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# KILLING WHAT KIND OF PAIN? LONELINESS AS A FORM OF EMOTIONAL STRAIN

A Thesis in

Sociology

by

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#### ABSTRACT

Both social marginalization and substance use have clear public health harms, but the relationships between them remains unclear. Criminological theories rely on mutually exclusive assumptions about the nature of substance use initiation with regard to social marginalization that have not been explored previously. In this paper, I use logistic regression to examine the influence of social isolation and loneliness on pain killer initiation among the Add Health cohort. Loneliness is positively and significantly correlated with pain killer initiation, and adolescents who report only loneliness or are experiencing social isolation are at higher risk of pain killer initiation than adolescents who report neither or both. These findings support strain theory's self-medication hypothesis and imply that prevention programs should consider the influence of social perceptive factors.

# TABLE OF CONTENTS

LIST OF FIGURES
LIST OF TABLESvii
ACKNOWLEDGEMENTS
Introduction1
Overview of Relevant Background4
Context of Adolescent Pain Killer Use
Temporal Context
Peer Context7
Family Context
Social Marginalization10
Hypotheses and Theoretical Background12
This Study16
Methods19
Data
Outcome
Predictors
Controls24
Analytic Approach
Results
Descriptive Statistics
Main Logistic Models
Predictive Margins
Behavioral Mediation
Discussion
Limitations
Future Directions
Conclusion
Appendix A Missingness Analysis
Appendix B Sensitivity Checks

Appendix C Detailed Item Descriptions for Scales	54
Appendix D Unweighted Descriptive Statistics	56
Appendix E Predictive Margins for Model 4	57
Appendix F Group Differences for Early Initiates	58
References	59

# LIST OF FIGURES

Figure 1: Social Marginalization Profiles

# LIST OF TABLES

Table 1:	Weighted Descriptive Statistics of Key Variables	27
Table <b>2</b> :	Pain Killer Initiation by Social Marginalization Profile	28
Table <b>3</b> :	Main Logit Models.	29
Table <b>4</b> :	Interaction Margins	31
Table 5:	Behavioral Mediation Check.	33

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## Introduction

The current opioid crisis has included adolescent initiation of opioids in unprecedented numbers (Levy, 2019), which is associated with a variety of harmful outcomes including increased risk of substance use disorders later in life (McCabe et al., 2007). Deficits in positive, satisfying relationships are present by the time older adolescents and adults who use substances enter recovery (Chou et al., 2011; Hosseinbor et al., 2014), but questions about the temporal emergence of these deficits remain unanswered. Qualitative research highlights the potential for a social pathway to substance use initiation that stems from social disconnection (Dingle et al., 2015). This pathway has not been examined in a quantitative, prospective way, which makes it challenging to assess its generalizability to the general population or separate whether deficits precede or follow from substance use.

Although receiving considerable attention in classical sociology across constructs (Merton, 1996), little work has examined the differing effects of objective factors compared to perceptions of those factors in the context of interpersonal social relationships. Though often conflated, loneliness, a distressing perception of inadequate social relationships (Peplau & Perlman, 1982; Weiss, 1973), and social isolation, an objective state of "aloneness" that may not involve distress (Cornwell & Waite, 2009; Y. Lee et al., 2018; Steptoe et al., 2013), are distinct constructs that vary in their effects (Russell et al., 2012). This distinction is vital for considering the fit of theoretical narratives to social reality. Control theory (Hirschi, 2001) and differential association

theory (Sutherland, 1939) emphasize the role of exposure to the behaviors, attitudes, and norms of others in the context of interpersonal relationships. Exposure requires contact, not satisfaction; admired others who may not increase the adequacy of social networks for support (and thus not decrease loneliness) can influence attitudes and behaviors. Control theory asserts that individuals learn to value normative behaviors through bonding to conventional others (friends, family, etc), while assuming that motivation for deviant behavior is constant (Hirschi, 2001). Differential association theory argues that motivation, beliefs, and methods for engaging in deviant behavior are learned in the context of interpersonal relationships with and observations of deviant others (Sutherland, 1939). In contrast, the psychosocial mechanisms posited by general strain theory (Agnew, 1992) require a negative emotional reaction to negative stimuli; substance use serves as a coping strategy for managing negative affect.

Prior literature has examined the role of the presence of social relationships as a catalyst for substance use initiation, but little work has examined how the absence and perceived inadequacy of social relationships influence initiation (Gutkind et al., 2022; Kreager, 2004). Using the National Survey of Adolescent to Adult Health (Add Health), I analyze the independent and interactive effects of perceptive and objective dimensions of social marginalization (loneliness and social network indegree isolation) on the initiation of unprescribed painkillers among adolescents in the United States. I focus on adolescence because this is when the majority of people who develop substance use disorders later in life initiate substance use (McCabe et al., 2007). Using the first experience respondents report with unprescribed pain killers across the United States during adolescence grants the opportunity for a stronger understanding of the temporal

ordering of social mechanisms and substance use. This deeper understanding of the problems leading to the initiation of pain killers provides information about what factors prevention programs should target to help the populations at highest risk of harmful substance use later in life.

In addition, examining both loneliness and social isolation grants the ability to distinguish between the effects of objective social relationship factors and perceptive, emotional, subjective social relationship factors, which can provide evidence that adjudicates between mutually exclusive underlying assumptions about the roles of exposure and emotional response across control theory, differential association theory, and general strain theory in the context of the early opioid crisis. By examining the relationship between social isolation, loneliness, and unprescribed pain killer initiation among adolescents in the United States, this paper also builds on prior empirical literature by examining potential negative effects of not having strong, satisfying peer connections, contrasting most other work examining the positive influence of prosocial relationships (C. S. Lee & Goldstein, 2016), negative influence of deviant relationships (Deutsch et al., 2015), and the harms of relationships with lots of conflict (Kreager, 2004).

## **Overview of Relevant Background**

The context of adolescent pain killer use is complex and multifaceted, and evidence regarding adolescent substance use broadly seems to support multiple mutually exclusive theoretical orientations. Rich literatures on social support and familial bonds show that bonding to conventional social structure is protective as control theory would suggest. Other strong evidence indicates that deviant peer relationships are a risk factor as differential association theory posits. Prior work examining the relationships between mental health condition symptomatology and substance use seems to support general strain theory's self-medication hypothesis. However, very little work has examined how social disconnection at the individual level, whether objective or perceived, is related to pain killer use among adolescents.

I begin by presenting current evidence describing the context of adolescent pain killer use. Next, I present competing hypotheses about the relationship between social marginalization variables (loneliness and social isolation) and adolescent pain killer use, rooted in social control theory, differential association theory, and general strain theory, as well as the proposed mechanisms driving those predictions. Then, I describe a plan for testing those hypotheses.

#### **Context of Adolescent Pain Killer Use**

#### **Temporal Context**

Adolescence as a developmental stage represents a vital transition from relying on household family structure for bonds to society to the development of an identity outside of the family, which then necessitates newly individual bonds to the larger social world (Mitic et al., 2021). Volatility in this transition may explain the spikes in delinquent behavior among adolescents that decrease as individuals progress into adulthood. In addition, prior work indicates that there are patterns of sequence and timing with regard to substance use, and pain killers are not typically the first substances adolescents use (Yamaguchi & Kandel, 1984a).

Although the gateway hypothesis is, at best, highly contested as a causal explanation for the escalation of substance use (P. N. Lee, 2015), it remains epidemiologically supported that the majority of people who use "harder" substances, including the misuse of prescription drugs, initiate the use of more widely used and easier to access substances first (typically alcohol, cigarettes, and marijuana, and sometimes inhalants such as glue or solvents) (D. Kandel & Kandel, 2015). Prior literature has found strong relationships between substance use and social marginalization, typically emphasizing the role of substance use in the degradation of prosocial networks and the development of deviant networks where substances are found, thus assuming that substance use drives social network changes (Dingle et al., 2015). However, adolescents' typical sources of pain killers and how those sources relate to behavioral escalation are not well understood.

There are two predominant theories driving understanding of adolescent pain killer access: the availability of pills in social contexts and the presence of excess prescription drugs in medicine cabinets (Brown et al., 2021; Ciccarone, 2019; Levy, 2019). Despite most substance use among adolescents occurring in unstructured, unsupervised environments, schools remain a major source of substances (Brown et al., 2021). In every year from 2001-2015, at least one in five adolescents reported having a "drug transaction experience" in high school, which could include being offered, sold, or given an illegal drug (Brown et al., 2021). Adolescents also understand and report peers as the predominant source of substances, including diverted prescriptions, even in situations where parents or other adults could provide substances (Hadler et al., 2021; Johnston et al., 2011; Kulis et al., 2006). Drug resistance responses, including both actively saying no and passively choosing to not engage in substance use while others do so, are weaker and occur less often in situations with peers (Okamoto et al., 2004). This is connected not only to the frequency of drug offers (which is higher with peers than family members), but also to adolescents' perceptions of the risk of negative social ramifications connected to their refusal (Okamoto et al., 2004). In fact, adolescents generally do not resist even passive drug offers from their peers (Lopez-Quintero & Neumark, 2015).

As a result, the role of overprescription and access to substances in medicine cabinets has been largely overlooked in studies of drug supply, even within the first wave of the opioid crisis that was driven largely by prescription misuse (Ciccarone, 2019). Even when increasing numbers of adolescents understand pain relievers as dangerous and difficult to get, the prevalence of prescription opioid misuse remained constant from 2009-2013 (*PATS 2013 Full Report*, 2013). Social marginalization mechanisms may be particularly salient for pain killers precisely because the peer social connections required for the use of other substances may not be necessary.

## **Peer Context**

Friendships are necessary for long-term well-being (Umberson et al., 2010), providing an avenue for learning how to seek and provide social support (Stanton-Salazar & Spina, 2005). Supportive peer relationships decrease neural sensitivity to risk taking (Telzer et al., 2015), and social connectedness also influences depressive symptoms indirectly, buffering stress associated with loneliness (Jose & Lim, 2014). In fact, social support from peers has a uniquely strong stress buffering effect for adolescents (C. S. Lee & Goldstein, 2016). These findings are also consistent with evidence that adolescents tend to prefer emotional support from familiar, mature, friendly, and trustworthy sources (Camara et al., 2017).

