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Aggressive Behavior and Cannabis Use

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Abstract

Motivated by the significant public health impact of a potential association between aggressive behavior and cannabis use, we reviewed international literature to assess the empirical evidence supporting either the co-occurrence hypothesis or the directional hypothesis (i.e., aggressive behavior leading to cannabis use or cannabis use leading to aggressive behavior). Support for any of these hypotheses has implications for preventive interventions targeting either the underlying causes of both behaviors or by specifically targeting one of these behaviors as a risk factor for the other. Despite the theoretical and empirical evidence supporting a positive association between early childhood aggressive behavior and cannabis use later in life, the causal relationship remains unsupported. In addition, inconsistent results were found for the interrelationship between these two behaviors during adolescence. We cited several study characteristics as plausible culprits for these inconsistent results and suggested future research efforts.

Keywords: Aggressive and disruptive behavior, Cannabis use, co-occurrence, directionality, causality

Abbreviations

ADB: Aggressive and disruptive behavior

PBT: Problem Behavior Theory

1. Introduction

The prevention and treatment of both substance use and aggressive, disruptive behavior (ADB) are national priorities in countries around the world. Good epidemiological evidence exists to suggest that both behaviors lead to significant proximal (e.g., truancy, suspension and expulsion) as well as distal (e.g., school dropout, criminality, suicidal behavior) negative social and health outcomes (Hall & Solowij, 1998; S. G. Kellam et al., 2008; Petras et al., 2008; Petras, Masyn, & Ialongo, 2011).

Substance use, especially cannabis use, has been often found to have a positive link with aggressive behavior, found in cross-sectional and longitudinal studies (Goodman, 2010; Jester et al., 2008; Schofield, Bierman, Heinrichs, & Nix, 2008). Liu, Lynne-Landsman, Petras, Masyn, and Ialongo (2013) found that early childhood aggressive behavior (grades 1-3) in turn doubles the odds of high-frequency marijuana use in adolescence (grades 8-12). Petras et al. (2011) found that early childhood aggressive behavior during grade 1-3 increased the odds of conduct problems during grades 6-12 eight-fold. The common co-occurrence of cannabis and aggressive behavior in adolescence is often explained by the Problem Behavior Theory (PBT; Jessor, 1991). PBT proposes that many problem behaviors, including substance use, conduct problems and other antisocial behaviors are interrelated in that the personal and situational factors influencing one behavior may be the same as those influencing another.

Huizinga, Loeber, Thornberry, and Cothorn (2000) assessed the level of co-occurrence of multiple problem behaviors in three large longitudinal studies, including the Denver Youth Survey (PI: David Huizinga), the Pittsburgh Youth Study (PI: Rolf Loeber), and the Rochester Youth Development Study (PI: Terence Thornberry). It was found that 34 percent to 44 percent of male delinquents (defined as involvement as a perpetrator in serious violent or property crimes in at least two out of three years examined) and 46 percent to 48 percent female delinquents were also drug users, and between 54 percent and 70 percent of male drug users and between 20 percent and 23 percent female drug users were also delinquents. While these relationships are statistically significant, it cannot be assumed that most delinquents are also drug users. Causal inferences are not possible insofar as a causal relationship indicates that changes in one variable *cause* changes in another, and this type of relationship can be investigated only through experimental and quasi-experimental methods in order to address observed and unobserved *confounding* (Rosenbaum (2002)).

This raises questions about the causal basis for this association, in particular during early and late adolescence. For example, if the association between early childhood aggression and later cannabis use is non-causal, then harm reduction and substance use prevention/intervention programs in adolescence are

expected to be effective. On the other hand, evidence for causality would make cannabis use a hidden but preventable public health problem responsible for many psychosocial problems among youth.

This book chapter represents an intermediate step towards the goal of assessing the potential causality between ADB and cannabis use by conceptually summarizing the current literature focusing on the co-occurrence of these two behaviors during childhood and adolescence. The chapter is structured as follows: Building upon the descriptive epidemiology of cannabis use and ADB, we will review theoretical models as well as the extent of empirical support for the different possible hypothesized associations between the two behaviors.

