The Development of Impulsivity and Sensation Seeking: Sources of Between- and Within-Individual Differences Over Time and Across Sex

by

Kara Valentina Hannula

A Dissertation Presented in Partial Fulfillment
of the Requirements for the Degree
Doctor of Philosophy

Approved April 2019 by the
Graduate Supervisory Committee:

Gary Sweeten, Chair
Scott Decker
Adam Fine

ARIZONA STATE UNIVERSITY

May 2019

ABSTRACT

Criminological theories have long incorporated personality traits as key explanatory factors and have generally relied on assumptions of trait stability. However, growing evidence from a variety of fields including criminology, psychology, and neurobiology is demonstrating that personality traits are malleable over the life-course, and substantial individual variation exists in the developmental patterns of personality traits over time. This research is forcing criminologists to consider how and why "enduring" individual characteristics may change over the life course in ways that are meaningfully related to offending. Two traits that have been consistently linked to offending and conflated in key criminological theories (i.e. Gottfredson and Hirschi's (1990) self-control theory), impulsivity and sensation seeking, have recently been shown to be independent personality traits with different normative maturational timetables and biological underpinnings. This dissertation extends this work by examining developmental patterns of impulsivity and sensation seeking and social sources of variation in these traits with the Family and Community Health Survey, a longitudinal data set that consists of approximately 900 African American youth and their families followed from late childhood to their late-twenties. Multiple longitudinal modeling methods are employed (hierarchical linear modeling and group-based trajectory modeling) to address this research agenda. Results from this dissertation lead to four broad conclusions. First, and in support of existing research, there is substantial variability in developmental trajectories of impulsivity and sensation seeking. Average developmental trajectories of these traits greatly mask the degree of individual variability in developmental patterns that exists. Second, social factors are significantly associated with levels of impulsivity and sensation seeking. Socio-environmental experiences characterized by hostility and unsupportiveness are generally associated with elevated

levels of impulsivity and sensation seeking while socio-environmental experiences characterized by warmth and supportiveness are associated with lower levels of impulsivity and sensation seeking. Third, sex differences in developmental patterns of impulsivity are nonexistent while sex differences in developmental patterns of sensation seeking are significant. Finally, with few exceptions, predictors of trait levels operate in a general fashion such the same factors typically explain both male and female trait levels and produce similar effects on impulsivity and sensation seeking.

ACKNOWLEDGMENTS

In many ways, I'm still in awe that this research project is nearing completion. While the research and writing aspects of this project were at times difficult, the real challenge of the dissertation process was emotional in nature when I struggled to maintain confidence in my abilities, and even desire, to complete such a massive endeavor. I am thankful I never gave up, and I owe that to the support I received from an incredible group of people.

Most importantly, I would like to thank my committee for their support, guidance, and flexibility. In particular, thank you to Dr. Gary Sweeten for patiently waiting for me to "come back" to the program, letting me attempt the near-impossible by completing the dissertation on an incredibly tight timeline, and always being available to answer my questions. Thank you to Dr. Scott Decker for always being an incredible source of support; your confidence in me helped me maintain confidence in myself. Thank you to Dr. Adam Fine for your willingness to jump on my committee at the last minute and providing thoughtful, challenging, and helpful feedback. The time you all invested in me is immensely appreciated. Each of you has taught me important lessons about how to interact with my students that I will carry with me for years to come.

I would not have completed my degree without my incredible social support network, primarily consisting of Callie Burt, Anne Tseng, and Arynn Infante, among other ASU graduate students (Kyle Ernest, Chantal Fahmy, Megan Parry, Kimberly Kaiser, and Kate Ginsburg Kempany) and non-academic friends (especially Derek House for financially motivating me). Callie, thank you for constantly reminding me to give myself the self-care I need and to proceed as if success is inevitable. Also, thank you for putting up with my decision to throw myself into my dissertation for several months which led to long nights at the office and a total neglect of our personal lives. Arynn, your

support has been invaluable. Our daily communication has kept me from falling into bouts of serious self-doubt and has kept me focused on just getting it done. Your emotional support and logistical aid (constantly being my chauffeur and dining budding) during my visits to Phoenix made the entire dissertation process so much more manageable. And, as we all know, misery loves company, so it was great to have someone in my life who genuinely understood my struggles. Anne, I'm not sure I would have completed my dissertation without our writing sessions—as you know, our first writing session was a major turning point for me. The social support and social control you provided by writing by my side was more influential in my completion of this project than you could possibly imagine.

Although perhaps odd, I would probably regret failing to acknowledge the individuals/things that helped maintain my motivation throughout this process. The people who will most likely never know how much they helped me in the process include Karen Kilgariff and Georgia Hardstark of the My Favorite Murder podcast who kept me laughing throughout this process, and Enya, who composed, hands-down, the best studying/writing music in existence to this day.

Finally, I would like to thank my parents, Rick and Joyce Hannula, for instilling in me a love of learning, demonstrating how to be a compassionate, caring, and effective teacher, and unconditionally supporting all of my academic pursuits.

TABLE OF CONTENTS

Page

LIST OF TABLES viii

LIST OF FIGURES ix

CHAPTER

1 INTRODUCTION 1

Purpose of Current Study 7

Organization of Dissertation 9

2 LITERATURE REVIEW 11

Trait Heterogeneity as an Explanation of Criminal Behavior 11

Empirical Links Between Personality Traits and Offending 11

Personality Traits in Theoretical Explanations of Offending 14

Gottfredson and Hirschi's Self-Control 22

Between- and Within-Individual Variation in Traits 34

Stability of Gottfredson and Hirschi's Self-Control 34

Sources of Between and Within Individual Variation in Traits 46

Social Sources of Personality Trait Variation 50

Social Sources of Variation in Gottfredson and Hirschi's Self-Control 51

Social Sources of Impulsivity and Sensation Seeking 55

Conclusions 56

Social Schematic Theory as A Framework for Trait Variation 57

Sex Differences 62

Sex Differences in Impulsivity and Sensation Seeking 66

Current Study 72

3 DATA AND METHODS 76

CHAPTER Page

Overview 76

Procedures 76

Sample 77

Measures 78

Dependent Variables.... 78

Independent Variables....79

Control Variables 87

Analytic strategy 88

4 RESULTS 91

Developmental Trajectories of Impulsivity and Sensation Seeking.... 94

Sources of Variation in Trajectories of Impulsivity and Sensation Seeking..... 100

Sex Differences in Trajectories of Impulsivity and Sensation Seeking 107

Impulsivity GBTMs.... 114

Sensation Seeking GBTMs....117

Sex Differences in Sources of Trait Variation.... 121

Sensitivity Analyses 128

5 DISCUSSION 135

Policy Implications 148

Limitations and Future Directions 150

Conclusion 157

REFERENCES 159

APPENDIX

A SUMMARY OF RELEVANT RESEARCH 177

B VARIABLE SCALES 183

APPENDIX Page

C WAVE SPECIFIC SAMPLE DESCRIPTIVES 186

D PARTIAL CORRELATION MATRIX 189

E SUPPLEMENTAL GBTMS 192

F SENSTIVITY ANALYSES 197

LIST OF TABLES

Table Page

1. Summary Studies Examining Heterogeneity in Developmental Patterns of Impulsivity and Sensation Seeking 43
2. Summary of Studies Examining Sex Differences in Developmental Patterns of Impulsivity and Sensation Seeking..... 70
3. Sample Size and Summary Statistics of Sex and Age Across Wave..... 78
4. Descriptive Statistics 92
5. Unconditional HLMs of Impulsivity and Sensation Seeking 96
6. Hierarchical Linear Models Predicting Impulsivity 102
7. Hierarchical Linear Models Predicting Sensation Seeking 105
8. Unconditional Growth Models of Impulsivity and Sensation Seeking By Sex....108
9. Fit Indices of Best-Fitting Group Based Trajectory Models of Impulsivity and Sensation Seeking 113
10. HLMs Predicting Impulsivity with Sex Interactions 122
11. HLMs Predicting Sensation Seeking with Sex Interactions 126
12. Summary of SST Effects on Impulsivity and Sensation Seeking.....143
13. Summary of Relevant Research on Self-Control 178
14. Wave-Specific Sample Descriptives.....187
15. Partial Correlation Matrix.....190

LIST OF FIGURES

Figure Page

1. Unconditional Growth Curves of Impulsivity and Sensation Seeking 99
2. Unconditional Growth Curves of Female and Male Impulsivity.....109
3. Unconditional Growth Curves of Female and Male Sensation Seeking..... 110
4. GBTM of Male Impulsivity 114
5. GBTM of Female Impulsivity..... 116
6. GBTM of Male Sensation Seeking 118
7. GBTM of Female Sensation Seeking.....120
8. GBTM of Male Impulsivity with Confidence Intervals.....193
9. GBTM of Female Impulsivity with Confidence Intervals.....193
10. GBTM of Male Sensation Seeking with Confidence Intervals.....194
11. GBTM of Female Sensation Seeking with Confidence Intervals.....194
12. Alternate Male Impulsivity GBTM 195
13. Alternate Male Impulsivity GBTM with Confidence Intervals.....195
14. Alternate Male Sensation Seeking GBTM.....196
15. Alternate Male Sensation Seeking GBTM with Confidence Intervals.....196

Chapter 1: Introduction

While theoretical explanations of crime incorporate a wide variety of factors, they can generally be categorized by their key focus. Traditionally, theories with different key foci have been pitted against one another. For example, theories that explain crime via individual differences (e.g., Lombroso's (1876) born criminal and Hare (1975) and Cleckley's (1976) psychopath) have been pitted against theories that seek to explain crime primarily via social processes (e.g., Shaw and McKay's (1942) social disorganization, Sutherland's (1947) differential association theory, and Sampson, Raudenbush, and Earls's (1997) collective efficacy). In the former approach, crime is partially explained by individual differences in biological or psychological qualities. In the latter approach, structural and cultural characteristics are central to the explanation of crime. For several decades, theories in the latter camp dominated criminology. Despite initial evidence that personality traits could be linked to criminal behavior, many criminologists appeared to reject this work. Andrews and Wormith (1989) noted that the dismissal of trait-based approaches in the 1960s through 80s was not based on a solid empirical foundation that called for rejection. Rather, the trend seemed to be driven by "professional, moral, and ideological considerations that provided justifications for…knowledge destruction efforts which focus[ed] on personality research in mainstream criminology" (p. 306). They argued that empirical evidence of the personality trait-antisocial behavior link was valid despite arguments about methodological shortcomings of this work. Three decades ago, they urged criminologists to realize that the acknowledgment of the importance of individual differences in the explanation of crime need not threaten sociological explanations. Rather, these two approaches should be viewed as complimentary: "there is no theoretical difficulty with the idea that behavior is function of the person in immediate situations and that those

immediate contingencies of action which influence human behavior are themselves a function of personal, interpersonal, and broader community factors" (p. 307).

Fortunately, it appears as if progress has been made towards theoretical integration and an acceptance in criminology of the importance of personality traits. The late 80s and early 90s appeared to bring renewed interest to the ways in which personality may be linked to offending. As many of the methodological concerns were addressed (e.g., the development of personality inventories that did not solely rely on subjective personality tests such as the Rorschach Ink Blot test to identify personality differences and did not rely on criterion groups to establish key scales) more studies emerged successfully linking traits to involvement in criminal behavior (e.g., Caspi et al., 1994; Krueger et al., 1994) and several major theoretical explanations of crime incorporated individual personality differences as important explanatory factors (Agnew, 2006; Gottfredson & Hirschi, 1990; Moffitt, 1993). Just this year, in their review of individual differences related to offending, Jolliffe and Farrington (2019) conclude, "any comprehensive theory that attempts to explain crime should incorporate the temperamental, individual, and socio-cognitive features that have been found to differentiate those who go on to commit offenses from those who do not" (p. 371).

While the importance of personality traits in the explanation of crime is now rarely denied, criminological theorists are hardly in full agreement about the nature of this importance. Specifically, theories that invoke personality traits differ in the traits they highlight as key, the assumptions of stability of those traits across the life course, and the origins of traits (i.e. biological or social).

Although various traits have been linked to offending, two traits that appear with much consistency include impulsivity and risk-taking/sensation seeking. A massive body of empirical work now links these traits to externalizing, antisocial, and criminal

behavior (Cale, 2006; Carrasco, Barker, Tremblay, & Vitaro, 2006; Cauffman, Fine, Thomas, & Monahan, 2017; Cooper, Wood, Orcutt, & Albino, 2003; Lynam, 1996; Eisenberg et al., 2005, 2009; Farrington, 1989; Fite, Goodnight, Bates, Dodge, & Pettit, 2008; Harden, Quinn, & Tucker-Drob, 2012; Jiménez-barbero, Ruiz-hernández, Llor-esteban, & Waschgler, 2016; Lynam, Moffitt, & Stouthamer-Loeber, 1993; Lynam et al., 2000; Monahan, Steinberg, Cauffman, & Mulvey, 2009; Newcomb & McGee, 1991; Ruiz, Pincus, & Schinka, 2008; Samuel & Widiger, 2008; Farrington, Biron and LeBlanc, 1982), and one or both of these traits appear in major theoretical explanations of crime (Arnett, 1992; Cauffman & Steinberg, 2000; Delisi & Vaughn, 2015a, 2015b, Eysenck, 1970, 1996; Gottfredson & Hirschi, 1990; Moffitt, 1993; Steinberg, 2004, 2008; Steinberg & Cauffman, 1996). One of the most influential trait-based theories of crime came from Gottfredson and Hirschi, when they argued, in 1990, that one latent trait, self-control, could explain all crime at all times. Gottfredson and Hirschi (1990) also highlight the role of impulsivity and sensation seeking, yet they combine these traits with several others into a global trait they call self-control. Recent evidence suggests that employing global measures of self-control may be problematic. Specifically, evidence is quickly accumulating that suggests several of the elements captured in the global measure of self-control are independent traits that demonstrate unique relationships with offending (Arneklev, Cochran, & Gainey, 1998; Burt & Simons, 2013; Burt, Sweeten, & Simons, 2014; Ward, Nobles, & Fox, 2015; Wood, Pfefferbaum, & Arneklev, 1993). This evidence is particularly pronounced when considering the traits of impulsivity and sensation seeking. A large body of literature now exists that suggest these two traits develop along different maturational timelines, are differentially related to various relevant outcomes, and do not always co-occur in the same individuals (Burt et al., 2014; Shulman, Harden, Chein, & Steinberg, 2015; Steinberg, 2008). Thus, advances since the

publication of Gottfredson and Hirschi's (1990) theory indicate that impulsivity and sensation seeking are important, but they should be examined separately when attempting to incorporate personality traits in explanations of criminal behavior.

Despite the field moving away from the original conceptualization of self-control by Gottfredson and Hirschi, many of the tests of their theory continue to provide important insights into the sources and stability of traits linked to offending—two topics that are key to working through theoretical differences in how traits are incorporated into explanations of criminal behavior. Gottfredson and Hirschi (1990) suggested that self-control is developed prior to the ages of 8-10, primarily via parenting, and after that age, self-control should remain relatively stable throughout the life-course. Tests of this theory suggest that self-control is not relatively stable throughout the life course and other factors in addition to parenting appear to explain variation in trait levels, even well beyond the age of 8-10 (Agnew et al., 2011; Burt, Simons, & Simons, 2006; Chapple, Vaske, & Hope, 2010; Forrest & Hay, 2011; Gibson, Sullivan, Jones, & Piquero, 2010; Hay & Forrest, 2008; Meldrum, 2008; Na & Paternoster, 2012; Nofziger, 2008; Perrone, Sullivan, Pratt, & Margaryan, 2004; Pratt, Turner, & Piquero, 2004; Teasdale & Silver, 2009; Turner, Piquero, & Pratt, 2005; Unnever, Cullen, & Pratt, 2003; Vazsonyi & Huang, 2010). While the findings that self-control is not relatively stable and additional factors are needed to explain variation in levels of self-control across the life-course are important, their limitations are obvious when considered in combination with the evidence that self-control should be disaggregated into its lower-level facets. It is unclear which lower-level facets are responding to social sources of influence and contributing to the observed instability in self-control over the life course.

Evidence on the instability and social sources of self-control is consistent with research on broad personality traits. That is, recent explorations into the developmental

stability of broad personality traits has suggested that personality traits are not stable over time (Caspi, Roberts, & Shiner, 2005; McCrae et al., 2002). Not only does normative change exist, such that individuals similarly increase or decrease on certain traits throughout the life-course, but significant individual variation in developmental trajectories is also being uncovered (Helson, Jones, & Kwan, 2002; Srivastava, John, Gosling, & Potter, 2003). In other words, evidence that some individuals demonstrate developmental patterns of personality traits that substantially depart from the normative pattern of change is growing. Given that this evidence of instability is relatively recent, very few studies have explored the sources of this variation. Traditionally, the basis for differences in personality has been located within the body (e.g, genes, McCrae et al., 2000). However, the observed instability in personality is encouraging us to take the possibility that social factors could influence traits over the life course seriously. While a body of literature is accumulating that demonstrates that some personality factors are altered by social experiences/conditions (e.g., Lehnart, Neyer, & Eccles, 2010; Lockenhoff, Terracciano, Patriciu, Eaton, & Costa, 2009; Neyer & Lehnart, 2007; Roberts, Walton, Bogg, & Caspi, 2006) much of this evidence, like the evidence produced by tests of Gottfredson and Hirschi's theory, was produced by focusing on higher-level factors and limits our ability to understand the variation and causes of variation in developmental patterns of impulsivity and sensation seeking specifically.[1]

Taken together, then, research from a variety of fields indicates that impulsivity and sensation seeking are relevant for the explanation of crime and they should not be

[1] This discussion of trait malleability specifically focuses on changes in trait levels across the life course. Recent reconceptualizations of self-control have highlighted the potential for situational variability in levels of self-control (Hirschi, 2004; Pratt, 2015). These approaches recognize that self-control may change from situation to situation. Although these differences are likely highly important, they are not the focus of the current paper. Rather, the focus is on trait level change over time, holding the situation constant. For example, the goal is to capture how individuals might change their responses over time to an item such as "You stick with what you are doing until you finish with it."

conflated in higher-level factors that are then linked to offending. Furthermore, growing empirical evidence suggests that personality traits are less stable than generally assumed within both criminological and psychological scholarship. Evidence of instability and variation in developmental patterns of traits has been observed when examining higher-level personality factors, self-control specifically, and even impulsivity and sensation seeking directly. Consequently, assumptions of personality trait stability that often underlie theoretical explanations of crime that incorporate personality traits are not consistent with empirical reality. Theoretical explanations of crime that incorporate individual differences in the form of personality traits need to be adjusted to accommodate this reality, and much work needs to be done address the gap in the literature regarding potential social sources of variation in traits.

One recently developed theory, the Social Schematic Theory (SST), proposed by Simons and Burt (2011), is consistent with the growing evidence regarding the importance of impulsivity and sensation seeking in the explanation of criminal behavior. Furthermore, this theory incorporates traits in a manner that is consistent with emerging evidence of trait instability. Not only does this theory anticipate changes in trait levels over time, but it effectively integrates key variables from the most well-supported theories of offending in a coherent explanation of how individual differences and environmental characteristics work together to lead to offending for certain individuals. Simons and Burt (2011) propose that various adverse environmental conditions work together to send shared messages to individuals about the way the world works. These messages are internalized in the form of three interrelated cognitive schemas, which include a hostile view of relationships, a commitment to conventional norms, and a preference for immediate gratification (which captures impulsivity and sensation seeking). These schemas then guide interpretations of new situations and direct courses

of action. Ultimately, these three schemas increase the likelihood that crime will be viewed as a legitimate response in certain situations. Importantly, Simons and Burt (2011) highlight the adaptive nature of the schemas. That is, the schemas are continuously open to socio-environmental input and as exposure to certain conditions changes, so too will the schemas. Thus, due to the unique ability of this theory to account for potential trait variation across the life course, this theory is employed as the theoretical framework used to guide the specific research questions of this dissertation.

One of the most consistent findings within criminology is that males are more likely to engage in crime than females (Steffensmeier & Allan, 1995). The sex disparity in offending is one of the few "facts" of criminology. While much evidence has documented this sex difference, less evidence has explicitly focused on sex differences in traits that are linked to offending (Moffitt, Caspi, Rutter, & Silva, 2001). Furthermore, the existing evidence is still in the descriptive stage such that differences between males and females in traits are commonly reported, yet not explained. Several studies have explored sex differences in the sources of self-control (e.g., Chapple et al., 2010; Shoenberger & Rocheleau, 2017), but once again, these studies are limited by their conflation of impulsivity and sensation seeking. Existing psychological attempts to explain sex differences in impulsivity and sensation seeking in particular largely focus on evolved differences between males and females and neglect more immediate influential factors (Campbell, 1999; Daly & Wilson, 1983). Thus, a significant gap in the literature remains regarding not only sources of impulsivity and sensation seeking generally, but also in terms of potential sex differences in the development of these traits.

Purpose of Study

This study has three primary aims, each related to the overall goal of enhancing our understanding of trait development across the life course with an emphasis on two

traits that have been identified as both theoretically and empirically important to the explanation of criminal behavior: impulsivity and sensation seeking. With the development of longitudinal modeling methods, literature is quickly accumulating that demonstrates substantial variation in developmental patterns of personality traits over the life course, including impulsivity and sensation seeking. Thus, this study will first estimate individual variation in developmental trajectories of impulsivity and sensation seeking in a sample of African Americans from age 9 to 31. Although individual variation in these traits has already been captured for this sample (see Burt et al., 2014), this study incorporates an additional wave of data, extending the observation period by four years and expands on the previous study in two important ways (aims 2 and 3). This additional wave of data is important given evidence of increased trait stability nearing the end of the third decade of life (Caspi et al., 2005; Terracciano, McCrae, & Costa, 2010). Second, this study will explore *sources* of individual differences in impulsivity and sensation seeking. Given the long-standing assumption that personality traits are defined by their stability, explorations into the sources of these between-individual differences and within-individual changes are scarce. Thus, using Simons and Burt's (2011) Social Schematic Theory as a framework, this study hopes to identify both factors that explain some of the variation between individuals in their overall levels of these traits and factors that may be responsible for changes in these traits over time. Harsh environmental conditions including parental hostility, romantic partner hostility, exposure to neighborhood crime, and exposure to death, illness, and racial discrimination are expected to be related to increased impulsivity and sensation seeking while supportive environmental conditions including primary caregiver warmth and romantic partner warmth are expected to be related to decreased impulsivity and sensation seeking. Third, this study will examine whether developmental trajectories of these traits, and

influencing factors, differ across sex. While the gender gap in offending has long been noted, very few studies have directly examined sex differences within these two traits and in their development. These aims will be addressed with two diverse longitudinal modeling methods. Specifically, hierarchical linear modeling (HLM; Raudenbush & Bryk, 2002; Singer & Willett, 2003) will be used to address all three aims while group based trajectory modeling (GBTM; Nagin, 2005) will be used to potentially identify unique developmental trajectories of impulsivity and sensation seeking in males and females separately. Specifically, HLM will be used to estimate normative developmental trajectories of impulsivity and sensation seeking and variation in both baseline levels and growth rates. HLM will also be used to identify sources of this variation. HLM and GBTM will be used to explore sex differences in developmental patterns of impulsivity and sensation seeking, and HLM will be used to explore sex differences in their predictors.

Organization of Dissertation

The remainder of this document consists of four separate sections. The next section, chapter two, presents a comprehensive review of relevant theories and empirical studies to introduce the reader to the important work that has led up to the research questions posed in this dissertation. Specifically, criminological theories that emphasize the role of personality traits in the genesis of offending behavior are discussed. Special attention is given to Gottfredson and Hirschi's general theory of crime due to the enormous amount of research it has generated and the need for the field to appreciate empirical evidence that has accumulated since the publication of the theory that demands theoretical refinement/adjustment. Special attention is also given to Simons and Burt's (2011) Social Schematic Theory as it provides the theoretical framework that guides the selection of key variables in this study. Chapter three describes the methods

used to answer the research questions. Specifically, it includes descriptions of data collection procedures, the sample, variables, and the analytic strategy. Chapter four presents the results of the statistical analysis used to address the research questions. These results are presented in four separate sections, each corresponding to a separate research question. First, hierarchical linear modeling (HLM) will be used to demonstrate the development of impulsivity and sensation seeking over time. Second, HLM will be used to identify predictors that may explain individual variation in levels and growth rates of impulsivity and sensation seeking over time. Third, both HLM and group-based trajectory modeling (GBTM) will be used to demonstrate heterogeneity in developmental patterns of these two traits within and across sex. Finally, HLM will be used to explore whether predictors of impulsivity and sensation seeking vary by sex. In the final section, chapter five, the results of the study will be placed in context of the larger body of relevant literature. The meaning of these findings for existing theoretical explanations of crime, longitudinal modeling methods, and policy approaches will be discussed along with limitations of the current study and suggestions for future research.

Chapter 2: Literature Review

Trait Heterogeneity as an Explanation of Criminal Behavior

Trait heterogeneity has long been included in explanations of antisocial and criminal behavior. Numerous attempts have been made to identify the personality traits associated with being a criminal or identify a constellation of traits that captures the "criminal personality" (Caspi et al., 1994; Glueck & Glueck, 1950; Jones, Miller, & Lynam, 2011; Krueger et al., 1994) and some of the most prominent criminological theories have either explicitly emphasized the importance of traits or have been expanded to incorporated traits into their causal explanations (Agnew, 2006; Delisi & Vaughn, 2014; Gottfredson & Hirschi, 1990; Moffitt, 1993; Van Gelder & De Vries, 2012). While this literature has helped us identify traits that may be key to explaining offending, the conclusions are not unquestionably clear due to the variety of personality models/traits used in empirical tests and the various, divergent ways personality traits are incorporated into theoretical explanations of crime.

Empirical Links Between Personality Traits and Offending

One of the most common approaches to exploring the potential importance of personality traits in the explanation of criminal behavior is to give individuals personality tests, inquire about offending behavior from various sources, and test for associations between trait level and offending (e.g., Carrasco et al., 2006; Caspi et al., 1994; Jolliffe, 2013; Jones et al., 2011; Krueger et al., 1994; Miller & Lynam, 2001; Walton et al., 2017). There are several major drawbacks to this method of exploring the relationship between traits and offending. First, it can be difficult to draw clear conclusions from this work due the variety of personality measures and outcome variables employed. Although there is much overlap between the various models of personality, there are also important differences. Personality models are generally

structured such that several independent higher order factors are identified, and each of these higher order factors capture multiple lower-level facets. The most popular models of personality diverge on the number of higher order factors, with the HEXACO model (De Vries, De Vries, De Hoogh, & Feji, 2009) including six, McCrae and Costa's (1999) Five Factor Model including five, and both Eysenck's (1970) biological model and Tellegen's (1982) Multidimensional Personality Questionnaire including three (although three very different higher order factors). Furthermore, due to the various higher-order factor structures, the lower-level facets that are identified as collectively representing a higher-order latent structures vary. In other words, lower-level facets that are grouped together in one personality inventory may not be grouped together in a different personality inventory. Second, many of these findings lack specificity given that the associations are captured between crime and the higher-level factors, masking potentially important and independent effects of distinct lower-level traits. When lower level facets are examined as predictors of outcomes of interest, it is generally the case that all lower-level facets do not share the same association with the outcomes of interest (e.g., Krueger et al., 1994; Lehnart et al., 2010). Third, many of the studies that aim to test for empirical links between personality traits and antisocial behavior are often atheoretical. Or, to be sure, once a theory of personality has been developed, the establishment of a link between traits and offending often proceeds without any proposed underlying theoretical mechanism. This leaves us with a list of traits potentially linked to offending, but without any understanding of how and why these traits manifest in the ways they do and how and why they may lead to offending.[2]

[2] To be clear, I am not critiquing the entirety of the body of literature that links personality traits and offending. Rather, I am suggesting that a portion of this work focuses only on identifying and describing traits potentially related to offending without any additional theoretical elaboration on why and how this connection exists. These studies lead to an unsatisfactory explanation of crime, and a poor ability to *predict* who is likely to offend. The key argument here is that these studies

A few examples of this work provide evidence of these limitations. Several studies have explored associations between personality and criminal status with the Multidimensional Personality Questionnaire (MPQ; Tellegen, 1982). The MPQ consists of three higher order factors (constraint, negative emotionality, and positive emotionality) and eleven lower-level facets. The studies using this approach generally find that two of the three higher order-factors, constraint and negative emotionality, are consistently related to offending. This finding holds across gender, age, type of reporting (self-report, informant-report, police contact, court convictions), and geographical location (Caspi et al., 1994; Krueger et al., 1994). When considering the lower-level factors, traditionalism, control, and aggression appear to consistently be related to all types of delinquency measures. However, not all lower-level facets within constraint and negative emotionality are related to delinquency. Furthermore, when lower-level facets are examined independently, more inconsistency in observed relationships is found when comparing various reporting methods (self-reported delinquency versus official reports).

The issue of cross-model inconsistency is exemplified when considering results of meta-analyses on the personality trait-offending link. For example, Cale (2006) performed a meta-analysis of studies that explored the relationship between antisocial behavior and personality dimensions while using Eysenck's model of personality to guide the analyses and found that only two of Eysenck's three personality factors (which she referred to as extraversion/sociability, neuroticism/emotionality, and impulsivity/disinhibition to increase consistency with factor names in other personality inventories), were related to antisocial behavior. She found that impulsivity/disinhibition demonstrated the strongest relationship while

---

need to be supported by/integrated with theoretical explanations of when and why these traits matter.

neuroticism/emotionality produced a moderate overall effect size and the effect size for extraversion/sociability was negligible. Miller and Lynam (2001) performed a meta-analysis to summarize associations between personality traits captured in several of the most popular personality inventories and antisocial behavior including Eysenck's (1970) biological model, Tellegen's (1982) MPQ, McCrae and Costa's (1990) five factor model, and Cloninger, Svrakic, and Przybeck's (1993) temperament/character model. They found that the largest effect sizes were for psychoticism, agreeableness and novelty-seeking. Given the differences in higher-order traits found across the four models, the authors attempted to interpret this finding as suggesting, broadly, that antisocial individuals are hostile, self-centered, spiteful, jealous, indifferent to others, impulsive, lack ambition, motivation, perseverance, and hold nontraditional and unconventional values and beliefs. However, with these meta-analytical methods, little clarity is gained into the specific traits that are linked to offending due to the forced merging of different personality models with various hierarchical structures of traits.

Despite these limitations, it does appear that most of these tests converge on the finding that traits capturing tendencies related to self-regulation, self-control, impulsivity, sensation seeking, risk taking, egocentrism, harm avoidance and traditionalism/conventionality are commonly related to offending. Importantly, for the purposes of this study, there is strong evidence that higher order factors capturing the traits of impulsivity and sensation seeking, and in some cases, the specific traits of impulsivity and sensation seeking, are related to offending. These findings are generally consistent with the nature in which traits are employed in some of the most prominent theoretical explanations of crime or antisocial behavior

Personality Traits in Theoretical Explanations of Crime

Although empirical tests of associations between personality traits and offending

are important, theoretical explanations are needed to elaborate upon these links and make sense of when, how, and why these associations are observed. Multiple theoretical explanations of crime have incorporated personality traits, but there is much variation in the ways traits are incorporated as causal factors. While each of these theories highlight traits conceptually related to impulsivity or sensation seeking as key in the explanation of criminal behavior, these theories vary in the assumptions they make about trait stability across the life-course, assumptions of generality (do traits matter for all individuals in the same way), and the mechanisms by which the traits are thought to lead to offending. Several notable theories include Eysenck's (1970) biological model of personality, Moffitt's (1993) theories of life-course persistent and adolescent-limited offenders, Arnett (1992)'s developmental theory of reckless behavior, Cauffman and Steinberg's (Cauffman & Steinberg, 2000; Steinberg & Cauffman, 1996) theory of psychosocial maturity, Delisi and Vaughn's (Delisi & Vaughn, 2014, 2015b) temperament-based theory of antisocial behavior, and Gottfredson and Hirschi's (1990) general theory of crime.

