

DATING VIOLENCE VICTIMIZATION AND SUBSTANCE  
USE: DO GENES PLAY A ROLE?

by

ALEXIS YOHROS  
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Major Professor: Jason Ford

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## **ABSTRACT**

Dating violence (DV) victimization in adolescence has been shown to be predictive of both negative emotions and delinquent behavior later in life. However, research that delves into DV victimization and subsequent outcomes, such as deviant behavior, is largely atheoretical. Robert Agnew's general strain theory (GST) provides a theoretical framework to address this limitation. In focusing on negative interactions with others, the theory posits that strain produces negative affect states which leads to deviant or criminal coping. Prior research has identified victimization as a strain, a type of noxious stimuli, which is significantly related to negative emotionality, crime, and deviance. I build on this literature by examining the relationship between dating violence victimization, negative emotionality, and substance use. In addition, little research to date has examined the role that biological factors play in moderating these relationships. Using Add Health, and drawing on two separate, but related, theories, I explore whether the serotonin transporter gene (5-HTTLPR) interacts with dating violence victimization to affect depressive symptoms and self-reported substance use. The analytic strategy involved a series of logistic regressions separated by gender. Results show DV victimization is significantly related to increased odds of binge drinking in males, DV victimization is significantly related to marijuana use for both males and females, and 5-HTTLPR moderates the effect of DV victimization on marijuana use for females only. Although depression does not mediate the relationship between DV victimization and substance use, results show depressive symptoms are independently associated with increased odds of marijuana use. Utility of a GST and biosocial model, implications, and avenues for future research are discussed.

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## **LIST OF ACRONYMS (or) ABBREVIATIONS**

### **ACRONYMS**

DV = Dating violence

GxE = Gene-environment

GST = General Strain Theory

HTT = 5-HTTLPR

### **ABBREVIATIONS**

Add Health = National Longitudinal Study of Adolescent Health

CDC = Center for Disease Control

CES-D = Center for Epidemiologic Studies–Depression

SAMHSA = The Substance Abuse and Mental Health Services Administration

WHO = World Health Organization



## **CHAPTER ONE: INTRODUCTION**

Dating violence (DV) is defined as physical, sexual, psychological, stalking, or emotional violence within a teen or adolescent dating relationship (Black et al., 2010). The World Health Organization (WHO) defines adolescence as a transition between child and adulthood, including any person ages 10-19. This is a critical time in development, and violent behavior often times begins between the ages of 12 and 18 (Rosardo, 2000). Adolescent dating violence is a widespread issue that requires nationwide cognizance. Statistics found that 23% of females and 14% of males who ever experienced rape, physical violence, or stalking by an intimate partner, first experienced partner violence between the ages of 11 and 17 (Center for Disease Control (CDC), 2011). Further, nearly 1.5 million high school students nationwide have experienced physical abuse from a dating partner in a single year (CDC, 2006).

Dating violence victimization can lead to various short and long term consequences. For instance, adolescents who are victims of DV are at higher risk of experiencing symptoms of depression, exhibiting antisocial behaviors, engaging in substance use such as illicit drugs and alcohol, and falling into victimization again later in life (Exner-Cortens, Eckenrode, & Rothman, 2013; Foshee et al., 2013; Roberts, Klein & Fisher, 2003). The current research that examines DV victimization and subsequent outcomes, such as deviant behavior, is largely atheoretical. In order to address this important gap in the literature, this study uses Robert Agnew's general strain theory (GST) as a theoretical framework to further understand dating violence among adolescence.

Briefly stated, the theory suggests that strains, or conditions disliked by an individual, increase negative emotions such as anger, depression, and frustration. This may lead to an individual engaging in deviant behavior to cope with this negative emotionality if he or she lacks the appropriate resources to cope in a legal manner (Agnew, 1992). The current research explores dating violence victimization as a source of strain to analyze deviant outcomes such as substance use, and the mediating role of negative affect.

General strain theory research has looked at various conditioning factors that may influence emotional and deviant responses to strain, although most moderating variables have been sociological in nature (Agnew, 2012). To gain a more complete picture of DV victimization and deviant outcomes, the study includes a biological component to explore if and how genes moderate the relationship between DV victimization, negative emotions, and deviant outcomes. More explicitly, this builds on the literature demonstrating that the effects of stressful life events on emotionality and behavior are conditioned by genes (Caspi et al., 2003).

In summation, the current research looks at the relationship between dating violence victimization, negative emotions, and delinquency through a general strain theory context. It is argued that dating violence victimization is a source of strain that leads to emotional distress such as depression and subsequent deviant behavior, more specifically, substance use (binge drinking and marijuana use). Expanding the literature, the research analyzes the moderating effect of genetic predisposition for stress hardiness on the relationship between depressive symptoms and substance use. As both the GST and biosocial literature highlights differences between males and females, gender differences are also examined in regards to dating violence victimization and negative outcomes. The integrated GST and biosocial model is tested using

data from the National Longitudinal Study of Adolescent Health (Add Health). This research represents the first systematic examination of GST extended to DV victimization as a source of strain and genes as conditioning factors for negative outcomes.

## **CHAPTER TWO: LITERATURE REVIEW**

### Dating Violence Victimization as Strain

Victimization may likely lead to some form of direct harm or disturbance, physically or emotionally, to personal and social development (Macmillan, 2001). Much of the victimization literature focuses on childhood maltreatment by a parent or family member in which a large majority of the results show a relationship between childhood victimization and future engagement in criminal behavior (Ireland et al., 2002; Thornberry et al., 2001; Widom, 1989). A small number of studies have also looked at adolescent victimization and subsequent delinquent behavior, with similar results pointing to a link between physical and sexual victimization by a family member and later delinquency (Menard, 2002; Ireland et al., 2002; Vissing et al., 1991). For example, Smith, Thornberry & Ireland (2005) found that adolescent maltreatment such as physical, sexual, neglect, and/or emotional abuse by a family member was positively associated with arrest, self-reported general and violent offending, and illicit drug use. Results from such studies show that both childhood and adolescent victimization may increase the likelihood of subsequent delinquent behavior (Cleary, 2000; Menard, 2002; Zingraff, 1993). This also includes use of drugs as adolescents and adults (Dembo et al., 1987; Kilpatrick et al., 2000). These studies, however, suffer from some methodological limitations, including a lack of theoretical grounding.

General strain theory has been used as a framework to test the victimization/crime relationship (Agnew et al., 2002, Agnew & White, 1992; Agnew, 2002; Brezina, 1998; Katz, 2000; Mazerolle, 1998; Mazerolle et al., 2000; Mazerolle & Maahs, 2000; Piquero & Sealock, 2004). In GST, Agnew presents a modified and broader version of Merton's (1938) strain theory.

Merton (1938) posits that crime results from the inability to achieve monetary success or other esteemed goals through legitimate means. According to Agnew, strains refer to events or conditions that are disliked by an individual (Agnew, 1992; Agnew, 2006a). These strains increase negative emotions such as anger, depression, and frustration, which create pressure to reduce, escape, or correct the strain. This may lead to crime when an individual lacks the ability to cope in a legal manner (Agnew, 1992; 2006a).

Agnew distinguishes three major sources of strain: individuals unable to achieve their goals (goal-blockage), individuals losing something they value (removal of positive stimuli), or individuals treated in a negative manner by others (presence of negative stimuli). In terms of the presence of negative stimuli, Agnew (1992) states that noxious strains refer to “relationships in which others are not treating the individual as he or she would like to be treated” (p. 48). Much of the GST and victimization literature focuses on strain as the presence of negative stimulus or a negative relationship with others. Victimization such as bullying (i.e. Cullen et al., 2008; Hay & Meldrum, 2010), parental abuse (Carson et al., 2009; Watts, & McNulty, 2015) and prison victimization (Zweig et al., 2015) have been empirically tested as sources of this type of strain and show moderate support for GST.

Research that has attempted to measure the most criminogenic strains has found that victimization has a significant relationship to drug use, property crime, and violent offending (Baron, 2009; Carson, Sullivan, Cochran, & Lersch, 2009; Lin, Cochran & Miecskowski, 2011). In addition, various studies have deemed violent victimization as a strain that leads to various forms of negative emotions and criminal offending; these studies have found support for general strain theory (Agnew, 2002; Baron, 2009, Hay & Evans, 2006; Jang & Johnson, 2003; Kort-

Butler, 2010; Moon et al., 2009; Ousey, Wilcox, Schreck, 2015; Piquero & Sealock, 2000; Piquero & Sealock, 2004; Turanovic & Pratt, 2013). Researchers have also studied victimization and GST in a broad sense, incorporating victimization as sexual, physical, and or other type victimization (Harell, 2007; Manasse, & Ganem, 2009). Lo, Kim, & Church (2008) utilized a general strain theory framework to look at the effect of sexual victimization, physical victimization, and “other” victimization on substance use. Although the results were supportive of general strain theory, authors noted future studies should clarify the role of victimization (by type) in different drug-using behaviors. One such type of victimization that has not been directly tested is dating violence.

Studies have used general strain theory as a theoretical framework to look at dating violence perpetration as an outcome of strain (i.e. Murphy & Williams, 2008), yet no such study has directly nor specifically looked at dating violence victimization as a source of strain. Although this is the case, the current research argues that dating violence victimization should be considered in these studies as it captures various facets of strain. Similar to other victimization/GST research, dating violence victimization presents the presence of a negative stimulus. This may be in the form of physical, sexual, and/or verbal assaults. Agnew (1997, 2001a, 2001b) argues that although a range of negative or noxious stimuli may cause delinquency, physical and verbal assaults are of special significance. In the theoretical explanation, delinquency is an adaptation to stress, with the main source of strain being a negative relationship with others (Agnew 1992). In this sense, the “other” is the perpetrator of dating violence to his/her partner and the victim is experiencing the strain of being mistreated. Agnew (1992) also mentions that strains of abuse are more severe when experienced by someone

with a close personal connection. Although most studies have looked at childhood sexual and physical abuse, abuse by an intimate partner also falls into such category.

