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## School Violence and Suicidal Ideation: The Mediating Roles of Perceived School Safety and Substance Use Among Adolescents

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School Violence and Suicidal Ideation:  
The Mediating Roles of Perceived School Safety and Substance Use Among Adolescents

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A dissertation in partial fulfillment of the requirements for the degree of

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## Abstract

Substance use and suicidal ideation are prevalent among adolescents. An adolescent's school environment, such as threatening or violence-related experiences at school, may influence their perceived sense of safety, thus influencing their substance use and potentially increasing suicidal ideation. The current study examined the mediating roles of perceived school safety and substance use (alcohol use, binge alcohol use, cannabis use, and vaping) on the relationship between experienced weapon threat/violence at school and suicidal ideation. Data was used from the 2019 Youth Risk Behavior Surveillance Survey and participants were 13206 adolescents attending high school in the United States. Preliminary analyses indicated significant positive bivariate correlations between study variables and significant differences between race/ethnicity groups. A double mediation analysis was conducted for each substance use variable to assess the conditional indirect effect of experienced weapon threat/violence at school on suicidal ideation through perceived school safety and substance use, and to assess for the conditional indirect effect of experienced weapon threat/violence at school on suicidal ideation through substance use alone. Each indirect and direct pathway was statistically significant, however with small effect sizes, partially supporting the proposed hypotheses. Results suggest that other construct(s), in addition to the ones examined in this study, may influence the pathway from experienced weapon threat/violence at school to suicidal ideation. Clinical implications, study limitations, and future research directions are discussed.

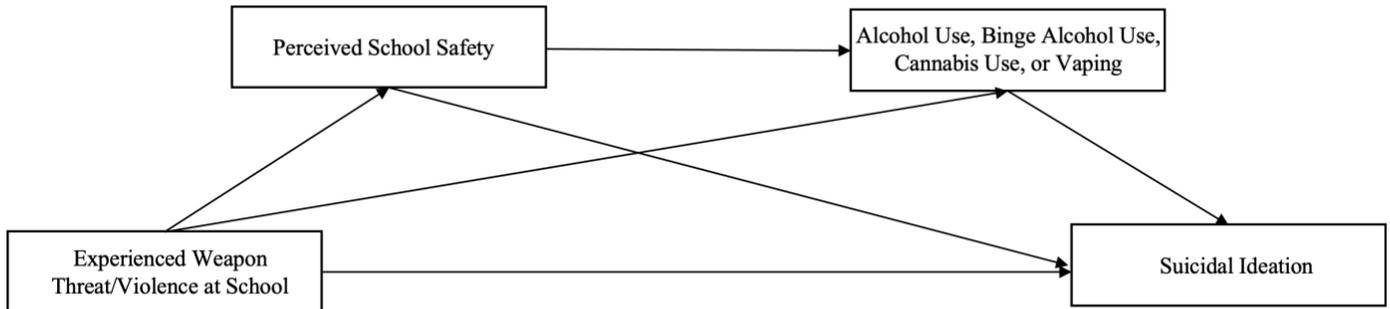
## **Chapter I: Introduction and Literature Review**

Suicide-related outcomes, a term which encompasses suicidal ideation, suicidal behavior, suicide attempts, and death by suicide, and substance use continue to be key impairing mental health concerns among high school-aged adolescents. Suicidal behavior among this population has significantly increased, becoming the second leading cause of death for this age group, surpassing homicide (Population Reference Bureau, 2016). Previous literature suggests adolescent substance use, such as alcohol and cannabis use (the two most commonly used substances among this age group), may be predictive of suicide-related outcomes, increasing the risk of suicidal behavior (Dawes et al., 2008; Litwiller & Brausch, 2013; Wang & Yen, 2017). Vaping and electronic cigarette use is also on the rise among high school-aged adolescents (Miech et al., 2019), but there is little current research on its impact on suicidal behavior. Given both the high levels of substance use reported by high schoolers (e.g., National Institute of Drug Abuse, 2018) and its well-established relationship to suicidal behavior, identifying factors which may contribute to increased substance use is an important area of research. One factor implicated in suicide-related outcomes and substance use is violence in schools and perceived school safety.

With the United States experiencing a rise in weapon violence and fatalities in schools and a significant number of such incidents taking place in high schools (Center for Homeland Defense and Security, 2019), recent research has begun to examine the impact of school safety on a variety of outcomes related to psychological well-being among high school-aged adolescents. For example, perceived school safety, such as feeling unsafe at school or fearing victimization at school, has been associated with an increase in truancy, which has a well-established positive association with substance use (Perumean-Chaney & Sutton, 2013). Likewise, feeling unsafe at school has been associated with increased risk of suicidal behavior

(Olcon et al., 2017). Proximity to violence, either feeling threatened or experiencing violence, within school, has also been positively associated with both substance use (Vidourek et al., 2016) and suicidal behavior (Espelage et al., 2018). As adolescents experience an increase in concern for school safety and the threat and experience of weapon violence in high school, it is important to understand the connected impact these mechanisms may have on key adolescent mental health concerns, such as high school substance use, and suicide-related outcomes. Although previous research has explored these associations independently, research has yet to connect and create a causal model to explain the relationship between weapon violence, perceived school safety, substance use, and suicide-related outcomes. As such, the current study seeks to address this gap.

The current study aims to explore the relationship between experienced weapon threat/violence at school, and suicidal ideation mediated by both perceived school safety and substance use, among high school-aged adolescents (Figure 1). I hypothesize that perceived school safety and substance use (alcohol, binge alcohol use, cannabis, and vaping) will mediate the relationship between experienced weapon threat/violence at school and suicidal ideation. The implications of this study will be informative for understanding the current climate of school safety, threat, and weapon violence and the impact this may have on the adolescent mental health concerns of substance use and suicide-related outcomes, specifically suicidal ideation – a phenomenon that may have lasting long-term negative consequences for adolescents.



*Figure 1.* Proposed model examining the mediating role of perceived school safety and substance use between experienced weapon threat/violence at school, and suicidal ideation among adolescents.

### **Adolescent Suicide-Related Outcomes**

Suicide, defined as death caused by self-directed injurious behavior with intent to die as a result of the behavior, is the second leading cause of death in the United States for 15-24-year-olds (National Institute of Mental Health [NIMH], 2019). Self-directed injurious behavior with intent to die may include death by firearm, suffocation, and poisoning – the three most common methods for suicide among adolescents (NIMH, 2019). Suicide rates among 15-19-year-olds have increased from 2000 to 2017, to the highest number of recorded suicides, after several years of suicide rates plateauing (Miron et al., 2019). Not limited to the final self-inflicted act itself, suicidal ideation and suicide behaviors also continue to be a major health concern (NIMH, 2019). Suicidal ideation, previous suicide attempts, and non-suicidal self-injury, are significant predictors of later suicide attempts and ultimately, death by suicide, and are, therefore, critical to examine (Shain, 2016; Wilkinson, 2011).

Several risk factors have been identified in the literature for adolescent suicide, such as mood disorders, particularly depressive symptoms, psychosis, and bully victimization and perpetration (Shain, 2016). Previous non-fatal suicide attempts continue to be the most reliable and strongest indicator of future suicide attempt risk (Bostwick et al., 2016). Behavioral risk factors such as delinquency, impulsivity, alcohol use, and poly-drug use have been linked to increased suicide risk among adolescents (Thompson & Swartout, 2018; Brockie et al., 2015). Additionally, family and friend suicide history, adverse childhood experiences, and exposure to violence have been associated with adolescent suicide risk (Bostwick et al., 2016; Castellvi et al., 2017; Brockie et al., 2015). Finally, specific groups of adolescents are at an even greater risk, such as non-Hispanic American Indians/Alaska Natives and Whites, and adolescents who identify as a sexual minority (Centers for Disease Control and Prevention, 2014).

### **Adolescent Substance Use**

Adolescent substance use has been identified as a risk factor for adolescent suicidal ideation, suicide attempts, and deaths by suicide (Gart & Kelly, 2015; Schilling et al., 2009; Wu et al., 2004). Most notably, among high school-aged adolescents, an earlier onset of alcohol use has been associated with an increased likelihood of suicidal ideation (Baiden et al., 2019). Similarly, early, frequent, and heavy use of cannabis in adolescence has been posited as a risk factor that may predict the onset of poor psychiatric outcomes and suicidal behavior (Levine et al., 2017; Wang & Yen, 2017) due to the possibility of cannabis exacerbating the symptoms and distress of mood disorders (Serafini et al., 2012; Raphael et al., 2005). Recent research has shown that both cannabis use and vaping have been linked to depressive symptoms and suicide-related outcomes among adolescents, compared to those who do not use (Chadi et al., 2019; Demissie et al., 2017). While less research has been done on vaping to date, a recent rise in the

popularity of vaping (Miech et al., 2019), has increased the need for research into the consequences of vaping in adolescence. However, while the literature on vaping consequences is currently lacking, previous nicotine research has shown nicotine dependence to be associated with suicide attempts and self-injury among adolescent females (Riala et al., 2009). Across these three substances (alcohol, cannabis, and vaping), there appears to be a trend in that substance use may be a plausible risk factor for suicidal ideation and behavior. Additionally, it is important to note that while research attempts to tease apart substance use to understand the consequences of an individual substance, polysubstance use is high among high school-aged adolescents (Conway et al., 2013).