While criminology was still largely rejecting explanations of crime based in individual differences, Eysenck (1970) began linking his model of personality to criminal behavior in a series of publications (Eysenck, 1978; 1996). Initially, his personality model was defined by two higher order factors, which he labeled extraversion (E) and neuroticism (N). He argued that individuals high in E have low levels of cortical arousal (i.e. they are underaroused and engage in sensation seeking to achieve normal stimulation). Low arousal prevents high E individuals from experiencing the stimulation generally required for developing a conscience. Thus, he expected that individuals high in E were more likely to be criminals. He argued that individuals high in N have heightened emotional drives (i.e. their autonomic nervous systems overreact). The

tendency of high N individuals to emotionally overact affects their ability to refrain from antisocial behavior, which should increase their chances of engaging in criminal acts. Initially, Eysenck considered both venturesomeness (similar to sensation seeking) and impulsivity to be facets of extraversion. However, he subsequently revised his theory in multiple ways. He added a third dimension to his model, psychoticism (P), and located the lower-level trait of impulsivity within this domain. High P individuals were also defined by their tendencies to be unempathic, aggressive, egocentric, and tough-minded. Ultimately, high levels on all three factors were linked to criminal behavior, with the association between P and criminal behavior expected to be the strongest. Various empirical studies have demonstrated that P is most strongly associated with criminal or antisocial behavior, with E also demonstrating significant associations (Cale, 2006). However, many of the tests of these associations do not allow for straightforward interpretations because the higher order factors are linked to antisocial behavior, not individual lower-level traits. Thus, it is unclear whether some or all of the lower-level factors of P are driving the association with antisocial behavior (e.g., is the link between criminal behavior and P due to impulsivity, aggression, both, neither?). In an exception, Carrasco, Barker, Tremblay, and Vitaro (2006) examined lower-level facets of Eysenck's model and found that empathy, impulsivity, energy, and venturesomeness were the most important factors for discriminating between trajectories of various criminal behavior (aggression, theft, vandalism) in adolescence.

Moffitt (1993) provided one of the first theoretical explanations of the age-crime curve and in doing so highlighted the potentially important role of individual traits for a minority of the offending population. She argued that the observed peak in offending in adolescence is due to a temporary increase in number of offenders, not in the frequency of offending by a few particularly active offenders. Thus, she argued that there are two

types of qualitatively unique offenders with distinctive criminal etiologies and trajectories: a very small group that starts offending early and persists throughout the life course (life course persistent offenders) and a much larger group that only offends during the adolescent years (adolescent limited offenders). Life course persistent offenders account for a very small proportion of the offending population (about 5%) and it is this group of offenders who possess traits that increase their probability of engaging in crime or analogous behaviors throughout the life course. Moffitt suggested that neuropsychological deficits are present in this group, which lead to the manifestation of psychological traits, including poor self-control, intention, overactivity, and impulsivity, that create stability in antisocial behavior over the life course. The origin of life course persistent offending does not lie solely with neuropsychological deficits, however. Rather, the interaction between difficult child behavior and an adverse child-rearing context leads to sustained antisocial behavior. These life-course persistent offenders are contrasted with the adolescent-limited offenders who are not driven to antisocial behavior on the basis of neurological deficits and manifested traits. Rather, the adolescent limited offenders begin offending during the adolescent years due to entry into what Moffitt (1993) termed the "maturity gap." With changing social expectations (elongated time spent in educational institutions and delayed marriage, childbearing, and independence relative to our ancestors), adolescents find themselves in a stage in which they are biologically but not socially mature. They desire to engage in adult behaviors and display their independence, yet society limits their opportunities to do so. Thus, adolescents who have reached puberty look to their peers who are demonstrating independence (the life course persistent offenders) and mimic them in attempt to gain the independence and adult status (with corresponding power and privilege) they desire. Thus, Moffit (1993) highlights the role of underlying traits, but not for the majority of

offenders. Traits, including impulsivity, are psychological manifestations of underlying neurological deficits and the presence of these manifestations start off the negative chain of interactions that keep a small minority of offenders engaged in antisocial behavior.

Arnett (1992, 1995) was creating a developmental model of heightened reckless behavior in adolescence around the same time Moffitt introduced her ideas. Similar to Moffitt, his model was motivated by the need to explain increased deviance observed during adolescence. Rather than identifying distinct types of offenders, he suggested that normative trait maturation is partially responsible for heightened adolescent reckless behavior, including criminal behavior. He suggested that developmental predispositions interact with cultural socialization environment to lead to increased reckless behavior during adolescence. Specifically, all adolescents experience elevated levels of sensation seeking, egocentrism, and aggression relative to adults, which predisposes them to engage in reckless behavior including risky sexual behavior, dangerous driving, and criminal behavior. However, simple possession of the traits is insufficient to produce reckless behavior. The socialization environment is essential for how these dispositions are expressed (i.e. if they are and what form they take). Specifically, Arnett distinguishes between broad and narrow socialization. In cultures that engage in narrow socialization, individuals are socialized to strict standards and norms. Very little autonomy and deviation from cultural norms is expected. Individuals are punished for failing to adhere to the cultural norms. In these cultures, the three key developmental predispositions are less likely to lead to reckless behavior because the constraints provided the by the culture override freely acting on those predispositions. The narrow socialization dictates how/when it is appropriate to act on sensation seeking or aggressive impulses, for example. In cultures that engage in broad socialization, cultural guidelines are not as clear. Rather, individuals are less directed to adhere to cultural norms and individual

variation and self-expression is encouraged. Here, natural predispositions are less controlled, leading to less inhibited displays of sensation seeking and aggression. Broad cultural socialization leads to what could be considered true expression of underlying predispositions while narrow socialization leads to more controlled expression of these dispositions.

Another more recent model is consistent with Arnett's description of normative trait change and its association with offending. Several researchers (Cauffman & Steinberg, 2000; Steinberg & Cauffman, 1996) have suggested that increases in what they label *psychosocial maturity* are related to offending (or, more accurately, desistance). Psychosocial maturity has been described as the constellation of three broad factors that generally show mean-level increases throughout development. These three factors are labeled responsibility, temperance, and perspective. Normative increases in these traits explain improved decision-making from adolescence to adulthood, which then explains the reduction of risky, including offending, behavior. Importantly, temperance captures traits related to self-regulation including sensation seeking, impulsivity, and moodiness or suppression of aggression. Studies have shown that elements of psychosocial maturity are related to age of onset of delinquent acts, frequency of delinquent acts (Cruise et al., 2008), trajectories of antisocial behavior, and desistance from antisocial behavior (Monahan et al., 2009; Monahan, Steinberg, Cauffman, & Mulvey, 2013). While Cauffman and Steinberg (2000) and Cruise et al., (2008) found that all three aspects of psychosocial maturity were related to delinquent behavior, Monahan et al. (2009, 2013) found that only some of the elements were related to desistance from antisocial behavior. However, a shared finding across all studies is that the temperance factor was the strongest predictor of criminal or antisocial behavior.

Delisi and Vaughn (2015a, 2015b) recently introduced a temperament-based theory of antisocial behavior. Their key proposition is that two specific temperamental features, negative emotionality and effortful control, are capable of explaining antisocial behavior and behavioral responses to the criminal justice system over the life course. They define temperament as "the stable, largely innate tendency with which an individual experiences the environment and regulates his or her responses to it" (Delisi & Vaughn, 2015b, p. 331). Thus, they reduce all antisocial behavior to largely innate predispositions that govern responses to social situations and evoke negative social responses that further imbed individuals with these temperamental qualities in antisocial lifestyles. While negative emotionality and effortful control should demonstrate independent effects on antisocial behavior, they argue that their interplay is key; those individuals with high negative emotionality and low effortful control are most likely to continuously be engaged in antisocial behavior.

While each of these theories point to the importance of individual differences, including those related to impulsive or sensation seeking tendencies, as key explanatory factors, they vary in important ways. They appear to diverge in their assumptions about the stability of the underlying traits, their importance for all versus a small minority of the population, and the type of environmental interactions that matter. On one end of the spectrum are the theories that assume individual differences are absolutely stable—i.e. impulsivity is treated as a stable individual characteristic that is unlikely to be changed across the life-course (e.g., Moffit and Delisi and Vaughn's theories). In the middle are the theories that anticipate change in trait level over time, but expect this change to be normative such that most individuals will experience similar changes in these traits over time and retain their position in the distribution (e.g, Gottfredson and Hirschi (1990)'s general theory, Cauffman and Steinberg's psychosocial maturity theory).

Another type of mid-spectrum theory suggests that normative trait change occurs, but environmental conditions interact with trait levels to determine how underlying propensities manifest (e.g., Arnett's developmental model of reckless behavior). On the other extreme end of the spectrum lays theories that assume personality traits themselves are not stable. These theories allow environmental conditions to not only interact with traits to determine outcomes, but to also directly alter trait levels. Very few theories anticipate this potential, but emerging evidence suggests that this may be the most realistic approach to understanding the complex relationship between individual differences, environmental conditions, and offending. Simons and Burt's (2011) Social Schematic Theory is a theory that theorizes personality trait malleability and it will be reviewed in a subsequent section, along with the evidence demonstrating the need for theories that accommodate the reality of trait instability.

In sum, the empirical work that links personality traits to offending has demonstrated that individual personality differences should not be overlooked when attempting to explain crime. This work has given us an idea, albeit a messy idea, of which traits seem to matter. Theoretical explanations of criminal behavior have also highlighted the important role of individual differences, as personality traits, in the explanation of crime, and have provided mechanisms for linking personality traits to offending. However, there is much discrepancy in various theoretical explanations of crime in the assumptions they make about the nature of personality traits. They vary in the degree to which they assume trait stability over the life-course and in their expectations of how social and environmental factors interact with traits to produce offending. Most of these theories rely on assumptions of absolute or relative trait stability (absolute stability meaning no individual change in trait level over the life course and relative stability meaning that individual change is anticipated, but it is

normative such that all individuals change in similar ways and their relative position in the distribution of trait levels remains the same—i.e. those who are relatively high in trait levels early on in life will remain relatively high throughout the life course despite overall changes in their levels). When theories incorporate social/environmental factors, they generally assume that social factors interact with pre-existing trait levels to lead to offending, and overlook the possibility that social/environmental factors directly contribute to between-individual differences in trait levels and changes in trait levels within individuals over time. However, two notable exceptions are Gottfredson and Hirschi's (1990) general theory of crime and Simons and Burt's (2011) Social Schematic Theory (2011). Both of these theories emphasize social sources in the development of traits related to offending, yet do so in drastically different ways. Gottfredson and Hirschi (1990) suggest that social sources are only important before the ages of 8 to 10 and after that age, relative stability in trait levels should be observed. In contrast, Simons and Burt (2011) suggest that traits are malleable through the life course, adapting to various socio-environmental factors.

Gottfredson and Hirschi's Self-Control

Gottfredson and Hirschi's (1990) theory is a particularly influential theory of crime that has both brought a trait-based explanation of crime to the center of mainstream criminology and stimulated a large body of research that has led to new insights about the stability of traits across the life course and the role of social/environmental factors in the development of traits linked to offending.

In 1990, Gottfredson and Hirschi published their general theory of crime in which they suggested that one latent trait, which they labeled self-control, could explain all crime and analogous behavior (behavior that shares certain characteristics with criminal behavior yet is not illegal). Gottfredson and Hirschi (1990) developed their

theory by considering the typical characteristics of criminal acts and then inferring from this list the characteristics that criminals are likely to possess to be able to engage in these acts. They summarize that individuals with low self-control and a high propensity for criminal behavior tend to be "impulsive, insensitive, physical (as opposed to mental), risk-taking, short-sighted, and nonverbal. . ." (p. 90). After identifying the traits that should define individuals with criminal propensities, they suggested that because these traits tend to occur in the same people and persist through life, they should be thought of as comprising a single, relatively stable latent trait. Gottfredson and Hirschi (1990) suggested that this latent trait should be established by the age of 8-10 and any changes in self-control after this age would be due to natural aging processes. Thus, changes in individual levels of self-control after the age of 10 are to be expected, but the changes are normative such that all individuals experience them similarly and their relative level of self-control is fixed.

Since Gottfredson and Hirschi (1990) presented their theory, many of the propositions have been empirically tested. Overall, the general theory of crime has garnered much support. The central proposition that low self-control explains a substantial amount of variation in criminal and analogous behavior has been widely supported (see meta-analyses by Pratt & Cullen, 2000; Vazsonyi, Mikuška, & Kelley, 2017). However, support for some of the ancillary propositions has not been as easily obtained. Specifically, the propositions that the elements of self-control cohere into one latent trait and that self-control remains relatively stable past age 10 have been seriously challenged by empirical tests (e.g., Arneklev, Cochran, & Gainey, 1998; Beaver, Connolly, Schwartz, Al-Ghamdi, & Kobeisy, 2013; Burt, Sweeten, & Simons, 2014; Cochran, Wood, Sellers, Wilkerson, & Chamlin, 1998; Conner, Stein, & Longshore, 2009; Hay & Forrest, 2006; Longshore, Turner, & Stein, 1996; Meldrum, Young, & Weerman, 2012; Meldrum,

2008; Mitchell & MacKenzie, 2006; Na & Paternoster, 2012; Vazsonyi & Huang, 2010). This empirical work, combined with insights provided by research on the elements of self-control in other fields, has led to the conclusion that using the concept of self-control, as Gottfredson and Hirschi (1990) initially conceptualized it, in explanations of deviance and crime is likely to be problematic, preventing us from a more nuanced and accurate understanding of how personality traits are implicated in offending behavior.[3] However, insights gained from the work testing Gottfredson and Hirschi's (1990) original conceptualization of self-control offer a useful starting point for continuing to explore sources of trait levels and developmental patterns of traits related to offending over the life course.

To interpret the substantial body of work testing Gottfredson and Hirschi's (1990) theory, it is key to understand how self-control has been operationalized. The overwhelming majority of tests of self-control have been performed with what has been called the Grasmick scale or scales that include items reflective of those in the Grasmick scale (see Appendix A for a summary of key research on self-control and the measures employed in these studies). Shortly after Gottfredson and Hirschi (1990) published their theory, Grasmick and colleagues (1993) published a test of the theory that guided much of the research on self-control for the next few decades. Grasmick et al. (1993) attempted to come up with a way to measure self-control and test whether self-control should be considered a unidimensional trait as Gottfredson and Hirschi (1990) had proposed. They developed a list of 24 items that were thought to represent six unique traits that comprise self-control, which they identified as 1) impulsivity, 2) a preference for simple

[3] To be clear, Gottfredson and Hirschi (1990) did not set out to explain how personality traits are implicated in offending. Rather, we may interpret their theory as contributing to this topic given that they labeled their key explanatory factor a trait and suggested that it consists of multiple lower level traits, which they labeled "elements." Furthermore, the extreme majority of tests of Gottfredson and Hirschi's self-control have employed operationalizations of self-control that are based on their listed elements of self-control.

rather than complex tasks, 3) risk seeking, 4) a preference for physical rather than cerebral activities, 5) a self-centered orientation, and 6) a volatile temper. Factor analyses on these 24 items led to the conclusion, consistent with Gottfredson and Hirschi (1990)'s suggestions, that self-control should be considered a unidimensional trait.[4] The results were not unquestionably clear and the authors warned: "We do not, however, wish to give the impression that we consider ours the definitive conclusion on this issue. We would encourage others to replicate our measure and develop other items, testing their unidimensionality with a wide variety of samples" (p.17). Despite this encouragement, many scholars continued to test self-control theory with those items explicated by the Grasmick et al. (1993) article, moving forward with an assumption that self-control should be treated as a single latent trait, rather than waiting for empirical evidence demonstrating additional support for this notion or paying attention to the few studies that did provide evidence against this notion.[5]

Subsequent tests of the multidimensionality of self-control have provided mixed results. Since Grasmick et al.'s (1993) initial test, several studies have led to conclusions that self-control should not be considered a single latent factor (Cochran et al., 1998; Conner et al., 2009; Longshore et al., 1996) while others supported Grasmick et al.'s initial findings and concluded that self-control is best described as six traits that come together as a higher order latent factor (Arneklev, Grasmick, & Bursik, 1999; Piquero &

---

[4] However, one item was dropped to improve fit, and thus, the final scale used in this paper consists of 23 items.

[5] Perhaps one reason for the quick reliance on the Grasmick scale was that Gottfredson and Hirschi (1990)'s concept of self-control was neither fully developed nor clearly articulated and Grasmick et al. (1993) provided the first clear example of exactly how this concept could be measured. For example, as Grasmick et al. (1993) note, in their discussion of the "elements of self-control" Gottfredson and Hirschi (1990) appeared to reference tendencies that should more appropriately be considered outcomes of possessing low self-control, instead of elements of it. Further complicating the conceptual confusion over what self-control is, is the clear mismatch between how Gottfredson and Hirschi (1990) conceptualized self-control and how scholars in other fields have historically conceptualized the trait of self-control (see Duckworth and Kern, 2011 for a discussion of self-control-related concepts typically employed in psychological research).

Rosay, 1998; Vazsonyi, Pickering, Junger, & Hessing, 2001). The opposing conclusions are likely due to the use of different samples (high risk versus general population) and methodologies.

While studies on the factor structure of self-control have not sufficiently settled the single factor/multiple factor debate (Ward et al., 2015) the overall evidence from a variety of additional sources appears to tip the scales in the direction of multidimensionality and independence and encourages scholars to rethink including global measures of self-control into their studies as it was initially captured with the Grasmick et al. (1993) scale. Much evidence, both directly testing Gottfredson and Hirschi (1990)'s propositions, and in other disciplines, has emerged suggesting that impulsivity and sensation seeking in particular, two traits conflated in Gottfredson and Hirschi (1990)'s concept of self-control, should be considered independent traits that uniquely contribute to offending. Despite much initial definitional ambiguity and overlap of sensation seeking and impulsivity (see Cross et al., 2011; Smith et al., 2007; Whiteside & Lynam, 2001) over time, research in various fields has led to the conclusion that these two traits should be considered conceptually distinct (Burt & Simons, 2013; Cross et al., 2011; Eysenck & Eysenck, 1978; Horvath & Zuckerman, 1993; Quinn & Harden, 2013; Steinberg, 2008).[6] Impulsivity is defined as the tendency to act rapidly without deliberation or consideration of long-term consequences. This definition treats impulsivity as a cognitive ability, which cleanly separates it from the more affective, motivational nature of sensation seeking and other characteristics that are often captured in impulsivity-like measures (e.g., urgency—"the tendency to commit rash or regrettable actions as a result of intense negative affect"; Smith et al., 2007, p. 677).

[6] To be clear, an argument for *conceptual* distinctness does not preclude to possibility that these two traits should be more appropriately combined in a global scale of self-control. What determines whether or not they should be combined in a global scale is their relationship to each other and to relevant predictors.

Sensation seeking has been clearly described by Zuckerman (1979) as "a trait defined by the need for varied, novel, and complex sensations and experiences and the willingness to take physical and social risks for the sake of such experience" (p. 10). Thus, impulsivity describes a tendency to act without thinking while sensation seeking describes a tendency to enjoy thrilling sensations. To be clear, these are the definitions of impulsivity and sensation seeking employed in the current paper. The definitional issues are not completely resolved and various measures still treat sensation seeking as a sub-factor of impulsivity (see Cross et al., 2011). Furthermore, several scholars have treated impulsivity as a facet of sensation seeking, justifying this by the existence of Zuckerman's "disinhibition" scale in his four-facet measure of sensation seeking. However, disinhibition is not equivalent to impulsivity. Disinhibition refers to the tendency to be disinhibited in social situations, such as by attending "wild parties." Zuckerman was clear in several writings that impulsivity is related to sensation seeking, yet they capture unique tendencies. Zuckerman (1979) highlighted the conceptual distinctness of these two traits when he explained that activities associated with thrilling or risky sensations, which may be sought out by high sensation seekers, are not always impulsive activities by nature and rather, may require a great deal of planning and consideration (e.g., skydiving and planning a trip to ride a roller coaster). Further demonstrating the conceptual distinctness of these two traits, Burt, Sweeten, and Simons (2014) articulate how the reverse is true as well; impulsive decisions such as rashly deciding to quit a job likely do not involve motivation to seek thrills.

Although conceptually distinct, it could be the case that these two traits develop simultaneously and co-occur in the same individuals, and as such, could be subsumed within a global measure of self-control without problem when attempting to explain crime. However, scholarship from a variety of sources is suggesting that this is not the

case. Literature on the structure of personality suggests that two traits captured in Gottfredson and Hirschi's self-control, impulsivity and sensation seeking, do not always co-occur in the same individuals. Furthermore, recent models of risk-taking during adolescence suggest that these two traits mature along different timetables and are based in different neurological systems. Finally, several scholars, including Hirschi himself, have argued for a reconceptualization of self-control altogether that rejects the practice of operationalizing self-control as six elements that co-occur in the same individuals.

Although different personality classifications exist (e.g., McCrae and Costa's (1987) five factor model; Eysenck's (1970) biological based model of personality), they all take the similar approach of classifying cognitive, emotional, and behavioral tendencies along several independent higher order dimensions. In most of these classifications, items that tap into impulsivity and sensation seeking lie within different dimensions. For example, in McCrae and Costa's (1987) five factor model, sensation seeking is captured in the extraversion domain while impulsivity is captured in the neuroticism domain.[7] Importantly, the construction of personality axes *requires* that the traits in each axis are independent from those in other dimensions, which provides additional evidence that the self-control traits do not consistently co-occur in the same individuals.

In an attempt to explain elevated levels of risky behavior in adolescence, several scholars have introduced the dual systems model of risk-taking (Casey, Jones, & Hare, 2008; Steinberg, 2004, 2008; Steinberg et al., 2008). It is suggested that impulsivity is implicated in the cognitive control system of the brain, which is responsible for high-level decision-making and behavioral and emotional regulation while sensation seeking is implicated in the lower-level socioemotional system of the brain, which is sensitive to

[7] In some cases, impulsivity is captured in the conscientiousness domain instead of the neuroticism domain, (e.g. Roberts & Bogg, 2004) but regardless of model, items that capture sensation seeking-like traits and impulsive-like traits are classified on independent axes.

rewards, emotions, and novelty. While impulsivity is thought to steadily improve throughout adolescence and emerging adulthood, manifesting in consistently better regulation of behavior, sensation seeking appears to peak after puberty, creating an additional motivation to seek thrilling or exciting sensations during this period. Elevated risky behavior is thought to result during the temporal gap when sensation seeking drives increase, yet before the cognitive control system has developed sufficiently to inhibit sensation-driven behaviors. Additional tests of this model have demonstrated that impulsivity and sensation seeking do indeed appear to mature along different timelines. Harden and Tucker-Drob (2011) found diverging patterns of normative development for the two traits across early adolescence. Shulman, Harden, Chein, and Steinberg (2014) built off of the previous study and tested whether the growth in these two traits between the ages of 12 and 25 were prospectively related. They found no support for the idea that the development of these traits influence one another. Tests of this model demonstrate that these traits are important for explaining risky behavior, yet they should not be conflated in a global measure of self-control.

When studies explore the relationship between the traits of self-control and various relevant outcomes, a clear picture emerges that examining the traits independently is likely to be a more useful approach than using a global measure of self-control. Studies have compared the ability of these different approaches to predict imprudent behaviors (Arneklev, Grasmick, Tittle, & Bursik, 1993; Wood, Pfefferbaum, & Arneklev, 1993) and various types of crime among random community samples (Arneklev et al., 1993), non-random samples of high school students (Wood et al., 1993) and juvenile and adult offenders in treatment programs (Conner et al., 2009; Longshore et al., 1996). Without exception, the overall conclusion is that the individual elements (usually measured with the Grasmick et al. (1993) scale, including the six elements of 1)

impulsivity, 2) a preference for simple rather than complex tasks, 3) risk seeking, 4) a preference for physical rather than cerebral activities, 5) a self-centered orientation, and 6) a volatile temper) are better predictors of crime and analogous behavior than the combined scales. Although the specific conclusions regarding the relative importance of the various elements in predicting different types of crime vary by study, it is possible to draw a few broad conclusions. A preference for simple tasks and a preference for physical activities are two elements that consistently demonstrate the poorest (or no) ability to explain any of the measured outcomes. Impulsivity, risk-seeking, and volatile temper tend to demonstrate the strongest relationships with a variety of outcomes. Thus, it has been argued that examining the elements of self-control separately may be the best approach and failing to consider the unique contributions of the separate elements of self-control to criminal and analogous behavior has serious consequences, especially for effective interventions (Conner et al., 2009; Longshore et al., 1996).

It is worth noting that two of the elements in self-control, impulsivity and risk-seeking, often required additional discussion in these studies. In Grasmick et al.'s (1993) initial development of their scale, they found that one of the best-fitting solutions was a five-factor solution with all of the impulsivity items removed. Removing impulsivity, however, was not consistent with Gottfredson and Hirschi (1990)'s conceptualization of self-control so a one-factor solution was preferred. Arneklev et al. (1999) found that impulsivity appeared to be the central dimension of low self-control based on the strong factor loading of impulsivity on the latent factor of low self-control. While these two findings may suggest opposing conclusions about the importance of impulsivity in low self-control, they also provide motivation for the continued exploration of how impulsivity, uniquely, or in combination with other traits, is related to criminal behavior. The element of risk-seeking was particularly important in both Arneklev et al.'s (1993)

examination of imprudent behavior and Vazsonyi et al.'s (2001) examination of self-control's factor structure and ability to explain deviant behavior in four countries. Arneklev et al. (1993) concluded, "Gottfredson and Hirschi's key independent variable, low self-control, fares no better (in fact, somewhat worse) than risk seeking as a predictor of imprudence" (p. 243). Vazsonyi et al. (2001) found that risk-seeking was consistently the best predictor of a variety of deviant outcomes with the exception of assault.

Several studies have specifically contrasted the ability of impulsivity and sensation seeking to explain crime and analogous behavior and generally find that these two traits exhibit independent relationships with the outcome of interest and important correlates. Scholars have found that impulsivity and sensation seeking play different roles in alcohol, marijuana, and cigarette use (Gullo, Ward, Dawe, Powell, & Jackson, 2011; Littlefield, Stevens, & Sher, 2014; Magid, MacLean, & Colder, 2007; Quinn & Harden, 2013), binge eating, gambling, and poor school performance (Smith et al., 2007), and antisocial behavior (Burt et al., 2014; Smith et al., 2007). Furthermore, these two traits appear to show different sex patterns (Cross et al., 2011). That is, clear gender differences in levels of sensation seeking are consistently observed, with men showing elevated levels relative to women, while these differences appear to be absent when examining impulsivity, or only appear when specific forms of impulsivity are examined (a lengthier discussion of sex differences among these two traits is presented in a subsequent section).

While the purpose of this discussion is to critique the empirical validity of the argument that self-control exists as a latent trait (i.e. whether it is more appropriate and useful to employ a global measure self-control or specific traits to explain criminal behavior), this discussion would be incomplete without acknowledging how the

conceptualization of self-control has evolved over time. Several scholars, including Hirschi himself (Burt, 2012; Hirschi, 2004, 2007, Marcus, 2003, 2004) have called attention to contradictions and inconsistencies within the original publication of the theory and misinterpretations of the basic idea of low self-control by readers. There appears to be agreement between the original theory creators and critics that the trait Gottfredson and Hirschi (1990) were attempting to describe boils down to what has been similarly (but not exactly) captured in non-criminological work as impulsivity (Burt, 2012; Mamayek, Paternoster, & Loughran, 2017). Outside of the small section of their book in which the "elements of self-control" were (problematically) identified, Gottfredson and Hirschi (1990) consistently described low self-control as the tendency to engage in acts for immediate gratification, without consideration of the long-term negative consequences (see how similar this is to the definition of impulsivity provided previously). Furthermore, several of the elements of self-control, including sensation seeking, are motivational in nature, and Gottfredson and Hirschi (1990) explicitly rejected any role of motivational factors, arguing that motivation is a given and we must understand why we are restrained from crime (Burt & Simons, 2013). Thus, we are in a position where perhaps low self-control should be equated with common definitions of impulsivity and some of the other elements, especially sensation seeking, are incompatible with the control framework with which Gottfredson and Hirschi (1990) explain crime (that assumes constant motivation). In 2004, Hirschi admitted that their reliance on personality traits in their discussion of the elements of self-control "introduced a language [he] did not understand, championed ideas contradicting [their] theory, and otherwise muddied the waters" (p. 541). Thus, although a massive amount of research has been generated on self-control, the findings from studies employing the Grasmick et al. (1993) scale, or other similar scales that operationalize self-control as a

combination of six lower-level traits, is no longer consistent with contemporary definitions of self-control. Despite the reconceptualization of Gottfredson and Hirschi (1990)'s self-control, however, the studies relying on the Grasmick et al (1993) scale or similar scales, have produced a vast body of literature that provides important insights into how the "elements" of self-control are related to offending and develop over the life course.

In sum, although self-control is consistently associated with offending, and has even been named "one of the strongest known correlates of crime" (Pratt & Cullen, 2000, p. 952) we are becoming more and more aware that we are not sure what this finding means, given the heavy reliance on the Grasmick scale and Grasmick-like scales to capture self-control in criminological studies, the demonstrated evidence of independence of some of these elements, and Hirschi's (2004) personal rejection of the initial characterization of self-control as consisting of six traits that co-occur as a stable individual factor. Evidence suggests that the majority of the relationship between self-control and crime, when it is measured as lower-level elements, is primarily due to its disaggregated traits of impulsivity, risk-taking, and temper, which are independently related to offending behavior. Thus, the body of work generated by Gottfredson and Hirschi (1990)'s theory is limited due the conflation of independent traits when self-control is measured as a global trait, as has consistently been done since the publication of the theory. To be clear, other conceptualizations and operationalizations of self-control exist, but nearly all studies that claim to test Gottfredson and Hirschi's self-control measure it as a global construct that captures various lower-level facets. The purpose here is to clearly articulate the complications arising from treating self-control as a global factor of six lower-level traits as continues to be done in recent publications (see, e.g., Kim, Siennick, & Hay, 2018; Shoenberger & Rocheleau, 2017), and to suggest

that exploring impulsivity and sensation seeking independently is likely our best avenue forward should we continue to explore how traits or self-control related concepts are linked to offending. Despite the issues of trait conflation in Gottfredson and Hirschi's (1990) theory and tests of it, this body of work has led to important insights into the stability of traits related to offending. Specifically, tests of Gottfredson and Hirschi's self-control have challenged the idea of relative trait stability across the life course. Furthermore, this finding is consistent with research on traits in other disciplines.

Between- and Within-Individual Variation in Traits

While individual differences in traits have long been recognized, studied, and related to offending with the assumption that individual differences in traits are likely to contribute to individual differences in offending propensity, the potential for within-individual trait levels to change over time has largely been neglected in both empirical investigations and theoretical explanations of crime that incorporate personality traits. This neglect is likely due to the definition and assumed nature of a personality trait. That is, personality traits have been defined by their stable nature. They are thought to be enduring predispositions that present consistently across time and situation, yet recent evidence from a variety of fields is calling into question this fundamental basis of personality traits.[8]

Stability of Gottfredson and Hirschi's Self-Control

Although the conceptualization of self-control as a global factor consisting of six lower-level traits has been challenged by empirical evidence, tests of this version of self-control have provided important evidence about the stability of traits related to offending across the life course. Recall, Gottfredson and Hirschi (1990) initially treated

[8] However, debate on whether or not stable predispositions exist is not new. Mischel (1973) questioned the notion of stable traits fifty year ago. It appears as though the majority of researchers temporarily concluded that personality traits were valid constructs (Caspi et al., 1994), but concerns about the validity of this position appear to gaining momentum once again.

self-control as a stable, enduring higher-order personality trait, acknowledging that between-individual differences in self-control are key for explaining crime, yet denying that self-control is malleable past the ages of 8 to 10. They claimed that after this age individuals' positions relative to others in the distribution should remain the same over time. Although they anticipated maturational change, such that individuals should demonstrate improvements in self-control over time, they denied any relative reshuffling of the distribution. While evidence supports the notion that, overall, levels of self-control do appear to increase over time, regardless of population studied (Mitchell & MacKenzie, 2006; Turner & Piquero, 2002; Winfree, Taylor, He, & Esbensen, 2006)[9] the argument of relative stability has not consistently received empirical support. There appears to be significant change in self-control level for a substantial portion of individuals, above and beyond normative change. Several methods have been used to demonstrate relative instability of levels of self-control over time.

