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Examining Substance Use from Adolescence to Young Adulthood and the Impact of COVID-19

DISSERTATION

submitted in partial satisfaction of the requirements
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DOCTOR OF PHILOSOPHY

in Psychological Science

by

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ABSTRACT OF THE DISSERTATION

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Adolescent and young adult substance use is associated with a wide range of poor mental and physical health outcomes and continues to be an area of substantial public health concern. Substance use has been linked to higher rates of long-term substance abuse and dependence, worse academic and occupational outcomes, impaired cognitive function, poorer physical and mental health, and greater criminal behavior. Therefore, the goal of this two-part dissertation was to better understand the risk and protective factors linked to substance use among adolescents and young adults. Employing a combined sample of 2,386 justice-system-involved youth from the longitudinal Pathways to Desistance and Crossroads studies, Study One examined the associations between a broad range of risk and protective factors and within-person changes in substance use from adolescence through young adulthood, whether any links between predictors and substance use were asymmetric, and whether associations varied by age. The results indicate that offending and peer substance use were the factors more strongly related to different types of substance use. While most predictors did not have asymmetric effects, offending was asymmetrically associated with alcohol use and future expectations were asymmetrically related to marijuana use. Further, decreased offending was more strongly related to lower rates of alcohol use in young adulthood than in adolescence, while having more positive future

expectations was related to decreases in marijuana use throughout adolescence and young adulthood. Study Two identified whether the COVID-19 pandemic was related to changes in substance use and whether depressive symptoms, anxiety symptoms, sensation seeking, future expectations, and motivation to succeed moderated those changes. Findings show that alcohol and marijuana use increased during the COVID-19 pandemic and sensation seeking and future expectations moderated the increases in alcohol use, while depressive symptoms, anxiety symptoms, and sensation seeking moderated the increases in marijuana use. Overall, the results from Study One suggest that intervention and treatment efforts should focus on reducing criminal behavior and discouraging friendships with substance-using peers to help youth reduce or desist from using substances. Reducing offending during young adulthood in particular may be effective in discouraging problematic alcohol use. The results from Study Two highlight the importance of providing mental health services, helping high sensation seeking youth find healthy outlets, and providing resources to encourage more optimistic expectations of life after the pandemic to reduce costly iatrogenic effects such as problematic substance use that could have lasting impacts on youth long after the pandemic is over.

INTRODUCTION

Adolescent and young adult substance use is associated with a wide range of poor mental and physical health outcomes and continues to be an area of substantial public health concern (Otten et al., 2017; Zhang et al., 2021). Although tobacco and alcohol use among youth have decreased over the past two decades, marijuana use has increased and become less stigmatized while non-marijuana illicit drug use has remained fairly stable (Hughes et al., 2015; Rudy et al., 2021; SAMHSA, 2020).

Problematically, adolescents and young adults exhibit higher rates of substance use than any other age group (SAMHSA, 2014; Sussman et al., 2008). In addition, substance use during adolescence and young adulthood has been linked to higher rates of long-term substance abuse and dependence, worse academic and occupational outcomes, impaired cognitive function, poorer physical and mental health, and greater criminal behavior (Bava & Tapert, 2010; Brière et al., 2014; Degenhardt & Hall, 2012; King & Chassin, 2007; Volkow et al., 2014). The societal consequences of adolescent and young adult substance use can also be clearly seen through the mortality rates among young substance users and enormous financial costs (Brady & Li, 2014; WHO, 2019). While illicit drug use in particular claims tens of thousands of lives and contributes to billions of dollars in societal costs each year (Normile et al., 2018), tobacco, alcohol, and marijuana use have also been linked to negative consequences such as diminished mental health, sexually transmitted infections, violence victimization and perpetration, and school dropout (Cooper, 2002; Gidycz et al., 2007; Green et al., 2017; Mathers et al., 2006).

It is therefore critical to identify the factors that put youth at greater risk of substance use. Importantly, most existing research focuses on identifying between-group differences in substance use; that is, why some individuals use substances while others do not. However, few

studies have assessed the risk and protective factors linked to within-individual changes in substance use over time, where they determine what contributes to why someone uses substances in one year but not another. Additionally, prior work has not considered the potential asymmetric associations between those factors and substance use (Allison, 2019). That is, most studies have assumed that the effect of a particular risk factor on substance use equals the opposite effect of removing the risk factor. However, for most (if not all) real world phenomena, this is not the case. The factors that lead an individual to use substances might not be the same factors that lead them to desist from using them. Further, studies examining whether the predictors of substance use vary by age are scarce, which could help to identify when certain predictors are most closely linked to substance use throughout development. Determining which factors are related to changes in youths' substance use behaviors, whether the effects are asymmetric, and how predictive effects vary by age could provide critical information towards substance use prevention and reduction efforts.

To contribute to this important line of research, this dissertation examined how a broad range of risk and protective factors are associated with within-person changes in substance use among justice-system-involved adolescents and young adults. Study One employed a sample of 2,386 male youth drawn from two studies, the Pathways to Desistance Study and the Crossroads Study. The Pathways to Desistance Study followed a sample of adolescent males who committed a serious felony offense over a seven-year period, while the Crossroads Study is an ongoing study of adolescent males who were arrested for a misdemeanor for the first time, now in its ninth year of data collection. Study One comprised three parts. Part one identified which factors in youths' lives were most predictive of within-individual changes in substance use (including tobacco, alcohol, marijuana, sedatives/tranquilizers, stimulants/amphetamines, cocaine, opiates,

ecstasy, hallucinogens, and other drugs) over time. Part two determined whether the associations between the significant within-individual change predictors and youths' substance use behaviors were asymmetric. In part three, age moderations were conducted to assess whether the effect of significant asymmetric predictors on substance use varied across adolescence and young adulthood.

In addition to risk and protective factors that may be associated with youths' changes in substance use behaviors over time, the ongoing COVID-19 pandemic might have unique impacts on young adults' substance use behaviors. Beyond the direct physical health impacts resulting from the virus, the global pandemic has caused disruptions to daily life including work, school, and interpersonal relationships, which may contribute to increases in psychological distress and substance use (De Goeij et al., 2015; Foa et al., 2006; Maeda & Oe, 2017; Parslow & Jorm, 2006). Therefore, using data from the Crossroads Study, Study Two examined how the COVID-19 pandemic has impacted youths' substance use behaviors. First, this study identified changes in youths' use of cigarettes, alcohol, marijuana, and other illicit drugs from before versus during the pandemic. Then, the study determined whether COVID-19's impact on substance use might depend on moderating risk factors such as youths' depressive symptoms, anxiety symptoms, and sensation seeking levels, as well as protective factors such as future expectations and motivation to succeed. Findings from Study Two could provide a better understanding of how and for whom substance use behaviors may shift as a result of the devastating events and disruptions to daily life brought by the COVID-19 pandemic.

STUDY ONE

Research Rationale

Bronfenbrenner's social ecological model of human development suggests that individuals' behaviors are influenced by the interactions between their own individual characteristics and the contexts that surround them (Bronfenbrenner, 1979). Indeed, past empirical literature has identified a variety of individual characteristics (e.g., future expectations, impulse control, resistance to peer influence), legal factors (e.g., criminal offending, arrest, probation), social factors (e.g., peer substance use, gang involvement, romantic relationships), contextual factors (e.g., neighborhood disorder, exposure to violence, homelessness), and educational/occupational factors (e.g., school enrollment, employment) that are associated with adolescent and young adult substance use (Oesterle et al., 2012; Stone et al., 2012; Trucco, 2020).

Importantly, these factors not only differentiate between youth who use substances and those who do not use (Oesterle et al., 2012; Stone et al., 2012), but might also be associated with changes in an individual's substance use behaviors over time and across development (Stone et al., 2012). Identifying what contributes to increases in substance use at certain times, or the protective factors that may be linked to decreases in substance use at other times, could inform the goals of treatment and intervention efforts to reduce youths' substance use behaviors. However, prior research that has examined predictors of within-person changes in substance use have focused on only one predictor or a small set of predictors. They have not been able to compare a comprehensive set of predictors and identify the factors that are the most strongly associated with changes in substance use over time. Below, existing literature on risk and protective factors linked to substance use during adolescence and young adulthood is discussed.

In instances where there were no studies employing within-person analytic methods, studies investigating predictors of between-individual differences in substance use are discussed.

Predictors of Changes in Substance Use

Individual Factors

Future Expectations. Future expectations are key tenets of prominent developmental and criminological theories, such as life-course (Elder Jr, 1998; Laub & Sampson, 1993) and social control theories (Hirschi, 1969), where more positive future expectations tend to be associated with more positive outcomes and reduced antisocial behavior. Indeed, adolescents' expectations of future work, education, and family prospects are associated with substance use behaviors (Knight et al., 2017; Prince et al., 2019). In a between-person analysis, McDade and colleagues (2011) found that adolescents who had more positive expectations of attending college and living to age 35 smoked fewer cigarettes as young adults. Similarly, results from a study examining the association between baseline future expectations and substance use three years later showed that more negative future expectations were linked to higher rates of all types of substance use including tobacco, alcohol, marijuana, and other illicit drug use (Traube et al., 2012). Yet, in a within-individual examination of the relation between academic expectations and binge drinking, Patte, Qian, and Leatherdale (2017) found that when high school students had greater expectations of obtaining a higher educational degree, they tended to engage in more frequent binge drinking. However, there are no studies that have examined the within-person associations between career, relationship, or family expectations and substance use.

Impulse control. Research suggests that poor impulse control is associated with adolescent and young adult problem behaviors, including substance use (Cooper et al., 2003; Gottfredson & Hirschi, 1990; Stone et al., 2012). Specifically, a study of young adults looking at

within-person associations found that when youth had poorer impulse control, they were more likely to engage in hazardous alcohol use (Watkins et al., 2015). Impulse control was also found to be related to the within-individual onset and change in frequency of adolescent substance use including marijuana and alcohol use (Morin et al., 2019).

Resistance to peer influence. Given the importance of peer relationships and the influence of peers in the lives of adolescents and young adults (Barnes et al., 2006; Urberg et al., 2003), the ability to resist peer influence throughout a youth's life is likely to be related to their changes in substance use over time. Most prior work employing within-individual analytic techniques have examined whether youths' associations with antisocial peers are linked within-person increases in substance use (Childs et al., 2010; Mak et al., 2020; Prins et al., 2021), finding that deviant peer influence is associated with increases in substance use. In the only study that has examined the within-person link between susceptibility to peer influence and substance use, Duell, Clayton, Telzer, and Prinstein (2020) found that greater peer influence susceptibility was associated with greater self-reported alcohol use.

Legal Factors

Offending. Previous research has also found strong associations between offending and substance use (Elliott et al., 2012; Gottfredson & Hirschi, 1994; Mulvey et al., 2010). According to problem behavior theory (Jessor & Jessor, 1977), substance use and crime often co-occur because they are both symptoms of a general tendency for engaging in antisocial behavior. In line with this theory, a variety of studies on adolescents and young adults have found reciprocal relations and high comorbidity between the two behaviors (**Error! Hyperlink reference not valid.**; DeLisi et al., 2015; Mason & Windle, 2002; Sullivan & Hamilton, 2007). Indeed, studies using within-person models have found different types of crime (e.g., drug dealing, property crime, and

violence) to be related to greater substance use (Boden et al., 2013; Fergusson & Horwood, 2000; Horney et al., 1995; Uggen & Thompson, 2003).

Arrest. Beyond engaging in criminal behavior, getting caught for one's crime might be uniquely associated with substance use given prior work demonstrating the links between justice-system involvement and higher rates of use (Chassin, 2008; Green et al., 2019). Most prior work has focused on between-person links between arrest and substance use, finding that youth who are arrested are more likely to use substances (Link & Hamilton, 2017; Tolou-Shams et al., 2007). Within-person examinations of the arrest and substance use relationship are limited. In the only study to date using individual fixed effects regression models to assess the relation between arrest and substance use, Powell (2022) found that being arrested was linked to increases in alcohol and drug use among a national sample of youth.

Probation. After youth are arrested and convicted of a crime, they may face consequences such as being on probation. While many assume that increased supervision while youth are on probation would decrease substance use, existing literature suggests that youth who are on probation actually tend to engage in higher rates of alcohol and marijuana use (Donenberg et al., 2015; Udell et al., 2017). Unfortunately, however, no studies to date have examined how changes in probation status might be related to within-individual shifts in substance use behavior among adolescents and young adults. It will thus be interesting to assess how being on probation or getting off probation might be associated with changes in substance use over time.

Social Factors

Peer substance use. Youth increase time spent with their peers throughout adolescence and into young adulthood (Lam et al., 2014) and are more likely to engage in activities that their friends are involved in. Indeed, peer cluster (Oetting & Beauvais, 1986), socialization (Oetting &

Donnermeyer, 1998), and interactional (Thornberry, 1987) theories suggest that adolescent friendships can have strong influences on behavior development. While prosocial friendships can protect youth from risk taking and unhealthy behaviors, associating with and being influenced by deviant peers can have the opposite effect (Elliott et al., 1985; Forman-Alberti, 2017; Monahan et al., 2009). In particular, spending time with substance-using friends or peer groups has been linked to an adolescent's own substance use initiation and frequency (Hussong, 2002; Simons-Morton, 2007). Within-person studies of the relation between peer substance use and youths' own substance use have found that when their friends used alcohol, youths' own alcohol use tended to increase (Henry et al., 2009) and that adolescents' alcohol and marijuana use increased in the year after they spent time with friends who engaged in those behaviors (Beardslee et al., 2018).

Gang involvement. While some youth associate with deviant peers, most are not affiliated with gangs. However, among those who are members of a gang, gang involvement is associated with a host of negative outcomes such as higher rates of serious and violent offending, being victims of violence, as well as substance misuse (Hill et al., 2001; Huff, 1998; Peterson et al., 2004). Although youth who join gangs are more likely to be delinquent prior to entering the gang than non-gang-affiliated youth, there is evidence that antisocial behaviors tend to increase when youth are members of a gang (Gordon et al., 2004). Gang-involved adolescents were found to have 2.58 greater odds of substance use (Harris et al., 2013). Young adults who were members of gangs were also more likely than non-gang-involved violent and non-violent young men to exhibit alcohol dependence and drug dependence (Coid et al., 2013). In addition to between-person differences in antisocial behavior, gang involvement has been linked to within-individual changes in offending over time. In a meta-analysis, Pyrooz, Turanovic, Decker, & Wu (2016)

found that gang membership is consistently associated with within-person increases in offending. Luckily, gang membership is typically short-lived, lasting approximately one year (Weerman et al., 2015). However, while some studies have found associations between gang desistance and reduced delinquent peer association, increased impulse control, and increased aggression control (Sweeten et al., 2013), leaving a gang does not necessarily reverse delinquent behaviors (Melde & Esbensen, 2014), suggesting that the impacts of gang involvement on substance use may be enduring.

Serious romantic relationships. Beyond the negative social influences that could put youth at risk for substance use, in their theory of informal social control, Sampson and Laub (1995) posit that positive social contexts such as being in a serious romantic relationship can reduce risk taking through strengthening an individual's conformity to society. Indeed, research has found that serious romantic relationships, whether within and outside the context of marriage, are linked to lower rates of substance use (Angulski et al., 2018; Bachman et al., 2014). There are several studies that have used within-individuals techniques to examine the association between romantic relationships and substance use. Using fixed effects models, Thompson and Petrovic (2009) found that getting married reduced the likelihood that men engaged in non-marijuana illicit drug use. On the other hand, dissolution of romantic relationships has been linked to increases in cigarette smoking, heavy drinking, marijuana use, and cocaine use (Fleming et al., 2010; Larson & Sweeten, 2012).

Contextual Factors

Neighborhood disorder. Another important contextual risk factor for youth substance use is the level of disorder in their neighborhoods (Jang & Johnson, 2001; Shaw & McKay, 1942). Indeed, neighborhood disorder has been linked to between-person differences in substance use

onset (Burlew et al., 2009) and specifically to differences in non-marijuana illicit drug use (e.g., injection drugs, crack cocaine). Importantly, however, youth may not always live in the same neighborhood throughout adolescence and young adulthood, and neighborhood conditions are not necessarily fixed. Yet, there are no existing studies that have examined how changes in the conditions of a youth's neighborhood may be related to changes in their substance use behavior over time. Given the consensus among prior work that youth who live in more disordered neighborhoods are more likely to use substances than youth living in better neighborhood conditions, it will be important to assess how changes in neighborhood disorder may be associated with within-person changes in youth substance use.

Exposure to violence. Related to neighborhood disorder is exposure to violence, which prior research has also found to be linked to higher rates of substance use (Begle et al., 2011; Fagan, 2003). Studies of within-person associations between violence exposure and substance use have found that exposure to violence during adolescence increased youths' alcohol and marijuana use frequency three years later (Wright et al., 2013). In another study that examined within-person associations between violence exposure and past month marijuana and alcohol use from ages 14-23, Goldstick et al. (2019) found that when youth witnessed violence, they were more likely to increase in their marijuana and alcohol use and the strength of the associations varied by age. Specifically, the positive association between witnessing violence and alcohol use increased steadily from ages 14 to 23, while the association between witnessing violence and marijuana use peaked around age 18 (Goldstick et al., 2019).

Homelessness. Another contextual factor that can negatively impact youth development is homelessness (Stablein & Appleton, 2013). Unfortunately, approximately 5% of adolescents and young adults in the U.S. are homeless each year (Heerde et al., 2020; Morton et al., 2018),

and being homeless puts youth at greater risk of substance use and misuse (Davies & Allen, 2017; Folsom et al., 2005; Tompsett et al., 2013). Importantly, within-person investigations of this relation have found that, during episodes of homelessness, youth are more likely to use alcohol or drugs and that homelessness also predicts increases in substance use three months later (Davis et al., 2019). However, in a study by McVicar, Moschion, & Van Ours (2015), scholars found that while there were between-person differences in substance use based on whether youth experienced homelessness, there were no significant within-person associations between homelessness and alcohol or drug use.

Educational/Occupational Factors

School Enrollment. Key theoretical frameworks such as the social development model (Catalano & Hawkins, 1996) and social control theory (Hirschi, 1969) emphasize the importance of bonds to conventional institutions such as schools in reducing rates of antisocial behavior including substance use. Given that school is one of the most important social institutions for adolescents and young adults, enrollment in school may be associated with substance use behaviors (Hirschi, 1969). By attending school, youth may be more likely to conform to the school's values which tend to promote positive development and discourage substance use. Indeed, previous work has found strong links between attending school and reduced substance use (Edlund et al., 2015; Henry & Thornberry, 2010; Schepis et al., 2018). Given these associations found in existing literature, enrollment in school is likely to be related to youths' substance use behaviors.

Employment. As adolescents move into young adulthood, many are entering new adult roles such as finding jobs and gainful employment. Laub and Sampson (1993)'s age-graded social control theory and Yamaguchi and Kandel (1985)'s role socialization theory also

emphasize the importance of work in young adults' lives as it facilitates socialization and deters antisocial behavior. Indeed, research has found that youth who are unemployed tend to engage in greater rates of heavy episodic drinking, cigarette use, and illicit drug use (Henkel, 2011; Lee et al., 2015). In a study using fixed-effects regression analysis to examine whether employment is associated with within-person changes in substance use, Fergusson et al. (2014) found that unemployment was significantly related to alcohol misuse/dependence but was not significantly linked to illicit substance use/dependence. However, Popovici and French (2014) did not find a significant within-person association between employment and marijuana use.

The Present Study

Although previous studies have assessed how different risk and protective factors are associated with a greater likelihood of adolescent and young adult substance use, few have assessed a broad set of risk and protective factors together using a within-person framework. This study examined a comprehensive set of predictors and their within-person associations in youths' substance use over time. Examining all factors together is important to better understanding and identifying the factors that are the most strongly related to youths' substance use behaviors over and above other factors. Further, utilizing within-individual change models also provides a stronger assessment of causal associations between the predictors and changes in substance use behaviors by essentially treating each individual as their own control group and accounting for any non-measured between-individual variations. Results of this study directly inform treatment and intervention efforts as to why a youth uses substances in some years but not others.

This study also specifically tested whether factors that are significantly related to within-person changes in substance use have asymmetric effects, which identifies whether the addition

of a risk factor leads to an increase in substance use that is equivalent to the decrease in substance use upon removal of that risk factor. As an example, the presence of deviant peers may be associated with youth being twice as likely to use substances. However, the absence of those deviant peers might not be linked to youth now being half as likely to engage in substance use. As such, this study specifically tested for asymmetric effects among predictors of within-individual changes in substance use.

The present study also examined different types of non-marijuana illicit drug use, which is rare in existing literature, largely due to low base rates and difficulty in following illicit drug users consistently over time. Most studies have combined different types of illicit drugs into one group. While some studies have examined predictors of ecstasy (Meikle et al., 2020), cocaine (Lee et al., 2018), or opioid (Tucker et al., 2020) use specifically, they did not assess any other types of illicit drugs. By assessing within-individual changes in youths' use of sedatives/tranquilizers, stimulants/amphetamines, cocaine, opiates, ecstasy, hallucinogens, and other drugs (inhalants, amyl nitrite/odorizers/rush, non-medical use of prescription medication), while also examining tobacco, alcohol, and marijuana use, this study not only compared how predictors may be related to different types of substance use, but also accounted for co-occurring other substance use in each analytic model.

Lastly, this study's longitudinal design spanning adolescence through early young adulthood allowed for an examination of whether the associations between the predictors and changes in substance use differ by age. Understanding whether risk and protective factors are more closely associated with substance use during certain developmental periods helps policymakers and treatment providers identify sensitive periods during which intervention and treatment might be most critical or most effective.

Aims and Hypotheses

This study examined the risk and protective factors that are associated with within-person changes in tobacco, alcohol, marijuana, and other illicit drug use. The first aim was to identify the risk and protective factors that were most strongly associated with within-individual changes in youths' use of tobacco, alcohol, marijuana, sedatives/tranquilizers, stimulants/amphetamines, cocaine, opiates, ecstasy, hallucinogens, and other drugs (e.g., inhalants, amyl nitrite/odorizers/rush, non-medical use of prescription medication) over time. I hypothesized that impulse control, offending, peer substance use, and exposure to violence would be the strongest predictors of substance use.