Disclaimer: This study is not meant to be an exhaustive literature review, but it rather aims to describe the rather complex relationship between cannabis use and aggressive behavior, and by identifying important research gaps, this chapter may inspire future empirical research to respond to such challenges.

1.1 Descriptive Epidemiology of Cannabis use:

Cannabis is the most widely cultivated, trafficked and abused illicit drug worldwide. It is estimated that 147 million people or 2.5 percent of the world population consume cannabis. This annual prevalence is over 10 times higher than the prevalence for cocaine or opiates. The most rapid abuse, starting in the 1960s, has occurred in developed countries, including North America, Western Europe and Australia.

Recent data from the Monitoring The Future study (Johnston, O'Malley, Bachman, Schulenberg, & Miech, 2014) revealed that between 2008 and 2013, past-month use increased from 5.8 percent to 7.0 percent among 8th graders, from 13.8 to 18.0 percent among 10th graders and from 19.4 to 22.9 percent among 12th graders. The 2011 ESPAD Report (Hibell et al., 2011) reported a wide range of prevalence rates in Europe. In 2011, the prevalence among 15 and 16 year-old school students was 13 percent with the highest prevalence found in France at 35 percent.

For many youth, initiation and experimentation with cannabis begin during late adolescence (Fuller et al., 2005). The hazard of first use follows a typical age-curve characterized by an increase in risk at age 10-11 and peaking around age 18 (Wagner & Anthony, 2002).

1.2 Descriptive Epidemiology of aggressive/disruptive behavior

ADB (e.g., being stubborn, lying, disobeying) is considered to be normal and highly frequent in young developing children. Approximately 50 percent of social exchanges between children 12-18 months of

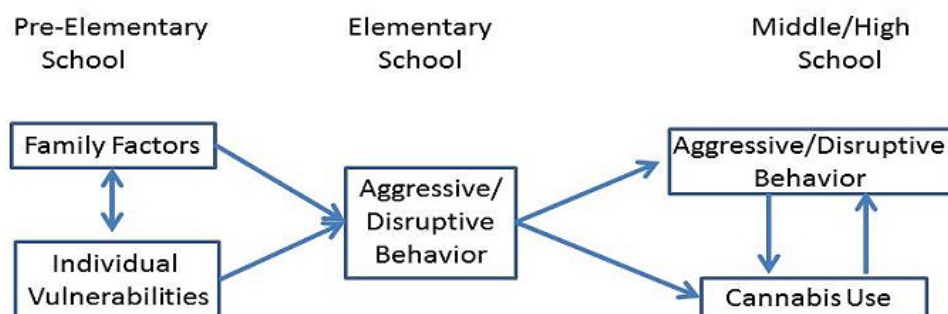
age can be considered ADB (Holmberg, 1980). During this age period, ADB is seen as adaptive and is part of the infants' training ground to develop effective social strategies for assertiveness, ownership of objects and resolution of social conflict. For the majority of children, ADB tends to decrease overall during childhood and adolescence due to increases in self-control, hormonal regulation and cognitive capacity (Tremblay, 2006).

However, for a small, but significant number of children, ADB does not decrease or starts to reemerge in later childhood. Two prominent theoretical models have discussed this phenomenon (Moffitt, 1993; Patterson, DeBaryshe, & Ramsey, 1989). Patterson's model argues for two distinct pathways toward antisocial behavior: those of early starters (i.e., involving coercive parenting, school failure, and antisocial behavior problems starting in childhood) and late starters (i.e., involving poor parental monitoring, contrarian behavior, and deviant peer involvement starting in early adolescence). Moffitt's model also proposes two mutually exclusive subgroups of antisocial youth: life-course persistent offenders, who show high levels of aggressive behavior throughout development and continue to be violent as adults; and adolescence-limited offenders, who engage in nonviolent forms of antisocial behavior only during the teen years.

2. Theories and empirical support

Building on the descriptive epidemiology of aggressive behavior and cannabis use, we reviewed theories and empirical support of cannabis use-aggressive behavior relationship. Our review was conceptually motivated by a path model depicting three developmental periods: the pre-elementary, elementary and middle school period (see Figure 1).

