighborhood drug exposure); and Macrosystem: larger cultural context (e.g.

values, policies/ laws, resources available, neighborhood poverty) (McGrady, Rich, &

Crosby, 2018; Wilson et al., 2018). These systems work together to impact individuals'

overall outcomes, including problematic cannabis use. To date, many health promotion

and intervention programs have been less successful in addressing substance use because

they only targeted the individual or microsystems, and neglected to target the socio-

cultural, environmental, or structural influences that contribute to risky health behaviors

(Backer, 2000). Importantly, there are several examples of successful programs that use a

systems-level approach to understand and address obesity, substance abuse, heart disease,

and risky sexual behaviors in the U.S. (McGrady et al., 2018; Wilson et al., 2018). The

current study will investigate how adolescent neighborhood factors (neighborhood

poverty; neighborhood drug exposure), family factors (access to illegal drugs in the

home), peer factors (peer cannabis use), and individual factors (delinquency), predict

problematic cannabis use in adulthood. In the following sections, research on the

associations between each of these factors and problematic cannabis (or more broadly

cannabis use when there is scant literature on problematic cannabis use) will be

summarized. Next, research that utilized a multilevel approach to investigating numerous

predictors of problematic cannabis use will be presented.

Neighborhood: Drug Exposure and Poverty

Cannabis use, and more specifically problematic cannabis use, is influenced by a

variety of socio-cultural, environmental, and/or structural influences (Hayatbakhsh et al.,

2009). The neighborhoods that individuals live in during adolescence may contribute to

problematic cannabis use in adulthood via multiple pathways, such as increased exposure

to other individuals' risky behaviors, access to cannabis products, neighborhood culture

and functioning, and markers of systemic racism (neighborhood poverty, safety,

resources). Social disorganization theory (Shaw & McKay, 1942) suggests that

neighborhood characteristics such as low socio-economic status (SES) can hinder

neighborhood socialization (e.g. fewer adults available to supervise) which can contribute

to a context with greater substance use and deviancy by adolescents (Handley, Rogosch,

Guild, & Cicchetti, 2015). The current study will investigate neighborhood poverty and

neighborhood drug exposure during adolescence as risk factors for problematic cannabis

use during adulthood.

Longitudinal studies have documented that neighborhood drug exposure and

neighborhood poverty during adolescence are predictive of subsequent cannabis

initiation, use, and problematic cannabis use (Karriker-Jaffe, 2011; Jungeun Olivia Lee et

al., 2017; Leifheit et al., 2015). First, the longitudinal research on how neighborhood

drug exposure and neighborhood poverty during adolescence are predictive of subsequent cannabis initiation will be reviewed. Next, a summary of research on how these factors correspond to later problematic cannabis use will be reviewed.

Neighborhood Drug Exposure and Poverty and Subsequent Cannabis Use Initiation. Overall, several studies have shown that neighborhood drug exposure is predictive of *cannabis use initiation* (Karriker-Jaffe, 2011; Leifheit et al., 2015). Burlew et al. (2009) conducted a longitudinal study with Black middle schoolers (N=95) and assessed if neighborhood risk during 6th grade (i.e., exposure to drugs, fighting, arrests, crime in their neighborhood) predicted substance use initiation in 8th grade (alcohol, cigarette, and cannabis use). Participants were assessed annually for three years and provided data on their onset of substance use via the CSAP National Youth Survey by answering lifetime use, frequency of use and quantity of use. Exposure to neighborhood risk was assessed with five items from the Individual Protection Factors Index (e.g. how often they observed someone drinking on the streets, getting robbed using drugs, fighting and getting arrested) responses ranged from 'almost every day' to 'never'. Parental supervision was assessed by questions like 'My parents want me to tell them where I am if I don't come home right after school' responses range from 'almost all the time' to 'almost never'. At baseline all participants in this sample reported abstaining from using any substance; by 7th and 8th grade, 60% of participants were using at least one of the substances. The results demonstrated that higher neighborhood risk was associated with an increased likelihood of substance use initiation (Burlew et al., 2009). High parental supervision was associated with a lower likelihood of substance use initiation, and mitigated the risk associated with neighborhood risk (Burlew et al., 2009). This study

highlights how neighborhood risk impacts youth substance use initiation and that protective factors can buffer against these adolescent risk factors.

Karriker-Jaffe et al. (2011) conducted a review that explored the relationship between area-level SES and substance use, including 34 studies (the majority of which were cross-sectional studies). Results from this review are conflicting about the different effects of area-level SES and substance use. Among the studies with illicit drug use as the outcome, 19.4% found that neighborhood disadvantage was associated with illicit drug use; on the other hand, 6.5% found the opposite association such that more affluent neighborhoods were associated with increased substance use. Of note, studies with adult participants were more likely to support the disadvantage hypothesis relative to studies done with adolescents.

Neighborhood Drug Exposure and Poverty and Subsequent Problematic Cannabis Use. Additionally, longitudinal studies have demonstrated a link between childhood or adolescent neighborhood drug exposure and neighborhood poverty and *problematic cannabis use in adulthood*; though this research is more limited. In one of the few longitudinal studies examining adolescent neighborhood drug exposure and subsequent problematic substance use in adulthood, Lee and colleagues (2017) examined the associations between substance-use specific neighborhood factors in childhood (age 13) and problematic cannabis use in adulthood (age 39). Substance-use specific neighborhood factors (e.g., drug selling in the neighborhood, more tolerant attitudes about drug use, selling drugs at younger ages) was positively associated with more problematic cannabis, alcohol and nicotine use in adulthood (Jungeun Olivia Lee et al., 2017). This neighborhood risk does not stand alone and rather often coincides with other

neighborhood risk: Neighborhood poverty is associated with increased drug exposure opportunities among adolescents and adults (Storr et al., 2004), and both drug exposure opportunities and neighborhood poverty are associated with drug use (Storr et al., 2004).

In one of them few longitudinal studies investigating neighborhood poverty during adolescence as a risk factor for later problematic cannabis use, neighborhood poverty was not identified as risk factor of problematic cannabis use. (J. O. Lee et al., 2018). Using a diverse sample (N=808), Lee and colleagues (2018) assessed how neighborhood disadvantage (e.g. neighborhood poverty, adult educational attainment) and neighborhood stability (i.e., home ownership and percentage of population living in neighborhood at least five years) in childhood (ages 10-16) predicted problematic alcohol, cannabis or nicotine use in adulthood (18-39). Neighborhood stability in childhood was predictive of fewer alcohol use disorder symptoms and fewer cannabis use disorder symptoms (though this was marginally significant) in adulthood, even after controlling for adult socioeconomic status. Neighborhood disadvantage was not associated with later substance use. Longitudinal research that investigated numerous, multilevel risk factors for substance use has also documented that neighborhood unemployment but not neighborhood poverty is related to subsequent cannabis use initiation (Tucker, Pollard, de la Haye, Kennedy, & Green, 2013). This limited longitudinal research did not find that neighborhood poverty was a risk factor for problematic cannabis use. However, neighborhood poverty was identified as a risk factor more general cannabis use (Burlew et al., 2009; Karriker-Jaffe, 2011). The current study will use a larger sample to investigate these associations, thereby extending the existing literature.

Cross-sectional research also supports the importance of neighborhood factors (e.g., poverty, drug exposure) in predicting cannabis initiation, use, and problematic use patterns. For example, Handley and colleagues (2014) conducted a cross-sectional study on how neighborhood factors (neighborhood safety, drug availability, and poverty) were related substance use disorder among a sample of 411 adolescents (ages 15-18), and how child maltreatment history moderated this association (66% of whom were maltreated during childhood). Neighborhood safety was assessed via parent and adolescent reports on the Neighborhood Environment for Children Rating Scale (NERS). Items included, gang activity, abandoned, vacant, or boarded up buildings, and unemployed adults loitering. Adolescents self-reported on *neighborhood drug availability* (e.g. ease of finding marijuana in my neighborhood; frequency of drugs being sold in my neighborhood). *Neighborhood poverty* was measured using 2000 US census data and parent-reported total family income. These three neighborhood factors were used to create a latent neighborhood disadvantage variable. Current adolescent alcohol and cannabis dependence were assessed via the Diagnostic Interview Schedule for Children (DISC): 4.7% met criteria for alcohol dependence and 7.4% met criteria for cannabis dependence. Results of the multigroup structural equation models indicated that higher levels of neighborhood disadvantage were significantly associated with more adolescent cannabis dependence symptoms among maltreated adolescents but not non-maltreated adolescents (Handley et al., 2015).On the other hand, higher levels of neighborhood disadvantage were significantly associated with more adolescent alcohol dependence symptoms, regardless of maltreatment history. This in conjunction with the broader cross-sectional research on how neighborhood factors may serve as risk factors for

problematic cannabis use (Handley et al., 2015; Storr et al., 2004) highlight the importance of using multilevel approaches to understanding risk factors for cannabis use. In the next section, a family-level risk factor (access to illicit drugs in the home) for problematic cannabis use will be reviewed.

Family: Access to Illicit Drugs

There are several well-established family level risk factors for problematic cannabis use (Schuler et al., 2019; Von Sydow et al., 2002). Twin studies have documented that shared environments account for most of the variation in cannabis use between twins (Tsuang, 1998; hopefer,2003). Numerous studies have shown that parental and older sibling cannabis use is positively associated with adolescent cannabis use (Hopfer, Stallings, Hewitt, & Crowley, 2003; Madras et al., 2019; Tiberio, Kerr, Bailey, Henry, & Capaldi, 2020) . For example, Bailey and colleagues conducted a longitudinal study to investigate the intergenerational transmission of substance use behaviors (e.g. cigarette, alcohol and cannabis) across three generations (e.g. grandparents (G1), parents (G2), and grandchildren (G3)). They found that children (G3) whose parents (G2) currently use cannabis were more likely to use alcohol and cannabis within the past year (Bailey et al., 2016). This intergenerational pattern also holds true for problematic cannabis use: Adolescents with family members who struggle with problematic cannabis use are more likely to struggle with problematic cannabis use across adolescence (Schuler et al., 2019).

Research has documented several pathways that lead to the intergenerational transmission of substance use, including social learning of substance use behaviors via family modeling (Bandura, 1969) and having access to substances. Prior studies have

shown that exposure to alcohol and illicit drugs prior to 15 years old predicts substance

use disorders (cannabis, alcohol and other illicit drugs) in adulthood (Odgers et al., 2008).

Access to products is also an important aspect of overall cannabis use in adolescents. A

cross-sectional study utilizing Wave 1 of Add Health found that adolescents who reported

having easy access to alcohol, cigarettes, and illegal drugs in the home were more likely

to be involved in substance use behaviors (Swahn & Hammig, 2000). To date, there is

only one longitudinal study examining how access to illicit drugs in the home predicts

subsequent cannabis use. Using two waves from the Add Health study, Bouchard et al.

(2017) investigated if numerous adolescent risk factors (Wave I), including individual

factors (delinquency), peer substance use and relationships, parental smoking/alcohol use

and relationships, school risk factors, and access to illegal drugs, tobacco, or alcohol in

the home, predicted cannabis use in later adolescence (Wave II). Having access to illegal

drugs, tobacco, and alcohol in the home were not significant predictors of subsequent

cannabis use at Wave II. The following were risk factors for cannabis use: being male,

poor grades, poorer parental relationships, less peer attachment, delinquency,

unstructured socializing, peer substance use, and parental smoking. Despite the limited

research focused on cannabis, many studies have demonstrated that access to substances

in the home is a risk factor for alcohol use and abuse (Komro, Maldonado-Molina,

Tobler, Bonds, & Muller, 2007; Ragan, Osgood, & Feinberg, 2014) and cigarette/

tobacco use and abuse in adulthood(Benjet et al., 2007). The current study will add to the

literature by identifying how access to illicit drugs in the home predicts later problematic

cannabis use in adulthood. Understanding how access to substances in the home predicts

subsequent problematic cannabis use is important given it is a modifiable point of intervention.

Peers: Substance Use

Peer relationships are essential for adolescents to develop appropriate social skills and behaviors; however, peer relationships (Tucker et al., 2014) and substance use are also major influences on the development and maintenance of adolescent delinquency and substance use (Allen et al., 2012; Moffitt et al., 1996), including problematic cannabis use (Buckner et al., 2006). Consistent with social ecology theory and social learning theory, there is a well-documented transactional relational pattern between peers, such that non-deviant adolescents exposed to deviant peers may become more deviant over time, or a deviant adolescent exposed to non-deviant peers may become less deviant overtime (Allen et al., 2012).

Peer Cannabis Use and Subsequent Cannabis Use Initiation. Peer cannabis use is a strong risk factor for cannabis initiation and use among adolescents (Johnson et al., 2018). A longitudinal study by Allen and colleagues (2011) identified peer and family level risk factors for changes in substance use across adolescence. Participants and their parents were recruited from a pool of 7th and 8th graders from suburban and urban middle schools in Southeastern United States. Adolescent autonomy and maternal support were assessed at ages 13-15 via coded parent-child discussions. At age 15, participants identified their closest friend of the same gender, and then adolescents and their identified closest friend individually completed self-report measures of past month alcohol and cannabis use. A year later (age 16) the target adolescent self-reported on current substance use and how they handle deviance in social settings. Adolescents with a weak

family base (e.g. coded interactions suggesting less support autonomy development) and less social skills with peers (e.g. saying no to peer pressure) at age 13 were more likely to use alcohol and cannabis at ages 15-16. Importantly, the strongest predictor of substance use at age 16 was peer substance use at age 15 (Allen et al., 2012). Other longitudinal research suggests that peer cannabis use is a stronger risk factor for adolescent cannabis use within close reciprocated relationships as compared to within non-reciprocated relationships, and that peer substance use is a stronger predictor of adolescent cannabis use when the friend is perceived as relatively more popular than the target adolescent (Tucker et al., 2014). Taken together, this research identifies peer cannabis use as a strong predictor of adolescent cannabis use and highlights the impact and influence of close peer relationships and the possible motive of cannabis use a tool to attain a higher social status.