### Dating Violence Victimization, Negative Emotions, & Negative Outcomes

Various studies have shown a multitude of negative consequences associated with dating violence victimization, further highlighting the validity of dating violence victimization as a measure of strain. These negative outcomes for both females and males include eating disorders (Ackard & Neumark-Sztainer, 2002; Ackard, Neumark-Sztainer, & Hannan, 2003; Ackard, Eisenberg, & Neumark-Sztainer, 2007; Exner-Cortens et al., 2013; Silverman, Raj, Mucci & Hawthaway, 2001; Wolitzky-Taylor et al 2008), poor educational outcomes (Banyard & Cross, 2008; Eaton et al., 2007), risky sexual behaviors (Black et al., 2006; Exner-Cortens et al., 2013; Howard, Donna & Wang 2003b; Silverman, et al., 2001), poor physical and mental well being (Ackard et al., 2003; Coker et al., 2000; Wolitzky-Taylor et al., 2008), and injury (Barter, 2009; Button, & Miller, 2013; Exner-Cortens et al., 2013; Foshee, 1996; Halpern et al., 2001; Molidor & Tolman, 1998; Sears et al., 2006). In addition, studies have found dating violence victimization to be associated with subsequent antisocial behavior such as violent acts and other deviant behaviors such as substance use (Exner-Cortens et al., 2013; Donna & Wang, 2003b; Roberts et al., 2003).

This ties into Agnew's argument that strains influence negative outcomes such as delinquency because they result in a range of negative emotions such as anger, frustration, jealousy, depression, and fear (Agnew, 1985; 1992; 2006a). These make an individual want to do something to alleviate these negative emotions. Therefore, negative emotionality mediates the

relationship of strain on delinquency and/or substance using behaviors. For instance, Broidy (2001) found a relationship between anger and negative emotions and general crime among college students. In another study, Ford & Shroeder (2009) found students who experienced academic strain reported higher levels of depression and those who reported higher levels of depression were more likely to report non-medical use of prescription stimulants. These studies and others (i.e. Aseltine et al., 2000; Piquero & Sealock, 2000) support the notion that strain produces delinquency indirectly through its impact on negative emotionality.

Research highlights a link between adolescent dating violence and negative emotional states such as stress, anger, hurt, fear, and depression (Barter, 2009; Foshee, 1996; Molidor & Tolman, 1998; Sears et al., 2006; Button, & Miller, 2013). More specifically, research displays that depressive symptoms are common of victims of adolescent dating violence for both males and females (Ackard, et al., 2007; Callahan, Tolman & Saunders, 2003; Banyard & Cross, 2008; Roberts, Klein, & Fisher, 2003; Wolitzky-Taylor et al., 2008). Holt & Espelage (2005), through self-reports, found that greater victimization (physical or emotional) is associated with more anxiety and depression. Additionally, a nationally representative study by Ackard, Neumark-Sztainer, & Hannan (2003) found that dating violence is associated with detriments to mental health including depression and poor self-esteem. The same study found dating violence to be associated with suicidal thoughts. This finding is consistent with the research, in both cross-sectional and longitudinal studies, that finds a relationship between dating violence victimization and suicidal ideations and attempts (Ackard, et al., 2002; Ackard et al., 2007; Banyard & Cross, 2008; Black et al., 2006; Coker et al., 2000; Olshen, McVeigh, Wunsch-Hitzig & Rickert, 2007; Roberts, Klein, & Fisher, 2003; Silverman et al., 2001).



In addition to negative emotional states such as depression, anxiety, and suicidality, the literature also points to a link between dating violence victimization and consequent deviant behavior (Donna & Wang, 2003b). Two longitudinal studies using Add Health found a positive effect of dating violence victimization on later antisocial behavior, including violent behavior (Exner-Cortens, et al., 2013; Roberts, Klein, & Fisher, 2003). Both studies also found that dating abuse for both sexes is associated with higher rates of illicit substance use. Alcohol consumption and illicit substance use have been frequently cited to be associated with dating violence victimization (Ackard, et al., 2003; Ackard et al., 2007; Black et al., 2006; Eaton et al., 2007; Foshee et al., 2013; Lormand, 2009; Silverman et al., 2001). Ackard et al (2007) found that adolescent dating violence led to future marijuana use among females and Eaton et al (2007) found victimization to be associated with marijuana use among both males and females. In a recent study, Baker (2016) conducted eight sex-specific focus groups with high school students who had experienced prior dating violence. Adolescents in the focus group reported using alcohol/and or drugs at the start, duration, and end of the relationship as a way to cope with being in an abusive relationship or ending the abusive relationship. This is important, as GST literature indicates that substance use can be used as a coping mechanism for those exposed to negative stimuli (Agnew, 1992). In this sense, victims of dating violence may use alcohol and illicit substances as a way to manage the stress and depression that results from dating violence. Overall, the literature shows that antisocial behavior and substance use are one of the many consequences that may develop as a result of dating violence victimization (Button & Miller, 2013). For this reason, dating violence victimization should be considered a strain (presence of noxious stimuli) that can affect both negative affective states and delinquency during

adolescence, and general strain theory provides a framework for further analyzing this relationship.

Agnew (2006) states that negative emotions play an important role in explaining the effect of strain on types of deviant behaviors and/or delinquency. For instance, anger may be related to violent crimes, whereas substance use as a form of coping might be more related to feelings of depression and anxiety. Drug use may be a consequence of inner-directed negative emotions such as depression (Drapela, 2006). With the voluminous amount of research linking dating violence victimization to depressive and suicidal feelings, particular importance should be paid to both depressive symptoms and substance use as a consequence of victimization. More explicitly, general strain theory provides a theoretical model to analyze the mediating role of depressive symptoms on substance use. Furthermore, previous research on general strain theory have mostly either excluded alcohol and drug use in their measure of delinquency (Bao, Haas, Pi, 2004; Brezina, 1996; Hoffman & Miller, 1998; Paternoster & Mazerolle, 1994; Sigfusdottir, Farkas, & Silver, 2004) or have combined both alcohol and drug use in a composite measure of delinquency (Agnew et al., 2002; Jang & Johnson, 2003). By focusing on alcohol and marijuana use as its own measure, more specific and relevant information can be drawn from the study.

#### Dating Violence Victimization, Strain & Gender

Recent GST research has found that males and females both experience strain, although the types of strain and associated emotions may vary between genders (Broidy and Agnew, 1997; Mazerolle, 1998). For example, Jang (2007) found that African American women were more likely to experience strains from financial, health, and relationship reasons, while African

American men were more likely to experience strains related to discrimination in the workplace. Another study by Eriksson and Mazerolle (2013) found that both male and females who killed an intimate partner experienced negative emotions from strain, however; women who killed their intimate partners experienced strain such as long-lasting abuse from their partner, while male perpetrators experienced strain such as jealousy and lack of control. Piquero and Sealock (2004) also found that females were more likely to use spiritual coping and males used more physical and cognitive ways of coping with strains. This is noteworthy, as females and males experiencing dating violence may perceive, react, and cope with the strain of victimization in unique ways.

Generally speaking, research examining gender differences and dating violence victimization has remained inconclusive. Some studies have reported that males and females experience dating violence at similar rates (Eaton et al., 2007; Halpern et al., 2001; Molidor and Tolman 1998; O'Leary et al., 2008; Sears et al., 2006), while others have found women to report higher rates of dating violence victimization (Ackard et al., 2007; Button & Miller 2013; Coker et al., 2000; Wolitzky-Taylor et al., 2008). When it comes to negative outcomes that result from dating violence victimization, some studies have found that adolescent or teenage girls tend to have more severe consequences. For example, a study by Molidor & Tolman (1998) found that 81% of female victims of dating violence reported that their dating partner's aggression caused serious harm or hurt. This same study found that over 90% of male victims of dating violence reported feeling minimally hurt or not hurt at all. Foshee (1996) also found that female victims of dating violence are more likely to be injured in comparison to males and Button & Miller (2013) found that females more frequently experience the negative well-being outcomes associated with

both nonviolent and violent dating relationships. Other studies mentioned previously have also found some gender differences in subsequent negative outcomes (Ackard et al., 2007; Baynard & Cross 2008; Coker et al., 2000; Exner-Cortens, Eckenrode, & Rothman 2013). For instance, the study by Exner-Cortens, Eckenrode, & Rothman (2013) found that female victims of dating violence reported increased drinking, depressive symptoms, suicidal ideation, and cigarette smoking whereas male victims reported antisocial behaviors, suicidal ideation, and marijuana use. This underlines the importance of further analyzing how dating violence victimization may differentially affect females and males.

While general strain theory as a whole has received much empirical support (Langton & Piquero, 2007; Paternoster & Mazerolle, 1994; Mazerolle, Piquero, & Capowich, 2003; Piquero & Sealock, 2004; Akers & Sellers, 2009), this study also focuses on another key aspect of general strain theory that has exposed more mixed results; that strain, negative emotionality, and delinquency may be conditioned or influenced by other outside factors (Agnew, 2006). Some of these variables that have revealed varied results include coping skills, resources, social support, social control, association with criminal peers, beliefs regarding crime, and individual traits such as low self-control (see Agnew 2012 for specific studies). As more research is needed in this area, Agnew (2012) explains that general strain theory literature has neglected several core conditioning variables, including biological and psychological factors that influence the sensitivity and response to stressors (Agnew, 2012; Agnew, 2016; Rutter, 2006; Williams et al., 2011). This study, therefore, argues that the biological facet of genetic factors may condition the strain-negative emotions-crime relationship (Watts, 2015; Connolly & Beaver, 2015). The aim is to fill this gap in the theoretical literature by analyzing if certain biological factors make

individuals who are victims of dating violence more likely to develop negative emotions, such as depression, and cope in unhealthy ways. The following section outlines gene-environment interactions and the moderating effects of genes on both emotion and behavior in greater detail.