The second aim was to determine whether any of the significant associations were asymmetric. I hypothesized that future expectations and exposure to violence would have asymmetric associations with substance use. Specifically, having more positive future expectations might motivate youth to refrain from substance use (Elder Jr, 1998; Hirschi, 1969; Laub & Sampson, 1993; McDade et al., 2011). However, not having positive future expectations or having more negative expectations may not put youth at higher risk of substance use given that these perceptions of the future may be realistic if youth are facing tangible disadvantages. Next, being exposed to violence might be linked to increases in substance use among youth (Goldstick et al., 2019). Yet, youth may keep using substances even in times when they do not experience violence exposure if they use substances as a means of coping with lasting psychological distress from the traumatic experience. As such, decreased exposure to violence may be not as strongly associated with substance use as increases in violence exposure.

The third and final aim for Study One was to determine whether the effects of significant asymmetric predictors of within-person changes in substance use varied by age. First, I

hypothesized that the relation between future expectations (positive or negative) and substance use would be stronger in young adulthood than in adolescence. Future expectations in young adulthood (when reaching academic goals, having a job, and being in a good romantic relationship become more salient and important than earlier in adolescence) are likely to be more strongly associated with changes in youths' substance use behaviors. Next, in line with prior research, I hypothesized that the link between greater exposure to violence and increased substance use is likely to be stronger in young adulthood than in adolescence (Goldstick et al., 2019). Exposure to violence may become a more important predictor of substance use during young adulthood as predictors that were more prominent during adolescence (e.g., impulse control, peer influences) dissipate as youth age.

Method

Data were be drawn from two longitudinal studies, the Pathways to Desistance Study and the Crossroads Study (see Table 1.1 for descriptive information about both studies, see Table 1.2 for descriptive information about study variables).

Pathways to Desistance Study

Participants. The Pathways to Desistance Study surveyed 1,170 male adolescents (aged 14-18 at baseline) who had committed serious felony level offenses and were adjudicated in Philadelphia County, Pennsylvania ($N = 605$) and Maricopa County, Arizona ($N = 565$). See Mulvey (2004) and Schubert et al. (2004) for full details of sample description and study methodology. Serious offenses that made youth eligible for study participation included violent crimes against persons (e.g., assault, robbery, rape, murder), property crimes (e.g., receiving stolen property, burglary, arson), weapons offenses, and misdemeanor sex crimes. Participants were approached for their first interview approximately 37 days after adjudication or

decertification hearing, biannually for 3 years, and then annually 4, 5, 6, and 7 years after baseline. The sample comprised of predominantly youth of color, with 42.1% identifying as Black, 34.0% as Latino, 19.2% as White, and 4.6% as a self-identified other race.

Procedures. The Institutional Review Board (IRB) at the participating universities approved the Pathways to Desistance study procedures. Names of eligible adolescents, based on age and offense charge, were obtained from the juvenile court in each locale. Signed parental consent and youth assent were obtained for all participants prior to conducting interviews. Participants were informed of the nature of the study and that participation was voluntary. Face-to-face interviews were conducted by a trained interviewer using a secure, computer-administered program at the youth's home, a mutually agreed-upon location in the community, or in a facility if the youth was incarcerated. Interviews typically lasted for 2 hours. Participants' identities and responses were protected and kept confidential, and participants were notified that a Privacy Certificate from the U.S. Department of Justice prohibited disclosure of any identifiable information to anyone outside of the research team.

Crossroads Study

Participants. The Crossroads Study is an ongoing longitudinal study that examines the effects of juvenile justice system contact on a sample of 1,216 male adolescents who were arrested for the first time for a range of moderate- to low-level offenses (e.g., theft, vandalism). Youth were aged 13-17 years at the time of first arrest and were recruited from three locales: Orange County, California ($N = 532$); Philadelphia County, Pennsylvania ($N = 533$); and Jefferson Parish, Louisiana ($N = 151$). Participants were interviewed six weeks after their first arrest, biannually for the next three years, annually 4 and 5 years after baseline, and then once every two years 7 and 9 years after baseline. Data collection for the 9-year interview is still

ongoing. For the purposes of this study, only data from baseline to the 5-year follow-up were used in order to match the recall periods of the Pathways to Desistance Study. The sample is ethnically diverse, 36.9% identifying as Black, 45.8% as Latino, 14.8% as White, and 2.5% as a self-identified other race. The geographic and racial/ethnic diversity of the current sample increased the generalizability of our findings to the broader population of justice-system-involved male youth.

Procedures. The Institutional Review Board (IRB) at the three participating universities approved all Crossroads Study procedures. Contact information and names of eligible adolescents, based on age and initial offense charge, were obtained from the Department of Probation at each study site. Prior to conducting interviews, signed parental consent and youth assent were obtained from all participants. Participants were informed of the nature of the study and that participation was fully voluntary with no penalty for not participating. Face-to-face interviews lasting 2-3 hours were conducted by trained research assistants using a secure, computer-administered program. Interviews took place at the youth's home, a mutually agreed-upon location in the community, or in a facility if the youth was incarcerated. Participants' identities and responses are protected from subpoenas, court orders, or any other type of involuntary disclosure by a Privacy Certificate from the Department of Justice.

Table 1.1.
Comparison of Study Characteristics Between the Pathways to Desistance and Crossroads Studies

	Pathways to Desistance	**Crossroads**
Study Sites	Maricopa County, AZ Philadelphia County, PA	Orange County, CA Philadelphia County, PA Jefferson Parish, LA
Interview Schedule and Retention		
Baseline	1,170	1,216
0.5-year follow-up	1,094 (94%)	1,161 (95%)

1-year follow-up	1,087 (93%)	1,141 (94%)
1.5-year follow-up	1,058 (90%)	1,141 (94%)
2-year follow-up	1,061 (91%)	1,132 (93%)
2.5-year follow-up	1,061 (91%)	1,124 (92%)
3-year follow-up	1,056 (90%)	1,107 (91%)
4-year follow-up	1,042 (89%)	1,054 (87%)
5-year follow-up	1,031 (88%)	1,027 (84%)
Participants' Ages at Baseline	Mean = 16.6 Range = 14-19	Mean = 15.3 Range = 13-17
Participants' Race		
White	19.23%	14.80%
Black	42.14%	36.92%
Latino	34.02%	45.81%
Other	4.62%	2.47%

Measures

Data for the current study was drawn from two sources, Pathways to Desistance and the Crossroads studies, and the measures described below are identical across the two studies. Only variables that were measured in an identical manner between the two studies was able to be included in the present analyses. Any variables that differed in the way they were measured between the two studies was unable to be included in the analyses.

Key Outcome Variable

Substance Use. Using the Substance Use/Abuse Inventory (Chassin et al., 1991), participants were asked to self-report on the frequency with which they engaged in thirteen different types of substance use during each recall period: tobacco, alcohol, binge drinking (five or more alcoholic drinks), marijuana, sedatives/tranquilizers, stimulants/amphetamines, cocaine, opiates, ecstasy, hallucinogens, inhalants, amyl nitrite/odorizers/rush, and any other drugs not listed (inhalants, amyl nitrite/odorizers/rush, non-medical use of prescription medication). Responses were 0 (did not use at all) or 1 (used substance during recall period).

Individual Factor Predictors

Future Expectations. At each interview, participants self-reported their expectations of achieving goals related to work, education, family, and law-abiding behavior. Participants were asked seven items that were adapted from Elliott et al. (2012). For example, participants were asked, "What do you think your chances are to have a good job or career?". Responses ranged from 1 "Poor" to 5 "Excellent." A composite future expectations score was created using the mean score from the 7 items at each interview wave. Higher scores were indicative of more positive future expectations. The future expectations composite score combined across both studies demonstrated high reliability over the study period (mean $\alpha = 0.89$, range = 0.86-0.91).

Impulse Control. At each interview, participants' impulse control levels were measured using the Impulse Control subscale of the Weinberger Adjustment Inventory (WAI; Weinberger & Schwartz, 1990). The scale consists of 8 items that participants used to rate the extent to which each statement (e.g., "I do things without giving them enough thought") reflected their behavior during the recall period, with 1 "False" and 5 "True." Higher scores represented higher impulse control. The mean score from the 8 items was used to create a composite impulse control score at each wave. The impulse control composite score demonstrated acceptable reliability across the study (mean $\alpha = 0.79$, range = 0.75-0.80).

Resistance to Peer Influence. Resistance to peer influence was assessed through the Resistance to Peer Influence scale (Steinberg & Monahan, 2007). This measure was developed to examine the degree to which youth act autonomously when in the presence of peers. Participants were shown ten sets of two contrary scenarios (e.g., "Some people will not break the law just because their friends say that they would" versus "Other people would break the law if their friends said that they would do it"). They were then asked to select the scenario that most closely

reflected their behavior and then to rate the degree to which that scenario truly reflected their behavior (i.e., "Sort of true" or "Really true"). Responses were coded into scores that represented participants' degree of resistance to peer influence, with 1 "Not resistant, really true," 2 "Not resistant, sort of true," 3 "Resistant, sort of true," and 4 "Resistant, really true." The 10-item mean was used to create a resistance to peer influence index, with higher scores indicative of greater resistance to peer influence. Internal consistency was acceptable across the study (mean $\alpha = 0.75$, range = 0.72-0.77).

Legal Factor Predictors

Offending. Participants self-reported on their involvement in 24 different crimes during each recall period using the Self-Report of Offending scale (SRO; Huizinga et al., 1991). Youth indicated whether they had committed any of the offenses (e.g., theft, drug, dealing, homicide) during the recall period. The first two interviews of the Pathways to Desistance Study did not include "joyriding" or "broken into a car" as offense items, although these were included for all subsequent interviews as well as all interviews in the Crossroads Study. To account for these differences, a substance use variety proportion score was created by dividing the total count of the different types of crimes that youth engaged in during the recall period by the total number of the possible types of crime, with higher scores indicating greater offending. Prior research has found that variety scores are associated with both seriousness and frequency of offending (see Monahan & Piquero, 2009) and are less vulnerable to recall bias than frequency scores (Osgood et al., 2002).

Arrest. The consequence of criminal behavior, namely being caught and arrested for the offense, has been found to be associated with substance use among adolescents and young adults. Data on whether and how often participants were arrested during each recall period after the

baseline interview were obtained from official court and probation records. Because there was a non-normal distribution and low base rate of arrests, a dichotomous arrest variable was created indicating whether youth were arrested at least once during each recall period. On average, in the combined sample, approximately 18% of youth were arrested during each recall period (range = 15-25%) and approximately 62% of the sample had been rearrested at least once during the 5-year study period.

Probation. Whether participants were on probation during each recall period was obtained through official justice system records. On average, in the combined sample, 31% of youth were on probation during each recall period (range = 21-50%) and approximately 70% of the sample had been on probation at least once during the study period.

Social Factor Predictors

Peer Substance Use. Two items from the Delinquent Peers scale (Thornberry et al., 1994) assessed peer substance use among participants. At each interview, participants self-reported the proportion of their friends who had "gotten drunk once in a while" or had "gotten high on drugs" during the recall period. Responses ranged from 1 "None of them" to 5 "All of them." An overall peer substance use score was created using the mean of the two items, with higher scores representing a higher proportion of substance using peers.

Gang Involvement. Participants' gang involvement was assessed using one item from the Delinquent Peers scale (Thornberry et al., 1994). Participants self-reported whether they had joined a gang or had been a member of a gang at any point during each recall period. Response options were 0 "No" or 1 "Yes."

Serious Romantic Relationships. Participants self-reported whether they were involved a serious romantic relationship at any point during each recall period. Response options were 0

"not involved in a romantic relationship" or 1 "involved in a romantic relationship." On average, 49% of participants were in a serious romantic relationship during the 5-year study period (range = 42-56%).

Contextual Factor Predictors

Neighborhood Disorder. A modified version of the Neighborhood Conditions measure (Sampson & Raudenbush, 1999) was used to examine participants' perceptions of the conditions of their neighborhoods. The scale comprises 21 items that assess levels of physical and social disorder in youths' neighborhoods. Sample physical disorder items included whether participants saw garbage in the streets or on the sidewalk, abandoned cars, or gang graffiti. Sample social disorder items included whether participants saw people drunk or passed out, prostitutes in the streets, or adults fighting or arguing loudly. Participants self-reported how frequently they observed each item using a 4-point Likert scale ranging from 1 "Never" to 4 "Often." A combined index of neighborhood disorder was created using the mean of the 21 responses, with higher scores indicative of greater neighborhood disorder. Internal consistency was high across the study (mean $\alpha = 0.96$, range = 0.94-0.97).

Exposure to Violence. Participants' levels of exposure to violence were measured using 13 items from an adapted version of the Exposure to Violence Inventory (adapted from Selner-O'Hagan et al., 1998). Six items asked youth whether they had been victimized during the recall period (e.g., "Have you been beaten up, mugged, or seriously threatened by another person?") and 7 items asked youth whether they had witnessed violence during each recall period ("Have you seen someone else get beaten up, mugged, or seriously threatened by another person?"). An overall exposure to violence variety score was computed by summing the count of the different types of violence that the participant experienced or witnessed. Higher scores represent a greater

amount of exposure to violence. Internal consistency was acceptable across the study (mean α = 0.75, range = 0.72-0.79).

Homelessness. Homelessness was assessed using a single item that asked participants to report on whether there was any period of time in each recall period during which they were living in the streets or moving around place to place, staying with different people. Homelessness was measured at every interview except the baseline interview. Youth self-reported whether they had been homeless (yes or no) during each follow up period (range = 13-20%).

Educational/Occupational Factor Predictors

School Enrollment. Two questions measured whether participants were enrolled in school during each recall period. Participants were first asked whether they were enrolled in school, with responses being "yes" or "no." If participants responded "no," they were then asked whether they had dropped out of school. Rates of school enrollment ranged from 30% to 94% across the study period.

Employment. At each interview, participants were asked whether they currently have a paying job or had a paying job (yes or no) at any time during the recall period (range = 22-75%).

Time-Varying Covariates

Age. Participants' ages were calculated by subtracting their birthdates from the dates of their interviews. Youths' ages were truncated to the nearest integer (e.g., 14.7 was truncated to 14).

Other Types of Substance Use. When examining each specific type of substance other types of substance use were included as time-varying covariates. For example, when investigating within-person changes in alcohol use, youths' use of cigarettes, marijuana, and other illicit drugs were accounted for.

Facility Time. To account for youths' opportunities to engage in substance use, the amount of time that participants spent inside secure, locked facilities (e.g., secure institutions, jails, or detention centers) was included as a time-varying covariate. Facility time was measured using the proportion of time during each recall period that a participant spent in a secure facility. This was assessed using a life event calendar approach, where participants were shown a calendar of each month during the recall period at each interview and were asked to report where they lived each month. The proportion of time spent in a secure facility was calculated by dividing the total number of months in the recall period during which participants were housed in a secure facility by the total number of months in the recall period. Scores ranged from 0 to 1, with higher scores indicating a greater proportion of the recall period spent in a secure facility. An overall facility time variable was created for the study period. On average, in the combined sample, youth spent 21% of their time during each recall period in a secure facility (range = 19-26%). Approximately 59% of the sample had been placed in a facility during the 5-year study period.

Recall Length. The recall periods differed across follow-up interviews for both studies (see Table 1.1). Since some recall periods were 6 months while others were 12 months, I included recall length as a time-varying covariate given that longer recall periods may provide more time for youth to have used substances during the recall period.

Table 1.2.

Descriptive Statistics of Study One Variables

	M / %	*SD*	Min	Max	*W*
Substance Use Outcomes					
Cigarette Use	41.92	0.49	0.00	1.00	-
Alcohol Use	51.47	0.50	0.00	1.00	-
Marijuana Use	42.78	0.49	0.00	1.00	-
Sedative Use	5.40	0.23	0.00	1.00	-
Stimulant Use	4.23	0.20	0.00	1.00	-
Cocaine Use	5.08	0.22	0.00	1.00	-
Opiate Use	3.40	0.18	0.00	1.00	-
Ecstasy Use	3.68	0.19	0.00	1.00	-
Hallucinogen Use	5.16	0.22	0.00	1.00	-
Other Drug Use	2.29	0.15	0.00	1.00	-
Individual Factors					
Future Expectations	3.82	0.88	1.00	5.00	0.99***
Impulse Control	3.27	0.92	1.00	5.00	0.99***
Resistance to Peer Influence	3.23	0.56	1.00	4.00	0.98***
Legal Factors					
Offending	0.06	0.11	0.00	0.92	0.80***
Arrest	19.20	0.39	0.00	1.00	-
Probation	28.86	0.45	0.00	1.00	-
Social Factors					
Peer Substance Use	2.63	2.50	0.00	8.00	0.99***
Gang Involvement	7.20	0.26	0.00	1.00	-
Serious Romantic Relationships	49.90	0.50	0.00	1.00	-
Contextual Factors					
Neighborhood Disorder	2.13	0.79	1.00	4.00	0.98***
Exposure to Violence	1.01	1.72	0.00	11.00	0.90***
Homelessness	2.57	0.16	0.00	1.00	-
Educational/Occupational Factors					
School Enrollment	6.17	0.49	0.00	1.00	-
Employment	53.87	0.50	0.00	1.00	-
Age	18.00	3.16	13.00	23.00	
Facility Time	15.56	0.32	0.00	1.00	
Recall Length					
6 Months	69.00				
12 Months	31.00				

**p<0.05, **p<0.01, ***p<0.001*

Plan of Analysis

Combined data from the two studies were first aligned by age, which ranged from ages 13 to 23[1] (see Figures 1.1 and 1.2 for age distribution, see Supplemental Figures 1.1-1.10 for age

[1] Only two participants were 24 years old during the study. Due to low sample size, age 24 data was dropped for the analyses.

growth curves of substance use). All variables had enough within-person variation over time. If there was no within-person variation for any variables, those data were dropped from the analyses. Regular (symmetric) fixed-effects logistic models were first used to examine the associations between the predictors and tobacco, alcohol, marijuana, and seven types of other illicit drug use (i.e., sedatives/tranquilizers, stimulants/amphetamines, cocaine, opiates, ecstasy, hallucinogens, and any other drugs not listed) from ages 13 to 23. First, five separate fixed-effects logistic models were conducted for each type of substance use, with a) the three individual factors (i.e., future expectations, impulse control, resistance to peer influence); b) the three legal factors (i.e., offending, arrest, probation); c) the three social factors (i.e., peer substance use, gang involvement, serious romantic relationships); d) the three contextual factors (i.e., neighborhood disorder, exposure to violence, homelessness); and e) the two educational/occupational factors (i.e., school enrollment, employment) predicting substance use. All predictors were standardized to allow for a comparison of the strength of their associations with substance use behaviors, and all models included age, other types of substance use, facility time, and recall length as time-varying covariates.

Next, all of the significant factors within each grouping (e.g., individual, legal) were placed in the same fixed-effects logistic model by substance. For example, if impulse control, offending, and peer substance use were the factors significantly associated with cocaine use, then those three standardized predictors were then placed in the same model to predict within-person changes in cocaine use. By comparing the significant factors from the previous step in the same model, I was able to identify the factors that were the most strongly linked to each type of substance use over and above all other factors. All models included age, other types of substance use, facility time, and recall length as time-varying covariates.

Second, I tested whether the factors that were the most strongly associated with each type of substance use (from the previous step) had asymmetric links to substance use. Asymmetric fixed-effects logistic models allowed for separation of the potentially differing effects of increasing or decreasing the predictors on substance use (Allison, 2019). Fixed-effects models also treat each individual as his own "control." That is, the effects of any time-invariant factors (e.g., a participant's race, prior substance use) were automatically controlled for in the models (Allison, 2019). All models included age, other types of substance use, facility time, and recall length as time-varying covariates.

Lastly, I assessed whether the significant asymmetric associations between predictors and substance use varied across adolescence and young adulthood by including an age interaction in all asymmetric fixed-effects logistic models. All models included other types of substance use, facility time, and recall length as time-varying covariates.