Alcohol use is high among adolescents, with 19.3% of 12 to 20-year-olds reporting current alcohol use in the United States in 2016 (Substance Abuse and Mental Health Services Administration [SAMHSA], 2017). Alcohol use has also been associated with other various problems and impairment for adolescents. Among these issues include short-term problems, such as an increase in risky sexual behavior, legal troubles, accidents and injuries, aggressive behavior, and an increase in problems at school (e.g., school expulsion, truancy, and academic difficulties) (Bugbee et al., 2019; Goldberg-Looney et al., 2016; Marlatt & Witkiewitz, 2002; Masterman & Kelly, 2003). Long-term consequences of beginning alcohol use in adolescence have been indicative of development of future substance use disorders and other psychiatric problems in adulthood (McCambridge et al., 2011).

Cannabis is the most used illicit drug in the United States among adolescents (Substance Abuse and Mental Health Services Administration [SAMHSA], 2017). Adolescent cannabis use is connected to several negative consequences, including lower rates of high school graduation, delinquent behaviors, and alcohol use (Castellanos-Ryan et al., 2016; Chabrol & Saint-Martin,

2009). Consequences in adulthood from adolescent cannabis use include cognitive impairments, such as memory and learning, possible increase in prevalence in psychotic and mood disorders, and other substance use (Levine et al., 2017). Long-term heavy cannabis use in adolescence has been associated with an increased risk of low socioeconomic status and higher levels of anxiety in adulthood (Green et al., 2017). Additionally, adolescent cannabis users have a higher prevalence of early onset cigarette use (i.e., nicotine) (Pampati et al., 2018).

Again, while there is currently less research on electronic cigarette use (e-cigarettes), also known as vaping, which is the act of using an electronic cigarette, adolescent nicotine use has been linked to nicotine dependence in adulthood (Doubeni et al., 2010). Adolescents who vape are significantly more likely to use cannabis, and at a higher frequency (Azagda, 2018), possibly due to using vaping as a route of administration for cannabis. Recent research suggests that high school vapers are more likely to engage in physical fighting, suicidal behaviors, alcohol use, and risky sexual behavior than non-users (Demissie et al., 2017). The long-term effects of vaping are largely unknown due to their recent popularity and difficulty in measuring the substance as it is generally consumed through an electronic cigarette; however, we can extrapolate from previous research on adolescent nicotine and cannabis use.

Mechanisms that contribute to adolescent substance use include exposure to violence, chronic stress, such as living up to parental expectations and academic pressure, and bullying victimization (Kobulsky et al., 2016; Leonard et al., 2015; Feldman Hertz et al., 2015). Similarly, school disengagement (Henry et al., 2012), and mental health issues, such as social anxiety and generalized anxiety have been identified as predictors of high school substance use (Marmorstein et al., 2009). However, due to the complexity of research on mental health disorders, such as depression and anxiety, and substance use, researchers have not reached a consensus on which

may occur first – the substance use or mental health symptoms. Despite this, with various mechanisms contributing to the onset of adolescent substance and polysubstance use, it is essential to understand and mitigate the effects of adolescent substance use as it is directly linked to adolescent suicidal behavior.

### **Theoretical Foundation**

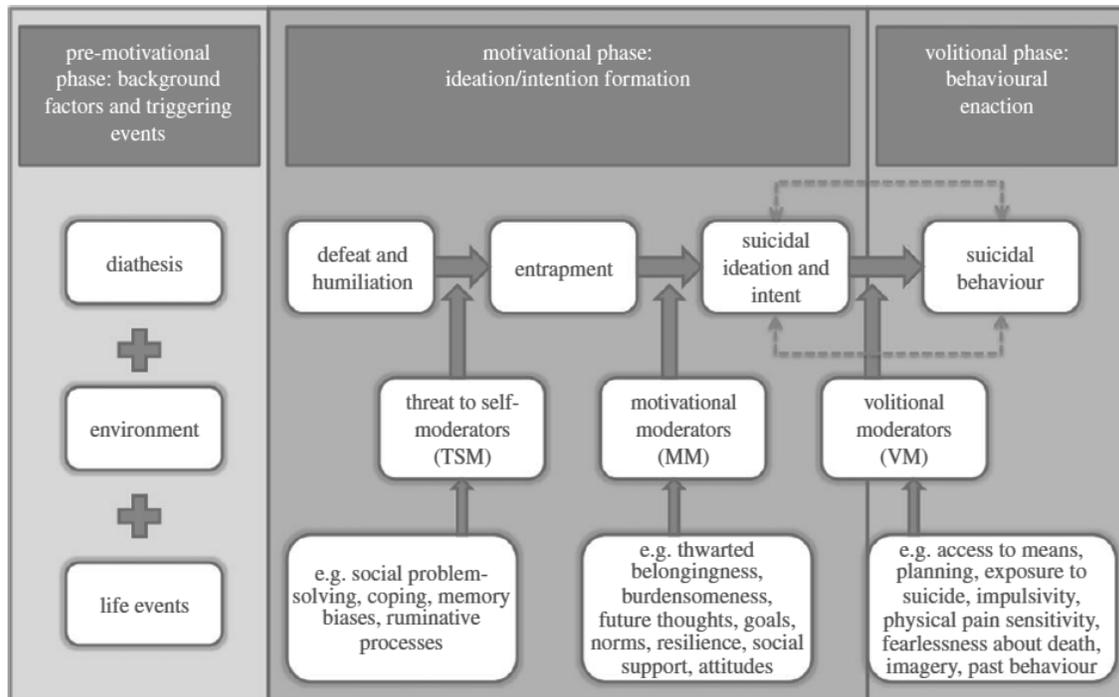
Suicidal ideation and substance use in adolescence are strongly associated with one another. While we know that, often, substance use precedes suicidal ideation, or suicide behaviors, such as suicide attempts, we are less certain of the constructs that proceed substance use and the causal model that ultimately links adolescent substance use and suicide-related outcomes. A large portion of an adolescent's time is spent in high school and thus, it is plausible that experiences within the high school environment may impact overall adolescent mental health, potentially due to repeated exposure. Weapon threat or violence within high schools is one such experience that may be repeated and subsequently impact an adolescent's mental health, as well as how safe an adolescent feels while at high school (also referred to as perceived school safety). The experience of weapon threat or violence may affect an adolescent's substance use and suicidal ideation as they seek to cope with the negative emotions that follow a scary or unsettling experience. The following theoretical review draws together the literature on the integrated motivational-volitional model of suicidal ideation, adolescent substance use as a coping mechanism, and disinhibition as it follows the use of substances. These theories are used to explain the relationship between experienced weapon threat/violence at school and perceived school safety, with the outcomes of substance use and suicide-related outcomes, such as suicidal ideation.

## **The Integrated Motivational-Volitional Model of Suicidal Behavior**

There are several models of suicide – all seeking to explain how and why suicide-related outcomes occur. The most well-known theory is the interpersonal theory of suicide (Joiner et al., 2009), however, the second-generation models, such as the integrated motivational-volitional (IMV) model of suicidal behavior (O'Connor & Kirtley, 2018) and the three-step theory (3ST) (Klonsky & May, 2015) provide an updated and more robust model of suicide-related outcomes through an “ideation-to-action” framework. For the purpose of this study, the IMV model of suicidal behavior is helpful in understanding how adolescents may arrive at the suicidal ideation and intent motivational phase, the precursor to suicidal behaviors.

The IMV model (Figure 2) provides a thorough understanding of the development of suicide-related outcomes, while the 3ST (Klonsky & May, 2015) can be viewed as a supportive theory for the IMV model. The IMV model of suicidal behavior, proposes three phases to suicidal outcomes: 1) the pre-motivational phase (background factors and triggering events), 2) the motivational phase (ideation/intention formation), and 3) the volitional phase (behavioral enaction) (O'Connor & Kirtley, 2018). The IMV model of suicidal behaviors also posits that it is defeat and/or humiliation and a feeling of entrapment that are the proximal predictors of suicidal ideation (phase 2, the motivational phase) (O'Connor & Kirtley, 2018). Furthermore, there are two moderators within phase 2 (the motivational phase) – threat to self-moderators, such as lack of coping skills, and motivational moderators, such as low belongingness and low social support. This theory provides a foundation for considering the impact of how the environment that adolescents exist in, such as high school, their exposure and experience of violence at school (the pre-motivational phase and/or a volitional moderator), their perception of their own safety at school (the motivational phase and/or a threat to self-moderator), and substance use (the

motivational phase) could lead to suicidal ideation (the motivational phase) or suicide attempts (the volitional phase).



*Figure 2.* The integrated motivational-volitional (IMV) model of suicidal behavior as shown in O'Connor and Kirtley (2018).

The 3ST suggests that a combination of 1) psychological pain, hopelessness, 2) low connectedness, and 3) dispositional, acquired, and practical contributors provide an ideation-to-action framework (Klonsky & May, 2015). The 3ST theory provides support for the IMV model, in that psychological pain may coincide with the pre-motivational phase, hopelessness with defeat and humiliation (the motivational phase), low connectedness (a motivational moderator), and dispositional, acquired, and practical contributors, as part of the pre-motivational phase and/or volitional moderator. This could potentially be viewed as a volitional moderator within the IMV model and could provide further support for substance use and/or experienced weapon

threat or violence as a predictor of suicidal behavior, and as such, these predictors may contribute to the formation of suicidal ideation and intent.

The IMV model for suicidal behavior is relatively new, however, the model, the phases, and the moderators, have already begun to be supported in the literature. Support for this theory, and its ability to distinguish between those who experience suicidal ideation and those who engage in suicidal behaviors, has been examined among adolescents with reported self-injury (O'Connor et al., 2012). Similarly, in a recent cohort study, Mars and colleagues (2019) found support for the ideation-to-action framework, specifically the IMV model, among young adults, suggesting there are differentiating factors between those who experience suicidal ideation and those who attempt suicide.