#### GxE Interactions: 5-HTTLPR, Strain, Depression & Deviance

Gene-environment (GxE) interactions refer to behavioral potentials and susceptibilities that can be triggered by the interaction of environmental and biological factors. The ongoing nature versus nurture debate states that variation in behavior is primarily due to either genetic or environmental differences. However, gene-environment interactions assume a “nature via nurture” occurrence, in which traits and behaviors are influenced by both environmental and genetic differences and more specially, the interaction between genetic predispositions and environmental triggers (Ridley 2003; Rutter 2006). Biosocial criminologists are currently examining the interplay between biology/genetics and environmental factors (Beaver, Barnes, & Boutwell, 2014).

One gene that has been studied in relation to gene-environment interactions is the serotonin transporter (5-TT). The serotonin transporter removes serotonin released into the synaptic cleft. 5-TT is encoded by one single gene, SLC6A4. 5-TTLPR is a degenerate repeat polymorphic region in SLC6A4, which is the gene that codes for the transportation of serotonin. The study of this gene is important, as researchers have looked at serotonin to further understand feelings of subjective well-being and happiness (De Neve, 2011). Evidence also demonstrates that 5-HTTLPR moderates the effect of environmental stressors, particularly developmental and life experiences, on later emotional and social behavior (Canli & Lesch, 2007).

In addition, 5-HTTLPR is composed of a short (s) and long (l) version, which result in differential 5-TT expression. The S variation has been found to affect regulation of serotonergic availability in the brain. From a neurological perspective, having a short serotonin transporter gene boosts the excitability of the amygdala, which is in charge of processing fear and other emotions (Canli, 2008). This makes them more vulnerable to depression and other maladaptive problems when faced with stressful life events or adversity (Belsky & Pluess, 2009; Caspi et al., 2003).

In a landmark study, Caspi et al (2003) found that 5-HTTLPR moderates the effects of stressful life events on depressive symptoms, probability of suicidal ideation/attempts, and episodes of major depression in early adulthood. In this same study, those homozygous (having two of the same) short alleles were the most negatively effected by stressful life events. In 2005, Kendler and his colleagues replicated this finding using fifteen types of stressful life events (i.e. divorce, job loss, robbery, illness) and found that individuals with two short forms of 5-HTTLPR were more likely to become depressed after mild stressors than those with other allele combinations. Since then, a multitude of studies have shown similar results in terms of stressful life events, depressive symptomology, and the role of 5-HTTLPR (Eley et al., 2004; Kaufman et al., 2004; Taylor et al., 2006). Prior research shows as well, those with S-allele are more likely to experience anxiety and depression after victimization (Cicchetti, Rogosch, & Struge-Apple, 2007; Scheid et al., 1997). However, the role of 5-HTTLPR in moderating stressful life events and depression is not entirely conclusive, with studies failing to replicate these results (Gillespie et al. 2005; Surtees et al 2006; Middeldorp et al. 2008; Chipman et al. 2007; Power et al, 2008; see Risch et al. 2009).

Although less examined than depression and negative emotionality, research on 5-HTTLPR has also analyzed the gene's association to adverse environmental stressors and subsequent anti-social behaviors and aggression (Li et al., 2010; Reif et al., 2007; Retz et al., 2008; Verona, Johnson & Bender, 2006; Watts, 2015), as well as substance use (Van der Zwaluw, 2010; Vaske, Newsome & Wright, 2012). In a recent meta-analysis evaluating 5-HTTLPR and its relation to adverse environments and antisocial behavior, Cormand and colleagues (2016) found a robust overall interaction effect. In addition, Li, Li & Lee (2010) examined the interaction between 5-HTTLPR and maltreatment to find that maltreated girls homozygous for the short allele were twelve times more likely to be in the Exclusive Covert group, which is what they referred to as the group with antisocial behavioral problems. Maltreatment, such as neglect, has also been studied in relation to alcohol use, where a finding by Kaufman et al (2007) found that maltreated adolescents with the short allele were more likely to abuse alcohol than those who did not carry the short allele. A later study also looking at adolescent maltreatment found that 5-HTTLPR conditions the effect of neglect on marijuana use for females only (Vaske, Newsome & Wright, 2012). In addition, a meta-analysis involving 17 studies found that the s allele is positively associated with alcohol dependence (Feinn et al., 2005).

Various studies have also explored the role of gender in the interactions between 5-HTTLPR and negative outcomes. Delving further, many of the studies involving the relationship between 5-HTTLPR and depression have found significant effects for females but not males (Aslund et al., 2009; Katsuyama et al., 2008; Eley et al., 2004). This association was further reinforced with the presence of stressful life events (Gressier, Calati, & Serretti, 2016). In

addition, research involving 5-HTTLPR and substance use have produced similar findings. In a sample of college students, the S allele was found to moderate the effect of past-year life stressors on the both drinking and heavy drinking, however; there was no moderating effect found among men (Kanzler et al., 2012). Similarly, a study by Vaske et al. (2012) also found that females experiencing neglect with the SS alleles were reported to have higher rates of marijuana use than females without the SS alleles, further strengthening the argument that the effects of 5-HTTLPR may vary by gender.

As shown, a multitude of research points to a link between S carriers of 5-HTTLPR, depression, antisocial behavior, and substance use when exposed to negative life events. Many of these adverse experiences, such as neglect or sexual abuse, are events in which the individual experiences the presence of negative stimuli in the form of victimization. In addition, biosocial inquiry has pointed to genetic factors that influence the sensitivity and response to certain negative pressures (Beaver, Barnes, and Boutwell, 2015; Simons et al., 2011). This brings into question whether the biological factor 5-HTTLPR will influence the sensitivity and response to the presence of a negative stressor such as dating violence victimization. More explicitly, an individual homozygous for the s-allele of 5-TTLPR may be more likely to experience depression in response to dating violence victimization and also engage in coping behaviors such as substance use.

Tying into GST, offering a biosocial perspective allows the analysis of a much more infrequently tested but central proposition in GST framework, that the strain, negative emotions, and crime relationship might be conditioned by other outside factors (Agnew 2006). Studies have examined Agnew's research on the various factors that may condition the relationship between



strain and delinquency or deviant behavior; however, most have been sociological in nature. Only a dearth of studies have acknowledged genetics as a potential conditioning factor in the study of GST (Agnew 2015; Connolly & Beaver, 2015; Watts 2015). Rather than solely looking at sociological variables, integrating genetics as a potential conditioning factor allows for more in-depth analysis into genes' roles in effecting both emotions and behavioral outcomes. Specifically, within a GST framework the current research will be able to analyze if persons with homozygous s-alleles of 5-TTLPR may be more likely than those who are not to experience depression and engage in deviant coping behaviors when experiencing the strain of dating violence victimization.

## **CHAPTER THREE: THE PRESENT STUDY**

The present study seeks to integrate both a general strain theory and biosocial framework to look at the effects of dating violence victimization on substance use outcomes, the mediating factor of negative emotionality, and the conditioning factor of genetic predisposition. The present study adds to the existing literature on dating violence victimization and theoretical criminological developments in significant ways. First, in terms of general strain theory, this research is the first to exclusively use dating violence victimization as a source of strain. Second, this study uses a dependent measure of alcohol and marijuana use, which will provide information on how and if specific types of substance use will be mediated by depressive symptoms. Third, there is a scarcity of studies that integrate both general strain and biosocial theory to explain deviant behavior (Watts 2015; Connolly & Beaver 2015). However, strain, negative emotionality and substance use are prominent in dating violence, general strain, and 5-HTTTPR literatures. Therefore, integrating both frameworks will ensure that neither sociological nor biological factors are overestimated, providing a more thorough and accurate depiction of the effect of dating violence victimization on subsequent substance use. Additionally, this study takes into account and further explores gender differences in dating violence victimization outcomes, as this a common theme that arises in both the GST and biosocial literature.

Based on the literature, this research makes five main hypotheses. The first hypothesis is that dating violence victimization will have a direct positive effect on depressive symptoms. The second hypothesis is that dating violence victimization will have a positive effect on alcohol and marijuana use. The third hypothesis is that 5-HTTPLR will moderate the effect of dating violence victimization on depressive symptomology in that those who are homozygous for the s-

allele will experience more depressive symptoms than those who are not homozygous for the s-allele. The fourth hypothesis is that 5-HTTLPR will moderate the effect of dating violence victimization on substance use in that those who are homozygous for the s-allele will have higher rates of substance use than those who are not homozygous for the s-allele. The final hypothesis is that depressive symptoms will significantly mediate the effect that the interaction between 5-HTTLPR and dating violence victimization has on both alcohol and marijuana use. It is expected that these results will vary by gender.