Peer Cannabis Use and Subsequent Problematic Cannabis Use. Longitudinal research has also documented that exposure to peer cannabis use during adolescence is predictive of subsequent personal problematic cannabis use later in life (Von Sydow et al., 2002). A longitudinal study by Johnson and colleagues (2018) examined the roles of genetics (e.g. genome-wide polygenic risk for substance use (PRS)) and environmental factors (e.g. perceived peer cannabis use) in predicting subsequent cannabis use and cannabis use disorder. This study included a sample of 1,167 European participants taken from a larger longitudinal study (Collaborative Study on genetics and Alcoholism). Participants were 12-26 years old at baseline and were offspring of parents who struggled with addiction (61% had one parent with alcohol use disorder). Participants completed the same semi-structured interview every 2 years; data collection is still on-going. Cannabis use was

assessed by the semi-structured Assessment for the Genetics of Alcoholism which included an assessment of life-time cannabis use (yes vs no) and frequency of past year cannabis use. Cannabis use disorder was coded using DSM-IV criteria. To assess perceived peer cannabis use, participants were asked 'When you were 12-17 how many of your best friends used marijuana?'; responses ranged from none to all. Participants also self-reported on externalizing behaviors. Results identified three different classes of cannabis users: 1) No/Low Use: infrequent users or never users; 2) High Use: high frequency of use at baseline that escalated and remained elevated; and 3) Moderate Use: high frequency of use at baseline that slightly increased throughout follow-up. Next, predictors of class membership and cannabis use disorder were examined. Peer cannabis use at age 13 was a significant predictor of being in a riskier cannabis use class and cannabis use disorder at age 19. In fact, the authors note that peer cannabis use was a more significant predictor of problematic cannabis use compared to genetics alone (Johnson et al., 2018).

Piehler et al. (2012) conducted a longitudinal study with over 900 adolescents, and their family and a target friend, that examined the progression of substance use (including problematic cannabis use) across adolescence and young adulthood. The authors also examined how effortful control (e.g. regulating emotions and behavior though voluntary regulation of attentional processes, and goal-direct attentional persistence), familial, and peer factors were associated with substance use across development. Participants completed assessments in 6th, 7th, 8th 9th and 11th grade, and then a final assessment when they were between the ages of 22 and 23. During middle and high school, participants self-reported on effortful control (parents and teachers also

reported on this) and the frequency of substance use during the past month (e.g. tobacco, alcohol and cannabis). In the 11th grade assessment, participants attended the study with one of their self-selected best friends; in this assessment, friends of participants self-reported on their own substance use, and participated in a conversation with the participant about various topics surrounding substance use (e.g. planning a party and drug and alcohol use). To assess problematic substance use in adulthood, participants were asked questions via a semi-structured interview that assess the symptoms of cannabis abuse and dependence (e.g., Have you tried to stop using marijuana and found that you could not?; Have you ever had any problems related to school or work such as not doing assignments or forgetting things because of marijuana?). These observed variables were used to create two latent factors when predicting problematic cannabis use: 1) substance use lifestyle (this was created based on adolescent self-reported substance use, peer self-reported substance use, and the coding of the observed drug talk during the peer interaction task), and 2) effortful control (based on adolescent, parent, and teacher reports). Results indicated that the substance use lifestyle latent variable was a strong significant predictor of problematic cannabis use in early adulthood. Additionally, they demonstrated that effortful control was a strong negative predictor of problematic cannabis use in early adulthood (Piehler et al., 2012). Peer cannabis use is a strong predictor of later problematic cannabis use, additionally research is needed to identify what factors may disrupt this risk.

Individual: Delinquency

Delinquency, i.e., engagement in illegal activities, is associated with numerous risky health behaviors, e.g., substance use and abuse, risky sexual behaviors in

adolescence (Henggeler, 1989). "Delinquency involves learning techniques of committing crimes and motives, drives, rationalizations and attitudes favorable to the violations of the law" (Sykes & Matza, 1957). Research has shown that these delinquent techniques are typically learned within the peer and/ or familial context (Henry et al., 2001; Hoeben et al., 2016), and that familial and peer influences may also work together to influence individual delinquency, and ultimately substance use (Dishion et al., 1995). For example, poorer family functioning may lead adolescents to spend more unsupervised time with peers (and affiliate with peers engaging in delinquent behaviors), which in turn results in increased delinquency (Henry et al., 2001). This highlights how factors across multiple systems may interact to influence individuals' participation in delinquent acts as an adolescent. The next two section will review the literature on individual delinquency and cannabis use initiation/use and then problematic cannabis use.

Delinquency and Subsequent Cannabis Use Initiation. There is a well-documented association between delinquency and substance use (Bennett et al., 2008; Popovici, French, Pacula, Maclean, & Antonaccio, 2014; Rocca, Verde, & Gatti, 2019). Bennett and colleagues (2008) conducted a meta-analysis that included 30 studies that examined the relationship between crime (a common measure of delinquency) and substance use among juveniles and adults; results indicated that the odds of engaging in delinquent behavior were 1.5 times greater for cannabis users compared to non-users. Cross-sectional research focused on adolescents has also demonstrated associations between cannabis use and delinquency when delinquency is measured more broadly (Brook et al., 1998; Rocca et al., 2019). To date, there is a paucity of longitudinal research focused on how earlier delinquency predictor subsequent cannabis use in adulthood. Brook and

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colleagues (1986) conducted a longitudinal study with 356 mother- child dyads examining if child early pre-delinquency traits (e.g. caregiver perception of frequency of child taking items that don't belong to them) at ages 5-10 (T1) and adolescent self-reported delinquency at ages 13-18 (T2) predicted substance use (e.g. illegal drugs, and marijuana) at T2. Overall, pre-delinquency (T1) and greater task persistence (T1) were significant predictors of adolescent drug use at T2 (Brook 1986). Concurrent correlates of T2 substance use included: delinquency, tolerance of deviance, rebelliousness, poorer school-related behavior, and an orientation to sensation seeking were significantly associated with higher rates of drug use. Overall, early delinquent behavior appears to be significant risk factor for later cannabis use.

Delinquency and Subsequent Problematic Cannabis Use. To date, there only two studies investigating if individual delinquent behavior during adolescence is predictive of subsequent problematic cannabis use in adulthood. Both studies identified early delinquent behaviors as risk factors for subsequent problematic cannabis use (Fergusson et al., 2007; Zohsel et al., 2016). These two studies are described further below. Of note, both of these studies are international studies, highlighting the need for research focused on youth in the United States.

Zohsel and colleagues (2016) conducted a 25-year longitudinal study of German at-risk infants (i.e., those with a history of psychosocial adversity or birth complications; N=384) that investigated the role of externalizing disorder symptomatology (conduct disorder (CD)/ oppositional defiant disorder (ODD)) during childhood and adolescence predicting later problematic cannabis use in adulthood. The authors conceptualized externalizing symptoms as encompassing delinquent behaviors. This study included

assessments at child ages 4.5, 8, 11, 15 and 25. To assess symptoms of CD and ODD and other psychological disorders (e.g., attention problems, hyperactivity/impulsivity, internalizing disorders), parents were given the Mannheim Parent Interview (MPI) when their child was 4.5, 8, and 11 years old. When the child was 15 years old, both the parent and adolescent were administered the Kiddie Schedule for Affective Disorders and Schizophrenia in School- Age Children (K-SADS) to assess DSM-IV externalizing and internalizing symptoms. Problematic cannabis use at age 25 was defined as those who met DSM-IV criteria for cannabis abuse and dependence based on the Structured Clinical Interview for the DSM-IV (SCID-I) or who scored greater than two on the Severity of Dependence Scale (SDS). After controlling for sex, psychosocial adversity during infancy, and comorbid symptoms of psychopathology, symptoms of CD/ODD in childhood and adolescence (p=.08) were significantly associated with adult problematic cannabis use (Zohsel et al., 2016). While this study was able to demonstrate the link between CD/ODD and later problematic cannabis use among an at-risk sample, the present study will directly assess delinquent behavior and will utilize a larger, more representative sample.

A similar 25-year longitudinal study based in New Zealand (N=1265) also demonstrated the link between early CD/ODD symptoms and later cannabis use disorder symptoms in adulthood (Fergusson et al., 2007). The cohort was assessed at birth, 4-months, 1 year, and then annually until 16 year of age; participants were then assessed at ages 18, 21, and 25 years old. This study assessed CD/ODD symptoms (e.g. lying, stealing, and disobeying adults) at childhood (ages 7-9) via parent and teacher report, and again during adolescences (ages 14-16) via parent (Self-Report Early Delinquency scale-

Parent (SRED)) and self-report (e.g. Diagnostic Interview Schedule for Children

(DISC)). At ages 18, 21, and 25, participants' substance use behaviors were assessed via

the Composite International Diagnostic Interview (CIDI)) which included questions

about the pattern and frequency of cannabis use and problems associated with use since

the previous time-point. This data was used to determine cannabis abuse and dependence

according to the DSM-IV. Greater childhood and adolescent behavior problems (e.g.

conduct and attentional problems) at ages 7-9 predicted increased risk for cannabis abuse

and dependence in early adulthood (i.e., a diagnosis between the ages of 19-25). They

found that attentional problems at ages 14-16 were related to cannabis dependence but

none of the other outcomes(Fergusson et al., 2007). This study supports that early

behavioral problems, often conceptualized as early predictors of engagement in

delinquent behavior, are associated with subsequent problematic cannabis use. Overall,

the aforementioned sections have reviewed studies investigating how adolescent

neighborhood factors (neighborhood poverty; neighborhood drug exposure), family

factors (access to illegal drugs in the home), peer factors (peer cannabis use), and

individual factors (delinquency) independently relate to problematic cannabis use in

adulthood. The next section summarizes research that simultaneously investigated

numerous multilevel risk factors for problematic cannabis sues.

Multi-level Predictors of Problematic Cannabis Use

Consistent with the Social Ecological Model, several longitudinal studies have

simultaneously investigated multiple risk factors for problematic cannabis use across

multiple systems. Several key studies, which are described below, have identified

numerous multilevel risk factors for problematic cannabis. Yet, to date, there is a paucity

of research investigating potential protective factors that may disrupt early multilevel risk for problematic cannabis use.

A longitudinal Australian birth cohort study (N=2,493 pregnant woman and their babies) assessed babies and their mothers 3-5 days after child birth and then 6 months later, and then again when the child was 5, 14, and 21 years old. Overall, this study investigated numerous potential multilevel influences on offspring cannabis use disorder (i.e., cannabis abuse or dependence) at 21 years of age. At baseline, mothers self-reported on demographic variables and substance use behaviors (e.g. cigarette and alcohol use).When the child was 14 years old, the following constructs were assessed: maternal current drinking habits, paternal criminal behavior, mother and child communication, changes in maternal marital status, gross family income, problems in residential areas (e.g. house burglaries, violence in the streets, drug abuse, and school truancy), and adolescent-reported behavioral problems, tobacco use, and drinking behaviors. At the 21 year follow- up, participants self-reported on lifetime cannabis use and the presence of DSM-IV cannabis abuse or dependence symptoms. Alarmingly, 21.1% of the sample met criteria for cannabis abuse or dependence by age 21. Results indicate that children who experienced more changes in their parents' marital status, exhibited more aggressive/ delinquent behavior, had poor academic performance, had a history of sexual abuse, smoked cigarettes, had a mother who smoked cigarettes, and who had a father involved in criminal behavior were more likely to develop cannabis abuse or dependence by age 21(Hayatbakhsh et al., 2009). These results highlight the importance of mitigating childhood adverse experiences to promote better subsequent behavioral health.

von Sydow and colleagues (2002) investigated cannabis use and abuse/dependence across three assessments spanning four years among a German cohort of 1,101 adolescents (14-17 at baseline) and a German cohort of 1, 345 young adults (18-24 at baseline). At baseline, participants completed computer-assisted interviews assessing intrapersonal variables (e.g. behavior during childhood, trauma, self–control), developmental interpersonal family variables (e.g. parent substance use history, divorce or death of parents), current interpersonal family variables (e.g. parent attitude toward legal and illegal drug use, siblings illicit drug use, availability of alcohol and medication at home), socio-environmental variables (e.g. socioeconomic status, place of residence), and substance use variables (frequency and intensity of substance use, DSV-IV and ICD-10 substance abuse and dependence symptoms, availability of drugs, peer drug intake). These substance use variables were also assessed at the follow-assessments. Risk factors for subsequent higher frequency of cannabis use were male gender, maternal affective problems, poor financial status, employment (vs school), peer drug use, easy availability of drugs, and baseline use of other illicit drugs; resources factors included being older, living in a rural place (vs. urban), behavioral inhibition in childhood, positive life events, positive parental attitudes towards drugs, grandparent alcohol use, parental illicit drug use and medication misuse, father affective problems, and maternal anxiety. Clearly, the relationships between family substance use and mental health and offspring substance use are complex. The pattern of risk and resource factors for cannabis abuse differed between the younger cohort and older cohort. Only being male and having a history of more frequency cannabis use were risk factors for a cannabis abuse diagnosis among the younger cohort; only older age was a resource factor. For the older cohort, male gender,

more positive attitude about future drug use, baseline illicit substance abuse or

dependence, poor relationships with father, and grandparent alcohol problems were risk

factors for cannabis abuse. Resource factors for this older cohort included older age, not

living with parents, anxiety, poor relationship with mom, and availability of alcohol at the

home. Across the entire sample, risk factors for cannabis dependence included parental

death before the age of 15, lower socio-economic status, mental health problems, low

self-esteem, poor financial situation, and other illicit substance abuse or dependence at

baseline. Resource factors the protected against cannabis dependence were being older

and low self-control/coping skills (Von Sydow et al., 2002). This study documents

individual, family, and sociocultural risk factors for subsequent problematic cannabis use

across four years, and demonstrates a somewhat perplexing pattern of results. More

research is needed to help elucidate multilevel prospective risk factors for problematic

cannabis use, and how protective factors may buffer against early risk.