While future research is needed to unpack other mechanisms contributing to adolescent suicide, the current literature does shed light on the importance of assessing suicidal ideation and behavior through theories that consider coping behavior, such as substance use, the effects of substance use, seen through the lowering of inhibition, and the importance of fostering safe environments for adolescents, including their social environment. In the context of the social environment, social connectedness, which has been proposed as playing a central role in the etiology of suicide (You et al., 2011), directly counteracts social isolation, arguably one of the strongest predictors of suicidal ideation and suicidal behavior (Van Orden et al., 2010). While social connectedness regarding suicide emphasizes the importance of belongingness (You et al., 2011), it is also applicable to both coping with substances and perceived school safety. In both instances, there may be a gap in social connectedness – adolescents may experience isolation and/or alienation due to substance use or exposure to violence. Similarly, social connectedness may lessen the perception of burdening others and mitigate social alienation. Furthermore,

fostering safe environments for adolescents reduces the opportunity of exposure to painful or feared experiences, thus, hypothetically reducing an adolescent's capability to die by suicide. Overall, the role of the social environment may be key in preventing suicidal ideation and behaviors among adolescents. This is especially critical for youth, who are disproportionately affected by suicide (Hacker et al., 2008), and more immersed in social networks and environments, both online and in-person, than any other generation.

### **Substance Use as a Coping Mechanism**

Adolescence is a developmental time period that can be emotionally turbulent, with adolescents experiencing both highs and lows of positive and negative emotions. When experiencing negative emotions, adolescents may seek to lower their distress and improve their affective state, sometimes through maladaptive coping styles that are associated with negative outcomes. Substance use, particularly among adolescents, is a well-known maladaptive coping strategy when experiencing negative emotions. Multiple studies have shown that substance use is often preceded by coping, or the desire to cope, with distress. Previous research examining coping among incarcerated adolescents indicate avoidant coping strategies were more likely to use alcohol and cannabis and thus, experience more alcohol and cannabis-related consequences (Eftekhari et al., 2004). Similarly, distraction and avoidance coping has been associated with lifetime cannabis use and past 12-month frequency of use among adolescents in a nationally representative sample in the United States, such that coping positively predicted use (Lee-Win et al., 2018). Relatedly, Mason and colleagues (2019) reviewed over 20 articles to understand solitary alcohol and cannabis use among adolescents. These authors found that using substances to cope are a risk factor for solitary alcohol and cannabis use, which has been associated with more adverse physical and mental health consequences (Tucker et al., 2006; Keough et al.,

2015). It is evident that the maladaptive coping strategy of substance use has short- and long-term negative implications for adolescents. However, a more critical concern is that of the immediate effect of substance use on adolescent suicide-related outcomes. For example, in the IMV model substance use may serve as a threat to self moderator, contributing to the formation of suicidal ideation.

### **Disinhibition as a Mechanism Linking Substance Use with Suicidal Behavior**

Disinhibition can be defined as one's inability to control their behavior, or the inability to change, stop, or suppress their response to a stimulus (Jones et al., 2013). Disinhibition has been hypothesized as a mechanism in which substance use increases the likelihood of suicidal behavior through impaired judgment and weakened impulse control (Esang & Ahmed, 2018; Pompili et al., 2010). There is limited research on the role of disinhibition on adolescent suicidal behavior in the context of substance use. However, there is evidence of higher disinhibition being associated with a greater likelihood of suicide attempts and an overall elevated level of suicide risk among adolescents experiencing depression (Stewart et al., 2015). This may suggest that as adolescents experience high levels of negative emotions, due to low inhibition, they may engage in suicidal behavior to cope – similar to the notion of using substances to cope with negative emotions to lower distress. Comparatively, in a longitudinal cohort study, Cable and Sacker (2007) suggest problematic alcohol use in adulthood can be mitigated by decreasing social disinhibition in adolescence. Thus, higher disinhibition may be associated with both increased substance use and suicidal behavior. While coping with negative emotions and lower inhibition may be predictive of increased substance use and suicidal behavior, it is also plausible that higher disinhibition may act as a volitional moderator within the IMV model (within the volitional phase) or may increase capability through the 3ST model.

## **Violence in Schools**

The above theoretical review suggests that adolescent substance use may function in part to help adolescents cope with stress, and that both stress and subsequent substance use may in turn predict suicide-related outcomes. One important source of stress for adolescents is school violence. Adolescents in high school in the United States spend approximately 6.5 hours a day at school, about 180 days a year (National Center for Education Statistics, 2018). The prevalence of violence within high schools has been steady since 2015, with 6% of adolescents reporting they were threatened or injured with a weapon at school, with male students (7.8%) and African American/Black students (7.8%) reporting they experience more violence (Centers for Disease Control and Prevention, 2018). According to the National Center for Education Statistics (2018) during the 2015-2016 school year, 79% of public schools reported one or more incidents of violence. Violence, either experienced or witnessed, within schools is associated with the following negative consequences: serious emotional and behavioral consequences, such as depressive symptoms, anxiety, and other symptoms of trauma, violent behavior, truancy, and poor academic performance (Flannery et al., 2004; Flannery et al., 2001; Hurt et al., 2001). Carrying a weapon at school, which increases the likelihood of violence occurring within school, has been associated with substance use, depressive symptoms, and being threatened or injured with a weapon on school property (Muula et al., 2008).

Experienced weapon threat/violence undoubtedly increases negative emotions, and thus may be predictive of substance use and suicide-related outcomes (Flannery et al., 2001). Longitudinal research has found positive associations between substance use in early high school and weapon carrying later in high school (Simon et al., 1998), while other research has indicated a positive relationship among victimized adolescents and weapon carrying (Rudatsikira et al.,

2007; Sullivan et al., 2006). In contrast, Parker and colleagues (2016) reported that adolescents who used alcohol and cannabis recently were at increased odds of physical dating violence, compared to students who did not report using substances. Experienced weapon threat/violence at school coincides with the IMV model, which suggests triggering events and the environment contribute to the development of suicidal behavior (O'Connor & Kirtley, 2018). It is plausible that as school violence increases, capability of suicidal ideation and behaviors may increase as school violence may contribute to an adolescent moving from the motivational stage of the IMV model of suicidal behavior to the volitional stage, potentially with substance use as a catalyst through higher disinhibition. Similarly, students may suffer from isolation and poor socialization with peers when in an environment of violence (Flannery et al., 2004), ultimately lowering their social connectedness and feeling of belonging. Flannery and colleagues (2004) suggest violence in schools creates a climate that perpetuates the continuation of a cycle of violence, such that both adolescent victims of violence and violent adolescents are both at risk for suicidal behaviors (Espelage et al., 2018; Flannery et al., 2001); thus, it is imperative to shed light on the impact school violence has on the physical and mental well-being of high school students. A direct consequence and important outcome of violence within schools is perceived school safety.

### **Perceived School Safety**

Perceived school safety can be defined as the perception of “instances of threats to or actions against one’s well-being” in the context of the school environment (Kitsantas et al., 2004). Despite the prevalence of weapon threat and violence in schools holding steady since 2015, the percentage of students who did not go to school in 2017 due to feeling unsafe either at school or on their way to school has increased (Centers for Disease Control and Prevention, 2018). African American/Black and Hispanic students reported missing school more often due to

safety concerns (Centers for Disease Control and Prevention, 2018). Not feeling safe in the school environment has similar outcomes to experiencing violence in schools, as low perceived school safety has been associated with increased risk of negative psychological (Nihs et al., 2014; Landstedt & Gillander, 2011) and behavioral outcomes (Hughes et al., 2015); while feeling safe at school has been connected with better psychological outcomes (Ozer & Weinstein, 2004).

Perceived school safety among adolescents, which may be a direct outcome of experienced weapon threat/violence, has been found to affect the likelihood of carrying a weapon (Esselmont, 2014), such that the safer an adolescent feels at school, the less likely they may feel the need to protect themselves through potentially violent means. Adolescents who feel the need to protect themselves at school may then have an increased capability of suicidal ideation and/or behaviors as they are exposed to more violent means to ensure their own safety. Low perceived school safety and/or experienced weapon threat/violence at school may also act as a background factor or triggering event within the premotivational stage of the IMV model, again a potential contributing factor to the development of suicidal ideation. Perceived school safety has also been associated with adolescent dating violence victimization, suggesting school environment norms may either facilitate or ignore victimization by peers (Earnest & Brady, 2016). Coping effectively has been found to buffer the effects of victimization on perceived school safety (Harper et al., 2012), suggesting that adolescents who feel unsafe at school may have a higher likelihood of experiencing negative emotions, thus predicting maladaptive coping strategies, such as substance use and suicide-related outcomes, may be due to a lack of effective coping skills to handle the distress of an unsafe school environment. Previous research has also suggested students may avoid school due to safety concerns, which decreases their sense of

belonging at school (Williams et al., 2018). The notion that low perceived school safety may increase an adolescent's feelings of social alienation and/or isolation, coincides with the IMV model of suicidal behavior in regard to feelings of defeat and humiliation and entrapment, respectively. Comparatively, perceived school support has been found to be a protective factor among adolescents who experience both physical and verbal dating violence and may lessen the effects of being victimized at school (Parker et al., 2016; Esselmont, 2014). Perceived school safety then may play a critical role in mediating the effect of experienced weapon threat/violence at school, lessening the likelihood of concerning consequences, such as substance use and suicide-related outcomes, such as suicidal ideation.