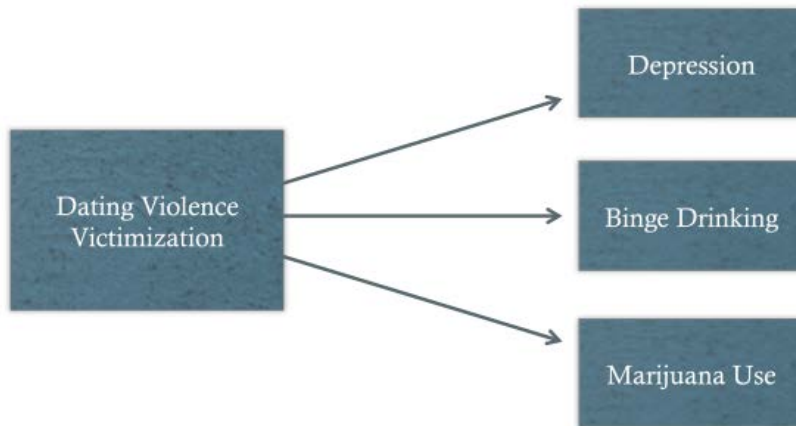


Figure 1: Hypothesis 1 & 2

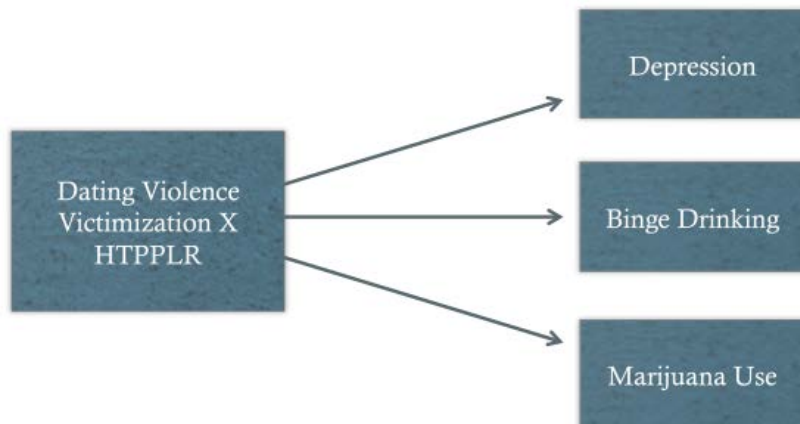


Figure 2: Hypothesis 3 & 4

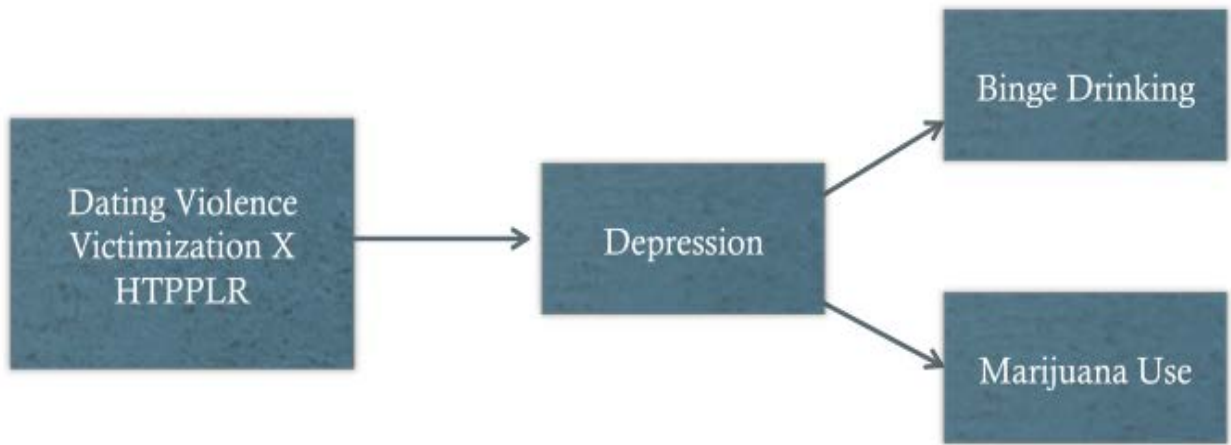


Figure 3: Hypothesis 5

## CHAPTER FOUR: METHODOLOGY

### Data

The data for the study is derived from the National Longitudinal Study Adolescent to Adult Health (Add Health). This project is funded by the National Institute of Child Health and Human Development, with co-funding from 23 other federal agencies and foundations. Add Health is a nationally representative and school-based longitudinal study of adolescents in grades 7-12 in the United States in 1994-95. The data collection is still ongoing and includes information from adolescents, their fellow students, school administrators, parents, siblings, friends, and romantic partners. This data collection involves a multi-survey, multi-wave interdisciplinary design and data is collected through multiple components, which includes four respondent in-home interviews (Harris et al., 2003). Furthermore, information about respondents' neighborhoods and communities including: income and poverty, unemployment, accessibility of health services, crime, church membership, and social programs and policies have also been incorporated and merged into Add Health data (Harris et al., 2003). The study also includes useful data for the current study involving experiences with dating violence, illicit drug use, alcohol use, information on negative emotionality, and genetic markers.

Data for the first Add Health Wave I were collected between 1994-1995 using both an in-school questionnaire and in-home interview of more than 90,000 students in grades 7-12. Information collected through the in-school questionnaire included such as but not limited to: social and demographic characteristics of adolescent respondents, education and occupation of parents, household structure, self-esteem, health status, risk behaviors, friendships, and school-year extracurricular activities. In-home interviews included topics such as health, peer networks,

family dynamics, employment experience, romantic and sexual partnerships, substance use, and criminal activities. A parent of the adolescent interviewed was also asked to complete a questionnaire (Harris et al., 2003).

Wave II of the Add Health data were collected in 1996 with close to 15,000 follow-up in-home interviews of adolescents originally interviewed in Wave I. These questions were similar to Wave I but also included more detail about nutrition and participants were also measured and weighed during the interview (Harris et al., 2003). Questions on both romantic and sexual relationships, including violence, were asked during Wave II home interviews.

Wave III data collection occurred from 2001-2002 using in-home interviews of over 15,000 participants from Wave I. At this time, these participants were now 18 to 26 years old and were asked questions designed to collect data about topics such as: relationships, family, sexual history, childbearing, mental illness, substance abuse, and delinquency. In addition, partners of participants were also interviewed.

The most recent Wave, Wave IV, involved data collection from 2008-2009 when respondents were 24-32 years of age. In-home interviews were conducted to obtain data on longitudinal geographic data, key life events, and detailed social, economic, psychological, and health information. Physical measurements (i.e. weight, height, waist circumference) and biomarkers (i.e. cardiovascular measures, diastolic blood pressure, pulse) were also collected. Among the data collected, Add Health took saliva swabs for DNA analysis, which provided genetic markers and genotypes of the respondents (Harris et al., 2003).

The present research utilizes Waves II, III, and Waves IV of the Add health data. Wave II is used to measure dating violence in adolescence while Wave III measures depressive symptoms

and substance use in young adulthood. The biological component is derived from Wave IV, requiring the use of the restricted version of the Add Health data and its corresponding sample. The longitudinal aspect of the study and detailed collection of both social and genetic factors is useful for testing out the predictions and further analysis of the present study. Add health also incorporates systematic sampling methods and implicit stratification into its design to ensure a representative sample of US schools. The sample in this study includes all respondents in Waves II, III, and IV who did not have any missing variable or genetic data. After accounting for these factors and appropriate weights, the analysis includes Add Health information from 8,799 participants, 3,963 males and 4,836 females.

### Variables

*Binge Drinking and Marijuana Use.* The main dependent variable consists of alcohol and marijuana use. To measure alcohol use in adolescents and young adults, a measure of binge drinking was created. The Substance Abuse and Mental Health Services Administration (SAMHSA) defines binge drinking as 5 or more alcoholic drinks for males or 4 or more alcoholic drinks for females on the same occasion on at least one day in the past month (<https://www.niaaa.nih.gov/alcohol-health/overview-alcohol-consumption/moderate-binge-drinking>). Taking into account this definition, the variable for binge drinking originated from two questions in Wave III: “During the past two weeks, how many times did you have five or more drinks on a single occasion, for example, in the same evening?” for males and “During the past two weeks, how many times did you have four or more drinks on a single occasion, for example, in the same evening?” for females. From this, a dichotomous measure of binge

drinking was created, where respondents were coded as non-binge drinkers or 0 if they responded “none”; otherwise, they were coded as 1, reflecting any binge drinking within the past two weeks. As binge drinking is common among young adults and adolescents, a measure of two weeks was used to capture more frequent binge drinking behaviors.

The string variable for marijuana use was derived from Wave III that asks, “During the past 30 days, how often did you use marijuana?” This was recoded into 0= those who have not used marijuana and 1= those who have used marijuana.

*Dating Violence Victimization.* The independent variable of adolescent dating violence victimization is measured at Wave II using items from the Conflict Tactics Scale. These questions measure psychological and physical abuse from a maximum of three sexual and three romantic partners (Straus et al., 1996). This analysis was limited to romantic partners. For each reported partnership, respondents were asked if the partner ever called them names, insulted them, or treated them disrespectfully in front of others (Item 1); swore at them (Item 2); threatened them with violence (Item 3); threw something at them that could hurt them (Item 4); or pushed or shoved them (Item 5). For the present analyses, a dichotomous variable was created indicating whether participants endorsed any of the particular victimization items in any of their romantic relationships (1= Yes, 0= No).

*Depressive Symptoms.* Depressive symptoms were measured using 9 items from the Center for Epidemiologic Studies–Depression (CES-D), administered during Wave III interviews. This



scale includes items that ask about feelings of loneliness, fear, sadness, fearfulness, and depression in the week before being interviewed, with responses ranging from 0 (never or rarely) to 3 (most of the time or all of the time). A scale was created using these items, with the appropriate questions reverse coded for consistency. Depressive symptoms were measured as a dichotomous variable, with respondents coded as 1 if they reported a score of 10 or higher and 0 otherwise. This cut-off point has been established by previous studies using the CES-D scale (Boardman and Alexander 2011; Fletcher 2009; Holway, Umberson, & Thomeer 2017).

*5-HTTLPR.* The genetic polymorphism was characterized from genomic DNA collected and isolated using the Oragene system (DNAgenotek, Kanata, Ontario, Canada) at Wave IV (2008–2009) in Add Health. The genetic variable was divided into two categories: those homozygous for the s-allele and those heterozygous for the s-allele; 0= No presence of s alleles, 1= presence of two s alleles. This is consistent with the literature that shows those homozygous for the s-allele are more susceptible to negative emotional responses and behaviors compared to those who are not (Scheid et al., 1997; Cicchetti, Rogosch, & Struge-Apple, 2007).