In a US-based study, Defoe and colleagues (2018) investigated if adolescent

cannabis use, conduct problems, and exposure to peer cannabis use predicted cannabis

use disorder in adulthood. This study assessed 364 12-14-year-olds across four waves,

with the last wave occurring when participants were 18-21. Across waves, participated

self-reported on cannabis use frequency and peer cannabis use, and reported on conduct

problems via the Youth Self Report (YSR). At the final time-point, participants self-

reported on DSM-IV cannabis abuse and dependence symptoms. Overall, mediation

analyses demonstrated that early conduct problems predicted cannabis use at waves III

and IV, which in turn predicted problematic cannabis use in adulthood (wave IV). In

addition, increased affiliation with cannabis using peers at baseline was related to

subsequent increased personal cannabis use, which in turn predicted problematic cannabis use (Defoe et al., 2019). This study highlights the importance of investigating conduct problems and peer substance use as risk factors for subsequent problematic cannabis use.

Using data from the Lives Across Time study (LAT), Windle and colleagues (2004) examined eight adolescent multilevel predictors of subsequent problematic cannabis use in young adulthood, including variables at the individual level (e.g. delinquency, alcohol use, depressive symptoms, stressful life events, grade point average), peer-level (e.g. percentage of friends using alcohol and other drugs), and family-level (e.g. perceived familial support). Participants were first assessed in 10th and 11th grade (Wave I), then every 6 months for 2 years (11th and 12th grade; Waves II-IV), and finally in young adulthood (Mage= 23.5; Wave V). Adolescents self-reported on their frequency of cannabis use, current depressive symptoms, perceived social support from family, delinquent activity, peer substance use, and stressful life events across waves. GPA and educational attainment was assessed by school transcripts and self-reported educational completion. Finally, psychiatric and substance abuse disorders in young adulthood were assessed via the World Health Organization (WHO) Composite International Diagnostic Interview (WHO-CIDI). First, semiparametric group-based mixture modeling identified five trajectory groups of cannabis use across middle adolescence: Abstainers (never used cannabis), Experimental Users (rarely used cannabis during adolescence), Decreasers (gradually decreased cannabis use), Increasers (continuously increased cannabis use), and High Chronic Users (maintained high levels of cannabis use). The High Chronic Users group endorsed the highest levels of

involvement in delinquent activity, stressful life events, peer drug use, and lower GPA. The authors then investigated how cannabis use trajectories predicted lifetime cannabis use disorder (assessed in young adulthood): The High Chronic User group exhibited the highest rate of cannabis use disorder (78%) relative to the other groups. Notably, the Increasers (60%), Decreasers (48%), and Experimental Users (43%) also had relatively high rates of cannabis use disorder. This finding highlights the equifinality nature of cannabis use disorder (Windle & Wiesner, 2004).

Overall, longitudinal research to date supports the importance of investigating influences from multiple systems to understand subsequent problematic cannabis use. The current study will investigate how individual (delinquency), family (access to illegal drugs in the home), peer (peer cannabis use), and neighborhood factors (neighborhood poverty; neighborhood drug exposure) during adolescence predict problematic cannabis use in adulthood. Further, this study will expand prior research by investigating the role of natural mentors in mitigating adolescent risk factors for problematic cannabis use in adulthood. Resilience theory is useful for conceptualizing why some youth are able to refrain from adverse health behaviors despite their environmental influences.

Resilience Theory

Resilience theory offers a framework for understanding why some adolescents who are exposed to adverse conditions early in life (e.g. poverty, parental and peer drug use) do not exhibit the problem behavior associated with that environment (N. Hurd & Zimmerman, 2010a; Zimmerman et al., 2002). Resilience is a dynamic process where individuals who have experienced adverse situations exhibit positive adaptation across development (Luthar & Cicchetti, 2000). Resiliency is demonstrated when an individual

overcomes the negative effects of exposure to risk and is able to successfully cope with traumatic experiences, thus avoiding the negative trajectories associated with that risk. One key aspect of resiliency research is identifying and enhancing protective and promotive factors associated with resiliency among youth who are exposed to risk factors (Fergus & Zimmerman, 2005a). Promotive factors are variables associated with positive outcomes for youth exposed to adversity; promotive factors can be further delineated as having direct effects or as having protective, or moderating, effects (and thus called protective factors) (Zimmerman et al., 2013). Beauvais and Oetting (2002) describe two categories of protective factors needed to obtain optimal resilience: Personal assets (e.g. competence, coping skills) and resources (e.g. parental support, adult mentoring, and community organizations)(Beauvais & Oetting, 2002). The more promotive factors an individual has, the more likely they are to be resilient in the face of adversity or risk. Using the resiliency framework, past research has identified four possible combinations of risk and subsequent outcomes. First, adolescents who are exposed to high levels of risk can either follow the expected trajectory and have negative outcomes, or they can achieve positive outcomes demonstrating a resilient trajectory. On the other hand, adolescents who are exposed to low levels of risk can either exhibit a normative developmental trajectory and have positive outcomes, or exhibit an unexpected trajectory associated with negative outcomes(Beauvais & Oetting, 2002). Of note, research has suggested in this case a stressor was likely present but not properly assessed at baseline. Resiliency theory and further be broken down in three main models: compensatory, protective, and challenge models.

Compensatory Model of Resiliency. The compensatory model of resiliency is demonstrated when a promotive factor (e.g. adult monitoring) counteracts the effects of a risk factor (e.g. poverty) via a direct effect of the promotive factor on the outcome (Fergus & Zimmerman, 2005a). For example, Edari (1998) and colleagues demonstrated that youth living in poverty were more likely to be involved in violent delinquency than youth not living in poverty. Yet, among youth experiencing poverty, adult monitoring was associated with lower engagement in delinquent behaviors, thereby counteracting the negative effects of poverty (Edari & McManus, 1998). In another study consistent with the compensatory model of resiliency, Zimmerman and colleagues found that among at-risk high school students the presence of a natural mentor decreased the likelihood for the adolescents to smoke cannabis, be involved with nonviolent delinquency (e.g. shoplifting), and express a more positive attitude towards school (Zimmerman et al., 2002).

Protective Factor Model of Resiliency. The protective factor model states that assets or resources may moderate the effects of risk on future negative outcomes (Luthar & Cicchetti, 2000; Zimmerman et al., 2013). For example, the documented relationship between youth poverty and subsequent violent behavior may be reduced for youth with higher levels of parental support versus lower levels support. Thus, demonstrating that parental support serves as a protective factor by mitigating (i.e., moderating) the influence of poverty on violent behavior. In this model, the protective factor may completely eliminate the negative outcome or it may greatly reduce the negative outcome. In some cases, the presence of a protective factor may enhance the effects of other protective factors resulting in a protective-protective factor (Zimmerman et al.,

2013)(e.g. greater parental support strengthens the association of positive appraisal of school on educational success; (Fergus & Zimmerman, 2005a)).

Challenge Model of Resiliency. The third model of resilience is the challenge model where the impact of risk exposure (e.g., early stress) depends on the level of exposure: Both high and low exposures to risk may lead to negative outcomes, but moderate exposure is related to more positive outcomes. This is consistent with inoculation approaches such that having too low levels of risk or adversity may not prepare adolescents to know how to cope with difficult situations (Zimmerman et al., 2013). On the other hand, high levels of adversity maybe overwhelming and impossible to overcome (Fergus & Zimmerman, 2005a; Zimmerman et al., 2013).

The current study will utilize the protective and compensatory factor model to investigate if having a natural mentor, a form of social support, buffers the influence of multi-level risk during adolescence on later problematic cannabis use in young adulthood. The extant literature documents that social support, across multiple levels, is an important protective factor for youth (N. Hurd & Zimmerman, 2010a). For example, social support within the family, peers, and neighborhood systems promotes resilience among youth (Jaffee et al., 2007).

For example, a United Kingdom 2007 study by Jaffee and colleagues utilized data from the Environmental Risk (E-Risk) Longitudinal Twin Study which includes a nationally- representative sample of 1,116 twin pairs and their families to explore what factors promote resiliency in the midst of adversity. One- third of the families in the study were categorized as 'high risk' (i.e. mothers had their first child between the ages 13-20) the other two-thirds of the sample were in the 'general population' (i.e. mothers had

children between the age 20-48). At baseline the child was 5 years old and families reported on family characteristics (i.e. mothers' warmth, parents' psychopathology and substance use) and neighborhood characteristics (e.g. crime, social cohesion (e.g. neighbors helped one another)). Teachers and parents reported on child behavior (e.g. getting in many fights, depression symptoms), and child cognitive abilities (e.g. Wechsler Preschool and Primary Scale of Intelligence – Revised). Mothers also reported on past child physical maltreatment via structured interview from the Multi-Site Child Development Project (e.g. do you remember any time when the child was disciplined severely that they may have been hurt). At the follow-up visit children were 7 years old and reported on the above-mentioned measures with the addition of sibling conflict and sibling warmth. Resiliency was measures at both visits by a history of child maltreatment and their teachers' report of antisocial behavior. Multinomial logistic regressions analyses were conducted to compare resilient and non-resilient children and identity what factors may contribute to being a part of each group. Results displayed that boys who had above average IQ, less symptoms of antisocial personality, less parental substance use problems, lived in lower crime neighborhoods characterized by higher levels of informal social control and social cohesion were more likely to be resilient to maltreatment. Additionally, they found that the more risk factors a child experienced the more difficult it was to be resilient. This study highlights the importance of multi-level support as a mechanism to promote resilience (Jaffee et al., 2007). One protective factor that has emerged is social support within one's neighborhood and its ability acts as a buffer against the trajectory of risk. This has been demonstrated in a number of studies (N. M. Hurd et al., 2014), and more specifically social support in the form of natural mentors.

Social Support Theory

Past research has demonstrated a positive relationship between social support and psychological and physical well-being(G. Rhodes & Lakey, 1999). It is hypothesized that social support leads to positive health outcomes by reducing the negative effects of stress (N. Hurd & Zimmerman, 2010a). These findings support the idea that social support may be protective for youth, especially youth exposed adverse conditions (Hussong, 2000) such that it mitigates the influence of risk exposure on future outcomes. These supportive relationships may be with peers, parents, nonparental adults, and non-related adults (N. Hurd & Zimmerman, 2010a). Research has shown that relationships with caring adults are critical promotive resources for adolescents (Zimmerman et al., 2013). Importantly, adolescents receive similar levels of support from nonparental adults as they receive from their mothers, at times even reporting higher levels of support from nonparental adults than their own fathers (Munsch & Blyth, 1993). Supportive relationships between a nonparental adult and an adolescent are typically referred to as mentoring relationships, and is often characterized as being either formal mentorship or informal mentorship.

Natural Mentorship

A mentoring relationship is a social connection between a more experienced (typically older) mentor and a less experienced (typically younger) mentee (N. Hurd & Zimmerman, 2010a). Today, most people think of more formal mentoring relationships when they hear the term "mentor," programs such as Big Brothers/ Big Sisters or vocational mentoring within a company. However, findings from a descriptive study on mentoring found that most adults (83%) who reported being involved in a mentoring relationship with an adolescent age 10-18 were involved in informal mentoring

relationships as opposed to formal ones (McLearn et al., 1998). Informal mentoring, or natural mentoring relationships, are often developed organically between youth and nonparental family members or community adults, and are not initiated through a program (Hagler & Rhodes, 2018). Informal mentors are more common than formal mentors among adolescents and young adults (DuBois & Silverthorn, 2005b; N. Hurd & Zimmerman, 2010a; Miranda-Chan et al., 2016; Sterrett et al., 2011). Natural mentors provide emotional support (i.e. offering comfort), informational support (i.e. providing advice, affirming the mentees value and competence), and instrumental support (i.e. concrete aid) to their mentees (Sterrett et al., 2011). Cross-sectional nationally representative data focused on 1,504 adults who have mentored at least one adolescent within the past five years found that informal mentors reported that they saw greater improvements in their mentees relative to formal mentors (McLearn et al., 1998). Importantly, the overall impact of the mentoring relationship was greater the longer the relationship was present (McLearn et al., 1998).

Natural mentoring relationships are mutual and form organically, which could contribute to the greater longevity and prevalence of natural mentoring relationships over formal mentoring relationships (N. M. Hurd et al., 2014). This is an advantage of natural mentoring relationships, given findings that suggest that longer mentoring relationships are linked to more positive outcomes (McLearn et al., 1998). The extant research demonstrates that natural mentorship is associated with better educational outcomes(Kelley & Lee, 2018; Sterrett et al., 2011), less problem behaviors (e.g. non-violent delinquency and substance use) (DuBois & Silverthorn, 2005a; Zimmerman et al., 2002), greater psychological well-being and self-esteem(Ahrens et al., 2008; N. M. Hurd

et al., 2014), improved employment rates in young adulthood (Kelley & Lee, 2018), and decreases in risky sexual behavior (N. Hurd & Zimmerman, 2010a).