Additionally, in the context of substance use specifically, not only do peers encourage abstinence from substances far more than they encourage use, but adolescents perceive *direct* peer pressure as independence-threatening (Rulison et al., 2015). These findings indicate that direct negative influence from peers is a rare, ineffectual, and minor factor in adolescent substance use initiation broadly. Though some work has examined the negative effects of conflict-ridden relationships, there remains a dearth of evidence examining social isolates—adolescents who are disconnected from their peers in some form (Kreager, 2004).

However, adolescents display an increased neurological sensitivity to risk-taking behavior as a result of restructuring of reward systems (Steinberg, 2008). This sensitivity is further exacerbated by peer influence—reward pathways respond more strongly in the presence of peers, and adolescents are particularly vulnerable to distress resulting from social exclusion and rejection (Albert et al., 2013; Falk et al., 2014; Somerville, 2013; Steinberg, 2008). However, mere peer presence is not the lone factor involved in the decision to engage in risk taking behavior—the quality of peer relationships also matters for the strength of peer influence (Telzer et al., 2017).

Adolescents also spend more time with their peers, particularly in unstructured environments, than they did as children (Barnes et al., 2007; Osgood & Anderson, 2004), leading to increased exposure to peer modeling behavior, which often includes risktaking. Indirect peer pressure through the development of norms, which then change behavior through attitudes, does have empirical support as an important predictive factor in adolescent choices to initiate substances (D. B. Kandel & Andrews, 1987; Rulison et al., 2015). Peer norms describe the understanding adolescents have of what "normal" behaviors are—understandings created on the basis of their perception of others' behavior. Adolescents' perceptions of their friends' attitudes and behaviors, which are commonly more powerful predictors of behavior, often differ significantly from selfreports by their friends (Deutsch et al., 2015; Iannotti & Bush, 1992). For example, one study found that friends' perceived use of alcohol, marijuana, and cigarette use significantly predicted initiation of those substances respectively among adolescents, and had a significantly stronger effect than friends' actual use on cigarette initiation (Deutsch et al., 2015). Such results are concerning given adolescents' tendency to overinflate the frequency and amount of their friends' substance use (Deutsch et al., 2015; Rulison et al., 2015).

#### **Family Context**

Families remain a vital part of the adolescent social environment and do influence substance use initiation, primarily through child disclosure of behavior to their parents, which stems from parental closeness and monitoring (D. B. Kandel et al., 1976; Keijsers, 2016; Stattin & Kerr, 2000). Despite positive correlational relationships with time use and supervision (Barnes et al., 2007; Elam et al., 2020; Reimuller et al., 2011), causal models investigating the mechanisms through which parental monitoring influences delinquency consistently show that child disclosure is the most likely mechanism (Keijsers, 2016). Child disclosure depends heavily on the quality of the parent-child relationship; thus, indirectly, the quality of parental relationships influences delinquent outcomes including substance use initiation (Keijsers, 2016; Stattin & Kerr, 2000).

Though family influence tends to be prosocial, the parents of some adolescents use substances, exposing them to substance use behaviors and culture through their families. However, evidence indicates that the effect of parental modelling on substance use initiation is small; parents tend to affect behavior through the transmission of norms rather than behavior (Biddle et al., 1980; D. Kandel, 1974; D. B. Kandel & Andrews, 1987). Although it is true that children with parents who use substances are more likely to use substances, this effect seems to be mediated by parental knowledge; parents who use substances tend to have a lower awareness of their child's activities and this lack of monitoring and knowledge has fully mediated the effect of parental substance use in some work (Elam et al., 2020). Additionally, although families clearly influence substance use, prior literature illustrates that family factors are not sufficient to fully explain adolescent substance use behavior and are often mediated by the effects of (often negative) peer influence (even including sibling norms (Fagan & Najman, 2005)) (Bahr et al., 2005; D. B. Kandel & Andrews, 1987). Early work comparing the influence of parental and peer influence found that peer relationships were the stronger predictor of adolescent substance use, with family factors moderating the impacts—the adolescents at highest risk of illicit substance use were those in both peer network- and family units that contained people who use substances (D. Kandel, 1974; D. B. Kandel & Andrews, 1987; Umberson et al., 2010). Work using path modelling has claimed that peer influence is a stronger and more proximal predictor of substance use behavior, with family connectedness and parental monitoring moderating peer influence (Sale et al., 2003). Additionally, because peer interactions are often most influential in unsupervised contexts, peer factors influencing delinquent behavior need to be examined in their own right (Mitic et al., 2021).

#### **Social Marginalization**

Loneliness remains a mostly unexplored source of strain for the explanation of *deviance*. Some have argued that indicators of social marginalization, including loneliness and other related constructs like belonging, have served the evolutionary purpose of keeping humans in coherent social structures—the discomfort felt should push people to change their behavior in a way that increases their chance at participating in activities productive to their survival (Cacioppo et al., 2014). However, some evidence also indicates that social marginalization either pushes people away from others (Vanhalst et al., 2015) or toward networks of other marginalized people that do not alleviate, but may instead exacerbate marginalization (Schaefer et al., 2011). Higher levels of distress, lower levels of enthusiasm, and a lack of social skills needed to develop

strong friendships can either limit friendship networks, causing a network selection effect or social withdrawal, particularly in the case of abnormally high (anxious) and low (uncaring) sensitivities to social exclusion (Schaefer et al., 2011; Vanhalst et al., 2015). While this is often cited as a function of mental health conditions (most commonly depression and social anxiety) (Vanhalst et al., 2013) and loneliness is understood as a component of different forms of mental health conditions (Blodgett et al., 2021), factor analyses have indicated that loneliness and depression are distinct constructs (Cacioppo et al., 2006).

Both social isolation and loneliness have clear negative implications for physical and mental health including increased risk of substance use (Ingram et al., 2020). The effects of social marginalization by peers are particularly salient and far-reaching for adolescents; a lack of supportive peers in adolescence is associated with negative mental health outcomes through at least midlife (Kamis & Copeland, 2020). Different forms of marginalization affect well-being through multiple mechanisms. Prior literature has typologized adolescents with differing marginalization indicators into peer-rejected (actively disliked adolescents), peer-neglected (ignored adolescents), and introverted (adolescents who prefer little interaction) categories (Copeland et al., 2018; Kreager, 2004). Peer-rejected adolescents exhibit lower rates of psychosocial functioning, as well as adjustment problems (East et al., 1987), and prior experiences of chronic peer stress, rejection, and victimization, also increase the strength of peer negative influence (Telzer et al., 2017). Peer-rejected youth tend to be at lower risk for initiation of alcohol and cigarettes, possibly because of a lack of access to social settings where substance use is occurring (Mason et al., 2017), but do experience lower levels of well-being stemming

from that rejection (Corsano et al., 2019). Evidence shows that while there are youth (often with high levels of introversion) who have a strong affinity for being alone, their outcomes are often better when they have high quality friendships (Corsano et al., 2019).

Social factors are clear predictors of later substance use outcomes (Collinson & Hall, 2021; Gutkind et al., 2022; Ingram et al., 2020; Polenick et al., 2019), but it remains unclear how the experiences of social marginalization influence substance use *initiation*. Prior work has often explored how stigma surrounding substance use fuels social marginalization (Link et al., 1997), thus assuming substance use comes prior to social marginalization in the causal chain. Recreational drug use is reported more often among people who are lonely, and loneliness is often cited as a trigger for relapse in recovery settings (Cacioppo et al., 2002; Polenick et al., 2019). People who use substances also report higher levels of social isolation, particularly isolation from people in shared religious groups (Chou et al., 2011). The temporal ordering and mechanisms driving these differences among people who use substances remain unclear; qualitative work has shown the presence of an alternate pathway in which social marginalization not only precedes but also fuels the initiation of substance use (Dingle et al., 2015). However, its retrospective nature and inability to distinguish between social isolation and loneliness mechanistically are significant weaknesses.

#### Hypotheses and Theoretical Background

**Hypothesis 1**: Social isolation is positively associated with unprescribed pain killer initiation. (Control)

**Hypothesis 2**: Social isolation is negatively associated with unprescribed pain killer initiation. (Differential Association Theory)

**Hypothesis 3**: Loneliness is positively associated with unprescribed pain killer initiation. (Strain)

Control, differential association, and general strain theories have a long history in sociology, psychology, and criminology for explaining deviant behavior. Control theory and differential association theories both emphasize exposure as the primary mechanism through which behaviors are developed. For control theory, exposure to conventional social structure prevents deviance, for which motivation remains constant (Hirschi, 2001). Differential association theory posits that exposure to deviant behavior teaches the activities and motivations needed for engaging in deviance (Sutherland, 1939). General strain theory takes a distinctly different approach, focusing on emotional responses to aversive stimuli as the primary mechanism motivating deviant behavior (Agnew, 1992). These assumptions result in not only distinct interpretations of current evidence, but also generate mutually exclusive hypotheses regarding individual level social marginalization.

Control theory hypothesizes that social isolation is positively associated with unprescribed pain killer initiation. Friendships are conventional bonds, and adolescents report receiving messaging predominantly discouraging substance use from their peers (Rulison et al., 2015). The primary importance of prosocial familial bonds and development of socially supportive friendships for adolescent well-being also support control theory's emphasis on exposure and bonding to conventional structures as the primary mechanism for preventing deviant behavior. Additionally, increased prescribing of pain killers in the 1990s often resulted in large amounts of excess pain medication in medicine cabinets, leaving adolescents with easy access to those substances in their home, potentially negating the need for peer social connections to obtain substances (Levy, 2019).