Figure 1: Risk Factors for Cannabis Use during Three Developmental Periods



Risk factors for cannabis use in three developmental periods are depicted in Figure 1. Arrows are not meant to indicate causal pathways. During the pre-elementary school years, family factors interacting with individual vulnerabilities are hypothesized to influence levels of aggressive behavior during the elementary school years. These levels in turn may influence cannabis use directly or indirectly through increasing level of aggressive and disruptive behavior during the middle and high school years. In addition, it is hypothesized that both cannabis use and levels of aggressive and disruptive behaviors during this period may influence each other.

During the pre-elementary school period, the focus is on delineating etiological factors of ADB, namely family factors and individual vulnerabilities. During the elementary school period, the focus is on ADB as a risk factor for both later aggressive behavior as well as cannabis use. Lastly, during the middle-school period, we focus on the co-occurrence between the two behaviors of interest.

In the following sections, we will discuss three likely pathways of the relationship between cannabis use and aggressive behavior in elementary school, as well as in middle and high school, respectively: ADB in elementary school leading to later cannabis use (2.1); ADB leading to cannabis use in middle and high school (2.2); cannabis use leading to ADB in middle and high school (2.3).

2.1 ADB in Elementary School Leading to Later Cannabis Use

Theory: Life course-social field theory (S.G. Kellam, Branch, Agrawal, & Ensminger, 1975) and its integration with the developmental model of antisocial behavior (Patterson et al., 1989) have been used to explain the relationship between early ADB and cannabis use. Life course/social field theory posits that,

over the course of development, individuals are evaluated on how they respond to different task demands in various social fields (e.g., the family, the classroom etc.). At the heart of this theory is the tenet that early success in meeting these demands promotes success in later stages of life as individuals face new challenges (Cicchetti & Schneider-Rosen, 1984).

According to life course-social field theory (S.G. Kellam et al., 1975), when first transitioning into formal education, children are confronted with teachers' demands for following classroom rules and participating in classroom activities. Successfully meeting these demands will promote the successful transition into early adolescence, a period characterized by a different set of demands defined by family, school, and peers. In contrast, engagement in ADB in early elementary school may indicate the failure to meet classroom demands and eventually lead to negative behavior and consequences in adolescence such as engaging in antisocial behavior and frequent use of illicit drugs.

The origins of early classroom ADB are explained by referring to Patterson's developmental model of antisocial behavior (Patterson et al. 1989). Patterson et al.'s early starter model posits that aggressive children are more likely to provoke parents' and teachers' punitive discipline, leading to their rejection, which can facilitate children's drift into deviant peer groups where a range of antisocial behaviors, including drug use and sustained levels of ADB, are reinforced and further opportunities to engage in these behaviors may be provided.

Peer rejection is another common correlate of chronic aggressive behavior problems (Haselager, Cillessen, Van Lieshout, Riksen-Walraven, & Hartup, 2002; Hektner, August, & Realmuto, 2000; Schwartz, 2000) and, in accord with Patterson, Reid, and Dishion (1992), may serve to hasten the aggressive and disruptive child's drift into a deviant peer group in late childhood and early adolescence. In these deviant peer groups, ADB is reinforced, thereby increasing the likelihood of later antisocial behavior (Deater-Deckard, 2001; French, Conrad, & Turner, 1995; Hektner et al., 2000). Deviant peer affiliation exposes youth to negative peer influences, including access and opportunities to use illicit drugs, such as cannabis.

Empirical Support: Large prospective longitudinal studies with sufficiently long follow-ups have been utilized to test for this relationship (see Table 1). Together, these studies have found a positive relationship between childhood ADB and later cannabis use: increases in aggressive behavior in childhood is longitudinally associated with early onset and/or frequency of cannabis use. Using longitudinal data collected from a community sample consisting predominantly of inner-city African

American youths, a group of scholars have examined the relationship between aggressive behavior, measured as early as first grade of elementary school, on adolescent substance use.