*Controls.* Several controls were included in the study that research links to delinquency and substance use. This includes age, race, gender, respondents' education level, and previous substance use and depression. Age was measures as a continuous variable in Wave III ranging from 18 to 28. Race was coded into a dichotomous variable with 0= white respondents and 1= non-white respondents. Respondent's education level derived from Wave III and is coded 1 = some college or more and 0= no college. Including "some college" is used to differentiate

between those who may be still be college or further along in higher education during the time of the interview and those who did not enter college. In terms of previous substance use and depression, these variables came from the same questions as the dependent variables in Wave III but derived from Wave II and identically coded.

### Analytic Strategy

First, descriptive statistics were calculated for the entire sample and then by gender. Chi-square tests and t-tests by were calculated to examine mean differences between variables by gender (Table 1). To examine the research hypothesis, a series of logistic regressions were run first with the entire sample and then separately for males and females. Logistic regression was chosen as the appropriate statistical method because of the dichotomous nature of both the dependent and mediating variables. In addition, regressions were run separately for males and females because, as discussed previously, the literature suggests that both males and females differ in their emotional responses to negative stimuli, which may also result in gender differences in crime (Broidy & Agnew, 1997). In addition, some studies have indicated that greater reactivity to life stress among individuals with the s-alleles regarding substance use might be limited to females (Covault et al., 2007; Grabe et al., 2005).

Logistic regressions in the first models were run to examine the direct effects of dating violence and controls on depressive symptoms, binge drinking, and marijuana use. The second model also examined the direct effect of dating violence on depressive symptoms, binge drinking, and marijuana use while also controlling for 5-HTTLPR. The third model analyzed the moderating effect of 5-HTTLPR on depressive symptoms, binge drinking, and marijuana use. In

addition, several logistic regressions were also run to examine the mediating effect of depressive symptoms on the GxE interaction models for both binge drinking and marijuana use (Model 4).

STATA 14.0 was used to estimate the models defined above (Version 14.0; StatsCorp LP, College Station, Texas). All logistic regression models provide odds ratios (OR) and 95% confidence intervals (95% CI) while controlling for covariates. In addition, to account for the complex Add Health survey design, appropriate weight, cluster, and strata variables were used in the analysis. Analyses were conducted using the SVYSET and SVY commands in STATA, which allowed STATA to consider survey design effects, including stratification and weight variables and the primary sampling unit, when estimating test statistics.

## CHAPTER FIVE: FINDINGS

Sample characteristics for the entire sample (n=8,799), separated by males (n=3,963) and females (4,836), and mean comparisons for the two groups are shown below in below in Table 1. Approximately 20% of the sample reported an experience of dating violence victimization, with 18% of males and 21% of females having experienced some form of dating violence. Additionally, 19% of the sample is homozygous for S allele with the approximately the same mean (.19) for both males and females in the sample. Males on average reported more binge drinking and marijuana use than did females. The mean for depressive symptoms is .113 for the entire sample, with females significantly more likely to report depressive symptoms in comparison to males. In addition, statistically significant differences by gender were found using chi-square tests and t-tests for past/present depressive symptoms, age, and education level.

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Table 1: Descriptive Statistics- Entire Sample & Separated by Gender

Variables	Total Sample (n=8,799)	Males (n=3,963)	Females (n= 4,836)	$\chi^2$ //Ttest	
Range	M (SE)	M (SE)	M (SE)		
<b>Dependent Variables</b>					
Marijuana use	0/1 (1- Yes)	.242 (.01)	.284 (.012)	.200 (.010)	53.69***
Binge drinking	0/1 (1- Yes)	.357 (.01)	.450 (.013)	.265 (.011)	245.4***
<b>Independent Variables</b>					
Dating Violence	0/1 (1- Yes)	.196 (.01)	.184 (.011)	.208 (.010)	3.74
5-HTTLPR genotype	0/1 (1- short/short)	.192 (.01)	.194 (.009)	.190 (.008)	.027
<b>Mediating Variable</b>					
Depressive Symptoms	0/1 (1- Yes)	.113 (.00)	.083 (.005)	.143 (.007)	51.20***
<b>Control Variables</b>					
Gender	0/1 (1- male)	.498 (.01)			
Race	0/1 (1- white)	.217 (.02)	.215 (.023)	.219 (.025)	.001
Education Level	0/1 (college or more-1)	.521 (.02)	.487 (.021)	.554 (.020)	29.14***
Age W3	18-28	21.4 (.11)	21.5 (.117)	21.3 (.116)	6.849***
Past depression	0/1 (1- Yes)	.172 (.01)	.118 (.007)	.226 (.009)	113.8***
Past marijuana use	0/1 (1- Yes)	.173 (.01)	.180 (.010)	.165 (.010)	1.22
Past alcohol use	0/1 (1- Yes)	.456 (.01)	.451 (.017)	.461 (.014)	.526

\*Note: because statistics are weighted and adjusted for survey design, standard errors are produced rather than standard deviations. W3= wave three. Education level includes 0 for those who did not/have not yet entered college and 1 for those who are in college or further in higher education.

\*Final column shows test statistic from  $\chi^2$  between categorical variables and gender- \*p<.05. \*\*p<.01 \*\*\*p<.001

Findings for the logistic regressions examining the effect of dating violence, 5-HTTLPR and controls on depressive symptoms are shown in Table 2 and Table 3. For the entire sample (Table 2), dating violence victimization does not have a significant effect on depressive symptoms, as shown in Model 1. When controlling for 5-HTTLPR in Model 2, findings indicate that those with two s alleles are at an increased odds for reporting depressive symptoms (OR, Odds Ratio=1.31). Respondents with two short alleles have 31% greater odds of reporting depressive symptoms. Model 3 shows that 5-HTTLPR does not have a moderating effect on the relationship between dating violence victimization on depressive symptoms.

Differences between males and females are found in Table 3, where the regressions examining the effect of dating violence victimization, 5-HTTLPR and controls on depressive symptoms were separated by gender. Results show dating violence victimization is not positively associated with depressive symptoms for neither males nor females in Model 1 or when controlling for 5-HTTLPR in Model 2. This goes against the hypothesis and Agnew's General Strain Theory that victimization strain is associated with negative affect and that negative affect mediates the relationship between strain and substance use. No significant interaction emerges between 5-HTTLPR and dating violence on depressive symptoms in Model 3. Interestingly, results find that males with two s/s alleles are at an increased risk of experiencing depressive symptoms when controlling for 5-HTTLPR in Model 2 (OR=1.55) and when examining the gene-environment interaction in Model 3 (OR=1.76). The same result is not found for females.

Table 2: Depressive Symptoms Regressed on Dating Violence Victimization, 5-HTTLPR, & Controls

	<b>Model 1</b>	<b>Model 2</b>	<b>Model 3</b>
	OR (95% CI)	OR (95% CI)	OR (95% CI)
<b>Variables</b>			
DV Victimization (1=Yes)	1.23 (.960, 1.57)	1.24 (.959, 1.61)	1.35* (1.01, 1.81)
5-HTTLPR (1 = s/s)		1.31* (1.04, 1.67)	1.45* (1.09, 1.92)
Two-way interaction DV Victimization x 5-HTTLPR			.655 (.351, 1.22)
Gender (1=Male)	.638*** (.540, .753)	.624*** (.526, .739)	.624*** (.526, .739)
Race (1= White)	1.41** (1.12, 1.79)	1.39 ** (1.15, 1.74)	1.38** (1.11, 1.73)
Age	.962 (.911, 1.02)	.957 (.907, 1.01)	.957 (.907, 1.01)
Education Level (1=College)	.561 *** (.477, .661)	.560*** (.472, .665)	.557*** (.470, .660)
Past Depression (1=Yes)	3.66 *** (3.05, 4.39)	3.66*** (3.05, 4.41)	3.65*** (3.04, 4.39)

\*\*Note: This table includes odds ratios (95% confidence intervals) from logistic model. \*p<.05. \*\*p<.01 \*\*\*p<.001

Table 3: Depressive Symptoms Regressed on Dating Violence Victimization, 5-HTTLPR, & Controls Stratified by Gender

Variables	Model 1		Model 2		Model 3	
	Males	Females	Males	Females	Males	Females
	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)
DV Victimization (1=Yes)	1.17 (.814, 1.68)	1.27 (.938, 1.73)	1.26 (.865, 1.82)	1.23 (.900, 1.68)	1.43 (.939, 2.19)	1.30 (.911, 1.87)
5-HTTLPR (1 = s/s)			1.55* (1.08, 2.23)	1.18 (.894, 1.57)	1.76** (1.16, 2.67)	1.27 (.914, 1.76)
Two-way interaction DV Victimization x 5-HTTLPR					.541 (.189, 1.56)	.739 (.28) (.352, 1.55)
Race (1=Non-white)	1.38 (.967, 1.98)	1.43** (1.12, 1.85)	1.41 (.992, 2.00)	1.38* (1.08, 1.78)	1.38 (.970, 1.95)	1.38* (1.08, 1.78)
Age	.978 (.907, 1.05)	.950 (.885, 1.02)	.978 (.907, 1.06)	.941 (.877, 1.01)	.979 (.907, 1.06)	.940 (.876, 1.01)
Education Level (1=College)	.545*** (.405, .734)	.569*** (.466, .694)	.554*** (.409, .751)	.564*** (.459, .694)	.547*** (.404, .741)	.562 *** (.458, .691)
Past Depression (1=Yes)	4.06*** (2.93, 5.63)	3.45*** (2.82, 4.22)	4.02*** (2.87, 5.62)	3.50*** (2.84, 4.30)	4.02*** (2.87, 5.64)	3.48 *** (2.83, 4.28)

\*Note: This table includes odds ratios (95% confidence intervals) from logistic model. \*p<.05. \*\*p<.01 \*\*\*p<.001



Findings for the logistic regressions examining the effect of dating violence, 5-HTTLPR and controls on binge drinking are shown in Table 4 and Table 5. Table 4 examined these effects using the entire sample. These results indicate that dating violence victimization is significantly related to binge drinking for the entire sample, in Model 1 (OR=1.25), and is also significant when controlling for 5-HTTLPR in Model 2 (OR=1.29). No moderating effect is found in Model 3 and depressive symptoms are not significant when looking at the effect of depressive symptoms on the GxE interaction in Model 4. However, having two s/s alleles decreases the odds of binge drinking among the sample in Model 2, which controlled for 5-HTTLPR (OR=.806), in Model 3, which examined the interaction term (OR=.710), and Model 4, which included a measure for depressive symptoms in the GxE model (OR=.796).