Differential association theory hypothesizes that social isolation is positively associated with unprescribed pain killer initiation, which is supported by a considerable body of evidence. Peer relationships are a key risk factor in adolescent substance use initiation (Oxford et al., 2001), stemming from a combination of neurobiological sensitivity to risk, increases in unstructured time use with peers whose influence is increasingly powerful compared to traditional family structures, and peers as the primary source of illicit substances including diverted prescriptions. Differential association theory's roots in the social learning tradition translates to an emphasis on interactions with others from deviant subgroups as the primary causal agent for deviant behaviors (Sutherland, 1939). Rather than emphasizing factors within singular interactions as environmental criminological theories do (D. Wayne Osgood et al., 1996), differential association theory stresses the importance of the amount and duration of exposure to peer behaviors, which build attitudes that favor deviant behavior. The degree to which exposure to deviant behavior produces attitudes favorable to it also depends on childhood experiences with peers and the timing of exposure (Sutherland, 1939). Adolescents ultimately learn behavior from those they value, which may mean close friendships, but could also mean peer mentors or "cool" kids they admire (Burgess & Akers, 1966; Glaser, 1956).

General strain theory hypothesizes that loneliness, a form of negative affect, is positively associated with unprescribed pain killer initiation. Substance use is conceptualized as a form of "inner-directed delinquency" (as opposed to vengeful or violent behavior) aimed at managing negative affect, particularly for individuals who don't experience anger or blame others for their adversity (Agnew, 1992). Literature focusing on later substance use stages (use, treatment, relapse, etc) consistently finds that the painful experience of loneliness is not only associated with higher rates of substance use, but cited as a reason for using substances (Dingle et al., 2015; Gutkind et al., 2022). In the context of the opioid crisis, a definite link between experiences of social isolation (often conflated with loneliness) and opioid use is present, but assumed to be onedirectional (ie opioid use decreases the neurological motivation to form satisfying social bonds) (Christie, 2021). However, considering that evidence shows that social pain, which encompasses a variety of perceptive constructs that result in distress, is as neurologically painful as physical pain (Eisenberger, 2012; Eisenberger & Lieberman, 2004; Inagaki & Eisenberger, 2013) and constitutes a deep form of negative affect, which Agnew cites as the primary causal mechanism for delinquency (Agnew, 1992), examining loneliness in comparison to social isolation as a predictor of pain killer initiation is both timely and theoretically important.

#### **This Study**

In summary, social isolation and loneliness, while both measures of social marginalization, have different anticipated effects on pain killer initiation across theoretical frameworks. These hypotheses and the assumptions they are rooted in are mutually exclusive, leaving important questions about the social mechanisms driving adolescent substance use initiation. Understanding these mechanisms requires an approach that sits at the intersection of demand for substances and supply of substances (Dasgupta et al., 2018). Someone having access to substances does not mean they want to or will misuse them; conversely, someone wanting to use substances may not have access to them.

For adolescents, access to substances generally requires social connections. Thus, loneliness and social isolation may influence substance use differently—if substance use is a form of self-medication for loneliness as general strain theory predicts, it may be that only lonely adolescents who are not socially isolated (and therefore have easier access to substances) are the ones at substantial risk. Alternatively, as differential association theory suggests, loneliness might not matter and social isolation may be protective because of both access to substances themselves and knowledge about how to and why you should use them. Prior literature has also illustrated that pathways to substance use and the social mechanisms that underlie those pathways vary by substance type (Vergunst et al., 2021). For pain killers in the late 90s and early 2000s, unmonitored medicine cabinets were a common source of substances, albeit at home or in the homes of others,

meaning the adolescent's individual bonds to either peers or others may not have been strictly necessary (Levy, 2019). Thus, as control theory suggests, a lack of bonds preventing adolescents from using substances may be the key to understanding initiation patterns.

In this project, I use social marginalization measures to adjudicate the claims made by control theory, differential association theory, and strain theory about the etiology of substance use. I use data from the National Study of Adolescent to Adult Health (Add Health) to test (1) whether social isolation and loneliness are distinct predictors of unprescribed pain killer initiation and (2) whether social isolation and loneliness interact with one another to produce differential risk across social marginalization profiles, described in Figure 1. The Classically Isolated are isolated adolescents who also report high loneliness, thus fitting the typical classical understanding of social marginalization. The Alienated are adolescents who are not isolated, yet report high loneliness, and thus represent the experience of "lonely in a crowd". Adolescents in the Solitude group are isolated, but do not report loneliness, indicating relative contentment with their aloneness. Typical adolescents are not isolated and also do not report high levels of loneliness, indicating no social marginalization on these measures.

Figure 1: Social Marginalization Profiles				
		Loneliness		
		High	Low	
Sacial	Yes	Classically Isolated	Solitude	
Isolation	lal No	Alionatad	Typical	
1501211011	INO	Allenated	Adolescent	

Finally, in line with previous literature (Keijsers, 2016; Kreager, 2004), I will control for family factors and previous deviant behavior, including parental monitoring, child disclosure of personal problems to residential parents, prior delinquency and prior substance use (including alcohol, marijuana, and cigarettes). This allows for comparison of the influence of parental and peer effects on initiation and an understanding of escalation pathways, since the initiation of unprescribed substances including pain killers is often preceded by other deviant behavior. These controls are necessary because of their likelihood of influencing access to substances and the influence of loneliness; in the case of non-isolated adolescents, higher parental monitoring indicates less access to more deviant networks (Mahedy et al., 2018) where substances are often found, and higher child disclosure indicates closer parental bonding (Keijsers, 2016) that may decrease overall loneliness.

## Methods

#### Data

The National Longitudinal Study of Adolescent to Adult Health (Add Health) is a population-based cohort representative of U.S. adolescents in middle and high schools during 1994-5. It oversamples twins, immigrants, and racial and ethnic minorities and includes appropriate sample weights for each wave. I use data from Waves I and III inhome interviews, as well as the parent survey collected at the same time as the Wave I inhome interviews. Wave I covers late middle school through high school, grades 7-12. Wave III, collected 6 years after Wave I, covers late adolescence into early adulthood, ages 18-26. Add Health is a high quality survey with high response rates and low levels of nonresponse and attrition, both in general and for the waves in question (79.0%, >85%, and 77.4% of eligible respondents participated in Wave I, parent, and Wave III surveys respectively) (Harris, 2013; Harris et al., 2019). The parent survey was collected at the same time as the Wave I in home interview in 1994/1995. Primary residential parents (mothers were preferred when possible) were given a 40-minute pencil-and-paper questionnaire to complete which included questions about the adolescent, heritable conditions, and household factors. Surveys of the primary respondents at both Waves I and III were completed with computer-assisted personal- and self-interviews (CAPI, CASI), meaning that respondents reported their answers directly into computers rather than to an interviewer or on paper.

My final analytic sample includes 4,425 respondents. While the full sample contains data for over 20,000 adolescents at Wave I and over 15,000 adolescents and

young adults at Wave III, I use the public use files, which contain data for approximately one-third of the full sample (N=6,504 at Wave I). Specifically, the public use datasets contain "... one-half of the core sample, and one-half of the oversample of African-American adolescents with a parent who has a college degree, chosen at random. This is roughly 1/3 of the full sample" (*DSDR*, 2022). To account for Add Health's sampling design, I utilize the svy package in Stata to apply survey weights to account for oversamples and cluster weights to account for the school-based design (Harris & Udry, 2003). 1,622 respondents did not have longitudinal survey weights for Waves I and III, leaving the possible analytic sample at 4,882 respondents. A full missingness analysis, including counts for missingness based on weights and listwise deletion, is included in Appendix 1.

There is an additional important exclusion criterion, which is necessitated analytically. I am predicting *initiation* of unprescribed pain killer use—that is, the *first* time adolescents use these substances. For a small portion of the sample (N=330, 7.47% of the possible analytic sample), initiation occurred before Wave I data were collected, rendering that subset of data unusable. The majority of initiation occurred between Waves I and III (the focal waves for my outcome variable), primarily due to the timing of data collection—the majority of adolescents were at the ages of highest risk of pain killer initiation between Waves I and III (D. B. Kandel & Logan, 1984). After accounting for missingness discussed later, my final sample consists of 4,425 adolescents who had not initiated non-marijuana illicit substances before Wave I.

#### Outcome

Add Health does not directly measure initiation of unprescribed pain killers; however, the availability of substance use measures across waves and the longitudinal design allows for the construction of an appropriate likelihood of initiation measure. At Wave I, participants were asked, "During your life, how many times have you used any of these types of illegal drugs? (LSD, PCP, ecstasy, mushrooms, speed, ice, heroin, or pills)" If they answered yes, they were dropped from the study. Then, at Wave III, participants were asked "Have you taken any of the following without a doctor's permission?" and were presented with a list of substance types, including "pain killers, such as Darvon, Demerol, Percodan, or Tylenol with codeine." If participants answered "Yes", they were coded as 1, indicating initiation between Waves I and III. If they answered "No" or legitimately skipped the question (reported not using drugs at another point in the survey), they were coded as 0, indicating that they did not initiate between Waves I and III.

Any time a study of deviant behavior is conducted, particularly for adolescents, social desirability bias is a concern (respondents may be less likely to report stigmatized behavior), and in the case of substance use, differential attrition is also an issue (respondents with substance use disorders may be more likely to be lost to follow up). However, Add Health's computer assisted self-interview technology and informing adolescents that their answers would not be shared with their parents or their schools limited social desirability issues as much as possible (Kaestle, 2015; Moss & Harris, 2015). In comparison to most other longitudinal studies, attrition rates in Add Health have been low and resulting biases minimal (Harris et al., 2019). Additionally, appropriate survey weights were used to ensure representativeness and correct for differential attrition (Harris & Udry, 2003).

#### Predictors

I use two primary predictor variables (loneliness and isolation), both of which were collected in the in-home Wave I survey.

Loneliness is measured using an item in the Center for Epidemiologic Studies of Depression Scale (CES-D), which asks "How often you have felt lonely during the past week?" (missing n=11). Response options are presented as an ordinal scale (never or rarely=0, sometimes=1, a lot of the time=2, most of the time or all of the time=3). I dichotomize the variable, with any reported loneliness coded as 1 and never or rarely coded as 0.