### **Current Study**

In sum, experienced weapon threat/violence at school may heavily impact and contribute to an adolescent's overall sense of safety in their environment, lowering their perceived school safety. As adolescents seek a way to cope with an adverse environment and not feeling safe, substance use may occur, contributing to the formation of suicidal ideation and coinciding with the development of suicidal ideation as seen through the IMV model of suicidal behavior. The current study seeks to examine the relationship between experienced weapon threat/violence at school, perceived school safety, substance use (alcohol, binge alcohol use, cannabis, and vaping), and suicidal ideation among high school-aged adolescents.

**Hypothesis 1.** Perceived school safety and substance use, namely alcohol use, binge alcohol use, cannabis use, and vaping, will each mediate the relationship between experienced weapon threat/violence at school and suicidal ideation.

**Hypothesis 2.** Each substance, alone, will mediate the relationship between experienced weapon threat/violence at school and suicidal ideation.

## **Chapter II: Method**

### **Participants**

Participants were 13,206 high school-aged adolescents attending high school within the United States. Students were primarily between 14 – 17-years-old (87.6%). The remainder of students were 18 years old or older (11.8%), 13 years old (0.2%), and 12 years old or younger (0.3%). Sex was evenly represented between female (51.1%) and male (48.6%) students. Each grade, 9<sup>th</sup> – 12<sup>th</sup> grade level was relatively equally represented (9<sup>th</sup> grade, 26.8%; 10<sup>th</sup> grade, 27.3%; 11<sup>th</sup> grade, 24.4%; 12<sup>th</sup> grade 21.0%) as well. Half of the sample identified as White (49.9%), with the other half identifying as American Indian or Alaska Native (1.0%), Asian (4.6%), Black or African American (14.6%), Hispanic/Latinx (7.5%), Native Hawaiian or Other Pacific Islander (0.5%), Biracial, Hispanic (15.0%), or Biracial, non-Hispanic (4.9%). The majority of the sample identified as Heterosexual (80.2%), with the remaining students identifying as Bisexual (8.4%), Gay or Lesbian (2.6%), or “not sure” (4.2%).

### **Procedure**

Data was used from the 2019 Youth Risk Behavior Surveillance Survey (YRBSS; Centers for Disease Control and Prevention, 2019). The YRBSS was a national, random, and anonymous survey conducted by the Centers for Disease Control and Prevention, bi-annually (every odd year), in the United States. The YRBSS’s primary use was to assess for physical and mental health-risk behavior prevalence and trends among high school students. The YRBSS sought to provide data representative of public high school students in the United States across various behaviors that may lead to death, disability, and social problems for adolescents. These behaviors included dietary behaviors, physical activity, tobacco, alcohol, and other substance use, truancy, sexual behaviors, suicidal behavior, and behaviors that may contribute to injury

and/or violence. The 2019 YBRSS standard questionnaire contained 89 multiple-choice questions to assess for the previously mentioned behaviors.

One hundred and thirty-six schools participated in the 2019 YRBS. In each grade, 9<sup>th</sup> – 12<sup>th</sup> grade, at each school, one to two classes were randomly chosen to receive the survey. All students in the randomly chosen classes were eligible to participate in the survey. Permission for students to participate in the survey was conducted based on local procedures. Schools had the option to use active permission, where parents or guardians provided permission prior to their child completing the survey, or schools used passive permission, where parents and guardians only needed to complete a form to opt their child out of completing the survey. Data collectors visited each school participating in the YRBSS and read a standardized script to participating students, or procedures were performed by school personnel. Participation in the survey was voluntary and responses were anonymous. Participants completed the survey during one class period and recorded their responses on a computer-scannable booklet and answer sheet. Students that were absent on the day of data collection at their school were offered a make-up day at a later date to complete the survey. Survey responses were collected by the data collector or mailed to the CDC by school personnel. A total of 13,872 completed questionnaires were returned, however, after the dataset was cleaned, 13,677 usable questionnaires were left, providing a student response rate of 80.3%.

### **Sample Size, Power, and Precision**

Power analysis was conducted using G\*Power (Faul et al., 2008). The linear multiple regression: fixed model,  $R^2$  deviation from zero, *a priori* power analysis was used with three predictors (two mediators and one independent variables), a power of .80 (Fritz & MacKinnon,

2007), alpha level of .05, and the suggested medium effect size ( $f^2 = .15$ ). This analysis yielded a suggested total sample size of 119.

Power analysis was also run *post hoc* to assess for appropriate power needed given the large sample sizes ( $n = 12008$  for alcohol use,  $n = 11423$  for binge alcohol use,  $n = 12596$  for cannabis use, and  $n = 12102$  for vaping). Utilizing MedPower (Kenny, 2017), results indicated that power was virtually 1, suggesting that the models were overpowered and had the potential to detect very small effects that may not be indicated in a smaller sample size. Thus, results were interpreted with caution.

## Measures

*Weapon threat/violence in school.* To assess for experienced weapon threat/violence in school, the question, “During the past 12 months, how many times has someone threatened or injured you with a weapon such as a gun, knife, or club on school property?” was used. Participants could indicate the frequency using the following scale: A = “0 times”, B = “1 time”, C = “2 or 3 times”, D = “4 or 5 times”, E = “6 or 7 times”, F = “8 or 9 times”, G = “10 or 11 time”, or H = “12 or more times”. This was recoded from A-H, to a 0-7 ordinal scale.

*Perceived school safety.* The item, “During the past 30 days, how many days did you not go to school because you felt you would be unsafe at school or on your way to or from school?” was used to measure perceived school safety. Participants indicated the number of days they did not go to school due to safety concerns using the following scale: A = “0 days”, B = “1 day”, C = “2 or 3 days”, D = “4 or 5 days”, or E = “6 or more days”. This was recoded from A-E, to a 0-4 ordinal scale.

*Substance use.* All substance use was looked at within the past 30 days. Any alcohol use was assessed using one item, which questioned any drinking, “During the past 30 days, on how

many days did you have at least one drink of alcohol?” This question used the following scale: A = “0 days”, B = “1 or 2 days”, C = “3 to 5 days”, D = “6 to 9 days”, E = “10 to 19 days”, F = “20 to 29 days”, or G = “All 30 days”. Binge alcohol use was assessed using one item, “During the past 30 days, how many days did you have 4 or more drinks of alcohol in a row, that is, within a couple of hours (if you are a female) or 5 or more drinks of alcohol in a row, that is, within a couple of hours (if you are a male)?”. This question used the following scale: A = “0 days”, B = “1 day”, C = “2 days”, D = “3 to 5 days”, E = “6 to 9 days”, F = “10 to 19 days”, or G = “20 or more days”. Both alcohol questions were recoded from A-G, to a 0-6 ordinal scale.

Cannabis use within the past 30 days was measured with the question, “During the past 30 days, how many times did you use marijuana?”. Participants could indicate their frequency of cannabis use with the following scale: A = “0 times”, B = “1 or 2 times”, C = “3 to 9 times”, D = “10 to 19 times”, E = “20 to 39 times”, or F = “40 or more times”. This was recoded from A-F, to a 0-5 ordinal scale.

Prior to answering a question about vaping frequency, participants were prompted with the text, “The next 3 questions ask about electronic vapor products, such as blue, NJOY, Vuse, MarkTen, Logic, Vapin Plus, eGo, and Halo. Electronic vapor products include e-cigarettes, e-cigars, e-pipes, vape pips, vaping pens, e-hookahs, and hookah pens”. The item used to measure vaping was the following: “During the past 30 days, on how many days did you use an electronic vapor product?”. Participants were provided with the multiple options to indicate frequency; a = “0 days”, B = “1 or 2 days”, C = “3 to 5 days”, D = “6 to 9 days”, E = “10 to 19 days”, F = “20 to 29 days”, or G = “All 30 days”. This was recoded from A-G, to a 0-6 ordinal scale.

*Suicidal ideation.* Suicidal ideation was measured using two items. The first item, “During the past 12 months, did you ever seriously consider suicide?”, was answered with A =

“Yes” or B = “No” by participants. The second item, “During the past 12 months, did you make a plan about how you would attempt suicide?”, was also answered with A = “Yes” or B = “No”. These two items were used to create an ordinal suicidal ideation severity variable indicating that a participant had not considered suicide at all (coded as 0), seriously considered suicide (coded as 1), or made a plan about how they would attempt suicide (coded as 2). If a participant indicated they had both considered suicide and made a plan, they were coded as 2.

## Chapter III: Results

### Data Preparation

IMB SPSS Statistics (Version 27; IMB Corp, 2019) was used to recode and analyze the data. Missingness and outliers were examined, as well as the violations of the assumptions for logistic regression, including linearity, independence, normality, homoscedasticity, and multicollinearity.

**Missingness.** Missingness was examined and cases with over 24% of missing data were removed from the data set (Olinsky et al., 2003), resulting in 471 deleted cases, 3.44% (n = 13206). Due to the large discrepancy between the resultant sample size (over 13,000) and the sample size suggested to detect a medium effect (119) there was not a concern for power reduction. Missing value patterns were inspected visually. A General Pattern of missingness, as described by Enders (2010) was evident, specifically for questions related to sexual identity, alcohol use, and vaping. Multiple imputation was not used due to the independent and dependent variables being categorical rather than continuous.

**Linearity.** The relationship between the independent variable and the dependent variable must be linear to satisfy the assumption of linearity for linear regressions (Field, 2013). Logistic regression assumes this assumption is violated and thus traditionally the logit of the data is

utilized to assess for linearity. However, continuous independent variables are needed to assess for the assumption linearity in a logistic regression. Thus, due to the categorical nature of the independent and dependent variables, the assumption of linearity did not apply to the current analyses.