Differences between males and females can be found in Table 5, where the regressions examining the effect of dating violence victimization, 5-HTTLPR and controls on binge drinking were separated by gender. The results show that dating violence victimization increases the odds of binge drinking for males but not females, as shown in Model 1. When controlling for 5-HTTLPR in Model 2, results show that both dating violence victimization and having two s/s alleles are significant for males but not females. Similar to the results for the entire sample, having two s/s alleles decreases the odds of binge drinking among males in Models 2,3 and 4. 5-HTTLPR does not moderate the effect of dating violence victimization on binge drinking (Model 3). In addition, no relationship between depressive symptoms and binge drinking is found for males or females.

Table 4: Binge Drinking Regressed on Dating Violence Victimization, 5-HTTLPR, & Controls

	<b>Model 1</b>	<b>Model 2</b>	<b>Model 3</b>	<b>Model 4</b>
	<b>OR</b>	<b>OR</b>	<b>OR</b>	<b>OR</b>
<b>Variables</b>	<b>(95% CI)</b>	<b>(95% CI)</b>	<b>(95% CI)</b>	<b>(95% CI)</b>
DV Victimization (1=Yes)	1.25** (1.08, 1.45)	1.29** (1.11, 1.50)	1.28** (1.07, 1.52)	1.28** (1.06, 1.51)
5-HTTLPR (1 = s/s)		.806** (.690, .942)	.710* (.667, .960)	.796* (.665, .953)
Two-way interaction DV Victimization x 5-HTTLPR			1.04 (.707, 1.53)	1.04 (.712, 1.53)
Depressive Symptoms (1=Yes)				1.16 (.965, 1.40)
Gender (1=Male)	2.59*** (2.32, 2.89)	2.55*** (2.28, 2.84)	2.55*** (2.28, 2.84)	2.56*** (2.29, 2.85)
Race (1=Non-white)	.414*** (.346, .496)	.412*** (.344, .494)	.413*** (.343, .495)	.408*** (.340, .490)
Age	.905*** (.867, .945)	.908*** (.868, .949)	.908*** (.868, .949)	.909*** (.869, .951)
Education Level (1=College)	1.35*** (1.19, 1.53)	1.35*** (1.19, 1.52)	1.35*** (1.19, 1.52)	1.35*** (1.20, 1.53)
Past Alcohol Use (1=Yes)	2.34*** (2.04, 2.68)	2.29*** (2.00, 2.62)	2.29*** (2.00, 2.62)	2.28*** (2.00, 2.61)
<b>**Note: This table includes odds ratios (95% confidence intervals) from logistic model. *p&lt;.05. **p&lt;.01 ***p&lt;.001</b>				

Table 5: Binge Drinking Regressed on Dating Violence Victimization, 5-HTTLPR, & Controls Stratified by Gender

	Model 1		Model 2		Model 3		Model 4	
	Males	Females	Males	Females	Males	Females	Males	Females
	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)
<b>Variables</b>								
DV Victimization	1.47** (1.16, 1.85)	1.04 (.853, 1.27)	1.51** (1.19, 1.93)	1.08 (.879, 1.32)	1.59** (1.23, 2.06)	1.01 (.785, 1.30)	1.57** (1.22, 2.04)	1.00 (.775, 1.29)
5-HTTLPR (1 = s/s)			.798* (.651, .979)	.812 (.641, 1.03)	.836 (.662, 1.05)	.751* (.557, .995)	.836 (.663, 1.05)	.742* (.560, .983)
DV Victimization x 5-HTTLPR					.779 (.461, 1.32)	1.43 (.796, 2.56)	.780 (.464, 1.31)	1.44 (.801, 2.59)
Depression							1.19 (.870, 1.62)	1.16 (.940, 1.42)
Race (1=White)	.444*** (.356, .554)	.360*** (.268, .482)	.445*** (.356, .556)	.355 *** (.263, .487)	.442*** (.353, .554)	.355 *** (.263, .479)	.437*** (.350, .548)	.350*** (.259, .471)
Age	.907** (.857, .959)	.907*** (.857, .948)	.910** (.856, .967)	.905*** (.861, .951)	.910** (.857, .967)	.905*** (.861, .951)	.911** (.857, .968)	.906*** (.862, .953)
Education Level	1.33** (1.12, 1.57)	1.37** (1.15, 1.64)	.133** (1.12, 1.57)	1.38*** (1.16, 1.64)	1.32** (1.17, 1.57)	1.38*** (1.16, 1.65)	1.32** (1.11, 1.57)	1.40*** (1.18, 1.67)
Past Alcohol Use	2.31*** (1.89, 2.82)	2.38*** (2.01, 2.83)	2.25*** (1.84, 2.75)	2.34*** (1.96, 2.79)	2.25*** (1.84, 2.75)	2.35*** (1.97, 2.80)	2.25*** (1.85, 2.75)	2.34*** (1.96, 2.79)
**Note: This table includes odds ratios (95% confidence intervals) from logistic model. *p<.05. **p<.01 ***p<.001								

Findings for the logistic regressions examining the effect of dating violence, 5-HTTLPR and controls on marijuana use are shown in Table 6 and Table 7. Table 6 examined these effects using the entire sample. Results in Model 1 show that dating violence victimization is significantly related to higher odds of marijuana use (OR=1.50). Results in Model 3 also show no moderating effect between 5-HTTLPR and DV victimization on marijuana use. However, results in Model 4 show that depressive symptoms increase the odds of reporting marijuana use (OR=1.44).

Table 7 displays differences between males and females, where regressions examining the effect of dating violence victimization, 5-HTTLPR and controls on marijuana use were separated by gender. Model 1 and Model 2 show that dating violence is significantly associated with higher odds of marijuana use for both males and females. Predicted probabilities of reporting marijuana use by dating violence victimization and gender are shown in Figure 5. Adjusting for all factors in the model, it is expected that 36% of males and 24% of females who have experienced dating violence to report marijuana use. This is compared to 27% of males and 19% of females reporting marijuana use among those who have not experienced dating violence. Results in Model 3 show that 5-HTTLPR moderates the effect of dating violence victimization on marijuana use for females only; females who experience dating violence victimization and are homozygous for the s-allele experience over 2 times greater odds of reporting marijuana use (OR=2.02). Predicted probabilities for Model 2 looking at this GxE interaction effect are shown in Figure 4. Adjusting for all factors in the model, it is expected that 32% who have experienced dating violence and also have the s/s combination of alleles will use marijuana compared to 22% who have experienced dating violence and have another combination of alleles. Finally, Model 4,

which includes an independent measure of depression on marijuana use in the GxE model, shows that depressive symptoms are significantly associated with marijuana use for both males and females. Predicted probabilities of reporting marijuana use by those reporting depression and separated by gender are shown in Figure 5. Controlling for all factors in the model, we expect 37% of males with depression and 24% of female with depression to report marijuana use. We expect 27% of males and 19% of females with no depression to report marijuana use. This shows a notable gap between males and females in the depressed group.

Table 6: Marijuana Use Regressed on Dating Violence Victimization, 5-HTTLPR, & Controls

	<b>Model 1</b>	<b>Model 2</b>	<b>Model 3</b>	<b>Model 4</b>
	<b>OR</b> (95% CI)	<b>OR</b> (95% CI)	<b>OR</b> (95% CI)	<b>OR</b> (95% CI)
<b>Variables</b>				
DV Victimization (1=Yes)	1.50*** (1.28, 1.74)	1.51*** (1.30, 1.77)	1.45*** (1.20, 1.74)	1.42*** (1.18, 1.70)
5-HTTLPR (1 = s/s)		.903 (.758, 1.07)	.854 (.697, 1.05)	.842 (.684, 1.04)
DV Victimization x 5-HTTLPR			1.28 (.856, 1.91)	1.30 (.868, 1.96)
Depressive Symptoms (1=Yes)				1.44** (1.16, 1.78)
Gender (1=Male)	1.74*** (1.16, 1.99)	1.69*** (1.46, 1.94)	1.69*** (1.46, 1.94)	1.74*** (1.51, 2.00)
Race (1= Non-white)	.686*** (.571, .824)	.683*** (.566, .824)	.686*** (.569, .827)	.675*** (.560, .815)
Age	.852*** (.810, .896)	.853*** (.811, .898)	.853*** (.810, .898)	.853*** (.811, .898)
Education Level (1=College)	1.06 (.915, 1.24)	1.04 (.894, 1.21)	1.04 (.895, 1.21)	1.08 (.925, 1.26)
Past Marijuana Use (1=Yes)	3.94*** (3.30, 4.71)	3.90*** (3.24, 4.68)	3.90*** (3.25, 4.69)	3.9*** (3.22, 4.64)
<b>**Note: This table includes odds ratios (95% confidence intervals) from logistic model. *p&lt;.05. **p&lt;.01 ***p&lt;.001</b>				

Table 7: Marijuana Use Regressed on Dating Violence Victimization, 5-HTTLPR, & Controls Stratified by Gender