One important sensitivity check is to ensure that loneliness is a distinct predictor of substance use initiation from mental health conditions—particularly depression. Therefore, I plan to use the full Center for Epidemiologic Studies Depression Scale (CES-D) in place of loneliness for all the models and compare the magnitude and direction of the results. Unfortunately, the only valid measure of loneliness on its own in Add Health is part of the CES-D, so comparing the effects in the same model is less than ideal at best (a recent systematic review examined papers that used factor analysis on portions of the CES-D, and loneliness was included in all of them (Blodgett et al., 2021)). I completed 3 sets of analyses to check this sensitivity—first, I added the full CES-D to the main models presented here, then I removed the loneliness item from the CES-D, and then I included a simple measure of adolescent self-report of feeling depressed from the CES-D. The results of these analyses are included in Appendix 2, but ultimately did not change the interpretation of the main results presented here.

Social isolation is measured in Wave I using social network nominations. Respondents were asked to nominate up to 10 friends, 5 male and 5 female, from the rosters of their school and its "sister school" (schools in the same community as the reference school-most often middle schools that feed into the same high school) when applicable (National Longitudinal Study of Adolescent Health Network Variables Codebook, 2001). If an adolescent was not nominated as a friend by any peers in their school social network, they are coded as isolated; otherwise, they are coded as not isolated. This specification allows for an externally reported measure of isolation, strengthening confidence in the difference between loneliness as a perception and isolation as an objective factor as opposed to outdegree measures, which require the use of self-report (and thus perception). Degree measures are consistent with measures used in prior research of adolescent social isolation (Copeland et al., 2018) and reliable and robust to missingness (Smith & Moody, 2013). Prior literature shows that the effects of social isolation, including relational satisfaction and propensity for interaction, are most powerful when examining close ties such as friendships (Y. Lee et al., 2018; Russell et al., 2012). Although fixed-nomination designs like the one used in Add Health can lead to relatively more bias in degree centralization (Smith & Moody, 2013), the risk of bias in this study is minimal. Add Health's sample size is quite large, and fixed-nomination

designs primarily affect the bias of outdegree centrality measures by including truncation bias (Smith & Moody, 2013).

To test the sensitivity of isolation specification, I performed analyses using in school outdegree isolation (when adolescents did not nominate any in school peers as friends), school harsh isolation (adolescents who both did not nominate any peers and were not nominated by any peers as friends in their school), and an even harsher isolation condition in which adolescents nominate no friends outside their school in addition to school harsh isolation. In addition to the reasons for main model specifications cited above, the indegree isolation measure provided an adequate cell size for trustworthy analysis, which was not the case for alternate specifications (specifically, for the harsher forms of isolation involving indegree/outdegree overlap, the cell sizes for the interaction terms were as small as 4 and 5 cases). These analyses are presented in Appendix 2 and did not substantively change the interpretation of the results presented here.

### Controls

All control variables, with the exception of parental education, were collected in the Wave I in-home interview. For self-reported demographic controls, I use race (categories: white, black/African-American, American Indian or Native American, Asian or Pacific Islander, other), ethnicity (Hispanic/Latino, not Hispanic/Latino, missing n=15), biological sex (male or female), and age (measured continuously in years, missing n=1). To measure household economic status, I use the following categorical variable based on parental report of educational attainment: no parents with college, one parent with at least some college, and both parents with at least some college. In cases where the parental survey measures are missing, I use respondent-reported parental educational attainment. This decreased the number of cases missing parental educational attainment from 597 to 44.

A large body of research has illustrated major differences in outcomes across family structures. Not all adolescents in Add Health live with their biological parents, and the identification of residential parents is analytically difficult. To test the sensitivity of these results with regard to family structure abnormalities, I performed a sensitivity check in which parent-reported education was only preferred when biological parents were surveyed; otherwise, the student measure, in which students defined who their parents were, was used. The results of main analyses did not substantively change as a result of this measurement difference. Results of the sensitivity check are included in Appendix 2.

In line with previous criminological literature (Kreager, 2004), I also include measures of prior substance use and delinquency. For prior substance use, I created a dichotomous measure indicating whether respondents reported the use of cigarettes, alcohol, marijuana, or inhalants at Wave I (missing n=35). For delinquency, I use a validated summary measure that has been used in prior research (Pechorro et al., 2019). A comprehensive list of the items in this scale are included in Appendix 3. I also completed a sensitivity check including impulsivity in all the main models, which did not substantively change results, included in Appendix 2.

Finally, I include 2 control measures for family environment: parental monitoring and child disclosure. I control for parental monitoring with a summary measure used in prior research (Ornelas et al., 2007). A comprehensive list of the items is provided in Appendix 3. Higher scores indicate higher levels of parental monitoring. To measure child disclosure, respondents were asked "Have you had a talk about a personal problem you were having with your residential [father/mother] in the past 4 weeks?" (missing n=86). If a respondent reported talking about a personal problem with any residential parent in the past 4 weeks, they are coded 1, otherwise they are coded 0. Additionally, I completed a sensitivity check using the availability of illicit drugs in home as a control. This did not substantively change the results presented here, and the results of that analysis are included in Appendix 2.

#### **Analytic Approach**

First, I use logistic regression models to predict initiation of unprescribed pain killer use between Waves I and III. I control for all demographic variables in all models. Models 1, 2, and 3 look at the independent and combined main effects of loneliness and isolation on unprescribed pain killer use initiation. Models 4 introduces interaction terms and family environment controls. Model 5 represents the fully adjusted model, controlling for demographics, main and interaction effects of primary predictor variables, substantive moderation checks, and behavioral controls.

It is necessary to compare predictive margins in order to properly interpret interaction terms in non-linear models, including logistic regression (Ai & Norton, 2003). I completed predictive margins for Model 5 to test differences between social marginalization profiles, which constitute the interaction term.

# Results

# **Descriptive Statistics**

Table 1 contains weighted descriptive statistics for each analytic variable

presented in the analysis. Unweighted tables are presented in Appendix 4 for comparison.

	2	Standard	Cronbach's		
	Mean	Errors	Alpha	Minimum	Maximum
Pain Killers Initiation	0.179			0	1
Any Loneliness	0.337			0	1
School Indegree Isolation	0.056			0	1
Parental Monitoring Score	1.92	0.05	0.61	0	7
Child Disclosure	0.405			0	1
Delinquency Score	0.242	0.01	0.80	0	3
Prior Substance Use	0.672			0	1
Age	15.33	0.12		11	21
White	0.736			0	1
Black/African American	0.173			0	1
American Indian/Native					
American	0.011			0	1
Asian/Pacific Islander	0.033			0	1
Other Race	0.047			0	1
Hispanic Ethnicity	0.110			0	1
Female	1.495			1	2
Highest Residential Parent					
Education	2.85			1	4

Table 1: Weighted Descriptive Statistics of Key Variables

Source: AddHealth Waves I&III

Table 2 contains the crosstabulation of social marginalization profile by Wave III painkiller initiation.

Table 2: Pain Killer Initiation by Social Marginalization Profile				
	Non-Initiates	Initiates		
Typical Adolescent	2253		475	
Alienated	1159		282	
Solitude	134		29	
Classically Isolated	70		16	
Source: AddHealth Waves I&III				

**Main Logistic Models** 

# Main logit model results are included in Table 3.
	Model 1	Model 2	Model 3	Model 4	Model
Pain Killers Initiation					
Any Loneliness	1.296*		1.296*	1.314*	1.221 +
	(0.137)		(0.137)	(0.144)	(0.132
School Indegree Isolation		1.055	1.055	1.189	1.247
		(0.192)	(0.192)	(0.284)	(0.303
Loneliness and Isolation					
Interaction				0.718	0.722
				(0.322)	(0.326
Parental Monitoring Score				0.976	0.985
				(0.035)	(0.035
Child Disclosure				1.082	1.059
				(0.093)	(0.091
Prior Substance Use					1.414*
					(0.174
Delinquency Score					1.649*
					(0.261
Age	0.925**	0.935*	0.926**	0.916**	0.904*
-	(0.026)	(0.028)	(0.026)	(0.025)	(0.026
Black/African American	0.643**	0.654**	0.643**	0.647**	0.645*
	(0.091)	(0.093)	(0.091)	(0.092)	(0.093
American Indian/Native			. ,		
American	1.580	1.614	1.582	1.582	1.518
	(0.538)	(0.546)	(0.538)	(0.535)	(0.550
Asian/Pacific Islander	0.655	0.675	0.653	0.668	0.677
	(0.184)	(0.189)	(0.182)	(0.186)	(0.187
Other Race	1.239	1.237	1.240	1.254	1.264
	(0.283)	(0.281)	(0.284)	(0.286)	(0.281
Hispanic Ethnicity	0.669*	0.685*	0.670*	0.672*	0.651*
	(0.112)	(0.112)	(0.112)	(0.113)	(0.115
Female	0.865	0.895	0.866	0.852	0.924
	(0.087)	(0.088)	(0.088)	(0.087)	(0.092
Highest Residential Parent	. /	. /	. /		
Education	1.050	1.050	1.051	1.047	1.064
	(0.047)	(0.047)	(0.048)	(0.047)	(0.050
Observations	4425	4425	4425	4425	4425
Exponentiated coefficients;	Standard er	rors in parent	heses		
Source: AddHealth Waves	I&III	1			

Table 3: Main Logit Models

Across models, both loneliness and social isolation are positively correlated with pain killer initiation. However, in no model is social isolation significantly correlated with pain killer initiation. Loneliness is positively and significantly correlated with pain killer initiation at a 95% confidence level in all but the fully adjusted model, in which it still has a positive association (p value=0.066).

No family environment controls were statistically significant in any of the models, though directionality and magnitude stayed consistent. Parental monitoring was associated with decreased odds of pain killer initiation (ranging from 1.5%-2.4%). Child disclosure was associated with increased odds of pain killer initiation (ranging from 5.9% to 8.2%).