**Independence.** The Durbin-Watson test (Field, 2013) was used to test the assumption of independence, which asserts that residuals are not correlated. A violation of independence is indicated if the Durbin-Watson value is lower than one or greater than three. The Durbin-Watson tests yielded a range of 1.95 to 1.96 for the dependent variables, suggesting a likelihood of residual independence. Thus, the assumption of independence was met for each model, for each specific substance use variable (alcohol use, binge alcohol use, cannabis use, and vaping).

**Normality.** The Kolmogorov-Smirnov (K-S) test was used to assess the assumption of normality, which ascertains that data should follow a normal distribution (Field, 2013). The distribution was significant ( $p < .001$ ) for experienced weapon threat/violence at school, perceived school safety, alcohol use, binge alcohol use, cannabis use, vaping, and suicidal ideation. Normality was also examined visually with histograms, which showed all variables appeared to be significantly skewed. The majority of participants reported no experienced weapon threat/violence at school, perceived school safety, alcohol use, binge alcohol use, cannabis use, vaping, or suicidal ideation.

**Homoscedasticity.** The assumption of homoscedasticity suggests equal levels of variability between the dependent variable across the independent variables (Salkind, 2010). Scatterplots were utilized to examine the standardized residuals of the independent variables and the dependent variable, which showed an unequal disbursement, suggesting a violation of the assumption of homoscedasticity. This was expected as violations of homoscedasticity typically

result from normality violations (Salkind, 2010). Data transformation on the dependent variable is generally recommended for addressing violations of homoscedasticity, however, when the variable scale range is less than ten, data transformations are often minimally effective (Salkind, 2010). As the dependent variable, suicidal ideation, has three answer choices, data transformation was not utilized. Similar to the justification for proceeding with non-normality, it is plausible that variability across the dependent variable, suicidal ideation, was strongly associated with similar reporting on experienced weapon threat/violence at school, perceived school safety, and substance use.

**Multicollinearity.** When more than one predictor is in a model, multicollinearity is a concern (Field, 2013). A strong or perfect correlation between two or more predictors can make it difficult to obtain unique estimates of the regression coefficients. Variance inflation factor (VIF) and Tolerance statistics were examined to assess for strong linear relationships between predictors. VIF substantially greater than one or a Tolerance below .10 may be indicative of multicollinearity (Bowerman & O'Connell, 1990; Menard, 1995, in Field, 2013). VIF ranged from 1.03 to 1.15 and Tolerance ranged from .87 to .97, suggesting multicollinearity was not of concern.

### **Preliminary Analysis**

Frequencies and descriptive statistics across study variables were examined (Table 1). Bivariate correlations were analyzed between demographic variables and study variables – experienced suicidal ideation, weapon threat/violence at school, perceived school safety, alcohol use, binge alcohol use, cannabis use, and vaping (Table 2). Weak to moderate relationships were observed across demographics and study variables. Due to age, sex, and race/ethnicity being

significantly correlated with several of the model variables, these demographic variables were entered into the primary analyses as covariates.

Table 1. *Frequencies and Descriptives for the Total Sample (N = 13277).*

	n	% of Sample	M	SD
<b>Suicidal Ideation</b>			.39	.75
Considered Suicide	925	7.0		
Made a Plan	2091	15.8		
No Suicidal Ideation	10119	76.6		
<b>Weapon Threat/Violence</b>	925	7.0	.15	.73
<b>Perceived School Safety</b>	1138	8.6	.15	.58
<b>Substance Use</b>				
Alcohol Use	3591	27.2	.52	1.03
Binge Alcohol Use	1607	12.2	.31	.94
Cannabis Use	2839	21.5	.54	1.24
Vaping	4003	30.3	1.03	1.86

Note. Weapon Threat/Violence and Perceived School Safety, respectively, indicated how many participants experienced at least one day of weapon threat/violence at school and skipped school at least one day due to concerns of safety at school or on their way to or from school. Substance use variables indicated at least one day of endorsed use.

Table 2. *Bivariate Correlations Among Study Variables (N = 13277).*

	1	2	3	4	5	6	7	8	9	10	11
1. Age		-0.42**	-.01	-.01	-.02	-.04**	-.02	.12**	.11**	.13**	.12**
2. Sex			.02*	.18**	.14**	-.05**	.03**	.01	-.02	-.05**	-.04**
3. Race/Ethnicity				.001	.02*	.02**	.03**	.06**	.05**	.03**	.07**
4. Sexual Identity					.23**	.07**	.07**	.02	.01	.04**	-.03**
5. Suicidal Ideation						.14**	.15**	.13**	.09**	.13**	.14**
6. Weapon Threat/Violence							.31**	.24**	.21**	.16**	.15**
7. Perceived School Safety								.16**	.14**	.12**	.12**
8. Alcohol Use									.82**	.44**	.54**
9. Binge Alcohol Use										.39**	.48**
10. Cannabis Use											.52**
11. Vaping											

Note. \*  $p < .05$ , \*\*  $p < .001$

Frequencies and descriptives were also assessed by race/ethnicity (Table 3). A one-way between-groups analysis of variance (ANOVA) was conducted to explore the impact of race/ethnicity on each of the independent variables and the dependent variable. Levene's test of homogeneity of variances was not violated across race/ethnicity and study variables. There was a

statistically significant difference between race/ethnicity groups across suicidal ideation  $F(6.58, 7) = 3.64, p < .001, \eta^2 = .004$ , experience weapon threat/violence at school,  $F(8.56, 7) = 4.53, p < .001, \eta^2 = .005$ , perceived school safety  $F(14.81, 7) = 4.74, p < .001, \eta^2 = .008$ , alcohol use  $F(24.99, 7) = 26.07, p < .001, \eta^2 = .014$ , binge alcohol use  $F(21.13, 7) = 18.20, p < .001, \eta^2 = .013$ , cannabis use  $F(9.14, 7) = 13.99, p < .001, \eta^2 = .005$ , and vaping  $F(59.94, 7) = 201.85, p < .001, \eta^2 = .033$ . Effect sizes, calculated using eta squared ( $\eta^2$ ), indicated small effect sizes across all significant differences, however, due to the study being overpowered were interpreted with care. Post hoc comparisons using the Tukey HSD test indicated mean differences among race/ethnicity across the study variables, however, due to overall small effect sizes and the tendency for large samples to inflate small statistical differences, these results were interpreted with discretion. As a result of these analyses, race/ethnicity was entered as a covariate for the preliminary analyses.

Table 3. *Frequencies, Means, and Standard Deviations by Race/Ethnicity.*

	<i>n</i>	%	<i>M</i>	<i>SD</i>
<b>American Indian or Alaska Native (n = 133)</b>				
Suicidal Ideation	44	33.1	.55*	.82
Weapon Threat/Violence	21	15.8	.40*	1.23
Perceived School Safety	20	15.0	.24	.67
Alcohol Use	39	29.3	.71	1.32
Binge Alcohol Use	14	10.5	.39	1.14
Cannabis Use	38	28.6	.88*	1.58
Vaping	54	40.6	1.48*	2.17
<b>Asian (n = 607)</b>				
Suicidal Ideation	142	23.4	.40	.76
Weapon Threat/Violence	18	3.0	.06*	.44
Perceived School Safety	32	5.3	.08*	.38
Alcohol Use	81	13.3	.24*	.74
Binge Alcohol Use	29	4.8	.14*	.64
Cannabis Use	55	9.1	.22*	.83
Vaping	80	13.2	.46*	1.37
<b>Black or African American (n = 1932)</b>				
Suicidal Ideation	418	21.6	.37	.74
Weapon Threat/Violence	149	7.7	.17	.74
Perceived School Safety	201	10.7	.20*	.65
Alcohol Use	331	17.1	.33*	.85

Binge Alcohol Use	119	6.2	.14*	.64
Cannabis Use	433	22.4	.57*	1.26
Vaping	322	16.7	.44*	1.20
<b>Hispanic/Latinx (n = 986)</b>				
Suicidal Ideation	195	19.8	.34	.71
Weapon Threat/Violence	49	5.0	.10*	.57
Perceived School Safety	85	8.6	.14	.49
Alcohol Use	225	22.8	.43*	.91
Binge Alcohol Use	90	9.1	.21	.77
Cannabis Use	211	21.4	.49*	1.13
Vaping	252	25.6	.72*	1.51
	<i>n</i>	%	<i>M</i>	<i>SD</i>
<b>Native Hawaiian or Other Pacific Islander (n = 62)</b>				
Suicidal Ideation	16	25.8	.42	.76
Weapon Threat/Violence	7	11.3	.21	.68
Perceived School Safety	7	11.3	.15	.44
Alcohol Use	19	30.6	.57	.98
Binge Alcohol Use	9	14.5	.36	.92
Cannabis Use	11	17.7	.43	1.13
Vaping	23	37.1	1.46*	2.19
<b>White (n = 6586)</b>				
Suicidal Ideation	1454	22.1	.37	.73
Weapon Threat/Violence	419	6.4	.13*	.67
Perceived School Safety	440	6.7	.11*	.49
Alcohol Use	2104	31.9	.61*	1.08
Binge Alcohol Use	986	15.0	.40*	1.02
Cannabis Use	1416	21.5	.54*	1.25
Vaping	2400	36.4	1.30*	2.06
<b>Biracial, Hispanic (n = 1977)</b>				
Suicidal Ideation	473	23.9	.41	.76
Weapon Threat/Violence	166	8.4	.22*	.95
Perceived School Safety	231	11.7	.23*	.74
Alcohol Use	554	28.0	.56*	1.11
Binge Alcohol Use	255	12.9	.34*	1.02
Cannabis Use	463	23.4	.59*	1.27
Vaping	606	30.7	.98*	1.79
<b>Biracial, Non-Hispanic (n = 646)</b>				
Suicidal Ideation	210	67.0	.55*	.83
Weapon Threat/Violence	70	10.8	.23*	.83
Perceived School Safety	82	12.7	.23*	.70
Alcohol Use	171	26.5	.48*	.95
Binge Alcohol Use	75	11.6	.28	.89
Cannabis Use	163	25.2	.67*	1.38
Vaping	193	29.9	1.02*	1.83

Note. \* = mean difference between this group and another group is significant at the 0.01 level. Due to the discrepancies in race/ethnicity group sizes, significance between groups should be interpreted with caution.