Specifically, Liu et al. (2013) reported that trajectories of ADB measured at grades 1-3 are significantly associated with frequency of cannabis use in grades 8-12. A similar finding was also documented in Lynne-Landsman, Bradshaw, and Ialongo (2010) using the same dataset. In addition, Reboussin, Hubbard, and Ialongo (2007) also found that aggressive behavior in first grade was associated with an increased risk of cannabis exposure opportunities as well as cannabis use and problems in middle school.

Using data from the Raising Healthy Children (RHC) study, Kim, Catalano, Haggerty, and Abbott (2011) found that self-reported bullying behavior at grade 5 is significantly associated with increased cannabis use at age 21. Analyzing a longitudinal sample of youths followed from kindergarten to high school, Schofield et al. (2008) found that, regardless of gender and race, high rates of ADB at school entry increased risk of substance use, including cannabis use, in middle school.

Using a community sample of children at high risk for conduct disorder, Wu, Witkiewitz, McMahon, and Dodge (2010) found that higher levels of childhood conduct problems in kindergarten, including aggressive behavior, predicted higher levels of cannabis use in adolescence.

Korhonen et al. (2010) analyzed data collected from Dutch adolescents as part of the Tracking Adolescents' Individual Survey (TRAILS), and reported that childhood externalizing behavior (including aggressive behavior) measured at age 10-12 predicts the initiation and use of cannabis at age 12-18 both directly and indirectly through the initiation of cigarette smoking. Using the same data set, Creemers et al. (2009) found that conduct problems at ages 10-12 predicted early onset of cannabis use in adolescence at age 12-14.

Similarly, Jester et al. (2008) found that aggression trajectories in childhood measured between ages 7 and 16 predict early onset of cannabis use. Analyzing a 25-year prospective longitudinal study of a New Zealand birth cohort, Fergusson, Boden, and Horwood (2008) reported that childhood and early adolescent conduct problems, including aggressive behavior, were significantly associated with illicit drug abuse, including cannabis abuse and dependence, measured at ages 16 to 25.

Studies also found that, when coupled with other behavioral problems, aggressive behavior is a stronger predictor of cannabis use and abuse/dependence. Examining the Gazel Youth study, which uses a population-based longitudinal sample, Galera et al. (2010) found that conduct disorder combined with hyperactivity-inattention in childhood predicts early initiation of cannabis use in males.

Using a community sample of youths from multiple schools, Flory, Milich, Lynam, Leukefeld, and Clayton (2003) found that disruptive behavior at grade 6 significantly contributed to later cannabis use and dependence in young adulthood (ages 19-22), while this effect on cannabis dependence is stronger when Hyperactivity–Impulsivity–Inattention is presented in addition to disruptive behavior. Similarly, using an inner-city community sample from a mid-west city followed from ages 6 to 32, Ensminger, Juon, and Fothergill (2002) examined childhood antecedents of cannabis use in adulthood. They found that males who were both shy and aggressive in first grade were more likely to use cannabis in adulthood than those who were neither.

Some studies have specifically examined gender differences in the aggressive behavior-cannabis use relationship. Taken together, these studies suggest that the effect of aggressive behavior on cannabis use may differ by gender, consistent with the general hypothesis that risk factors of cannabis use may be gender-specific (van den Bree & Pickworth, 2005).

For example, Pedersen, Mastekaasa, and Wichstrom (2001) investigated the relationship between early conduct problems and early onset of cannabis use with a focus on gender differences using a prospective longitudinal study of a national sample of adolescents in their early teens in Norway. They found a strong association between early conduct problems and subsequent early initiation of cannabis use, and that the effect was stronger for girls than for boys. Liu et al. (2013) reported that ADB measured at grades 1-3 is significantly associated with frequency of cannabis use among males in grades 8-12, but not females.

Other studies have found that ADB only leads to cannabis use in certain circumstances. For example, Prinstein and La Greca (2004) analyzed a sample of girls assessed in grades 4-6 and then again in grades 10-12. They reported an interaction between aggressive behavior and peer rejection, whereby aggressive behavior was significantly associated with adolescent cannabis use only among those experiencing peer rejection. When girls were accepted by peers, the association between childhood aggression and adolescent cannabis use did not hold.