As anticipated, behavioral controls were strongly, positively, and significantly associated with pain killer initiation. Prior substance use increased the odds of pain killer initiation by 41.4% (p<0.01) in Model 5. Delinquency was associated with increased odds of pain killer initiation by 64.9% (p<0.01) in Model 5.

In terms of demographic controls, results remained consistent across models. Each year of age significantly decreases the odds of pain killer initiation by 9-10% (p<0.05). Compared to white race, Black/African American race was significantly associated with an approximately 35% decrease in the odds of pain killer initiation (p<0.01). Compared to non-Hispanic ethnicity, Hispanic ethnicity was associated with an approximately 34% decrease in the odds of pain killer initiation (p<0.05).

#### **Predictive Margins**

Predictive margins for social marginalization profiles from the fully adjusted model are included in Table 4. A similar table for Model 4 is included in Appendix 5.

Table 4: Interaction Margins									
			Compare	Compared to					
			Typical		Compared to		Compared to		
			Adolescents		Solitude		Alienated		
Typical	16.8	84%							
Adolescent	14.91%	18.78%							
	20.1	10%	3.26%						
Solitude	12.16%	28.04%	-4.30%	10.81%					
	19.7	77%	2.9	2%	-0.33%				
Alienated	17.16%	22.37%	-0.24%	6.08%	-8.32%	7.66%			
Classically	18.1	18%	1.34%		-1.9	2%	-1.59%		
Isolated	8.87%	27.49%	-8.35%	11.03%	-15.20%	11.37%	-11.38%	8.20%	
95% Confid	95% Confidence Intervals Below Each Estimate								
Source: Add Health Wayes L&III									

Source: Add Health Waves 1&111

Typical adolescents (those not experiencing social marginalization) are at the lowest risk of pain killer initiation, followed by classically isolated adolescents (those experiencing both social isolation and loneliness). While the point estimate for adolescents in solitude (experiencing social isolation but not loneliness) is slightly higher than alienated adolescents (those experiencing loneliness but not social isolation), the confidence interval of the difference compared to typical adolescents is much more predominantly positive for alienated adolescents. While there are no statistically significant differences at a 95% confidence level between social marginalization profiles, these results do indicate that adolescents experiencing either social isolation or loneliness are at higher risk of pain killer initiation than those experiencing neither or both.

## **Behavioral Mediation**

Since the magnitude of loneliness in the main models decreased with the inclusion of behavioral controls, I completed mediation checks between delinquency and loneliness and prior substance use and loneliness by regressing them on loneliness, independently and then in the same model, with all other controls included. Results are in Table 5.

	Model A	Model B	Model C					
Any Loneliness								
Delinquency Score		2.717***	2.469***					
		(0.365)	(0.340)					
Prior Substance Use	1.485***		1.234*					
	(0.132)		(0.117)					
School Indegree Isolation	1.038	1.051	1.065					
-	(0.181)	(0.177)	(0.182)					
Parental Monitoring Score	1.080**	1.071**	1.077**					
-	(0.025)	(0.025)	(0.025)					
Child Disclosure	1.503***	1.517***	1.505***					
	(0.120)	(0.121)	(0.120)					
Age	1.177***	1.206***	1.195***					
-	(0.026)	(0.027)	(0.027)					
Black/African American	1.380***	1.273*	1.301**					
	(0.123)	(0.120)	(0.124)					
American Indian/Native			× ,					
American	1.462	1.419	1.417					
	(0.453)	(0.461)	(0.456)					
Asian/Pacific Islander	1.884***	1.704**	1.765**					
	(0.330)	(0.297)	(0.303)					
Other Race	0.971	0.964	0.966					
	(0.203)	(0.195)	(0.196)					
Hispanic Ethnicity	1.451*	1.362*	1.374*					
	(0.223)	(0.201)	(0.204)					
Female	1.719***	1.886***	1.889***					
	(0.112)	(0.126)	(0.126)					
Highest Residential Parent								
Education	1.010	1.009	1.013					
	(0.035)	(0.036)	(0.036)					
Observations	4425	4425	4425					
Exponentiated coefficients; Standard errors in parentheses								
Source: AddHealth Waves I&III								
* p<0.05	** p<0.01	*** p<0.00	1					

Table 5: Behavioral Mediation Check

As anticipated, both delinquency and prior substance use were significantly associated with loneliness independently. Prior substance use increased the odds of loneliness by 48.5% (p<0.001). For each unit increase on the delinquency scale, the odds of loneliness increased by 171.7% (p<0.001). When combined in the same model, prior substance use increased the odds of loneliness by 23.4% (p<0.05) and each unit increase on the delinquency scale increased the odds of loneliness by 146.9% (p<0.001). Surprisingly, social isolation was not significantly or strongly correlated with loneliness, though the directionality was positive, indicating that higher social isolation does increase odds of loneliness by between 3.8% and 6.5%.

#### Discussion

Using data from Add Health, I examined the potential independent and interactive influence of social isolation and loneliness on pain killer initiation among US adolescents. Social isolation maintained a positive (but not statistically significant) association across models. Loneliness is a positive and significant (p<0.10) predictor of pain killer initiation net of family environment, behavioral, and demographic controls. Interactively, typical adolescents were at the lowest risk of initiation across models. Alienated adolescents (those who reported loneliness but were not socially isolated) were at a significantly (p<0.10) increased risk of initiation compared to typical adolescents, and adolescents experiencing *either* social isolation *or* loneliness were at higher risk of initiation than adolescents experiencing both across models.

It is puzzling that loneliness and social isolation are not correlated in the mediation models. This could be a result of measurement— "more" loneliness has multiple connotations, including both frequency and strength of the emotion, and this measure only picks up frequency. In addition, prior research found that loneliness and sociometric measures are correlated in a very gendered way, and the sample size of this dataset did not allow for separation of the models by sex (though it's still unclear how isolation is related) (Stokes & Levin, 1986), so the independent and interactive effects of loneliness and social isolation on pain killer initiation may be obscured by a sex moderation.

Most adolescents who use unprescribed pain killers and other illicit substances do not begin substance use generally with those substances; more often, initiation of cigarettes, alcohol, and marijuana precede initiation of harder substances (D. Kandel & Faust, 1975; D. Kandel & Yamaguchi, 1993; Yamaguchi & Kandel, 1984a). Risk factors for the initiation and use of substances vary across both escalation timelines and substance type (Yamaguchi & Kandel, 1984b). These findings demonstrate that loneliness, particularly in the absence of social isolation, is a risk factor for *escalation* to unprescribed pain killer initiation above and beyond partial mediation by prior delinquent behavior, including prior substance use. In line with general strain theory's emphasis on the role of negative affect in driving deviant behavior (Agnew, 1992), this study indicates a need for a deeper understanding of the role of perceptions and emotions about social network satisfaction and adequacy in behavioral escalation to harder substances.

Of note, no family environment controls significantly predicted pain killer initiation. While most research on the US and some work on other countries has shown decreases in deviant behavior associated with higher parental monitoring and child disclosure (Stronski et al., 2000), other international work has found that child disclosure and parental social support have either null or positive relationships with substance use and problem behavior (Piko & Fitzpatrick, 2002; Piko & Kovács, 2010). Prior work using Add Health has shown mixed results with both parental monitoring and parental communication across substances—for example, one study found that neither construct significantly predicted illicit drug use, but did predict heavy alcohol use (Hackshaw, 2017). Some findings are likely a result of study design. Selection bias from the exclusion of adolescents who had initiated before Wave I (termed "early initiates") likely skewed results for some variables. Early initiates differed significantly in age and parental monitoring from the analytic sample (see Appendix 6). This may explain why age is seemingly protective—many of the older adolescents in the original sample had passed the critical period of initiation (Yamaguchi & Kandel, 1984a), so the majority of those who would have initiated from that age group likely did so already by the time Wave I occurred. Additionally, the analytic sample was disproportionately young, parental monitoring decreases as adolescents get older (Li et al., 2000), and the measure was not able to capture the ways parental monitoring changed over the period when initiation occurred, all of which are important factors for studying parental monitoring.

The opioid crisis has gripped national popular and policy attention for years, remaining relevant even throughout the COVID-19 pandemic (Ghose et al., 2022). While prior research has clearly illustrated the influence of social deprivation factors including unemployment and a lack of community engagement (Dasgupta et al., 2018), very little research to date has examined the prospective effects of individual level social marginalization on the initiation of pain killers like opioids. The younger adolescents in the sample are participants in the first wave of the crisis, which primarily consisted of prescription pills similar to the ones studied here; decreasing supply of pain killers after the study period drove increasing demand for heroin and later synthetics like fentanyl, the central substance of the modern "third wave" of the crisis (Ciccarone, 2019). COVID-19 has increased the prevalence of social disconnection, including increased isolation as a result of stay-at-home orders and increases in loneliness (*Loneliness in America*, n.d.), along with increases in substance use (American Medical Association, n.d.), which this study indicates may be more related than previously considered. Understanding demandside drivers of pain killer use is vital for anticipating the long-term effects of COVID-19 on substance use and the development of appropriate prevention programs in response.

These findings also have important theoretical implications; specifically, they indicate that strain theory has a decisive explanatory advantage over differential association and control theories regarding pain killer initiation—not only was loneliness a significant predictor, but isolation, the exposure-based measure that differential association and control theory value, was not significant in any of the models presented, and the only significant interactive comparison did not include social isolation. This fits precisely with hypothesis 3, which is rooted in strain theory. It is important to remember that these findings apply only to pain killers—escalation to other types of substances, particularly substances that are used primarily in party settings, likely have very different mechanisms for initiation that may fit the assumptions of differential association theory and control theory better (Yamaguchi & Kandel, 1984b).