In fact, Van Dam et al. (2018) conducted a meta-analysis that examined the relations between natural mentoring and youth outcomes in four domains: academic and vocational functioning (e.g. high school completion and fulltime employment), social-emotional development (e.g. life- satisfaction and self-regulation), physical health (e.g. body mass index, sexually transmitted disease diagnosis), and psychosocial problems (e.g. depression, delinquency, substance use) (Van Dam et al., 2018). The meta-analysis included 30 studies from 1992-2018 (15 cross-sectional studies; 15 longitudinal studies). Results indicated that the presence of a natural mentor was significantly associated with positive youth outcomes across all domains, including substance use (Van Dam et al., 2018). Of note, only a few studies in this review investigated how the presence of a natural mentor relates to substance use over time (these studies are described in detail in the next section). Overall, youth with natural mentors from helping profession backgrounds (e.g., teachers, coaches) experienced more positive outcomes relative to youth with natural mentors from non-helping profession backgrounds (e.g., business). Importantly, natural mentorship was associated with positive youth outcomes for all youth, not just youth from at-risk backgrounds.

Compensatory Model: The associations between Natural mentoring and cannabis/substance use. To date, there are few studies examining the prospective associations between having a natural mentor and adolescent/young adult substance use, both demonstrating direct or indirect benefits of natural mentorship. Hurd and colleagues (2010) conducted a longitudinal study with African American adolescents with a lower

8th grade point average to explore how natural mentors impacted the trajectories of health outcomes post high school. African American participants (N=615) completed assessments (i.e., self-report measures; interviews) in their senior year of high school and then at 2, 3, 4, and 5 years post high school. At each assessment, participants reported on depressive symptoms, sexual risk behaviors (e.g. frequency of sexual intercourse, frequency of condom use), substance use (past month alcohol, cigarette and cannabis use), stress, and parental support. To assess for the presence of a natural mentor, participants reported on if they had an adult 25 and older (not an immediate family member) who they went to for support. Importantly, 63% of participants reported had a natural mentor. Hierarchical linear modeling was used to identify psychosocial outcome trajectories. Individuals with a natural mentor had greater decreases in depressive symptoms and sexual risk behavior over time relative to those without a natural mentor (and lower overall sexual risk behaviors). Contrary to the authors' hypothesis, having a natural mentor was not predictive of baseline levels or growth in substance use behaviors over time. Mediation analyses showed that having a natural mentor was associated with a lower likelihood of using cannabis and cigarettes through coping abilities and having a sense of life purpose; additionally, having a natural mentor was related to less depressive and anxiety symptoms through improved coping abilities and having a sense of life purpose (N. Hurd & Zimmerman, 2010a).

Next, Black and colleagues (2010) explored if school attachment mediated the longitudinal relationships between school-based natural mentors and risk behaviors one year later (substance use and delinquent behavior). Adolescent participants (N=3320; Mage= 14.8) were students in one of the 65 high schools across eight states in the United

States that were involved in a larger intervention study (Project toward No Drug Abuse (TND)). At baseline, participants reported on their level of school attachment (e.g., "how interested are you in school now?") and the presence of a natural mentor ("at my school, there is a teacher or other adult… who cares about me; tell me when I do a good job etc."). Participants self-reported on past 30- day cigarette, alcohol, cannabis and hard drug (i.e. cocaine) use and delinquent behavior (e.g., hit, punched kicked or beaten someone up etc.) at baseline and at 1-year follow-up. Mediation analysis showed that there was 1) a direct, negative effect of natural mentorship on subsequent substance use and 2) indirect effect of natural mentorship on reduced substance use through school attachment. Overall, the results of these two studies demonstrate that natural mentorship is associated reduced substance use or time via either direct effects (Black et al., 2010) and indirectly by enhancing youths' coping abilities, sense of purpose, and school attachment (Black et al., 2010; N. M. Hurd et al., 2014). The current study will expand the existing longitudinal research by utilizing a nationally representative sample with data spanning 15 years to investigate natural mentoring as a protective and compensatory factor against problematic cannabis use in adulthood.

There have been several cross-sectional studies that demonstrated having a natural mentor was associated with decreased substance use (Van Dam et al., 2018). Importantly, patterns of results have varied some across populations. For example, one cross-sectional study with youth who were homeless found that natural mentorship was associated with higher satisfaction with social support and less risky sexual behaviors; however, mentorship was not associated with substance use (Dang, Conger, Breslau, & Miller, 2014). Other cross-sectional studies have analyzed data from the Add Health Study, the

same sample that will be used for the present study. Hackshaw (2017) examined the cross-sectional associations between natural mentor relationships and past year substance use (excessive alcohol use, illicit drug use, and cannabis use) during young adulthood, finding that youth with community natural mentors were less likely to have used cannabis during the past year (Hackshaw, 2017). In another study utilizing Wave III Add Health data, Ahrens et al. (2007) found that among youth in foster care, having a natural mentor was associated with greater perceived general health, higher education attainment, lower risk for suicidal ideation and having a diagnosis of an STD, and physical fighting (Ahrens et al., 2008). The present study will extend these Add Health studies by capturing problematic substance use in adulthood and investigating both the main effects of mentorship (and multilevel risk factors) on subsequent substance use and the moderating role of Wave III mentorship on the association between adolescent risk factors and adult problematic cannabis use.

Protective Model: The Moderating Role of Natural Mentorship on the Associations between Adolescent Risk Factors and Adult Problematic Cannabis use. The above literature largely supports natural mentorship as a promotive or a compensatory factor. To date, only one study has investigated the protective role of mentorship on youth substance use. In a cross-sectional study, Zimmerman and colleagues (2002) used a primarily African American sample of adolescents (N=770) with low GPAs to investigate if having a natural mentor fits the compensatory and/or protective factor model of resiliency when examining youth problem behaviors (cannabis use, non-violent delinquent behavior) and school attitudes; the authors also examined if natural mentorship affects youth outcomes by leading to less exposure to risk factors.

Participants participated in a 1 hour interview that assessed the following constructs: presence of a natural mentor (e.g. is there an adult 25 or older who you consider to be your mentor), problem behaviors (e.g. substance use, non-violent and violent behaviors), school attitudes (e.g. most mornings I look forward to school), friend problem behaviors (e.g. how many friends smoked cannabis in the past month) and problem school behaviors (e.g. how many friends 'cut class'), and norms regarding friend school perceptions (e.g. would your friends think it's cool or uncool if you had very good grades) and friend perceptions about problem behaviors (e.g. do your friends think it's cool to drink alcohol). To test if having a natural mentor fits the compensatory and/or protective favor of resiliency, the authors conducted a set of hierarchical linear regressions and moderation analyses. Results indicated that having a natural mentor had both compensatory and protective factor qualities. Having a natural mentor was associated with more positive school attitudes and lower levels of problem behaviors (less cannabis use and fewer nonviolent delinquent behaviors), supporting that having a natural mentor was a compensatory factor. When examining school attitudes, having a natural mentor also demonstrated protective factor qualities. There was an interaction between natural mentorship and friend's problem school behaviors and friend negative school norms such that having a natural mentor buffered against these risk factors in predicting positive school attitudes. Finally, this study also used mediation analyses to identify if natural mentorship affected youth outcomes by leading to less exposure to risk factors. Results indicated that having a natural mentor directly affected all outcomes (e.g., less problem behaviors, more positive school attitudes), with larger effects of school attitudes than problem behaviors. In addition, results showed that natural mentorship was

associated with more positive outcomes by reducing youth's exposure to friend-related

risk factors (Zimmerman et al., 2002). Overall, this study highlights a range of positive

outcomes due to having a supportive natural mentor for at risk youth. To date there have

been no longitudinal studies that explored the possible pathways and buffers of

problematic cannabis use.

Relatedly, a study by DuBois et al. (2005) investigated the differential impact of

mentorship on adolescent outcomes depending on individual and environmental risk (i.e.,

the moderating role of risk exposure on the relations between mentorship and youth

outcomes). This differs from the present study that aims to identify if mentorship buffers

against adolescent risk in predicting Wave IV problematic cannabis use (i.e., the

moderating role of mentorship on the relations between risk exposure and youth

outcomes). DuBois and Silverthorn (2005) utilized waves I and III of Add Health to

examine the association between natural mentorship and adolescent education and health

outcomes at Wave III. Additionally, the authors investigated if the relationship between

natural mentorship and adolescent outcomes differed based on individual and

environmental risk. Data came from participants (N=3,187) who were randomly selected

from a larger sample of Add Health (N=15,197). The analyses controlled for numerous

baseline risk variables that were assessed at Wave I: individual risk (e.g. past year

counseling or substance abuse treatment) and environmental risk (e.g. parent receiving

public assistance, adolescents not feeling safe in the neighborhood, not feeling connected

to home or school). At Wave III, participants self-reported on education and work

outcomes (e.g. completion of school, employment), problem behavior (e.g. past year and

month binge drinking, drug use, smoking), psychological well-being (e.g. depression and

self-esteem), and physical health (e.g. diagnosis of STD, perceived general health). Controlling for Wave I risk variables and Wave I assessments of the variables of interest, logistic regressions indicated that having a natural mentor was associated with completing high school and attending college, higher levels of physical activity, regular use of birth control, higher levels of self-esteem and life satisfaction, and decreased likelihood of being a gang member and risk taking. Natural mentorship did not have a main effect on substance use. Regarding the moderating role of individual/environmental risk on the association between mentorship and outcomes, there was no significant interaction for substance use; however, other interactions emerged indicating a complex pattern of relations where the association between mentorship and fighting, depressive symptoms, and physical activity depended on adolescents' Wave I risk exposure. Taking the results of these two studies together, one study supported that mentorship was a moderator of the association between risk and subsequent cannabis use (i.e., as a protective factor (Zimmerman et al., 2013); however, moderation was not found when risk was examined as the moderator between mentorship and drug use(DuBois & Silverthorn, 2005a).

Summary

Overall, prior literature on adolescent and young adult cannabis use has largely focused on only one or two predictors of substance use or cannabis use (e.g. parent use, peer use), with very few studies investigating multi-level risk factors for cannabis use or problematic cannabis use in adulthood (Burlew et al., 2009; Johnson et al., 2018; Storr et al., 2004). Research to date is mixed regarding if natural mentors decreases the likelihood that adolescent cannabis use. Some studies found that natural mentors have a

compensatory role on substance use trajectories such that it decreases risk of cannabis use (i.e., demonstrated a main effect on cannabis use among those exposed to risk;(Black et al., 2010; Zimmerman et al., 2002); others demonstrated that natural mentorship is associated reduced substance use over time by enhancing youths' coping abilities, sense of purpose, and school attachment (Black et al., 2010; N. Hurd & Zimmerman, 2010a). On the other hand, other studies have failed to demonstrate that mentorship is association with subsequent substance use (DuBois & Silverthorn, 2005b). One explanation for these mixed results may be related to the fact that substance use is a highly normative aspect of adolescence and young adulthood (Ahrens et al., 2008), and as such mentorship may be less influential on reducing risk against normative adolescent cannabis experimentation (and yet it hypothesized mentorship will be important for problematic cannabis use). Another explanation may be related to differences in the nature of the mentorship relationship; for example, natural mentors' modeling of substance use behavior may increase the likelihood of the young adult substance use. Despite the mixed results of the compensatory role of mentorship on substance use, there is both cross-sectional and longitudinal data supporting this role for substance use (Black et al., 2010; N. Hurd & Zimmerman, 2010a) and overall positive outcomes for youth (Ahrens et al., 2008). To date, there are only two studies examining the protective role of mentorship, and the results were mixed (DuBois & Silverthorn, 2005b; Zimmerman et al., 2013).

The current study will extend the prior literature by investigating the main effects of multi-level adolescent risk factors and natural mentorship (as a compensatory factor) on problematic cannabis use in young adulthood utilizing a longitudinal, nationally representative sample. Additionally, the current study will explore if natural mentoring

has a protective effect against problematic cannabis use such that it moderates the association between adolescent multi-level risk factors on problematic cannabis use in adulthood. This study will be the first to investigate both the compensatory role of mentorship against problematic cannabis use in adulthood and the protective role of natural mentorship against the association between adolescent multilevel risk factors influence and problematic cannabis use in adulthood.

CHAPTER III

METHODOLOGY

Participants and Procedure

Participants in the current study were adolescents who completed Waves I-IV of Add Health (Harris et al., 2009) and who endorsed a lifetime history of using cannabis at least weekly, including participants who endorsed weekly cannabis use during the past year (N=2, 510). Add Health is a nationally representative longitudinal study examining the general health and welling being of adolescents in the United States across many contexts such as school, family, peers, neighborhood and community. Add Health includes a representative sample of adolescents and their caregivers from across the United States that were recruited from 132 schools. Add Health utilized systematic sampling methods and implicit stratification to ensure that the study adequately represented schools in the United States. Sampling stratification of schools was based on region, school size, urbanicity, type (public, private, parochial), and racial/ethnic representation of the schools. Participation rates among the originally identified schools was over 70%. Schools were identified in the appropriate stratum to replace schools that refused. Overall, 79% of all schools contacted to participate in Add Health agreed to participate.