The most common method of examining the issue of relative stability of self-control is via stability coefficients—i.e. simple correlations between the same measure at two time points. High stability coefficients suggest that individuals who are relatively low on self-control at time one are the same individuals who are relatively low on self-control at time two. Low stability coefficients suggest that individuals are changing in their position in the distribution of scores over time. While less than perfect stability has been observed in every study (e.g., Arneklev et al., 1998; Beaver et al., 2013; Beaver & Wright, 2007; Burt et al., 2014; Higgins, Jennings, Tewksbury, & Gibson, 2009; Mitchell & MacKenzie, 2006; Turner & Piquero, 2002; Vazsonyi & Huang, 2010), the degree of

[9] For a couple exceptions, see Arneklev et al. (1998) and Higgins, Jennings, Tewksbury, & Gibson, (2009). Arneklev et al. (1998) examined the mean-level stability of self-control across the very short period of four months in a population of college student and found no evidence of change (although, when examining stability of individual elements, risk-seeking was the only element to demonstrate significant change). Higgins et al. (2009) examined mean-level stability of self-control from ages 12 to 16 and found small decreases from 12 to 14, an increase at 15, and decline again at 16.

instability varies widely. Self-control stability correlations have ranged from as low as .22 over a period of about 15 years from late childhood to early adulthood in a sample of African Americans who self-reported self-control levels (Burt et al., 2014) to as high as .96 from the start of kindergarten to the end of kindergarten in a national sample of 17,000 youth whose self-control was captured based on parent and teacher reports (Beaver & Wright, 2007). The majority of studies report correlations that suggest moderate correlations of self-control between two or more time points, and a clear pattern emerges such that as the time between measurements becomes longer, the smaller the stability coefficient. Both Burt et al. (2006) and Mitchell and MacKenzie (2006) attempted to quantify stability in a different way by calculating the percentage of individuals who changed quartiles between two time points, or by rank-ordering individuals and showing how many positions in the distribution each individual moved. Burt et al. (2006) took this approach with a community sample of African American males and females between the ages of 10 and 14 across two years while Mitchell and MacKenzie (2006) took this approach with a sample of incarcerated adult male offenders over a period of six months. Both studies found that the majority of individuals moved quartiles from time 1 to 2, and Burt et al. (2006) found that 52% of participants moved more than one standard deviation in ranking and slightly more than 21% of the sample moved more than two standard deviations.

While these studies have given us insight into the amount of distribution shuffling that might be occurring and hint at the amount of within-individual change in traits over time, they are unable to reveal anything about the nature of that reshuffling—are people moving in the same direction at different rates, or do drastically different developmental trajectories exist? Luckily, more advanced methods for modeling development over time have been introduced over the past couple decades. To address

how much variation there is around the mean-level pattern of increasing self-control over time, researchers have employed various types of longitudinal modeling techniques, such as growth curve or hierarchical linear modeling (HLM; Raudenbush & Bryk, 2002) and group-based trajectory modeling (GBTM; Nagin, 2005). HLM and growth curve modeling enable researchers to estimate parameters for both average initial trait level (at the start of the observation period) and the average growth rate over time while GBTM enables researchers to identify and visualize groups of individuals that follow distinct developmental patterns. Importantly, these advances enable researchers to test specific propositions made about the existence of developmental patterns of personality traits and their associations with developmental patterns of offending (e.g., Moffit's (1993) proposition of two qualitatively distinct types of offenders based on offending patterns over the life course, or Arnett's (1992) proposition that sensation seeking rises in all adolescents and should be linked to elevated offending during this time period).

Studies using HLM or growth curve modeling have produced mixed findings on between-individual variation in the development of self-control. Vazsonyi and Huang (2010) examined the development of self-control from age 4.5 to 10.5. Their sample consisted of youth belonging to families interviewed as part of a national study of child health and human development that targeted 10 different data collection sites across the US and included over 1500 families. Using latent growth curve modeling they found significant variance in initial value, but no variation in the rate of change of self-control over time, leading them to conclude that although between-individual differences in trait levels exist, there is no clear rank-order shuffling through the years captured in their study. However, two other studies using similar methods found significant variation in growth rates. Na and Paternoster (2012) used HLM to examine the stability of self-control with slightly older subjects. They captured self-control between grades 6 through

12 in a sample of around 400 youth in Baltimore public schools and found significant variation among the intercepts and slopes of individual trajectories. The covariance between the intercept and slope parameters also suggested that individuals with lower levels of self-control tended to gain it faster, which led the authors to conclude that substantial shuffling of the distribution of self-control may be occurring over time. Meldrum, Young, and Weerman (2012) examined the stability of self-control with growth curve modeling in a sample of Dutch students in schools between the ages of 12 and 16, with oversampling of "high risk" students from lower educational strata. They found significant individual variation in incepts and growth rates. Collectively, these studies reveal variance in growth rates observed after Gottfredson and Hirschi (1990)'s assumed age of self-control crystallization, but not before. It could also be the case, however, that the divergent findings are due less to age differences and more to measurement differences. Vazsonyi and Huang (2010) captured self-control with mother reports and 10 items from the Social Skills Rating System, while the other two studies both used self-reports of self-control based on the Grasmick scale or items reflecting some of the Grasmick scale items.

The several studies that employ GBTM allow us to summarize and characterize the shape of diverse trajectories and report a percentage of the population that is not likely to follow each different trajectory. While all GBTM studies reject the notion of absolute stability of self-control, they vary in the degree of relative stability they identify and the number and nature of diverse developmental trajectories identified. Higgins et al. (2009) used GBTM with a sample of nearly 3,500 adolescents drawn from six cities throughout the US. The adolescents were followed for six years, starting in sixth or seventh grade. Interestingly, their study is the only GBTM study on the stability of self-control to demonstrate relative stability. Four of the five trajectories showed near

absolute stability while one of the trajectories showed significant decreases in self-control over the observation period, yet the changes were not large enough to lead to any crossing with the other groups. However, it is important to note the short observation period. If the observation period had been extended into emerging adulthood, there is a possibility that relative instability would have been observed, especially if their declining group continued on its observed trajectory. Furthermore, this study used a self-control measure that captured only items related to impulsivity and risk seeking, and not the other four elements of self-control. Hay and Forrest (2006) examined the stability of self-control over a slightly longer time frame with group-based methods. They identified eight trajectories of self-control with a national sample of nearly 4,000 children aged 7 through 15 and concluded that 84% of that sample displayed relative stability (i.e. 84% of the individuals were classified into six groups with self-control trajectories that never crossed). This also meant that 16% of the population, divided among the two final groups, demonstrated significant instability. One group demonstrated significant improvements in self-control throughout the observation while a second group unexpectedly reported substantial losses in self-control throughout the observation period. Finally, Burt et al. (2014) identified six different trajectories of self-control among a group of nearly 800 African Americans followed from ages 10 to 24. Four of the six groups displayed relative stability while the other two groups, constituting about 35% of the sample, demonstrated substantial movement in the distribution over time. In general, and consistent with conclusions drawn from stability coefficient examinations, we see a clear pattern emerge that greater instability (both absolute and relative), is captured within longer follow-up periods.

Overall, a proportion of the population *does* appear to follow a normative pattern of self-control development in which self-control improves over time and individuals

retain their relative position in the distribution. However, the use of more advanced statistical methods that allow us to "view" the heterogeneity in trajectory groups has clearly demonstrated that some individuals follow developmental patterns of self-control that are meaningfully different from the normative trajectory and disrupt the distribution. While this building evidence of significant instability in self-control over time is important, drawing clear conclusions from this body of work is complicated by the previously discussed evidence pointing to the need to reconceptualize Gottfredson and Hirschi's self-control and separately examine the independent traits that have been conflated in global measures of self-control that are commonly used in criminology. While this body of evidence demonstrates that the global measure of self-control is not stable over time, it is unclear what is driving this instability—could it be impulsivity, sensation seeking, both, or neither?

Consistent with this argument, several studies have explicitly explored the stability of impulsivity and sensation seeking separately. These studies demonstrate that neither impulsivity nor sensation seeking are absolutely or relatively stable throughout the life course. Overall, studies have suggested that impulsivity, or its higher order big five factor, neuroticism, decreases linearly throughout the life-course (Carmichael & McGue, 1994; Monahan et al., 2009; Roberts, Walton, & Viechtbauer, 2006; Robins, Fraley, Roberts, & Trzesniewski, 2001; Steinberg, 2010; Vaidya, Gray, Haig, Mroczek, & Watson, 2008) [10] while sensation-seeing, or its higher order big five factor, the sociability component of extraversion, appears to increase in adolescence followed by a decrease or relative stability throughout the remainder of the life course (Caspi et al., 2005; Collado, Felton, MacPherson, & Lejuez, 2014; Harden & Tucker-Drob, 2011; Steinberg, 2010;

[10] Although, some studies have captured slight increasing in impulsivity right before or at the start of adolescence, before the linear improvement begins (e.g., Shulman et al., 2015; Vazsonyi & Ksinan, 2017)

Steinberg et al., 2008; Winfree et al., 2006). Recently, Steinberg et al. (2018) found that these general patterns were consistent around the world, with a sample that captured mean-level growth patterns of these two traits in 11 countries. While slight differences were observed in the magnitude or timing of changes, the developmental patterns of the two traits (i.e. the shape) were generally similar across countries. While sensation seeking demonstrated a curvilinear pattern with peaks in late adolescence or early adulthood for almost all countries (except Jordan, which displayed a surprising increasing trajectory over the entire period), the developmental patterns were slightly more diverse for impulsivity. About half of the counties demonstrated constant improvements in impulse control while the other half demonstrated a peak around early adulthood.[11] While the authors conclude that this study suggests remarkable consistency in developmental patterns of these traits, this study is limited by its cross-sectional nature and failure to capture any potential individual variation around the mean levels. While normative mean-level patterns are identifiable, latent growth models and group based trajectory models have provided clear evidence of population heterogeneity in the developmental patterns of these two traits, including variation in baseline levels and growth rates over time (Burt et al., 2014; Côté, Tremblay, Nagin, Zoccolillo, & Vitaro, 2002; Harden et al., 2012; Harden & Tucker-Drob, 2011; Lynne-Landsman, Graber, Nichols, & Botvin, 2011; Monahan et al., 2009, 2013; Pedersen, Molina, Belendiuk, & Donovan, 2012; Quinn & Harden, 2013; Vaidya et al., 2008). Furthermore, group-based developmental modeling methods have enabled us to capture distinct patterns of development in these two traits. However, there is much discrepancy in the number and shape of distinct trajectories identified. A summary of these studies is presented in Table

[11] I referred to Steinberg et al.'s (2018) second trait as impulsivity, but they have labeled this trait self-regulation. The measures employed in this study reflect the definition of impulsivity presented in this paper.

1. The studies included in the table are limited to those that explicitly looked for the existence of different developmental patterns in impulsivity or sensation seeking (e.g. studies that describe mean-level patterns or attempted to identify unique developmental patterns for males and females separately are not included here).[12]

Five studies were identified that explored the potential of distinct developmental trajectories of impulsivity. These studies all found that models consisting of more than one trajectory group fit the data best, but conclusions regarding the number and shape of distinct groups varied dramatically, with groups ranging from two to six. For example, Khurana, Romer, Betancourt, and Hurt (2018) and Diamond, Morris, and Piquero (2017) both identified two groups in their examination of impulsivity trends, but the identified trajectories were far from consistent. Khurana et al. (2018) identified one group characterized by low levels of stable impulsivity and one group that increases in impulsivity until around age 16-17 and then begins to decrease. Diamond et al.'s (2017) two groups were both characterized by overall reductions in impulsivity throughout the observation period. Although the studies captured different age ranges (11-18 in the former and 5-26 in the latter), they both captured changes in adolescence with one study demonstrating stability or increases during this time and the other showing decreases. At the other end of the spectrum, Burt et al. (2014) reported the largest number of distinct trajectories when they captured impulsivity between ages 10 and 24 in a community sample of over 800 African Americans. Their best fitting model consisted of six groups, three of which demonstrated the expected decreases in impulsivity over time, while one demonstrated dramatic rises, one demonstrated a curvilinear pattern, peaking during late adolescence, and one demonstrated high levels of stable impulsivity.

[12] Studies that examine sex differences in developmental patterns are summarized in Table 2.

Table 1. Summary of Studies Examining Heterogeneity in Developmental Patterns of Impulsivity and Sensation Seeking

Study	Sample Description	N	Sample age	Method	# Groups	Description of Developmental Patterns and Sex Differences
Impulsivity						
Littlefield et al. (2010)	First year college students	489	18-35	RM: FMM	5	4 relatively stable groups with different overall levels of impulsivity 1 group demonstrating major reductions between 18 and 25
White (2011)	Random sample of 1st grade boys in Pittsburgh public school	503	9-17	RM: GBTM	4	1 low stable group 3 groups with peaks: 1 high level of impulsive behavior, peaks around 12; 1 moderate level, peaks around 14; 1 low level, peaks around 11.
Burt et al. (2014)	Community African Americans	775	11-24	RM: GBTM; HLM	6	3 decreasing groups (different baselines and rates of improvement) 1 high stable group 1 peak during late adolescence group 1 increasing group
Diamond et al. (2017)	Simmons Longitudnal Study: community youth sample	349	5-26	RM: GMM	2	1: 66% of sample, sharp declines through adolescence and continued, slower declines into adulthood 2: 34%, sharp declines through adolescence, slight increase in early 20s *they only tested up to 3 groups and used single indicator of impulsivity
Khurana et al. (2018)	Philadelpha Trajectory Study	400	11-18 (average)	RM: LGCA	2	1: high baseline levels and increases through wave 4 and then decreases (6 waves) 1: lower baseline levels and almost no change
Sensation Seeking						
Lynne Landsman et al. (2011)	Drawn from control condition of randomized school-based substance use and violence prevention trial	868	grades 6-8	RM: GBTM	3	High stable group Low stable group Mid-level increasing group
Burt et a.l (2014)	Community African Americans	775	11-24	RM: GBTM; HLM	6	1 low stable group (largest--47.2%) 1 low slight increaser group 2 peaking groups (1 peaks in early adolescence, 1 peaks in emerging adulthood) 1 decreaser in early adolescence 1 decreaser in early adolescence followed by increases in emerging adulthood
Khurana et al. (2018)	Philadelpha Trajectory Study	400	11-18 (average)	RM: LGCA	1	Increases in sensation seeking until wave 5, declining after (6 waves)

ABBREVIATIONS: RM = Repeated Measures; LGCA = Latent Growth Curve Analysis; GBTM = Group-Based Trajectory Modeling; FMM = Finite Mixture Modeling; CS = Cross-Sectional; GMM: Growth Mixture Modeling

Despite the inconsistencies in results, some broad conclusions may be drawn. With the exception of one study (Diamond et al., 2017), when development before adolescence is captured, increases in impulsivity are consistently reported. Only when the observation begins later, such as in Littlefield, Sher, and Steinley's (2010) study, which began capturing developmental trends at age 18, do groups characterized by any increases in impulsivity fail to emerge. Furthermore, there appears to be a clear and unsurprising pattern such that the more variation in impulsivity the measure allows, the greater the number of identified groups. For example, Khurana et al. (2018) used a 9-item scale of impulsivity yet restricted the responses to each item in the scale to yes or no (i.e. you usually do or say things without thinking), collapsing variation in the degree of impulsivity that might have been reported for each item. This could be the reason they identified only two groups. The other study that identified only two groups (Diamond et al., 2017) stated that they only estimated models with up to three groups. This methodological limitation could have resulted in failure to identify the correct model and number of groups. The other three studies (Burt et al., 2014; Littefield et al., 2010; White et al., 2011) were more consistent in their findings. These studies suggest that the majority of the population either remains stable or decreases in impulsivity, especially after mid-adolescence.

Fewer studies have directly examined distinct trajectories of sensation seeking, but those that have, identified best-fitting models with as few as one group to as many as six groups. Surprisingly, in Khurana et al.'s (2018) study of 400 adolescents from the Philadelphia Trajectory Study followed from age 11 to 18 and interviewed at six times, they found no heterogeneity in sensation seeking trajectories. They determined that a one-class model fit the data the best. This trajectory was characterized by a quadratic curve with sensation seeking rising until about wave five and then declining thereafter,

which corresponds to a peak around age 16-17. Lynne-Landsman et al. (2011) identified three distinct developmental trajectories of sensation seeking in nearly 900 male and female adolescents between 6th and 8th grade drawn from public and parochial schools. They identified a low stable group and a high stable group, each accounting for about 20% of the population. The remaining 60% followed a moderate, increasing developmental trajectory.[13] None of these trajectories crossed, demonstrating relative stability over their observation period. It is important to note, however, that this study observed trait levels until grade eight, at the latest. Differences between these traits are likely to be highly important during adolescence and emerging adulthood (e.g., after puberty and when some externalizing behaviors associated with impulsivity and sensation seeking peak). It could be the case that substantial rank-order shifting occurs after this age, as was the case in the study by Burt et al. (2014), who captured levels of sensation seeking among African Americans between the ages of 10 and 25 and found substantial instability when they identified six distinct trajectories. Two of the trajectories were characterized by peaks in early adolescence or emerging adulthood, but the majority of the trajectories were characterized by more unexpected patterns. The largest group demonstrated low, absolute stability in sensation seeking. The second largest group demonstrated low sensation seeking with small increases throughout the entire observation period. The final two groups demonstrated significant decreases in sensation seeking between age 11 to early mid adolescence. Overall, it is clear more evidence of the developmental patterns of sensation seeking are needed. The limited number of studies examining these developmental patterns in combination with the

[13] However, the findings of this study should be interpreted with caution, especially given the focus of the current paper. Their measure of sensation seeking was a composite measure of items that captured *enjoyment of risky activities* and *self-control* (which they argued was a proxy for the disinhibition component of Zuckerman's sensation seeking scale, an approach the current author disagrees with).

various operationalizations of sensation seeking, age ranges, and follow-up periods in existing studies leads to unclear conclusions.

In sum, there is clear and building evidence that impulsivity and sensation seeking are key traits in the explanation of offending behavior. Furthermore, evidence from a wide variety of sources suggest that these traits should be considered independent traits that are not stable over time, demonstrate significant individual variation in development trajectories, and differentially predict various types of crime and analogous behavior. While these advances in understanding are important progress, perhaps the most essential question for a more complete understanding of the causal chain leading to eventual criminal behavior has been neglected: what determines levels of impulsivity and sensation seeking and changes in these traits over time? Understanding the unique contributions of impulsivity and sensation seeking to criminal behavior is useful, but to change these traits and ultimately impact criminal behavior, via interventions or broad social structural transformative efforts, we must understand their sources.

Sources of Between- and Within-Individual Variation in Traits

Discussion on the etiology and development of personality traits broadly, and impulsivity and sensation seeking specifically, has heavily focused on biological bases while largely neglecting potential social sources of influence. Some of the most prominent models of personality emphasize the biological origins of individual differences in traits and contemporary explanations of developmental patterns of impulsivity and sensation seeking highlight the role of underlying biological maturation.

For example, Eysenck (1970, 1978, 1996), the creator of the PEN model of personality, explicitly linked personality traits to underlying individual differences in biological processes. As previously discussed, he identified three distinct traits that he labeled extraversion, neuroticism, and psychoticism. He suggested that these traits have

their origins in genetic-based differences (i.e. differences in DNA). These differences lead to differences in "biological intermediaries" which manifest as different forms of limbic system arousal. These intermediaries then lead to differences in psychometric trait constellations (i.e. different levels on the P, N, and E scales). Although social factors are thought to matter for the link between personality trait possession and social behavior consequences (e.g., involvement in crime), trait levels are determined fully by biological differences.

Perhaps the most well-known and tested personality theory, the five factor model of personality (McCrae & Costa, 1999; McCrae et al., 2000), is based in an extreme biological deterministic perspective. According to McCrae et al. (2000), "personality traits, like temperaments, are endogenous dispositions that follow intrinsic paths of development essentially independent of environmental influences" (p. 173). Thus, between-individual differences in traits are due to genetic factors and changes in these traits over time are due to intrinsic maturation. The evidence in support of this model largely comes from studies that show consistency in mean-level development of traits across time and place. For example, McCrae et al. (2000) examined mean-level changes in the big five traits in individuals aged 14 and over in German, British, Spanish, Czech, and Turkish samples. They concluded that mean-level patterns were similar enough across all five samples to suggest that culture does not matter for the development of traits, and changes in traits over time must be due to some natural, biological process inherent in all humans.

In discussing the maturational timelines of impulsivity and sensation seeking specifically in their dual systems model of risk-taking, Steinberg and colleagues focus largely on normative neurological restructuring as the driving factor of changes in impulsivity and sensation seeking over time (e.g., Steinberg, 2008; Steinberg et al.,

2008). Specifically, intrinsic improvements in the cognitive control system lead to the normative decreasing trajectory of impulsivity observed throughout adolescence and emerging adulthood while intrinsic heightened reward sensitivity in the socioemotional system leads to a rise in sensation seeking during early adolescence before reductions in late adolescence and emerging adulthood. This normative development is thought to be universal and indeed, a recent study demonstrated that the normative patterns of development in these two traits are quite similar across 11 countries (Steinberg et al., 2018). Steinberg explicitly stated: "this disjunction is biologically driven, normative, and unlikely to be remedied through educational interventions designed to change adolescents' perception, appraisal, or understanding of risk" (Steinberg, 2004, p. 51). However, the studies regularly cited in support of the notion of universal, biologically based trait development are cross-sectional studies that draw conclusions based on reported mean-levels of traits at different ages, and fail to investigate potential individual variation around these mean levels. Furthermore, they generally do not account for the possibility that key social experiences may be consistent across countries, partially accounting for similar cross-country developmental patterns.

Finally, Zuckerman, the creator of the most well-known sensation seeking scale, views variation in sensation seeking as a result of biological differences (Zuckerman, 2007). Specifically, he notes that the heritability of sensation seeking is higher than most other personality traits and he points to various biological factors associated with sensation seeking levels, including sex hormones, the enzyme monoamine oxidase (MAO), and the D4 dopamine receptor gene (Daitzman & Zuckerman, 1980; Daitzman, Zuckerman, Sammelwitz, Ganjam, 1978; Zuckerman 1984; 1985; Zuckerman & Kuhlman, 2000). Biological correlates of sensation seeking is a topic that has continued to be explored with some frequency, with researchers pointing to a host of biological

characteristics that appear to be associated with sensation seeking levels including neurotransmitters or genes that regulate neurotransmitter function (Roberti, 2004). However, much of this research is necessarily performed on animals (rats), and the extent to which these relationships exist within the human population is uncertain. Despite much attention paid to the biological origins of sensation seeking in Zuckerman's writings over the last decades, he does note, "biology is *not* destiny. Genes are in constant interaction with environmental events and changing these events or their expectations can change behavior or divert the unhealthy personality expressions into healthier forms of behavior" (Zuckerman, 2007, p. 201).

These explanations of individual differences and normative developmental change based in biological origins are likely valid, at least in part, but these explanations are limited in several key ways. First, they are unlikely to fully explain changes in traits that meaningfully deviate from the normative developmental pattern, a phenomenon that is observed in a growing number of empirical studies (e.g. Burt et al., 2014; Côté et al., 2002; Harden & Tucker-Drob, 2011; Quinn & Harden, 2013). This points to the idea that these changes, for at least some individuals, are dependent on environmental conditions and/or social experiences. This notion of environmental importance is consistent with findings from heritability studies. While genes are consistently found to account for a significant portion of variance in trait level, it is nearly always that case that environmental factors also explain a substantial portion (Plomin, DeFries, McClearn, & McGuffin, 2008), including when the trait of interest is self-control (Beaver, Wright, DeLisi, & Vaughn, 2008), and heritability estimates have been criticized for potential methodological issues that overestimate the effects of genetic differences (Burt & Simons, 2015, 2014). Furthermore, associations between biological markers (for example, sex hormone levels) and trait levels should not be considered unidirectional

such that the only possible causal chain involves the biological characteristic causing the observed psychological characteristic. As an alternative, a biological moderation model would suggest exposure to certain environmental conditions may lead to elevated testosterone, which is then related to increased sensation seeking, for example. Thus, observed associations between biological characteristics and traits do not preclude the possibly that social experiences are also key to trait development. Finally, most of these purely biological explanations are being challenged by recent scientific advances that demonstrate the complexity with which biology and environment interact to produce phenotypes (observed characteristics, including personality traits). The growing field of epigenetics has demonstrated that gene expression may *depend* on environmental input (Bird, 2007). Thus, it is essential that research continue to explore social sources of trait variation.

Social Sources of Personality Trait Variation

In a pattern that somewhat mirrors the progression of self-control research, personality researchers have been uncovering more instability and individual variation in developmental patterns of traits than initially expected (e.g., Johnson, Hicks, McGue, & Iacono, 2007). Empirical papers are now searching for the causes of this instability and variability while theoretical models of personality are being updated to account for and explain this variability (see, for example, Lewis, 2001; Mischel & Shoda, 2008; Roberts & Caspi, 1990). Much of this work has grounded its exploration of non-biological sources of change in theoretical perspectives, such as the social investment principle (Roberts, Wood, & Smith, 2005) or the plasticity principle (Roberts, 1997) that emphasize the importance of changing social roles and major life experiences on trait development. The social investment principle suggests that individuals take on age-graded social roles that require certain behaviors via the norm expectations associated

with those roles (Roberts, Wood, & Smith, 2005). Thus, traits change to accommodate the age-graded roles, producing both a normative developmental pattern across the life course and between-individual variation in trait levels as people enter into these roles on slightly different timelines, have different expectations of the requirements of their roles, or refrain from taking on these new roles. Using these approaches, studies have demonstrated that intimate partner and family relationships (Lehnart et al., 2010; Neyer & Lehnart, 2007; Roberts & Bogg, 2004; Specht, Egloff, & Schmukle, 2011), negatively and positively appraised life events (Costa, Herbst, McCrae, & Siegler, 2000; Lockenhoff et al., 2009; Specht et al., 2011; Vaidya, Gray, Haig, & Watson, 2002), and job characteristics (Roberts, 1997; Roberts, Caspi, & Moffitt, 2003; Roberts, Walton, Bogg, et al., 2006) may be responsible for some of the observed personality change over time. Unfortunately, most of these studies have identified relationships between these predictors and higher order personality factors, not the lower-level factors, which would directly capture the how they may alter levels of impulsivity and sensation seeking. Thus, these observed relationships could be driven by changes in impulsivity and sensation seeking or other lower-level factors, yet this possibility has largely been unexplored.

Social Sources of Variation in Gottfredson and Hirschi's Theory

While the operationalization of Gottfredson and Hirschi's (1990) self-control as six elements has been challenged by empirical evidence, studies on the source of self-control (with this operationalization) have provided important insights into the social sources of traits linked to offending. As noted, very few criminological theories explicitly allow social factors to influence trait levels and as such, minimal research exists exploring potential social sources. However, the body of work exploring social sources of self-control is one exception. Many studies have now examined the source of Gottfredson and Hirschi's self-control, but these findings must be reinterpreted given our recent

recognition of the complications that arise from treat self-control as a global construct. That is, it is important to understand whether the factors deemed as important for establishing and influencing levels of self-control affect all elements of self-control broadly, or if various elements are independently responsible for the associations with identified predictors.

In addition to describing the make-up of self-control, Gottfredson and Hirschi (1990) addressed how self-control levels develop and persist over the life course. Departing from the commonly held view that traits are reflections of biological predispositions that endure throughout the life-course, they emphasized the social sources of trait development that are primarily at play during the early years of life. They suggested that self-control is primarily a consequence of parenting. Although other institutions, such as schools, have a secondary role in instilling self-control, the main responsibility lies with the primary caregivers who are capable of helping their children develop self-control by monitoring their children, recognizing deviant behavior, and punishing that behavior. Much research has been conducted to test whether self-control (and consequently it's elements) is affected by parenting. This research has confirmed that parenting influences levels of self-control, but not in the exact form as Gottfredson and Hirschi (1990) suggested. Gottfredson and Hirschi (1990) suggested that parenting only matters until the age of 8 to 10. Parenting does indeed appear to matter during this time (Na & Paternoster, 2012; Turner et al., 2005; Vazsonyi & Huang, 2010), but it also matters in later years (Burt, Simons, & Simons, 2006; Hay & Forrest, 2006; Meldrum, 2008; Na & Paternoster, 2012), in more complex ways than suggested by Gottfredson and Hirschi (1990) (e.g., Blackwell & Piquero, 2005; Chapple et al., 2010; Hay, 2001; Nofziger, 2008; Perrone et al., 2004; Unnever et al., 2003), and it most certainly does not fully explain levels of self-control. For example, Vazsonyi and Huang (2010) found

that parenting explained less than 10% of variation in developmental changes of self-control before age 10.5. Meldrum (2008) found that parental monitoring, single parent household status, and several demographic control variables only explained around 5% of the variance in self-control combined, and Perrone, Sullivan, Pratt, and Margaryan (2004) found that parental efficacy, in combination with demographic factors, only explained about 7% of the variance in self-control. In a relatively recent review of the parenting proposition of Gottfredson and Hirschi (1990)'s theory, Cullen, Unnever, Wright, and Beaver (2008) concluded that the theory's narrowness, in its focus on parenting, "leaves too much variation in the nature or parenting and in the nature of self-control unexplained. Its claims of generality are overstated and its dismissal of alternative causal factors is indefensible" (p.69). However, empirical tests of the theory have expanded our understanding of which social factors may matter for self-control development and how.

While studies nearly invariably find parenting effects, they are more nuanced than Gottfredson and Hirschi (1990) suggested. Specifically, Gottfredson and Hirschi (1990) suggested that parents only need to monitor their children, recognize deviant behavior, and punish it when it occurs. Discipline or punishment appears to matter, but it is the nature of the discipline that is important, not just the presence. For example, Pratt et al. (2004) found that increased discipline was related to reductions in self-control while other studies have found that in order for discipline to show a positive relationship with self-control, it needs to be consistent or perceived as fair (Hay, 2001; Unnever et al., 2003). Overall, parenting variables that are consistently positively related to self-control appear to capture elements of supervision, attachment, and warmth (e.g., Burt et al., 2006; Chapple et al., 2010; Cochran et al., 1998; Hope, Grasmick, & Pointon, 2003; Perrone et al., 2004; Pratt et al., 2004).

Several scholars have taken on the question of which other factors, besides parenting in its various forms, might be responsible for the development of self-control and continue to affect levels of self-control beyond the key period of development that Gottfredson and Hirschi (1990) identified. These studies have found each of the following factors to be related to levels of self-control: school and peer relationships (Agnew et al., 2011; Burt et al., 2006; Meldrum et al., 2012; Meldrum, 2008; Turner et al., 2005); neighborhood characteristics (Forrest & Hay, 2011; Pratt et al., 2004; Teasdale & Silver, 2009; Turner et al., 2005; Unnever et al., 2003)[14]; experiences with victimization (Agnew et al., 2011); household structure (Blackwell & Piquero, 2005; Chapple et al., 2010; Winfree et al., 2006); maternal characteristics (Nofziger, 2008); and major life events, (Forrest & Hay, 2011).[15]

While this growing body of literature has demonstrated that parenting and additional environmental factors continue to influence levels of self-control throughout adolescence and adulthood, the meaning of these findings are clouded by the growing evidence of the need to disaggregate self-control's elements. The extreme majority of these studies have been performed with measures of self-control that use the Grasmick et al. (1993) scale, limited items from the scale, or items that are intended to capture the "elements" of self-control that Gottfredson and Hirschi presented in their theory (see Appendix A for specific measures). Thus, it is not clear whether these changes in self-control are operating through impulsivity, sensation seeking, both, or neither. For example, it could be the case that sensation seeking is largely unresponsive to

[14] However, some studies suggest that all of the neighborhood effects on self-control are partially or fully mediated by parenting practices and demographic variables (e.g., Cochran et al., 1998; Gibson et al., 2010; Hope et al., 2003; Meldrum, 2008).
[15] See Buker (2011) for a thorough review of literature focused on the formation of self-control, but note, Buker (2011) includes explanations of self-control formation that are not limited to a focus on Gottfredson and Hirschi (1990)'s conceptualization of self-control.

environmental influences, yet impulsivity is more responsive and driving the observed changes in self-control.

Social Sources of Impulsivity and Sensation Seeking

Studies testing for potential associations between social/environmental experiences and levels of impulsivity and sensation seeking are nearly nonexistent. Only three studies were identified that directly address this topic. Although not the primary focus of their study, Quinn and Harden (2013) found that maternal characteristics were associated with initial levels and rates of the change in impulsivity and sensation seeking over time in a sample of over 5000 individuals from a nationally representative sample followed from age 15 to 26. With the exception of one characteristic, maternal delinquency, impulsivity and sensation seeking were associated with different characteristics. In addition to maternal delinquency, impulsivity was associated with maternal cognitive ability, earlier age at first birth, and depression while sensation seeking was associated with maternal years of education. White et al. (2011) limited their analysis to the trait of impulsivity, and found evidence of substance use covarying with impulsivity for a portion of their sample. They performed group-based trajectory analysis to explore variation in impulsivity trajectories among their sample of just over 500 boys from the Pittsburgh Youth Study, followed from first grade through age 24-25. After identifying four groups that follow different trajectories, they examined the effect of adding of lagged time-varying heaving drinking variable to their model and discovered that increases in heavy drinking in the prior year was associated with increased impulsivity in the largest group, but not all groups. Quinn, Stappenbeck, and Fromme (2011) attempted to more directly parse out potential bidirectional effects (i.e. traits altering substance use versus substance use altering traits) in a sample of nearly 1500 male and female college students at a public university across three waves of data

collection. They provided evidence that heavy drinking in college significantly predicted change in both impulsivity and sensation seeking after accounting for the effects of traits on drinking.