#### Limitations

From a study design standpoint, using the public use files is problematic, primarily because of the risk of Type II error (the presence of false negatives). Particularly due to the inclusion of interaction terms and the relative rarity of the outcome, the cell sizes for some tests are below the preferred size for the avoidance of Type II error (Simmons et al., 2011). Some of the most significant limitations in this project stem from measurement. Loneliness is a 1-item measure only based on frequency. There are validated scales for different *kinds* of loneliness, and strength of loneliness is also a potentially significant factor in how loneliness determines outcomes (Ingram et al., 2020). This lack of specificity limits understanding of the precise mechanisms by which loneliness influences outcomes and what factors of loneliness are most important. Additionally, prior research has illustrated differences in outcomes for different types of social isolation (Chou et al., 2011)—specifically rejected adolescents (those who are disliked) vs neglected adolescents (those who are ignored) (Asher & Wheeler, 1985). Add Health's network measures do not include dislike nominations, making the proper measurement of this important distinction impossible.

Additionally, there are multiple design factors that limit the generalizability of the results. First, the exclusion of the earliest initiates is especially problematic since early initiation tends to be a strong predictor of negative outcomes later in life (McCabe et al., 2007). Therefore, my sample of adolescents who initiate substance use is smaller than the general population of adolescents who initiate substance use in middle and high-school and excludes the highest risk adolescents. This exclusion could mean an understatement of the real risks of deficits in social well-being for adverse outcomes later in life for adolescents who initiate substance use is shown in the initiation of unprescribed pain killers limits generalizability to the use of other types of substances both separately and concurrently.

#### **Future Directions**

This work lays the foundation for understanding the influence of individual social marginalization on substance use initiation. Although this study illustrates the validity of general strain theory's self-medication hypothesis on *pain killer* initiation, one important step is testing the influence of similar variables across substance type and age groups to understand the scope and limitations of this hypothesis on substance use initiation more broadly. During the opioid crisis, there has been an increase in the prevalence of substance use disorders in older age (Chhatre et al., 2017; Huhn et al., 2018); understanding the influence of similar social marginalization mechanisms at other points of the life course is needed to clarify the generalizability of these findings. In addition, understanding how these mechanisms apply to other substances could be helpful in the context of both law enforcement responses and prevention programs.

Another important step is expanding the measurement of social marginalization variables like social isolation and loneliness to understand what components of these constructs are important for pain killer initiation. Factors like strength and type of loneliness, subtypes of social isolation, but also other constructs like belonging are not well understood as predictors of substance use initiation. As qualitative work suggests, better understanding of initiation pathways could fundamentally change how recovery programs structure services and messaging (Dingle et al., 2015).

Additionally, further work examining if and how both loneliness and isolation, as well as perceptive and objective, sociometric factors more broadly, are related to one another and various forms of deviance is a crucial step both analytically and theoretically. In Agnew's terms regarding general strain theory (Agnew, 1992), the stimuli that lead to negative affect driving deviant behavior are often important points for intervention.

### Conclusion

Social isolation and loneliness are separate constructs that have distinct interactive influence on the initiation of unprescribed pain killers among US adolescents. Alienated adolescents (those who are lonely but are not socially isolated) are at significantly higher risk for pain killer initiation than typical adolescents not experiencing social marginalization. These findings indicate that loneliness is a form of emotional strain that adolescents are self-medicating with substance use and that prevention programs should look to social network satisfaction as a way to decrease propensity for initiation.

## Appendix A

# **Missingness Analysis**

Missingness Analys	sis				
	Flat Frequency	Flat Percentage of Full Sample	Adjusted Frequency	Percentage of Possible Analytic Sample	Cumulative Percentage of Possible Analytic Sample
Total	6504			-	
No Survey					
Weights	1622	24.94%			
Total Possible					
Analytic Sample	4882	75.06%			
Final Analytic					
Sample	4425	68.04%		90.64%	
-					
Reason for Missing					
Prior Initiation					
Missing	330	5.07%	330	6.76%	6.76%
Any Loneliness					
Missing	11	0.17%	11	0.23%	6.98%
Child Disclosure					
Missing	86	1.32%	67	1.37%	8.36%
Drugs In Home					
Missing	29	0.45%	11	0.23%	8.58%
Prior Substance					
Use Missing	35	0.54%	16	0.33%	8.91%
Age Missing	1	0.02%	0		8.91%
Race Missing	4	0.06%	0		8.91%
Hispanic					
Ethnicity Missing	15	0.23%	12	0.25%	9.16%
Female Missing	0		0		9.16%
Highest					
Residential Parent					
Education					
Missing	44	0.68%	10	0.20%	9.36%

Source: AddHealth Waves I&III

## **Appendix B**

## **Sensitivity Checks**

I.Full CES-D Models

II.CES-D without Loneliness Models

III.CES-D Direct Depression Item Models

IV.Outdegree Isolation Models

V.School Harsh Isolation Models

VI.Harsh Isolation Models

VII.Alternate Education Specification Models

VIII.Impulsivity Models

IX.Drug In Home Models

Table I: Full CES-D Models

	Model 1	Model 2	Model 3	Model 4	Model 5
Pain Killers Initiation					
Any Loneliness	1.159		1.159	1.175	1.185
	(0.144)		(0.144)	(0.149)	(0.155)
School Indegree Isolation		1.053	1.053	1.191	1.248
		(0.188)	(0.189)	(0.283)	(0.302)
Loneliness and Isolation					
Interaction				0.712	0.717
				(0.318)	(0.323)
Parental Monitoring Score				0.975	0.986
				(0.034)	(0.034)
Child Disclosure				1.076	1.060
				(0.092)	(0.091)
Prior Substance Use					1.404**
					(0.173)
Delinquency Score					1.617**
					(0.267)
Full CES-D	1.014	1.020**	1.014	1.014	1.004
	(0.008)	(0.007)	(0.008)	(0.007)	(0.008)
Age	0.924**	0.927*	0.924**	0.914**	0.905***
e	(0.027)	(0.027)	(0.027)	(0.025)	(0.027)
Black/African American	0.637**	0.637**	0.637**	0.641**	0.648**
	(0.090)	(0.091)	(0.090)	(0.092)	(0.093)
American Indian/Native	× ,	× ,			
American	1.621	1.641	1.623	1.624	1.553
	(0.551)	(0.554)	(0.552)	(0.550)	(0.568)
Asian/Pacific Islander	0.640	0.640	0.638	0.653	0.674
	(0.180)	(0.180)	(0.179)	(0.182)	(0.186)
Other Race	1.233	1.229	1.234	1.247	1.263
	(0.282)	(0.281)	(0.283)	(0.286)	(0.282)
Hispanic Ethnicity	0.660*	0.663*	0.660*	0.663*	0.648*
1 5	(0.112)	(0.113)	(0.112)	(0.113)	(0.115)
Female	0.856	0.866	0.858	0.845	0.919
	(0.087)	(0.087)	(0.087)	(0.087)	(0.092)
Highest Residential Parent	(0.007)	(0.007)	(0.007)	(0.007)	(0.0) =)
Education	1.062	1.068	1.063	1.060	1.066
	(0.050)	(0.050)	(0.050)	(0.050)	(0.051)
Observations	4418	4418	4418	4418	4418
Exponentiated coefficients:	Standard error	s in parenthe	eses		
Source: AddHealth Wayes L	&III	- in paronale			

\* p<0.05 \*\* p<0.01 \*\*\* p<0.001

	Model 1	Model 2	Model 3	Model 4	Model 5		
Pain Killers Initiation							
Any Loneliness	1.176		1.176	1.192	1.189		
	(0.141)		(0.141)	(0.147)	(0.150)		
School Indegree Isolation	× /	1.054	1.054	1.191	1.248		
-		(0.188)	(0.189)	(0.283)	(0.302)		
Loneliness and Isolation		```	` '	· /	× /		
Interaction				0.713	0.717		
				(0.319)	(0.323)		
Parental Monitoring Score				0.975	0.986		
č				(0.034)	(0.034)		
Child Disclosure				1.076	1.060		
				(0.092)	(0.091)		
Prior Substance Use					1.404**		
					(0.173)		
Delinguency Score					1.616**		
					(0.267)		
CES-D without Loneliness	1.015	1.020**	1.015	1.015	1.005		
	(0.008)	(0.007)	(0.008)	(0.008)	(0.008)		
Age	0.924**	0.928*	0.924**	0.914**	0.905***		
0-	(0.027)	(0.027)	(0.027)	(0.025)	(0.027)		
Black/African American	0.638**	0.638**	0.637**	0.642**	0.648**		
Linen / Hilloun / Hillorioun	(0, 090)	(0.090)	(0, 090)	(0.092)	(0.093)		
American Indian/Native	(0.070)	(0.071)	(0.070)	(0.072)	(0.075)		
American	1.621	1.644	1.623	1.624	1.553		
<b>v </b>	(0.551)	(0.555)	(0.551)	(0.550)	(0.568)		
Asian/Pacific Islander	0.639	0.640	0.637	0.652	0.673		
	(0.180)	(0.180)	(0.179)	(0.182)	(0.186)		
Other Race	1 232	1 228	1 233	1 246	1 263		
	(0.282)	(0.281)	(0.283)	(0.285)	(0.282)		
Hispanic Ethnicity	0.660*	0 664*	0.660*	0.663*	0.648*		
mopune Dunneity	(0.112)	(0.113)	(0.112)	(0.113)	(0.115)		
Female	0.856	0.867	(0.112) 0.857	0.844	0.919		
i cinute	(0.087)	(0.007)	(0.057)	(0.034	(0.097)		
Highest Residential Parent	(0.007)	(0.007)	(0.007)	(0.000)	(0.072)		
Education	1 063	1 069	1 063	1 060	1 066		
Education	(0.050)	(0.050)	(0.050)	(0.050)	(0.051)		
Observations	4418	<u>(0.050)</u> <u>4418</u>	4418	4418	4418		
Exponentiated coefficients: Star	dard armana in a	noronthagas	7710	4410	7710		
Exponentiated coefficients; Standard errors in parentneses							