	Model 1		Model 2		Model 3		Model 4	
	Males	Females	Males	Females	Males	Females	Males	Females
	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)
<b>Variables</b>								
DV Victimization	1.60*** (1.30, 1.96)	1.37* (1.07, 1.75)	1.63*** (1.31, 2.03)	1.39** (1.09, 1.76)	1.69*** (1.33, 2.15)	1.21 (.915, 1.60)	1.64*** (1.30, 2.09)	1.97 (.909, 1.58)
5-HTTLPR (1 = s/s)			.801 (.623, 1.03)	1.04 (.821, 1.31)	.837 (.636, 1.10)	.871 (.641, 1.18)	.818 (.616, 1.09)	.863 (.635, 1.17)
DV Victimization x 5-HTTLPR					.811 (.454, 1.45)	2.02* (1.13, 3.61)	.837 (.471, 1.49)	2.03* (1.13, 2.66)
Depression							1.60* (1.08, 2.36)	1.33* (1.03, 1.72)
Race (1=White)	.753* (.588, .963)	.598*** (.452, .792)	.759* (.592, .972)	.584*** (.435, .687)	.754* (.589, .967)	.585** (.434, .789)	.745* (.579, .958)	.575*** (.428, .772)
Age	.867*** (.811, .925)	.833*** (.784, .887)	.871*** (.814, .932)	.831*** (.779, .885)	.872*** (.815, .932)	.831*** (.780, .886)	.871*** (.814, .932)	.832*** (.780, .886)
Education Level	1.07 (.884, 1.31)	1.06 (.865, 1.30)	1.04 (.853, 1.27)	1.04 (.853, 1.28)	1.04 (.851, .126)	1.04 (.857, 1.28)	1.07 (.876, 1.31)	1.08 (.892, 1.32)
Past Marijuana Use	3.74*** (2.95, 4.73)	4.16*** (3.28, 5.26)	3.71*** (2.92, 4.71)	4.08*** (3.21, 5.17)	3.71*** (2.92, 4.70)	4.10*** (3.22, 5.23)	3.67*** (2.89, 4.66)	4.07*** (3.19, 5.17)
**Note: This table includes odds ratios (95% confidence intervals) from logistic model. *p<.05. **p<.01 ***p<.001								

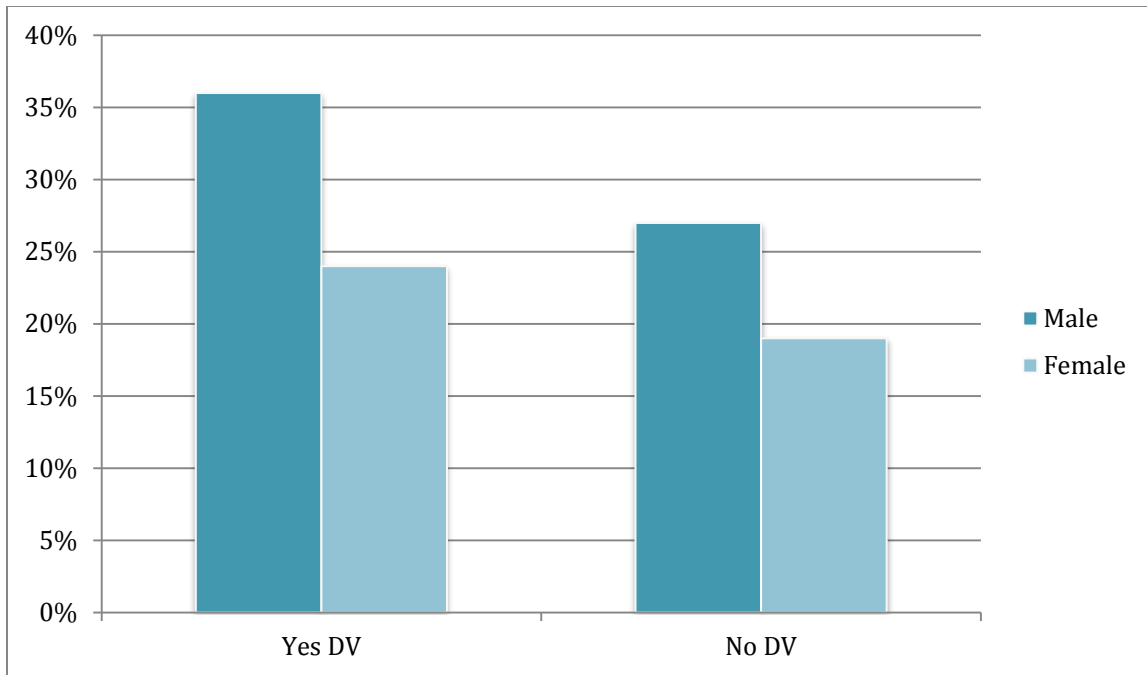


Figure 4: Predicted Probability of Reporting Marijuana Use (yes) by Dating Violence (DV) Victimization and Gender

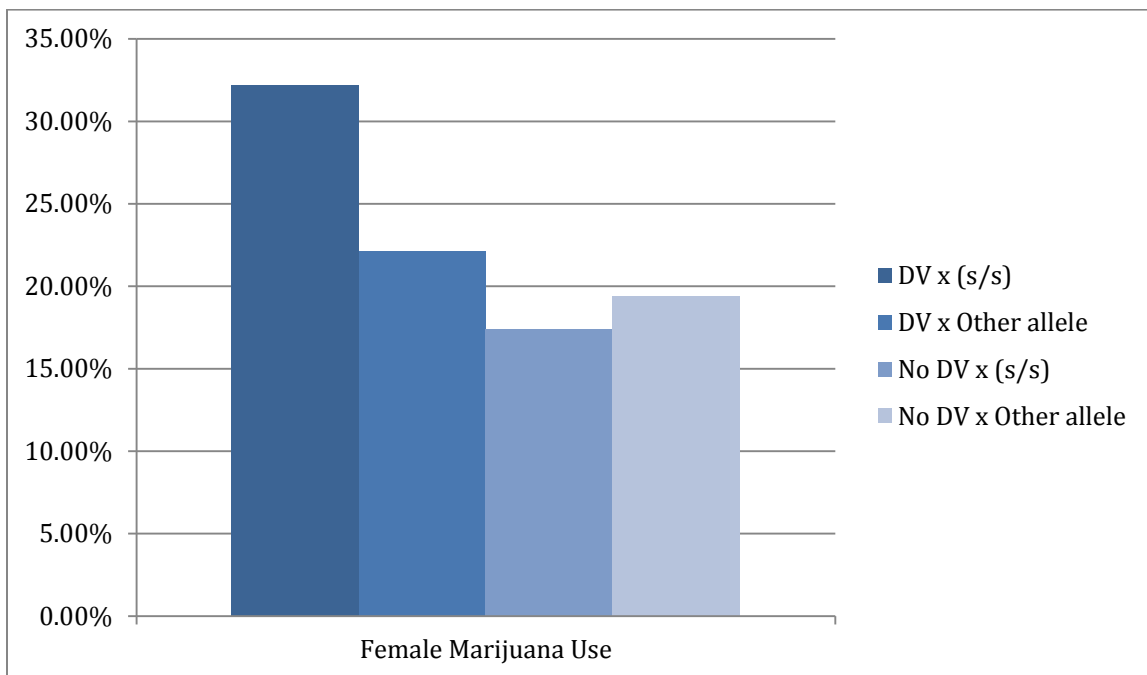


Figure 5: Predicted Probability of Reporting Marijuana use (yes) for Interaction Term- Dating Violence (DV) Victimization x 5-HTTLPR Allele Combinations - Females only



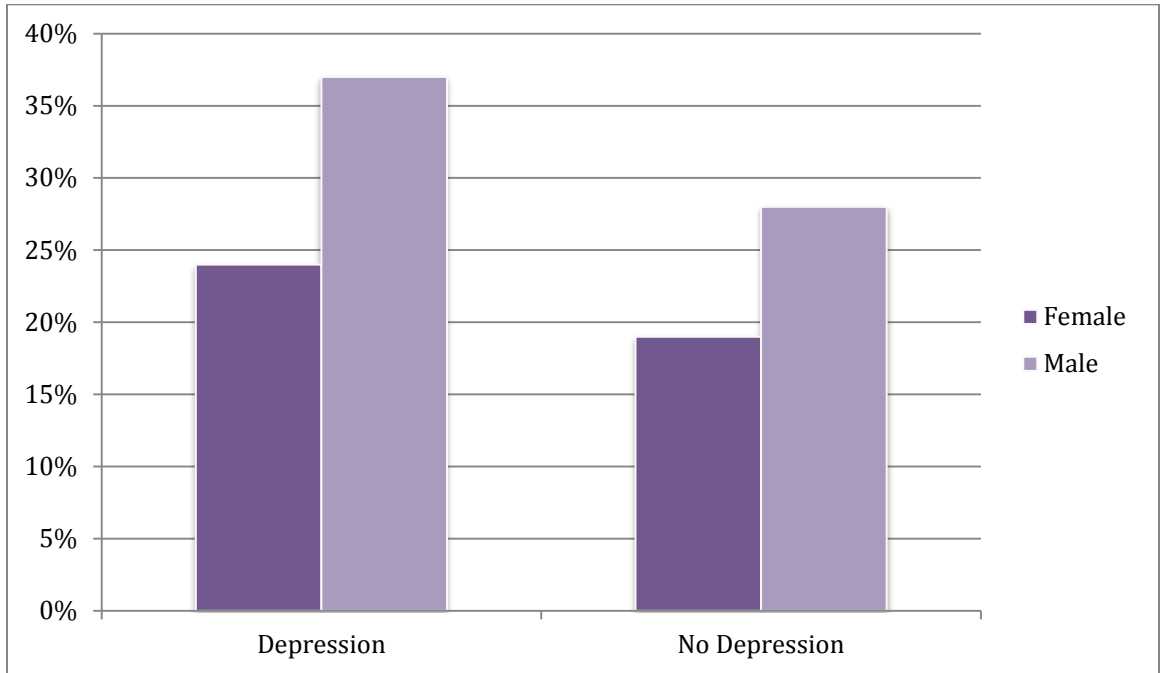


Figure 6: Predicted Probability of Reporting Marijuana Use by Depressive Symptoms and Gender

## CHAPTER SIX: CONCLUSION

As previously stated, dating violence and the associated negative outcomes of victimization are widespread issues that have been studied in great depth. However, much of the vast literature on dating violence victimization and subsequent negative outcomes has 1) been largely atheoretical and 2) ignored the potential effects of genetic predisposition. The present study augments the current literature through the testing of an integrated theoretical model to explain findings concerning 5-HTTLPR, life stressors such as dating violence victimization, negative emotions, and substance use behaviors. More specifically, taking main components from both GST and the GxE, this study sought to examine whether dating violence victimization has direct effects on depressive symptoms and substance use, whether these effects are moderated by 5-HTTLPR genotype, whether depressive symptoms mediate these gene-environment effects on both binge drinking and marijuana use, and whether these effects vary by gender.