In Wave 1, a school-based assessment was completed with more than 90,000 students. A

subset of youth was chosen to participate in the core sample that completed in-home assessments for Wave I and subsequent waves (III, IV). The core sample was created by stratified sampling based on grade and sex, resulting in 200 students from each pair of schools (high schools and their associated middle school/ feeder school). The initial core sample was comprised of 12,105 youth who completed the Wave 1 in-home assessment. In addition to the core sample, multiple special samples were purposefully enrolled in the study to increase representation, including ethnic and racial diverse youth, individuals with varying relatedness to an identified participant (e.g., twins, half-siblings, full siblings, unrelated adolescents living in the same home), individuals who were adopted, youth with disabilities, samples from schools with varying urbanicity, and additional individuals who were identified via social network/ romantic partnership identification procedures. Overall, the core sample plus the special samples resulted in an overall baseline sample of 20,745 youth.

The present study will utilize three waves from the larger Add Health Study: Wave I, Wave III, and Wave IV. The first wave of data (Wave I) was collected during the 1994 – 1995 academic school year when participants were in grades 7 – 12; in Wave 1, adolescents, and one caregiver, completed in-home assessments. To ensure confidentiality at home, the adolescent was given a computer-assisted personal interview in which they listened to pre-recorded questions though headphones and recorded responses directly on a laptop. Waves III and IV utilized the same in-home interview procedures. The third wave of data (Wave III) was collected between 2001 and 2002 when participants (N = 15,197) were between the ages of 18 – 26; the response rate for this wave was 77.4%. Wave IV data was collected between 2008 and 2009 when

participants (N = 15,701) were between the ages of 24 – 32 years; the response rate for this wave was 80.3%. Participants in the current study will be adolescents (N= 9, 421) who completed Waves I-IV. Retention rates for this sample are consistent with other longitudinal studies (Harris et al., 2019); being female, being younger, having higher SES, living in an urban area, being native born, and being White was associated with being more likely to respond at Waves III and IV (Harris et al., 2019). Importantly, analyses focused on evaluating bias introduced by difference in attrition demonstrated minimal bias after adjusting for sampling weights (Harris et al., 2019).

Measures

  Demographic. Adolescents self-reported on gender *(1= male, 2= female)*, age, ethnicity (Hispanic or non-Hispanic), and race (Black/ African American, Asian/ Pacific Islander, American Indian or Native American, White; more than one answer could be selected) in Wave I (Udry, 2003).

  Neighborhood Drug Exposure. Caregivers of participants were asked the following question at Wave I: *'In this neighborhood, how big a problem are drug dealers and drug users?'* Response options ranged from 1= 'no problem at all' to 3= 'a big problem' on a three-point Likert scale, with higher scores indicating greater neighborhood drug problems. Other research has used this variable in investigating neighborhood drug exposure (Clawson et al., 2021).

  Neighborhood Poverty. Neighborhood poverty was assessed by using variables (e.g. home address) that linked participants' Wave I geocodes for the block group level to the 1990 US census data in order to identify the proportion of individuals < 18 years old with income below the poverty line (Harris, 2012). Values ranged from 0 to 1, with

higher scores representing a larger proportion of youth living in poverty for the block

group. This definition of poverty is supported by prior literature (Billy, Wenzlow,

William, & National Longitudinal Study of Adolescent Health, 1998).

Access to Drugs in the Home. Participants were asked at Wave I '*Are illegal*

drugs easily available to you in your home?'. Adolescent participants responded with

'no' (coded 0) or 'yes' (coded 1). This question has been used in previous research to

assess the availability of illegal drugs in the home (Bouchard, Gallupe, Dawson, &

Anamali, 2018).

Peer cannabis use. At Wave I, adolescent reported on how many of their three

best friends used cannabis at least once a month. Responses options range from 0= no

peer cannabis use to 3= three friends used cannabis.

Delinquency. Wave I delinquency was assessed via the 15-item Add Health Self-

Report Delinquency Scale (SRD) (Elliott, Huizinga, & Ageton, 1982) assessed the past

year frequency of the following activities: lying to parents, painting graffiti, damaging

others' property, shoplifting, getting into a physical fight, hurting someone, borrowing a

car without asking, burglarizing, stealing something worth more or less than $50, using a

weapon, selling drugs, group fighting, and being rowdy in public. Response options were

as follows: *0='never did this activity', 1='did this activity once or twice, 2= 'did this*

activity three or four times, and *3 ='did this activity five or more times.'* Scores will be

summed and divided by the number of items which produces an index of 0 to 3, with

higher scores indicating more involvement in delinquent behaviors. Prior research has

found good internal consistency (alpha coefficient= 0.84) for this measure (Greenberg,

Tamarelli, & Kelley, 2002).

Cannabis Use. Wave I lifetime cannabis use served as a covariate in primary analyses (0= never tried cannabis, 1= tried cannabis).

Natural Mentoring. During the Wave III in-home interview, young adult participants (ages 18-26) were asked *"other than your parents or step-parents, has an adult made an important positive difference in your life at any time since you were 14 years old?".* Participants responded 'no' (0) or 'yes' (1). If participants endorsed a natural mentor, they reported the nature of that relationship (e.g. teacher, sibling, coach, community member, extended family). Based on prior mentoring literature that defines natural mentorship as a relationship between an adolescent and an older, non-parental adult (DuBois & Silverthorn, 2005a), natural mentorship will be defined as having a natural mentor who was not a younger sibling, spouse or partner, or friend. The presence of a natural mentor was coded as 1 and the lack of a natural mentor was coded as 0.

Cannabis Use and Problematic Cannabis Use. At Wave IV (ages 24-32), participants self-reported on their lifetime cannabis use and symptoms consistent with problematic cannabis use. Participants who endorsed a lifetime history of using cannabis at least weekly, including participants who endorsed weekly cannabis use during the past year, were included in the current sample (N=2, 510). Assessed cannabis abuse criteria included: how many times has your use interfered with your responsibilities at work or at school, how often have you been under the influence of cannabis when you could have gotten yourself or others hurt or at risk, legal problems (e.g. arrested for disturbing the peace) because of use, and how often you had problems with your family, friends or people at work or school because of your use. Participants who endorsed one or more of these symptoms met criteria for cannabis abuse. For the present study, problematic

cannabis use was defined as a meeting criteria for a lifetime diagnosis of abuse or dependence based on DSM-IV-TR symptoms and assessment of tolerance and withdrawal symptoms (0=no abuse/dependence; 1= lifetime history of DSM-IV-TR abuse or dependence) (Haberstick et al., 2014).

Using a lifetime history of cannabis abuse/dependence rather than using a current diagnosis of cannabis abuse/dependence limits inferences that can be made about causality due to the murkiness of temporal precedence. Lifetime history of problematic cannabis use versus current problematic cannabis was used for several reasons. First, due to limitations of the Add Health data, only lifetime history and not current diagnosis of cannabis abuse/dependence were available. Second, there are low prevalence rates of cannabis dependence prior to age 14, with onset peaking at age 20 (Haberstick et al., 2014); based on when constructs were assessed, this suggests that is unlikely the adolescent risk factors or natural mentorship occurred after the onset of problematic cannabis use. Third, using a lifetime history of problematic cannabis use increases the available sample size. Lastly, other longitudinal research that investigates risk factors for problematic cannabis use have also used lifetime history of problematic cannabis use as an outcome (Farmer et al., 2015; Kevorkian et al., 2015).

Overview of Analyses

Mplus version 8 was used for all analyses (Muthen & Muthén, 2017). For all analyses, appropriate weighting strategies for the study design were used (Chen & Chantala, 2014). Descriptive statistics were employed to describe participant characteristics.

Preliminary Analyses. Missing data indicators (variables that identify whether data were missing or not missing) were created for problematic cannabis use in order to conduct missing data analyses (Collins, Schafer, & Kam, 2001). There was no missing data for problematic cannabis use (beyond legitimate missing data based on skip patterns). Full-information maximum likelihood methods were used to address other missing data (Muthen & Muthén, 2017). Based on prior research, the main analysis included the following control variables: baseline cannabis use (never vs. ever use), sex, age, family income, race (dummy coded variables with White as the referent), and ethnicity (Latinx vs. not Latinx). To address missingness on demographic variables, their variances were estimated in the model, with the main analysis having a sample size of 2,153 due to missingness on independent variables (85.77% of the available sample).

Analysis. Moderation analyses were used to simultaneously investigate the main effects of adolescent risk variables (Wave I) and natural mentorship (Wave III) on lifetime history of problematic cannabis use (as measured at Wave IV). The MLR estimator was used. The path between Wave I reported cannabis use and Wave III mentorship as also identified in the model. Continuous independent variables were mean centered.

Aim 1 was executed by investigating the main effects of adolescent risk variables (Wave I) on lifetime history of problematic cannabis use. Aim 2 was completed by evaluating the main effect of natural mentorship on problematic cannabis use, thus identifying if mentorship is a compensatory factor on problematic cannabis use. For Aim 3, we investigated the moderating role of mentorship on the association between each adolescent risk variable and later problematic cannabis use to test if mentorship is a

protective factor. This was done by creating interaction terms between mentorship and each adolescent risk factor. Significant interactions were probed by follow-up analyses that investigate the relations between the adolescent risk factor and Wave IV problematic cannabis use at each level of mentorship (i.e., no mentorship versus mentorship); follow-up analyses are presented as odds ratios. Data visualizations are included to interpret interactions. Unstandardized and standardized coefficients are presented. STDY standardization was used for binary predictor variables (and interactions involving binary predictors); STDYX standardization was used for continuous predictor variables (and interactions involving continuous predictors).

CHAPTER IV

FINDINGS

Preliminary Analysis

Participants in the current study endorsed a lifetime history of using cannabis at least weekly, including participants who endorsed weekly cannabis use during the past year (N=2, 510). Additional information about participant demographics and descriptive statistics on the independent variables, moderator, and dependent variable is in Table 1.

Due to missing data on some independent variables, participants for the present study included individuals who endorsed a lifetime history of using cannabis at least weekly, including participants who endorsed weekly cannabis use during the past year, and who had data for the independent variables (N=2,153). Of those in this sample, 45.9% endorsed a lifetime history of problematic cannabis use; 77.57% reported having a natural mentor since age 14.

Main Analysis

Study aims were evaluated in a single model that included demographic control variables (e.g. age, sex, history of cannabis use, race and ethnicity), risk factors (e.g. neighborhood poverty, neighborhood drug access, drugs in the home, peer cannabis use, and delinquency), natural mentorship, and the interactions between all risk factors and natural mentorship. For the overall model, unstandardized results are presented in Table 2

and standardized results are presented in Table 3; only significant associations are discussed in text (standardized coefficients are presented in text).

Females were less likely to report a lifetime history of problematic cannabis use (B= -0.120, p <.001). The regression between Wave 1 cannabis use and mentorship approached significance (B= .048, p =.072): Those with a history of cannabis use at Wave I were more likely to have a mentor at Wave III. Of the independent variables, only having access to the drugs in the home at baseline was a significant predictor of problematic cannabis use: Those with access to drugs in the home were less likely to have a history of problematic cannabis use (B= -.812, p = .029). Mentorship was associated with an increased likelihood of problematic cannabis use, though this relationship was not statistically significant (B= .049, p = .081). The only significant interaction was the interaction between mentorship and drugs in the home (B= .844, p = .038). Follow-up probing of the significant interaction indicated that for those who did not have a mentor, having access to drugs in the home during adolescence was not related to a lifetime history of problematic cannabis use (OR=.222, p = .148). On the other hand, among those with a mentor, having access to drugs in the home during adolescence was associated with a greater likelihood of having a lifetime history of problematic cannabis use (OR=1.062, p < .001).

Initially, this pattern of results for the interactions seemed counterintuitive. However, upon considering past literature and the finding that baseline cannabis use was associated with a greater likelihood of having natural mentor, it was hypothesized that youth with mentors may have increased risk due to contextual risk factors (above and beyond home drug exposure) relative to youth without mentors (Gowdy, Miller, &

Spencer, 2020). Given the substantial literature documenting greater exposure to systemic racism and contextual risk among Black youth in the United States (Marks, Woolverton, & Garciacutea Coll, 2020), a considerable amount of the literature on natural mentorship has focused on Black youth. Therefore, it was hypothesized that racial marginalization may be an important variable to contextualize how natural mentorship, and its interaction with risk factors, may differentially relate to problematic cannabis use depending on youth people's racial marginalization status. Thus, we conducted two additional analyses to test the study aims (removing race as a control variable) among a sample restricted to Black youth (N=367) and then among a sample restricted to White youth (N=1654). See Table 4 for standardized model results for Black youth. See Table 5 for standardized model results for White youth. For the model with White youth, none of the independent variables and none of the interactions were significant predictors of problematic cannabis use; however, females were less likely to have a lifetime history of problematic cannabis use (B= -.102, p <.001) and youth with a history of cannabis use at Wave I were more likely to have a mentor at Wave III (B= .059, p =.035).

Among participants who identified as Black, adolescents who had tried cannabis at baseline were more likely to have a lifetime history of problematic cannabis use (B= .175, p = .036). Again, those who identified as female were less likely to have a lifetime history of problematic cannabis use (B= -.235, p <.001). Notably, Wave I cannabis use was not associated with having a mentor at Wave III. Mentorship was not associated with problematic cannabis use. The drugs in the home*mentorship interaction (B= 1.290, p = .051) and the peer use*mentorship interaction (B= -.402, p = .056) were marginally significant. Though these results only neared significance, likely due to reduced power to

detect these relationships, we moved forward with follow- up probing of these interactions to inform the scant longitudinal literature on problematic cannabis use and mentorship. See Table 4 for standardized model results.