Table II: CES-D without Loneliness Models

Source: AddHealth Waves I&III \* p<0.05

\*\* p<0.01 \*\*\* p<0.001

Table III: Feeling Depressed Models

	Model 1	Model 2	Model 3	Model 4	Model 5
Pain Killers Initiation					
Any Loneliness	1.242		1.241	1.261*	1.215
	(0.140)		(0.141)	(0.147)	(0.143)
School Indegree Isolation		1.063	1.059	1.198	1.250
		(0.192)	(0.191)	(0.287)	(0.303)
Loneliness and Isolation					
Interaction				0.710	0.716
				(0.319)	(0.323)
Parental Monitoring Score				0.977	0.987
				(0.034)	(0.034)
Child Disclosure				1.077	1.061
				(0.092)	(0.091)
Prior Substance Use					1.409**
					(0.173)
Delinquency Score					1.638**
					(0.265)
Feeling Depressed	1.079	1.145*	1.079	1.078	1.017
	(0.072)	(0.071)	(0.073)	(0.072)	(0.072)
Age	0.924**	0.930*	0.925**	0.915**	0.905***
	(0.026)	(0.027)	(0.026)	(0.025)	(0.027)
Black/African American	0.646**	0.650**	0.645**	0.649**	0.650**
	(0.091)	(0.093)	(0.091)	(0.093)	(0.093)
American Indian/Native					
American	1.615	1.646	1.617	1.619	1.550
	(0.551)	(0.553)	(0.551)	(0.550)	(0.569)
Asian/Pacific Islander	0.650	0.657	0.647	0.662	0.677
	(0.182)	(0.184)	(0.181)	(0.184)	(0.187)
Other Race	1.243	1.243	1.244	1.257	1.266
	(0.282)	(0.280)	(0.283)	(0.285)	(0.281)
Hispanic Ethnicity	0.665*	0.673*	0.665*	0.667*	0.649*
	(0.111)	(0.111)	(0.111)	(0.112)	(0.115)
Female	0.856	0.870	0.857	0.844	0.921
	(0.087)	(0.087)	(0.088)	(0.087)	(0.093)
Highest Residential Parent					
Education	1.052	1.055	1.053	1.049	1.063
	(0.048)	(0.048)	(0.048)	(0.048)	(0.050)
Observations	4418	4418	4418	4418	4418
Exponentiated coefficients; Standa	ard errors in p	arentheses			
Source: AddHealth Waves I&III					
* p<0.05	** p<0.01	*** p<0.0	001		

	Model 1	Model 2	Model 3	Model 4	Model 5
Pain Killers Initiation					
Any Loneliness	1.296*		1.295*	1.331*	1.241
	(0.137)		(0.137)	(0.147)	(0.136)
School Outdegree Isolation		1.220	1.214	1.377	1.366
		(0.187)	(0.187)	(0.252)	(0.247)
Loneliness and Isolation					
Interaction				0.723	0.699
				(0.221)	(0.215)
Parental Monitoring Score				0.975	0.984
				(0.035)	(0.035)
Child Disclosure				1.088	1.064
				(0.094)	(0.092)
Prior Substance Use					1.410**
					(0.174)
Delinquency Score					1.648**
					(0.260)
Age	0.925**	0.933*	0.924**	0.913**	0.902***
-	(0.026)	(0.028)	(0.026)	(0.025)	(0.026)
Black/African American	0.643**	0.647**	0.637**	0.640**	0.639**
	(0.091)	(0.092)	(0.090)	(0.090)	(0.091)
American Indian/Native		, ,	. ,		
American	1.580	1.612	1.581	1.568	1.500
	(0.538)	(0.545)	(0.537)	(0.531)	(0.544)
Asian/Pacific Islander	0.655	0.673	0.651	0.665	0.678
	(0.184)	(0.189)	(0.182)	(0.186)	(0.188)
Other Race	1.239	1.227	1.231	1.249	1.260
	(0.283)	(0.280)	(0.282)	(0.284)	(0.280)
Hispanic Ethnicity	0.669*	0.681*	0.666*	0.669*	0.649*
	(0.112)	(0.112)	(0.112)	(0.113)	(0.116)
Female	0.865	0.900	0.871	0.856	0.926
	(0.087)	(0.088)	(0.088)	(0.087)	(0.092)
Highest Residential Parent	× /	` '	· /	` '	· /
Education	1.050	1.052	1.052	1.047	1.063
	(0.047)	(0.048)	(0.048)	(0.047)	(0.049)
Observations	4425	4425	4425	4425	4425

Table IV: School Outdegree Isolation Models

Exponentiated coefficients; Standard errors in parentheses

Source: AddHealth Waves I&III \* p<0.05

\*\* p<0.01 \*\*\* p<0.001

	Model 1	Model 2	Model 3	Model 4	Mode
Pain Killers Initiation					
Any Loneliness	1.296*		1.302*	1.312*	1.218
	(0.137)		(0.138)	(0.143)	(0.130
School Indegree and					
Outdegree Isolation		1.652	1.691	1.990	2.075
		(0.484)	(0.494)	(0.708)	(0.759
Loneliness and Isolation					
Interaction				0.559	0.579
				(0.402)	(0.420
Parental Monitoring Score				0.974	0.983
				(0.034)	(0.034
Child Disclosure				1.085	1.061
				(0.094)	(0.092
Prior Substance Use				· · · ·	1.415
					(0.17
Delinquency Score					1.656
1 2					(0.26
Age	0.925**	0.935*	0.925**	0.915**	0.904
e	(0.026)	(0.028)	(0.026)	(0.025)	(0.02
Black/African American	0.643**	0.650**	0.638**	0.644**	0.642
	(0.091)	(0.092)	(0.090)	(0.091)	(0.092
American Indian/Native			( )	( )	× ·
American	1.580	1.617	1.585	1.584	1.521
	(0.538)	(0.541)	(0.533)	(0.530)	(0.54
Asian/Pacific Islander	0.655	0.671	0.648	0.664	0.675
	(0.184)	(0.187)	(0.180)	(0.184)	(0.18)
Other Race	1.239	1.241	1.244	1.269	1.278
	(0.283)	(0.283)	(0.285)	(0.291)	(0.28
Hispanic Ethnicity	0.669*	0.679*	0.664*	0.665*	0.643
1 5	(0.112)	(0.112)	(0.111)	(0.112)	(0.114
Female	0.865	0.900	0.871	0.856	0.928
	(0.087)	(0.089)	(0.088)	(0.087)	(0.09)
Highest Residential Parent	(0.007)	(0.003)	(0.000)	(0.007)	(0.05)
Education	1.050	1.052	1.052	1.048	1.064
	(0.047)	(0.048)	(0.048)	(0.048)	(0.05)
	(0.0.7)			(0.010)	(0.05)

\* p<0.05 \*\* p<0.01 \*\*\* p<0.001

Table VI: Harshest Isolation Models

	Model 1	Model 2	Model 3	Model 4	Model 5
Pain Killers Initiation					
Any Loneliness	1.296*		1.301*	1.307*	1.214
	(0.137)		(0.138)	(0.141)	(0.129)
In and Out of School					
Outdegree and School					
Indegree Isolation		2.092*	2.128*	2.586*	2.774*
		(0.714)	(0.724)	(1.070)	(1.193)
Loneliness and Isolation					
Interaction				0.560	0.566
				(0.456)	(0.478)
Parental Monitoring Score				0.971	0.980
				(0.034)	(0.034)
Child Disclosure				1.086	1.061
				(0.094)	(0.092)
Prior Substance Use					1.414**
					(0.175)
Delinquency Score					1.665**
					(0.264)
Age	0.925**	0.934*	0.925**	0.914**	0.902***
-	(0.026)	(0.028)	(0.026)	(0.025)	(0.026)
Black/African American	0.643**	0.648**	0.636**	0.642**	0.640**
	(0.091)	(0.093)	(0.091)	(0.092)	(0.092)
American Indian/Native					
American	1.580	1.605	1.573	1.572	1.508
	(0.538)	(0.536)	(0.529)	(0.525)	(0.537)
Asian/Pacific Islander	0.655	0.667	0.645	0.658	0.670
	(0.184)	(0.187)	(0.180)	(0.183)	(0.184)
Other Race	1.239	1.228	1.229	1.256	1.263
	(0.283)	(0.281)	(0.283)	(0.288)	(0.283)
Hispanic Ethnicity	0.669*	0.682*	0.667*	0.669*	0.648*
-	(0.112)	(0.112)	(0.112)	(0.113)	(0.115)
Female	0.865	0.900	0.871	0.856	0.929
	(0.087)	(0.088)	(0.088)	(0.087)	(0.092)
Highest Residential Parent	<b>`</b>	× /		× ,	
Education	1.050	1.053	1.053	1.049	1.066
	(0.047)	(0.048)	(0.048)	(0.048)	(0.050)
Observations	4425	4425	4425	4425	4425
Exponentiated coefficients;	Standard error	s in parenth	eses		
Source: AddHealth Waves I	&III	-			
* p<0.05	** p<0.01	*** p<0.0	01		

Table VII. Alternate Educa					
	Model 1	Model 2	Model 3	Model 4	Model 5
Pain Killers Initiation					
Any Loneliness	1.290*		1.290*	1.309*	1.217
	(0.136)		(0.136)	(0.144)	(0.131)
School Indegree Isolation		1.055	1.055	1.188	1.248
		(0.192)	(0.191)	(0.283)	(0.302)
Loneliness and Isolation					
Interaction				0.717	0.720
				(0.321)	(0.324)
Parental Monitoring					
Score				0.980	0.989
				(0.035)	(0.035)
Child Disclosure				1.071	1.048
				(0.092)	(0.090)
Prior Substance Use					1.420**
					(0.175)
Delinquency Score					1.643**
					(0.259)
Age	0.926**	0.935*	0.926**	0.918**	0.906***
-	(0.026)	(0.028)	(0.026)	(0.025)	(0.026)
Black/African American	0.652**	0.663**	0.652**	0.655**	0.653**
	(0.091)	(0.093)	(0.091)	(0.092)	(0.092)
American Indian/Native	× ,		× ,		× ,
American	1.585	1.618	1.587	1.587	1.524
	(0.538)	(0.546)	(0.538)	(0.535)	(0.550)
Asian/Pacific Islander	0.661	0.681	0.659	0.673	0.683
	(0.187)	(0.193)	(0.186)	(0.189)	(0.191)
Other Race	1.241	1.239	1.242	1.254	1.264
	(0.283)	(0.282)	(0.284)	(0.286)	(0.281)
Hispanic Ethnicity	0.672*	0.688*	0.673*	0.675*	0.654*
1 2	(0.113)	(0.113)	(0.113)	(0.113)	(0.116)
Female	0.870	0.899	0.871	0.859	0.931
	(0.088)	(0.089)	(0.089)	(0.088)	(0.093)
parentedsens	1.052	1.052	1.053	1.050	1.069
1	(0.048)	(0.048)	(0.048)	(0.048)	(0.050)
Observations	4411	4411	4411	4411	4411
Exponentiated coefficients	; Standard err	ors in parent	heses		