Conclusions

It should now be clear that most models of personality and theoretical approaches to crime that invoke personality traits are limited by their assumptions of relative or absolute stability. Most assume that once individual differences in trait levels are formed early on in the life course or determined before birth via genetic predispositions or in-utero experiences, they remain time-stable factors that exert consistent effects on behavior throughout the life-course. Research is showing that this assumption in untenable. Studies of Gottfredson and Hirschi (1990)'s self-control and personality traits broadly demonstrate change above and beyond what is expected as normative maturation. Given this emerging evidence of instability, scholars have attempted to identify sources of both between-individual differences and within-individual changes in self-control and personality traits over time. However, this research is limited in important ways. While evidence suggests that certain forms of parenting and perhaps victimization, neighborhood context, and school context affect levels of and changes in self-control, the underlying mechanisms are unclear. Do these factors broadly affect all traits captured by Gottfredson and Hirschi's self-control or are the mechanisms more precise? Emerging evidence suggests that these mechanisms may indeed be more precise, especially when considering the lower-level facets of impulsivity and sensation seeking. Impulsivity and sensation seeking should be thought of as independent traits with different normative developmental patterns, underlying neurological structures, and associations with offending. Studies that have specifically examined the traits of impulsivity and sensation seeking, however, have largely neglected

to examine sources of variation. Rather, this work is dominated by biological explanations. Thus, the central aim of this study is to address this gap in knowledge by exploring social sources of variation in impulsivity and sensation seeking across a twenty-year period.

Social Schematic Theory as a Framework for Trait Variation

As mentioned, most theories of crime that incorporate individual differences, as personality traits, in their explanations assume at least relative trait stability, yet empirical evidence suggests this assumption is inappropriate. One theory that accommodates this reality of within-individual variation in trait levels over time is Simons and Burt's (2011) Social Schematic Theory (SST). The SST is a particularly appealing explanation of crime as it successfully integrates key factors from multiple theoretical approaches (strain, cultural, control, social-learning, and life course) into a coherent framework that emphasizes how individuals adapt to social circumstances in ways that can be meaningfully linked to criminal behavior. This theory uniquely accounts for how variation in environments may produce characteristic adaptions (i.e. traits) that increase the propensity for criminal behavior. Thus, the SST provides an account of both the importance of traits in the explanation of criminal behavior and an explanation for how and why these traits may change over the life course, highlighting the importance of key socio-environmental factors.

Acknowledging the consistently strong evidence within criminological literature on the relationship between diverse socio-environmental conditions and offending, Simons and Burt (2011) propose a new mechanism for how these conditions lead to offending. Specifically, previous research has consistently demonstrated that parenting, community characteristics, peers, and other group-specific harsh experiences, such as racial discrimination, increase the likelihood of offending. Although these factors are

often examined separately, Simons and Burt suggest that they are united by the shared messages they send to individuals. They suggest that these various conditions work together to send messages to individuals about the way world works. When individuals are consistently exposed to various situations that send similar messages, these messages are internalized in the form of schemas. Schemas can be thought of as characteristic ways of viewing and interpreting the world that link our past experiences to our future behavior. Schemas act as heuristic tools to sort through the extreme variety of stimulus input we are exposed to, to help us quickly make decisions regarding the meaning of new situations, based on past experiences, and the most appropriate course of action based on that meaning. Thus, schemas act as mediating factors between previous experiences, such as exposure to neighborhood crime or poor parenting, and future behavior, such as offending. Individuals who are exposed to a common set of experiences then, should be expected to hold similar schemas, interpret new situations in similar ways, and engage in predictable forms of behavior.

Simons and Burt (2011) suggest that three key schemas are important for explaining the relationship between socio-environmental factors and offending, and these include, 1) a hostile view of people and relationships, 2) a cynical view of conventional norms and 3) a preference for immediate rewards. Possession of these schemas will increase the likelihood that individuals will justify criminal behavior and therefore engage in it. To identify these three schemas, Simons and Burt integrated a large body of work on characteristic ways that offenders view themselves, their situations, and the legitimacy of their criminal behavior. For example, the notion that offenders hold a schema that guides interpretation of others as hostile is consistent with Dodge and colleagues' work on the hostile attribution bias (Dodge, 2006; Dodge, Bates, & Pettit, 1990). Empirical studies have demonstrated that some people are more likely to

hold a bias that leads them to interpret ambiguous cues as possessing hostile intent (e.g., an accidental bump is more likely to be interpreted as an intentional shove by individuals who possess this bias, and consequently, different courses of action will be preferred based on the meaning attributed to the bump—i.e. whether the bump is viewed as accidental or intentionally hostile). Individuals who hold a hostile view of others are cynical and expect other people to be selfish, untrustworthy, cheaters who are likely to take advantage of them, and criminal behavior that harms others, then, is more justifiable. The notion that offenders hold a schema that guides them to interpret conventional rules and norms as invalid is consistent with both learning and social control theories that emphasize the role of commitment to conventional conduct (e.g., Akers, 1998; Hirschi, 1969). Finally, the notion that offenders hold a schema that guides them to prioritize immediate gratification in courses of action is consistent with the vast body of scholarship that links self-control to offending (Gottfredson & Hirschi, 1990).

Importantly, one of the three schemas, a preference for immediate rewards captures tendencies consistent with impulsivity and sensation seeking. Thus, they expect that impulsivity and sensation seeking are partially consequences of exposure to certain socio-environmental factors and will increase the likelihood of offending. Their arguments are consistent with previous theoretical and empirical evidence linking these traits to common socio-environmental predictors of offending including harsh parenting (Gottfredson and Hirschi, 1990), deviant peers (Burgess & Akers, 1966; Warr, 2002), and negative community characteristics (Morenoff, Sampson, & Raudenbush, 2001; Sampson, Morenoff, & Gannon-Rowley, 2002). Simons and Burt suggest that these adverse social conditions are related to a preference for immediate rewards because these conditions send messages about the certainty of the future, the utility of waiting for delayed rewards to manifest, and the fairness of the world. Research has demonstrated

that when long-term rewards are unlikely to manifest, individuals engage in steeper future discounting (Brezina, Tekin, & Topalli, 2009). That is, if a positive outcome is less guaranteed in the future, immediately gratifying action becomes more appealing. Furthermore, in the midst of these harsh and unpredictable circumstances, the potential payoff for high risk, novel, or exciting experiences may outweigh even costly negative consequences (Daly & Wilson, 1985). Thus, behavior driven by impulsive action and risk taking is likely to be more common when individuals are persistently exposed to adverse environmental conditions that indicate the world is unpredictable and harsh. And, it follows, behavior driven by impulsive action and risk taking is likely to be less common when individuals are consistently exposed to supportive and predictable environmental conditions.

Because the purpose of this study is to explore factors that influence levels of sensation seeking and impulsivity, Simons and Burt's (2011) proposed mechanism of how adverse conditions lead to schemas is of central interest. However, it may be useful to quickly elaborate on the other theoretical propositions made by Simons and Burt. They also suggest that the three schemas generally covary and are mutually reinforcing. As such, they are combined into what they label the criminogenic knowledge structure (CKS). The CKS can be thought of as a higher-order cognitive structure that guides interpretations of situations and legitimizes criminal behavior in certain situations. Possession of a high CKS does not directly link to criminal behavior. Rather, they suggest that the CKS increases the probability that situations are interpreted as justifying law violating behavior. Thus, a full explanation of offending behavior involves both the schemas that individuals bring into situations and cues provided within situations. Additionally, this theoretical approach is unique in that it assumes future discounting is likely to be an appropriate response tendency given certain environmental conditions

and constraints. In other words, departing from the traditional view that impulsivity and a focus on immediate gratification is a sign of a deficit, this theory treats it as an appropriate adaptation to one's surroundings. Or put even more simply, individuals learn what will give them the best outcome given their context/situation and act accordingly.

Initial tests of the theory have provided support for the three schemas, their contribution to a higher order criminogenic knowledge structure, and its relation to offending. With their publication of the theory, Simons and Burt (2011) demonstrated that changes in parenting practices, community crime, poor collective efficacy, racial discrimination, and deviant peers over time was related to changes in the three social schemas with structural equation modeling and a sample of over 700 African Americans between ages 12 to 18. They also demonstrated that their three schemas represented one latent trait (the CKS) that mediated the relationship between these social conditions and crime, with one exception. Racial discrimination maintained a direct effect on crime after considering commitment to the CKS. The role of deviant peers was also unique. The other social conditions had both direct influences on the CKS and indirect influences through deviant peers. In a follow-up study Simons, Burt, Barr, Lei, and Stewart (2014) found additional evidence that adolescent adversity increased the CKS as well as selection into criminogenic activity spaces. The CKS and heightened selection into criminogenic activity spaces increased the likelihood of offending, but this effect was through the use of situational definitions that legitimized offending. Baron (2017) provided additional support for the theory when he applied it to the criminal offending of street youth. He incorporated homelessness and emotional neglect as additional adverse conditions and found that Simons and Burt's (2011) proposed mechanisms provided a good explanation of the youths' criminal behavior. Although several adverse

conditions maintained direct effects on crime, much of the offending was mediated by the CKS. Overall, initial evidence suggests that the SST may provide a valuable framework for understanding how characteristic ways of perceiving and behaving are established and increase the probability of engaging in crime.

Thus, the present study employs the SST as a framework for identifying factors that may explain some of the developmental variation between individuals in impulsivity and sensation seeking. The SST suggests that adverse social environments are likely to increase levels of impulsivity and sensation seeking while supportive social environments are likely to decrease levels of impulsivity and sensation seeking due to the diverse messages they send about the way the world works. Although Simons and Burt (2011) captured both impulsivity and sensation seeking as facets of the immediate gratification schema in initial descriptions and tests of the theory, previously discussed emerging evidence highlights the independence of these traits. It could be the case that while overall patterns may be similar such that, broadly, adverse conditions affect impulsivity and sensation seeking the same direction, there may be important nuances. A comparison of stability coefficients for impulsivity and sensation seeking suggests that impulsivity is less stable than sensation seeking and as such, we may expect that impulsivity is more responsive to socio-environmental input than sensation seeking. Thus, a key aim of this dissertation is to examine whether factors affecting levels of impulsivity are specific or general and if these two traits should indeed be captured together in the preference for immediate gratification schema.

Sex Differences

As noted, one of the most consistent findings within criminological literature is that males offend at higher rates than females (Steffensmeier & Allan, 1995). Although the specific nature of the sex difference appears to vary by type of crime and

developmental phase of the life-course (Moffitt, Caspi, Rutter, & Silva, 2001), the sex disparity is undeniable, and these sex differences may be partially explained by personality differences between males and females. Indeed, theories that invoke personality traits into their explanations of criminal behavior often highlight sex disparities in trait levels. Furthermore, empirical evidence has confirmed that sex differences in impulsivity and sensation seeking do appear to be meaningfully linked to sex differences in offending behavior (Byck, Swann, Schalet, Bolland, & Mustanski, 2015; Vazsonyi & Ksinan, 2017).

Gottfredson and Hirschi (1990) suggest that the sex gap in offending is primarily due to greater self-control in women. While they acknowledge that opportunities for engaging in crime may account for some of the sex gap, they suggest self-control should play a larger role in determining sex patterns of offending. Research has consistently supported the notion that males demonstrate lower levels of self-control than females, on average, and this disparity partially explains sex differences in offending and antisocial behavior (Burton, Cullen, Evans, Alarid, & Dunaway, 1998; Nagin & Paternoster, 1993; Thijs, Dijk, Stoof, & Notten, 2015; Wood et al., 1993). However, emerging evidence once again complicates our interpretation of these findings. First, given our field's heavy reliance on the Grasmick et al. (1993) scale or similar scales that aim to capture the "six elements" of self-control discussed by Gottfredson and Hirschi (1990) and the recognition that the elements of self-control should be disaggregated and examined separately, it is unclear whether sex differences in impulsivity, sensation seeking, or other elements of self-control exist and are driving some of the observed sex disparity in self-control. Second, this explanation only forces us to push the explanation of the sex gap in offending a step further back—i.e. what, then, explains the difference in trait levels across sex?

Simons and Burt (2011) incorporated an explicit discussion of expected sex differences, and their sources, in their presentation of the SST. They predicted that the criminogenic knowledge structure would fully explain the sex gap in offending, and that is exactly what they found. They suggested that males and females would differ in their schemas (i.e. traits), but this difference would fully account for the sex gap in offending. Thus, to understand sex differences in offending, it is key to understand why and how males and females differentially develop levels of the mediating traits. Based on previous research they suggest that sex differences in schemas are partially explained by males experiencing more adverse social conditions than females (e.g., Sobsey, Randall & Parrila, 1997; Warr, 2002). However, a larger portion of the difference is likely to be explained by evolved sex differences. Evolutionary theorists have articulated how the diverse reproductive roles and selection pressures for males and females have favored different personality traits for the two sexes. Specifically, the level of involvement required for child rearing drastically varies across sex. Mothers are more critical to the survival of the children and devote a much greater amount of time to rearing each child. Thus, it is more important for women to be cautious and avoid risky situations to ensure the survival of their progeny (Campbell, Muncer, & Bibel, 2001). Males, however, do not need be as cautious in avoiding dangerous situations to ensure the survival of their offspring, and the benefits of risky and impulsive behavior are likely to outweigh the costs (Campbell & Muncer, 2009). Indeed, risky behavior may pay off when men are competing against other men for access to mates (Daly & Wilson, 1985). Thus, evolutionary pressures have selected for lower fear thresholds in women compared to men and more aggressive and risk taking tendencies in men.

Thus, the SST, and existing tests of it (Burt, Lei, & Simons, 2017; Simons & Burt, 2011; Simons et al., 2014) lead us to expect that males will experience slightly elevated

levels of adverse conditions relative to females. However, the effect of the conditions on traits should vary by sex. Females should be less likely to demonstrate elevated levels of impulsivity and sensation seeking than males given comparable exposure to adverse social conditions. Overall, we may expect that biological factors act in combination with social influences to explain the sex difference in traits, the CKS more broadly, and in offending. To be clear, evolutionary processes such as those described by Simons and Burt (2011) should also partially explain differences within sex groups—i.e. they should also broadly explain variation in individual personality levels (but not directly linked to the different male and female roles in reproduction). Several evolutionary psychologists have reconceptualtized personality traits as "alternative strategies for solving recurrent adaptive problems" (Buss, 2009, p. 364). Personality traits represent preferred methods of responding to problems faced by all humans, such as negotiating social hierarches and gaining access to resources, in addition to raising offspring. Importantly, these problems vary across context and time; individuals will be faced with different problems at different times and will have differential access to resources available to address those challenges. Thus, preferred strategies will also vary across context and time, based on what is likely to be the most successful strategy given competing problems and contextual restrictions. The same mechanisms proposed in SST to explain within-individual adaptation and development over the life-course and differences between the sexes should also explain sources of individual variation in personality traits.

Gottfredson and Hirschi (1990) and Simons and Burt (2011) both account for sex differences in offending by highlighting sex differences in trait levels. Furthermore, they both point to the role of socio-environmental factors as a cause of the sex disparity in trait levels. However, their major point of divergence is in what they expect throughout the life-course. Specifically, as a consequence of their stability postulate, Gottfredson and

Hirschi assume that sex differences will remain relatively stable past the ages of 8 to 10. Simons and Burt (2011) view schemas as individual characteristics that continue to be malleable across the life-course, dependent upon exposure to certain messages embodied in socio-environmental contexts. Simons and Burt's (2011) perspective appears to be more consistent with empirical reality demonstrated by studies of sex differences in trait levels.

Sex Differences in Impulsivity and Sensation Seeking

Arriving at clear conclusions regarding sex differences in impulsivity and sensation seeking is a difficult task given the extensive inconsistencies in the literature regarding the meaning, overlap, and factor structure of these traits. Despite this limitation of the literature, it does appear that males consistently report higher levels of sensation seeking compared to females (e.g., Ball, Farnnill & Wangeman 1984; Beauducel, Strobel & Brocke 2003; Caspi et al., 1997; Newcomb & McGee, 1991; Rolison & Scherman, 2002; Roth, Schumacher, & Brähler, 2005; Zuckerman, Eysenck, & Eysenck, 1978; Zuckerman, Kuhlman, Thornquist, & Kiers, 1991; Zuckerman & Neeb, 1980). However, one major exception appears with the use of the experience seeking subscale of Zuckerman's Sensation Seeking Scale. Cross, Cyrenne, and Brown (2013) performed a meta-analysis of studies that specifically employed Zuckerman's Sensation Seeking Scale and compared sex disparities across the four different facets of the scale (boredom susceptibility, thrill and adventure seeking, experience seeking, and disinhibition). They included all identified studies in which Zuckerman's scales were used to capture levels of sensation seeking in males and females and in which participants were over the age of 17 and populations were not selected based on pathological, criminal, or addictive behavior (three outcomes related to elevated levels of these traits). They found that, overall, males consistently score higher than women. They

also evaluated changes in the sex disparity over the past 35 years to explore whether the sex gap in sensation seeking may have any cultural basis (i.e. possible changing gender roles) and discovered that the sex gap on the overall scale remained stable, but different patterns were observed upon evaluation of the separate dimensions. Specifically, sex differences in disinhibition and boredom susceptibility remained stable, but the sex difference in the thrill and adventure seeking dimension declined. Over the past 35 years, males demonstrated thrill and adventure seeking levels that more closely matched female levels. This meta-analysis suggests that the various facets of sensation seeking might need to be disaggregated to understand sex differences. Importantly, the sensation seeking measure employed in the current study only captures one of Zuckerman's four facets: thrill and adventure seeking. This is the form of sensation seeking that is most commonly linked to offending behavior and has demonstrated some of the most consistent sex differences.

One of the most comprehensive studies of sex differences in these traits was performed by Cross et al. (2011). They performed a large meta-analysis of sex differences using studies that employed various measures of impulsivity and different populations (but limited to ages 10 and above). Given the definitional problems in the literature regarding impulsivity and sensation seeking, they tackled the issue of conceptual distinctness of these traits in their review. They initially grouped measures of impulsivity into one of six categories: reward sensitivity; punishment sensitivity; sensation seeking and risk taking; general impulsivity; specific forms of impulsivity; and behavioral measures of impulsivity and examined effect sizes for the six kinds of measures separately.[16] They found consistent evidence of sex differences in sensation seeking. The

[16] The measures employed in the current study are consistent with three of these categories. The current study's measure of impulsivity is most similar to the categories of "general impulsivity" and "narrow impulsivity" while the current measure of sensation seeking is similar to their

total effect size for all sensation seeking measures was .39 with men reporting higher levels of sensation seeking than women. Sex differences in general impulsivity were much smaller. General impulsivity studies captured impulsivity by asking general questions about impulsivity such as "I am an impulsive person." The overall effect size for all studies was significant, yet the magnitude was quite small (d = .07). Men were slightly elevated in levels of general impulsivity. It is much more difficult to identify a pattern of sex differences with the specific impulsivity measures. These measures of impulsivity capture domain or context-specific forms of impulsivity such as motor impulsivity or task perseverance. Males reported significantly higher levels of impulsivity with some measures while females reported higher levels on others, and in still others, no significant differences emerged in either direction. Overall, male impulsivity was higher for a slight majority of the measures, but females showed higher urgency, a form of impulsivity that specifically captures impulsiveness under emotional arousal, and the authors suggested that sex differences might disappear when measures evaluate cool cognitive process and may be more pronounced when individuals are forced to control their behavior in emotionally "hot" situations.

This meta-analysis suggests that there are clear differences in levels of sensation seeking between the sexes, yet differences in impulsivity may depend on the type of impulsivity being captured (general versus specific and type of specific). Furthermore, while this meta-analysis provides a good starting point for the exploration of sex differences in these traits, it is limited by its focus on summarizing the magnitude of sex differences across a variety of measures at one time point. That is, it does not provide any insight into potential sex-specific developmental patterns over time or into potential differences among individuals within sex.

---

category of sensation seeking and risk taking and as such, only sex differences in these domains are reviewed.

Several studies have tackled the issue of whether developmental patterns in these traits vary by sex. A summary of these studies is presented in Table 2. The top half of the table provides a summary of studies that have examined sex differences in impulsivity development and the bottom half summarizes studies focused on sensation seeking. Six studies were identified that examined sex differences in impulsivity with four of them observing sex differences. Collado et al. (2014) and Khurana et al. (2018) examined impulsivity development across the adolescent years with different methods and neither observed significant sex differences. Collado et al. (2014) found that impulsivity was best characterized by a curvilinear trajectory with increases until around age 16-17, followed by decreases through the end of the observation period, and males and females did not differ in baseline levels of impulsivity or rate of change. Khurana et al. (2018) identified two distinct impulsivity trajectories but found that males and females did not differ in these developmental patterns. Although the other four studies varied in their sample characteristics and methodology, they produced consistent findings. Males consistently report higher levels of impulsivity than females, yet the overall developmental pattern is similar across sex, with increases in early adolescence, followed by decreases or stability in late adolescence and early adulthood (Shulman et al., 2015, Vazsonyi & Ksinan, 2017). When studies do not capture early adolescence, the increases in impulsivity are not observed (e.g., Cauffman et al., 2017).[17] Furthermore, when studies capture emerging adulthood, they generally find that females decrease in impulsivity at a faster rate than males (Cauffman et al., 2017; Shulman et al., 2015).

Six studies were also identified that examined sex differences in developmental patterns of sensation seeking. Only one study (Collado et al., 2014) failed to find sex

[17] However, the lack of increase observed in this study could also be due to the high-risk sample. The baseline for impulsivity was relatively high to start with and there is nowhere for these individuals to go except for staying stable or improving in impulse control.

Table 2. Summary of Studies Examining Sex Differences in Developmental Patterns of Impulsivity and Sensation Seeking

Study	Sample Description	N	Sample age	Method	Sex separated	# groups	Description Developmental Patterns and Sex Differences
Impulsivity							
Côté et al. (2002)	Public School Kindergartners in Quebec	1,867	6-12	RM: GBTM	Y	M: 4 F: 4	Male: 1 low stable (22%), 2 decreasing (high-28%, low-35%), 1 increasing (14%) Female: 1 low stable (43%), 2 deceasing (high-15%, low-16%), 1 moderate stable (26%)
Collado et al. (2014)	Nonrandom sample of of 5th and 6th graders in Washington D.C. area	277	9-18	GM: HLM	N	n/a	Normative curvilinear trajectory over time: uncreases in impulsivity through wave 4, decreases after (5 waves total) No sex differences
Shulman et al. (2015)	NLSY and CNLSY	8,270	10-25	RM: LGCA	Y	n/a	Similar male and female shapes: increases in impulsivity ages 10 to 14-15 followed by decreases through age 25 Male higher than female at every age Sex difference not constant: females show faster rate of decreases
Cauffman et al. (2017)	Pathways to Desistance: serious juvenile offenders	244	15-24	RM: GBTM	Y	M: 2 F: 2	Male: 1 high group that remained stable and one low group that improved in impulse control Female: similar shapes to male groups, but improvement in low impulse group occurred at a faster rate, and larger proportion of sample in low impulsivity group
Vazsonyi & Ksinan (2017)	International Study of Adolescent Development and Problem Behaviors (11 countries)	15,839	12-27	CS	N	n/a	Similar male and female shapes: increases in impulsivity until age 15-16, followed by decreases through age 27 Male higher than female at every age with the smallest difference at start of observation period (age 12)
Khurana et al. (2018)	Philadelpha Trajectory Study	400	11-18 (average)	RM: LGCA	N	2	2 gropus, one low stable and one higher group that increses through wave 4 and then decreases (6 waves total) No sex differences
Sensation Seeking							
Zuckerman et al. (1978)	English subjects: Maudsley Twin Register (947) American subjects: U of Delaware (97 undergrads)	1,044	16-70	CS	Y	n/a	Males higher than females at all ages Similar rate of change across sex Both sexes linear decreases in impulsivity between 16 and 70
Lynne Landsman et al. (2011)	Drawn from control condition of randomized school-based substance use and violence prevention trial	868	grades 6-8	RM: GBTM	N	3	High stable group, low stable group, mid-level increasing group Males overreprestened in high stable group Females overrepresented in low stable group
Collado et al. (2014)	Nonrandom sample of of 5th and 6th graders in Washington D.C. area	277	9-18	RM: HLM	N	n/a	Normative trajectory characterized by linear increases over time with no sex differnces
Shulman et al. (2015)	NLSY and CNLSY	8,270	10-25	RM: LGCA	Y	n/a	Male higher than female at every age, sex difference not constant Similar overall shape for male and females: dramatic rise between ages 10 and 14-15, peak between ages 15-19, folled by reductions through 25 Females peak earlier and demonstrate faster reduction in sensation seeker after the peak
Vazsonyi & Ksinan (2017)	International Study of Adolescent Development and Problem Behaviors (11 countries)	15,839	12-27	CS	N	n/a	Similar male and female shapes: rise until around age 16 and then decrease Male higher than female and female decrease at a faster rate after late adolescence
Khurana et al. (2018)	Philadelpha Trajectory Study	400	11-18 (average)	RM: LGCA	N	1	One group identified: increases through wave 5, followed by reductions (6 waves total) Females lower baseline levels and slower rate of change

NOTES: Sex separated column indictes whether male and female samples were analyzed independently; n/a in # groups indicates that group-based analyses were not performed
ABBREVIATIONS: RM = Repeated Measures; LGCA = Latent Growth Curve Analysis; GBTM = Group-Based Trajectory Modeling; FMM = Finite Mixture Modeling; CS = cross-sectional; GMM: Growth Mixture Modeling

differences. In this study of a non-random sample of 5th or 6th graders followed from around age 9 to 18, sensation seeking development was characterized by a linear, increasing trend across the entire observation period, and males and females did not differ in baseline levels or rate of change. As with the studies on impulsivity, developmental patterns of sensation seeking vary by developmental period captured. The only study that failed to demonstrate any increases in sensation seeking used a cross-sectional cohort approach with individuals between ages 16 and 70 (Zuckerman et al., 1978). This study found that males report higher levels of sensation seeking than females at all times, but the linear declines in sensation seeking over time are nearly identical for males and females. Studies that capture earlier developmental periods (e.g., Khurana et al., 2018; Lynne-Landsman et al., 2011; Shulman et al., 2015; Vazsonyi & Ksinan, 2017) capture increases in sensation seeking. This increasing trend is observed for some of the population in middle school (Lyyne-Landsman et al., 2011), and is the normative trend for both males and females between the ages of 10 and 14-16 (Shulman et al., 2015; Vazsonyi & Ksinan, 2017).

In sum, both cross-sectional and longitudinal studies demonstrate that males consistently display higher levels of sensation seeking than females. This conclusion holds across different age ranges and populations (e.g., general versus high risk), and especially when isolating sensation seeking characterized by the desire for *risky* or *thrilling* sensations. The evidence regarding impulsivity is less straightforward. While the majority of studies have found sex differences, with males demonstrating more impulsive behavior than females, there are some exceptions. This literature is limited in two additional ways, beyond the occasionally conflicting findings on male and female differences in trait levels and development. First, there are very few studies that have captured variation in developmental patterns *within* sex groups. That is, most existing

work has examined differences in normative developmental patterns of these traits across sex and have failed to consider whether unique developmental trajectories may be identifiable within sex. Only two studies have taken this approach when examining impulsivity and none have taken this approach when examining sensation seeking. Of the two impulsivity studies, one is limited by a focus on the elementary and middle school years only (Cote et al. 2002) while another is limited by its high-risk sample, which likely limits variation in the traits of interest (Cauffman et al., 2017). However, both of these studies did identify important sex differences. Second, and most importantly, with few exceptions, this research has not moved beyond the descriptive and predictive stage. That is, most studies describe levels of these traits over time and use them to predict a variety of outcomes, yet few studies have directly explored sources of these traits and the potential causes of these observed sex differences.

Current Study

The goal of the present study is to address several gaps in the literature regarding the development of impulsivity and sensation seeking, two traits consistently linked to antisocial and criminal behavior. Adding to the body of literature that demonstrates substantial variation in developmental patterns of impulsivity and sensation seeking, this dissertation explores variation in these traits over a longer period of time than has previously been reported with a sample of African Americans. Second, this dissertation addresses the major gap in both criminological and psychological work on social sources of variation in traits. While criminological work has identified various social sources of variation in levels of self-control across the life course, emerging evidence on the independence of traits conflated in Gottfredson and Hirschi's (1990) self-control suggests that impulsivity and sensation seeking should be examined separately. Although psychological research has explored social sources of variation in traits, much

of this work also fails to directly capture impulsivity and sensation seeking by focusing on higher-order personality factors. Thus, using the SST as a framework, this dissertation explores how social sources may explain variation in impulsivity and sensation seeking specifically. Finally, no existing studies examine how social sources of impulsivity and sensation seeking may vary by sex. While research consistently demonstrates that males report higher levels of sensation seeking across the life course than females, the potential social sources of this disparity have remained unexplored. Thus, this study addresses this gap by first characterizing differences in developmental trajectories of impulsivity and sensation seeking across sex and exploring whether effects of social factors on trait levels are general or sex-specific. The specific research questions and hypotheses guiding this dissertation follow:

RQ1. How much individual variation exists in developmental trajectories of impulsivity and sensation seeking?

a. *Using HLM, is there significant individual variation in levels and growth rates of impulsivity and sensation seeking?*

   There is conflicting evidence regarding variation in developmental trajectories of impulsivity and sensation seeking, but the majority of evidence suggests that individuals differ both in baseline levels and rates of change over time in these traits. Thus, impulsivity and sensation seeking are expected to demonstrate variation in both baseline levels and rates of change for the sample of African Americans used in this study.

RQ2. Are factors identified by the Social Schematic Theory (SST; Simons & Burt, 2011) able to explain variation in developmental trajectories of impulsivity and sensation seeking?

a. *Using HLM, do these factors account for some of the variation in both between- and within-individual levels of impulsivity and sensation seeking over time?*
b. *Are the two traits similarly affected by socio-environmental factors? That is, is impulsivity associated with the same socio-environmental factors as sensation seeking?*

Greater exposure to harsh and unpredictable socio-environmental factors is expected to be related to higher levels of impulsivity and sensation seeking. Greater exposure to supportive socio-environmental factors is expected to be related to lower levels of impulsivity and sensation seeking. According to SST, the same factors should be associated with impulsivity and sensation seeking.

RQ3. Do trajectories of impulsivity and sensation seeking vary by sex?

a. *Using HLM, do males and females demonstrate different baseline levels, growth rates in impulsivity and sensation seeking?*
b. *Using GBTM, do males and females differ in both number and shape of developmental trajectories of impulsivity and sensation seeking?*

Males are expected to demonstrate higher baseline levels of sensation seeking and impulsivity than females. Females are expected to demonstrate faster rates of change in trait levels than males. The sex disparity is expected to be larger for sensation seeking than for impulsivity. Males and females are expected to demonstrate differences in the number and shape of impulsivity and sensation seeking trajectories. Furthermore, a smaller proportion of females are expected to be assigned to developmental trajectories characterized by high levels of the traits compared to males.

RQ4. Do factors identified by the SST vary in their ability to explain variation in impulsivity trajectories and sensation seeking trajectories across sex?

a. *Using HLM, do sex and SST factors interact to explain variation in developmental patterns of impulsivity and sensation seeking? That is, does the importance/strength of the factors depend on sex or are general mechanisms observed?*

Overall, the same harsh and supportive socio-environmental factors are expected to influence male and female trait levels. The effects of these factors on female trait levels is expected to be weaker than the effects on male trait levels.

Chapter 3: Data and Methods

Overview

This chapter details the methodology employed in this study. First, data collection procedures are described, followed by a summary of the final sample used to test the research questions. Second, the dependent and independent variables are described. For variables measured as scales, several items in each scale are described and scale properties are reported. Finally, the analytic strategy used to address the research questions are outlined.

Procedures

The data for the present study were taken from the Family and Community Health Survey (FACHS). The FACHS is an ongoing longitudinal investigation of African-American families originally based in Georgia and Iowa. The survey currently consists of seven waves of data, collected every two to three years. At the first wave of data collection, completed in 1998, the families resided in small towns and rural areas in which the neighborhoods displayed substantial variety in socioeconomic status. Families were recruited based on the identification of a fifth-grade target youth. The target youth, along with his or her primary caregiver and a secondary caregiver if one was present, was interviewed. See Simons et al. (2002) for a more thorough discussion of sampling, recruitment, and interviewing strategies employed during data collection. The FACHS is an appropriate data source for the present study as it focuses on various influences on youth development, including those related to family processes and community characteristics. Specifically, the survey captures items reflecting impulsive tendencies and preferences for sensation seeking behavior along with factors that may influence these traits.