Follow-up analyses that probed the drugs in the home*mentorship interaction indicated that among Black youth who did not have a mentor, having access to drugs in the home during adolescence was nonsignificantly associated with a lower likelihood of having a lifetime history of problematic cannabis use (OR=.104, p = .420). On the other hand, among Black youth with a natural mentor, having access to drugs in the home was nonsignificantly related to an increased likelihood of having a lifetime history of problematic cannabis use (OR=1.451, p = .272). Although these follow-up analyses were nonsignificant, the directionality of the associations found in this pattern of results (i.e. how having access to drugs to the drugs in the home related to problematic cannabis use depending on mentorship) were similar to the pattern we found for the overall sample. Importantly, no drugs in the home*mentorship interaction was found among the sample restricted to White youth.

Follow-up analyses that probed the peer use*mentorship interaction demonstrated that among Black youth who do not have a mentor, exposure to peer cannabis use in adolescence   was associated with an increased likelihood of having a lifetime diagnosis of problematic cannabis use in adulthood (OR=1.448, p = .009). On the other hand, among Black youth who had a mentor, exposure to peer cannabis use in adolescence was associated with a decreased likelihood of having a lifetime diagnosis of problematic cannabis use in adulthood (OR=0.636, p < .001). Again, no peer use*mentorship interaction was found among the sample restricted to White youth.

CHAPTER V

DISCUSSION

The current study extends prior literature by identifying multilevel risk factors for problematic cannabis use and by identifying whether natural mentorship served as compensatory or protective factor against adolescent risk factors for problematic cannabis use. Initially, study aims were evaluated using analyses conducted with the full sample of participants indicating a history of at least weekly cannabis use. Given the perplexing nature of the results and current state of the literature regarding natural mentorship, we decided to conduct additional analyses using two subsamples (White and Black participants) of the larger sample.

Full Sample

In the initial model with the full sample, natural mentorship did not emerge as a compensatory or protective factor. In fact, *among those who had a natural mentor since age 14*, access to drugs in the home was associated with an *increased* risk for a lifetime history of problematic cannabis use; on the other hand, *among those who did not have a mentor*, access to drugs in the home was not significantly related to problematic cannabis use (though the direction of this nonsignificant association suggested reduced risk). This pattern of results was unexpected. However, it is well documented that caregiver substance use is related to a multitude of negative child outcomes, including child

behavior problems (Bailey, Hill, Oesterle, & Hawkins, 2006) and child substance use (e.g. alcohol, cigarette, and cannabis) (Bailey et al., 2016; Leonardi-Bee, Jere, & Britton, 2011), and is associated with exposure to other contextual stressors such as poverty and neighborhood drug use (Dunlap, Stürzenhofecker, Sanabria, & Johnson, 2004). Therefore, our finding may suggest that youth with access to drugs in the home may also experience other deleterious contextual factors, such as parental/ familial substance use (Brook et al., 2001), lack of parental monitoring (Osgood, 1996), and drug street/ neighborhood subculture (Dunlap et al., 2004). These other contextual risk factors may work independently or synergistically with each other and/or access to drugs in the home to produce risk for problematic cannabis use, potentially washing out the buffering effects of having a natural mentor. This is the first study to investigate if natural mentorship moderates the relationship between access to drugs in the home and problematic cannabis use. Future research should investigate how access to drugs in the home clusters with other related contextual risks (such as caregiver substance use, reduced parental monitoring, neighborhood drug subculture) and how it relates to problematic cannabis use. Furthermore, future research should identify how natural mentorship may protect against these clustering risk factors, and explore other protective factors that may buffer against multilevel risks for problematic cannabis use.

As noted above, this pattern of results was contradictory to hypotheses; other paths in the model may help to elucidate some potential reasons for this perplexing finding. For example, those with a history of cannabis use at Wave I were more likely to have a mentor at Wave III, though this finding only approached significance ($p =.072$). This may suggest that youth who initiate cannabis use earlier may be more likely to

pursue a natural mentor, or that these youth may be more likely to have a natural mentor intervene. To date, there is a of lack empirical evidence on how youth substance use may contribute to the likelihood of receiving natural mentorship, and in general a paucity of longitudinal research on natural mentorship and problematic cannabis use. However, data on formal mentorship programs suggest youth experiencing adverse family situations or circumstances (e.g. only one involved parent) and/or experiencing psychosocial, behavioral, or academic challenges are more likely to be recruited into and participate in formal mentoring programs (DuBois & Silverthorn, 2005a; J. E. Rhodes, Reddy, & Grossman, 2005). Given this, youth in formal mentorship programs are at higher risk for developing problematic behaviors (e.g. substance use) due to these associated environmental factors such as family instability and poverty (Zimmerman et al., 2002). Importantly, longitudinal research suggests that longer involvement with formal mentoring positively impacts youth substance use, after controlling for baseline substance use: Youth with longer formal mentoring relationships (i.e., 12 months or longer) have significantly lower rates of substance use relative to youth without formal mentors and youth with shorter formal mentoring relationships (J. E. Rhodes et al., 2005). Taken together, the perplexing interaction between access to the drugs in the home and natural mentorship may be in part influenced by the absence of unmeasured contextual risk factors in our model and/or the lack of information about the temporal precedence between mentorship and substance use initiation.

Regarding Aim 1, only access to drugs in the home emerged as predictor of problematic cannabis use; however, the association was not in the hypothesized direction: Those with access to drugs in the home were *less* likely to have a history of problematic

cannabis use. Importantly, the main effect of access to drugs in the home has to be interpreted with the context of the significant interaction involving drugs in the home and mentorship. This was the first study to investigate the relationship between access to drugs in the home and problematic cannabis use. Thus, our hypothesis was proffered based on the research documenting that access to drugs in the home was prospectively related to substance use broadly (i.e. alcohol and tobacco)(Bouchard et al., 2018) and the established literature on intergenerational substance use patterns (Bailey et al., 2016; Bouchard et al., 2018). Access to drugs in the home was conceptualized as a potential byproduct of caregiver substance use; however, our finding that youth with access to drugs in the home were *less* likely to have a history of problematic cannabis use may suggest that a direct assessment of caregiver cannabis use (or direct assessment of access to the cannabis in the home) is needed to elucidate how it confers risk for offspring substance use. Alternatively, it may be that there are other factors related to caregiver substance use that are more predictive of youth problematic cannabis use. For example, prior literature has demonstrated that adolescent perceived parental attitudes about adolescent drug use are more of a predictor for adolescent substance use (two or more substances) than actual parental drug use (McDermott, 1984).

On the other hand, access to drugs in the home may have been related to decreased risk for problematic cannabis use because youth with access to drugs in the home have experienced the negative effects of substance use on their family, thereby, contributing to avoidance of drug use (Ronel & Levy-Cahana, 2011). In a qualitative study with youth who have substance-dependent parents, youth described numerous factors that supported their abstinence from substances, including views that their parents

were 'weak' because of their substance use, views that their own drug abstinence was 'strong', and that their abstinence was influenced by a desire to have a better future for themselves and their siblings (Ronel & Levy-Cahana, 2011). Importantly, youth also identified that they sought out positive adult relationships (either within or outside of the family) to support their abstinence from substances. Thus, negative family experiences with caregiver substance use may help to explain why youth with access to drugs in the home were less likely to have a history of problematic cannabis use in the current study. Future research should more fully assess the substance use behaviors, experiences, and socialization between all family members, including who is using drugs in the home, how families communicate about drugs use, and child exposure to unsafe and/or harmful substances and situations.

Despite the past literature influencing our hypotheses about the associations between multilevel risk factors (i.e. neighborhood poverty and drug exposure, access to drugs in the home, peer cannabis use, and delinquency) and a history of problematic cannabis use, many of these main effects were nonsignificant in the current study. There are several considerations as to why our hypotheses regarding these risk factors were not supported in the current study. First, as demonstrated in past literature there are many environmental and contextual influences that can lead to problematic cannabis use that were not explored in this current study (i.e., parental/ mentor attitudes towards cannabis use). These influences may have an even bigger impact on the development of problematic cannabis use than the risk factors explored in this current study. Additionally, the current study utilized a higher risk sample of participants (i.e., all participants had a history of at least weekly cannabis use) and was focused on a more

deleterious outcome (i.e., problematic cannabis use) compared to most of the extant longitudinal literature on cannabis use. More specifically, most of the empirical investigation focused on the identification of prospective predictors of cannabis use have focused on lower risk samples and outcomes, such as cannabis use initiation or experimentation. Furthermore, among the limited longitudinal literature focused problematic cannabis use, earlier onset of cannabis use was not controlled for in the analyses, as was done in the present study, which may contribute to the differing results patterns (Bouchard et al., 2018; Hayatbakhsh et al., 2009; J. O. Lee et al., 2018; Jungeun Olivia Lee et al., 2017; Zohsel et al., 2016). The current study included adolescent cannabis use history as a covariate because history of substance use is predictive of later problematic cannabis use (Von Sydow et al., 2002) and to allow for investigation of how earlier cannabis relates to both the receipt of natural mentorship and later risky cannabis use. Overall, of the available literature on the prospective predictors of problematic cannabis use, results on the identified predictors and risk factors have varied significantly across studies. For example, some studies that utilized multilevel predictors have found significant relationships between later problematic cannabis use and being involved in delinquency earlier in life (Hayatbakhsh et al., 2009; Windle & Wiesner, 2004)), having parents that use substances (Hayatbakhsh et al., 2009), lower SES (Von Sydow et al., 2002), and peer drug use (Windle & Wiesner, 2004); however, other studies have failed to identify these as significant predictors of problematic cannabis use (or did not investigate all of them together). Furthermore, another potential methodological differences between the current study and prior literature is that many of the prior longitudinal studies on multilevel predictors of problematic cannabis that utilized longer

follow-up periods (i.e., 25 years) were done outside of the United States (Fergusson et al., 2007; Zohsel et al., 2016). Of the studies that were conducted in the United States, the follow-up periods were much shorter (Bouchard et al., 2018) and utilized a smaller, local (Defoe et al., 2019), and less risky sample of participants (Allen et al., 2012). These factors, among others, may have contributed to the differing of outcomes when compared to the present study. The same inconsistencies are seen in the available longitudinal literature focused on multi-level risk factors to general cannabis use (i.e., the literature more focused on initiation and experimentation than problematic cannabis use) (Allen et al., 2012; Bennett, Holloway, & Farrington, 2008). Overall, the literature suggest that the more risk factors an adolescent is exposed to, the more likely they are to use substances and exhibit problematic substance use (Ronel & Levy-Cahana, 2011).

Subsample Analyses

As mentioned above, the pattern of results for the drug exposure in the home*mentorship interaction results were initially perplexing, leading to a more critical consideration of the literature on natural mentorship among Black youth and other youth of color (Hurd, Noelle, Tan, Joseph, & Loeb, 2016; N. M. Hurd et al., 2014). Prior research has produced mixed results with regard to who is most likely to receive natural mentorship; however, some research suggests that youth with parents with greater economic and social advantage (higher parental socioeconomic statutes, parental education, lived in safer neighborhoods, etc.) are more likely to have informal mentors (Schwartz et al., 2013). Regarding the social construct of race, some research suggests that non-Hispanic, Black youth are more likely to have natural mentors (Fergus & Zimmerman, 2005b; Gowdy et al., 2020), while other research has found that non-

Hispanic, White youth are more likely to have natural mentors (McDonald & Lambert, 2014). Social and economic advantage, including neighborhood quality and social capital, may create environments where youth feel safe and supported, and therefore youth may be more likely to obtain and value supportive adult relationships. The downstream effects of historical and current systemic racism may be playing an important role in hindering the acquisition of a natural mentor for some Black youth, thus hampering the potential positive outcomes of that supportive relationship. Despite the potential systemic barriers to minoritized youth accessing natural mentors, prior research focused on Black youth has demonstrated that having a natural mentor was related to significant positive outcomes when exploring substance use and school achievement (Hurd, Noelle et al., 2016; N. M. Hurd et al., 2014; N. Hurd & Zimmerman, 2010b). Taken together, this led us to explore how race as a social construct may be influencing the results of our aims; more specifically, models were re-run separately for White and Black youth.

When restricting the sample to Black youth, mentorship moderated the associations between two adolescent risk factors (peer cannabis use; access to the drugs in the home) and problematic cannabis. Importantly, the pattern of how mentorship changed these associations differed across risk factors. Mentorship emerged a *protective factor* against peer cannabis use. Among *youth who had a natural mentor*, exposure to peer cannabis use during adolescence was related to a *decreased* likelihood of having a lifetime history of problematic cannabis use. On the other hand, among *those who did not have a natural mentor*, exposure to peer cannabis during adolescence was related to an *increased* likelihood of problematic cannabis use. Though some literature suggests that

Black youth are less likely to have a natural mentor (McDonald & Lambert, 2014), our

finding may suggest that the effects of mentorship may be stronger for Black youth given

that that may have had to overcome barriers to be involved with natural mentorship, a

form of social support (Gowdy et al., 2020). There was also a marginally significant

interaction between drugs in the home and mentorship; though the pattern of the direction

of the associations was similar to that found in the overall model, all follow-up analyses

for this interaction when focusing on Black youth were nonsignificant. Again, this pattern

bolstered our hypothesis that there may be other important contextual factors influencing

problematic cannabis use among youth with access to drugs in the home. Mentorship may

not have emerged as a protective factor against drug exposure in the home because of the

abovementioned contextual risk and adolescents' inability to change the circumstances at

home. On the other hand, adolescents do have some power over what peers they associate

with. Though untested to date, mentorship relationships may focus on improving what the

adolescent can control (i.e. friend groups) and less on what seems more nonmodifiable

(i.e. home environment). This hypothesis may be somewhat supported by the fact that the

majority of the outcomes measured in the extant literature on natural mentorship are

focused on peer-level modifiable outcomes (such as exposure to peer risky behaviors

and/or responses to peer risky behaviors) (Zimmerman et al., 2002) and individual-level

modifiable outcomes (such as adolescent substance use, self-esteem, educational

attainment, risky sexual behaviors)(Ahrens, DuBois, Richardson, Fan, & Lozano, 2008;

N. M. Hurd et al., 2014; N. Hurd & Zimmerman, 2010)), and not on family-level

outcomes (such access to drugs in the home, caregiver substance use, parental practices).