Table 1: Empirical Studies Supporting ADB in Elementary School Leading to Later Cannabis Use

Author (Year)	Location	Sample
Liu et al. (2013)	Baltimore, MD USA	A sample of 678 urban first-graders from 27 classrooms in nine elementary schools who participated in the JHU PIRC's Second-Generation Intervention Trial.
Lynne-Landsman et al. (2010)	Baltimore, MD USA	A sample of 678 urban first-graders from 27 classrooms in nine elementary schools who participated in the JHU PIRC's Second-Generation Intervention Trial.

Author (Year)	Location	Sample
Reboussin et al. (2007)	Baltimore, MD USA	A sample of 678 urban first-graders from 27 classrooms in nine elementary schools who participated in the JHU PIRC's Second-Generation Intervention Trial.
Kim et al. (2011)	Seattle, WA USA	A longitudinal community sample of 957 young people from the Raising Healthy Children project.
Schofield et al. (2008)	Durham, NC; Nashville, TN; Seattle, WA; rural central Pennsylvania (USA)	A longitudinal sample of 694 boys and girls from four geographical locations was utilized, with data collected from kindergarten through high school from Fast Track project.
Wu et al. (2010)	Durham, NC; Nashville, TN; Seattle, WA; Pennsylvania (USA)	A sample of 446 high risk control group who participated in the follow up study from the Fast Track project
Korhonen et. al (2010)	Netherlands	Dutch adolescents (N = 1,606; 854 girls and 752 boys) from the TRacking Adolescents' Individual Lives Survey (TRAILS).
Creemers et al. (2009)	Netherlands	Data from 81% (n = 1,804) of the participants (51.9% girls) of the Tracking Adolescents' Individual Lives Survey (TRAILS), a prospective general population study were analyzed.
Jester et al. (2008)	Michigan, IL USA	A sample of 335 children of alcoholic and non-alcoholic fathers collected behavioral ratings by parents and teachers of aggression and inattention /hyperactivity across ages 7-16.
Fergusson et al. (2008)	New Zealand	A 25-year prospective longitudinal study of the health, development, and adjustment of a birth cohort of 1265 New Zealand children.
Galera et al.(2010)	France	A sample of 1107 participants (aged 4 to 18 years at baseline) recruited from the population-based longitudinal Gazel Youth study with a follow-up assessment 8 years later.
Flory et al. (2003)	Metropolitan area USA	A sample of 481 young adults with 10-12 years follow up.
Ensminger et al. (2002)	Chicago, IL USA	An inner-city community sample from a mid-west city followed from ages 6 to 32 (N=1242)
Pedersen et al. (2001)	Norway	A prospective longitudinal study of a national sample of 2436 adolescents followed up over a year and a half, when the adolescents were in their early teens
Prinstein and Le Greca (2004)	Metropolitan area USA	Participants were 148 girls from diverse ethnic backgrounds, who were initially assessed in Grades 4-6 and again in Grades 10-12.

2.2 ADB Leading to Cannabis Use in Middle and High school

Theory: It has been argued that, for adolescents who engage in both conduct disorder and substance use, conduct disorder typically precedes the initiation of substance use (Le Blanc & Loeber, 1998). Khantzian (1985) proposed a “self-medication hypothesis,” whereby individuals with mental health problems, including aggression and other externalizing behavioral problems, tend to resort to substance use as a “solution” to their problems. The short-term effects of alcohol and illicit drugs help these individuals to cope with stressful states experienced as a result of their mental health issues. A more recent version of

the theory developed by Khantzian (2003) discussed the particular effect of different substances. In particular, cannabis has both stimulating (i.e., boosting energy and calming hyperactivity) and sedatory (i.e., calming intense rage and creating the illusion of relief) effects.

Empirical Support: A large body of empirical studies have found that adolescent ADB is likely to lead to later substance use (see Table 2). Using a longitudinal community sample of twins (at age 11 and age 14), King, Iacono, and McGue (2004) found that externalizing behavior measured at age 11 (including aggressive behavior) predicts early onset of cannabis use by age 14 as well as regular use at that age.