Sample

Information from 6 of the 7 waves was employed in the present study. Wave 3 information was not included because the key measures of impulsivity and sensation seeking were not captured at this wave. Initially, 889 target youth (and their families) were interviewed. Of these initial participants, 88%, 80%, 78%, 79%, and 63% were reinterviewed in waves 2, 4, 5, 6, and 7, respectively. If participants missed a wave of interviews, they were not dropped from the study. Rather, they were given the opportunity to be included in subsequent waves (thus explaining the rise in percentage retained from wave 5 to 6). For the analyses performed in this study, information for the impulsivity and sensation seeking measures was required for at least 3 of the 6 waves. This criterion created a final sample size of 782. Of the final 782 targets, 55% provided full information for all six waves employed in the analyses while 27%, 11%, and 7% provided full information for five, four, and three of the waves, respectively. See Table 3 for sample size and age and sex distribution across the 6 used waves. There was no broad evidence that attrition selectively ruled out cases in a systematic manner. Families who participated in wave 2 interviews were not significantly different from the families who participated in wave 1 interviews in terms of family income, parental education level, or child's age, school performance, delinquency, or self-control (Burt et al., 2006). Additional attrition analyses were performed to test for selective attrition on three key variables in this study (impulsivity, sensation seeking, and sex) throughout all waves. Generally a pattern emerged such that participants in waves 2 through 7 did not differ from non-participants. However, individuals interviewed in waves 4 and 7 were more impulsive than individuals who were not interviewed, and a greater percentage of participants in wave 7 were female.

Table 3. Sample Size and Summary Statistics of Sex and Age Across Wave

	Wave 1	Wave 2	Wave 4	Wave 5	Wave 6	Wave 7
Total *n*	782	723	710	686	695	556
Male *n*	349	324	310	291	292	214
(%)	(44.6)	(44.8)	(43.7)	(42.4)	(42.0)	(38.5)
Female *n*	433	399	400	395	403	342
(%)	(54.4)	(55.2)	(56.3)	(57.6)	(58.0)	(61.5)
Age Mean	10.5	12.3	18.8	21.6	23.6	28.8
Age Min	9	11	16	19	21	27
Age Max	12	15	21	25	26	31

Measures

Dependent Variables

Impulsivity. Following Burt, Sweeten, and Simon's (2014) lead, impulsivity is measured as a 10-item scale. The 10 items are listed in Appendix B, but examples include, "you have to have everything right away," and "when you ask a question, you often jump to something else before getting an answer." Participants were asked to report whether the statements were "not at all true," "somewhat true" or "very true" for them. The scale was coded so that higher scores indicate higher levels of impulsivity. The scale score was calculated by averaging responses to all 10 items. The scale demonstrated good internal consistency (mean cronbach's α across all 6 waves = .70).[18]

Sensation Seeking. Again following the lead of Burt, Sweeten, and Simons (2014), sensation seeking is measured as a 4-item scale. The 4 items are listed in Appendix B, but examples include, "you would do almost anything for a dare" and "life with no

[18] The items selected for inclusion in the impulsivity scale (and all other scales) were initially chosen because they were the items that consistently appeared across all survey waves from the previously validated impulsivity scale. However, additional analyses were performed to confirm that the limited version of the scales (i.e. with missing items from the previously validated and published scales) could still be considered the most reliable version of the. I confirmed that the reliability of the scale was maximized across waves. The items producing the most reliable scale slightly varied from wave to wave. Items were retained if, overall, they improved the reliability of the scale. For example, dropping one item would have improved the reliability of the scale in wave 7 but it would have worsened the scale in waves 1 through 6, and thus that item was retained.

danger would be dull for you." These items were originally drawn from Eysenck and Eysenck's (1978) personality inventory and capture whether respondents enjoy taking risks and engaging in dangerous activities. Participants were asked to report whether the statements were "not at all true," "somewhat true," or "very true" for them. The scale score was calculated by averaging responses to all 4 items. Higher scores indicate higher levels of sensation seeking. The scale demonstrated adequate internal consistency (mean cronbach's $\alpha = .65$).

Independent Variables

The independent variables employed in the current study were primarily identified based on Simons and Burt's (2011) explanation of relevant socio-environmental factors in their theoretical presentation of the SST and future tests of it. Measures that are consistent with this work include the primary caregiver measures, neighborhood crime, and interpersonal racial discrimination. The additional measures, morbidity/mortality and romantic partner measures, were added based on consistency with arguments made in the SST and empirical evidence of the importance of these measures (elaborated below).[19]

With the exception of sex, all independent variables are time-varying. All time-varying variables except those relating to romantic partner relationship quality were captured at all waves and ask about the experiences during the past year or six months. Questions asking about romantic partner presence and nature of the relationship were

[19] In the current study, primary caregiver relationship quality, morbidity/mortality, neighborhood crime, interpersonal racial discrimination, and romantic partner relationship quality are explored as predictors of trait levels. Gottfredson and Hirschi (1990) suggested that these social experiences should be considered *consequences* of levels of self-control, not causes. Simons and Burt suggest that the causal chain is not unidirectional and much more complex. See the discussion section for an elaboration on the different mechanisms proposed by the social schematic theory and Gottfredson and Hirschi (1990) for explaining the association between these experiences and trait levels.

added at wave 4. Thus, the two scales used to capture romantic partner relationships are included for waves 4 through 7 only.

Sex is measured as a dichotomous variable (females = 1; males = 0). In some models, sex is included as an independent variable. Other models are performed on subsets of the sample, divided by sex. Of course, in these models, the sex variable is not included as it is a constant (male subsample n = 349; female subsample n = 433).

Age. At each interview, participants were asked share their current age in years. In general, each wave captured a range of about 4 to 5 years. The youngest target youth at wave 1 was age 9 and the oldest target youth at wave 7 was age 31. For HLM analyses age was centered at age 9 to capture baseline levels at the start of the observation period.

Primary Caregiver Hostility is used as time-varying measure of environmental harshness. It is measured as a 4-item averaged scale. The items on the scale were drawn from a global parenting style instrument developed by Conger et al. (1992) for the Iowa Youth and Families Project and adapted for use on the target youth. The full instrument included measures of parental hostility, supportiveness, warmth, discipline, problem solving, inductive reasoning and positive reinforcement. Items used for this scale captured only parental hostility and although the original scale included 13 items that captured these parental tendencies, only 4 items were consistently included across all waves, and thus, the measure used here is limited to those 4 items. The full list of items is available in Appendix B, but examples of items in this scale include, "during the past 12 months, how often did your [Primary Caregiver] get so mad at you that [he/she] broke or threw things?" and "during the past 12 months, how often did your [PC relationship] push, grab, hit, or shove you?" The respondents could answer with always (1), often (2), sometimes (3), or never (4). The scale was reverse coded so that high scores indicate

higher levels of harsh parenting. The scale demonstrates adequate internal consistency (average cronbach's α = .60).

Primary Caregiver Warmth is a time-varying measure of environmental supportiveness. It is measured as a 4-item averaged scale. These items were once again drawn from the parenting instrument developed by Conger et al. (1992) for the Iowa Youth and Families Project. The items used for this scale captured parental warmth and supportiveness and although this original scale included 9 items, only the 4 items used here were consistently present in all waves. Examples of items in this scale include, "during the past 12 months, how often did your [Primary Caregiver] tell you [he/she] loved you?" The respondents could answer with always (1), often (2), sometimes (3), or never (4). The scale was reverse coded so that high scores indicated higher levels of warm parenting. The scale demonstrates good internal consistency (average cronbach's α = .77).[20]

No Primary Caregiver As the target youth aged, some of them reported that they no longer had primary caregivers, either because they were no longer in contact with a primary caregiver or because their caregiver passed away. Thus, not all targets were able to report on primary caregiver warmth and hostility at all waves. To account for this data issue, a dichotomous variable was created to capture the presence of a primary caregiver. If targets reported that they had primary caregivers at the current wave, they were assigned a 0. If the targets reported that they no longer had primary caregivers or their primary caregivers passed away, they were assigned a 1. All targets reported primary caregivers in waves 1 and 2. In waves 4, 5, 6, and 7, .08%, 2.3%, 4.9%, and 9.1% reported

[20] It could be the case that primary caregiver effects (both hostility and warmth) diminish as individuals move out of the home and other relationships become more important. The methods employed in this study assume constant primary caregiver effects. Thus, supplemental analyses will be performed to check for timing effects.

that there was no longer a primary caregiver present. If a target indicated that he or she did not have a primary caregiver, the primary caregiver hostility and warmth questions were skipped for that individual. To maintain these individuals for analyses, the missing data on the hostility and warmth items was replaced such that these individuals were grouped in with the individuals who reported never experiencing hostility or warmth from their primary caregivers. This is consistent with the theoretical framework as not having a primary caregiver prevents the individual from receiving messages about the supportiveness or hostility of the world, while controlling for the specific effects of the absent caregiver with the dichotomous presence variable.

Morbidity/Mortality is a time-varying measure of environmental harshness that captures exposure to death, sickness, and violent victimization. It is measured as a 5-item variety count scale. Examples of items in the scale include "during the past 12 months, did a friend die?" and "in the past 12 months, were you seriously injured or ill?" All items in this scale are dichotomous and contribute one point to the morbidity/mortality scale if answered in a confirmatory manner (no = 0; yes = 1); higher scores indicate higher exposure to indicators of morbidity/mortality.
Morbidity/mortality is included as an independent variable because it is consistent with mechanisms proposed by the SST. Specifically, the underlying mechanism for producing variation in schemas and traits is variation in exposure to harsh and unpredictable conditions versus exposure to supportive and predictable conditions (Simons et al., 2014). Morbidity/mortality indicators have been frequently used in evolutionary-based approaches that link exposure to harsh and unpredictable environments to variation in psychological traits, including impulsivity and sensation seeking (Belsky et al., 2012; Ellis et al., 2012) even though they have rarely been incorporated in criminological work. Exposure to sickness and death sends messages to individuals that there is no guarantee

of a long life. Thus, it may be advantageous for individuals in certain conditions, including those characterized by higher levels of death and sickness to prioritize immediate gratification. Consequently, individuals who are exposed to high levels of morbidity and mortality should be more likely to demonstrate impulsive and risk seeking behaviors.[21]

Neighborhood Crime is a time-varying measure of environmental harshness. It is measured as a 3-item averaged scale with items drawn and adapted from the community deviance scale developed for the Project on Human Development in Chicago Neighborhoods (PHDCN; Sampson, Raudensbush, and Earls, 1997). This scale captures exposure to crime in the neighborhood surrounding where the target youth lived over the past year. The participants were asked about how often there was a fight in which a weapon like a gun or knife was used, how often there was a sexual assault or rape, and how often there was a robbery or mugging. They could answer with often (1), sometimes (2), or never (3). Items were reverse coded so that high scores indicate more exposure to crime over the past year. The scale demonstrates adequate internal consistency (average cronbach's $\alpha = .60$). Although the practice of measuring neighborhood characteristics via participant perceptions has been criticized for good reasons, such as same source bias in which the participant provides information on both the outcome of interest and its predictors (e.g., Duncan & Raudenbush, 1999), there are both practical and theoretical reasons for employing a perception-based measure in the current study. First, perception-based measures provide the only source of neighborhood crime in the existing data set. Second, given the theoretical propositions being explored in the current

[21] Morbidity/mortality will initially be treated as a global scale due to the tendency of life history theorists (e.g., Ellis, 2009) to combine indicators of death and sickness into one overarching concept. The items are united by the similar messages they send to individuals. Indicators of both death and sickness suggest that life may be short and thus fast life history strategies, including preferences for immediate gratification, may be more advantageous. However, I will also explore how outcomes change when I separate out items that capture exposure to sickness, exposure to violence, and exposure to death in three separate measures.

study, it is likely the case that perceptions of crime matter more than objective levels of crime. The SST suggests that environmental experiences send messages about the way the world works and alters how individuals interpret and respond to their worlds. If there is a mismatch between objective crime levels and perceptions of crime, the perception of crime is likely to be the more important factor.

Interpersonal Racial Discrimination is a time-varying measure of environmental harshness. It is measured as an 11-item averaged scale. The items come from a revised version of the Schedule of Racists Events (SRE; Landrine & Klonoff, 1996) a validated scale that captures perceived racism over the past twelve months. The participants were asked how often various events were experienced "just because of your race or ethnic background." Examples of items include "how often has someone ignored you or excluded you from some activity" and "how often have you been treated unfairly." Participants could answer with never (1), sometimes (2), often (3), or (4) always. See Appendix B for the full scale. The scale demonstrates good internal consistency (average cronbach's $\alpha = .70$).

Romantic Partner Warmth is a time-varying measure of environmental supportiveness and closeness. It is an averaged 3-item scale that captures how often the target's romantic partner, if he or she had one, displayed supportive behavior toward the target over the past month. The items were drawn from a scale developed for the Iowa Youth and Families Project (Conger et al., 1992). Examples of items include "how often did [romantic partner name] act loving and affectionate toward you" and "how often did [romantic partner name' let you know that he or she appreciates you, your ideas or the things you do." Participants could answer with always (1), often (2), sometimes (3), or never (4). Items were recoded such that high scores on this variable indicated high levels

of romantic partner warmth and supportiveness. The scale demonstrates excellent internal consistency (average cronbach's $\alpha = .96$).

Romantic Partner Hostility is a time-varying measure of environmental harshness. It is an averaged 2-item scale that captures how often the target's romantic partner, if he or she had one, was hostile or dishonest to the target over the past month. The items were drawn from a scale developed for the Iowa Youth and Families Project (Conger et al., 1992). Although the initial scale included 5 items, only the 2 items that were consistently included in waves 4 through 7 were used in the scale. Participants were asked "how often did [romantic partner name] shout or yell at you because they were mad at you" and "how often did [romantic partner name] push, grab, shove, slap, or hit you? Participants could answer with always (1), often (2), sometimes (3), or never (4). Items were recoded such that high scores on this scale indicated greater levels of romantic partner hostility.

No Romantic Partner is a dichotomous variable that captures whether or not the target was in relationship with a significant other at the time of the interview. The survey items inquiring about romantic partner status varied across the waves. As mentioned, no questions about romantic partners were included in waves 1 and 2 when the target youth average age was around 10 and 12, respectively. In wave 4, targets were asked to select which statement best represented their situation out of the following: 1) I am not dating or seeing anyone right now; 2) I date but do not have a steady, romantic relationship; 3) I date one person a regular basis but can still see other people; 4) I am in a steady, committed relationship but not engaged; 5) I am engaged to be married and don't live with my fiancé; 6) I live with my romantic partner but we do not currently have plans to marry; 7) I live with my romantic partner and we are engaged to marry; and 8) I am married. If the target answered with 3 or above, he or she was asked follow-up questions

about the romantic partner and the nature of their relationship. Thus, in wave 4, targets who selected 1 or 2 were coded as not having a romantic partner (= 1) and targets who selected 3 and above were coded as having a romantic partner (= 0) for the romantic partner missing dichotomous variable. In waves 5 through 7, targets were directly asked if they currently had a romantic partner. Those who answered no were coded 1 and those who answered yes were coded 0 and asked the follow-up romantic partner questions. In waves 4-7, 53%, 55%, 55%, and 65%, of the targets reported current romantic partners, respectively. If a target did not report a romantic partner, the missing data for the romantic partner items was replaced, grouping these individuals in with the individuals who reported never experiencing romantic partner warmth and never experiencing romantic partner hostility (i.e. they were assigned 1s on all items capturing romantic partner experiences). This practice is consistent with the theoretical expectation of the nature of effects of these social interactions as a 1 on these items appropriately represents an absence of messages from this potential social influence. Importantly, as noted, the romantic partner items were added to the FACHS at wave 4 when the targets reported an average age of 18.8 years. Thus, information on romantic partners is not captured in waves 1 and 2. To account for missing data on romantic partner presence an additional dichotomous variable, called *missing RP,* was included as a control to capture potential effects of the missing information (1 = missing for all subjects in waves 1 and 2; 0 = present for all subjects in waves 4 through 7). The primary caregiver and romantic partner variables are only incorporated into analyses with their necessary controls (no primary caregiver, no romantic partner, and missing RP).

While the SST does not highlight the role of romantic partner interactions as a potential source of trait/schema variation, romantic partner relationship quality is one of the few variables that has been linked to changes in personality traits within

psychological research that aims to tease out reciprocal effects between social factors and traits levels (i.e. whether the association between trait level and relationship quality is primarily due to individuals selecting into certain relationships because of pre-existing trait levels or partially due to relationship experiences altering trait levels. Furthermore, an assumption that exposure to harsh or supportive messages from romantic partners would influence trait levels much like exposure to harsh or supportive messages from primary caregivers, is not unreasonable. It may actually be key to capture this source of messaging in later adulthood when the relevance of primary caregiver interactions may be diminishing.

Control Variables

Deviant Peers is a time-varying measure that captures how often the target thinks his or her friends engage in various illegal or deviant activities. It is an averaged scale of 7 likert-type items. Example items include, "during the past 12 months, how many of your close friends have stolen something inexpensive (less than $25?)" and "during the past 12 months, how may of your close friends have hit someone with the idea of hurting them?" Participants could respond with (1) none of them, (2) some of them, or (3) all of them? The scale demonstrates good internal consistency (average cronbach's $\alpha = .80$). See Appendix B for all items included in the scale.

SES is a categorical proxy for socioeconomic status. This variable was only present at the wave 1 interview and is thus included as a time-stable measure. The primary caregivers were asked, "how often in the past year have you had no money at all?" and could respond with (1) often, (2) sometimes, or (3) never. Thus, higher scores on this scale indicate higher socioeconomic status.

Analytic Strategy

The present study employs two methods of longitudinal data analysis to address the primary aims of evaluating the degree of variability in developmental trajectories of impulsivity and sensation seeking over time, identifying social factors that explain some of this variation between individuals, and comparing whether the effects of these factors are general or sex-specific.

The first method employed in this study is hierarchical linear modeling (HLM; Raudenbush & Bryk, 2002; Singer & Willett, 2003). This type of modeling accounts for nesting of observations within individuals over time and allows researchers to explore not only developmental patterns of outcomes of interest, but it also enables researchers to identify factors that explain some of the variation both between- and within-individuals over time. The second method employed is group based trajectory modeling (GBTM; Nagin, 2005). GBTM is a semiparametric modeling method that allows for identification of population subgroups that appear to follow similar trajectories of development on variables of interest (here, impulsivity and sensation seeking) over time. The benefit of GBTM is that it may reveal unique trajectories that would have remained hidden with other common longitudinal modeling methods, such as hierarchical linear modeling. This method also enables researchers to calculate the proportion of the population likely to belong to each trajectory group.

All research questions will be addressed with hierarchical modeling while only sex differences in developmental patterns of impulsivity and sensation seeking will be addressed with group-based trajectory modeling. First, using HLM, unconditional growth models of impulsivity and sensation seeking will be presented using all six waves of available data to capture average patterns of growth in these two traits over time. Time in these models will be estimated as a function of age. A series of models will be

estimated to determine which growth pattern (constant, linear, quadratic, or cubic) most appropriately captures the normative developmental patterns of the two traits. Random effects will be allowed such that it is possible to identify any individual variation in both intercepts and growth rates (slopes). Next, conditional effects of sex and time-varying covariates on these trajectories will be modeled to explain variation in the intercepts and growth rates of these trajectories. Covariates will be entered into a series of models in a step-wise fashion (Singer & Willett, 2003). This process enables the researcher to allow theory to guide the final model selection and to capture potentially important mediating or confounding effects. To help guide in final model selection, a variety of indices will be examined, including Deviance, Bayesian information criterion (BIC; Schwarz, 1978), and Akaike's information criterion (AIC; Akaike, 1987). All of these models will be performed in Stata 12.

The group-based trajectory models of impulsivity and sensation seeking will be estimated to explore potential heterogeneity and sex differences in developmental patterns in these traits. These models will estimate trajectories of impulsivity and sensation seeking based on age alone. All GBTM analyses will be performed in SAS (Statistical Analysis Software, version 9.4), using the Proc Traj macro (Jones, Nagin, & Roeder, 2001). Given that both impulsivity and sensation seeking are continuous variables created by averaging responses to likert-type items, models will assume a censored normal distribution of the dependent variables. To identify the best-fitting solutions (the models with the number and shape of trajectories that most likely produced the observed patterns within the data) I will employ a stepping-stone approach (see Sweeten, *in progress*). This approach improves the model selection procedure by systematically altering start values, group numbers, and growth polynomials to identify the best solution. Several models with the lowest BIC (i.e. best) values will also be

compared on additional model fit criteria identified by Nagin (2005), including the average posterior probabilities for group membership, average odds of correct classification, entropy, and divergence (discussed below). The ultimate best model will be determined by the sum of the evidence from all fit statistics.

Chapter 4: Results

This chapter presents the results of all statistical analyses performed. Summary statistics and bivariate correlations are briefly reviewed before presentation of the results directly addressing the four research questions driving this dissertation. Summary statistics for all key variables (collapsed across waves) are presented in Table 4. Full sample summary statistics are presented first, followed by separate summaries for males and females, and finally, a summary of significant differences between males and females in mean levels of the variables. These initial descriptives demonstrate some potentially important sex differences. Average impulsivity does not significantly differ between the males and females but sensation seeking does, with the males reporting a higher average level ($p <. 001$).

One possible reason for elevated sensation seeking among males compared to females could be that males are exposed to higher levels of explanatory factors relative to females. An initial step in exploring this possibility is checking for significant differences in predictor variables between males and females. Table 4 demonstrates that in all cases where significant sex differences were found, except one (primary caregiver missing), males reported higher levels than females. Males reported significantly higher levels of racial discrimination ($p <. 001$), romantic partner hostility ($p <. 001$), and association with deviant peers ($p <. 001$). Given that these differences may vary over time, an additional table of summary statistics is presented in Table 14 in Appendix C that reports the summary statistics wave by wave.

A partial correlation matrix for all variables at all waves (except biological sex and age) is presented in Table 15 in Appendix D. This table is useful for examining both the stability of constructs over time and bivariate relationships between variables. To aid in readability, some of the more useful correlations are in bold. The bolded correlations

Table 4. Descriptive Statistics (*N =782, NT =4692*)

	Total				Male				Female				
Variable	Mean or %	SD	Min	Max	Mean or %	SD	Min	Max	Mean or %	SD	Min	Max	Sig.
Dependent													
Impulsivity	1.56	.34	1	3	1.56	.34	1	3	1.57	.34	1	2.8	
Sensation seeking	1.49	.46	1	3	1.55	.48	1	3	1.44	.43	1	3	***
Independent													
Age	18.77	6.26	9	31	18.49	6.20	9	31	18.97	6.30	9	31	*
Sex (female =1)	55.50												
SES	2.21	.67	1	3	2.22	.66	1	3	2.21	.68	1	3	
Primary Caregiver Hostility	1.48	.45	1	4	1.47	.42	1	4	1.49	.46	1	4	
Primary Caregiver Wamth	3.31	.70	1	4	3.33	.65	1	4	3.30	.73	1	4	
Primary Caregiver Missing	.03		0	1	.02		0	1	.04		0	1	*
Morbidity/Mortality	.64	.82	0	5	.64	.81	0	5	.64	.82	0	4	
Neighborhood Crime	1.27	.41	1	3	1.28	.43	1	3	1.27	.40	1	3	
Racial Discrimination	1.58	.56	1	4	1.62	.60	1	4	1.56	.54	1	4	***
Romantic Partner Hostility	1.40	.46	1	4	1.52	.51	1	4	1.32	.40	1	4	***
Romantic Partner Warmth	3.26	.74	1	4	3.25	.73	1	4	3.27	.74	1	4	
Romantic Partner Missing	.43		0	1	.46		0	1	.41		0	1	*
Deviant Peer	1.41	.36	1	3	1.44	.37	1	3	1.39	.35	1	3	***

NOTES: Overall values are reported (across all waves); Sig. refers to significant differences in overall level between sexes (ttests and chi-squares where appropriate); *p<.05, **p<.01, ***p<.001 (two tailed tests)

ABBREVIATIONS: SD = Standard deviation; N = number of individuals; NT = number of person waves

near the diagonal and in the third column highlight stability coefficients for each variable across the 6 waves. The bolded correlations in column three demonstrate the stability of the independent variables across the waves and the bolded correlations just below the diagonal present the stability correlations for the two dependent variables.

Looking at impulsivity, stability coefficients range from $r = 0.11$ to $r = 0.61$ with the weakest correlation between waves 1 and 7 and the strongest correlation between waves 5 and 6. A pattern emerges such that, in general, stability decreases as time between the waves increases. The weakest stability coefficient for sensation seeking is observed between waves 1 and 7 ($r = .16$) and the strongest is observed between waves 4 and 5 and 5 and 6 ($r = .53$ for both). While the pattern with time is consistent with previous research, these stability coefficients are lower than most observed in previous research. The bolded correlations on the diagonal, within each box, present the correlations between key variables at corresponding waves. For example, we can quickly observe that correlations between sensation seeking and impulsivity at the same wave range between $r = 0.25$ at wave 4 and $r = 0.38$ at wave 2.

These correlations provide initial evidence that the independent variables are associated with the dependent variables in expected ways. Primary caregiver warmth and romantic partner warmth, the two variables representing supportive socio-environmental conditions, are negatively associated with both impulsivity and sensation seeking. All other variables, those that capture harsh or unpredictable socio-environmental conditions, are positively associated with both impulsivity and sensation seeking. However, not all of the associations are consistently significant across all waves. For example, morbidity/mortality is only significantly associated with sensation seeking at wave 1. Measures that demonstrate consistent significant associations with impulsivity include primary caregiver warmth (at all waves except wave 7), primary caregiver

hostility, racial discrimination, romantic partner warmth, romantic partner hostility, and deviant peer association. Measures that demonstrate consistent significant associations with sensation seeking include primary caregiver warmth, primary caregiver hostility, racial discrimination, romantic partner hostility, and deviant peer association.

Developmental Trajectories of Impulsivity and Sensation Seeking

The first aim of this dissertation is to examine variation in developmental trajectories of impulsivity and sensation seeking between age 9 and 31. To address this aim, unconditional means and growth models for both traits were estimated with multilevel/hierarchical mixed-effects linear regression (HLM). When using this method with longitudinal data, level two consists of individuals and level one consists of the repeated measures for each individual at different time points (i.e. observations are nested within individuals). The level one equation, predicting individual *i*'s level of impulsivity or sensation seeking at time *t* in an unconditional means model follows:

$$Y_{ti} = \pi_{0i} + e_{ti} \quad (1)$$

The constant, π_{0i}, represents the person-specific mean. The e_{ti} term in the above equation represents individual error, or the level one residuals. This term captures all variation in the outcome not explained by the predictors included in the model. Since no predictors are included in the level one model, this error term captures all within-individual variation around the individual mean. The level two equation predicts the intercept in the level 1 model where β_{00} is the average intercept across the population (the grand mean) and r_{0i} is the deviation of the individual mean from the grand mean—i.e. residual errors at level two:

$$\pi_{0i} = \beta_{00} + r_{0i} \quad (2)$$

The level two equation allows time-stable characteristics to influence individual intercepts, but since no predictors are included in the unconditional means model, the

substitution of the level two equation into the level one equation, gives us the following equation for predicting the outcome of individual *i* at time *t:*

$$Y_{ti} = \beta_{oo} + r_{oi} + e_{ti} \quad (3)$$

As can be seen, Y_{it} is simply the grand mean of the sample plus level one error (between-individual residual error) and level one error (within-individual residual error). One benefit of this method is that it allows estimation of variation. The level one and two error terms are assumed to be normally distributed with a mean of 0 and variances of σ_ε^2 and σ_0^2, respectively. Thus, it is possible to test whether there is significant within- (level one) and between-individual (level two) variation in the outcome of interest.

The unconditional means models are presented in the first and third columns of Table 5 for impulsivity and sensation seeking, respectively. The intercept suggests that the grand mean of impulsivity (across all individuals and observations) is 1.567 (p <.001) while the grand mean of sensation seeking is 1.494 (p <.001).[22] Unsurprisingly, due to the nature of the data as observations nested within individuals, the results for both traits suggest that multilevel modeling describes the data better than a simple linear regression. Liklihood ratio tests confirmed that the multilevel model is better for both impulsivity and sensation seeking (χ^2_{imp}= 610.75, p <.001; χ^2_{ss}=691.92, p <.001). The random effects demonstrate that there is significant variation in both traits between individuals (*initial status* coefficient in table) and within individuals (*within-person* coefficient in the table). The intraclass correlation (ICC) summarizes the proportion of variation captured in each level. The ICC for the impulsivity model suggests that around 32% of the variation in impulsivity is due to between-individual differences. Similarly, around 34% of the variation in sensation seeking is due to between-individual

[22] The significance of the intercepts in these models is rather meaningless given that it tests whether the constant is significantly different from 0. A value of 0 does not exist on the impulsivity scale used in these analyses.

differences. This initial finding suggests that the majority of the variation in these traits is due to within-individual differences, not between-individual differences.

Table 5. Unconditional Hierarchical Linear Models of Impulsivity and Sensation Seeking

	Impulsivity (N = 782, NT = 4113)				Sensation Seeking (N = 782, NT = 4108)			
	Means		Growth		Means		Growth	
Fixed Effects	Coeff.	SE	Coeff.	SE	Coeff	SE	Coeff.	SE
Intercept	1.567***	0.008	1.635***	0.018	1.494***	0.011	1.498***	0.024
Linear slope			0.024**	0.008			-0.004	0.011
Quadratic slope			-0.005***	0.001				
Cubic slope			0.000***	0.000				
Random Effects	SD	SE	SD	SE	SD	SE	SD	SE
Initial status	0.192***	0.007	0.187***	0.008	0.268***	0.009	0.232***	0.011
Growth rate			0.011***	0.001			0.016***	0.001
Within-person	0.281***	0.003	0.253***	0.003	0.370***	0.005	0.351***	0.005
ICC	0.318		0.353		0.344		0.304	
Model Fit								
Deviance	2213.42		1767.58		4545.02		4406.54	
AIC	2219.42		1781.58		4551.02		4416.54	
BIC	2238.41		1825.83		4570.01		4448.15	

ABBREVIATIONS: SD = standard deviation; SE = standard error; AIC = Akaike's information criterion; BIC = Bayesian information criterion

*p<.05, **p<.01, ***p<.001 (two-tailed tests)

Next, unconditional *growth* models of impulsivity and sensation seeking were performed to characterize the average developmental pattern of each trait over time. In these models, age terms are added as predictors at level one:

$$Y_{ti} = \pi_{0i} + \pi_{1i}\text{age}_{ti} + e_{ti} \quad (4)$$

Now, levels of impulsivity and sensation seeking may vary by age. The introduction of $\pi_{1i}\text{age}_{ti}$ allows the outcome to vary by age, but forces the effect to be linear. That is, π_{1i} represents the value of the slope, or the annual change in impulsivity or sensation seeking each year. However, it may be the case that the average growth curve of impulsivity or sensation seeking is not best represented by linear change. Indeed, previous research on sensation seeking suggests that sensation seeking peaks during the adolescent years, and examinations of impulsivity patterns that capture early adolescence have also demonstrated curvilinear growth patterns. To test for this possibility, additional age terms may be added to the model and tested:

$$Y_{ti} = \pi_{0i} + \pi_{1i}\text{age}_{ti} + \pi_{2i}age^2_{ti} + e_{ti} \quad (5)$$

$$Y_{ti} = \pi_{0i} + \pi_{1i}\text{age}_{ti} + \pi_{2i}age^2_{ti} + \pi_{3i}age^3_{ti} + e_{ti} \quad (6)$$

Equation 5 adds a quadratic age term, which has the effect of modeling a curvilinear growth pattern. Equation 6 adds an additional cubic age term, which has the effect of modeling a growth curve with two turning points. In these models age is centered at 9 (the youngest age captured in wave 1 of data collection) to help ease interpretation. Thus, in the unconditional growth models, the intercept value represents the estimated value of the outcome at age 9. In these models, we now have additional level two equations, one that predicts the slope for each of the age terms. For example, the level two equation for the linear age effect is:

$$\pi_{1i} = \beta_{01} + r_{1i} \quad (7)$$

Once again, a level two error is introduced (r_{1i}), but now this error describes the variation around the growth rate. Again, an assumption of normality is made, and it is possible to test whether there are significant between-individual differences in growth rates of the outcome of interest.