Figure 1.1.
Frequency Distribution of the Study One Sample by Age

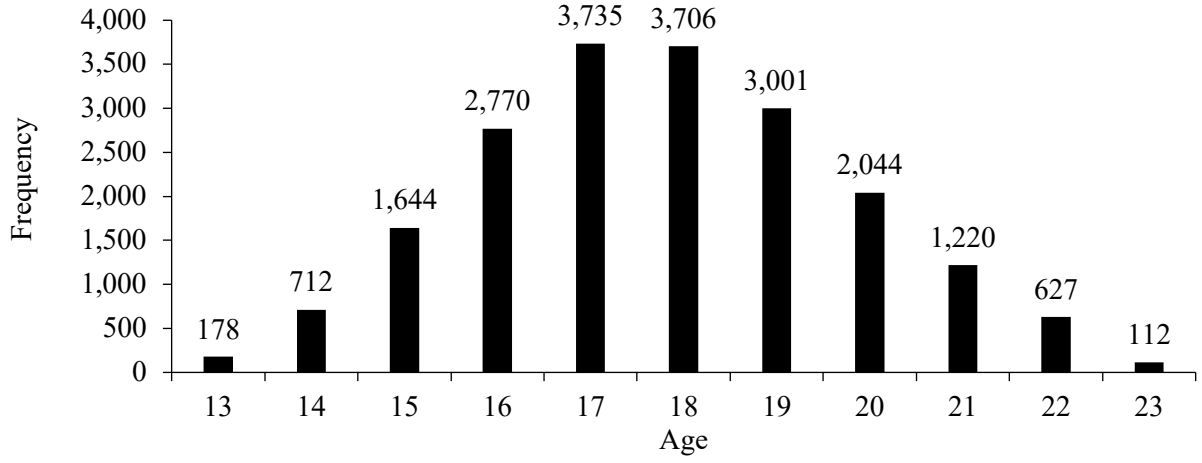
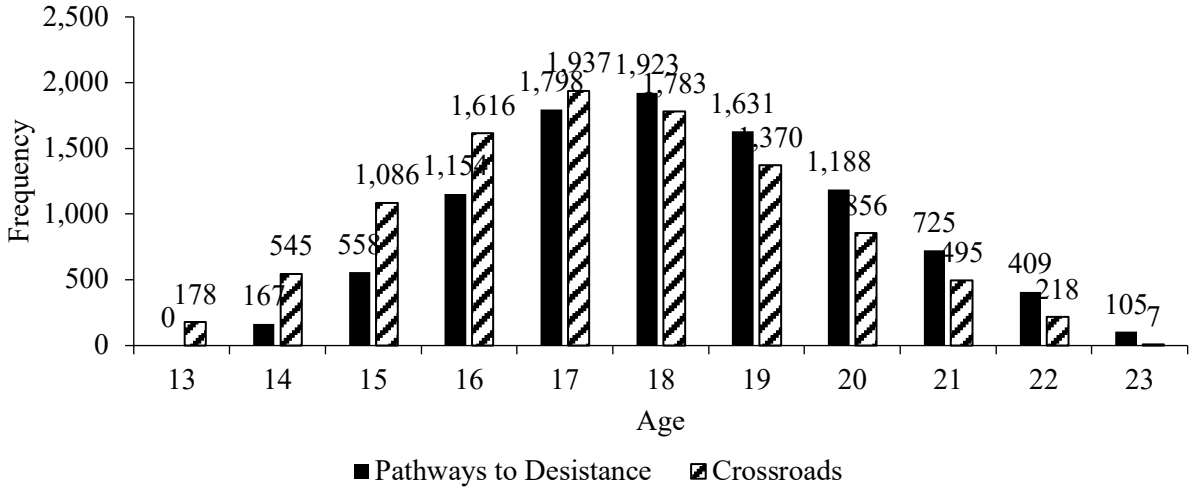


Figure 1.2.
Frequency Distribution by Age Comparing the Pathways to Desistance Sample vs. the Crossroads Sample



Results

Research Aim 1.1.

The first research aim was to identify the risk and protective factors that are most strongly associated with within-person changes in youths' use of cigarettes, alcohol, marijuana, sedatives/tranquilizers, stimulants/amphetamines, cocaine, opiates, ecstasy, hallucinogens, and other drugs (e.g., inhalants, amyl nitrite/odorizers/rush, non-medical use of prescription medication) over time. It was hypothesized that impulse control, offending, peer substance use, and exposure to violence would be the risk factors that are the most strongly linked to substance use.

In the first set of analyses, five separate fixed-effects logistic models for each type of substance use were used to assess the associations between the five categories of risk and protective factors (i.e., individual, legal, social, contextual, and educational/occupational). Then, in the second set of analyses, the factors that emerged as significant predictors for a specific type of substance (e.g., cocaine use) were then placed in one fixed-effects logistic model with that substance as the outcome. In all models, age, other types of substance use, facility time, and

recall length were included as time-varying covariates. For each substance type, unique sets of factors emerged as significant predictors.

Cigarette Use. For models examining individual factors as predictors, results indicated that youth were more likely to use cigarettes in years when they had more negative future expectations and lower impulse control (see Table 1.3, Model 1). Youths' resistance to peer influence was not significantly linked to changes in cigarette use. When examining legal factors, in years where youth engaged in greater levels of offending or were on probation, they were more likely to use cigarettes (see Table 1.3, Model 2). Whether youth were arrested in certain years was not significantly related to changes in their cigarette use. Next, for social factors, youth were more likely to use cigarettes in years when they had more substance-using peers; however, gang involvement and being in a serious romantic relationship were not significantly associated with within-person changes in cigarette use (see Table 1.3, Model 3). For models examining contextual factors, findings indicated that in years where youth perceived their neighborhoods to be more disorderly and experienced greater exposure to violence, they were more likely to use cigarettes (see Table 1.3, Model 4). Youths' changes in cigarette use behaviors were not significantly associated with homelessness. Then, results showed that youth were more likely to use cigarette in years when they were not enrolled in school, but employment did not emerge as a significant predictor (see Table 1.3, Model 5). Lastly, when all significant factors were considered together, the only significant predictors of cigarette use were future expectations, probation, and peer substance use (see Table 1.3, Model 6).

Table 1.3.

Within-individual Associations between the Predictors and Cigarette Use

Predictor	Model 1: Individual Factors				Model 2: Legal Factors			Model 3: Social Factors		
	B	*SE*	*95% CI*		*B*	*SE*	*95% CI*	*B*	*SE*	*95% CI*
Individual Factors										
Future Expectations	**-0.12**	**0.03**	**-0.18**	**-0.06**						
Impulse Control	**-0.06**	**0.03**	**-0.12**	**-0.00**						

RPI	-0.03	0.03	-0.09	0.03								
Legal Factors												
Offending					**0.14**	**0.04**	**0.07**	**0.21**				
Arrest					-0.04	0.03	-0.10	0.03				
Probation					**0.13**	**0.03**	**0.07**	**0.20**				
Social Factors												
Peer Substance Use									**0.13**	**0.03**	**0.06**	**0.19**
Gang Involvement									0.02	0.03	-0.04	0.09
Romantic Relationships									0.04	0.03	-0.02	0.10
Contextual Factors												
Neighborhood Disorder												
ETV												
Homelessness												
Educ./Occu. Factors												
School Enrollment												
Employment												

Notes. All models were estimated with binary fixed-effects logistic regressions. All models also controlled for age, concurrent use of other types of substances, facility time, and recall length. All predictor variables were concurrent with the outcome. Bolded text indicates findings that were significant based on $p<0.05$.

Table 1.3. (Continued)

Within-individual Associations between the Predictors and Cigarette Use

Predictor	Model 4: Contextual Factors				Model 5: Educ./Occu. Factors				Model 6: Combined Model			
	B	*SE*	*95% CI*		*B*	*SE*	*95% CI*		*B*	*SE*	*95% CI*	
Individual Factors												
Future Expectations									**-0.10**	**0.03**	**-0.17**	**-0.04**
Impulse Control									-0.05	0.04	-0.13	0.02
RPI												
Legal Factors												
Offending									0.04	0.06	-0.07	0.14
Arrest												
Probation									**0.17**	**0.04**	**0.09**	**0.24**
Social Factors												
Peer Substance Use									**0.14**	**0.04**	**0.06**	**0.22**
Gang Involvement												
Romantic Relationships												
Contextual Factors												
Neighborhood Disorder	**0.07**	**0.03**	**0.00**	**0.13**					0.05	0.03	-0.01	0.12
ETV	**0.12**	**0.04**	**0.04**	**0.20**					0.07	0.05	-0.02	0.17
Homelessness	0.05	0.03	-0.00	0.11								
Educ./Occu. Factors												
School Enrollment					**-0.07**	**0.03**	**-0.14**	**-0.01**	-0.06	0.04	-0.14	0.01
Employment					0.03	0.04	-0.05	0.11				

Notes. All models were estimated with binary fixed-effects logistic regressions. All models also controlled for age, concurrent use of other types of substances, facility time, and recall length. All predictor variables were concurrent with the outcome. Bolded text indicates findings that were significant based on $p<0.05$.

Alcohol Use. Next, results indicated that different factors were associated with within-person changes in alcohol use. When considering individual factors, findings were similar to the results when cigarette use was the outcome. Youth were more likely to use alcohol in years when they had poorer future expectations and lower impulse control (see Table 1.4, Model 1). Resistance to peer influence was not significantly linked to changes in youths' alcohol use. Next, for legal factors, in years where youth engaged in greater levels of offending, they were more likely to use alcohol (see Table 1.4, Model 2). However, neither arrest nor probation were significantly related to alcohol use. In the model including social factor predictors, results indicated that in years where youth interacted with more substance-using peers or when youth were in serious romantic relationships, they were more likely to use alcohol; however, gang involvement was not significantly related to alcohol use (see Table 1.4, Model 3). For contextual factors, youth were more likely to use alcohol in years where they lived in more disordered neighborhoods, but exposure to violence and homelessness did not emerge as significant predictors (see Table 1.4, Model 4). When examining educational/occupational predictors, in years when youth were employed, they were less likely to use alcohol (see Table 1.4, Model 5). School enrollment, however, was not significantly linked to alcohol use. Lastly, when all significant factors were considered together, impulse control, offending, peer substance use, and employment were the only significant predictors of alcohol use (see Table 1.4, Model 6).

Table 1.4.

Within-individual Associations between the Predictors and Alcohol Use

Predictor	Model 1: Individual Factors				Model 2: Legal Factors				Model 3: Social Factors		
	B	*SE*	*95% CI*		*B*	*SE*	*95% CI*		*B*	*SE*	*95% CI*
Individual Factors											
Future Expectations	**-0.06**	**0.03**	**-0.12**	**-0.00**							
Impulse Control	**-0.12**	**0.03**	**-0.18**	**-0.07**							
RPI	-0.02	0.03	-0.09	0.04							
Legal Factors											
Offending					**0.32**	**0.06**	**0.21**	**0.43**			
Arrest					0.03	0.02	-0.02	0.08			
Probation					-0.04	0.03	-0.10	0.02			

Social Factors												
Peer Substance Use									**0.47**	**0.03**	**0.41**	**0.53**
Gang Involvement									0.04	0.04	-0.04	0.12
Romantic Relationships									**0.10**	**0.04**	**0.03**	**0.17**
Contextual Factors												
Neighborhood Disorder												
ETV												
Homelessness												
Educ./Occu. Factors												
School Enrollment												
Employment												

Notes. All models were estimated with binary fixed-effects logistic regressions. All models also controlled for age, concurrent use of other types of substances, facility time, and recall length. All predictor variables were concurrent with the outcome. Bolded text indicates findings that were significant based on $p<0.05$.

Table 1.4. (Continued)

Within-individual Associations between the Predictors and Alcohol Use

Predictor	Model 4: Contextual Factors				Model 5: Educ./Occu. Factors				Model 6: Combined Model			
	B	*SE*	*95% CI*		*B*	*SE*	*95% CI*		*B*	*SE*	*95% CI*	
Individual Factors												
Future Expectations									-0.07	0.04	-0.14	0.00
Impulse Control									**-0.10**	**0.03**	**-0.16**	**-0.04**
RPI												
Legal Factors												
Offending									**0.13**	**0.06**	**0.00**	**0.26**
Arrest												
Probation												
Social Factors												
Peer Substance Use									**0.45**	**0.04**	**0.38**	**0.52**
Gang Involvement												
Romantic Relationships									-0.07	0.04	-0.00	0.14
Contextual Factors												
Neighborhood Disorder	**0.08**	**0.04**	**0.01**	**0.15**					0.03	0.04	-0.05	0.11
ETV	0.08	0.04	-0.01	0.16								
Homelessness	-0.03	0.04	-0.10	0.04								
Educ./Occu. Factors												
School Enrollment					-0.04	0.04	-0.09	0.04				
Employment					**0.10**	**0.03**	**0.03**	**0.16**	**0.08**	**0.04**	**0.01**	**0.15**

Notes. All models were estimated with binary fixed-effects logistic regressions. All models also controlled for age, concurrent use of other types of substances, facility time, and recall length. All predictor variables were concurrent with the outcome. Bolded text indicates findings that were significant based on $p<0.05$.

Marijuana Use. Similar to models with cigarette and alcohol use as the outcomes, results indicated that youth were more likely to use marijuana in years when they had more negative future expectations and lower impulse control (see Table 1.5, Model 1). Again, resistance to peer influence was not significantly related to changes in marijuana use. When assessing legal factors,

in years when youth engaged in greater levels of offending or were arrested, they were more likely to use cigarettes; however, being on probation was linked to decreases in marijuana use (see Table 1.5, Model 2). Next, all social factors were related to marijuana use. In particular, youth were more likely to use marijuana in years when they had more substance-using peers and were involved in a gang (see Table 1.5, Model 3). Being in a serious romantic relationship was not significantly related to marijuana use. For models examining contextual factors, findings indicated that only exposure to violence was associated with marijuana use, such that in years when youth experienced greater exposure to violence, they were more likely to use marijuana (see Table 1.5, Model 4). Marijuana use was not significantly associated with neighborhood disorder or homelessness. Then, results showed that educational/occupational factors were not associated with marijuana use (see Table 1.5, Model 5). Lastly, when all significant factors were considered together, the only significant predictors of marijuana use were future expectations, impulse control, offending arrest, probation, and peer substance use (see Table 1.5, Model 6).

Table 1.5.

Within-individual Associations between the Predictors and Marijuana Use

Predictor	Model 1: Individual Factors				Model 2: Legal Factors				Model 3: Social Factors			
	B	*SE*	*95% CI*		*B*	*SE*	*95% CI*		*B*	*SE*	*95% CI*	
Individual Factors												
Future Expectations	**-0.11**	**0.03**	**-0.16**	**-0.05**								
Impulse Control	**-0.11**	**0.03**	**-0.17**	**-0.05**								
RPI	-0.04	0.03	-0.10	0.03								
Legal Factors												
Offending					**0.63**	**0.06**	**0.51**	**0.74**				
Arrest					**0.11**	**0.02**	**0.06**	**0.15**				
Probation					**-0.15**	**0.03**	**-0.21**	**-0.10**				
Social Factors												
Peer Substance Use									**0.43**	**0.03**	**0.38**	**0.48**
Gang Involvement									**0.06**	**0.03**	**0.01**	**0.12**
Romantic Relationships									0.06	0.03	-0.00	0.12
Contextual Factors												
Neighborhood Disorder												

ETV												
Homelessness												
Educ./Occu. Factors												
School Enrollment												
Employment												

Notes. All models were estimated with binary fixed-effects logistic regressions. All models also controlled for age, concurrent use of other types of substances, facility time, and recall length. All predictor variables were concurrent with the outcome. Bolded text indicates findings that were significant based on $p<0.05$.

Table 1.5. (Continued)

Within-individual Associations between the Predictors and Marijuana Use

Predictor	Model 4: Contextual Factors				Model 5: Educ./Occu. Factors				Model 6: Combined Model			
	B	*SE*	*95% CI*		*B*	*SE*	*95% CI*		*B*	*SE*	*95% CI*	
Individual Factors												
Future Expectations									**-0.08**	**0.03**	**-0.14**	**-0.01**
Impulse Control									-0.05	0.03	-0.11	0.01
RPI												
Legal Factors												
Offending									**0.51**	**0.06**	**0.39**	**0.62**
Arrest									**0.12**	**0.03**	**0.06**	**0.17**
Probation									**-0.16**	**0.03**	**-0.23**	**-0.10**
Social Factors												
Peer Substance Use									**0.37**	**0.03**	**0.31**	**0.42**
Gang Involvement									-0.02	0.04	-0.05	0.09
Romantic Relationships												
Contextual Factors												
Neighborhood Disorder	0.04	0.03	-0.03	0.10								
ETV	**0.21**	**0.04**	**0.13**	**0.28**					-0.00	0.04	-0.08	0.07
Homelessness	0.06	0.03	-0.00	0.12								
Educ./Occu. Factors												
School Enrollment					-0.04	0.03	-0.11	0.02				
Employment					-0.03	0.03	-0.10	0.03				

Notes. All models were estimated with binary fixed-effects logistic regressions. All models also controlled for age, concurrent use of other types of substances, facility time, and recall length. All predictor variables were concurrent with the outcome. Bolded text indicates findings that were significant based on $p<0.05$.

Sedative/Tranquilizer Use. Next, no individual factors were significantly related to sedative/tranquilizer use (see Table 1.6, Model 1). However, youth were more likely to use sedatives/tranquilizers in years when they engaged in greater levels of offending (see Table 1.6, Model 2). Neither arrest nor probation were significantly related to sedative/tranquilizer use. In the model with social factors, results indicated that in years where youth interacted with more

substance-using peers, they were more likely to use sedatives/tranquilizers; however, gang involvement and serious romantic relationships were not significantly related to sedative/tranquilizer use (see Table 1.6, Model 3). For contextual factors, youth were more likely to use sedatives/tranquilizers in years when they experienced greater exposure to violence, but neighborhood disorder and homelessness did not emerge as significant predictors (see Table 1.6, Model 4). When assessing educational/occupational predictors, in years when youth were employed, they were less likely to use sedatives/tranquilizers (see Table 1.6, Model 5). School enrollment, however, was not a significant predictor. Lastly, when all significant factors were considered together, offending, peer substance use, and employment were the only significant predictors of sedative/tranquilizer use (see Table 1.6, Model 6).

Table 1.6.

Within-individual Associations between the Predictors and Sedative/Tranquilizer Use

Predictor	Model 1: Individual Factors				Model 2: Legal Factors				Model 3: Social Factors			
	B	*SE*	*95% CI*		*B*	*SE*	*95% CI*		*B*	*SE*	*95% CI*	
Individual Factors												
Future Expectations	-0.07	0.07	-0.20	0.07								
Impulse Control	-0.03	0.06	-0.15	0.09								
RPI	0.04	0.08	-0.10	0.19								
Legal Factors												
Offending					**0.30**	**0.06**	**0.19**	**0.42**				
Arrest					-0.03	0.06	-0.15	0.09				
Probation					0.01	0.06	-0.10	0.12				
Social Factors												
Peer Substance Use									**0.25**	**0.08**	**0.10**	**0.40**
Gang Involvement									-0.01	0.06	-0.12	0.10
Romantic Relationships									-0.05	0.06	-0.08	0.17
Contextual Factors												
Neighborhood Disorder												
ETV												
Homelessness												
Educ./Occu. Factors												
School Enrollment												
Employment												

Notes. All models were estimated with binary fixed-effects logistic regressions. All models also controlled for age, concurrent use of other types of substances, facility time, and recall length. All predictor variables were concurrent with the outcome. Bolded text indicates findings that were significant based on $p<0.05$.

Table 1.6. (Continued)

Within-individual Associations between the Predictors and Sedative/Tranquilizer Use

Predictor	Model 4: Contextual Factors				Model 5: Educ./Occu. Factors				Model 6: Combined Model			
	B	*SE*	*95% CI*		*B*	*SE*	*95% CI*		*B*	*SE*	*95% CI*	
Individual Factors												
Future Expectations												
Impulse Control												
RPI												
Legal Factors												
Offending									**0.25**	**0.08**	**0.09**	**0.41**
Arrest												
Probation												
Social Factors												
Peer Substance Use									**0.20**	**0.08**	**0.03**	**0.36**
Gang Involvement												
Romantic Relationships												
Contextual Factors												
Neighborhood Disorder	0.01	0.07	-0.14	0.15								
ETV	**0.18**	**0.06**	**0.06**	**0.29**					0.07	0.07	-0.07	0.21
Homelessness	0.00	0.08	-0.15	0.15								
Educ./Occu. Factors												
School Enrollment					0.15	0.09	-0.02	0.32				
Employment					**0.13**	**0.06**	**0.00**	**0.26**	**0.14**	**0.07**	**0.01**	**0.27**

Notes. All models were estimated with binary fixed-effects logistic regressions. All models also controlled for age, concurrent use of other types of substances, facility time, and recall length. All predictor variables were concurrent with the outcome. Bolded text indicates findings that were significant based on $p<0.05$.

Stimulant/Amphetamine Use. In contrast to predictors of sedative/tranquilizer use, future expectations and impulse control were significantly related stimulant/amphetamine use (see Table 1.7, Model 1). Resistance to peer influence was not a significant predictor. Next, youth were more likely to use stimulants/amphetamines in years when they engaged in greater levels of offending or were arrested (see Table 1.7, Model 2). Being on probation was not significantly related to stimulant/amphetamine use. No social factors were significantly associated with stimulant/amphetamine use (see Table 1.7, Model 3). However, all contextual factors were related to stimulant/amphetamine use (see Table 1.7, Model 4). That is, youth were more likely to use stimulants/amphetamines in years where they perceived greater disorder in their

neighborhoods, experienced greater exposure to violence, or were homeless. No educational/occupational factors were linked to stimulant/amphetamine use (see Table 1.7, Model 5). Lastly, when all significant factors were considered together, future expectations, impulse control, and offending were the only significant predictors of stimulant/amphetamine use (see Table 1.7, Model 6).

Table 1.7.

Within-individual Associations between the Predictors and Stimulant/Amphetamine Use

Predictor	Model 1: Individual Factors				Model 2: Legal Factors				Model 3: Social Factors			
	B	*SE*	*95% CI*		*B*	*SE*	*95% CI*		*B*	*SE*	*95% CI*	
Individual Factors												
Future Expectations	**-0.26**	**0.08**	**-0.41**	**-0.11**								
Impulse Control	**-0.26**	**0.09**	**-0.44**	**-0.09**								
RPI	-0.10	0.08	-0.25	0.05								
Legal Factors												
Offending					**0.39**	**0.07**	**0.25**	**0.53**				
Arrest					**0.21**	**0.07**	**0.08**	**0.34**				
Probation					0.14	0.08	-0.01	0.29				
Social Factors												
Peer Substance Use									0.12	0.08	-0.03	0.28
Gang Involvement									0.03	0.05	-0.07	0.13
Romantic Relationships									-0.03	0.07	-0.16	0.09
Contextual Factors												
Neighborhood Disorder												
ETV												
Homelessness												
Educ./Occu. Factors												
School Enrollment												
Employment												

Notes. All models were estimated with binary fixed-effects logistic regressions. All models also controlled for age, concurrent use of other types of substances, facility time, and recall length. All predictor variables were concurrent with the outcome. Bolded text indicates findings that were significant based on $p<0.05$.