Table VII: Alternate Education Specification Models

Source: AddHealth Waves I&III

* p<0.05 ** p<0.0	l *** p<0.001
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Table VIII: Impulsivity Models

	Model 1	Model 2	Model 3	Model 4	Model 5		
Pain Killers Initiation							
Any Loneliness	1.297*		1.297*	1.315*	1.223		
	(0.137)		(0.137)	(0.144)	(0.132)		
School Indegree Isolation		1.055	1.056	1.190	1.256		
		(0.193)	(0.193)	(0.286)	(0.307)		
Loneliness and Isolation							
Interaction				0.718	0.720		
				(0.323)	(0.326)		
Parental Monitoring Score				0.976	0.984		
				(0.034)	(0.034)		
Child Disclosure				1.080	1.052		
				(0.094)	(0.092)		
Prior Substance Use					1.421**		
					(0.173)		
Delinquency Score					1.685**		
1					(0.269)		
Impulsivity Score	0.984	0.988	0.983	0.984	0.928		
1 2	(0.070)	(0.070)	(0.070)	(0.070)	(0.065)		
Age	0.925**	0.935*	0.925**	0.915**	0.902***		
e	(0.027)	(0.028)	(0.027)	(0.025)	(0.026)		
Black/African American	0.642**	0.653**	0.641**	0.646**	0.639**		
	(0.091)	(0.093)	(0.091)	(0.093)	(0.093)		
American Indian/Native	( )						
American	1.574	1.610	1.576	1.576	1.491		
	(0.538)	(0.546)	(0.538)	(0.535)	(0.543)		
Asian/Pacific Islander	0.655	0.674	0.652	0.667	0.674		
	(0.184)	(0.189)	(0.183)	(0.186)	(0.187)		
Other Race	1.238	1.236	1.239	1.252	1.256		
	(0.282)	(0.281)	(0.283)	(0.286)	(0.279)		
Hispanic Ethnicity	0.670*	0.685*	0.670*	0.672*	0.652*		
1 5	(0.112)	(0.112)	(0.112)	(0.112)	(0.114)		
Female	0.865	0.895	0.867	0.853	0.930		
	(0.087)	(0.088)	(0.088)	(0.087)	(0.093)		
Highest Residential Parent	()		()	()	()		
Education	1.050	1.050	1.051	1.047	1.065		
	(0.047)	(0.047)	(0.047)	(0.047)	(0.050)		
Observations	4425	4425	4425	4425	4425		
Exponentiated coefficients:	Standard error	s in parenth	eses	-	-		
Source: AddHealth Wayes I&III							

\* p<0.05 \*\* p<0.01 \*\*\* p<0.001

Table IX: Drug in Home Models

	Model 1	Model 2	Model 3	Model 4	Model 5			
Pain Killers Initiation								
Any Loneliness	1.304*		1.303*	1.321*	1.226			
-	(0.138)		(0.138)	(0.145)	(0.132)			
School Indegree Isolation		1.054	1.054	1.191	1.248			
5		(0.192)	(0.191)	(0.284)	(0.303)			
Loneliness and Isolation				()	()			
Interaction				0.715	0.720			
				(0.321)	(0.325)			
Parental Monitoring Score				0.978	0.986			
i arentar mentering seere				(0.034)	(0.034)			
Child Disclosure				1.086	1.063			
Clinic Disclosure				(0.093)	(0.091)			
Prior Substance Use				(0.075)	(0.071) 1 /17**			
Thor Substance Ose					(0.174)			
Dolinguonou Sooro					(0.174) 1672**			
Definquency Score					(0.260)			
Drugg In Homo	0 995	0.001	0 005	0.870	(0.209)			
Drugs III Hollie	(0.003)	(0.901)	(0.003)	(0.079)	(0.713)			
<b>A</b> = -	(0.282)	(0.283)	(0.282)	(0.282)	(0.241)			
Age	0.926**	0.936*	0.926**	0.91/**	0.905***			
	(0.026)	(0.028)	(0.026)	(0.025)	(0.027)			
Black/African American	0.650**	0.661**	0.650**	0.654**	0.656**			
	(0.092)	(0.094)	(0.092)	(0.093)	(0.094)			
American Indian/Native								
American	1.618	1.655	1.620	1.623	1.573			
	(0.563)	(0.572)	(0.563)	(0.562)	(0.588)			
Asian/Pacific Islander	0.657	0.677	0.655	0.670	0.684			
	(0.184)	(0.190)	(0.183)	(0.186)	(0.188)			
Other Race	1.239	1.237	1.240	1.253	1.260			
	(0.282)	(0.281)	(0.283)	(0.285)	(0.279)			
Hispanic Ethnicity	0.670*	0.686*	0.670*	0.672*	0.654*			
	(0.112)	(0.112)	(0.112)	(0.112)	(0.115)			
Female	0.864	0.896	0.866	0.851	0.923			
	(0.088)	(0.089)	(0.089)	(0.088)	(0.093)			
Highest Residential Parent		· · ·		<b>`</b>	<b>、</b> ,			
Education	1.048	1.048	1.048	1.045	1.061			
	(0.047)	(0.047)	(0.047)	(0.047)	(0.050)			
Observations	4418	4418	4418	4418	4418			
Exponentiated coefficients: Standard errors in parentheses								
Exponentiated continents, standard enors in parenticeses								

 Source: AddHealth Waves I&III

 \* p<0.05</td>
 \*\* p<0.01</td>
 \*\*\* p<0.001</td>

### Appendix C

## **Detailed Item Descriptions for Scales**

## Delinquency

- In the past 12 months, how often did you paint graffiti or signs on someone else's property or in a public place?
- In the past 12 months, how often did you deliberately damage property that didn't belong to you?
- In the past 12 months, how often did you lie to your parents or guardians about where you had been or whom you were with?
- How often did you take something from a store without paying for it?
- In the past 12 months, how often did you get into a serious physical fight?
- In the past 12 months, how often did you hurt someone badly enough to need bandages or care from a doctor or nurse?
- How often did you run away from home?
- How often did you drive a car without the owner's permission?
- In the past 12 months, how often did you steal something worth more than \$50?
- How often did you go into a house or building to steal something?
- In the past 12 months, how often did you use or threaten to use a weapon to get something from someone?
- In the past 12 months, how often did you sell marijuana or other drugs?
- How often did you steal something worth less than \$50?

- In the past 12 months, how often did you take part in a fight where a group of your friends was against another group?
- How often were you loud, rowdy, or unruly in a public place?

### **Parental Monitoring**

Do your parents let you make your own decisions about...

- 1. the time you must be home on weekend nights?
- 2. the people you hang around with?
- 3. what you wear?
- 4. how much television you watch?
- 5. which television programs you watch?
- 6. what time you go to bed on weeknights?
- 7. what you eat?

I coded the "yes" responses as 0 and the "no" responses as 1 (reflecting a lack of respondent choice, i.e., monitoring), and then sum responses them so higher scores indicate higher parental monitoring and lower scores indicate lower parental monitoring.

## Appendix D

# **Unweighted Descriptive Statistics**

Unweighted Descriptive Statistics of Key Variables					
		Standard			Cronbach's
	Mean	Deviation	Minimum	Maximum	Alpha
Pain Killers Initiation	0.18		0.00	1.00	
Any Loneliness	0.36		0.00	1.00	
School Indegree Isolation	0.06		0.00	1.00	
Parental Monitoring Score	1.96	0.02	0.00	7.00	0.61
Child Disclosure	0.42		0.00	1.00	
Delinquency Score	0.26	0.00	0.00	3.00	0.80
Prior Substance Use	0.69		0.00	1.00	
Age	15.44	0.03	11.00	21.00	
White	0.66		0.00	1.00	
Black/African American	0.24		0.00	1.00	
American Indian/Native					
American	0.01		0.00	1.00	
Asian/Pacific Islander	0.04		0.00	1.00	
Other Race	0.04		0.00	1.00	
Hispanic Ethnicity	0.11		0.00	1.00	
Female	1.54		1.00	2.00	
Highest Residential Parent					
Education	2.91		1.00	4.00	
$\mathbf{C}$					

Source: AddHealth Waves I&III

## Appendix E

# Predictive Margins for Model 4

			Compared	to	<b>C</b> 1		<b>C</b> 1		
			Adolescer	its	Solitude	l to	Alienated	to	
Typical	16.5	51%							
Adolescent	14.61%	18.41%							
	19.0	)5%	2.54%						
Solitude	11.53%	26.56%	-4.67%	9.75%					
	20.5	56%	4.05%		1.51%				
Alienated	17.77%	23.35%	0.74%	7.36%	-6.11%	9.14%			
Classically	18.1	19%	1.68%		1.68% -0.8		6%	-2.37	'%
Isolated	8.53%	27.85%	-8.32%	11.68%	-13.82%	12.10%	-12.61%	7.87%	

Interaction Margins

Source: Add Health Waves I&III

## Appendix F

# **Group Differences for Early Initiates**

Group Differences for Early Initiates						
	Analyti	c				
	Sample		Early Initiates			
		15.39		16.17		
Age	15.30	15.47	15.89	16.45		
		2.25%		10.37%		
Drug In Home	1.53%	2.98%	4.77%	15.96%		
99.9% Confidence Intervals Below Mean						
Estimates						
Source: AddHealth Waves I&III						

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