The unconditional growth models are also presented in Table 5, with parameters presented in the "Growth" columns. To identify the best-fitting model (i.e. the correct growth curve pattern) for each trait, age terms were successively added and checked for significance while the model fit indices (Deviance, AIC, and BIC) were compared.

For the impulsivity model, all age terms were significant suggesting that that the average growth curve for impulsivity is characterized by two turning points. Furthermore, the addition of the cubic and quadratic age terms improved the overall model fit, demonstrated by reductions (improvements) in the fit indices. Deviance, calculated as -2(LL), the Bayesian information criterion (Schwarz, 1978) and Akaike's information criterion (Akaike, 1987) all improved with all of the age terms included in the model. As can be seen in Table 5, the intercept for the impulsivity model suggests

that the average impulsivity level at age 9 is 1.635 (p <.001). The age terms indicate that the impulsivity score initially increases .024 (p <.05) each year. However, the additional significant age terms suggest that this rate of change does not remain constant. Rather, the significant quadratic and cubic terms (-.005, p<.001; <.0001, p <.001, respectively) suggest two directional changes. Calculating a pseudo R^2 statistic reveals that about 10% of the within-individual variation in impulsivity is explained by the addition of the age terms.

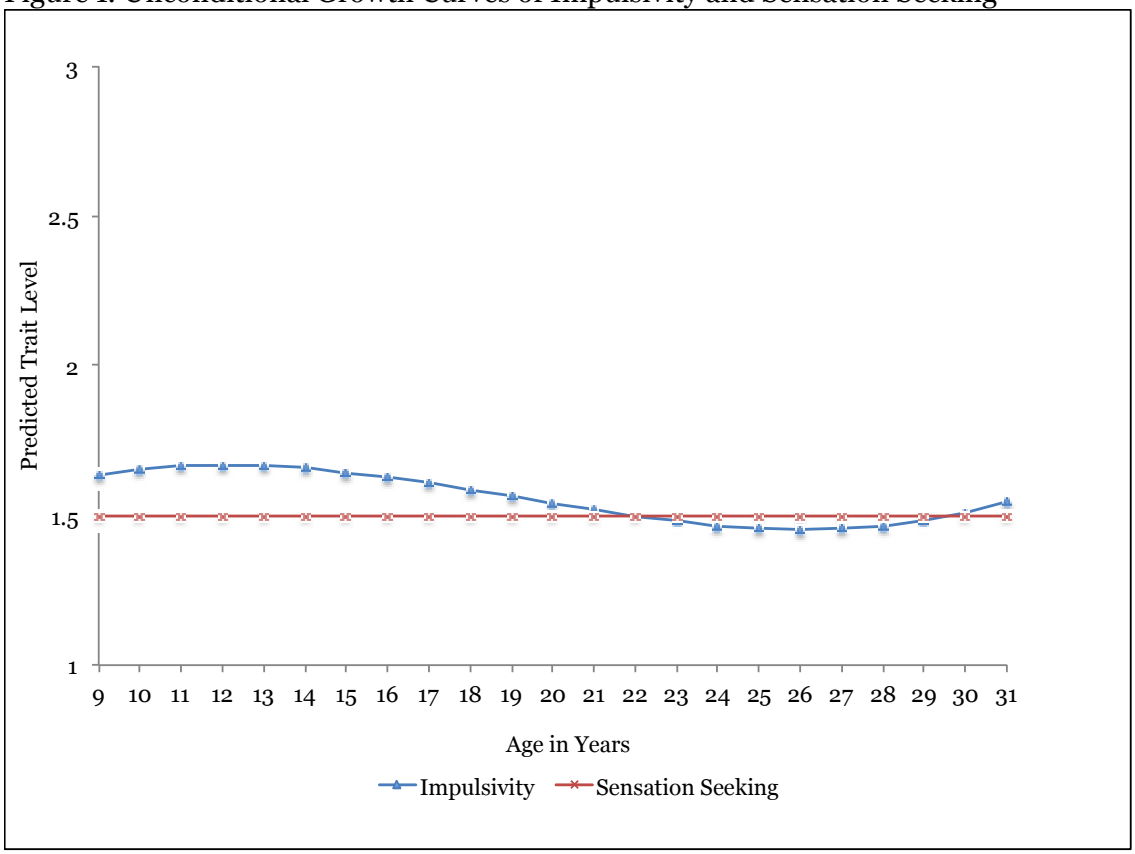
The unconditional growth model for sensation seeking is quite different. None of the age terms are significant, suggesting that, on average, there is no change in sensation seeking over time. Rather, the growth curve for sensation seeking is characterized by a flat line at the population average level of sensation seeking (1.498, p <.001). However, calculating a pseudo R^2 statistic tells us that about 5% of the within-individual variation in sensation seeking is explained by the addition of the age term.

A graphic of the average growth curves for impulsivity and sensation seeking is presented in Figure 1. To be clear, these growth curves were estimated in separate models, yet displayed together to demonstrate how the typical growth curves differ for impulsivity and sensation seeking. At the start of the observation period, impulsivity starts relatively high and increases until around the start of adolescence. Then, it decreases steadily into the mid-twenties before a slight rise is observed near the end of the observation period. Given that none of the age terms were significant in the sensation seeking model, the sensation seeking growth curve is simply a flat trajectory located at the population mean.

The random effects portion of Table 5 demonstrates that there is significant variation in initial status and growth rates for both traits. That is, individuals differ both in their levels of impulsivity and sensation seeking at age 9 and in their rate of change

over time. Despite the insignificant age term in the sensation seeking model, there is significant between-individual variation in the growth rate of sensation seeking over time. Thus, this observed overall growth pattern is masking potential important variation in developmental trajectories of sensation seeking.

Figure 1. Unconditional Growth Curves of Impulsivity and Sensation Seeking



The results presented here are consistent with previous research published on the same sample (e.g., Burt et al., 2014), yet inconsistent with much of the research performed with different data. Specifically, most previous research identifies a normative sensation seeking developmental pattern characterized by increases in adolescence, beginning around the time of puberty, followed by decreases into adulthood. The stable growth curve identified here is unexpected yet consistent with the HLM results of Burt et al. (2014) when they estimated growth curves with the same sample and one less wave of

data. The impulsivity growth curve identified here is mostly consistent with past research. The developmental pattern is primarily characterized by improvements in impulse control over time. However, the small uptick in impulsivity at the end of the observation period was unexpected. As will be discussed subsequently, it could be the case that the unexpected patterns observed in both of these traits' developmental trajectories are consequences of issues with the data.

In sum, there is clear evidence that impulsivity and sensation seeking follow different normative developmental patterns between ages 9 and 31. Furthermore, there is significant unexplained variation in both initial trait levels and growth rates for both of the traits. Thus, an exploration into sources of variation in trait levels beyond the effect of age is warranted for both traits.

Sources of Variation in Trajectories of Impulsivity and Sensation Seeking

The second aim of this dissertation is to explore which factors might explain some of the between- and within-individual variation in impulsivity and sensation seeking. To address this question, predictors are added to the multilevel mixed effects linear regression models. To examine effects of time-varying predictors on levels of impulsivity and sensation seeking, Raudenbush and Bryk's (2002) decomposition technique is employed. Each time-varying predictor is separated into its time-stable and time-varying components. First, a person-specific mean is calculated for each predictor. This is the person-specific average on the variable of interest across all waves in which measures were captured. This new variable is referred to as the between-individual, time-stable, component of the predictor. The average, of course, remains the same across all time points. Then, the within-individual change term is calculated to capture the time-varying component of the predictor. At each time point, the individual specific mean value is subtracted from the time specific value of the variable. This creates a time-

varying component of the predictor that captures deviation from the individuals' mean level over time. This decomposition technique enhances the ability to make causal claims. Without decomposition it is unclear whether a significant association between a predictor and an outcome represents a causal process. For example, it could be the case that individuals who experience harsh parenting tend to be more impulsive, but it is unclear whether the experience of harsh parenting *causes* impulsivity to be higher. The decomposition technique helps address these different possibilities. A significant association between the time-stable between-individual predictor and the outcome suggests that people who report high levels of the predictor also report high levels of the outcome while a significant association between the time-varying, within-individual predictor and the outcome demonstrates that a *change* in the predictor is significantly associated with the contemporaneous level of the outcome. Thus, a change in the predictor is thought to lead to the outcome of interest. Further enhancing the ability to make causal arguments in this study is the nature of the questions posted in the FACHS. Specifically, all impulsivity and sensation seeking items inquire about current attitudes and behaviors (e.g., "you like to switch from one thing to another) while all items capturing the predictors inquire about events over time preceding the interview (e.g., over the past year, over the past month). Thus, if impulsivity and sensation seeking are significantly associated with within-individual changes in the predictors, it is reasonable to conclude that the experiences captured by the predictors directly influence levels of the outcome.

Table 6 presents the results of the HLM models predicting impulsivity. The predictors were added to the model in a series of steps due to expected causal pathways based on previous published research and theory, which resulted in three progressively more complete models. Specifically, several studies on the development of self-control

Table 6. Hierarchical Linear Models Predicting Impulsivity

	Model A				Model B				Model C			
	Between		Within		Between		Within		Between		Within	
Fixed Effects	Coeff.	SE	Coeff.	SE	Coeff.	SE	Coeff.	SE	Coeff.	SE	Coeff.	SE
Intercept	1.656***	.082			1.627***	.079			1.607***	.078		
Morbidity/Mortality	.037	.019	.001	.006	0.026	.018	-.001	.006	.010	.018	-.004	.006
Neighborhood Crime	.036	.035	.037**	.013	-.013	.033	.028*	.012	-.050	.032	.021	.013
Racial Discrimination	.067**	.022	.064***	.011	.046*	.021	.053***	.011	.010	.021	.039***	.011
Romantic Partner Hostility	.223***	.064	.042*	.017	.103	.061	.038*	.017	.013	.059	.034*	.017
Romantic Partner Warmth	-.107**	.037	-.016	.011	-.055	.036	-.013	.011	-.038	.034	-.007	.011
No Romantic Partner	-.124	.102	-.025	.029	-.043	.097	-.021	.029	-.031	.093	-.010	.029
Control: RP Missing Waves	.050	.034			.043	.034			.043	.033		
Primary Caregiver Hostility					.263***	.032	.073***	.012	.221***	.031	.062***	.012
Primary Caregiver Wamth					-.058***	.018	-.041***	.008	-.042*	.018	-.039***	.008
No Primary Caregiver					-.030	.088	.007	.038	-.012	.085	.024	.038
Deviant Peers									.313***	.039	.106***	.017
SES									.026*	.011		
Linear slope	.029**	.009			.022*	.009			.023*	.009		
Quadratic slope	-.005***	.001			-.004***	.001			-.005***	.001		
Cubic slope	.0001***	.000			.0001***	.000			.0002***	.000		
Random Effects	SD		SE		SD		SE		SD		SE	
Initial status	0.259***		0.011		0.237***		0.011		0.227***		0.010	
Growth rate	0.018***		0.001		0.017***		0.001		0.017***		0.017	
Initial status X Growth rate	-0.676***		0.033		-0.673***		0.035		-0.685***		0.035	
Within-person	0.235***		0.003		0.233***		0.003		0.231***		0.003	
Model Fit												
Deviance	1434.40				1252.98				1119.76			
AIC	1476.40				1306.98				1179.76			
BIC	1608.09				1476.25				1367.66			

ABBREVIATIONS: SD = standard deviation; SE = standard error; AIC = Akaike's information criterion; BIC = Bayesian information criterion

*p<.05, **p<.01, ***p<.001 (two-tailed tests for all but variance components)

have found that parenting variables capture the effects of neighborhood conditions/characteristics (e.g. Cochran et al., 1998; Gibson et al., 2010; Hope et al., 2003; Meldrum, 2008). Thus, Model A includes key independent variables without the primary caregiver variables. Model B includes the primary caregiver variables, and thus, includes all key variables identified by the SST. Finally, Model 3 incorporates two additional controls: deviant peers and the socioeconomic status proxy. Burt and Simons (2011) both expected and found that some of the effects of neighborhood characteristics and parenting affected the criminogenic knowledge structure through deviant peers, and thus, the deviant peer measure is expected to capture some of the effects of parenting and the other key variables

As seen in Model A of Table 6, neighborhood crime, racial discrimination, romantic partner hostility, and romantic partner warmth are all related to impulsivity in the expected direction. The only predictor that failed to demonstrate a significant association with impulsivity is morbidity/mortality. While both the between- and within-individual components of racial discrimination and romantic partner hostility are significantly related to impulsivity, the neighborhood crime effect was restricted to the within-individual component and the romantic partner warmth effect was restricted to the between-individual component. This suggests that individuals who experience an increase in neighborhood crime report higher levels of impulsivity, but it is not the case that, overall, individuals who report high levels of neighborhood crime report high levels of impulsivity. Individuals who experience lower levels of romantic partner warmth report higher levels of impulsivity, but a change in romantic partner warmth is not associated with level of impulsivity.

Adding in the primary caregiver variables in Model B slightly changes results but not drastically. All of the primary caregiver variables predict impulsivity in the expected

directions. Primary caregiver warmth is associated with lower levels of impulsivity and primary caregiver hostility is associated with higher levels of impulsivity. Furthermore, the effects are significant for both the between and within components. Two effects from model A are reduced to insignificance in model B: the between individual effect of romantic partner hostility and the between individual effect of romantic partner warmth. This suggests that parenting variables account for some of the relationship between relationship quality and impulsivity, but the effect of changes in romantic partner hostility remains important after accounting for parenting.

Unsurprisingly, Model C produces the best model fit indices as deviant peers and SES are both significantly related to impulsivity. However, an unexpected finding is that individuals who reported never having monetary trouble over the past year reported higher levels of impulsivity (.026, $p<.05$). The association between deviant peers and impulsivity was in the expected direction for both between (.313, $p < .001$) and within (.106, $p<.001$) components. The addition of these predictors reduces two effects from Model B to insignificance: the between-individual effect of racial discrimination and the within-individual effect of neighborhood crime. In the full model, then, the predictors that retain significant effects on impulsivity include racial discrimination (within), romantic partner hostility (within), primary caregiver warmth (both), primary caregiver hostility (both), deviant peers (both), and SES. Calculating a pseudo R^2 statistic tells us that about 18% of the within-individual variation in impulsivity is explained by the level one predictors in the final model.

Table 7 presents the results of the HLM models predicting sensation seeking. Once again, the predictors were added in a series of steps, producing three successive models. As seen in Model A of Table 7, neighborhood crime, racial discrimination, and romantic partner hostility are all related to sensation seeking in the expected direction.

Table 7. Hierarchical Linear Models Predicting Sensation Seeking

	Model A				Model B				Model C			
	Between		Within		Between		Within		Between		Within	
Fixed Effects	Coeff.	SE	Coeff.	SE	Coeff.	SE	Coeff.	SE	Coeff.	SE	Coeff.	SE
Intercept	1.386***	.096			1.30	.096			1.24***	.095		
Morbidity/Mortality	-.028	.026	.009	.009	-.036	.026	.007	.009	-.0598	.025	.003	.009
Neighborhood Crime	.094*	.047	.043*	.018	.065	.047	.034	.018	.011	.045	.023	.018
Racial Discrimination	.137***	.031	.108***	.015	.122***	.030	.097***	.015	.065*	.029	.080***	.015
Romantic Partner Hostility	.282**	.086	.051*	.024	.220*	.087	.043	.024	.083	.084	.037	.024
Romantic Partner Warmth	-.033	.051	.019	.015	.019	.051	.021	.015	.045	.049	.027	.015
No Romantic Partner	.143	.139	.096*	.041	.243	.139	.093*	.041	.260	.133	.105*	.041
Control: RP Missing Waves	-.009	.027			.009	.027			.032	.027	.068	.044
Primary Caregiver Hostility					.127**	.045	.085***	.018	.068	.044	.071***	.018
Primary Caregiver Wamth					-.083**	.026	-.039**	.012	-.059*	.025	-.035**	.012
No Primary Caregiver					-.081	.127	-.104	.054	-.074	.121	-.112*	.054
Deviant Peers									.470***	.055	.149***	.024
SES									.044**	.015		
Linear slope	.002	.002			.003	.002			.002	.002		
Random Effects	SD		SE		SD		SE		SD		SE	
Initial status	0.255***		0.016		0.248***		0.016		0.237***		0.016	
Growth rate	0.018***		0.001		0.018***		0.001		0.018***		0.001	
Initial status X Growth rate	-0.319**		0.085		-0.314**		0.087		-0.362**		0.085	
Within-person	0.342***		0.005		0.341***		0.005		0.338***		0.005	
Model Fit												
Deviance	4055.56				3980.26				3840.17			
AIC	4093.56				4030.27				3896.17			
BIC	4212.69				4186.97				4071.5			

ABBREVIATIONS: SD = standard deviation; SE = standard error; AIC = Akaike's information criterion; BIC = Bayesian information criterion

*p<.05, **p<.01, ***p<.001 (two-tailed tests for all but variance components)

While only morbidity/mortality failed to be significantly associated with impulsivity, both morbidity/mortality and romantic partner warmth failed to be significantly associated with sensation seeking. While not a primary variable of interest, the within-individual component of not having a romantic partner was significantly associated with sensation seeking, suggesting that changing status from having a partner to not having one is associated with increases in sensation seeking. Finally, while the neighborhood crime effect was restricted to the within-individual component for impulsivity, both neighborhood crime components are significantly associated with sensation seeking.

Once again, adding in the primary caregiver variables in Model B slightly changes results, but not drastically. All of the primary caregiver variables predict sensation seeking in the expected directions. Both components of primary caregiver warmth are associated with lower levels of sensation seeking and both components of primary caregiver hostility are associated with higher levels of sensation seeking. Three effects from Model A are reduced to insignificance in model B: the between individual effect neighborhood crime and the within individual effects of neighborhood crime and romantic partner hostility. Racial discrimination and between-individual romantic partner hostility maintain significant relationships with sensation seeking after adding in the parenting variables.

As with the impulsivity models, Model C produces the best model fit indices as deviant peers and SES are also significantly related to sensation seeking. Once again, individuals who reported never having monetary trouble over the past year reported higher levels of the outcome (.044, $p<.01$), and the association between deviant peers and sensation seeking was in the expected direction for both between (.470, $p < .001$) and within (.149, $p<.001$) components. The addition of these predictors reduces two effects from Model B to insignificance: the between-individual effect of romantic partner

hostility and the between individual effect of primary caregiver hostility. In the full model, then, the predictors that retain significant effects on sensation seeking include racial discrimination (both components), not having a romantic partner (within), primary caregiver hostility (within), primary caregiver warmth (both), deviant peers (both), and SES. Calculating a pseudo R^2 statistic tells us that about 9% of the within-individual variation in sensation seeking is explained by the level one predictors in the final model, suggesting that additional factor not captured in the present study need to be considered for explaining individual changes in sensation seeking over time.

Sex Differences in Trajectories of Impulsivity and Sensation Seeking

Two longitudinal modeling methods are employed to explore potential sex differences in patterns of trait development. First, separate unconditional growth curve models (HLM) are performed for males and females for both impulsivity and sensation seeking. These models examine whether average growth curves and individual variation around the intercepts and growth curves varies by sex. Second, GBTM models are used to summarize potential variety in developmental patterns within sex groups. These models enable exploration of distinct developmental patterns that may be masked with methods such as HLM. While GBTMs capture variation in developmental patterns by identifying distinct developmental patterns of development and estimating the proportion of the population expected to belong to each group, HLM only provides estimates of the amount of variance around intercepts and growth rates.

The results of the sex-specific unconditional growth models for impulsivity and sensation are presented in Table 8. Visual inspection of the coefficients for impulsivity suggest that males and females have similar levels of impulsivity at age 9 and follow remarkably similar growth patterns. In other words, the general growth model for impulsivity accurately summarized the average growth pattern for both males and

females. Furthermore, random effects estimates are quite similar between males and females. Rather than estimating two separate sex-specific models, these results also could have been obtained by adding sex as a level two predictor and including sex interactions with each of the age terms. Although not shown here, the two methods provide the exact same results (the separate models are presented here for clarity in visualization of potential differences in the slopes across sex). However, the interaction model is useful in that it enables hypothesis testing of the differences. This interaction model confirms that neither the initial level of impulsivity at age 9, nor any of the slopes are statistically different between males and females (*intercept*= -.01, p = .67; *age*= .018, p = .28; age^2= -.002, p = .32; age^3= <.001, p = .39).

Table 8. Unconditional Growth Models of Impulsivity and Sensation Seeking By Sex

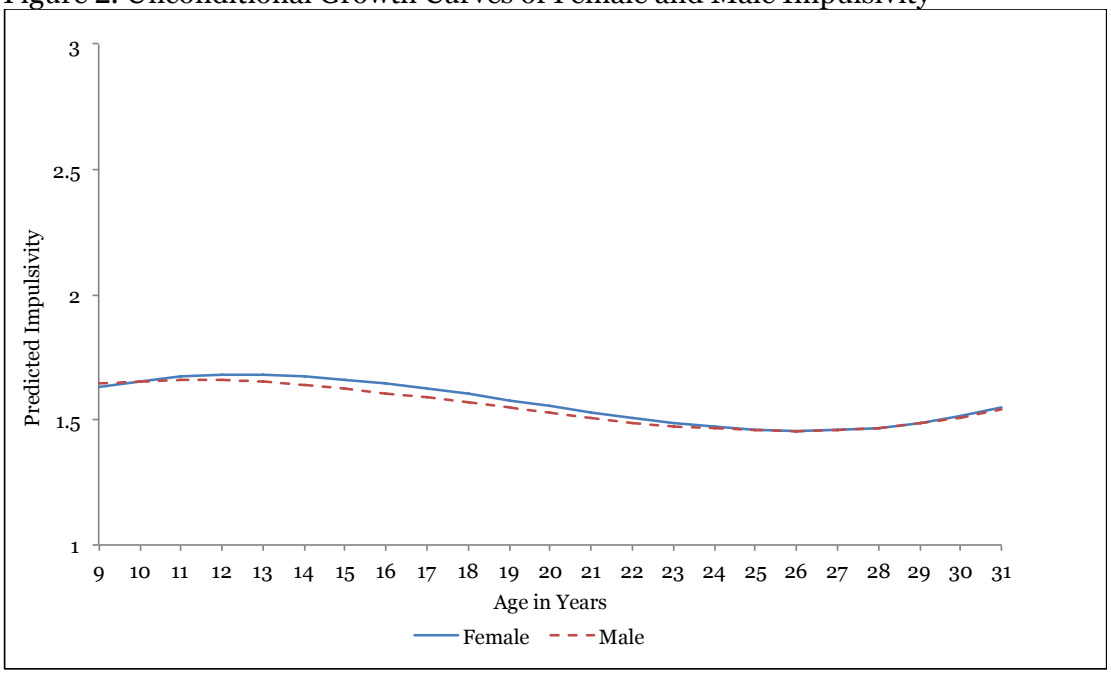
	Impulsivity				Sensation Seeking			
	Males (N = 348)		Females (N = 434)		Males (N = 348)		Females (N = 434)	
Fixed Effects	Coeff.	SE	Coeff.	SE	Coeff	SE	Coeff.	SE
Intercept	1.644***	.027	1.629***	.023	1.520***	.021	1.479***	.017
Linear slope	.014	.013	.031**	.011	0.003*	.002	-0.003*	.001
Quadratic slope	-.004*	.001	-.005***	.001				
Cubic slope	.0001**	<.0001	.0002***	<.0001				
Random Effect	SD	SE	SD	SE	SD	SE	SD	SE
Initial status	.174***	.012	.196***	.010	.236***	.018	.222***	.013
Growth rate	.011***	.001	.010***	.001	.017***	.002	.015***	.001
Within-person	.261***	.006	.247***	.004	.375***	.008	.333***	.006
ICC	0.308		0.386		0.284		0.308	
Model Fit								
Deviance	831.04		926.94		2086.94		2269.86	
AIC	845.04		940.95		2096.95		2279.86	
BIC	883.34		981.29		2124.30		2308.68	

ABBREVIATIONS: SD = standard deviation; SE = standard error; AIC = Akaike's information criterion; BIC = Bayesian
*p<.05, **p<.01, ***p<.001 (two-tailed tests except for variance components)

Visual inspection of the coefficients for sensation seeking suggest that there are sex differences in the average growth pattern of sensation seeking between males and females. Although average sensation seeking levels appear similar for males and females at age 9, and both male and female growth patterns were best captured with only linear growth terms, the growth terms indicate growth in opposite directions. That is, females demonstrate a .003 reduction in sensation seeking each year while the males

demonstrate a .003 elevation in sensation seeking each year. The general growth model for sensation seeking was masking sex-specific developmental patterns in which the growth rates of the two sexes nearly mirror each other. Again, significance of the sex differences was examined with an interaction model. The model confirms that males and females are not significantly different in average levels of sensation seeking at age 9 (*intercept* = -.042, p = .11), but they do significantly differ in their linear growth rates (*age* = -.007, p = .003). Graphics of the unconditional growth curves for impulsivity and sensation seeking are presented in Figures 2 and 3, respectively.

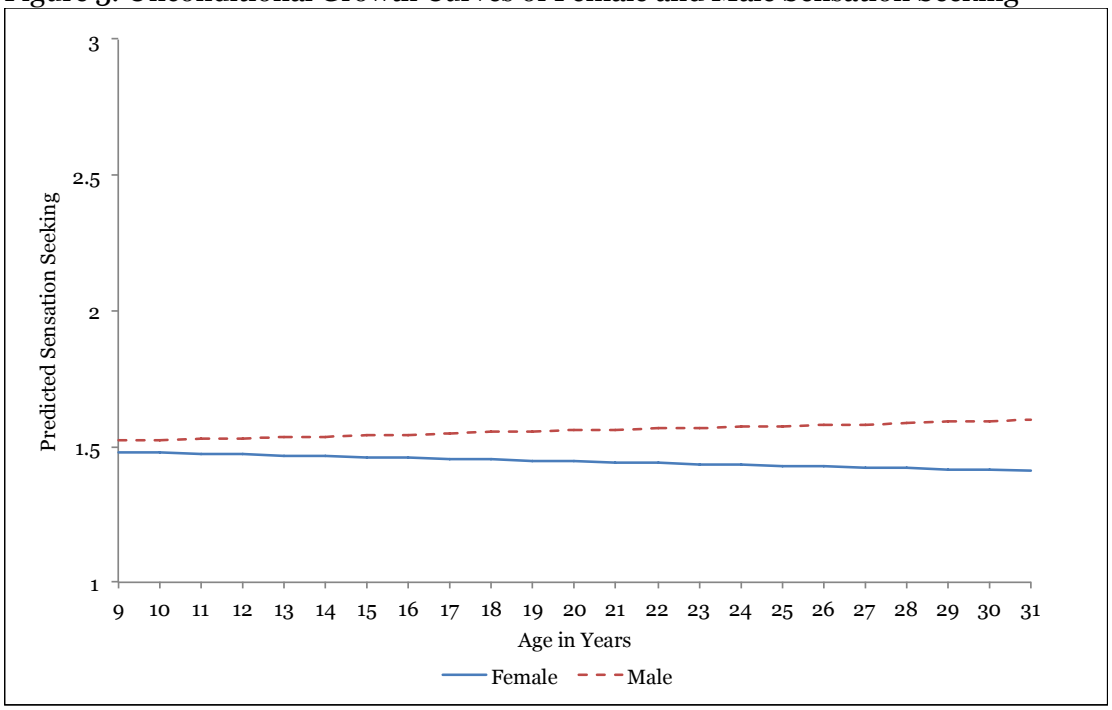
Figure 2. Unconditional Growth Curves of Female and Male Impulsivity



Given that HLM only enables estimation of average growth curves and variation around intercepts and growth rates, this method is unable to explore potential variation in unique developmental patterns (i.e. do some individuals demonstrate developmental patterns of these traits that dramatically differ in shape from the average growth curve). Rather than summarizing variation around the growth curves, group-based trajectory modeling is a semiparametric finite mixture method that helps summarize distinct

developmental patterns (Nagin, 2005). Thus, group based trajectory modeling was used to explore sex-specific variation in developmental patterns of impulsivity and sensation seeking. Specifically, four group-based trajectory models were estimated: male

Figure 3. Unconditional Growth Curves of Female and Male Sensation Seeking



impulsivity, female impulsivity, male sensation seeking, and female sensation seeking.

The model selection process proceeded in several steps for each of the four models. First, to narrow down on the likely optimal number of groups, models with 1 through 9 groups were estimated with varying polynomial orders. That is, 1 to 9 group models were estimated with intercepts only, first-order polynomials only, second-order polynomials only, and finally, third-order polynomials only. The models with the three to four best (least negative) BIC values for each set of polynomial order models were chosen as starting points for the next stage of model selection. The BIC values suggested that the ideal number of groups for impulsivity models would be between 2 and 6 for males and between 4 and 6 for females. The BIC values suggested that the ideal group number for

sensation seeking models would be between 3 and 5 for males and between 4 and 7 for females.[23] Next, restricting the model analysis to these group numbers, the polynomial orders were systematically altered based on significance of the growth parameters. Using BIC, several "best models" were retained for comparison. The next step was to engage in a stepping up and down approach with the best models (see Sweeten, in progress). Using start values from the best models, groups were added or taken away, with systematically varying polynomial orders, to determine whether adding or removing groups would improve the model fit. Finally, start values were manipulated using the altstart command in SAS and the entire process was repeated. In general, this approach resulted in a total of about 2,500 group-based trajectory models and the identification of 2-4 best models for each outcome of interest. The final best models were compared on a host of additional fit indices, including the AIC, the posterior probabilities of each group, the odds of correct classification, entropy, and divergence. The models were also examined for potentially meaningful differences in growth patterns and group sizes of the best fitting models. BIC and AIC are the same fit indices as used with the HLM models. The posterior probabilities are provided with the output in the SAS extension PROC TRAJ. The probability of belonging to each of the groups in the final model is calculated for each individual. A value of 0 means that the individual would not ever be assigned to that group, and a value of 1 means the group trajectory is a perfect estimate of the individual's growth pattern. Then, individuals are assigned to the group in which they have the highest probability of membership. The posterior probability of a group, then, is an average of the individual probabilities of belonging to that group for each of the individuals classified in that group and the group posterior probability gives us an

[23] Nagin (2005) recommends only using quadratic (second-order) growth polynomials to select the correct number of groups. However, experience with estimating GBTMs has demonstrated that limiting subsequent analysis to models with group numbers selected by only an initial exploration of quadratic growth models may fail to identify the best number of groups.

indication of how well the individuals follow the trajectory of the group to which they were assigned. Nagin (2005) suggests that all group posterior probabilities should be above .7. The odds of correct classification (OCC) is another group-specific indicator of model fit. It is a comparison of the odds of correctly classifying individuals into group *j* based on the posterior probabilities to the odds of correctly classifying individuals into group *j* based only on the estimated proportion of the sample that belongs to that group. Nagin (2005) suggests that each group should have an OCC value greater than 5. Entropy is a model fit index that characterizes the fit of the entire model (Ramaswamy, Desarbo, Reibstein & Robinson, 1993). An entropy value of 1 suggests that individuals can be perfectly classified into groups and a value of 0 means the model is fully unable to classify individuals. Finally, divergence is a measure of the discrepancy between estimated group probabilities versus the proportion of the sample actually assigned to each group. For example, if a two group model estimated group probabilities of .4 and .6 and then 40 percent of the sample was assigned to group 1 and 60 percent of the sample was assigned to group 2, then the divergence would be 0, representing a perfect match. Thus, the closer to 0, the better.

By analyzing all of these fit indices, and visually inspecting individual cases in small, unstable groups, one best model was identified each for male impulsivity, female impulsivity, male sensation seeking, and female seeking. In addition to these four models, two additional alternate best models were retained for review, one for male impulsivity and one for male sensation seeking. The fit indices for all of these models are summarized in Table 9. The majority of the results discussion will focus on the models ultimately selected as the best models, but these additional, alternate, models are provided because they provide important insights into the variation collapsed when estimating development patterns, even in this method that allows variation to be

characterized in such a flexible way. Importantly, the alternate models each include one additional group compared to the best models, which demonstrates a unique developmental pattern, and while the majority of the fit indices are better for the models ultimately presented here as the best model, the indices are not far off for the alternate models, and in a few cases, slightly better (e.g., the average OCC and divergence for the alternate male impulsivity model). Graphs of the alternate models are included in Appendix E with graphs of the best models with added confidence intervals.