Table 1.7. (Continued)

Within-individual Associations between the Predictors and Stimulant/Amphetamine Use

Predictor	Model 4: Contextual Factors			Model 5: Educ./Occu. Factors			Model 6: Combined Model			
	B	*SE*	*95% CI*	*B*	*SE*	*95% CI*	*B*	*SE*	*95% CI*	
Individual Factors										
Future Expectations							**-0.24**	**0.09**	**-0.41**	**-0.07**
Impulse Control							**-0.23**	**0.09**	**-0.41**	**-0.04**
RPI										
Legal Factors										
Offending							**0.36**	**0.10**	**0.16**	**0.55**
Arrest							0.16	0.09	-0.02	0.34
Probation										

Social Factors												
Peer Substance Use												
Gang Involvement												
Romantic Relationships												
Contextual Factors												
Neighborhood Disorder	**0.17**	**0.08**	**0.01**	**0.34**					0.13	0.08	-0.03	0.28
ETV	**0.16**	**0.07**	**0.02**	**0.30**					-0.00	0.09	-0.18	0.17
Homelessness	**0.09**	**0.03**	**0.02**	**0.16**					0.06	0.05	-0.04	0.15
Educ./Occu. Factors												
School Enrollment					-0.13	0.10	-0.32	0.05				
Employment					-0.15	0.09	-0.32	0.02				

Notes. All models were estimated with binary fixed-effects logistic regressions. All models also controlled for age, concurrent use of other types of substances, facility time, and recall length. All predictor variables were concurrent with the outcome. Bolded text indicates findings that were significant based on $p<0.05$.

Cocaine Use. The only significant factors associated with cocaine use when examining each group of predictors separately were impulse control for individual factors (see Table 1.8, Model 1), offending for legal factors (see Table 1.8, Model 2), peer substance use for social factors (see Table 1.8, Model 3), and exposure to violence for contextual factors (see Table 1.8, Model 4). No educational/occupational factors were linked to cocaine use (see Table 1.8 Model 5). When all significant factors were placed in the same model, offending emerged as the only significant predictor of cocaine use (see Table 1.8, Model 6).

Table 1.8.

Within-individual Associations between the Predictors and Cocaine Use

Predictor	Model 1: Individual Factors				Model 2: Legal Factors				Model 3: Social Factors			
	B	*SE*	*95% CI*		*B*	*SE*	*95% CI*		*B*	*SE*	*95% CI*	
Individual Factors												
Future Expectations	-0.08	0.09	-0.25	0.09								
Impulse Control	**-0.18**	**0.08**	**-0.35**	**-0.01**								
RPI	0.17	0.09	-0.00	0.35								
Legal Factors												
Offending					**0.42**	**0.08**	**0.26**	**0.58**				
Arrest					0.02	0.09	-0.15	0.19				
Probation					0.02	0.09	-0.16	0.20				
Social Factors												
Peer Substance Use									**0.21**	**0.08**	**0.06**	**0.37**
Gang Involvement									0.04	0.08	-0.11	0.19
Romantic Relationships									0.13	0.08	-0.02	0.28
Contextual Factors												
Neighborhood Disorder												

ETV												
Homelessness												
Educ./Occu. Factors												
School Enrollment												
Employment												

Notes. All models were estimated with binary fixed-effects logistic regressions. All models also controlled for age, concurrent use of other types of substances, facility time, and recall length. All predictor variables were concurrent with the outcome. Bolded text indicates findings that were significant based on $p<0.05$.

Table 1.8. (Continued)

Within-individual Associations between the Predictors and Cocaine Use

Predictor	Model 4: Contextual Factors				Model 5: Educ./Occu. Factors				Model 6: Combined Model			
	B	*SE*	*95% CI*		*B*	*SE*	*95% CI*		*B*	*SE*	*95% CI*	
Individual Factors												
Future Expectations												
Impulse Control									-0.09	0.09	-0.27	0.09
RPI												
Legal Factors												
Offending									**0.40**	**0.08**	**0.25**	**0.55**
Arrest												
Probation												
Social Factors												
Peer Substance Use									0.13	0.08	-0.02	0.29
Gang Involvement												
Romantic Relationships												
Contextual Factors												
Neighborhood Disorder	-0.02	0.07	-0.16	0.12								
ETV	**0.17**	**0.08**	**0.03**	**0.32**					-0.02	0.07	-0.16	0.12
Homelessness	0.04	0.05	-0.06	0.15								
Educ./Occu. Factors												
School Enrollment					-0.10	0.08	-0.24	0.05				
Employment					-0.06	0.08	-0.22	0.11				

Notes. All models were estimated with binary fixed-effects logistic regressions. All models also controlled for age, concurrent use of other types of substances, facility time, and recall length. All predictor variables were concurrent with the outcome. Bolded text indicates findings that were significant based on $p<0.05$.

Opiate Use. The only significant factor associated with opiate use when examining each group of predictors was exposure to violence, where youth were more likely to use opiates when they were exposed to more violence (see Table 1.9). As such, only exposure to violence was carried forward as the predictor for subsequent models.

Table 1.9.

Within-individual Associations between the Predictors and Opiate Use

Predictor	Model 1: Individual Factors				Model 2: Legal Factors				Model 3: Social Factors			
	B	*SE*	*95% CI*		*B*	*SE*	*95% CI*		*B*	*SE*	*95% CI*	
Individual Factors												
Future Expectations	-0.00	0.10	-0.20	0.19								
Impulse Control	-0.13	0.10	-0.32	0.06								
RPI	0.17	0.10	-0.17	0.21								
Legal Factors												
Offending					**0.19**	**0.07**	**0.05**	**0.34**				
Arrest					-0.03	0.08	-0.19	0.13				
Probation					0.07	0.08	-0.09	0.22				
Social Factors												
Peer Substance Use									0.02	0.09	-0.16	0.20
Gang Involvement									0.09	0.07	-0.05	0.23
Romantic Relationships									-0.02	0.10	-0.22	0.19
Contextual Factors												
Neighborhood Disorder												
ETV												
Homelessness												
Educ./Occu. Factors												
School Enrollment												
Employment												

Notes. All models were estimated with binary fixed-effects logistic regressions. All models also controlled for age, concurrent use of other types of substances, facility time, and recall length. All predictor variables were concurrent with the outcome. Bolded text indicates findings that were significant based on $p<0.05$.

Table 1.9. (Continued)

Within-individual Associations between the Predictors and Opiate Use

Predictor	Model 4: Contextual Factors				Model 5: Educ./Occu. Factors				Model 6: Combined Model			
	B	*SE*	*95% CI*		*B*	*SE*	*95% CI*		*B*	*SE*	*95% CI*	
Individual Factors												
Future Expectations												
Impulse Control												
RPI												
Legal Factors												
Offending												
Arrest												
Probation												
Social Factors												
Peer Substance Use												
Gang Involvement												
Romantic Relationships												
Contextual Factors												
Neighborhood Disorder	0.06	0.14	-0.20	0.33								
ETV	**0.21**	**0.08**	**0.06**	**0.37**					**0.23**	**0.08**	**0.07**	**0.39**
Homelessness	-0.03	0.06	-0.16	0.09								

Educ./Occu. Factors												
School Enrollment					0.06	0.08	-0.09	0.21				
Employment					0.06	0.09	-0.11	0.23				

Notes. All models were estimated with binary fixed-effects logistic regressions. All models also controlled for age, concurrent use of other types of substances, facility time, and recall length. All predictor variables were concurrent with the outcome. Bolded text indicates findings that were significant based on $p<0.05$.

Ecstasy Use. Similarly, the only significant factor linked to ecstasy use when examining each group of predictors was exposure to violence, where youth were more likely to use ecstasy in years when they experienced greater violence exposure (see Table 1.10). Therefore, only exposure to violence was carried forward as the predictor for subsequent models.

Table 1.10.

Within-individual Associations between the Predictors and Ecstasy Use

Predictor	Model 1: Individual Factors				Model 2: Legal Factors				Model 3: Social Factors			
	B	*SE*	*95% CI*		*B*	*SE*	*95% CI*		*B*	*SE*	*95% CI*	
Individual Factors												
Future Expectations	-0.09	0.09	-0.26	0.08								
Impulse Control	-0.16	0.10	-0.36	0.04								
RPI	-0.00	0.08	-0.16	0.16								
Legal Factors												
Offending					0.18	0.10	-0.02	0.37				
Arrest					0.08	0.09	-0.09	0.25				
Probation					-0.03	0.08	-0.18	0.12				
Social Factors												
Peer Substance Use									0.08	0.08	-0.09	0.24
Gang Involvement									-0.08	0.10	-0.27	0.11
Romantic Relationships									0.15	0.10	-0.06	0.34
Contextual Factors												
Neighborhood Disorder												
ETV												
Homelessness												
Educ./Occu. Factors												
School Enrollment												
Employment												

Notes. All models were estimated with binary fixed-effects logistic regressions. All models also controlled for age, concurrent use of other types of substances, facility time, and recall length. All predictor variables were concurrent with the outcome. Bolded text indicates findings that were significant based on $p<0.05$.

Table 1.10. (Continued)

Within-individual Associations between the Predictors and Ecstasy Use

Predictor	Model 4: Contextual Factors				Model 5: Educ./Occu. Factors				Model 6: Combined Model			
	B	*SE*	*95% CI*		*B*	*SE*	*95% CI*		*B*	*SE*	*95% CI*	
Individual Factors												
Future Expectations												
Impulse Control												
RPI												
Legal Factors												
Offending												
Arrest												
Probation												
Social Factors												
Peer Substance Use												
Gang Involvement												
Romantic Relationships												
Contextual Factors												
Neighborhood Disorder	0.09	0.08	-0.07	0.25								
ETV	**0.19**	**0.08**	**0.02**	**0.35**					**0.17**	**0.07**	**0.04**	**0.30**
Homelessness	-0.03	0.06	-0.14	0.09								
Educ./Occu. Factors												
School Enrollment					-0.09	0.09	-0.26	0.08				
Employment					0.13	0.08	-0.03	0.28				

Notes. All models were estimated with binary fixed-effects logistic regressions. All models also controlled for age, concurrent use of other types of substances, facility time, and recall length. All predictor variables were concurrent with the outcome. Bolded text indicates findings that were significant based on $p<0.05$.

Hallucinogen Use. The only significant factors associated with hallucinogen use when examining each group of predictors separately were offending and arrest for legal factors (see Table 1.11, Model 2) and peer substance use for social factors (see Table 1.11, Model 3). No individual, contextual, or educational/occupational factors were linked to hallucinogen use (see Table 1.11 Models 1, 4, and 5). When all significant factors were placed in the same model, arrest and peer substance use emerged as the only significant predictors of hallucinogen use (see Table 1.11, Model 6).

Table 1.11.
Within-individual Associations between the Predictors and Hallucinogen Use

Predictor	Model 1: Individual Factors				Model 2: Legal Factors				Model 3: Social Factors			
	B	*SE*	*95% CI*		*B*	*SE*	*95% CI*		*B*	*SE*	*95% CI*	
Individual Factors												
Future Expectations	-0.10	0.08	-0.25	0.05								
Impulse Control	-0.17	0.09	-0.35	0.01								
RPI	0.03	0.08	-0.13	0.19								
Legal Factors												
Offending					**0.18**	**0.07**	**0.03**	**0.33**				

Arrest					**0.12**	**0.06**	**0.00**	**0.25**				
Probation					0.11	0.08	-0.03	0.26				
Social Factors												
Peer Substance Use									**0.24**	**0.09**	**0.06**	**0.42**
Gang Involvement									-0.06	0.08	-0.22	0.09
Romantic Relationships									0.01	0.06	-0.12	0.13
Contextual Factors												
Neighborhood Disorder												
ETV												
Homelessness												
Educ./Occu. Factors												
School Enrollment												
Employment												

Notes. All models were estimated with binary fixed-effects logistic regressions. All models also controlled for age, concurrent use of other types of substances, facility time, and recall length. All predictor variables were concurrent with the outcome. Bolded text indicates findings that were significant based on $p<0.05$.

Table 1.11. (Continued)

Within-individual Associations between the Predictors and Hallucinogen Use

Predictor	Model 4: Contextual Factors				Model 5: Educ./Occu. Factors				Model 6: Combined Model			
	B	*SE*	*95% CI*		*B*	*SE*	*95% CI*		*B*	*SE*	*95% CI*	
Individual Factors												
Future Expectations												
Impulse Control												
RPI												
Legal Factors												
Offending									0.15	0.09	-0.02	0.33
Arrest									**0.14**	**0.07**	**0.01**	**0.27**
Probation												
Social Factors												
Peer Substance Use									**0.21**	**0.07**	**0.07**	**0.34**
Gang Involvement												
Romantic Relationships												
Contextual Factors												
Neighborhood Disorder	0.00	0.09	-0.17	0.17								
ETV	0.12	0.06	-0.00	0.24								
Homelessness	0.00	0.05	-0.10	0.10								
Educ./Occu. Factors												
School Enrollment					-0.03	0.08	-0.20	0.13				
Employment					0.10	0.09	-0.08	0.29				

Notes. All models were estimated with binary fixed-effects logistic regressions. All models also controlled for age, concurrent use of other types of substances, facility time, and recall length. All predictor variables were concurrent with the outcome. Bolded text indicates findings that were significant based on $p<0.05$.

Other Drug Use. The only significant factor related to other types of illicit drug use was homelessness, with youth being more likely to use other illicit drugs in years when they experienced homelessness (see Table 12). As such, only homelessness was carried forward as the predictor for subsequent models.

Table 1.12.

Within-individual Associations between the Predictors and Other Drug Use

Predictor	Model 1: Individual Factors				Model 2: Legal Factors				Model 3: Social Factors			
	B	*SE*	*95% CI*		*B*	*SE*	*95% CI*		*B*	*SE*	*95% CI*	
Individual Factors												
Future Expectations	-0.21	0.14	-0.47	0.06								
Impulse Control	0.02	0.12	-0.22	0.26								
RPI	-0.11	0.13	-0.35	0.14								
Legal Factors												
Offending					0.14	0.08	-0.02	0.30				
Arrest					-0.07	0.08	-0.23	0.08				
Probation					0.09	0.11	-0.12	0.31				
Social Factors												
Peer Substance Use									0.21	0.12	-0.02	0.44
Gang Involvement									0.01	0.09	-0.15	0.18
Romantic Relationships									0.01	0.11	-0.20	0.23
Contextual Factors												
Neighborhood Disorder												
ETV												
Homelessness												
Educ./Occu. Factors												
School Enrollment												
Employment												

Notes. All models were estimated with binary fixed-effects logistic regressions. All models also controlled for age, concurrent use of other types of substances, facility time, and recall length. All predictor variables were concurrent with the outcome. Bolded text indicates findings that were significant based on $p<0.05$.

Table 1.12. (Continued)

Within-individual Associations between the Predictors and Other Drug Use

Predictor	Model 4: Contextual Factors				Model 5: Educ./Occu. Factors				Model 6: Combined Model			
	B	*SE*	*95% CI*		*B*	*SE*	*95% CI*		*B*	*SE*	*95% CI*	
Individual Factors												
Future Expectations												
Impulse Control												
RPI												
Legal Factors												
Offending												
Arrest												
Probation												
Social Factors												
Peer Substance Use												
Gang Involvement												
Romantic Relationships												
Contextual Factors												
Neighborhood Disorder	0.05	0.12	-0.18	0.29								
ETV	0.17	0.12	-0.05	0.40								
Homelessness	**0.13**	**0.06**	**0.02**	**0.25**					**0.14**	**0.07**	**0.00**	**0.27**
Educ./Occu. Factors												
School Enrollment					-0.14	0.12	-0.38	0.10				
Employment					0.00	0.14	-0.27	0.28				

Notes. All models were estimated with binary fixed-effects logistic regressions. All models also controlled for age, concurrent use of other types of substances, facility time, and recall length. All predictor variables were concurrent with the outcome. Bolded text indicates findings that were significant based on $p<0.05$.

Research Aim 1.2.

The second research aim was to determine whether any of the factors that were significantly related to substance use had asymmetric associations. It was hypothesized that future expectations and exposure to violence would have asymmetric links to substance use. In particular, being more optimistic about their future might motivate youth to reduce their substance use behaviors; however, having poorer future expectations may be realistic in cases where youth are faced with substantial disadvantages. When considering exposure to violence, greater exposure may be related to increases in youths' substance use, but once youth start using certain, more addictive substances, they may continue using even in years where they are not exposed to violence.

Asymmetric fixed-effects logistic models were used to address this aim. These types of models allow for the effects of increasing or decreasing a predictor to be separated (Allison, 2019). These models included all positive and negative effects of the significant predictors from the final step of Research Aim 1.1. As in Research Aim 1.1., separate models were conducted for each substance use type. Age, other types of substance use, facility time, and recall length were included as time-varying covariates. The results indicate that the association between offending and alcohol use as well as the link between future expectations and marijuana use were asymmetric (Table 1.13). No other predictors had asymmetric associations with substance use.

Table 1.13.
Asymmetric Fixed-effects Logistic Regression Results.

Cigarette Use	*B*	*SE*	95% CI	
Future Expectations (+)	-0.11**	0.04	-0.19	-0.03
Future Expectations (-)	0.15***	0.04	0.07	0.22
Probation (+)	0.08	0.04	0.00	0.17
Probation (-)	-0.13***	0.04	-0.21	-0.06
Peer Substance Use (+)	0.13***	0.04	0.05	0.21

Peer Substance Use (-)	-0.15***	0.04	-0.22	-0.07
Alcohol Use	*B*	*SE*	95% CI	
Impulse Control (+)	-0.10**	0.04	-0.18	-0.02
Impulse Control (-)	0.10*	0.04	0.01	0.18
Offending (+)	**0.05**	**0.05**	**-0.06**	**0.15**
Offending (-)	**-0.20*** **	**0.04**	**-0.28**	**-0.12**
Peer Substance Use (+)	0.43***	0.04	0.34	0.51
Peer Substance Use (-)	-0.41***	0.04	-0.49	-0.33
Marijuana Use	*B*	*SE*	95% CI	
Future Expectations (+)	**-0.13*** **	**0.04**	**-0.20**	**-0.05**
Future Expectations (-)	**-0.02**	**0.04**	**-0.10**	**0.06**
Offending (+)	0.50***	0.06	0.38	0.62
Offending (-)	-0.47***	0.05	-0.57	-0.38
Arrest (+)	0.08*	0.04	0.01	0.15
Arrest (-)	-0.14***	0.04	-0.21	-0.07
Probation (+)	-0.06	0.05	-0.15	0.03
Probation (-)	0.14***	0.04	0.06	0.21
Peer Substance Use (+)	0.39***	0.04	0.30	0.47
Peer Substance Use (-)	-0.34***	0.04	-0.42	-0.26
Sedative/Tranquilizer Use	*B*	*SE*	95% CI	
Offending (+)	0.34***	0.08	0.18	0.49
Offending (-)	-0.21***	0.06	-0.34	-0.09
Peer Substance Use (+)	0.10	0.09	-0.07	0.27
Peer Substance Use (-)	-0.28***	0.08	-0.44	-0.13
Employment (+)	0.08	0.09	-0.09	0.25
Employment (-)	-0.13	0.08	-0.29	0.03
Stimulant/Amphetamine Use	*B*	*SE*	95% CI	
Future Expectations (+)	-0.16	0.10	-0.37	0.04
Future Expectations (-)	0.27**	0.09	0.09	0.45
Impulse Control (+)	-0.23*	0.10	-0.42	-0.04
Impulse Control (-)	0.17	0.09	-0.01	0.36
Offending (+)	0.28***	0.09	0.11	0.46
Offending (-)	-0.37***	0.07	-0.51	-0.24
Cocaine Use	*B*	*SE*	95% CI	
Offending (+)	0.35***	0.08	0.19	0.50
Offending (-)	-0.40***	0.07	-0.53	-0.28
Opiate Use	*B*	*SE*	95% CI	
Exposure to Violence (+)	0.27**	0.09	0.09	0.45
Exposure to Violence (-)	-0.23**	0.08	-0.38	-0.08
Ecstasy Use	*B*	*SE*	95% CI	
Exposure to Violence (+)	0.24**	0.08	0.08	0.40
Exposure to Violence (-)	-0.13	0.07	-0.27	0.02
Hallucinogen Use	*B*	*SE*	95% CI	
Arrest (+)	0.15*	0.07	0.00	0.29
Arrest (-)	-0.11	0.08	-0.27	0.05
Peer Substance Use (+)	0.24**	0.09	0.06	0.41
Peer Substance Use (-)	-0.29***	0.08	-0.46	-0.13
Other Drug Use	*B*	*SE*	95% CI	
Homelessness (+)	0.07	0.06	-0.05	0.20
Homelessness (-)	-0.19*	0.07	-0.33	-0.04

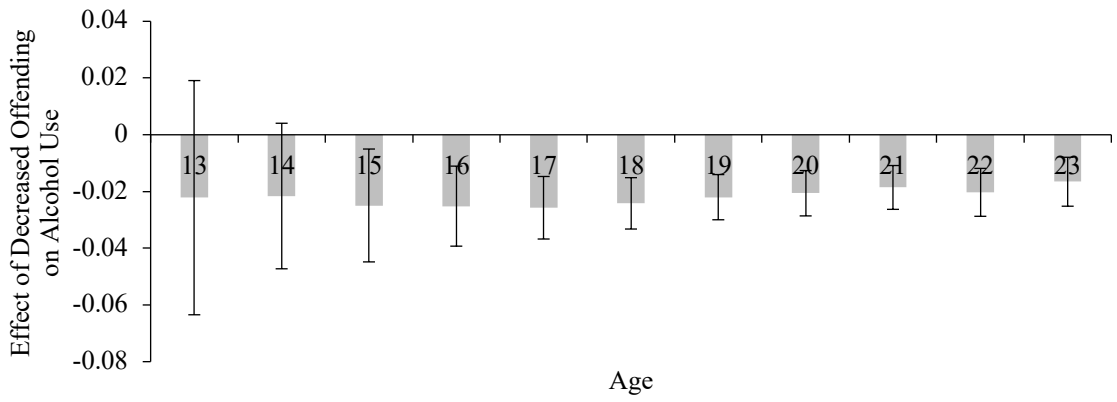
Bolded results indicate significant asymmetric associations.
**p<0.05, **p<0.01, ***p<0.001*

Research Aim 1.3.