## Primary Analysis

Hayes' (2013) PROCESS macro in SPSS was utilized to test the hypothesized models. Specifically, PROCESS estimated the conditional direct and indirect effects of weapon threat/violence at school on suicidal ideation through perceived school safety and substance use (alcohol use, binge alcohol use, cannabis use, and vaping). Each substance was run in a separate model with 99% confidence intervals. Age, sex, and race/ethnicity were entered as covariates for each model.

**Mediations.** Due to missing data, the sample sizes differed per model, per substance (alcohol use,  $n = 12008$ ; binge alcohol use,  $n = 11423$ ; cannabis use,  $n = 12596$ ; vaping,  $n = 12102$ ). Across the models, approximately 6.1% of the variance in suicidal ideation ( $R^2 = .061$ ) was accounted for by alcohol use, 5.4% ( $R^2 = .054$ ) by binge alcohol use, 6.3% ( $R^2 = .063$ ) by cannabis use, and 6.8% ( $R^2 = .068$ ) by vaping. Significant direct effects were similar across each model in that experienced weapon threat/violence at school predicted perceived school safety, substance use, and suicidal ideation. Perceived school safety predicted substance use and suicidal ideation, while substance use predicted suicidal ideation. Across each model, age and race/ethnicity were not significant, while sex significantly predicted suicidal ideation in each model. Direct effects for each pathway, per model, are displayed in Figures 3-6.

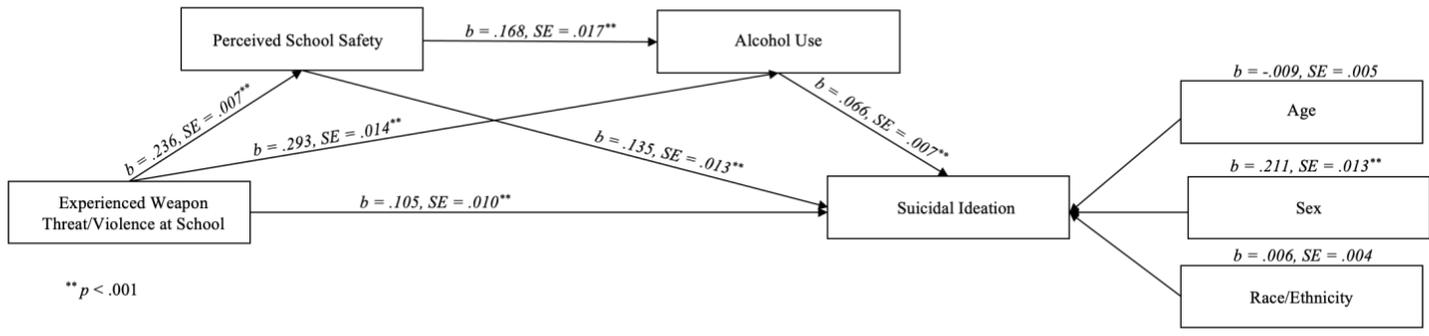


Figure 3. Model 1: Model examining the mediating role of perceived school safety and alcohol use between experienced weapon threat/violence at school and suicidal ideation ( $n = 12008$ ).

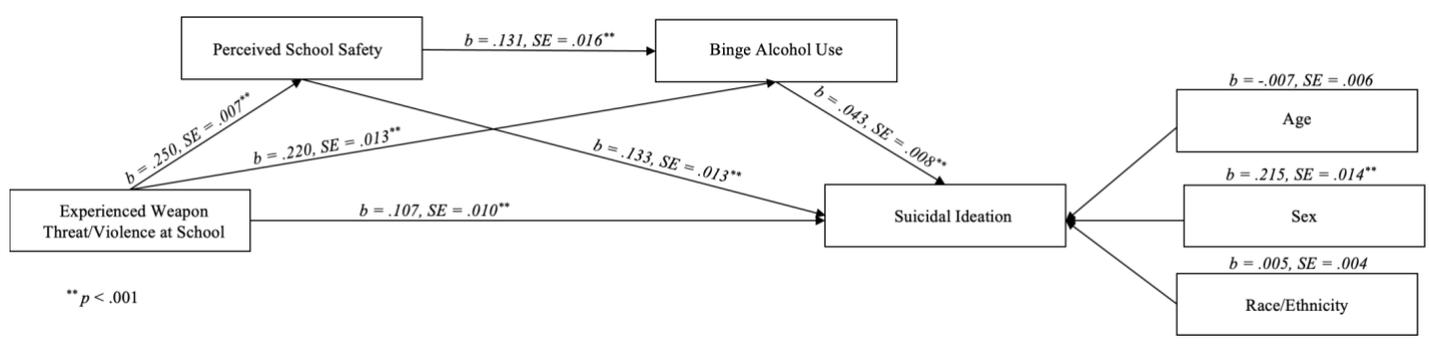


Figure 4. Model 2: Model examining the mediating role of perceived school safety and binge alcohol use between experienced weapon threat/violence at school and suicidal ideation ( $n = 11423$ ).

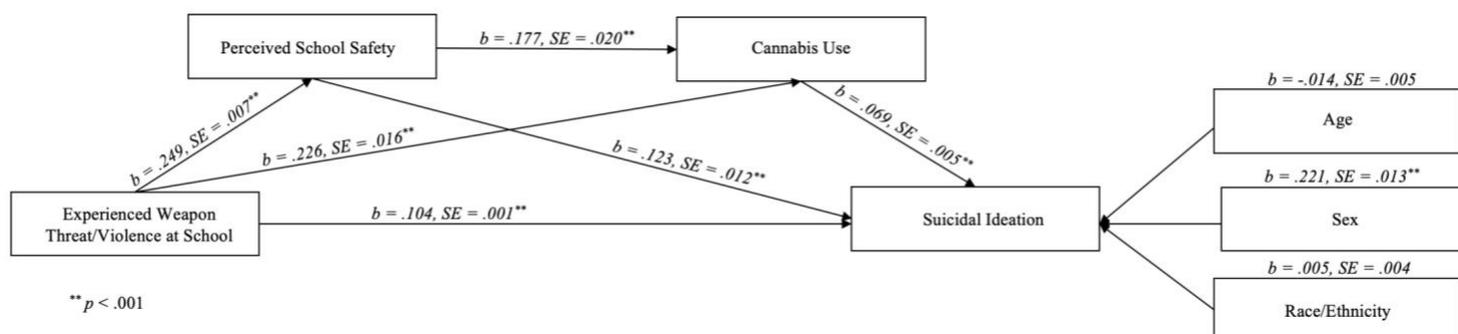


Figure 5. Model 3: Model examining the mediating role of perceived school safety and cannabis use between experienced weapon threat/violence at school and suicidal ideation ( $n = 12596$ ).

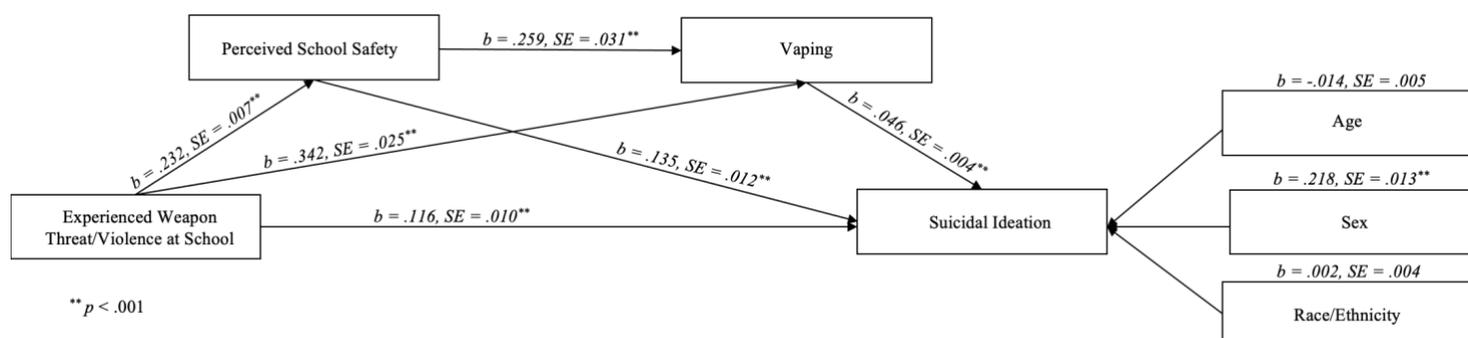


Figure 6. Model 4: Model examining the mediating role of perceived school safety and vaping between experienced weapon threat/violence at school and suicidal ideation ( $n = 12102$ ).

Results indicated that across each substance and model, experienced weapon threat/violence at school was a significant predictor of suicidal ideation through perceived school safety, and that experienced weapon threat/violence at school was a significant predictor of suicidal ideation through perceived school safety and each substance (alcohol use, binge alcohol use, cannabis use, and vaping). In addition, the direct effects were significant for each model,

suggesting a partial mediation for each substance use variable. Indirect, direct, and total effects with unstandardized coefficients (*b*) are displayed in Table 4.