Table 9. Fit Indices of Best-Fitting Group Based Trajectory Models of Impulsivity and Sensation Seeking

	Impulsivity		Sensation Seeking		Alternate	
	Male	Female	Male	Female	Male Imp	Male SS
# groups	5	6	4	6	6	5
polynomial orders	11021	131210	2020	212102	100112	02003
BIC (NT)	-2326.7	-3011.2	-2412.2	-2946.9	-2330.68	-2415.6
BIC (N)	-2314.5	-2994.2	-2402.5	-2930.0	-2316.92	-2403.5
AIC	-2285.6	-2953.5	-2379.4	-2889.3	-2284.18	-2374.6
Posterior Probability						
group 1	0.83	0.72	0.83	0.8	0.82	0.77
group 2	0.83	0.76	0.93	0.8	0.71	0.80
group 3	0.73	0.84	0.82	0.9	0.77	0.92
group 4	0.75	0.75	0.92	0.92	0.79	0.95
group 5	0.81	0.81	--	0.86	0.76	0.91
group 6	--	0.86	--	0.84	0.72	--
Ave. Post. Prob	0.79	0.79	0.90	0.88	0.76	0.88
OCC						
group 1	8.0	26.6	13.8	12.2	8.1	12.6
group 2	59.5	5.1	7.6	141.9	6.5	61.6
group 3	7.0	19.5	77.4	329.9	160.9	6.1
group 4	13.3	27.8	295.3	8.4	44.1	624.9
group 5	46.6	22.1	--	107.8	27.5	80.1
group 6	--	94.0	--	61.8	13.2	--
Ave. OCC	15.88	20.50	23.30	31.1	16.48	31.1
Entropy	0.67	0.70	0.83	0.82	0.67	0.8
Divergence	0.009	0.011	0.005	0.009	0.007	0.013

ABBREVIATIONS: BIC = Bayesian information criterion; AIC = Akaike's information criterion; N = person sample size; NT = observation sample size
Note. Graphics of the alternate best fitting models are presented in Appendix E.

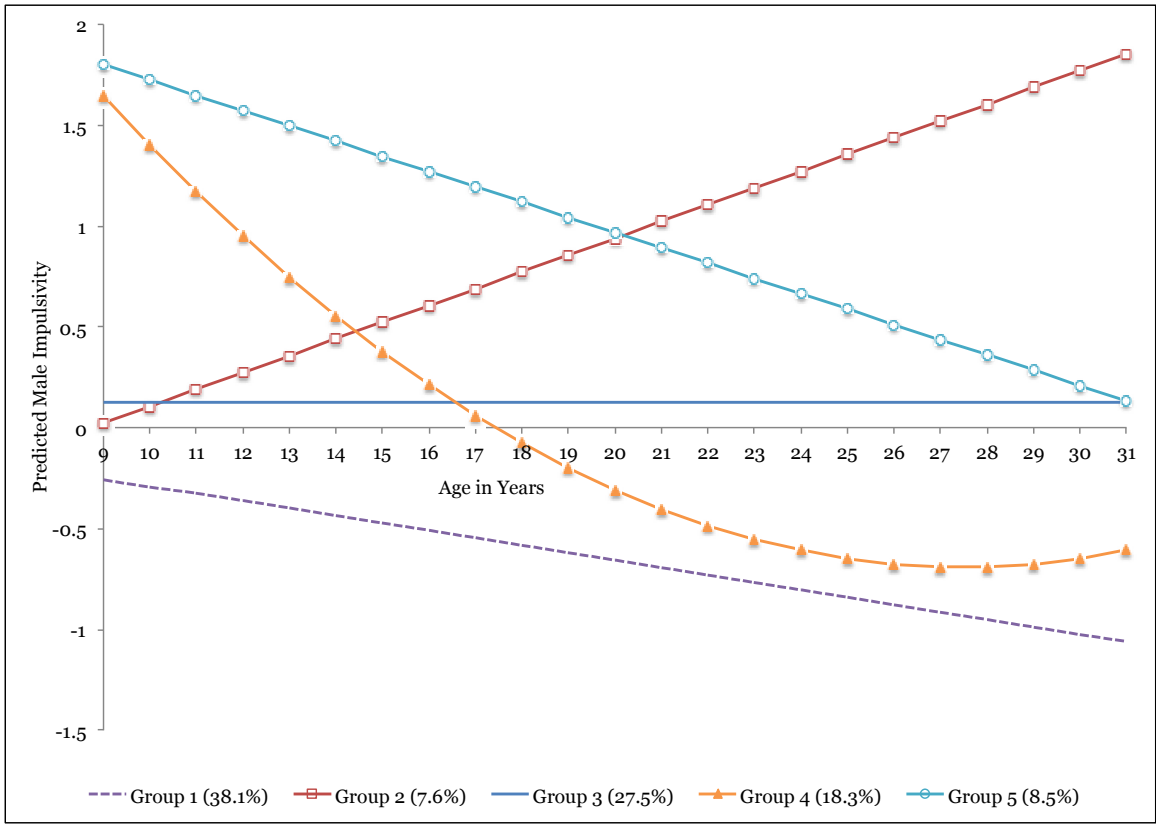
Regarding the models chosen as the best, all of the fit indices satisfy Nagin's (2005) suggested cutoffs. That is, all groups have posterior probabilities greater than .7

and an odds of correct classification higher than 5. Furthermore, these models all produced the best BIC values.

Impulsivity GBTMs

The results of GBTM models of impulsivity development for males and females are presented in Figures 4 and 5, respectively. For the GBTM analyses only, the impulsivity variable was centered around the grand mean. Thus, the 0 on the y-axis represents the overall mean level of impulsivity across all individuals and time points (the 0 represents a score of 1.56 on the raw impulsivity scale). Higher scores on the impulsivity scale indicate higher impulsivity or worse impulse control. Lower scores on the impulsivity scale indicate better impulse control.

Figure 4. GBTM of Male Impulsivity (*N* = 348, *NT* = 1757)

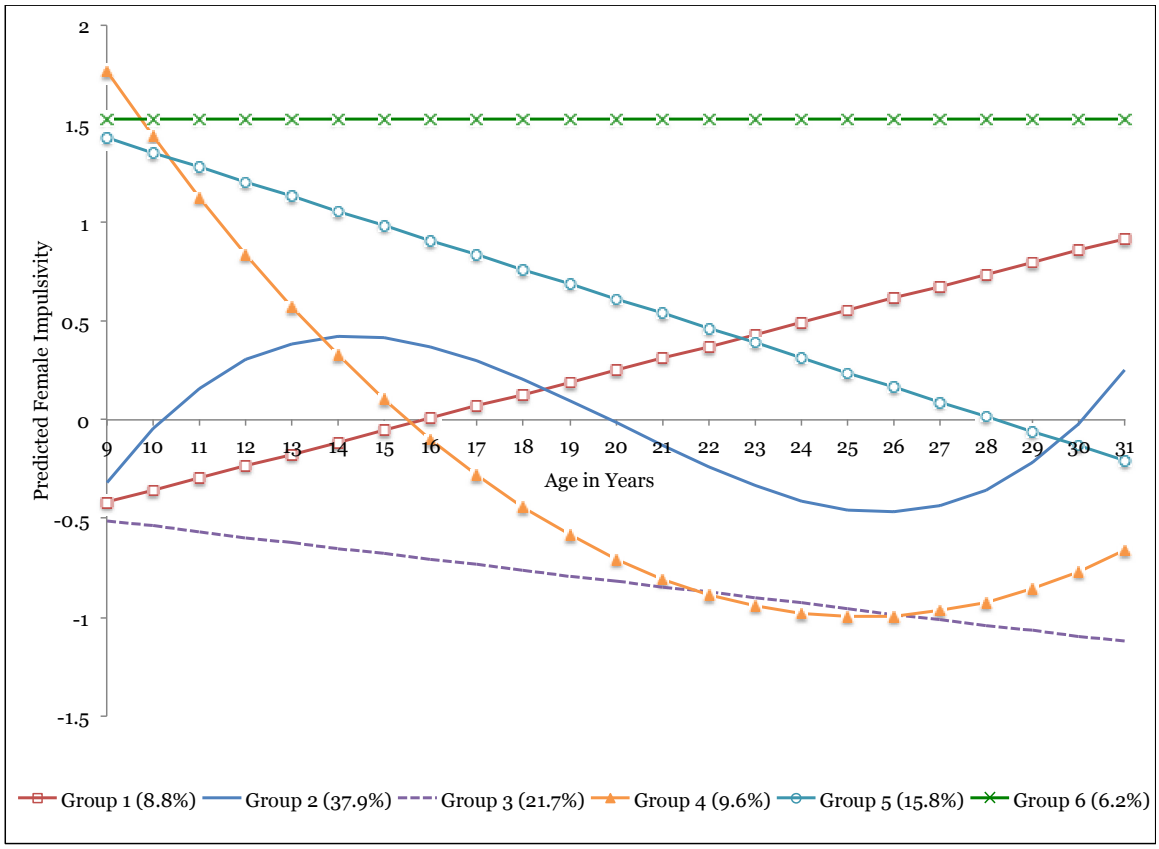


The best fitting impulsivity model for males is characterized by 5 groups. Three of the trajectories follow shapes consistent with evidence on normative developmental patterns of impulsivity. That is, several studies have demonstrated that impulsivity appears to decrease (individuals tend to become better at impulse control) with age. Groups 1, 4, and 5, which collectively account for and estimated 64.9% of the male population, demonstrate decreases in impulsivity with age. These groups vary in both baseline levels of impulsivity (i.e. levels at the start of the observation period) and rate of decrease. The largest group (group 1) reports the lowest levels of impulsivity at the start of the observation period and demonstrates small improvements in impulse control over time. The other two groups start with high levels of impulsivity and show varying rates of improvement with group 4 ending up with impulsivity levels not far off from group 1 and group 5 ending up with impulsivity levels around the grand mean. The other two groups show more unexpected patterns. Group 3, which accounts for an estimated 27.5% of the male population, follows a stable mid-level trajectory of impulsivity. Individuals classified in this group report impulsivity levels around the grand mean for the entire observation period. Group 2 reveals the most surprising pattern, and is the smallest group, accounting for only 7.6% of the male population. Individuals in this group demonstrate dramatic increases in impulsivity throughout the observation period, from a baseline level around the grand mean to an ending level near two standard deviations above the mean level. Overall, only one group demonstrated absolute stability (group 3), and the substantial crossing of trajectory groups suggests that an assumption of relative stability in impulsivity development is inconsistent with empirical reality.

The model presented here as the best-fitting male impulsivity model was the best fitting model according to the BIC, AIC, posterior probability values and visual inspection of groups for possible outliers, but another model came close the being the

best model and even produced better values for average OCC and divergence. The two models are nearly identical except for the addition of a high stable group of impulsive males in the alternate model. The majority of the evidence pointed to the model presented here as being the slightly better fitting model, but the alternate model is provided in Appendix E for comparison. Importantly, and surprisingly, not a single trajectory identified with this method mimics the developmental pattern of the male average growth curve of impulsivity identified with HLM. This suggests that the average impulsivity growth curve of a small uptick prior to the onset of adolescence followed by decreases during adolescence and a small uptick in the late twenties is a reflection of averages over time and not the most common individual growth pattern.

Figure 5. GBTM of Female Impulsivity (N = 434, NT = 2354)



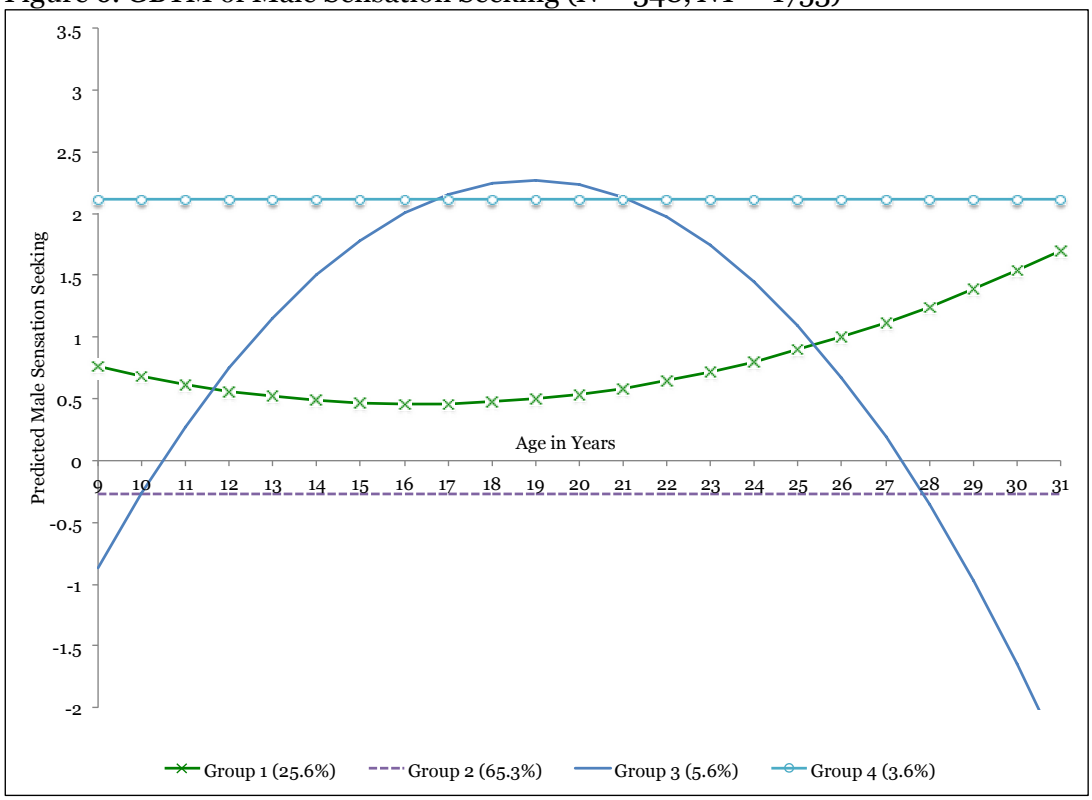
The best fitting impulsivity model for females is characterized by six groups. Overall, the trajectory shapes are remarkably similar in the separate male and female models. Once again, the majority of the population is characterized by improvements in impulse control throughout the observation period. Just as in the male model, three of the six impulsivity trajectories demonstrate this pattern. Collectively, these three groups account for an estimated 47.1% of the female population. Unlike in the male group, the largest female group does not demonstrate constant improvements in impulse control throughout the observation period. Rather, the largest group, consisting of 37.9% of the female population, is characterized by a cubic growth pattern. Individuals classified in this group report increases in impulsivity in early adolescence followed by decreases throughout young adulthood and then a final slight increase again near the end of the observation period. Once again, an unexpected group of impulsivity increasers is observed. Consistent with the male model, around 8% of the population is predicted to belong to this group. Absent from the female model is the stable mid-level group; this group appears to be replaced by the group with the cubic growth pattern. Added to the female model, however, is a stable high impulsivity group. This is the smallest female group, accounting for an estimated 6.2% of the female population. Interestingly, there is a female group that mimics the growth curve identified by HLM (group 2).

Sensation Seeking GBTMs

The best fitting male sensation seeking model is characterized by four groups and presented in Figure 6. One group dominates the model, accounting for an estimated 65% of the sample and is characterized low levels of stable sensation seeking. Surprisingly, this finding is inconsistent with the vast literature demonstrating normative increases in sensation seeking during early adolescence, but it is consistent with the HLM growth curve of male sensation seeking. The next largest group, accounting for an estimated

25% of the population is characterized by slight decreases in sensation seeking right before adolescence, and then increases throughout the twenties. The last two groups are relatively small, consisting of an estimated 5.6% and 3.5% of the population. The larger of these two groups is characterized by rather dramatic increases in sensation seeking throughout adolescence and then equivalently dramatic decreases throughout the twenties. The smallest group is characterized by high levels of sensation seeking that remain stable across the observation period. Interestingly, not a single group is characterized by reductions in sensation seeking throughout the observation period except for the group with the dramatic peak around age 18. This is inconsistent with expectations based on existing research and the dual systems model (Steinberg, 2008). It is clear that once again, the normative growth curve produced with HLM does not represent the most common developmental pattern. Rather, the majority of individuals in this sample maintained low stable levels of sensation seeking.

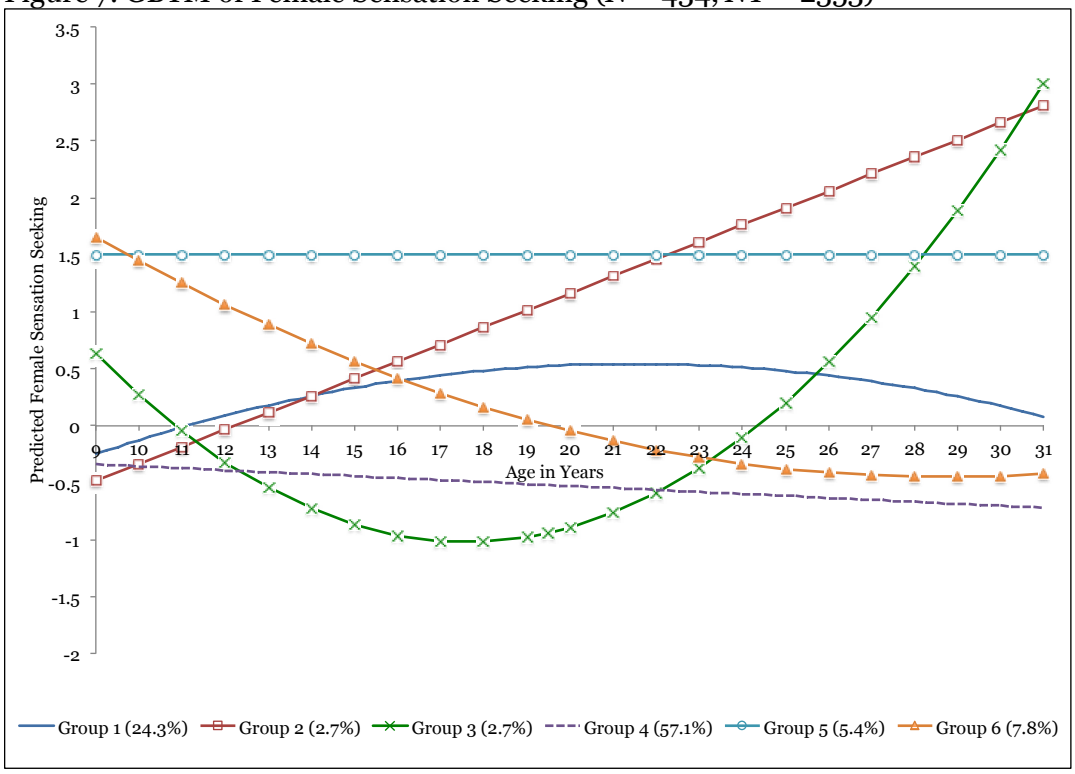
Figure 6. GBTM of Male Sensation Seeking (*N* = 348, *NT* = 1753)



Although the male sensation model that is presented in Figure 6 produces the best fit indices of all models, it became clear during the model fitting and selection process that the data did not lend itself to one clear model as the winner. Generally, the few models with the lowest BIC values are very similar in trajectory number and shape, with perhaps small differences, such as a relatively straight trajectory being described by either a linear or quadratic shape, but in this case, the best models substantially differed in trajectory number and shape. Thus, an alternate best male sensation seeking model is presented in Appendix E. Group 3 was not present is some of the other best-fitting models. Instead, it was replaced by a group that displayed dramatic increases throughout adolescence but did not experience dramatic reductions during the twenties. Group 1 changed to a more stable group and some of the group 3 members were classified in this group. Individual inspection of each of the cases classified in the unstable groups in the best models confirmed that the best model is the one presented in Figure 6, with one important note: overall, some of the individuals classified in group 3 do not report peaks of as great a magnitude as is suggested by the figure.

The best fitting model of female sensation seeking is presented in Figure 7 and is characterized by 6 groups. Similar to the male group, the female group includes one group that captures the developmental pattern of the majority of the population. Once again, this group displays the lowest overall levels of sensation seeking. The difference between the normative male and female groups is that the males in this group display stability throughout the observation period while the females display small decreases in sensation seeking throughout the observation period. Around 57% of the female population is estimated to follow this developmental pattern. The second largest female group captures an estimated 24.3% of the population and is characterized by mid-level sensation seeking that increases slightly until the early twenties and then reverses course

Figure 7. GBTM of Female Sensation Seeking (*N* = 434, *NT* = 2353)



and decreases slightly throughout the remainder of the observation period. The final four groups are all quite small, accounting for around 3%, 3%, 5%, and 8% of the population, respectively. One of these groups has an equivalent group in the male model: the high stable group. While this group accounts for a slightly larger portion of the population in the female group than the male group, the female group remains stable at a lower level of sensation seeking. That is, the male stable group consistently sits above 2 standard deviations away from the mean level of sensation seeking while the females sit just around 1.5 standard deviations above the mean. The final three groups are unique to the female sample. One group (group 2) is characterized by linear increases in sensation seeking throughout the entire observation period, starting at a low baseline level at age 9 and finishing with one of the highest levels of sensation seeking of all groups at age 31. A second group (group 3) is characterized by a slight reduction in sensation seeking throughout adolescence and then a dramatic increase in sensation seeking from the early

to late twenties. Finally, a third group (group 6) is characterized by reductions in sensation seeking throughout the observation period, with the rate of change slowing down as the group nears the end of the observation period.

Overall, there appears to be slightly less heterogeneity in the developmental patterns of sensation seeking than impulsivity. For both the male and female sensation seeking groups, a clear majority of the population could be classified into one group (low stable for males and low decreasing for females). In the impulsivity models, the population was more spread out among the different developmental patterns. The extreme majority of both males and females either report stable or decreasing impulsivity from just before adolescence to age 31. Only around 8% of the male sample and 9% of the female sample demonstrated increases in impulsivity. The male and female impulsivity groups were remarkably similar with the only notable difference being the addition of a small, stable high impulsive group of females. And, in the alternate model of male impulsivity, this group did exist, but it represented only 2% of the male population and the confidence intervals were quite wide.

The sensation seeking models demonstrated greater sex differences than the impulsivity models. Not only were the normative groups slightly different, but the additional groups also varied dramatically by sex. The high peaking group observed in the male model was not observed in the female group. The decreasing group, steady increasing group, and late increasing group observed in the female model were absent from the male model.

Sex Differences in Sources of Trait Variation

The final aim of this dissertation is to explore whether factors identified by the SST vary in their ability to explain variation in the development of impulsivity and sensation seeking by sex. The SST predicts that harsh and unsupportive environments

Table 10. Hierarchical Linear Models Predicting Impulsivity with Sex Interactions

	Model A		Model B				Model C				Model D			
			Between		Within		Between		Within		Between		Within	
Fixed Effects			Coeff.	SE	Coeff.	SE	Coeff.	SE	Coeff.	SE	Coeff.	SE	Coeff.	SE
Intercept	1.624***	.020	1.46***	.118			1.44***	.113			1.44***	.112		
Sex (Female = 1)	0.017	.016	.265°	.138			.281*	.132			.255*	.130		
Morbidity/Mortality			.004	.029	.000	.009	.006	.018	.001	.009	-.017	.027	-.003	.009
Sex_Morbidity/Mortality			.049	.038	.000	.012	.033	.037	-.002	.012	.044	.036	-.000	.012
Neighborhood Crime			-.028	.050	.027	.018	-.051	.047	.014	.018	-.102*	.045	.010	.018
Sex_Neighborhood Crime			.125°	.070	.018	.025	.074	.067	.025	.025	.101	.064	.020	.025
Racial Discrimination			.118***	.033	.058***	.015	.087**	.032	.048***	.015	.039	.031	.033*	.015
Sex_Racial Disrimination			-.084°	.045	.012	.021	-.064	.043	.011	.021	-.045	.042	.011	.021
Romantic Partner Hostility			.265**	.086	.051*	.024	.177*	.083	.040	.024	.133°	.080	.036	.024
Sex_Romantic Partner Hostility			.061	.133	-.018	.035	-.071	.130	-.005	.034	-.151	.126	-.006	.034
Romantic Partner Warmth			-.036	.060	-.034*	.017	.022	.058	-0.031°	.017	.018	.055	-.029°	.017
Sex_Romanic Partner Warmth			-.097	.077	.030	.022	-.121	.074	.029	.022	-.091	.070	.035	.022
No Romantic Partner			.141	.162	-.061	.046	.217	.153	-.063	.045	.199	.147	-.058	.045
Sex_No Romantic Partner			-.337	.210	.061	.058	-.389°	.200	.068	.058	-.343°	.191	.078	.058
Control: RP Missing Waves			.048	.034					.041	.034	.041	.033		
Primary Caregiver Hostility							.249***	.052	.071***	.019	.186***	.050	.059**	.019
Sex_Primary Caregiver Hostility							.011	.066	.004	.025	.038	.064	.005	.025
Primary Caregiver Wamth							-.051°	.029	-.048***	.013	-.036	.028	-.044***	.013
Sex_Primary Caregiver Warmth							-.004	.037	.012	.017	-.003	.036	.009	.017
No Primary Caregiver							-.029	.151	-.006	.066	.007	.145	.038	.067
Sex_No Primary Caregiver							-.011	.187	.020	.081	-.051	.179	-.015	.082
Deviant Peers											.352***	.058	.108***	.024
Sex_Deviant Peers											-.058	-.078	.000	.031
SES											.023	.016		
Sex_SES											.009	.021		
Linear slope	.024**	.008	.028***	.009			.022*	.009			.023*	.009		
Quadratic slope	-.005***	.001	-.005***	.001			-.004***	.001			-.005***	.001		
Cubic slope	.0002***	<.0001	.0001***	<.0001			.0001***	<.0001			.0002***	<.0001		
Random Effects	SD	SE	SD		SE		SD		SE		SD		SE	
Initial status	0.260***	0.011	0.257***		0.011		0.236***		0.011		0.225***		0.011	
Growth rate	0.018***	0.001	0.018***		0.001		0.017***		.0001		0.016***		0.001	
Initial status X Growth rate	-0.639***	0.035	-0.684***		0.033		-.677***		0.035		-0.690***		0.035	
Within-person	0.240***	0.003	0.235***		0.003		0.233***		0.003		0.231***		0.003	
Model Fit														
Deviance	1663.16		1411.67				1239.14				1099.03			
AIC	1681.17		1479.67				1331.13				1203.03			
BIC	1738.06		1692.88				1619.53				1528.71			

ABBREVIATIONS: SD = standard deviation; SE = standard error; AIC = Akaike's information criterion; BIC = Bayesian information criterion

° p <.10, *p<.05, **p<.01, ***p<.001 (two-tailed tests for all but variance components)

122

will have stronger effects on male trait levels given evolved sex differences between males and females. The conditional HLM models used to explore this possibility are presented in Tables 10 and 11 for impulsivity and sensation seeking, respectively. These models are replications of the models in Tables 6 and 7 but with the inclusion of sex as a level two predictor and interactions between sex and the between and within-individual deconstructed time-varying predictors. The predictors are entered in the same step-wise fashion as before, with one difference. Before entering the time-varying predictors, a simple initial model with only sex as a level two predictor was estimated.

Model A of Table 10 presents the results of this preliminary model predicting impulsivity. As expected, based on the initial sex-specific HLM growth curve models presented earlier, sex does not significantly alter impulsivity. In Model B, the key independent variables minus the primary caregiver variables are added, along with interaction terms for each independent variable and sex. The effects of the socio-environmental predictors are largely consistent with the non sex-interaction model. Racial discrimination, romantic partner warmth and romantic partner hostility continue to significantly predict impulsivity in the expected directions. None of the interaction terms are significant at an alpha level of .05, suggesting that males and females are similarly affected by the included socio-environmental experiences. However, two interactions are marginally significant ($p < .10$). Neighborhood crime and racial discrimination demonstrate marginally significant interaction effects. Neighborhood crime has a marginally significant stronger effect on impulsivity for females than males. That is, the same level of neighborhood crime is associated with higher levels of impulsivity for males relative to females. The effect of racial discrimination is opposite such that it produces a stronger effect for males than females. The same level of racial

discrimination is associated with higher levels of impulsivity for males relative to females.

In Model C the primary caregiver variables are added along with their interactions with sex. Primary caregiver hostility continues to be associated with impulsivity in the positive direction (between = .249, $p < .001$, within = .071, $p < .001$) while primary caregiver warmth continues to be associated with impulsivity in the negative direction (between = $p < .10$, within = $p < .001$), and the strength of the associations do not vary by sex. That is, the effect of parenting variables on impulsivity does not differ for males and females. Addition of the primary caregiver variables reduces the within-individual effect of romantic partner hostility on impulsivity to insignificance and the within-individual effect of romantic partner warmth to marginal significance ($p <.10$). However, the between-individual effect of romantic partner hostility is retained, indicating that individuals who tend to experience more romantic partner hostility also report higher impulsivity, after controlling for parenting effects. Interestingly, the marginal interaction effects for neighborhood crime and racial discrimination disappear when the primary caregiver variables are added in this model. After controlling for the parenting variables, then, neither morbidity/mortality nor neighborhood crime are significantly associated with impulsivity in any form.

The final control variables, deviant peers and SES, are added in Model D. Both between- and within- individual effects of deviant peers demonstrate main effects on impulsivity, but no significant interaction effects emerge. That is, the effect of deviant peers on impulsivity does not vary between males and females. Both between and within components of primary caregiver hostility maintain significant associations with impulsivity (between = .186, $p <.001$, within = .059, $p <.01$) while primary caregiver warmth only maintains significant within-individual effects (-.044, $p<.001$). Again, the

interaction effects are insignificant. Beyond the parenting variables, within-individual racial discrimination is the only key independent variable to retain a significant association with impulsivity (.033, $p < .001$). Romantic partner hostility (between) and romantic partner warmth (within) demonstrate marginally significant associations with impulsivity (hostility = .133, $p < .10$; warmth = -.029, $p < .10$).

Overall, the results from Table 10 demonstrate that the mechanisms producing levels of impulsivity are similar for males and females. Any interaction effects that were observed were only marginally significant and disappeared as the primary caregiver, deviant peer, and SES variables were added to the models. In the full model, the variables that retain significant or marginally significant effects on impulsivity include neighborhood crime, racial discrimination, romantic partner warmth, romantic partner hostility, primary caregiver warmth, primary caregiver hostility, and deviant peers.