The third research aim was to assess whether any of the significant associations between the asymmetric predictors and within-person changes in substance use from Research Aim 1.2. varied across age. It was hypothesized that link between future expectations (both positive and negative) and substance use as well as the link between greater exposure to violence and substance use would be stronger in young adulthood than in adolescence. However, the association between lower exposure to violence and reduced substance use is expected to be stable throughout adolescence and young adulthood.

Asymmetric fixed-effects logistic models with interaction terms for age and significant predictors from Research Aim 1.2. (e.g., age x more positive future expectations, age x lower exposure to violence) were used to address this aim. Models were the same as those Research Aim 1.2. but with the inclusion of an interaction term with age for the significant asymmetric predictors. Separate models were conducted for each substance use type, and time-varying covariates included other types of substance use, facility time, and recall length. The findings show that the association between decreased offending and within-person decreases in alcohol use was significantly moderated by age (linear age: X^2=5.46, p=0.02; quadratic age: X^2=4.62, p=0.03). Specifically, the effect of decreased offending on alcohol use is stronger in young adulthood than in adolescence (Figure 1.3). Results also indicate that the effect of more positive future expectations on marijuana use did not vary significantly by age (X^2 = 1.06, p=0.30).

Figure 1.3.
Effect of Decreased Offending on Alcohol Use Across Age.



Discussion

Overall, the risk factors most strongly related to different types of substance use (after all significant factors were placed in the same model) were offending and peer substance use Specifically, offending was linked to within-person changes in five different types of substance use: alcohol, marijuana, sedatives/tranquilizers, stimulants/amphetamines, and cocaine. These findings align with existing literature highlighting the close relationship between offending and substance use, where both behaviors tend to increase or decrease together (**Error! Hyperlink reference not valid.**; Fergusson & Horwood, 2000; Gottfredson & Hirschi, 1994; Jessor & Jessor, 1977; Mason & Windle, 2002; Uggen & Thompson, 2003). However, the present study is the first to examine these associations within-person and across multiple types of non-marijuana illicit drugs. Findings indicate that in years when youth engage in more different types of crime, they are also more likely to use substances. Perhaps, as posited by the general theory of crime (Gottfredson & Hirschi, 1990; Gottfredson & Hirschi, 1994) and problem behavior theory (Jessor & Jessor, 1977), youth who engage in criminal behavior may lack self-control not only in the context of offending, but also in the context of using substances.

Peer substance use was also related to within-individual changes in five distinct types of substance use: cigarettes, alcohol, marijuana, sedatives/tranquilizers, and hallucinogens. These

results support existing research that indicates that spending time with substance-using peers is linked to increases in substance use (Beardslee et al., 2018; Henry et al., 2009; Hussong, 2002; Simons-Morton, 2007). The present findings suggest that youth are more likely to engage in substance use in years when they have more substance-using friends. This association may be due to socialization, where spending time with peers who use substances makes a youth more likely to engage in substance use themselves, or it could be a selection effect, where youth who were already using substances are more likely to spend time with like-minded peers.

Two individual factors, future expectations and impulse control, were each associated with three types of substance use. Future expectations was linked to within-person changes in cigarette, marijuana, and stimulant/amphetamine use. In years when youth have more positive expectations of their futures, they were less likely to use these substances. This result aligns with previous research that has found that more positive expectations are typically linked to lower levels of substance use (McDade et al., 2011). Perhaps, as posited by life-course theory (Elder Jr, 1998; Laub & Sampson, 1993) and social control theory (Hirschi, 1969), having more positive expectations in the long run may help youth refrain from antisocial behavior in the short run in order to achieve those long-term goals. Next, when youth were better able to control their impulses, they were less likely to use alcohol, marijuana, and stimulant/amphetamines. This finding is in line with previous research (Morin et al., 2019) and suggests that youths' abilities to resist short-term rewards (e.g., feeling drunk or high; increasing social status among friends) can protect them from engaging in substance use.

Interestingly, being arrested and being on probation had unique associations with substance use. First, in years when youth were arrested, they were *more likely* to use marijuana and hallucinogens; however, in years when youth were on probation, they were *less likely* to use

marijuana. Perhaps arrest-related stressors (e.g., experiencing stigma if youth were arrested at school or in other public places; perceptions that the arrest was invasive, overly forceful, or procedurally unjust) increase the likelihood of substance use as a means of coping with the stress (Powell, 2022). Being arrested does not necessarily mean that the youth was charged with a crime, whereas youth are placed on probation as a result of a guilty charge. Unfortunately, the official arrest records used in the present study did not indicate whether an arrest led to criminal charges. Therefore, whether youth experienced increased supervision from law enforcement is unclear. However, youth likely experienced greater law enforcement supervision while on probation, which may be why probation is related to a lower likelihood of marijuana use. That is, refraining from any substance use was likely included in the terms of probation for youth. In contrast to marijuana use, however, in years when youth were on probation, they were *more likely* to use cigarettes. Since marijuana use had not been legalized in any of the sites during the Pathways to Desistance Study and was only legalized in California for individual aged 21 or older at the end of the Crossroads Study, perhaps youths' probation terms prohibited them from using marijuana but did not restrain them from using cigarettes. As such, being on probation may have been related to increases in cigarette use as youth might have switched from using illicit substances to smoking cigarettes.

Next, exposure to violence was the only significant predictor of opiate and ecstasy use, where youth were more likely to use those substances in years when they were exposed to a greater number of violent events. This finding aligns with results from prior work that has found positive associations between exposure to violence and substance use (Begle et al., 2011; Goldstick et al., 2019). When youth witness or experience violent acts, they may turn to opiate and ecstasy use as a means of coping with the negative emotions resulting from those

experiences (Fagan, 2003). While exposure to violence was a significant predictor of other types of substance use when only accounting for other contextual factors in the model, it was not significantly related to other types of substance use once all significant factors were included in the same model. This suggests that other factors (e.g., offending, peer substance use, impulse control) are stronger predictors of those other types of substance use, but in the absence of those predictors, exposure to violence still puts youth at risk of substance use.

Homelessness was found to only be significantly associated with other drug use, which includes inhalants, amyl nitrite/odorizers/rush, non-medical use of prescription medication, and any other drugs not listed. Since most of these "other drugs" are more accessible and lower in cost (e.g., paint thinner, glue, aerosols, air fresheners, unused prescription medication), perhaps when youth are homeless, they are more likely to use these types of substances given their limited financial resources. It is important to note that in all models, concurrent use of all other types of substances was accounted for, so homelessness may be specifically related to youths' use of these "other drugs" because of access and financial limitations.

Interestingly, in years when youth were employed, they were *more likely* to use sedatives/tranquilizers. This somewhat contradicts prior research that has found a significant link between unemployment and within-person increases in alcohol use (Fergusson et al., 2014). However, other studies have reported no significant associations between employment and marijuana use (Popovici & French, 2014). Importantly, the present study was the first to examine whether employment was related to non-marijuana illicit drugs. Perhaps some justice-system-involved youth experience increased work-related nervousness, anxiety, or stress and might use sedatives/tranquilizers to relieve that discomfort (Kokkevi et al., 2008). Kokkevi et al. (2008) even found that parents may be inclined to provide unprescribed sedatives/tranquilizers to youth

to relieve their stress, which may lead to subsequent self-medication behaviors as maladaptive ways of coping with negative feelings and emotions.

In contrast to the significant predictors of within-person changes in substance use described above, resistance to peer influence, neighborhood disorder, gang involvement, being in a serious romantic relationship, and school enrollment were not significantly associated with any type of substance use after accounting for other significant predictors. While this may contradict some existing literature that has found links between these predictors and substance use (Bachman et al., 2014; Duell et al., 2020; Edlund et al., 2015; Harris et al., 2013; Latkin et al., 2007; Shaw & McKay, 1942), the present results suggest that other factors (e.g., offending, peer substance use, impulse control) are more salient predictors of within-person changes in substance use.

For example, being able to resist the influence of one's peers may not be a protective factor if a youth spends time with many substance-using peers, especially if the youth selected into that friend group. In this example, the youth may be willingly engaging in substance use regardless of whether his peers were influencing him. It may also be that the effect of substance-using peers overpowers a youth's ability to resist to peer influence. Next, living in a disordered neighborhood may have lasting impacts on youths' substance use behaviors such that even moving out of the disordered neighborhood may not necessarily protect youth from substance use. Gang involvement is also typically associated with increased substance use behaviors (Coid et al., 2013). However, it is likely that whether the other gang members use substances (which would have been captured through peer substance use) is more closely related to youths' substance use behaviors than simply being a part of a gang.

Next, it may be the quality or interpersonal dynamics of a romantic relationship that are more closely related to substance use behaviors than simply being in a relationship. If a youth was in a relationship with a partner who disapproved of substance use, the youth may be less likely to use substances himself during that relationship; however, if the youth started a new relationship with a substance-using partner, he may then be more likely to use substances. As such, it will be important for future research to assess how romantic partners' substance use and relationship quality may be related to within-person changes substance use. Lastly, being enrolled in school may protect youth from using substances, as schools discourage substance use and aim to promote more prosocial behaviors. However, a youth who was enrolled in school most of his life may not start using substances just because he was no longer enrolled.

The present findings also indicated that most predictors of substance use did not have significant asymmetric effects. This suggests that the effects of most predictors of substance use are significant in both directions, where the increase in a protective factor, for example, is just as important as a decrease in that protective factor. For instance, if a youth made two new friends who used substances in one year, his likelihood of using hallucinogens would increase by approximately 24%. However, if in the next year, he stopped spending time with those two substance-using friends, his likelihood of hallucinogen use would decrease by 29%, back to approximately the same level as before he had made begun spending time with those peers. Thus, identifying the symmetric predictors of substance use informs intervention and treatment efforts that increasing protective factors and reducing risk factors can reverse the negative effects that a lack of protective factors or an increase of risk factors can have on youths' substance use.

Importantly, however, two asymmetric associations emerged. The first was that while greater offending was not significantly linked to increased alcohol use, in years when youth

decreased in offending, they were more likely to desist from alcohol use. This suggests that in years when youth increase in offending, their likelihood of using alcohol is not significantly impacted. Perhaps other types of substance use, which were accounted for the analytic models, were more closely associated with offending than alcohol use was. Alternatively, other factors (e.g., peer substance use) may be stronger predictors of increased substance use over and above the impacts that offending may have. In years when youth decreased in offending, however, they were significantly less likely use alcohol. Perhaps when youth desist from offending, they are also desisting from other types of antisocial behavior such as alcohol use. Choosing to desist from offending could be a more pervasive mindset such that youth may be deciding to stop engaging in antisocial behavior more broadly. However, the decision to engage in greater offending may not be as pervasive, where youth may consciously separate the feelings and emotions (e.g., guilt, responsibility, risk) associated with committing a crime from those linked to using substances. Therefore, it might be important for intervention efforts to prevent or reduce offending among justice-system-involved youth, as reductions in offending could lead to desistance from problematic alcohol use.

The second asymmetric association that was identified in the present study was between future expectations and marijuana use. In years when youth had more positive future expectations, they were less likely to use marijuana. Having more positive future expectations might motivate youth to refrain from using marijuana, as they may recognize that marijuana use can impede them from achieving those goals (Knight et al., 2017; Prince et al., 2019). However, having more negative future expectations was not related to a greater likelihood of marijuana use, perhaps because these poorer expectations may be realistic for youth living in more disadvantaged environments. Rather than trying to make youth be more optimistic in the face of

tangible disadvantages, intervention methods should focus on providing youth with resources and support to increase their likelihood of reaching their future goals. In turn, this could increase youths' confidence and future expectations and reduce their likelihood of marijuana use. For instance, if a youth had poor expectations of being financially stable as an adult, intervention efforts could provide youth with job skills training to improve their chances of getting a stable job. This could increase youths' confidence in being able to reach that goal and thus improve their expectations for the future.

Lastly, the present results also indicate that the within-person association between less offending and lower likelihood of alcohol use was moderated by age, whereas the link between more positive future expectations and marijuana use did not vary by age. Decreases in offending do not seem to be related to alcohol use during adolescence. In young adulthood, however, in years when youth decrease in offending, they are less likely to use alcohol. This result suggests that preventing or reducing offending when justice-system-involved youth are young adults may be most effective in reducing the likelihood of problematic alcohol use. In adolescence, other factors may play a larger role in why a youth does not use alcohol in certain years.

The non-significant association between positive future expectations and within-person decreases in marijuana use suggests that having more positive future expectations is a protective factor across adolescence and young adulthood. In years when youth have more positive perceptions of their future, whether they are adolescents or young adults, they are less likely to use marijuana. Thus, efforts to help justice-system-involved youth refrain from using marijuana could focus on providing resources and support to help youth gain confidence and have more positive outlooks on their future goals.

It is important to note several limitations of the present study. First, while fixed effects models allow for a stronger test of causality by automatically controlling for all time-stable confounding factors such as demographic differences and pre-existing conditions, the current study examined concurrent predictors of substance use outcomes. That is, whether a risk factor was present prior to youths' use of substances in unclear. It was hypothesized that the direction of the effect was from the risk and protective factors to substance use, but the present study did not test the precise temporal ordering. As asymmetric fixed effects model methods are expanded, future research should include lagged effects. Second, the substance use outcomes were dichotomized because the response options in the Substance Use/Abuse Inventory are ordinal rather than continuous and most youth who used non-marijuana illicit drugs did so rarely. As such, the present study was only able to identify whether risk and protective factors predicted whether youth used substances in certain years and not others, not whether use increased or decreased. Nonetheless, the current study was the first to examine how a broad set of predictors might be related to within-person changes in ten different types of substance use.

Third, while the present study included a fairly comprehensive set of predictors, how family factors (e.g., parental monitoring, parental warmth or hostility) are associated with substance use was unable to be assessed. Unfortunately, the measures that were used to ask participants about their family relationships differed between the Pathways to Desistance and the Crossroads studies. This prohibited an assessment of family factors since the same measures need to be used in both studies in order for the data to be combined. While the present study used combined data from the studies in order to have higher base rates of non-marijuana illicit drug use, future research should determine how family factors might be linked to within-person changes in youths' substance use behaviors. The present study was also limited by an all-male,

justice-system-involved sample. Therefore, findings may not generalize to other populations such as female, clinical, or community samples. Importantly, many of the associations between risk or protective factors and substance use that were identified in the present study aligned with prior research using different samples (Beardslee et al., 2018; Boden et al., 2013; Morin et al., 2019; Powell, 2022; Uggen & Thompson, 2003). Nonetheless, future studies should examine predictors of within-person changes in substance use with other samples.

Despite these limitations, the present study also had several strengths. The primary strength of this study is the assessment of asymmetric, within-person associations between predictors and substance use over time. Rather than focusing on between-individual differences and examining the factors that are linked to why some youth engage in substance use while others do not, the current work identifies factors that are associated with why a youth uses substances at one time but not another. Understanding the factors related to within-person changes in substance use over time directly informs the goals of intervention and treatment efforts to help individuals reduce or desist from using substances.

In addition, rather than assuming that all associations between risk or protective factors and substance use are symmetric, some associations may be asymmetric, where the effect of an increase in the predictor does not equal the opposite effect of a decrease in the predictor. The results that identify the asymmetric associations provide additional insight into how intervention and treatment efforts may best dedicate their time and resources to reduce youth substance use. For instance, decreases in offending were linked to a lower likelihood of alcohol use but increases in offending were not significantly related to a greater likelihood of alcohol use. As such, over time, even if a youth had been increasing in his offending behavior, finding ways to reduce his offending in subsequent years could serve as a protective factor against problematic

alcohol use even more than it had increased in the past. Additionally, rather than focusing on reducing poor future expectations among youth, it may be more important to provide resources and support to increase youths' positive future expectations (perhaps in other domains) as means of reducing problematic marijuana use. Indeed, prior work has linked greater hope for the future to lower rates of substance use (Carvajal et al., 1998; Wilson et al., 2005). Further, hope-focused intervention strategies have been found to play a critical role in substance use counseling for adolescents (Koehn, O'Neill, & Sherry, 2012).

Interestingly, however, this study found that most associations between predictors and substance use are symmetric, where the effects of increasing or decreasing the risk and protective factors are similar. Finding that most associations are symmetric informs intervention and treatment efforts that the negative effects from a lack of protective factors or an increase of risk factors are reversible. That is, even when a youth experiences increased risk factors, which are related to higher rates of substance use, efforts to reduce those risk factors in the next year can help lower the risk that he uses substances and help him desist from the substance use behaviors that had increased in the prior year.

Importantly, substance use does not occur in a vacuum. As individuals transition from adolescence to young adulthood, the developmental and social challenges they face also evolve. Another strength of the present study is that how the associations between predictors and substance use varied by age was assessed, providing important information on how these associations operate within the context of development. That is, the present results showed that association between less offending and lower rates of alcohol use was stronger in young adulthood than in adolescence. This highlights the importance of reducing offending among justice-system-involved young adults, as youth who continue to engage in criminal behavior in

young adulthood, when most of their peers begin to desist from antisocial activities, may not only be at greater risk for deeper involvement in the justice system but may also be more likely to continue problematic alcohol use and eventually develop chronic alcohol use problems. Thus, focusing on reducing offending when justice-system-involved youth are young adults may lower the likelihood of both chronic offending and chronic problematic alcohol use that continue into later adulthood. In contrast, the current study found that having positive expectations and hope for the future can be protective against marijuana use in both adolescence and young adulthood. While the types of goals that youth are focused on may shift across development (e.g., going to college as a goal during adolescence, having a stable job as a goal during young adulthood), having optimism about the future is critical for positive youth development (Lerner et al., 2012; Schmid, Phelps, & Lerner, 2011). Therefore, providing resources to help justice-system-involved youth be more positive about their futures throughout both adolescence and young adulthood is important and can lower the likelihood of problematic marijuana use throughout these critical developmental periods.

Lastly, the present work examined a fairly comprehensive set of predictors and youths' use of a wide variety of non-marijuana illicit drugs. No study to date has included such an extensive set of risk and protective factors and how they may be linked to within-person changes in specific types of illicit drugs. This was made possible by combining data from the Pathways to Desistance and the Crossroads studies, which provided a large enough base rate for specific types of non-marijuana illicit drugs. Importantly, when the results were conducted separately for each study, results were similar (see Supplemental Table 1.1). The current study demonstrates that unique predictors are associated with specific types of substance use, suggesting that youth who do engage in illicit substance use at certain periods in their lives may need individually

tailored intervention and treatment plans based on the type of substance or substances that they are using.

STUDY TWO

Research Rationale

When major catastrophes or devastating pandemics hit, people are impacted physically and psychologically by the event itself as well as by the resulting social disorder and emotional distress. Given the major disruptions to day-to-day functioning, considerable negative economic impact, and reduced sense of safety and security, it is not surprising that levels of depression, anxiety, stress, and, in turn, substance use tend to increase during and after these calamities (De Goeij et al., 2015; Foa et al., 2006; Maeda & Oe, 2017; Parslow & Jorm, 2006). Indeed, nearly 60% of Manhattan residents experienced at least one PTSD symptom following the terrorist attacks of September 11, 2001 (Galea et al., 2002), and approximately 25% of New Yorkers reported increased levels of cigarette, alcohol, and marijuana use during the six months following 9/11 (Vlahov et al., 2004). The 2003 SARS and 2014 Ebola epidemics were also associated with elevated psychological distress and worry (Lee et al., 2007; Thompson et al., 2017).

It is thus not surprising that scientists, public health officials, and policymakers expect similar effects from the COVID-19 pandemic (Gruber et al., 2020; Ornell et al., 2020). One study, which used a sample in China, found that shortly after the initial COVID-19 outbreak, approximately 1 in 6 citizens reported moderate to severe depressive symptoms, almost 1 in 3 reported moderate to severe anxiety symptoms, and 1 in 12 reported moderate to severe stress levels (Wang et al., 2020). A review by (Vindegaard & Benros, 2020) also showed that psychological well-being among the general public was lower during COVID-19 compared to before the pandemic, and individuals reported higher anxiety and depression scores during the pandemic relative to pre-pandemic levels. In light of the heightened emotional distress, fear, and

anxiety surrounding the COVID-19 pandemic, it is critical to assess how increases in psychological strain may elicit changes in substance use behaviors.

Psychological Distress and Substance Use

Psychological distress such as depression, anxiety, or stress has been consistently found to be a strongly associated with substance use (Fleming et al., 2008; Green et al., 2012; Marmorstein, 2010; Page et al., 2011). For example, higher rates of lifetime and daily cigarette use were observed among adults with serious symptoms of depression and anxiety (Hagman et al., 2008). In another study by Degenhardt et al. (2001), tobacco use was closely linked to higher rates of anxiety and affective disorders, despite controlling for demographics, comorbid use of other substances, and neuroticism. Studies on alcohol use have found similar associations, finding that greater psychological distress is related to a higher likelihood of alcohol use disorder among young adults (Jackson & Sher, 2003). Higher levels of depression and anxiety symptoms have also been linked to cannabis use among young adults (Beck et al., 2009; Bonn-Miller et al., 2014), as well as increased risk of non-marijuana illicit substance use such as methamphetamine, cocaine, and nonprescription use of painkillers and tranquilizers (Booth et al., 2010; Conway et al., 2006; Domier et al., 2000; Falck et al., 2002).

A theory that has been posited to explain the strong link between psychological distress and substance use is the Self-Medication Hypothesis (Khantzian, 1987). The Self-Medication Hypothesis was first proposed to explain why clinical patients were addicted to heroin, with scholars concluding that heroin was being used by patients as a coping mechanism to relieve symptoms of anxiety, depression, and other suffering (Khantzian et al., 1974). Khantzian (2003) later expanded this theory to encompass substance use disorders more broadly. In essence, the Self-Medication Hypothesis suggests that the underlying mechanism for the association between

psychological distress and substance use is an individual's desire to use drugs to alleviate and cope with depression, anxiety, and stress. More recently, Alexander and Ward (2018) proposed a conceptual model where disaster exposure predicted greater psychological distress which in turn increased individuals' perceptions of self-medication, consequently resulting in elevated substance use levels.