Table 4. *Effects of Experienced Weapon Threat/Violence on Suicidal Ideation through Perceived School Safety and Substance Use.*

<i>Mediations</i>	<i>b</i>	<i>SE(b)</i>	<i>99% CI</i>
<i>Alcohol Use</i>			
EWT/V → PSS → SI	.032	-	-
EWT/V → AU → SI	.019	-	-
EWT/V → PSS → AU → SI	.003	-	-
Total effect	.159	.010	.134-.184
Total direct effect of EWT/V → SI	.105	.010	.078-.131
<i>Binge Alcohol Use</i>			
EWT/V → PSS → SI	.033	-	-
EWT/V → BAU → SI	.009	-	-
EWT/V → PSS → BAU → SI	.001	-	-
Total effect	.151	.010	.126-.176
Total direct effect of EWT/V → SI	.107	.010	.081-.133
<i>Cannabis Use</i>			
EWT/V → PSS → SI	.031	-	-
EWT/V → CU → SI	.016	-	-
EWT/V → PSS → CU → SI	.003	-	-
Total effect	.153	.010	.129-.177
Total direct effect of EWT/V → SI	.104	.010	.079-.129
<i>Vaping</i>			
EWT/V → PSS → SI	.031	-	-
EWT/V → VAP → SI	.016	-	-
EWT/V → PSS → VAP → SI	.003	-	-
Total effect	.166	.010	.141-.191
Total direct effect of EWT/V → SI	.116	.010	.090-.142

*Note.* EWT/V = experienced weapon threat/violence at school; PSS = perceived school safety; AU = alcohol use; BAU = binge alcohol use; CU = cannabis use; VAP = vaping; SI = suicidal ideation.

## Chapter IV: Discussion

### Intepretation of Results

*Preliminary analysis.* Race/ethnicity was significantly correlated across all model variables. This was explored further through a one-way between-groups ANOVA, which indicated significant differences between race/ethnicity groups across all model variables. Biracial, Non-Hispanic adolescents reported significantly more suicidal ideation. Experienced weapon threat/violence at school was significantly higher among American Indian or Alaska Native adolescents, while skipping school due to concerns of safety at school or on their way to

or from school (perceived school safety) was reported significantly more by Black or African American, Biracial, Hispanic, and Biracial, non-Hispanic adolescents. White adolescents reported significantly more alcohol and binge alcohol use. The only significant difference between race/ethnicity groups regarding cannabis use was that Asian adolescents reported significantly less. A similar trend held for vaping in that Asian and Black or African American adolescents reported significantly less vaping than other race/ethnicity groups. Due to the sample size of each race/ethnicity group, these results were interpreted with caution, however, do suggest an overall trend. Specifically, that minority adolescents reported experiencing more weapon threat/violence at school, lower perceived school safety, and more suicidal ideation compared to White adolescents. This was consistent with prior research which has suggested race and ethnicity may play a significant role in an adolescent's victimization and experience of violence within the school environment (Peguero et al., 2013). This was particularly important to highlight as most research utilizes predominately White samples and does not prioritize the experience of minority adolescents, who may be experiencing more overall distress due to racial disparities. The difference between race/ethnicity groups regarding substance use suggested research should be more attentive to the differences between minority groups, rather than grouping all minority adolescents together, as each race/ethnicity reported significantly different levels of substance use. Again, it is crucial to note the differences among race/ethnicity groups as previous research has documented the significant relationship between systemic racism and substance use and how this differs across minority groups (Farahmand et al., 2020).

Sexual identify was also significantly correlated with several model variables. Identifying as gay or lesbian, bisexual, or questioning your sexual identity (coded as "not sure") was associated with more suicidal ideation, experienced weapon/threat at school, lower perceived

school safety, and more cannabis use. Interestingly, sexual identity was significantly negatively correlated with vaping, which suggested that identifying as heterosexual was associated with more vaping. These results highlight the importance of identity and understanding the differences between sexual minority adolescents compared to the majority – heterosexual adolescents. Similar to race/ethnicity, the majority of research has utilized heterosexual samples, and often groups together gay or lesbian adolescents with other sexual minority students. Additionally, these preliminary analyses emphasize the importance in understanding the intersectionality between race/ethnicity and sexual identity and how this may affect an adolescent's social and environmental experience at school and overall well-being.

*Primary analyses.* The proposed hypotheses were partially supported. The first hypothesis proposed the full model, that perceived school safety and substance use (alcohol use, binge alcohol use, cannabis use, and vaping) would mediate the relationship between experienced weapon threat/violence at school and suicidal ideation. Each model had similar results in that experienced weapon threat/violence at school predicted perceived school safety, meaning that more days of experienced weapon threat/violence at school predicted more days that adolescents skipped school due to safety concerns either at school or on their way to or from school. This was consistent with previous research in that experienced weapon/threat or violence at school may be predictive of skipping school (Williams et al., 2018). More days of experienced weapon threat/violence at school also predicted more days of alcohol use, binge alcohol use, cannabis use, and vaping, which suggested substance use may be used as a means to cope with negative emotions as a result of adverse experiences or events. Experienced weapon threat/violence at school also significantly predicted suicidal ideation, which may provide support for the theory of acquired capability, suggesting that exposure to painful and/or fearsome

behaviors may be predictive of suicidal behaviors (Anestis et al., 2014). Skipping school due to safety concerns either at school or on their way to or from school (perceived school safety) also predicted more days of alcohol use, binge alcohol use, cannabis use, and vaping, which may again be suggestive of the role of substance use as a means to cope. Perceived school safety also predicted suicidal ideation, and in turn, each substance use variable predicted more suicidal ideation, which may involve the lowering of disinhibition as a result of substance use. Among the covariates (age, sex, race/ethnicity), only sex predicted suicidal ideation, suggesting that female identifying adolescents reported more suicidal ideation, which is consistent with previous research suggesting that female adolescents may experience more depressive symptoms than their male counterparts. The indirect effects for each full model were significant at a 99% confidence interval, with unstandardized effect sizes ranging from .001 to .003. The direct effects were also significant, with unstandardized effect sizes ranging from .104 to .116, suggesting overall partial mediations for each model. It is important to note again, however, that the effect sizes across the results were diminutive, suggesting that while they were statistically significant, this does not equate to clinical significance.

The second hypothesis proposed that each substance, alone, would mediate the relationship between experienced weapon threat/violence at school and suicidal ideation. Similar to the first hypothesis, each substance and model produced similar results. The indirect effects for each model were significant at a 99% confidence interval, with unstandardized effect sizes ranging from .009 to .016. As reported previously, all the direct effects were significant, suggesting overall partial mediations with perceived school safety removed from the full model. As both the first and second hypotheses were supported by partial mediations, meaning that the indirect and direct effects were all significant, this suggests that other construct(s) aside from

perceived school safety and substance use may explain the relationship between experienced weapon threat/violence at school and suicidal ideation.

Overall, regarding both hypotheses, the IMV model of suicidal behavior (Figure 2; O'Connor & Kirtley, 2018) may be used to explain the relationship among the model variables. Experienced weapon threat/violence at school coincides with the pre-motivational phase including background factors and triggering events, and may also be associated with the motivational phase, where suicidal ideation and intention start to form. Defeat, humiliation, and entrapment may be a result from experienced weapon threat/violence at schools. This, in turn, increases the possibility that an adolescent skips school due to low perceived school safety, exacerbating feelings of not belonging, and thus negatively impacting social support and an adolescent's ability to engage in school, which overall decreases their academic performance and future opportunities. Substance use as a means to cope with these negative experiences and the consequences of these experiences (e.g., skipping school which may lead to more negative outcomes, such as suspension and at home punishments) may increase the possibility of disinhibition occurring, resulting in more suicidal ideation, such as seriously creating a plan to attempt suicide. It is of note that sex, race/ethnicity, and sexual identity may play a role in this model as well, as discrimination, victimization, and targeted aggression within the school context may be higher or experienced more by female identifying adolescents, minority race/ethnicity adolescents, and sexual identity minority adolescents.

### **Implications**

Results of this study have implications for the prevention and treatment of both substance use and suicidal ideation among adolescents. First, results suggest a direct relationship between substance use and suicidal ideation across substances and potentially provide support for this

relationship viewed through the IMV model. While this relationship is more well-established in the literature for alcohol and cannabis, the results of this study suggest that vaping may also be predictive of suicidal ideation, providing support for the theory that adolescents may, overall, use any substance to cope with negative emotions. Interestingly, as vaping does not inhibit disinhibition or allow the user to reach a level of intoxication similar to that of alcohol or cannabis, this finding may suggest there are similar temperament, personality traits, or state affective traits that are comparable across adolescents that use substances, which in turn predict suicidal ideation. Likewise, it is possible that adolescents who vape also utilize alcohol and/or cannabis, and the lowering of disinhibition theorized is done so through the concurrent or simultaneous use of those substances. In a review of outpatient behavioral treatments for adolescent substance use, Hogue and colleagues (2018) found that family-based treatment, and both group and individual cognitive behavioral focused therapies were the most well-established evidence-based treatments for treating adolescent substance use. Research implementing a school-based intervention for adolescents with substance use found support for a mixed modality approach, utilizing aspects of motivational interviewing, acceptance and commitment therapy, family sessions, and contingency management (Lintz et al., 2019). A common theme among successful treatment for adolescent substance use appears to be engagement with the adolescent client. As engagement in treatment is a significant predictor of treatment outcomes, particularly for adolescents (Hogue et al., 2018), it may be crucial for mental health care providers to prioritize fostering connections with adolescents in treatment and likewise for educators and school staff when approaching adolescents about substance use. Specifically, taking an empathetic and harm reduction approach to substance use may be more efficacious than a consequence and abstinence-oriented stance.