Goodman (2010) examined the longitudinal associations in both directions between externalizing behavior and cannabis use in adolescence using a British national cohort (ages 11-16 at baseline). It was found that externalizing behavior problems (including aggressive behavior) measured at baseline independently predicted cannabis use three years later with a dose-response relationship. No evidence was found that baseline cannabis use predicted externalizing behavior at follow-up.

Using data from the longitudinal TRAILS study, Griffith-Lendering, Huijbregts, Mooijaart, Vollebergh, and Swaab (2011) found that externalizing behavior at ages 11 and 13 predicted cannabis use at 13 and 16, respectively. van den Bree and Pickworth (2005) examined the risk factors of five stages of cannabis involvement, including “initiation of experimental use,” “initiation of regular use,” “progression to regular use,” “failure to discontinue experimental use,” and “failure to discontinue regular use” among middle and high school students as part of the Add Health study. They reported that delinquency was one of the strong predictors of all stages one year later.

Using a sample of adolescents (ages 13-18) from Seattle Homeless Adolescent Research Project (SHARP), Paradise and Cauce (2003) found that delinquent behavior is associated with changes in frequency of cannabis use measured three and six months later. Based on the results, they challenged the utility of single-factor explanations of adolescent deviance and substance use, suggesting a more dynamic relationship than previously thought.

Using data from Mater Hospital and University of Queensland Study of Pregnancy, a population-based prospective birth cohort study, Hayatbakhsh, Najman, Bor, O’Callaghan, and Williams (2009) found that adolescent aggressive behavior/delinquency measured at age 14 were strongly associated with cannabis use and disorder in young adulthood. Using a community sample of African-American youths, Doherty, Green, and Ensminger (2008) found that serious adolescent delinquency has at least some causal influence on cannabis use initiation through mid-life (age 42).

Some mixed findings were revealed when separate types of aggression were examined. For example, using self-reported data gathered from high school students, Skara et al. (2008) found that relational aggression at baseline was a strong predictor for cannabis use one year later for females, but not for males. However, physical aggression at baseline does not predict cannabis use either for males or females.

Table 2: Empirical Studies Supporting ADB Leading to Cannabis Use in Middle and High School

Author (Year)	Location	Sample
King et al. (2004)	Minnesota USA	A total of 699 twin girls and 665 twin boys from Minnesota Twin Family Study interviewed at age 11 and age 14
Goodman (2010)	UK	A sample of 3607 British national cohort (age 11-16 at baseline)
Griffith-Lendering et al. (2011)	Netherlands	Data were used from the TRAILS study, a longitudinal cohort study of (pre)adolescents (n=1,449), with measurements at age 11.1 (T1), age 13.6 (T2) and age 16.3 (T3).
van den Bree and Pickworth (2005)	USA	Data were from Add Health study collected over 2 time points with a sample of middle and high school students (N=13718, aged 11-21 years)
Paradise and Cauce (2003)	Seattle, WA USA	Using a sample of 200 adolescents (age 13-18) from Seattle Homeless Adolescent Research Project (SHARP)
Hayatbakhsh et al. (2009)	Australia	A longitudinal cohort of 2,493 young adults from Mater Hospital and University of Queensland Study of Pregnancy
Doherty et al. (2008)	Chicago, IL USA	A community sample of 1242 African American youths followed from 1 st grade to age 42
Skara et al. (2008)	Los Angeles and Ventura, CA	Self-reported data were gathered from 2064 high school students at pretest and 1-year post-test

2.3 Cannabis Use Leading to ADB in Middle and High School

Theory: Despite the abundance literature supporting the “self-medication” hypothesis, which posits that adolescent aggressive behavior leads to cannabis use, some studies have pointed out that cannabis use may actually influence levels of aggressive behavior. It has been proposed that cannabis use can damage the individual’s cognitive functions used to process complex stimuli in conflict and, in turn, decrease the ability to constrain oneself from inappropriate responses and increase premature responses (Moore & Stuart, 2005).