Findings from recent empirical studies on the impacts of catastrophes and disasters lend support to this pathway. In a study of individuals who were directly exposed to 9/11 in New York, findings indicated that 9/11-related PTSD symptoms were associated with self-medication with alcohol (Garrey et al., 2020). After the 2010 Chilean Earthquake, individuals who lived near the earthquake's epicenter also reported increased substance use (Garfin et al., 2014). Results from a study examining changes in substance use prevalence during the COVID-19 pandemic in China revealed that approximately 32% of regular drinkers increased alcohol use and nearly 20% of regular smokers increased cigarette use (Sun et al., 2020). Overall, there is robust evidence linking disaster- and pandemic-related psychological distress and substance use. However, thus far few studies have empirically assessed how the 2019 coronavirus pandemic has impacted substance use, and those that have examined these impacts have focused on cigarette smoking and alcohol use. It will also be important to investigate a broader range of substance use behaviors including marijuana use and non-marijuana illicit drug use.

COVID-19 and Substance Use Among Justice-system-involved Young Adults

People all over the world have been impacted by the COVID-19 pandemic. More than just the direct physical health impacts resulting from the virus, this global pandemic has required many countries to take swift, preventative action to combat the spread of the virus. In the United States, many states issued shelter-in-place orders, resulting in disruptions to work, school,

childcare, and many other services for citizens. While every individual has been impacted by the virus in some way, certain subpopulations may have incurred greater hardships than others. In particular, justice-system-involved young adults—those who were charged with or convicted of a crime—may be more likely to be furloughed or fired from their jobs, experience major disruptions to their education, or lose access to services such as mental health treatment during the pandemic (Chung et al., 2005; Sampson & Laub, 1990; Tschopp et al., 2007; Zajac et al., 2015). Given the psychological distress that these disturbances can cause (Brooks et al., 2020; Reneflot & Evensen, 2014; Wang et al., 2020), young adults' substance use behaviors are likely to have been impacted in some way by COVID-19. That is, young adults who experienced greater depression and/or anxiety during the pandemic might be more likely to exhibit increases in substance use than those with fewer symptoms.

In addition to disruptions to work and school, the majority of entertainment and recreational facilities were closed or severely restricted. The limitations in previously enjoyable activities likely contributed to psychological distress and reduced the frequency of novel and exciting experiences. This may particularly impact the wellbeing of high sensation seeking individuals. Extant research has found higher levels of sensation seeking among justice-system-involved youth (Robbins & Bryan, 2004), which is associated with elevated substance use behaviors (Crawford et al., 2003; Dunlop & Romer, 2010). Therefore, justice-system-involved young adults who are higher in sensation seeking may have been more likely to increase substance use behaviors during the pandemic than those with lower levels of sensation seeking.

On the other hand, having more positive future expectations and higher motivation to succeed might serve as protective factors for individuals. Indeed, prior work has found that more positive future expectations and greater motivation to succeed are linked to reduced substance

use behaviors among young adults (Kim & Kim, 2020; McDade et al., 2011; McKay, 2017; Sussman et al., 2004). Thus, youth may have been less likely to increase in substance use during COVID-19 if they had more to look forward to after the pandemic.

Aims and Hypotheses

The overarching goal of this study was to determine how certain risk and protective factors were related to how the COVID-19 pandemic impacted justice-system-involved young adults' use of cigarettes, alcohol, marijuana, and other illicit drugs. The first research aim was to assess whether young adults exhibited changes in their use of cigarettes, alcohol, marijuana, and other illicit drugs from before versus during the pandemic. I hypothesized that all types of substance use would increase during the pandemic. The second research aim was to examine whether risk factors such as depressive symptoms, anxiety symptoms, and sensation seeking, as well as protective factors like future expectations and motivation to succeed would be associated with whether some young adults increase in substance use while others do not. It was hypothesized that individuals with greater depressive symptoms, greater anxiety symptoms, and higher levels of sensation seeking would be more likely to have increased in their substance use during COVID-19. Further, it was expected that youth with more positive future expectations and greater motivation to succeed would be less likely to have increased in substance use during the pandemic.

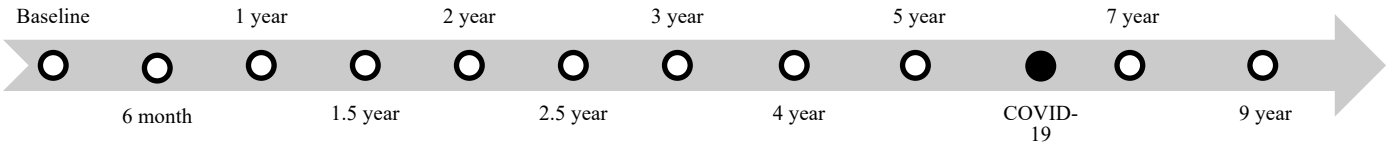
Method

Participants and Procedures

The present study used existing longitudinal data from the Crossroads study, enabling a prospective analysis of substance use before versus during the COVID-19 pandemic. The details regarding sampling and procedures of the Crossroads Study were previously described in Study

One. To separate pre-COVID versus during COVID data, the present study used March 11, 2020 which marked date when the World Health Organization declared COVID-19 a global pandemic. That is, pre-COVID data included data from interviews collected before March 11, 2020, and interviews with recall periods that began after March 11, 2020 provided the data on youths' behaviors during COVID-19. Figure 2.1 provides a timeline of the Crossroads Study interviews in relation to March 11, 2020 when COVID-19 was declared a global pandemic.

Figure 2.1.
Timeline of Crossroads Interviews and COVID-19



Measures

Data for Study Two were drawn from the baseline through the 9-year interviews from the Crossroads Study. Future expectations, age, race/ethnicity, facility time, and recall length were examined using the same measures from Study One (see pages 18-24). Additional measures used for Study Two are described below.

Substance Use. Participants were asked to self-report on the frequency with which they engaged in different types of substance use during each recall period using the Substance Use/Abuse Inventory (Chassin et al., 1991). Response options ranged from 0 "Not at All" to 8 "Every Day." Since there was a low base rate of different types of non-marijuana illicit drug use, the different types were collapsed into one non-marijuana illicit drug use category.

Depressive Symptoms. Depressive symptoms were measured using 10 items from the Revised Child Anxiety and Depression Scale (Chorpita et al., 2000). Participants were asked to self-report how often each of the items happened for them during the recall period, with

responses ranging from 0 “Never” to 3 “Always.” Depressive symptoms such as feelings of worthlessness, anhedonia, emptiness, and sleep disturbances were assessed (e.g., “Nothing is much fun anymore.”). Scores from the 10 items were summed to create an overall depressive symptoms score during each recall period, with higher scores representing greater symptoms of depression. Internal consistency was acceptable across the study (mean $\alpha = 0.851$, range = 0.81-0.89).

Anxiety Symptoms. Anxiety symptoms were measured using 6 items from the Revised Child Anxiety and Depression Scale (Chorpita et al., 2000). Participants self-reported how often each of the items happened for them during the recall period. Anxiety symptoms included general worries as well as worries about catastrophic events befalling themselves or loved ones (e.g., “I worry about what is going to happen.”). Responses ranged from 0 “Never” to 3 “Always.” Scores from the 6 items were summed to create an overall anxiety symptoms score during each recall period, with higher scores indicating greater anxiety symptoms. Internal consistency was acceptable across the study (mean $\alpha = 0.829$, range = 0.80-0.84).

Sensation Seeking. Youths’ levels of sensation seeking were examined using 6 items from Zuckerman et al. (1978)’s Sensation Seeking Scale that assess thrill-seeking or novelty-seeking behaviors, as was done in Steinberg et al. (2008). Participants self-reported whether each of the items was true for them (e.g., “I like new and exciting experiences and sensations even if they are a little frightening.”). Scores from the 6 items were summed to create an overall sensation seeking score, with higher scores indicating a greater propensity for sensation seeking. Internal consistency was acceptable across the study (mean $\alpha = 0.760$, range = 0.70-0.79).

Motivation to Succeed. Motivation to succeed was measured using the Motivation to Succeed scale (Eccles et al., 1998). Participants were asked to respond to 6 items about their

perceptions of academic and occupational opportunities in their neighborhoods (e.g., "My chances of getting ahead and being successful are not very good."). Responses were on a 5-point Likert scale from 1 "Strongly Disagree" to 5 "Strongly Agree." Some items were reversed scored, and scores from the 6 items were summed to create an overall motivation to succeed score. Higher scores indicate a greater motivation to succeed. Internal consistency was acceptable across the study (mean $\alpha = 0.686$, range = 0.60-0.74).

Highest Parent Education. The highest level of education that participants' parents achieved was used as a proxy for socioeconomic status and was included as a covariate in the present analyses (Galobardes et al., 2007). The highest level of education obtained by either parent was used as the indicator of socioeconomic status. Approximately 27.83% of participants reported that neither of their parents had graduated from high school and 72.17% of participants reported that at least one parent had graduated from high school.

Plan of Analysis

Generalized estimating equation (GEE) population-averaged models were first used to examine whether young adults' use of different types of substances increased, decreased, or remained at pre-pandemic levels. Second, to test for moderations by depression, anxiety, sensation seeking, future expectations, and motivation to succeed, interaction terms (e.g., sensation seeking x time) were added to the GEE models. Age, race/ethnicity, highest parent education, recall length, and facility time were included as covariates in all models. Descriptive statistics of study variables are presented in Tables 2.1 and 2.2.

Table 2.1.
Rates of Substance Use Before vs. During COVID-19.

Substance Use	Before COVID-19		During COVID-19	
	%	*SD*	*%*	*SD*
Cigarette Use	31.35%	0.46	26.38%	0.44

Alcohol Use	48.89%	0.50	72.11%	0.45
Marijuana Use	43.78%	0.50	50.85%	0.50
Other Illicit Drug Use	13.27%	0.34	15.75%	0.36

Table 2.2.
Descriptive Statistics of Moderators and Covariates.

	M / %	*SD*	Min	Max
Moderators				
Depressive Symptoms	5.37	4.82	0.00	30.00
Anxiety Symptoms	4.68	3.76	0.00	21.00
Sensation Seeking	3.78	1.87	0.00	6.00
Future Expectations	4.02	0.82	1.00	5.00
Motivation to Succeed	3.62	0.63	1.00	5.00
Age	18.10	2.71	13.00	27.00
Race/Ethnicity				
White	14.80			
Black	36.92			
Latino	45.81			
Other	2.47			
Highest Parent Education				
No HS Degree	29.16			
HS Degree or Higher	70.84			
Recall Length				
6 Months	69.74			
12 Months	18.10			
24 Months	12.17			
Facility Time	0.05	0.19	0.00	1.00

Results

Research Aim 2.1.

The first research aim was to examine whether young adults reported changes in their use of cigarettes, alcohol, marijuana, and other illicit drugs during the COVID-19 pandemic. It was expected that young adults would increase in all types of substance use during the pandemic. GEE population-averaged models were used to determine whether young adults' use of different types of substances significantly changed during the pandemic. Age, race/ethnicity, highest parent education, recall length, and facility time were included as covariates. Results showed that alcohol and marijuana use tended to increase during the COVID-19 pandemic, while there were no significant changes in cigarette and non-marijuana illicit drug use (Figure 2.2, Table 2.3).

Figure 2.2.
Substance Use Frequencies Before vs. During the COVID-19 Pandemic.

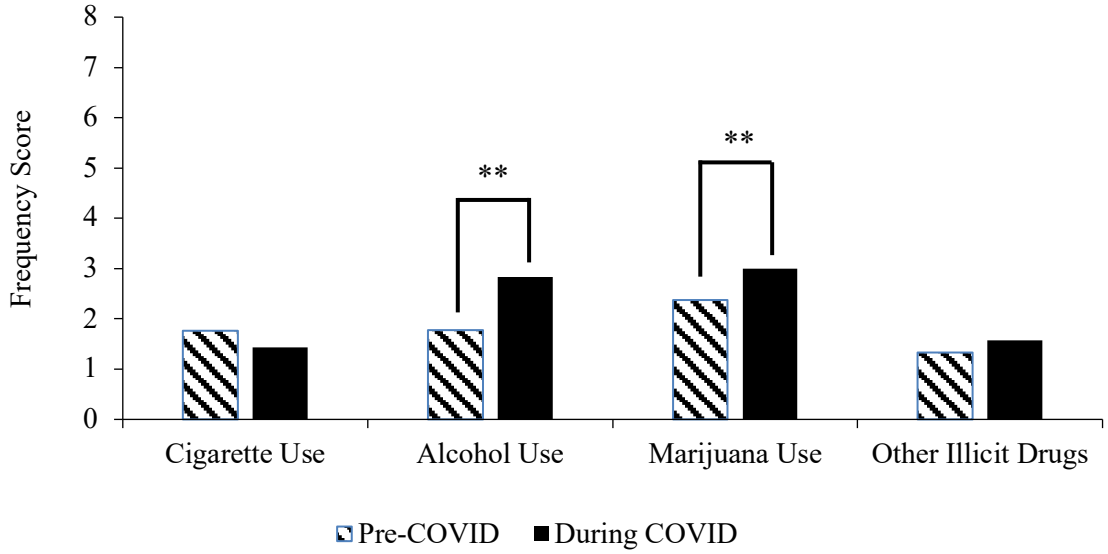


Table 2.3.
GEE Population-averaged Models with Time (Before vs. During COVID-19) Predicting Substance Use.

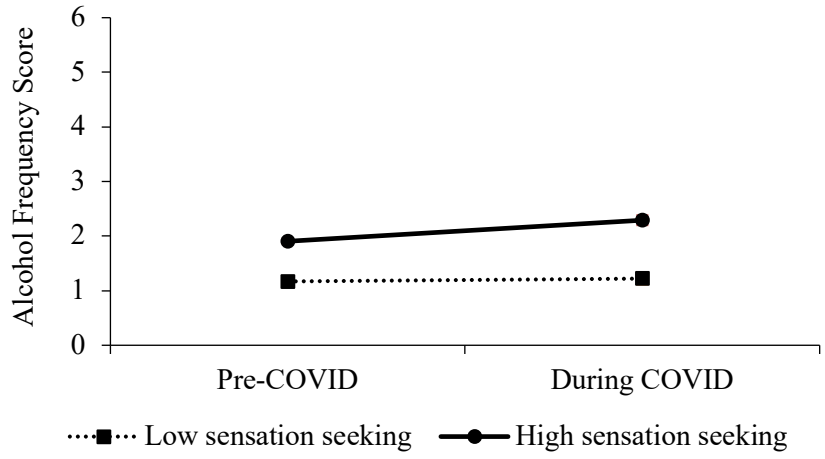
	B	*SE*	95% CI	
Cigarette Use	-0.03	0.04	-0.10	0.05
Alcohol Use	0.11	0.04	0.03	0.18
Marijuana Use	0.12	0.03	0.06	0.18
Other Illicit Drug Use	0.14	0.17	-0.18	0.47

Research Aim 2.2.

The second research aim was to identify whether depressive symptoms, anxiety symptoms, sensation seeking, future expectations, and motivation to succeed moderated the association between time (pre- vs. during-COVID) and substance use. It was hypothesized that youth who reported greater depressive symptoms, anxiety symptoms, and sensation seeking would be more likely to have increased in substance use during COVID-19. However, youth who had more positive future expectations and greater motivation to succeed would be less likely to have increased in substance use during the pandemic. Interaction terms between time and the respective moderator were added to each of the GEE population-averaged models from Research

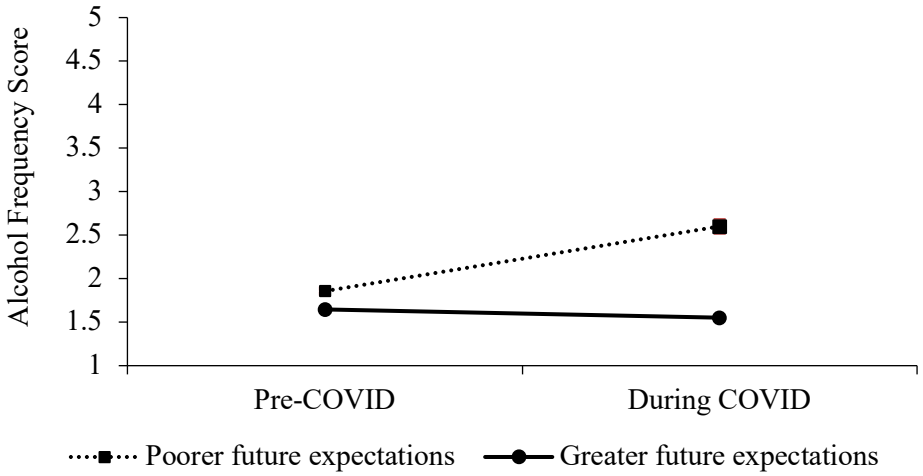
Aim 2.1. Age, race/ethnicity, highest parent education, recall length, and facility time were included as covariates. Separate models were conducted for each type of substance use. Results indicated that sensation seeking (X^2=8.43, p=0.004) and future expectations (X^2=5.27, p=0.022) were significant moderators in the models with alcohol use as the outcome. Specifically, young adults who reported greater sensation seeking were more likely to increase in alcohol use during the pandemic compared to lower sensation seeking individuals (Figure 2.3). Next, young adults with poorer future expectations were more likely to increase in alcohol use during COVID-19 compared to individuals with more positive future expectations (Figure 2.4). Depressive symptoms, anxiety symptoms, and motivation to succeed did not emerge as significant moderators.

Figure 2.3.
Sensation Seeking Moderating the Association Between Time (Before vs. During COVID-19) and Alcohol Use.



Note. A continuous measure of sensation seeking was used in the analyses. "Low" and "high" classifications of sensation seeking were calculated using values one standard deviation above and below the mean and were used here for illustrative purposes.

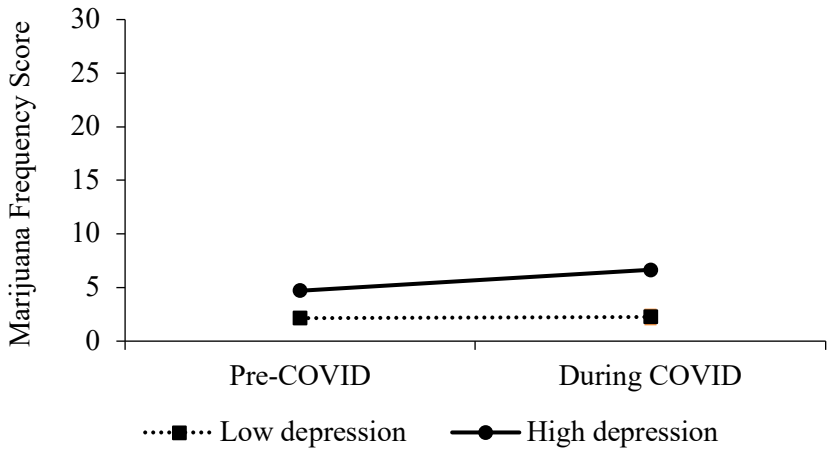
Figure 2.4.
Future Expectations Moderating the Association Between Time (Before vs. During COVID-19) and Alcohol Use.



Note. A continuous measure of future expectations was used in the analyses. "Poorer" and "Greater" classifications of future expectations were calculated using values one standard deviation above and below the mean and were used here for illustrative purposes.

For marijuana use models, findings showed that depressive symptoms (X^2=7.37, p=0.007), anxiety symptoms (X^2=4.80, p=0.028), and sensation seeking (X^2=5.41, p=0.020) were significant moderators. In particular, young adults who reported more depressive symptoms were more likely to increase in marijuana use during the pandemic compared to those with fewer depressive symptoms (Figure 2.5). Similarly, young adults with greater anxiety symptoms were more likely to increase in marijuana use during COVID-19 compared to individuals with fewer anxiety symptoms (Figure 2.6). Lastly, young adults who were higher in sensation seeking were more likely to increase in marijuana use compared to lower sensation seeking individuals (Figure 2.7). Future expectations and motivation to succeed did not emerge as significant moderators.

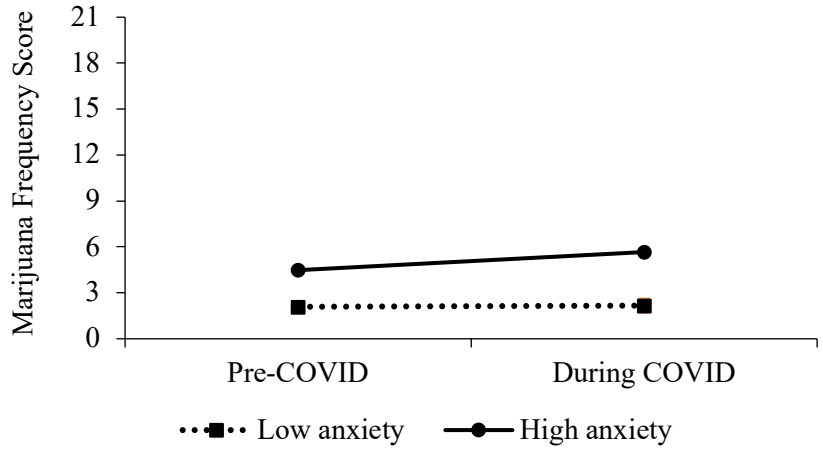
Figure 2.5.
Depressive Symptoms Moderating the Association Between Time (Before vs. During COVID-19) and Marijuana Use.



Note. A continuous measure of depressive symptoms was used in the analyses. "Low" and "high" classifications of depressive symptoms were calculated using values one standard deviation above and below the mean and were used here for illustrative purposes.

Figure 2.6.