Additionally, prioritizing connectedness may be beneficial for reducing suicidal ideation and suicide-related outcomes for adolescents, as engagement with others may increase feelings of belongingness and reduce negative emotions, such as feeling isolated. Asarnow and Mehlum's (2019) review of treatment for suicidal and self-harming adolescents noted progress over the past several years in research finding support for dialectical behavioral therapy, while also highlighting continued evidence for cognitive behavioral therapies. Notably, their review suggested that an adolescent's social-environmental context must be taken into consideration. While this often refers to the home environment, the authors underscore the importance of prevention and interventions happening within the school context, specifically the enhancement of protective factors within schools. The results of the current study provide support for the prioritization of ensuring that the school environment is not only perceived as safe by adolescents, but that steps are taken to reduce experienced weapon threat/violence at school. These findings may also provide evidence for the IMV model of suicidal behavior (O'Connor & Kirtley, 2018) in that threatening experiences and violence within the school environment may increase perceived burdensome and isolation. It is of note that educators, school personnel, and mental health care providers within the school context may be on the frontline for identifying and noticing when an adolescent is not only victimized but withdraws or appears isolated from other adults and peers. Again, fostering individual connectedness and engagement with adolescents within the school context and asking about suicidal ideation may be the first step to preventing more severe suicide-related outcomes, such as suicide attempts and suicide-related hospitalizations.

In addition, this study highlights the importance of addressing an unfortunately common phenomena in the United States – experienced weapon threat/violence at school. Experienced

weapon threat/violence at school directly predicted each study variable across every model hypothesized, underscoring the potential negative impact of experienced weapon threat/violence at school on adolescent psychological well-being. Strategies suggested by the Centers for Disease Control and Prevention (David-Ferdon et al., 2016) include promoting supportive family environments that encourage nonviolent discipline, providing quality education early in life, implementing universal school-based programs that strengthen an adolescent's socioemotional skills, and creating connections between adolescents and adults through schools and in the community may significantly lower the risk of adolescent violence. Likewise, David-Ferdon and colleagues (2016) recommend interventions and treatments to reduce the harms of violence exposures and to prevent the outcomes of problem behaviors. This study provided support for the relationship between experienced weapon threat/violence at school and such problem behaviors, such as substance use and truancy, which may be a result of not attending school due to not feeling safe at school. Ensuring that educators and school personnel have the resources and training to provide psychoeducation on the impact exposure to violence may have on an adolescent's psychological well-being may be crucial for preventing the escalation of mental health concerns, such as substance use and suicide-related outcomes. Again, this may be best achieved by fostering connections with adolescents to increase their perceived belongingness and by taking into consideration the role of violence and perceived school safety on behaviors that are often punished within the school context, such as truancy, and finding positively reinforcing alternatives.

This study also provided evidence for individualizing interventions for minority race/ethnicity and sexual minority adolescents. Prejudice, discrimination, and oppression are often experienced by minority groups (Meyer, 2003), stressors that the majority often do not

experience. The psychological literature, in general, has utilized majority samples (e.g., White, heterosexual, cisgender male), thus not prioritizing the experiences of students of color and sexual minority students. The current study supports previous research in that there were significant differences between race/ethnicity groups in experienced weapon threat/violence at school, perceived school safety, substance use, and suicidal ideation, particularly compared to White students. This is possibly due to systemic differences and racial tensions felt within the school environment, especially for Black and Hispanic students, who have consistently reported feeling the least safe in and outside of the classroom while on school grounds, compared to White and Asian students (Lacoe, 2015). As Lacoe (2015) notes, school intervention policies have traditionally sought to address racial and ethnic inequality through educational outcomes such as academic performance and have not focused on student safety. However, it is evident from the literature and from the findings of the current study that experienced weapon threat/violence at school and lower perceived school safety may have negative implications for the psychological well-being of minority students. Similarly, sexual minority students are at a greater risk for experiencing more negative school experiences including less positive peer and teacher interactions and inconsistent support, compared to heterosexual students (White et al., 2018). Interventions specifically created for race/ethnicity and/or sexual minority students are needed to foster greater acceptance and well-being for students. Culturally competent interventions, in addition to school personnel and mental health care providers explicitly providing their support for a student's race/ethnicity and/or sexuality may be beneficial. Moving forward, educators and health care professionals alike could better help their students by considering intersectionality as individuals with more than one minority identity frequently experience multiple discriminations (Hayes et al., 2011).

Overall, the findings from this study emphasize the need for targeted interventions aimed at improving the school environment, including lowering weapon threat/violence in schools and increasing perceived school safety. As mentioned elsewhere, while school administrations have focused on improving measurable outcomes, such as school attendance and academic performance, creating a positive environment for students where they feel a sense of belonging and support may have more positive psychological benefits in the long run. This may include fostering a school environment where difficult topics, such as suicidal ideation, violence, and substance use are openly discussed with trepidation. Additionally, school-based interventions focusing on substance use and suicidal ideation are crucial for students, as these are increasingly common psychological outcomes for students. Lastly, tailoring interventions to the specific experiences and needs of students of color and sexual minority students may do more in bridging gaps in inequality than interventions normed on White and predominately heterosexual samples.

### **Limitations**

There are several limitations worth mentioning. First, the presence of several small, but significant, effect sizes are indicative of the potential that the study was overpowered and thus should be interpreted with caution, particularly when considering the clinical implications. Second, the data utilized in this study was cross-sectional and therefore limited in proposing causality. Longitudinal research would strengthen the ability to make causal claims regarding experienced weapon threat/violence at school predicting suicidal ideation, mediated by perceived school safety and substance use. Future studies should also utilize zero-inflated negative binominal regression to account for the highly skewed nature of suicide-related data. This would allow for a more rigorous statistical approach to disproportionately skewed data by modeling the

probability of the symptom occurring (e.g., suicidal ideation) rather than the frequency (Gonzalez-Blanks et al., 2020).

An unavoidable limitation regarding the data utilized was the measurement of substance use and suicidal ideation. Substance use was measured over the past 30 days to assess current use rather than lifetime use, while suicidal ideation was only measured over the past 12 months. To more clearly understand the relationship between substance use and suicidal ideation, it would be crucial to measure substance use and suicidal ideation within the same time period. Data collection methods such as ecological momentary assessment, where participant's provide data in real time, rather than recalling their experience at a specific data point, could provide more accurate data. This would ideally provide more robust information, perhaps strengthening the theory for a causal relationship between substance use and suicidal ideation. For example, knowing if within a specific and smaller time frame (e.g., one week) if an adolescent drank alcohol and/or experienced suicidal ideation on the same days. Severity of substance use was also not measured with the exception of binge alcohol use, which suggests more severe alcohol use. As the intoxication effect of substances generally increase with more use of the substance, it would have been useful to know how much and how often a substance was being used in relationship to the other variables. Furthermore, concurrent or simultaneous substance use was not measured, which may provide evidence for substance use increasing suicidal ideation, particularly while under the influence of more than one substance.

It is plausible that the hypothesized models were so similar in their findings due to the same adolescents using multiple substances. Future research should also consider separating out singular substance users from polysubstance users while also thoroughly examining severity of use as it is possible that polysubstance users are using more than one substance due to

experiencing more distress. Thus, using more than one substance and/or experiencing the intoxication effects of more than one substance at one time may influence, possibly increasing, suicidal ideation as disinhibition increases. Similarly, understanding the difference between adolescents who experience suicidal ideation versus those who also attempt suicide may provide more information for targeted interventions.

In addition, data collection was done at schools and therefore excluded adolescents who do not attend school, who are chronically absent, or who may have dropped out of school, which may disproportionately include race/ethnicity and/or sexual minority students. Future research should consider data collection within the community to capture the experience of adolescents who are either unable to or no longer attending high school. This could provide more information on the consequences of experienced weapon threat/violence at school, low perceived school safety, substance use, and suicidal ideation. In addition, future research would benefit from including variables to control for socioeconomic status and/or the overall safety of the neighborhood and surrounding area, as this may influence school funding, which may impact available resources and overall perceived school safety. Another limitation regarding minority students was the small number of minority participants in comparison to the large number of White participants. This impacted interpretation of the significant differences between race/ethnicity groups. Future research should specifically focus on minority adolescent experiences and take into account the impact of intersectionality for adolescents with multiple minority identities.

### **Future Directions**

School safety, substance use, and suicidal ideation can have long-lasting consequences on the psychological well-being of adolescents. While the relationship between experienced weapon

threat/violence at school to suicidal ideation, mediated by perceived school safety and substance use was partially supported in this study, there are likely other construct(s) that are impacting or contributing to these relationships. Correlates of substance use and suicidal ideation for adolescents include stress, depression, anxiety, abuse, interpersonal conflict, lower socioeconomic status, and a history of engaging in other risk-taking behaviors (Biswas et al., 2020; Glied & Pine, 2002; Park & Kim, 2016). Future research should consider the role of these factors on the relationship between experienced weapon threat/violence at school, perceived school safety, substance use, and suicidal ideation as this would better inform the development of school-based interventions targeting these areas of concern. Finally, race/ethnicity and sexual minority adolescents are at an increased risk for negative psychological outcomes, which can be explained through the minority stress model (Meyer, 2003). Future research should explicitly prioritize race/ethnicity and sexual minority students as they may experience worsened consequences from weapon threat/violence at schools, low perceived school safety, substance use, and suicidal ideation, thus needing culturally tailored interventions to address their higher need and psychological distress.

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