Importantly, different mechanisms were proposed for regular versus novice users. For regular users, it is possible that cannabis intoxication may trigger maladjusted individuals with previous aggressive behavior and violence history to behave violently (Levinthal, 2008). It has also been argued that for those who develop cannabis dependence, cannabis withdrawal and abstinence may also increase anger and irritability (Budney & Hughes, 2006; Earleywine, 2002; Moore & Stuart, 2005; Ostrowsky, 2011). The

link between cannabis use and violent behavior for more novice users can be explained by panic reactions and paranoid feelings experienced more commonly by novice users (Moore & Stuart, 2005). The feelings of fear and paranoia in combination with a sense of losing control often lead novice users to feel threatened and behave violently.

Above and beyond these short-term effects of cannabis use applicable to both adolescence and adulthood, another mechanism points to the long-term impact of cannabis use in adolescence. High levels of cannabis use in adolescence may interfere with the development of communication and social skills and increase deviant peer associations, which may together lead to life-long persistent patterns of antisocial behavior that manifests as aggressive behavior and violence.

Lastly, it has also been argued that cannabis use may decrease aggressive and violent behavior through mechanisms consistent with the “self-mediation hypothesis,” which posits that individuals with mental-health problems may seek to relieve their problems through using cannabis. First, as cannabis has both stimulant and sedatory effects, under certain circumstances, users may experience calmness rather than increased energy, which typically does not lead to violent behavior (Pujazon-Zazik & Park, 2009). As a related mechanism, cannabis may also create a positive mood, providing the users a sense of contentment and good humor (Goode, 2008). A third reason explaining why cannabis may decrease violent behavior is that users self-reported being calmer, more open-minded, and tolerant of others’ opinions over time as a result of long-time leisure consumption of cannabis (Hathaway, 1997; Tart, 1970). Fourth, users typically expect cannabis to relax them and to give them a sense of pleasure and happiness, which increases the chance of them acting according to this expectation and avoiding the use of violence (Moore & Stuart, 2005).

Empirical Support: Empirical studies yield mixed results (see Table 3). For example, using a school-based sample of adolescents, Temple, Shorey, Fite, Stuart, and Le (2013) found that cannabis use in 10th grade predicted perpetration of physical dating violence one year later for both males and females. Analyzing longitudinal data on Mexican and European-American adolescents, Brady, Tschann, Pasch, Flores, and Ozer (2008) found that adolescents who used cannabis at age 15 were more likely to engage in violence perpetration at age 19.

A body of studies examines the relationship between adolescent cannabis use and dating violence specifically. It was suggested that the association may differ for males and females. For example, using longitudinal data, Foshee, McNaughton Reyes, and Ennett (2010) found that cannabis use predicted the onset of dating violence perpetration among girls, but not among boys. Examining a longitudinal sample

of youths between grades 8 and 12, Reyes, Luz, Foshee, Bauer, and Ennett (2014) also found that the effects of cannabis use on dating violence held only for violence perpetrated by girls, not boys.

There are also some mixed results in the literature. Using a longitudinal self-reported survey on high school students, Ellickson and McGuigan (2000) reported that frequency of cannabis use in grade 7 was a significant predictor only for the amount of predatory violence in grade 12, not the likelihood of any predatory violence in grade 12. Using data from Pittsburgh Youth Study, Wei, Loeber, and Whie (2004) found the longitudinal relationship between frequent cannabis use and violence (and vice versa) in adolescence and early adulthood was spurious after controlling for common risk factors such as race and hard drug use. They concluded that the observed cannabis-violence relationship is due to selection effects in that both are influenced by shared risk factors.

Using data from the National Longitudinal Study of Adolescence Health, Melander, Noel, and Tyler (2010) reported that cannabis use in adolescence was not related to perpetration of inter-partner violence. A similar finding was reported by Marie, Fergusson, and Boden (2008) using a longitudinal study of a New Zealand birth cohort.