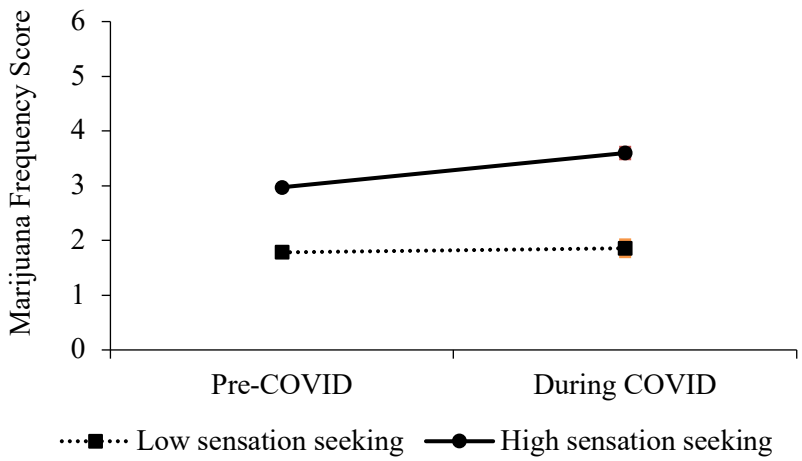
Anxiety Symptoms Moderating the Association Between Time (Before vs. During COVID-19) and Marijuana Use.



Note. A continuous measure of anxiety symptoms was used in the analyses. "Low" and "high" classifications of anxiety symptoms were calculated using values one standard deviation above and below the mean and were used here for illustrative purposes.

Figure 2.7.

Sensation Seeking Moderating the Association Between Time (Before vs. During COVID-19) and Marijuana Use.



Note. A continuous measure of sensation seeking was used in the analyses. "Low" and "high" classifications of sensation seeking were calculated using values one standard deviation above and below the mean and were used here for illustrative purposes.

Discussion

COVID-19 has had a significant impact on the daily lives of individuals around the globe. The preventative actions that governing bodies have been forced to take to fight the spread of the virus have included shelter-in-place orders, social distancing, and closure of the majority of schools and businesses. These changes are among the most drastic that anyone has seen in the U.S. in recent decades. Indeed, the present results show that levels of alcohol and marijuana use increased during the COVID-19 pandemic among justice-system-involved young adults. In line with my hypothesis, higher sensation seeking young adults were more likely than those who reported lower levels of sensation seeking to increase alcohol and marijuana use. Perhaps youth who have greater novelty-seeking and thrill-seeking behaviors used alcohol and marijuana to cope with boredom during the pandemic (Bizzarri et al., 2007; Byck et al., 2015), as nearly all entertainment and recreational were severely restricted or suspended.

Young adults who reported greater depressive and anxiety symptoms were also more likely to have increased in marijuana use than others who had fewer symptoms. Perhaps youth were self-medicating with marijuana to relieve the psychological distress that was brought on by

the pandemic (Khantzian, 2003; Khantzian et al., 1974). However, symptoms of depression and anxiety did not significantly moderate the association between time and alcohol use. This is surprising given the abundance of prior studies that have linked depression and anxiety coping motives to alcohol use (Grant et al., 2009; Ribadier & Varescon, 2019). However, some studies have also found that young adults are actually more likely to use marijuana rather than alcohol for coping reasons, as alcohol use is more likely to be tied to social motives (Patrick et al., 2018; Patrick et al., 2020; Skalisky et al., 2019). Marijuana may also have been used for coping more so than alcohol as, in more recent years, the belief that marijuana is less risky than alcohol has become more prevalent (Lee et al., 2009).

The present findings also show that youth with poorer future expectations are more likely to have increased in alcohol use during the pandemic compared to their peers with more positive future expectations. This result aligns with my hypothesis and existing literature that has found links between expectations of the future and alcohol consumption (Cerqueira et al., 2022; Chen & Vazsonyi, 2013; Robbins & Bryan, 2004). As described by the theory of future discounting (Hill et al., 1997), youth who have less to look forward to in their futures are more likely to discount negative future consequences of drinking and focus on the immediate benefits such as suppressing negative emotions and thoughts of hopelessness about the future. Surprisingly, future expectations did not moderate the association between time and marijuana use. A possible explanation is that perceptions that marijuana is less risky than alcohol are increasing, with recent data showing that only 21% of 12th graders reporting that occasional marijuana use is detrimental and only 44% perceiving daily use as harmful (Johnston et al., 2015; Kuehn, 2013). Thus, young adults' future expectations may not be related to their marijuana use behaviors if they do not perceive marijuana as risky and therefore do not need to make the trade-off between

short-term rewards (e.g., feeling high) and future consequences (e.g., less likely to succeed in school or work). That is, even young adults with positive future expectations may be using marijuana since they may not consider it risky or harmful.

In contrast to increases in alcohol and marijuana use during the pandemic, results of the present study indicate that cigarette and non-marijuana illicit drug use did not change significantly during COVID-19. Perhaps young adults' perceptions that alcohol and marijuana use are less harmful than cigarette and non-marijuana illicit drugs made them more likely to turn towards alcohol and marijuana use to cope with the psychological distress resulting from the pandemic and away from other substances (Johnston et al., 2015). In addition, shelter-in-place orders throughout the nation likely reduced access to non-marijuana illicit substances as youth were less able or unable to purchase drugs illegally in the streets.

Results from this study suggest that individuals higher in depressive and anxiety symptoms are more likely to increase marijuana use during COVID-19, suggesting the importance of providing justice-system-involved youth (who are particularly vulnerable to disruptions to services) with uninterrupted or even greater access to mental health services during a pandemic or other disastrous event. Further, finding healthy outlets for individuals to engage in novel and thrilling activities is also important when entertainment and recreational facilities are severely restricted. More positive future expectations also appeared to be a protective factor against increased alcohol use during the pandemic, suggesting that providing resources and support for individuals during disastrous events to increase hope and more optimistic outlooks after the pandemic can be important to prevent increased problematic drinking.

Although this study focuses on substance use changes due to COVID-19, findings can inform our understanding of how catastrophes, disasters, and pandemics impact substance use more broadly. The psychological distress, reductions in available services, and shelter-in-place orders are not unique to COVID-19, and natural disasters and wars can have similar impacts on individuals' lives. As such, the present study provides insight on how vulnerable populations such as justice-system-involved individuals may be impacted by other types of disasters or catastrophes.

Despite the contributions of the present study, it is important to consider several limitations. First, the present study examined a sample of justice-system-involved male youth, so results may not be generalizable to other populations (e.g., female, community). However, justice-system-involved young adults are greater of risk of being furloughed or fired from their jobs, experiencing major disruptions to their education, or losing access to services such as mental health treatment during the pandemic (Chung et al., 2005; Sampson & Laub, 1990; Tschopp et al., 2007; Zajac et al., 2015). As such, the present study provides a better understanding of the unique impacts that a pandemic can have on these high-risk individuals and findings can inform how to best address their needs when resources are especially limited. Second, the present study was only able to assess how substance use changed from before versus during COVID-19, but not how youths' substance use behaviors might or might not change again after the pandemic. It is possible that alcohol and marijuana use may decrease to pre-pandemic levels once the majority of the pandemic-related stressors and restrictions dissipate. However, it is also possible that alcohol and marijuana use may remain at elevated levels if youth become accustomed to using substances as a means of coping with stress and negative feelings. Therefore, it will be important for longitudinal studies on the impacts of COVID-19 to

examine longer term shifts in substance use behaviors. Third, other important moderators such as the extent to which individuals suffered direct, severe consequences of the pandemic (e.g., contracting COVID-19, family member dying of COVID-19) and social support were not assessed in the present study. Future research should consider how other key factors could be related to whether substance use behaviors changed during COVID-19.

Although there were some limitations, there were also some notable strengths in the present study. A key strength of this study is the examination of prospective longitudinal data, which allowed for a comparison of youths' pre-COVID versus during-COVID levels of substance use. Prospective data provides a more objective assessment of changes in substance use compared to asking youth to self-report on whether they perceive their behaviors to have changed. Further, the present study also examined substance use among a sample of justice-system-involved youth who tend to engage in higher levels of substance use than community samples (Chassin, 2008). As such, base rates of substance use were sufficiently high to allow an assessment of changes in non-marijuana illicit drug use, which most prior work has been unable to investigate (Garrey et al., 2020; Sun et al., 2020). Examining a justice-system-involved sample also provides the opportunity to better understand how vulnerable populations may be uniquely impacted by the pandemic and what services and support need to be provided in order to reduce maladaptive coping mechanisms and further health risks associated with substance use.

In sum, the results of the present study contribute to our understanding of how substance use behaviors among justice-system-involved youth changed as a result of the COVID-19 pandemic. Alcohol and marijuana use tended to increase during COVID-19 and youth who had higher levels of sensation seeking, greater depressive and anxiety symptoms, and poorer future expectations were more likely to increase in use during the pandemic. Identifying the individuals

who are at greater risk of increased substance use can help inform intervention efforts on who may need the most treatment and support when resources are limited. In particular, justice-system-involved youth are more likely than their non-justice-system-involved counterparts to experience loss of jobs and access to treatment services due to stigma and bias (Chung et al., 2005; Sampson & Laub, 1990; Tschopp et al., 2007; Zajac et al., 2015). Given the present findings, it is important to continue to provide mental health and substance use treatment services to justice-system-involved youth to reduce their likelihood of increased substance use and deeper, prolonged involvement in the justice system.

Conclusion

The goal of this dissertation was to understand predictors of within-person changes in substance and how substance use behaviors were impacted by COVID-19. Study One assessed how a broad range of risk and protective factors were associated with within-person changes in ten different types of substance use, including seven specific types of non-marijuana illicit drugs. Importantly, Study One identified whether the effects of any predictors were asymmetric and whether effects varied by age. Findings from Study One provide key insights into the factors that are related to why youth are more likely to use certain substances in some years and not others and when predictors of substance use are more salient from adolescence through young adulthood. Specifically, offending and peer substance use were the factors more strongly related to different types of substance use. While most predictors did not have asymmetric effects, results indicated that offending was asymmetrically associated with alcohol use and that future expectations was asymmetrically related to marijuana use. Further, decreased offending was more strongly linked to lower rates of alcohol use in young adulthood than in adolescence, and having more positive future expectations was related to decreases in marijuana use throughout

adolescence and young adulthood. Study Two examined how COVID-19 impacted substance use and whether increases in substance use were moderated by depressive symptoms, anxiety symptoms, sensation seeking, future expectations, and motivation to succeed. Results from Study Two show that alcohol and marijuana use tended to increase during the COVID-19 pandemic and sensation seeking and future expectations moderated the increases in alcohol use, while depressive symptoms, anxiety symptoms, and sensation seeking moderated the increases in marijuana use.

Overall, the findings from this dissertation can inform practice and policy in important ways. First, Study One identified the factors that are most strongly linked to within-person changes in different types of substance use. By understanding that increases in offending and peer substance use are most closely associated with within-person increases in substance use (over and above a host of other factors), intervention and treatment efforts should focus on reducing criminal behavior and discouraging friendships with substance-using peers to help youth reduce or desist from using substances. Doing so would not only help youth to decrease their own harmful, problematic substance use, but could also help steer them away from a delinquent lifestyle and keep them out of the justice system. Further, the present study found that reductions in offending have a stronger association with alcohol use than increases in offending, with the relationship being stronger in young adulthood than in adolescence. This finding suggests that reducing criminal behavior among justice-system-involved youth when they are young adults may be especially protective against problematic alcohol use behavior. Results from the current study also showed that more positive future expectations are more closely linked with marijuana use than poorer future expectations, with the association being significant through adolescence and young adulthood. Therefore, providing resources and support to justice-

system-involved youth to help them be better able to meet their future goals and thus have more positive expectations of their futures could be effective in reducing problematic marijuana use.

Next, results from Study Two identify the youth who were at greatest risk of increased substance use during COVID-19. That is, youth who have higher levels of sensation seeking, experience greater psychological distress (i.e., depression, anxiety), and have poorer future expectations were more likely to engage in higher levels of alcohol and marijuana use. Therefore, continued or increased mental health services need to be provided even when resources are limited during pandemics or disasters to reduce the costly iatrogenic effects that could have lasting impacts long after the event is over. Additionally, finding ways to meet the needs of high sensation seeking individuals is critical to reducing the likelihood that youth engage in maladaptive coping strategies like substance use. Lastly, providing resources and support to youth to encourage more optimistic expectations of life after a pandemic or other disastrous event can also reduce the likelihood of increased alcohol use which could negatively impact youths' abilities to reach their future goals.

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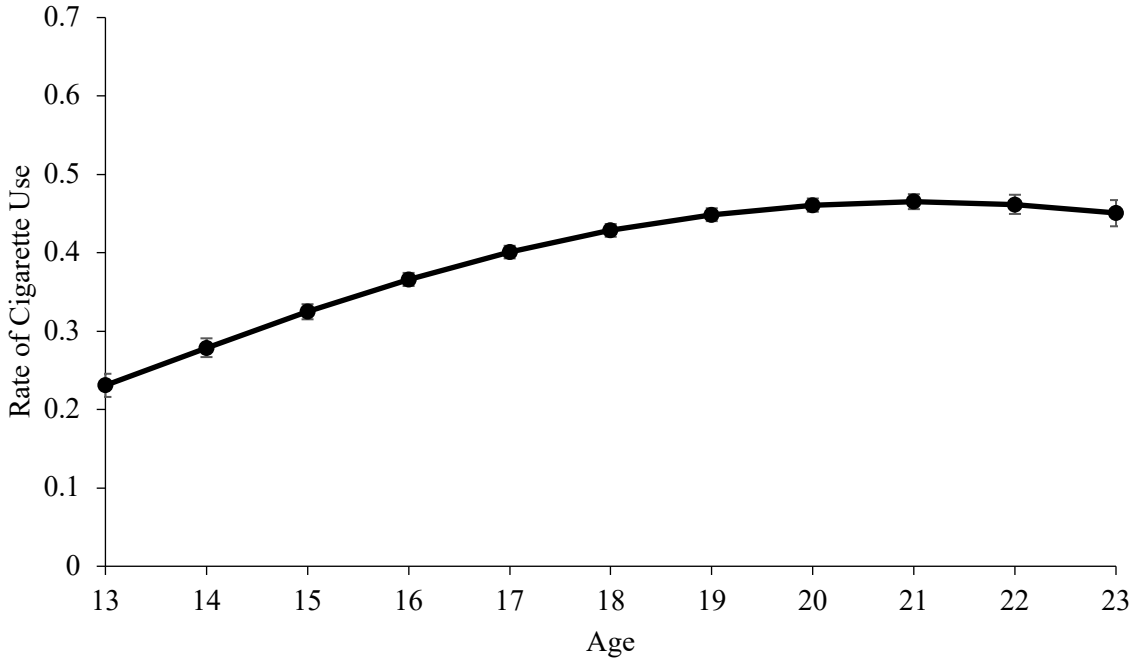
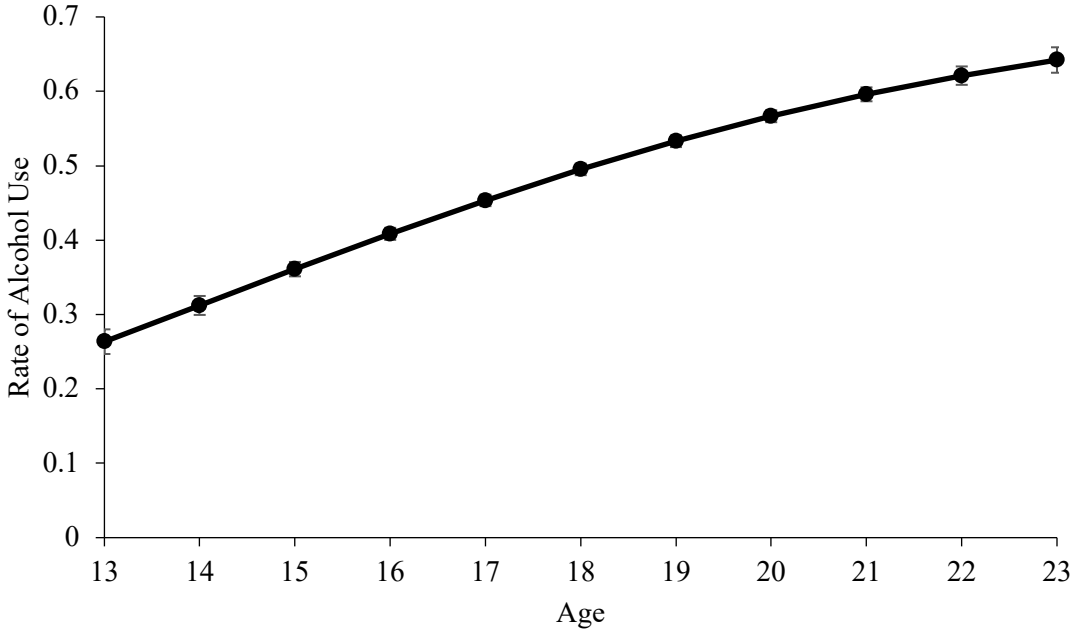
Supplemental Material

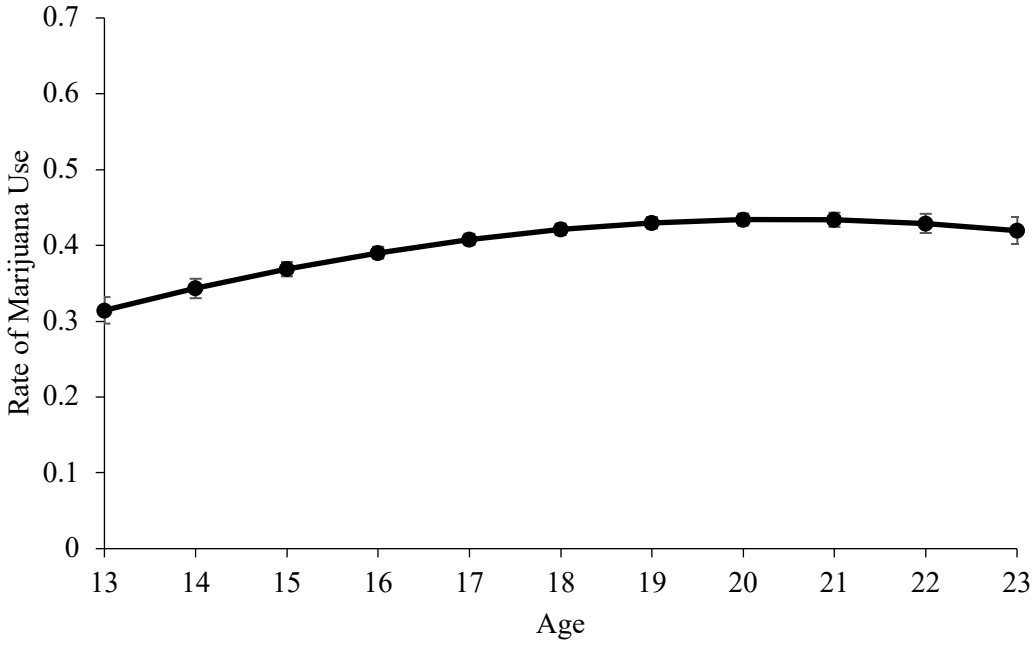
Supplemental Figure 1.1.
Rate of Cigarette Use Across Adolescence to Young Adulthood



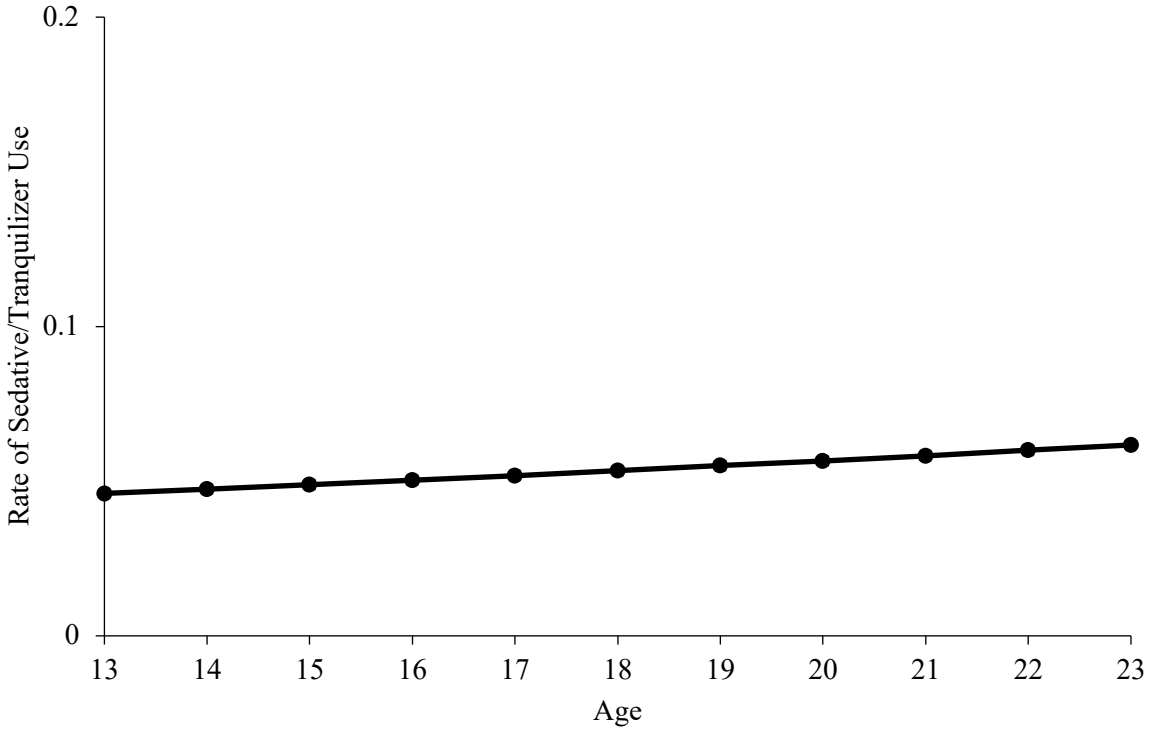
Supplemental Figure 1.2.
Rate of Alcohol Use Across Adolescence to Young Adulthood