Overall, the results show that dating violence victimization does not have direct effects on depressive symptoms, not lending support for the first hypothesis. Dating violence victimization does have a direct effect on binge drinking (males only) and marijuana use (males and females), partially supporting hypothesis 2. The 5-HTTLPR genotype moderates the effect of dating violence victimization and marijuana use (females only), partially supporting hypothesis 4. In addition, depressive symptoms do not significantly mediate the effect that the interaction between 5-HTTLPR and dating violence victimization has on both alcohol and marijuana use; however, depressive symptoms independently have positive effects on marijuana

use. As expected, differences arise when looking at outcomes of both males and females separately, although rates of dating violence does not significantly vary by gender.

The results from the analysis reveal various noteworthy findings that call for discussion in greater depth. First, results of the logistic regressions show that dating violence in adolescence is not significantly related to depressive symptoms in young adulthood. This is contrary to the first hypothesis, previous literature, and GST's notion that strains lead to negative affect. This finding also does not support the GST argument of a strain-negative affect-crime relationship in which negative affect mediates the relationship between strain and substance use. Although this opposes various studies reporting links between dating violence victimization and depression, many of these studies have been cross-sectional in nature (Ackard et al 2003; Banyard & Cross 2008; Callahan, Tolman & Saunders 2003; Roberts & Klein 2003) or have short follow-up periods (Roberts, Klein, & Fisher 2003). Having a five-year gap between the time dating violence victimization and depressive symptoms were reported could be a factor in explaining these non-significant results. The s/s allele combination in 5-HTTLPR is also associated with depressive symptoms in this study. As 5-HTTLPR is linked with serotonin regulation and scientific evidence shows that s/s alleles specifically are related to increased amygdala responses (Hariri et al. 2005; Heinz et al. 2005; Munafò, Brown & Harri 2008), it is not uncommon for this combination of alleles to be associated with traits such as anxiety, depression, stress sensitivity, and worrying (Munafò, Clark, & Flint 2005; Oo, Aung, Jenkins, & Win 2016; Sen, Burmeister, & Ghosh 2004). However, the results call for further investigation into why having two short alleles is related to depressive symptoms only among males in this sample.

In addition, dating violence victimization leads to higher odds of binge drinking among males but not females in the sample, supporting the hypothesis that the strain of dating violence victimization leads to binge drinking, although for males only. In general, research shows that women consume less alcohol and also have less alcohol-related problems in comparison to men (Nolen-Hoeksema & Hilt 2006; Nolen-Hoeksema 2004; SAMHSA, 2005; World Health Organization 2011). Findings from the current research show similar trends, with men reporting higher binge drinking behaviors than women in both adolescence and young adulthood. This also recounts back to the idea that males and females have different coping styles when it comes to dealing with strain (Brody & Agnew 1997). One theory related to heavy drinking involves a coping style referred to as avoidant coping; this involves avoiding one's stresses and negative emotions. Studies have shown that when compared to women, men are more likely to engage in avoidant coping (Cooper et al. 1992) and that this coping style is more strongly associated to alcohol consumption in men than in women (Cooper et al. 1992; Frone et al 1993). In addition, studies have shown that when comparing males and females, men have been more likely to report drinking to cope with distress and have the expectation that alcohol will reduce tension (Nolen-Hoeksema & Harrell 2002; Park & Levenson 2002).

Intriguingly, the s/s allele was associated with lower odds of binge drinking among the sample. These results are similar to one of the only other studies looking longitudinally at 5-HTTLPR and binge drinking behaviors specifically. In a large gender-balanced study of adolescent drinking and 5-HTTLPR, Olsson et al. (2005) found that securely attached young people carrying the S –allele reduced the odds of binge drinking. More recently, the association between 5-HTTLPR and drinking has become less clear, with some studies finding that the L

allele is more positively associated to alcohol use (Laucht et al 2009) and higher coping motivations to drink (Aremeli et al. 2008). This merits further investigation into which allele combination contributes to increased alcohol use as well as motivations for use.

One of the main findings reveal a significant gene-environment interaction among females, where female young adults who are victims of dating violence are more likely to report marijuana use if they are homozygous for the s-allele of 5-HTTLPR versus another allele combination. This supports the current literatures suggesting 5-HTTLPR moderates the effect of life stressors on negative outcomes, and that greater reactivity to life stress among individuals with the s-alleles regarding substance use might be limited to females (Covault et al., 2007; Grabe et al., 2005; Kanzler et al., 2012; Vaske et al. 2012). This also supports the third hypothesis, which predicted that 5-HTTLPR would moderate the effect of dating violence victimization on substance use. However, this hypothesis is only supported in regards to females and marijuana use. Although dating violence victimization is not related to depressive symptoms in this analysis, the gene-environment interaction among females is slightly and partially effected by depressive symptoms and depressive symptoms are positively associated with marijuana use. Although there is no significant gene-environment interaction among males, dating violence victimization and depressive symptoms both increase the likelihood of marijuana use. This is notable, as it supports the vast literature that links both dating violence victimization (Ackard et al 2007; Eaton et al 2008; Exner-Cortens et al 2013; Foshee et al 2013) and depression (Hooshmand, Willoughby, & Good, 2012; Repetto, Zimmerman, & Caldwell, 2008; Wilkinson et al 2016) to marijuana use outcomes. As marijuana policies continue to modify, it will be interesting to see if and how this relationship will change, as adolescents and emerging adults

have the highest rates of marijuana use (Johnston, O'Malley, Bachman, Schulenberg, Miech, 2014).

While this study makes significant contributions to dating violence, GST, and GxE literatures, there are a few limitations that should be noted. Although looking at dating violence victimization and negative outcomes used longitudinal data, the effects of depressive symptoms on marijuana use and binge drinking are cross-sectional. This makes it difficult to determine a temporal relationship between depressive symptoms and substance use behaviors. Also, although this research looks at dating violence victimization, it does not specify between different types of dating violence (i.e. psychological, physical, verbal, emotional). If looked at individually, each could have independent and different effects on depressive symptoms and substance use. For example, when looking at the longitudinal associations between teen dating violence victimization and adverse health outcomes using Add Health, Exner-Cortens, Eckenrode & Rothman (2012) found that those reporting psychological victimization only did not experience subsequent depression; however, when looking at respondents who reported both physical and psychological victimization, depression was significantly related to victimization. The main focus of this research examined dating violence victimization, so future studies looking to support the larger biosocial GST model should test more strains and also look at other genes that have been linked to substance use and anti-social behavior (i.e. MAOA, DAT1) in order to make a more definitive conclusion.

In summation, this research shows that 1) dating violence victimization is significantly related to binge drinking among males, 2) both depressive symptoms and dating violence victimization are significantly related to marijuana use among both males and females, and 3)

dating violence victimization interacts with 5-HTTLPR genotype to increase the risk for marijuana use among females. Although the study found direct effects of strain and depression on particular substance use behaviors, as well as a GxE interaction effect, the overall integrated GST and biosocial framework in which negative affect mediates the GxE relationship is not supported in this study. The study was able to use a large and representative sample to look at these effects. Another strength of this research is the longitudinal data used when examining dating violence victimization and subsequent negative outcomes. This is beneficial as it allowed the analysis of change over time while also controlling for past behaviors. These findings support the utility of GST as a partial explanation for previous findings in regards to substance use outcomes as a result of dating violence victimization. Furthermore, results offer provisional support for a biosocial GST model and grant further research into this theoretical topic. This analysis also highlights the importance of looking at the outcomes of victimization for both males and females separately, as strains in this analysis resulted in different outcomes for both males and females. The same can be stated of examining different substance using behaviors separately as well as opposed to one single indicator of substance use; the results show that dating violence victimization has distinctive effects on binge drinking and marijuana use.

There are various avenues for future research regarding an integrated GST and biosocial model to look at negative outcomes of life stressors. As discussed in brief previously, looking at the different types of dating violence separately can derive more information into this particular topic. Additionally, this research only looked at one type of stressful life event and one type of genetic variation, so delving into other types of stressors, gene-environment interactions, and negative outcomes through this theoretical framework would contribute greatly to the existing

literature. One question that comes to mind is why certain gene-environment interactions are activated for females and not for males. Although these differences have been noted in previous studies, there are still obscurities in genetics research as to why this occurs. One theory is that these differences might be due to different effects of the 5-HTT on brain development between males and females (Gressier, Calati, & Serretti 2016). Continuing research in combining mainstream criminological theory with biosocial approaches and genetic research can provide much understanding into how the environment and genes work reciprocally together to influence human behavior.



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