Given the well-documented influence of peers on substance use behaviors (Johnson et al., 2018; Von Sydow, 2002), natural mentorship emerging as a buffer for Black adolescents who have peers that use substances is important given the disproportional risk factors they experience throughout development (Marks et al., 2020). According to Spencer's adapted framework of Bronfenbrenner's social ecological model, the Phenomenological Variant of Ecological Systems Theory, communities of color historically have faced additional challenges and vulnerabilities compared to their white counterparts and protective factors, such as social support, help to combat these challenges and risks by giving these communities additional ways to cope (Spencer, Dupree, & Hartmann, 1997). Among Black adolescents who experience increased amounts of stress, social support is as an important predictor of resilience (Spencer et al., 1997). Therefore, promoting natural mentors, and other social support, within Black communities may be a key driver of reducing problematic cannabis use.

Alternatively, among White youth, no significant risk factors and no significant interactions were identified. Importantly, Wave I cannabis use was related to an *increased* likelihood of having a natural mentor (a promotive factor) but *unrelated* to a history of problematic cannabis use, suggesting that earlier cannabis use among these youth only contributed to acquisition of supports. On the contrary, among Black youth, Wave I cannabis use was related to an *increased* likelihood of problematic cannabis use but *unrelated* to having a natural mentor, suggesting that earlier cannabis use among these youth did not translate to more supports. Taken together, these results suggest that the downstream effects of racism and discrimination, including the inequitable access to resources such as mentors and increased exposure to risk factors, may be influencing the

rate of problematic cannabis use among Black people. Additionally, when comparing the models (full sample and subsample models), it appears that mentorship may be more protective for Black youth (who are fortunate enough to it) (Gowdy et al., 2020) relative to White youth, supporting the importance of promoting natural mentorship and social support among racially marginalized youth (Spencer et al., 1997).

This is the first study to longitudinally investigate 1) the main effects of natural mentorship on problematic cannabis use and 2) how natural mentorships moderates multilevel risk factors and problematic cannabis use. Contradictory of our hypotheses, the main effects of mentorship on problematic cannabis use were both nonsignificant and positive across all models (full sample and subsamples), and overall mentorship only demonstrated a protective role against one risk factor for Black youth (peer cannabis use). These results add to the already divisive literature on natural mentorship and substance use outcomes. Some studies have found that natural mentorship is associated with positive substance use outcomes for youth (Zimmerman et al., 2002), while others have found no significant relationship between the two (DuBois & Silverthorn, 2005a). It may be that there may be other factors that are influencing the relationship between natural mentorship and substance use in our study and prior research, such as the quality of the mentoring relationship and the content of what is discussed/provided in the mentor/mentee relationship (Zimmerman et al., 2002). The current study along with past literature has failed to investigate the mentors' stance on substance use. It could be that the mentor is pro-cannabis use, thus modeling and encouraging (directly or indirectly) their mentee to use cannabis. Additionally, most of the empirical investigation focused on how natural mentorship relates to cannabis use have focused on lower risk samples and

outcomes, such as cannabis use initiation or experimentation. The current study utilized a

higher risk sample (history of weekly cannabis use), and explored a riskier more severe

outcome, problematic cannabis use. Taken together, the current study suggests that

natural mentorship may provide some protection against exposure to peer cannabis use

influencing problematic cannabis use for Black youth, and highlights the need for more

nuanced, longitudinal research on how natural mentorship may work independently or

synergistically with other promotive factors to reduce problematic cannabis use.

Limitations and Future Directions

Several study limitations should be considered. Consistent with past literature

(Farmer et al., 2015; Kevorkian et al., 2015), the present study used a lifetime history of

problematic cannabis use as an outcome, thereby hindering the ability to determine the

temporal precedence of mentorship and problematic cannabis use. Given the rates of

problematic cannabis use in children and young adolescents are extremely low

(Haberstick et al., 2014), we believe our methodology is still valid, although using

lifetime history diminishes our ability to fully understand this relationship. Future

research should consider using current diagnosis of problematic cannabis use in order to

establish temporal precedence. Additionally, in accordance with past literature on

problematic cannabis use, there are many other contextual factors that may influence

problematic use that were not explored in this study. Since we found significant patterns

among Black youth but not White youth, future research should continue to explore the

multilevel influences (e.g., systemic racism) of problematic cannabis use to better

understand and inform interventions for problematic use. Additionally, cannabis use is a

highly normative behavior for adolescents and young adults, especially given the recent

uptake in legalization for both medicinal and recreational purposes (Parnes, Smith, & Conner, 2018). It may be that as the political stance and availability of cannabis is changing, the general population's views on use are also changing (Steigerwald et al., 2020). Given the changing climate and the current paucity of data on problematic cannabis use, future research should continue to explore the predictors and effects of *problematic cannabis use,* and disseminate these finding quickly, in order to inform public health policies and programming focused on reducing problematic patterns of cannabis use.

Other study limitations include our inability to identify causal relations between natural mentorship and problematic cannabis use and how the construct of natural mentorship was measured. First, due to the nature in which natural mentorship relationships are established, it is impossible to experimentally manipulate and explore the effects natural mentorship on problematic cannabis use, thus impacting our ability to determine causation. Identification of the casual relations between mentorship and cannabis use is further complicated by the potential role of selection bias, i.e., certain youth are more likely to have natural mentors due to being selected by mentors based on the youth's risk profile (e.g., adverse family conditions, psychosocial challenges) and others are more likely to have the stability and resources to seek out and obtain mentorship. Importantly, marginalized youth may desire natural mentorship, but may experience contextual barriers that influence their ability to obtain a quality natural mentor. The current study's lack of information about the nature and quality of the natural mentorship relationship also impeded our ability to fully understand how natural mentorship relates to problematic cannabis use. Prior literature has documented that the

quality of natural mentorship relationship (e.g., longer relationships, more frequent contact) influences how mentorship relates to positive youth outcomes (DuBois & Silverthorn, 2005a). Although past research suggests that natural mentors mainly have a positive influence on youth development (N. Hurd & Zimmerman, 2010a), we do not have information on the content of the relationship and it is possible that some natural mentors may have directly or indirectly been promoting cannabis use through their actions and/or inaction. By not investigating the mentor's views on cannabis use or the content of their conversations and interactions, we are not able to know if they may have been promoting use. This is especially important given the increase in legalization for medicinal and recreational use across the United States. Future studies should gather more information about the mentor's health habits, their views on cannabis use, and the nature of conversations and interactions with their mentee.

While our findings were not as expected, overall, they suggest that natural mentorship relationships may be beneficial in some contexts against problematic cannabis use, especially for Black individuals; however, future research should continue to explore the promotive effects of mentorship on problematic cannabis use by utilizing longitudinal, multilevel studies. There are likely unmeasured constructs such as family environment and quality of mentorship that may have a greater influence on the development of problematic cannabis use. No single protective factor has been shown to prevent cannabis use or the development of problematic cannabis use; however, consistent with the Phenomenological Variant of Ecological Systems Theory (Spencer et al., 1997) and prior research, the more protective factors youth have in place (e.g. natural mentorship, drug free home, increased parental monitoring), the higher the likelihood that

these promotive factors will buffer the risk trajectory associated with problematic

cannabis use.

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APPENDICES

APPENDIX A: TABLES

Table 1. Baseline Demographics

Table 1. Baseline demographics N=2510

	M (σ^2)	**%**
Wave I Covariates		
Age	15.37 (2.49)	
Sex		
Female	-	42.63%
Race		
White	-	75.52%
Black	-	18.05%
American Indian	-	1.67%
Asian	-	3.9%
Ethnicity		
Hispanic	-	12.57%
Income [a]	46,970 (187,710)	
Wave I endorsed Cannabis use history		46.10%
Wave I Independent Variables		
Neighborhood Poverty [b]	0.16 (0.03)	
Neighborhood Drug Exposure [c]	1.48 (0.40)	
Endorsed access to drugs in the home		5.07%
Peer Cannabis Use [d]	0.90 (1.30)	
Delinquency [e]	6.41 (40.33)	
Wave III Moderator		
Endorsed Natural Mentorship		77.45%
Wave IV Dependent Variable		
Endorsed Lifetime History of Problematic Cannabis Use		45.6%

*Participants for present study included individuals who endorsed a lifetime history of using cannabis at least weekly, including participants who endorsed weekly cannabis use during the

past year (N=2,510). [a] Range: 0-6 (ranging from 0-999 thousand). [b] Range: 0-1 (with higher scores representing a larger proportion of youth living in poverty for the block group). [c] Range: 1-3 (with higher scores indicating greater neighborhood drug problems). [d] Range: 0-3 (ranging from no friends to 3 friends). [e] Range: 0-45 (with higher scores indicating more involvement in delinquent behaviors).

Table 2. Moderator Analysis Predicting Multilevel Effects of a Natural Mentor

Table 2. Moderator Analysis Predicting Multilevel Effects of a Natural Mentor

	Unstandardized Estimate	*SE*	95% CI		*p*	*OR (LL,UL)*
			LL	UL		
Predictors						
Neighborhood Poverty	-.874	.931	-2.700	.951	.348	.417 (.067,2.588)
Neighborhood Drug Exposure [a]	-.213	.206	-.617	.190	.300	.808 (.540,1.209)
Access to illegal drugs in the home [b]	-1.504	.691	-2.859	-.149	.030	.222 (.057,.862)
Peer Cannabis Use [c]	.108	.112	-0.112	.328	.335	1.114 (.894,1.388)
Delinquency	.029	.024	-.018	.076	.222	1.029 (.983,1.078)
Natural Mentoring (NM) [d]	.218	.125	-.027	.463	.081	1.244 (.973,1.589)
NM * Neighborhood Poverty	.899	1.016	-1.092	2.889	.376	2.456 (.336,17.978)
NM* Neighborhood Drug Exposure	.090	.218	-.338	.518	.681	1.094 (.713,1.678)
NM* Illegal drugs in the home	1.564	.756	.083	3.046	.038	4.779 (1.086,21.022)
NM* Peer Cannabis Use	-.165	0.129	-.417	.088	.202	.848 (.659,1.092)
NM* Delinquency	.000	.029	-.057	.057	.995	1.000 (.945,1.059)

Note. Total $N = 2153$. CI = confidence interval; *LL* = lower limit; *UL* = upper limit. Dependent Variable: 0= No Natural Mentor, 1 = Yes Natural Mentor. ML estimator used.

[a] Range: 1-3 (not a problem- a big problem). [b] 0 = No, 1 = Yes. [c] Range: 0-3 (no friends to 3 friends). [d] 0= No, 1= Yes. Continuous variables were grand centered. Control variables in the model included: age, sex, history of cannabis use, income race and ethnicity.

Table 3. Moderator Analysis Predicting Multilevel Effects of a Natural Mentor

Table 3. Moderator Analysis Predicting Multilevel Effects of a Natural Mentor

	Standardized Estimate	SE	95% CI		p
			LL	*UL*	
Predictors					
Neighborhood Poverty [a]	-.083	.088	-.256	.090	.347
Neighborhood Drug Exposure [b]	-.073	.070	-.211	.065	.299
Access to illegal drugs in the home [c]	-.812	.372	-1.541	-.083	.029
Peer Cannabis Use [d]	.066	.068	-.068	.200	.334
Delinquency [e]	.098	.080	-.059	.254	.222
Natural Mentoring (NM)	.049	.028	-.006	.105	.081
NM * Neighborhood Poverty	.074	.083	-.090	.238	.375
NM* Neighborhood Drug Exposure	.027	.065	-.100	.153	.681
NM* Illegal drugs in the home	.844	.407	-.183	.279	.038
NM* Peer Cannabis Use	-.088	.069	-.223	.047	.200
NM* Delinquency	.001	.087	-.171	.172	.995

Note. Total *N* = 2153. CI = confidence interval; *LL* = lower limit; *UL* = upper limit. Dependent Variable: 0= No Natural Mentor, 1 = Yes Natural Mentor. ML estimator used.

[a] Range: 0-1 (with higher scores representing a larger proportion of youth living in poverty for the block group). [b] Range: 1-3 (with higher scores indicating greater neighborhood drug problems). [c] 0 = No, 1 = Yes. [d] Range: 0-3 (ranging from no friends to 3 friends). [e] Range: 0-45 (with higher scores indicating more involvement in delinquent behaviors). Continuous variables were grand centered.