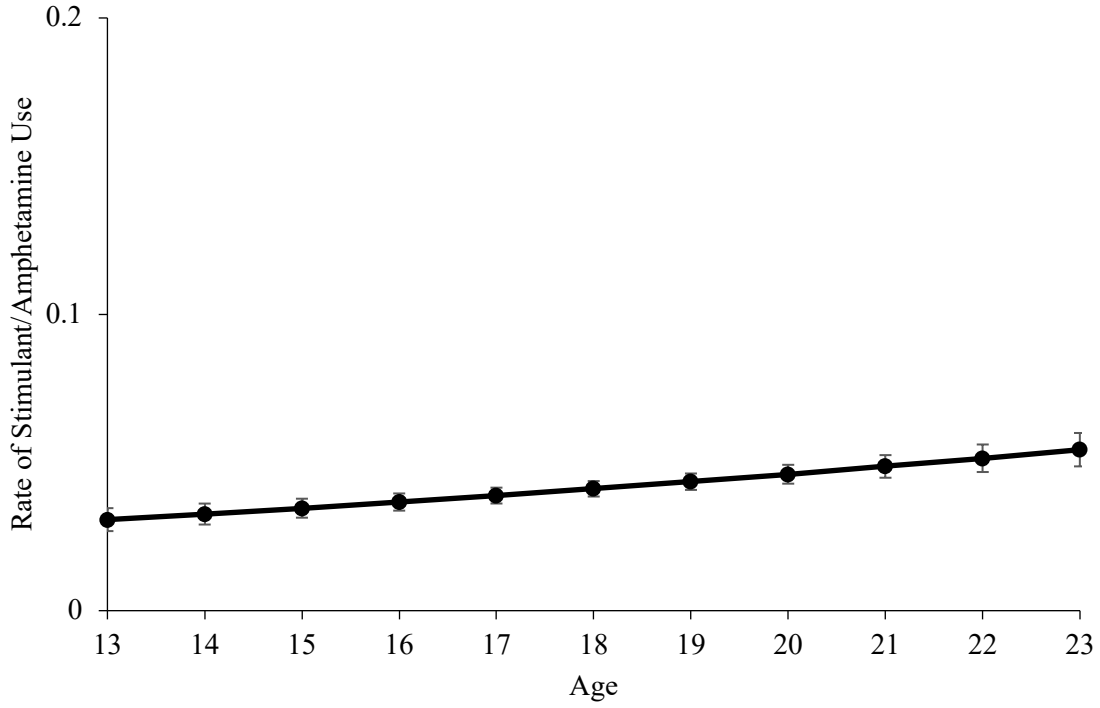
Supplemental Figure 1.3.
Rate of Marijuana Use Across Adolescence to Young Adulthood



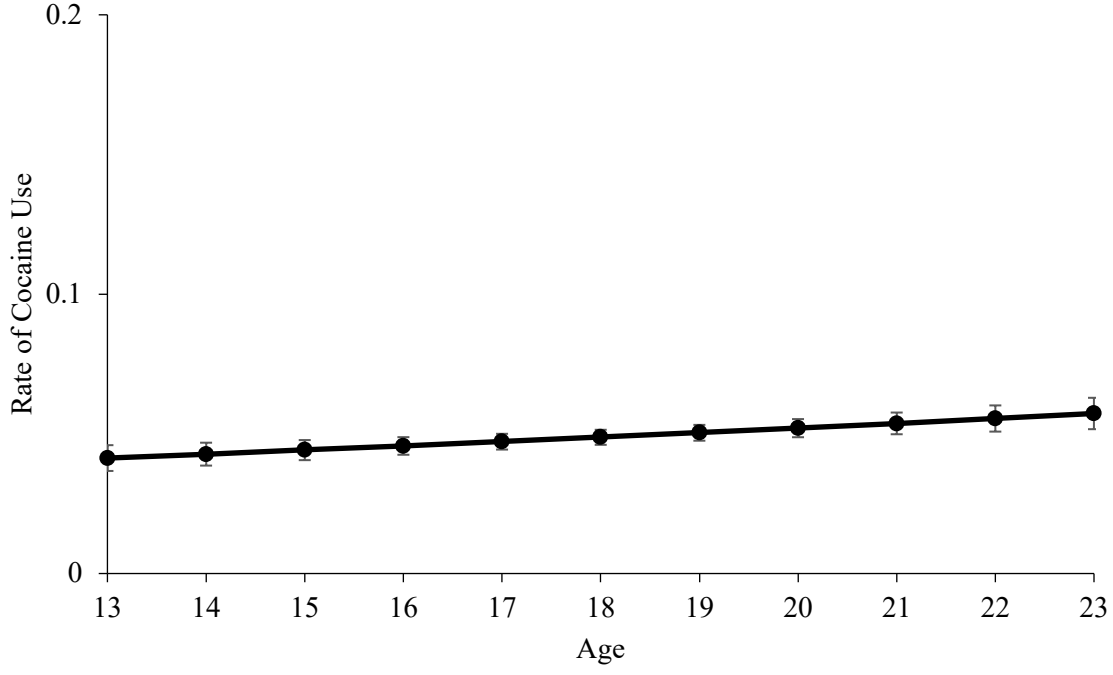
Supplemental Figure 1.4.
Rate of Sedative/Tranquilizer Use Across Adolescence to Young Adulthood



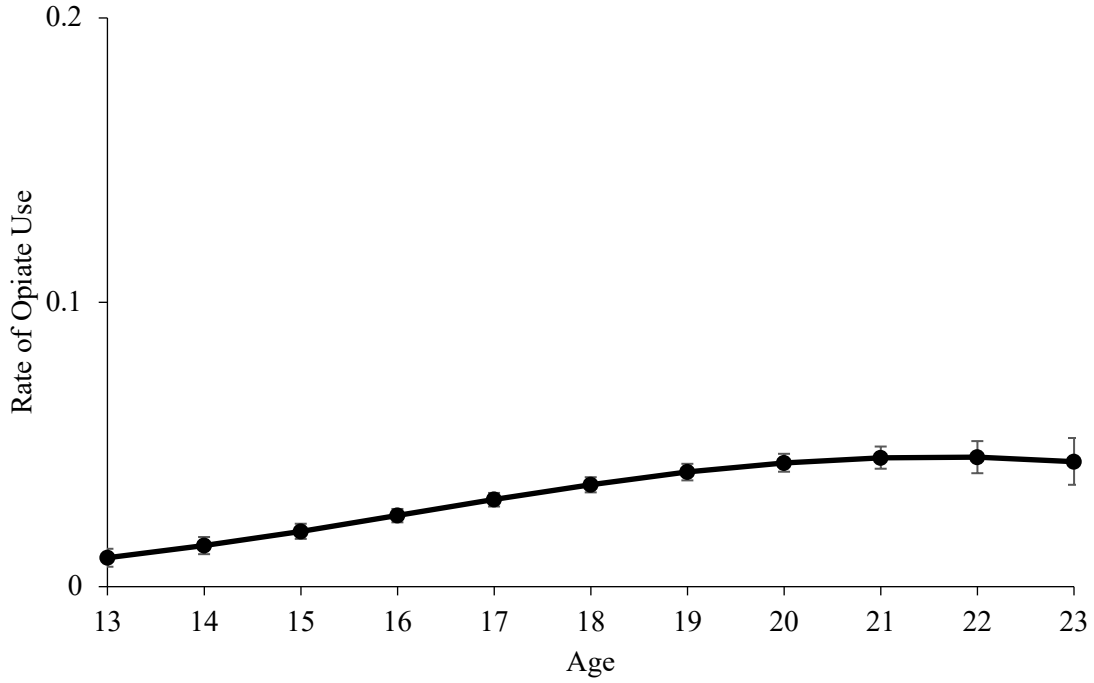
Supplemental Figure 1.5.
Rate of Stimulant/Amphetamine Use Across Adolescence to Young Adulthood



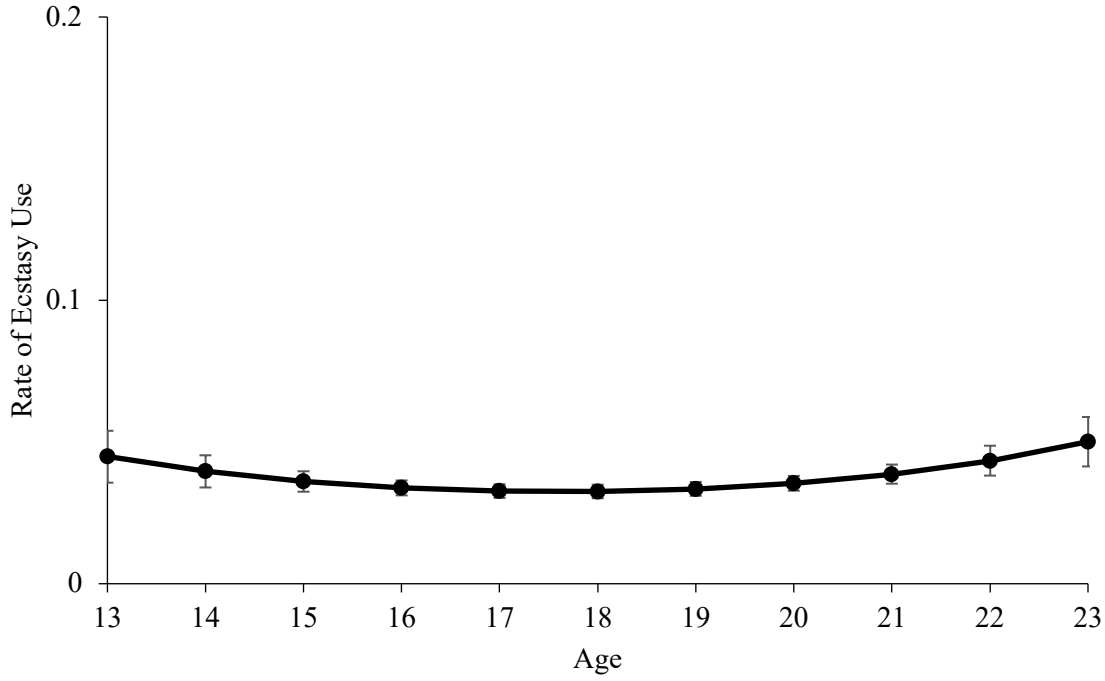
Supplemental Figure 1.6.
Rate of Cocaine Use Across Adolescence to Young Adulthood



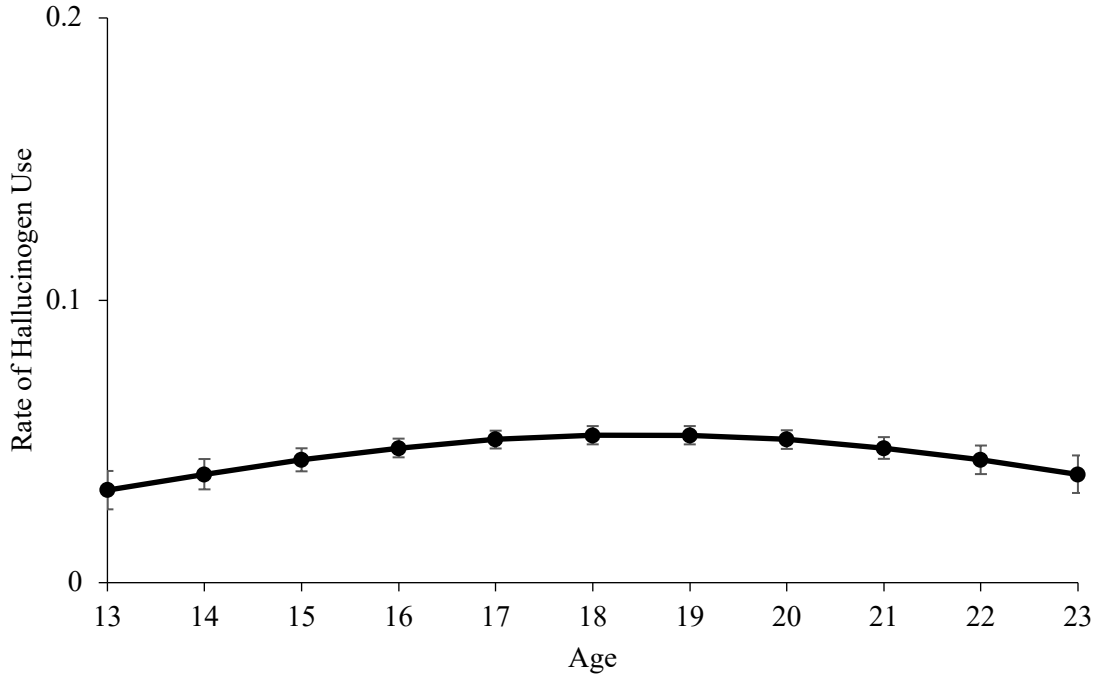
Supplemental Figure 1.7.
Rate of Opiate Use Across Adolescence to Young Adulthood



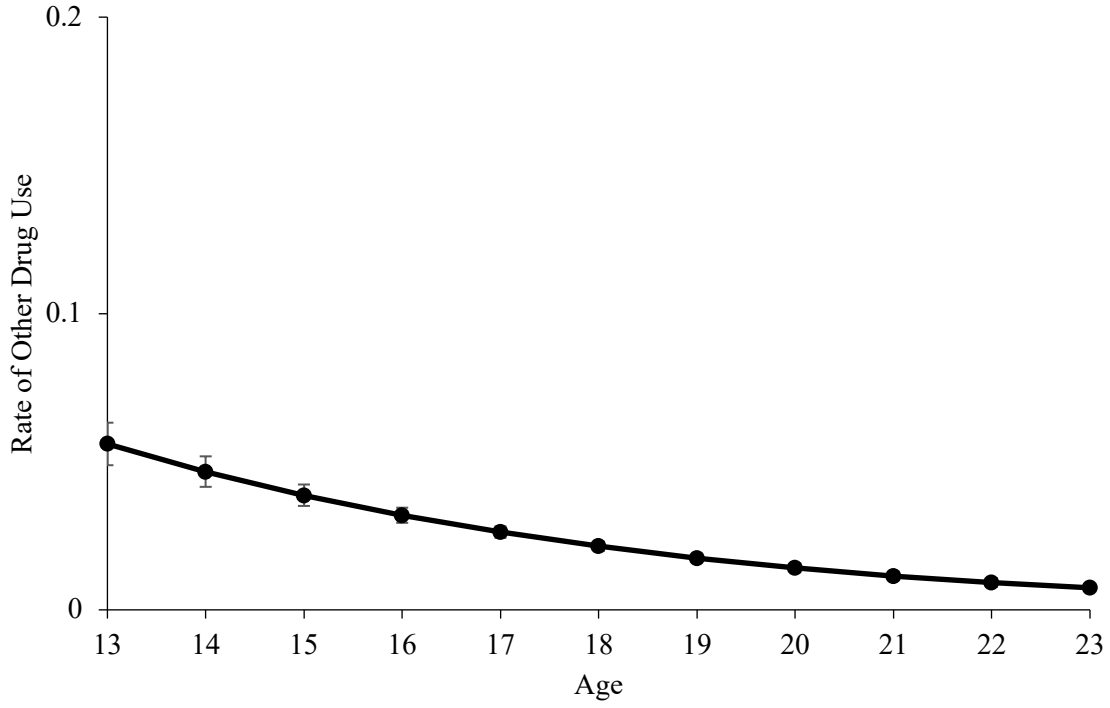
Supplemental Figure 1.8.
Rate of Ecstasy Use Across Adolescence to Young Adulthood



Supplemental Figure 1.9.
Rate of Hallucinogen Use Across Adolescence to Young Adulthood



Supplemental Figure 1.10.
Rate of Other Drug Use Across Adolescence to Young Adulthood



Supplemental Table 1.1.

Asymmetric Fixed-effects Logistic Regression Results by Study.

	Pathways to Desistance Study					**Crossroads Study**			
Cigarette Use	*B*	*SE*	95% CI			*B*	*SE*	95% CI	
Future Expectations (+)	-0.12*	0.06	-0.23	-0.01		-0.09	0.06	-0.20	0.03
Future Expectations (-)	0.10	0.05	0.00	0.20		0.19**	0.06	0.07	0.31
Probation (+)	0.01	0.05	-0.10	0.12		0.15	0.08	0.00	0.31
Probation (-)	-0.11*	0.05	-0.21	0.00		-0.23***	0.06	-0.35	-0.10
Peer Substance Use (+)	0.12*	0.05	0.02	0.23		0.14*	0.06	0.02	0.26
Peer Substance Use (-)	-0.06	0.05	-0.16	0.04		-0.26***	0.07	-0.39	-0.13
Alcohol Use	*B*	*SE*	95% CI			*B*	*SE*	95% CI	
Impulse Control (+)	-0.07	0.05	-0.18	0.03		-0.17**	0.06	-0.29	-0.05
Impulse Control (-)	0.02	0.05	-0.08	0.13		0.18**	0.07	0.04	0.32
Offending (+)	**0.01**	**0.07**	**-0.12**	**0.14**		0.15	0.11	-0.07	0.36
Offending (-)	**-0.25*****	**0.05**	**-0.35**	**-0.14**		-0.22*	0.09	-0.40	-0.05
Peer Substance Use (+)	0.36***	0.06	0.24	0.47		0.51***	0.07	0.37	0.66
Peer Substance Use (-)	-0.36***	0.06	-0.47	-0.25		-0.53***	0.07	-0.67	-0.40
Marijuana Use	*B*	*SE*	95% CI			*B*	*SE*	95% CI	
Future Expectations (+)	**-0.18****	**0.06**	**-0.29**	**-0.07**		-0.08	0.05	-0.19	0.02
Future Expectations (-)	**0.02**	**0.06**	**-0.09**	**0.13**		-0.07	0.06	-0.20	0.05
Offending (+)	0.57***	0.07	0.43	0.72		0.42***	0.11	0.20	0.65
Offending (-)	-0.44***	0.05	-0.55	-0.34		-0.52***	0.11	-0.73	-0.31
Arrest (+)	0.11*	0.05	0.02	0.20		0.05	0.06	-0.06	0.16
Arrest (-)	-0.17*	0.05	-0.27	-0.07		-0.08	0.06	-0.19	0.03
Probation (+)	-0.05	0.05	-0.16	0.05		-0.07	0.09	-0.25	0.11
Probation (-)	0.22***	0.05	0.13	0.32		0.02	0.06	-0.10	0.14
Peer Substance Use (+)	0.27***	0.06	0.15	0.38		0.54***	0.06	0.42	0.67
Peer Substance Use (-)	-0.19***	0.05	-0.29	-0.09		-0.54***	0.06	-0.66	-0.41
Sedative/Tranquilizer Use	*B*	*SE*	95% CI			*B*	*SE*	95% CI	
Offending (+)	0.45***	0.11	0.24	0.66		0.27*	0.12	0.04	0.50
Offending (-)	-0.23**	0.08	-0.38	-0.08		-0.24*	0.11	-0.45	-0.02
Peer Substance Use (+)	0.06	0.12	-0.17	0.30		0.20	0.14	-0.07	0.47
Peer Substance Use (-)	-0.30**	0.10	-0.49	-0.11		-0.33*	0.14	-0.61	-0.05
Employment (+)	0.11	0.12	-0.14	0.35		0.02	0.13	-0.23	0.27
Employment (-)	-0.28*	0.11	-0.49	-0.06		0.16	0.14	-0.12	0.44
Stimulant/Amphetamine Use	*B*	*SE*	95% CI			*B*	*SE*	95% CI	
Future Expectations (+)	-0.23	0.12	-0.46	0.01		-0.03	0.22	-0.46	0.39
Future Expectations (-)	0.29*	0.14	0.02	0.55		0.33*	0.15	0.04	0.61
Impulse Control (+)	-0.19	0.13	-0.44	0.06		-0.36*	0.17	-0.70	-0.02
Impulse Control (-)	0.17	0.13	-0.09	0.43		0.13	0.14	-0.15	0.41
Offending (+)	0.36**	0.12	0.13	0.60		0.16	0.16	-0.16	0.47
Offending (-)	-0.35***	0.08	-0.52	-0.19		-0.32*	0.14	-0.61	-0.04
Cocaine Use	*B*	*SE*	95% CI			*B*	*SE*	95% CI	
Offending (+)	0.42***	0.10	0.23	0.62		**0.22**	**0.13**	**-0.05**	**0.48**
Offending (-)	-0.25**	0.09	-0.42	-0.09		**-0.56*****	**0.11**	**-0.77**	**-0.34**
Opiate Use	*B*	*SE*	95% CI			*B*	*SE*	95% CI	
Exposure to Violence (+)	0.17	0.14	-0.11	0.45		0.38***	0.12	0.15	0.62
Exposure to Violence (-)	-0.39**	0.13	-0.64	-0.14		-0.20	0.11	-0.43	0.02

Ecstasy Use	*B*	*SE*	95% CI			*B*	*SE*	95% CI	
Exposure to Violence (+)	0.17	0.11	-0.05	0.39		0.40**	0.14	0.11	0.68
Exposure to Violence (-)	-0.13	0.12	-0.37	0.10		-0.17	0.11	-0.38	0.05
Hallucinogen Use	*B*	*SE*	95% CI			*B*	*SE*	95% CI	
Arrest (+)	0.17	0.09	-0.01	0.35		0.28*	0.13	0.03	0.53
Arrest (-)	-0.06	0.11	-0.28	0.15		-0.13	0.13	-0.39	0.13
Peer Substance Use (+)	0.23*	0.12	0.00	0.46		0.26	0.14	-0.02	0.55
Peer Substance Use (-)	-0.29**	0.11	-0.52	-0.07		-0.30*	0.12	-0.54	-0.06
Other Drug Use	*B*	*SE*	95% CI			*B*	*SE*	95% CI	
Homelessness (+)	-0.03	0.40	-0.81	0.75		0.06	0.06	-0.07	0.18
Homelessness (-)	-0.09	0.08	-0.24	0.06		-0.19*	0.09	-0.37	-0.01

Bolded results indicate significant asymmetric associations.
**p<0.05, **p<0.01, ***p<0.001*