The majority of research that supports the claim that cannabis use is associated with decreases in aggressive and violent behavior have been conducted using adult samples, and is thus beyond the scope of this study. We identified two studies using adolescent samples. Kaplan, Tolle, and Yoshida (2001) found that cannabis use in early adolescence is inversely related to violent behavior measured 3 years later. The findings were used to support the theoretical explanation that the use of cannabis can assuage distressful feelings that initiate violence. Similarly, in a four-wave study, White and Hansell (1998) found that heavy cannabis use in early to mid-adolescence predicted decreases in aggressive behavior in late adolescence and young adulthood.

Table 3: Empirical Studies Supporting Cannabis Use Leading to ADB in Middle and High School

Author (Year)	Location	Sample
Temple et al. (2003)	Houston, TX USA	A sample of 1,042 9th and 10th grade high schools students were recruited and assessed in the spring of 2010, and 93 % of the original sample completed the 1-year follow-up in the spring of 2011.
Brady et al. (2008)	California USA	Longitudinal data on a sample of 302 Mexican and European-American adolescents
Foshee et al. (2010)	North Carolina USA	A sample of 1,666 students in 8 th -10 th grade who reported ever dated

Author (Year)	Location	Sample
Reyes et al. (2014)	North Carolina USA	A sample of 2455 students followed up from 6 th grade
Ellickson and McGuigan (2000)	California and Oregon USA	A five year follow up of 4300 high school seniors and dropouts.
Wei et al. (2004)	Pittsburg, PA USA	A sample of 503 youths from the Pittsburgh Youth Study
Melander et al. (2010)	USA	A sample of National Longitudinal Study of Adolescence Health
Marie et al. (2008)	New Zealand	A longitudinal study of over 1000 New Zealand birth cohort sample
Kaplan et al. (2001)	Houston, TX USA	Using panel data (N = 2, 222) from subjects tested during early adolescence and three years later
White and Hansell (1998)	Rutgers, NJ USA	1,380 subjects followed up at age 12, 15 and 18 from the Rutgers Health and Human Development Project

3. Conclusion

This chapter examined the current evidence base supporting the co-occurrence hypothesis and the two directional hypotheses about the relationship between aggressive behavior and cannabis use. Any support for these hypotheses has the potential to guide public health-based preventive interventions by focusing on the underlying causes of ADB and cannabis use (i.e., co-occurrence hypothesis) or by specifically targeting one of the behaviors to prevent the other one (i.e., directional hypothesis). To this end, we inspected both the theories underlying these hypotheses as well as the existing empirical literature supporting them.

Clear theoretical and empirical support exists to support the claim that early aggressive behavior (i.e., during the elementary school years) is an antecedent not only of later ADB, but also cannabis use. However, the claim for a causal relationship between ADB and cannabis use remains unsupported. Preventive interventions targeting the onset of cannabis show little to no impact and, in the case of a clear causal relationship, interventions aiming to reduce early aggressive behavior should lead to reductions in cannabis use. As a result, factors more proximal to the onset of cannabis use, such as peer rejection, deviant peer affiliation and neighborhood disadvantage may be more suitable intervention targets (Liu et al., 2013). A cascading model of accumulating risk during the major socialization phases may be a more appropriate model for capturing the dynamic relationship between ABD and cannabis use.

Similarly, inconsistent results were found for the interrelationship between the two behaviors during adolescence and no clear support for the directionality could be found. Rather, there exists both theoretical and empirical evidence (albeit not causal) supporting the claim that ABD leads to cannabis use or vice versa.

Together with Ostrowsky (2011), we can speculate that several study characteristics are plausible culprits for the inconsistent results. Due to a lack of a comprehensive, integrated substance use prevention theory, little guidance exists for researchers on how to appropriately design their studies. Consequently, studies differ significantly with respect to measurement (e.g., diagnosis versus self-report; minor aggressive behavior versus violence), developmental periods studied (e.g., early adolescence and late adolescence), length of time between waves (e.g., long-term and short-term relationship), as well as the selection of the population under study (e.g., at-risk samples versus population sample).

These inconsistencies hinder the identification of typical pathways and how they may differ by gender and race/ethnic groups, as well as in different cultures and locations guided by different substance use

policies. It is our hope that the current chapter can help stimulate better coordination of efforts in the etiology and prevention of ADBs and cannabis as well as other illicit substances.

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