Table 4. Moderator Analysis Predicting Multilevel Effects of a Natural Mentor within Black Participants

Table 4. Moderator Analysis Predicting Multilevel Effects of a Natural Mentor within Black Participants

	Standardized Estimate	*SE*	95% CI		*p*	*OR (LL,UL)*
			LL	*UL*		
Predictors						
Neighborhood Poverty [a]	-.160	.141	-.436	.117	.258	.252 (.023,2.734)
Neighborhood Drug Exposure [b]	-.022	.144	-.305	.261	.881	.940 (.416,2.123)
Access to illegal drugs in the home [c]	-1.108	.600	-2.285	.068	.065	.104 (.009,1.179)
Peer Cannabis Use [d]	.217	.219	-.212	.646	.332	1.448 (.684,3.063)
Delinquency [e]	-.119	.234	-.577	.340	.612	.958(.809,1.134)
Natural Mentoring (NM)	.112	.083	-.051	.274	.177	1.695 (.771,3.728)
NM * Neighborhood Poverty	.090	.158	-.220	.400	.586	2.410 (.118,49.239)
NM* Neighborhood Drug Exposure	-.014	.145	-.298	.269	.920	.952(.362,2.501)
NM* Illegal drugs in the home	1.290	.660	-.004	2.584	.051	14.022 (.964,203.934)
NM* Peer Cannabis Use	-407	.213	-.825	.011	.056	.439 (.179,1.076)
NM* Delinquency	.093	.228	-.354	.539	.684	1.043 (.850,1.279)

Note. Total *N* = 367. CI = confidence interval; *LL* = lower limit; *UL* = upper limit. Dependent Variable: 0= No Natural Mentor, 1 = Yes Natural Mentor. ML estimator used.

[a] Range: 0-1 (with higher scores representing a larger proportion of youth living in poverty for the block group). [b] Range: 1-3 (with higher scores indicating greater neighborhood drug problems). [c] 0 = No, 1 = Yes. [d] Range: 0-3 (ranging from no friends to 3 friends). [e] Range: 0-45 (with higher scores indicating more involvement in delinquent behaviors). Continuous variables were grand centered.

Table 5. Moderator Analysis Predicting Multilevel Effects of a Natural Mentor within White Participants

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	Standardized Estimate	*SE*	95% CI		*p*	OR (LL,UL)
			LL	*UL*		
Predictors						
Neighborhood Poverty [a]	-.049	.099	-.243	.145	.621	.553 (.053,5.789)
Neighborhood Drug Exposure [b]	-.100	.076	-.249	.048	.186	.741 (.474,1.157)
Access to illegal drugs in the home [c]	-.678	.426	-1.513	.157	.111	.286 (.061,1.339)
Peer Cannabis Use [d]	.031	.082	-.130	.192	.708	1.052 (.807,1.371)
Delinquency [e]	.156	.087	-.014	.327	.073	1.047 (.996,1.102)
Natural Mentoring (NM)	.039	.031	-.021	.099	.207	1.187 (.909,1.550)
NM * Neighborhood Poverty	.050	.094	-.133	.233	.593	2.004 (.156,25.749)
NM* Neighborhood Drug Exposure	.048	.070	-.089	.184	.492	1.178(.738,1.881)
NM* Illegal drugs in the home	.677	.463	-.230	1.585	.144	3.494 (.652,18.717)
NM* Peer Cannabis Use	-.030	.079	-.185	.126	.708	.946 (.708,1.264)
NM* Delinquency	-.047	.098	-.240	.145	.630	.984 (.924,1.049)

Note. Total $N = 1654$. CI = confidence interval; *LL* = lower limit; *UL* = upper limit. Dependent Variable: 0= No Natural Mentor, 1 = Yes Natural Mentor. ML estimator used.

[a] Range: 0-1 (with higher scores representing a larger proportion of youth living in poverty for the block group). [b] Range: 1-3 (with higher scores indicating greater neighborhood drug problems). [c] 0 = No, 1 = Yes. [d] Range: 0-3 (ranging from no friends to 3 friends). [e] Range: 0-45 (with higher scores indicating more involvement in delinquent behaviors). Continuous variables were grand centered.

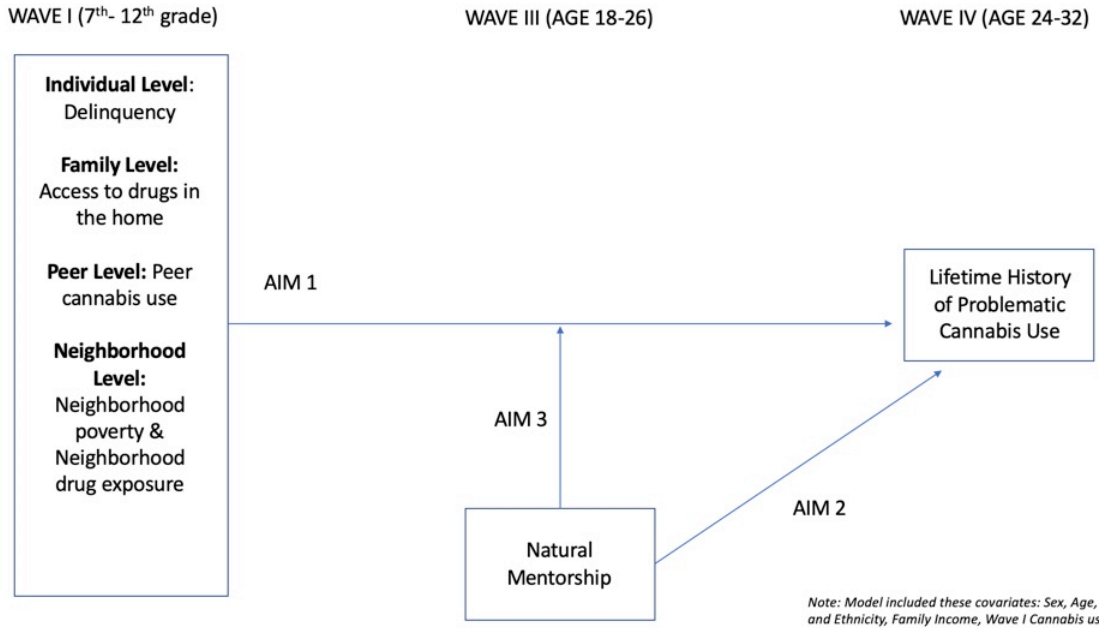Figure 1. Study Model and Aims

Study Model and Aims.

WAVE I (7th- 12th grade)   WAVE III (AGE 18-26)   WAVE IV (AGE 24-32)

Individual Level: Delinquency

Family Level: Access to drugs in the home

Peer Level: Peer cannabis use

Neighborhood Level: Neighborhood poverty & Neighborhood drug exposure

AIM 1

AIM 3

AIM 2

Natural Mentorship

Lifetime History of Problematic Cannabis Use

Note: Model included these covariates: Sex, Age, Race and Ethnicity, Family Income, Wave I Cannabis use.
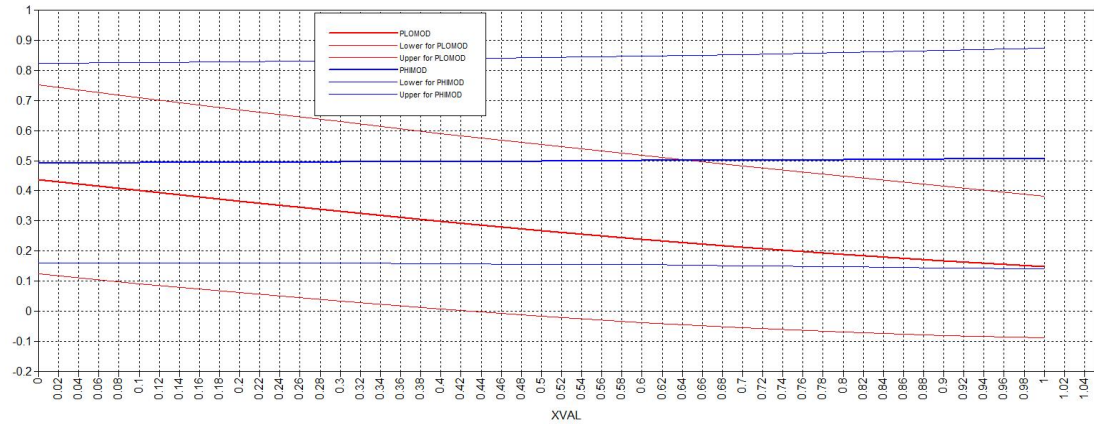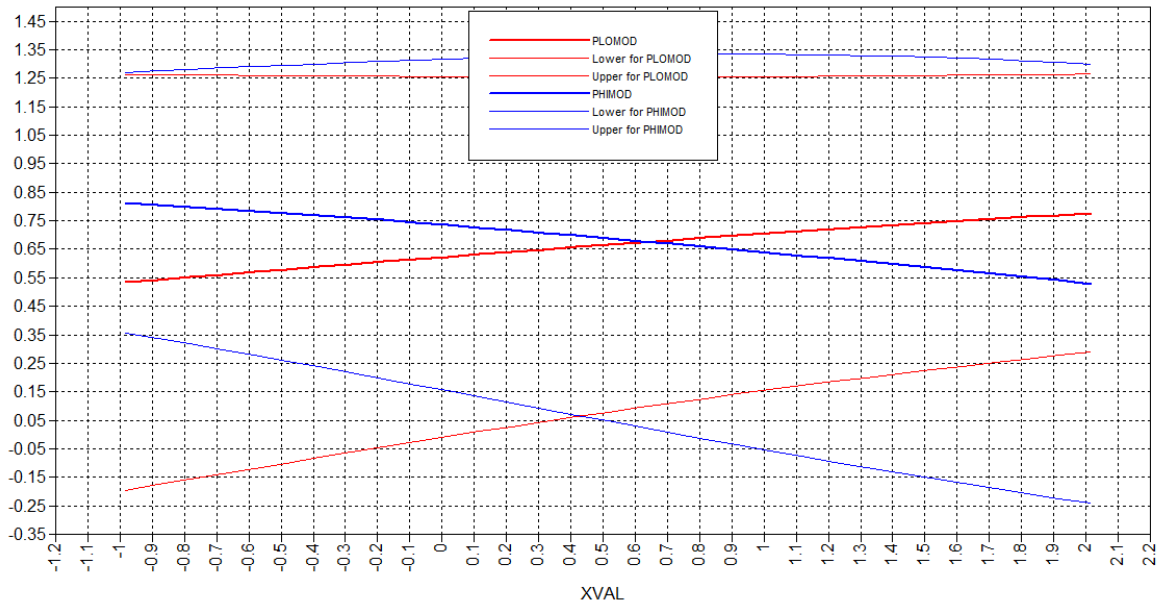
Figure 2. The moderating role of natural mentorship on the association between having access to drugs in the home and lifetime history of problematic cannabis use among the full sample.
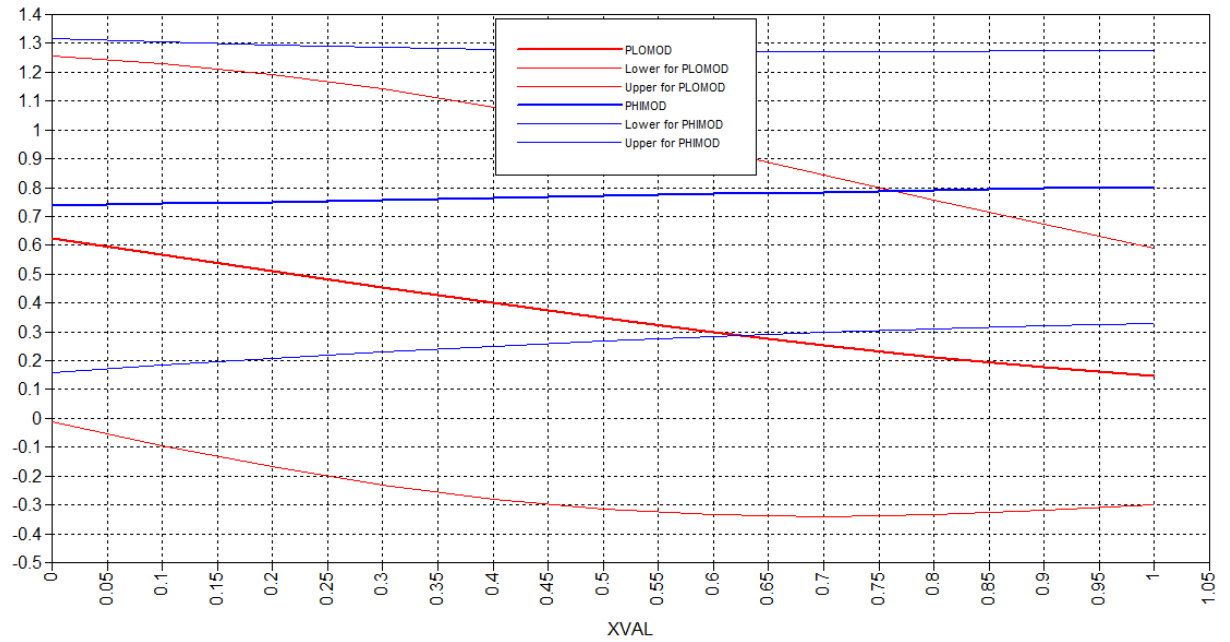

Note. XVAL: Drugs in the home originally coded (0= no drugs in the home, 1= drugs in the home). Y-axis: likelihood of having a lifetime history of problematic cannabis use.

Figure 3. The moderating role of natural mentorship on the association between having peers that use cannabis and lifetime history of problematic cannabis use among Black subsample.

Note. XVAL: Peer cannabis use originally coded Range: 0-3 (ranging from no friends to 3 friends). Y-axis: likelihood of having a lifetime history of problematic cannabis use.

Figure 4. The moderating role of natural mentorship on the association between having access to drugs in the home and lifetime history of problematic cannabis use among Black subsample.

Note. XVAL: Drugs in the home originally coded (0= no drugs in the home, 1= drugs in the home). Y-axis: likelihood of having a lifetime history of problematic cannabis use.

VITA

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