The results of the models predicting sensation seeking are presented in Table 11. Model A presents the results of the preliminary model: a conditional growth curve model of sensation seeking with the only predictor being the level two (time-stable) variable sex. As expected, based on the initial sex-specific HLM growth curve models presented earlier, sex does not significantly alter sensation seeking. In Model B, the key independent variables minus the primary caregiver variables are added, along with interaction terms of each independent variable and sex. The effects of the predictors are slightly altered by the addition of sex and sex interaction variables. Morbidity/mortality is now significantly related to sensation seeking, but in opposite directions for the between and within-individual components. Individuals who have higher levels of exposure to morbidity and mortality overall report lower levels of sensation seeking (-.090, $p < .05$) but an increase in morbidity/morbidity exposure is associated with higher levels of sensation seeking (.026, $p < .05$). The interaction effect of sex and

Table 11. Hierarchical Linear Models Predicting Sensation Seeking with Sex Interactions

	Model A		Model B				Model C				Model D			
			Between		Within		Between		Within		Between		Within	
Fixed Effects			Coeff.	SE	Coeff.	SE	Coeff.	SE	Coeff.	SE	Coeff.	SE	Coeff.	SE
Intercept	1.52***	.020	1.41***	.151			1.358***	.148			1.343***	.148		
Sex (Female = 1)	-.041	.027	.014	.190			-.026	.188			-.109	.187		
Morbidity/Mortality			-.090*	.040	.026*	.013	-.091*	.039	.026°	.013	-.116**	.038	.023°	.013
Sex_Morbidity/Mortality			.113*	.052	-.030°	.018	.105*	.051	-.033°	.017	.107*	.050	-.034°	.017
Neighborhood Crime			.078	.066	.057*	.026	.066	.065	.045°	.026	.015	.063	.039	.026
Sex_Neighborhood Crime			.048	.094	-.027	.035	.003	.093	-.021	.035	.006	.090	-.030	.036
Racial Discrimination			.166***	.044	.105***	.021	.142***	.044	.093***	.021	.086*	.044	.074***	.022
Sex_Racial Disrimination			-.065	.061	.002	.030	-.046	.060	.005	.030	-.039	.059	.007	.030
Romantic Partner Hostility			.167	.116	.031	.035	.094	.117	.019	.035	.041	.113	.015	.035
Sex_Romantic Partner Hostility			.104	.181	.019	.050	.042	.183	.026	.050	-.108	.179	.023	.050
Romantic Partner Warmth			.018	.081	.016	.024	.059	.082	.017	.024	.050	.078	.022	.024
Sex_Romanic Partner Warmth			-.090	.104	.001	.031	-.073	.104	.002	.031	-.012	.100	.004	.031
No Romantic Partner			.159	.220	.047	.066	.213	.217	.036	.065	.174	.208	.043	.065
Sex_No Romantic Partner			-.110	.286	.068	.084	-.056	.283	.081	.084	.055	.271	.087	.084
Control: RP Missing Waves			-.011	.084			.008	.027			.031	.027		
Primary Caregiver Hostility							.164*	.072	.101***	.027	.098	.071	.085**	.027
Sex_Primary Caregiver Hostility							-.041	.093	-.027	.036	-.034	.090	-.024	.036
Primary Caregiver Wamth							-.045	.041	-.034°	.018	-.030	.039	-.030°	.018
Sex_Primary Caregiver Warmth							-.065	.052	-.013	.023	-.051	.051	-.012	.024
No Primary Caregiver							.193	.215	-.088	.093	.155	.206	-.130	.094
Sex_No Primary Caregiver							-.397	.266	-.032	.114	-.353	.255	.017	.115
Deviant Peers											.375***	.081	.149***	.034
Sex_Deviant Peers											.150	.110	-.002	.047
SES											.030	.023		
Sex_SES											.024	.030		
Linear slope (Age)	-.004*	.002	.003	.003			.004	.003			.003	.003		
Sex_Age	-.007**	.002	-.002	.003			-.002	.003			-.002	.003		
Random Effects	SD	SE	SD		SE		SD		SE		SD		SE	
Initial status	0.261***	0.015	0.251***		0.016		0.243***		0.016		0.231***		0.016	
Growth rate	0.019***	0.001	0.018***		0.001		0.018***		0.001		0.018***		0.001	
Initial status X Growth rate	-0.301***	0.082	-0.324***		0.085		-0.319***		0.089		-0.361***		0.087	
Within-person	0.347***	0.005	0.342***		0.005		0.340***		0.005		0.338***		0.005	
Model Fit														
Deviance	4373.75		4025.73				3942.72				3805.01			
AIC	4389.75		4091.73				4032.72				3907.01			
BIC	4440.31		4298.64				4314.79				4226.36			

ABBREVIATIONS: SD = standard deviation; SE = standard error; AIC = Akaike's information criterion; BIC = Bayesian information criterion

° p <.10, *p<.05, **p<.01, ***p<.001 (two-tailed tests for all but variance components)

morbidity/mortality is also significant for both between- and within-individual components, and once again, in the opposite direction. The between-individual association of morbidity/mortality and sensation seeking is stronger for females than males while the within-individual association of morbidity/mortality is stronger for males. Similar to the models without the sex variables, neighborhood crime and racial discrimination significantly predict sensation seeking in the expected direction. Interaction terms with these variables are not significant suggesting that male and female sensation seeking is similarly affected by neighborhood crime and racial discrimination. None of the romantic partner variables (main or interaction) demonstrate significant associations with levels of sensation seeking.

In Model C the primary caregiver variables are added along with their interactions with sex. Primary caregiver hostility is associated with sensation seeking in the positive direction (between = .164, $p < .05$, within = .101, $p < .001$) while primary caregiver warmth is only marginally significantly associated with sensation seeking and only for the within-individual component (-.034, $p < .10$). The strength of the primary caregiver effects do not significantly vary by sex. Addition of the primary caregiver variables reduces the within-individual effect of neighborhood crime to marginal significance (.045, $p < .10$), but all other effects from Model B are retained. Between and within-individual morbidity/mortality continue to be significantly associated with sensation seeking and the effects vary by sex.

The final control variables, deviant peers and SES, are added in Model D. Both between- and within- individual effects of deviant peers demonstrate main effects on sensation seeking (between = .375, $p < .001$; within = .149, $p < .001$), but no significant interaction effects emerge. That is, the effect of deviant peers on sensation seeking, just like on impulsivity, does not vary by sex. SES is not significantly associated with

sensation seeking. The addition of these two control variables does not alter the effects of morbidity/mortality or racial discrimination on sensation seeking, but the effect of neighborhood crime on sensation seeking disappears, as does the between-individual effect of primary caregiver hostility. Within-individual primary caregiver hostility remains a significant predictor of sensation seeking (.085, p <.01) and within-individual primary caregiver warmth remains a marginally significant predictor of sensation seeking (-.030, p <.10).

While the majority of the sex interaction effects are insignificant, the models in Table 11 reveal that males and females differ in their responses to morbidity/mortality. Overall levels of morbidity/mortality (the between-individual component) have a larger effect on female sensation seeking while changes in exposure to morbidity/mortality having a larger effect on male sensation seeking. In the full model, in addition to morbidity/mortality, the predictors that are significantly associated with sensation seeking include racial discrimination, primary caregiver hostility, and deviant peers. None of these effects appear to vary by sex. However, as seen in Model B, including racial discrimination and morbidity/mortality in the prediction of sensation seeking eliminates the significance of the interaction between sex and age. That is, racial discrimination and morbidity/mortality exposure explain the divergent linear growth patterns of male and female sensation seeking.

Sensitivity Analyses

The structure of item inclusion across waves in the FACHS created complications for the intended data analysis in this project, particularly with the primary caregiver and romantic partner variables. Thus, additional sensitivity analyses were performed to provide indications of robustness of the presented findings.

Regarding primary caregiver variables, it could be the case that relationship quality with parents matters much less in adulthood than in childhood and adolescence, or that different parenting qualities matter at different ages. The FACHS targets were asked some of the same questions about the behaviors of their primary caregivers at age 9 as they were at age 31. To explore how age may affect the relationship between the primary caregiver scales and the outcomes of interest, several supplemental models were estimated. First, full models predicting impulsivity and sensation seeking were estimated with age interactions. That is, I explored whether the strength of the association between the primary caregiver variables and the outcomes varied by age. Because the between-individual levels of primary caregiver warmth and hostility capture individual average levels of the trait over time and are considered time-stable variables, it is not very useful to explore whether the association between outcomes and between-individual levels of primary caregiver variables vary with age. Thus, discussion here is restricted to within-individual components. Analyses suggest that the effect of changes in primary caregiver warmth and hostility on impulsivity do vary by age with a stronger effect being observed at earlier ages. Increases in primary caregiver hostility are associated with smaller increases in impulsivity in later years compared to earlier years (-.004, $p< .05$) and increases in primary caregiver warmth are associated with smaller decreases in impulsivity in later years (.006, $p<.001$). The results of these analyses are presented in Appendix F. For the sensation seeking models, a different picture emerges. The effect of the primary caregiver variables on sensation seeking do not significantly vary by age.
I also estimated models excluding data from waves 1, 2 and 4. Given that it is possible that parenting matters much more in earlier years, this model tested whether or not there are significant primary caregiver effects on impulsivity and sensation seeking when targets are all above the age of 18. When all waves were included, all components of

primary caregiver warmth and hostility maintained significant effects on impulsivity after all controls were added to the model. In contrast, in the model estimated with only wave 5 and above, only the hostility components remain significant (between = .19, $p<.001$; within = .037, $p<.05$). Neither between- nor within-individual primary caregiver warmth is significantly associated with impulsivity levels in this "adult" model. When all waves were included in predictions of sensation seeking, both primary caregiver warmth components and only the within-individual hostility component was significantly associated with sensation seeking. In the adult sensation seeking model, just as in the adult impulsivity model, the hostility measures are significantly associated with the outcome (between = .133, $p<.05$; within = .056, $p<.05$), but the primary caregiver warmth variables are not.

Finally, a check was performed to increase confidence in the decision to assign individuals with no primary caregivers scores on the primary caregiver scales. Recall, if individuals reported no primary caregiver or no romantic partner, their missing values on the respective warmth and hostility scales were replaced with 1s, indicating never experiencing warmth or hostility from their relationships over the past year/month. Additional models were run leaving the data missing—that is, individuals who did not report having primary caregivers were dropped from the primary caregiver analyses. For both impulsivity and sensation seeking, this approach had the effect of strengthening the relationship between primary caregiver variables and outcomes of interest. Specifically, the effects were larger in magnitude for all components and significant at smaller alpha levels. Thus, although the coding scheme involving missing data replacement retained a larger sample for these analyses, it may have had the effect of dampening the strength of the association between the primary caregiver warmth and hostility with impulsivity and sensation seeking. Again, the results of these analyses are presented in Appendix F.

Altogether, the supplemental analyses suggest that primary caregiver variables operate similarly for impulsivity and sensation seeking. In both cases, warmth and hostility are important predictors, and in both cases, primary caregiver hostility appears to maintain effects on the outcomes during adulthood while warmth does not, but the change in effects over time is more substantial for impulsivity than sensation seeking.

The romantic partner variables were potentially problematic for two reasons: 1) targets were not asked about romantic partner status at waves 1 and 2, and 2) not all individuals had romantic partners in waves 4 through 7. In general, a little over half of the sample in waves 4 though 7 reported the presence of a romantic partner. The former issue was dealt with by creating a dichotomous variable called *missing RP* in which all individuals were assigned a 1 for waves 1 and 2 and a 0 for waves 4 through 7 and all waves were included in the analyses. As noted, the second issue was dealt with by assigning individuals without romantic partners 1s on the romantic partner hostility and warmth scales to indicate that they never experienced hostility or warmth from a romantic partner and including a control variable to capture that they did not report the presence of a romantic partner. Several sensitivity models were estimated to make sure that the data manipulation did not bias the results. First, models were estimated that excluded data from waves 1 and 2. These models restricted analyses to waves in which romantic partner items were included. Findings perfectly mimic findings in the initial models. The only romantic partner variable that demonstrates a significant association with impulsivity is within-individual romantic partner hostility. The coefficient is even identical across the two approaches (.035, $p<.05$). In the initial sensation seeking model with all controls, none of the romantic partner variables significantly predicted sensation seeking. The same pattern is observed in this restricted model.

Second, as with the primary caregiver variables, models were performed without missing data replacement. That is, individuals who did not report having a romantic partner were dropped from analyses involving these variables. Overall, the findings mostly mimic what has already been presented. Romantic partner variables are not significantly associated with sensation seeking and between-individual romantic partner hostility is associated with increased impulsivity (.084, $p<.01$). The one difference with this method is that within-individual romantic partner warmth now becomes significantly associated with impulsivity at the alpha =.05 level (*coeff* = -.026).

Finally, an entirely different variable was created to capture romantic partner relationship quality and used as a comparison to the romantic partner warmth and hostility variables. In waves 4 through 7, targets were asked "how happy are you, all things considered, with your relationship?" Respondents could answer with (1) extremely unhappy, (2) very unhappy, (3) unhappy, (4) happy, (5) very happy, or (6) extremely happy. These responses were recoded such that 1-3 remained indictors of unhappiness, 4 became a neutral category, used to assign to individuals who did not have a romantic partner, and categories 5-7 became indicators of increasing happiness. Consistent with the theoretical approach, individuals who do not have a romantic partner are unable to be either happy or unhappy with their partner because they are not receiving any messages from a romantic partner. Thus, they should occupy this neutral position. When this single scale replaces the separate warmth and hostility scales, different findings emerge for impulsivity, but not sensation seeking. Specifically, this happiness scale is unrelated to levels of impulsivity (recall, hostility was related impulsivity previously). The happiness scale is also unrelated to levels of sensation seeking, consistent with the lack of all romantic partner variable significance in previous sensation seeking models. Although these two methods of operationalizing relationship

quality produce slightly different results, the approach taken initially seems more appropriate. The initial scales are more consistent with the theoretical framework. That is, the SST emphasizes harsh versus supportive environmental conditions. By asking about romantic partner behaviors that indicate hostility and warmth, it is possible to more directly tap into these concepts. Level of happiness in a relationship may not adequately capture harshness or supportiveness present in relationships. Furthermore, by using one continuous scale, an assumption is made that happiness indicates both lower levels of hostility and higher levels of warmth, but results suggest that these two concepts should be separated. Specifically, hostility consistently demonstrates a significant association with impulsivity, but warmth does not.

Finally, the effects of the morbidity/mortality variable on sensation seeking were complex and surprising in the sex-interaction model. To gain more insight into the nature of the effects, sex-specific models were first estimated predicting sensation seeking, and second, a series of models were estimated in which the morbidity/mortality scale was separated into three potentially unique components: exposure to death; personal illness; exposure to victimization. In the male-specific model, higher levels of between-individual morbidity/mortality are associated with lower levels of sensation seeking (-.12, $p<.01$). Neither of the morbidity/mortality components is significantly associated with sensation seeking in females. Although not the focus of the sensitivity analysis, the sex-specific models did reveal that primary caregiver warmth is significantly associated with sensation seeking in females (between = -.08, $p<.01$; within = -.04, $p<.01$), but not males, even though this interaction effect did not reach statistical significance in the sex interaction model. Higher levels of warmth and improvements in primary caregiver warmth are associated with lower levels of sensation seeking. Decomposing the morbidity/mortality variable into three components and running sex-

specific models provides insight into the unusual findings presented in the sex-interaction model. Specifically, between-individual levels of exposure to death are driving the observed significance between morbidity/mortality and sensation seeking for males. Overall, men who are exposed to more death demonstrate lower levels of sensation seeking (-.111, $p<.01$). Death did not have an effect on female impulsivity. However, within-individual victimization was marginally significantly associated with impulsivity for females (-.036, $p<.10$). Interestingly, both of these effects are in opposite directions to what is proposed in the SST. Increased exposure to these indicators of death and sickness are related to lower levels of these traits. Overall, these findings suggest that death, illness, and violent victimization should not be conflated in one measure of morbidity and mortality.

Chapter 5: Discussion

The purpose of this dissertation was to explore several aspects of developmental patterns of two traits frequently linked to offending or antisocial behavior in empirical studies and theoretical scholarship: impulsivity and sensation seeking. Growing evidence suggests that impulsivity and sensation seeking do not follow similar normative developmental patterns, that significant individual variation exists around these normative developmental patterns, and that developmental patterns may vary by sex. This dissertation builds on this evidence by examining the developmental patterns of these traits among males and females in a sample of nearly 800 African Americans who were followed from around age 9 to 31. Furthermore, this dissertation extends this work by exploring potential sources of this developmental variation. Growing evidence of trait malleability has necessitated an investigation into factors that may be responsible for altering trait levels over the life course, yet few studies have addressed this issue.

The first aim was to determine whether variation exists in levels and growth rates of impulsivity and sensation seeking. A preliminary indication of variation in development patterns of traits comes from stability coefficients, as they quantify the amount of distribution reshuffling that occurs over time. Consistent with recent evidence, substantial rank-order shuffling in both impulsivity and sensation seeking between the ages of 9 and 31 was observed. Stability coefficients were as low as .11 for impulsivity and .16 for sensation seeking (both between waves 1 and 7). Interestingly, this study demonstrated lower stability coefficients than most other studies examining the stability of self-control or its elements over time. These low estimates could be due to the long observation period of over 20 years; a well-documented finding is that stability estimates decrease as time between measurements increase.

The use of hierarchical linear modeling (HLM) directly addresses the question of whether and how much variation exists in developmental patterns of impulsivity and sensation seeing. HLM enables identification of an average developmental pattern of the trait of interest over time and variation in baseline levels of the trait (variation in the intercept) and variation in the growth rate of the trait over time (variation in the age slope). Confirming the majority of research on these traits, impulsivity and sensation seeking both demonstrated between-individual differences in baseline levels of the traits and in growth rates, suggesting that individuals significantly differ in their levels of impulsivity and sensation seeking at age 9 and in how much their levels change over time. The average impulsivity developmental pattern was consistent with the majority of previous work, but the sensation seeking trajectory was not. Specifically, I found additional evidence that, on average, individuals report improvements in impulsive behavior throughout adolescence and early adulthood. Furthermore, consistent with studies that capture development prior to adolescence, I observed a small increase in impulsive behavior between ages 9 and 12. Unlike most other studies, however, I observed a small increase in impulsivity at the end of the observation period (between ages 27 and 31). However, this small increase may be due to data limitations. Specifically, the sample size dropped substantially in wave 7 and attrition analyses determined that individuals retained in wave 7 interviews were significantly more impulsive than those not interviewed. Thus, little weight should be given to the slight uptick observed towards the end of the observation period.

While I expected the sensation seeking trajectory to show a spike around the time of puberty, I found a stable normative developmental pattern with this sample. However, again, it could be the case that my methodology was responsible for some of the unusual patterns. Recall that I was unable to include wave three in the analyses as this wave was

missing the key variables (impulsivity and sensation seeking). While there was generally a two-year gap between measurement periods, there was a four-year gap between waves 2 and 4. Importantly, this gap covers early adolescence and could have served to attenuate any significant changes during this period, a period identified as highly important for neurological restructuring in the dual systems model of risk-taking (Steinberg, 2008). However, it could also be the case that this mean-level trajectory is a true reflection of the normative developmental pattern for this homogenous sample of African Americans. Given evidence of racial differences in mean levels of self-control (De Li, 2005; Pratt et al., 2004; Winfree et al., 2006) it is not unreasonable to question whether racial groups display different mean-level developmental patterns of sensation seeking.

Another aim of this dissertation was to explore sex differences in developmental patterns of these traits. Given the documented sex disparity in offending, it is worthwhile to consider whether a portion of differential involvement in crime could be due to underlying differences in traits related to crime. Sex differences in developmental patterns of impulsivity and sensation seeking were explored with two longitudinal modeling methods that provide insight into this research question in unique ways. HLM was used to identify average developmental patterns and variation in baseline levels and growth rates for each sex. Group-based trajectory modeling was used to identify distinct developmental patterns for each sex.

No significant differences emerged between male and female normative developmental patterns of impulsivity. Both males and females demonstrated an average growth pattern characterized by a slight increase in impulsivity right before adolescence, constant improvements in impulse control throughout adolescence and early adulthood and a slight increase in impulsivity just before the end of the third decade of life.

Previous research has reported mixed findings on whether developmental patterns of impulsivity vary by sex with some findings, like the current study, finding no sex differences (Khurana et al., 2018) and others finding slight differences (Shulman et al., 2015). When sex differences were observed in previous studies, females generally reported lower levels of impulsivity across the full observation period and demonstrated faster improvements in impulse control than males. Differing sample characteristics and methodology could be the cause of the divergent findings. In addition to being restricted to African Americans, the FACHS targets were drawn from a limited geographical region (only two states).

While no sex differences were identified for impulsivity, sex differences did emerge for sensation seeking. Although males and females appear to have similar average levels of sensation seeking at age 9, males and females vary in their growth rates. Males and females both follow a linear developmental pattern yet do so in opposite directions. Specifically, males are characterized by slight increases in sensation seeking throughout adolescence and early adulthood while females are characterized by slight decreases throughout this period. These findings are somewhat inconsistent with previous research. Other studies that have examined sex differences in developmental patterns of sensation seeking have generally identified curvilinear developmental patterns for both males and females, with females demonstrating lower overall levels of the trait (Shulman et al., 2015; Vazsonyi & Ksinan, 2017; Zuckerman et al., 1978). While I also found that females reported overall lower levels, this study is the only one to identify a developmental trajectory for males characterized by constant small increases in sensation seeking throughout the observation period (no peak).

The random effects analyses suggested that there is significant variation around these baseline levels and growth rates for both traits. That is, both males and females

demonstrate variation in levels of traits at age 9 and in the rate of change in these traits over time (i.e. within male and female groups, individuals vary in their developmental patterns).

While HLM is useful for identifying the average developmental patterns of these two traits and demonstrating the existence of heterogeneity in developmental patterns, this method is unable to explicitly detect the presence of developmental trajectories that depart from the overall growth pattern. GBTM analyses address this shortcoming. Using GBTM, it is possible to explore whether there are sex differences in unique developmental patterns of these traits. Thus, GBTM models were estimated to describe male impulsivity trajectories, female impulsivity trajectories, male sensation seeking trajectories, and female sensation seeking trajectories. These models demonstrated that some individuals follow developmental patterns of impulsivity and sensation seeking that dramatically depart from the average growth curves identified by HLM.

The best fitting model for male impulsivity was characterized by 5 groups while the best fitting model for female impulsivity was characterized by 6 groups. Overall, the trajectories are remarkably similar across sex. Each male trajectory corresponds to a similar trajectory in the female model, and the only additional female trajectory, the high stable trajectory, was observed in the alternate best male model (but only about two male cases truly followed this developmental pattern). These models estimated that around 65% of the male sample follows impulsivity trajectories similar to the normative pattern (improvements in impulse control throughout most of the observation period, albeit with different base levels and different rates of change), and around 85% of the female sample follows impulsivity trajectories similar to the normative pattern. The remainder of the sample either remains stable (27% male, 6% female) or increases in impulsivity between ages 9 and 31 (8% both males and females). Despite the addition of another wave of data,

which extended the observation period by about five years, these findings are highly consistent with the six trajectories identified by Burt et al. (2014).

The best fitting model for male sensation seeking was characterized by 4 groups while the best fitting model for female sensation seeking was characterized by 6 groups. While the two groups that capture the individuals at the high and low ends of the spectrum are similar, the trajectories describing the remaining developmental patterns are not at all similar across sex. That is, both males and females demonstrate one high stable group of sensation seekers (4% male, 5% female) and one low stable or low decreasing group (65% male, 57% female). Importantly, the low female group demonstrates small reductions over time while the male group remains stable, perhaps driving the observed sex difference in the normative growth curves identified by HLM. The female trajectories are also slightly shifted down. That is, the high stable group of male sensation seekers report higher levels of sensation seeking than the high stable female group. These models demonstrate that the majority of males do not follow the normative sensation seeking trajectory identified by HLM. Rather, most follow a low stable trajectory, but there are enough males who do increase in sensation seeking in adolescence and in their twenties to pull the average growth trajectory into an upward trend. The majority of the female sample does follow a sensation seeking trajectory similar to the normative growth curve identified by HLM. However, there is still much variation in developmental patterns not captured by HLM, including females that demonstrate constant, rather dramatic, rises in sensation seeking throughout the observation period.

In combination, the results from HLM and GBTM models suggest that males and females are more similar in their developmental patterns of impulsivity than sensation seeking. Furthermore, a substantial proportion of the population does not follow the

normative patterns of impulsivity or sensation seeking described in previous research. Around 15% of females and 35% of males did not improve in impulse control over the observation period. Only 6% of the male sample demonstrated a peak in sensation seeking during adolescence and no female trajectories were characterized by this peak. These results demonstrate that although it is possible to identify normative patterns of development in these traits, it is unreasonable to assume all individuals follow this normative pattern. Furthermore, even though the goal of the current study was to explore variation in developmental patters, the methods used necessarily collapse much of the actual variation in individual developmental trajectories. As is hopefully clear by now, HLM dramatically simplifies the development of impulsivity and sensation seeking as the goal of this method is to characterize *average* growth over time. It is possible to see the variation collapsed when looking at the GBTM models. However, the GBTM models also result in much variation reduction. Specifically, the final models provide pictures that suggest individuals follow one of the identified trajectories. However, not all individuals follow one of these trajectories in lock-step. Rather, there is much fluctuation and individual variation within each group. Thus, variation demonstrated here should be considered a conservative estimate of variation in trait development. Given this evidence of variation in developmental patterns, claims that the rise in sensation seeking in adolescence is universal are unlikely to be valid. The diversity in developmental patterns identified here suggest that it is useful to engage in research exploring when, how, and why traits change over the life-course.

Another aim of this dissertation was to explore *sources* of variation in impulsivity and sensation seeking. Given the common assumptions that personality traits remain stable throughout the life-course and individual differences in trait levels are due to underlying difference in biology, potential social sources of influence on personality

remains an understudied topic. Recent personality research generally and research on self-control specifically has suggested that traits are malleable throughout the life-course and has pointed to potential sources of change. While self-control research has highlighted social experiences in the formative years that may alter the levels of self-control (and, by extension, the levels of the elements of self-control, including impulsivity and sensation seeking), personality research has highlighted role changes or exposures to new social experiences that often occur during emerging adulthood as a source of personality change (Roberts et al., 2005). Specifically, self-control research has suggested that factors including parenting, school attachment, neighborhood context, and victimization influence levels of self-control, and may continue to do so past the formative years. Personality research has suggested that factors such as major life events, and quality of social relationships, including parenting, friend, and significant other, may alter personality trait levels. Studies examining social influences on levels of impulsivity and sensation seeking in particular are nearly nonexistent. This gap in the literature was addressed using Simons and Burt's (2011) Social Schematic Theory (SST) as a theoretical framework for identifying potential causes of impulsivity and sensation seeking, and HLM as a method for exploring whether social factors are able to explain some of the variation observed in impulsivity and sensation seeking both between individuals and within individuals over time.

The SST suggests that harsh and unsupportive environmental conditions send messages to individuals about the way the world works that are internalized in the form of schemas, which then direct action in new situations, potentially leading to criminal outcomes. Impulsivity and sensation seeking are both captured within the *immediate gratification* schema, and as such, I expected harsh and unsupportive environmental conditions including neighborhood crime, exposure to indicators of morbidity and

mortality, racial discrimination, primary caregiver hostility, and romantic partner hostility to be associated with elevated levels of impulsivity and sensation seeking. Supportive environmental conditions send different messages about how the world works. Thus, primary caregiver warmth and romantic partner warmth were expected to be associated with lower levels of impulsivity and sensation seeking.

Overall, the propositions of SST were supported by the analyses. See Table 12 for a summary of findings. Four columns are presented for each outcome (impulsivity and sensation seeking). The first column for each outcome summarizes the significant between-individual effects and the second columns summarize the significant within-individual effects. The third columns summarize significant interaction effects with sex for the between-individual components of the time-varying predictors. Finally, the fourth columns summarize significant interaction effects with sex for the within-individual components of the time-varying predictors.

Table 12. Summary of SST Effects on Impulsivity and Sensation Seeking

	Impulsivity		x_Sex		Sensation Seeking		x_Sex	
	B/W	W/IN	B/W	W/IN	B/W	W/IN	B/W	W/IN
Morbidity/Mortality							**+**	**-**
Neighborhood Crime		+	+		+	+		
Racial Discrimination	+	**+**	-		**+**	**+**		
Romantic Partner Hostility	+	**+**			+	+		
Romantic Partner Warmth	-							
No Romantic Partner						**+**		
Primary Caregiver Hostility	**+**	**+**			+	**+**		
Primary Caregiver Warmth	**-**	**-**			**-**	**-**		
Deviant Peers	**+**	**+**			**+**	**+**		
SES		**+**				**+**		

NOTES. Bolded signs indicate the effect was retained at alpha < .10 when the control variables were included
The x_Sex columns indicate the direction of interaction effects only (main effects from sex models are not included).
A positive sign in the x_Sex column indicates larger effect for females; a negative sign indicates larger effect for males.

As can be seen in first two columns for each outcome, nearly all predictors demonstrated associations with impulsivity and sensation seeking in the expected direction. The only exceptions included the failure of morbidity/mortality to be associated with either impulsivity or sensation seeking and the failure of romantic

partner warmth to be associated with sensation seeking. At least one or both of the components (between- or within-individual) of all of the other predictors were significantly associated with impulsivity and sensation seeking. Neighborhood crime, racial discrimination, romantic partner hostility, and primary caregiver hostility were associated with increased impulsivity and sensation seeking. Primary caregiver warmth was associated with decreased impulsivity and sensation seeking while romantic partner warmth was only associated with between-individual levels of impulsivity, and this effect disappeared when the primary caregiver variables were added to the models.

As can be seen in the third and fourth columns for each outcome, several sex differences emerged. Impulsivity appears to be slightly differentially affected by neighborhood crime, racial discrimination, and the presence of a romantic partner for males and females. Neighborhood crime produces a larger effect on impulsivity in females while racial discrimination and not having a romantic partner produces a larger effect on impulsivity in males. None of these interaction effects emerged when predicting sensation seeking. Instead, effects of morbidity/mortality emerged with the addition of sex as a level two predictor and interaction effects. Not only did morbidity/mortality become a significant predictor of sensation seeking, but its effect also varied by sex with males demonstrating a larger effect of changes in morbidity/mortality exposure and females demonstrating a larger effect of overall exposure to morbidity/mortality. Sensitivity analyses provided further insight into the source of these differences. When breaking up the morbidity/mortality scale into three separate components (exposure to death, illness, and violent victimization), it became clear that males and females were responding to different predictors. Male sensation seeking is significantly associated with exposure to death while female sensation seeking is marginally associated with exposure to violent victimization.

Overall, however, more sex similarities than differences were revealed throughout this portion of the study. That is, when all control variables were entered into the models, not a single sex interaction was significant when predicting impulsivity, suggesting that factors identified as important in the development of impulsivity by the SST operate in a sex-general manner. It is not the case that females exposed to similar levels of predictors respond with lower levels of impulsivity. Indeed, the same factors mattered for males and females, and the effects were similar across sex.

The results of this study lead to four broad conclusions. First, there is clear evidence of heterogeneity in developmental patterns of impulsivity and sensation seeking, and a substantial portion of individuals do not demonstrate absolute or even relative stability throughout the life-course. This finding is problematic for criminological theories that invoke stable population heterogeneity assumptions. It is not appropriate to conclude that individuals who demonstrate relatively high levels of the traits related to offending at early ages are the same individuals who will show high levels two decades later. Furthermore, it is clear that not all individuals experience changes in the same manner, as is suggested by theories that emphasize normative maturation (e.g., Arnett, 2002: Cauffman & Steinberg, 2000). While normative patterns of development do exist, especially for sensation seeking, substantial departures from these patterns also exist.

Second, we have clear evidence that some socio-environmental conditions, and especially those identified by the SST, are related to the development of impulsivity and sensation seeking over time. That is, some of the variation observed in the developmental patterns of impulsivity and sensation seeking is likely due to exposures to certain socio-environmental conditions. Personality models that assume relative stability of traits over the life course and attribute any change in trait levels to biological causes

(e.g., McCrae et al., 1999; McCrae et al., 2000) are likely incomplete. Furthermore, explanations of the normative developmental patterns of impulsivity and sensation seeking that rely primarily on typical patterns of neurological restructuring throughout the life course, such as the dual systems model (Steinberg, 2005, 2008, 2010), are likely oversimplified descriptions of a more complex reality in which intrinsic biological process are working in combination with environmental input to determine trait levels throughout the life course. Steinberg's (2004) statement, "there is probably very little we can do with respect to intervention that will either attenuate or delay the shift in reward sensitivity [the basis for heightened sensation seeking] or accelerate the maturation of self-regulatory competence" (p. 57) is inconsistent with both the variation in developmental trajectories of these two traits observed in this and other studies and the significant effects of environmental conditions observed in this paper. Although these underlying developmental predispositions may exist for all, they clearly do not manifest for all and are capable of being affected by social experiences. Overall, supportive environmental conditions, measured as primary caregiver warmth and romantic partner warmth are associated with decreases in impulsivity and sensation seeking, and several harsh environmental influences, captured as neighborhood crime, racial discrimination, romantic partner hostility, and primary caregiver hostility are associated with increases in impulsivity and sensation seeking. Components of morbidity/mortality are also associated with levels of sensation seeking with exposure to death leading to higher levels of sensation seeking in males. However, these social predictors, in combination with age, are only able to explain 18% of within-individual variation in impulsivity and 9% of within-individual variation in sensation seeking.

Third, this examination of impulsivity and sensation seeking provides further evidence of the independence of the development of impulsivity and sensation seeking.

This study contributed to the building evidence that demonstrates impulsivity and sensation seeking follow different normative developmental patterns (Burt et al., 2014; Harden & Tucker-Drob, 2011; Quinn & Harden, 2013; Steinberg et al., 2008) and relationships with sex (Cross et al., 2011). Thus, the findings of this paper bolster the argument that continuing to use a global measure of self-control in explanations of crime is problematic as it fails to appreciate this independence and leads us to simplify a more nuanced explanation of how personal characteristics develop and may be linked to criminal and analogous behavior.

Fourth, and finally, sex differences in predictors of both sensation seeking and impulsivity are minimal. Of all predictors included in the primary analyses, only the effect of morbidity/mortality varied by sex, and this effect only varied for sensation seeking, not impulsivity. While some previous scholarship (e.g., Chapple et al., 2010) has found that parenting matters differently for males and females in the establishment of self-control, the present study found no evidence of such effects on the development of impulsivity and sensation seeking specifically. That is, primary caregiver hostility and warmth operated similarly for males and females. Hostility was associated with increased impulsivity and sensation for both males and females and in similar degrees while warmth was associated with decreased impulsivity and sensation seeking in similar degrees. It could be the case that previous studies identifying sex-variant effects were capturing effects on other elements of self-control, besides impulsivity or sensation seeking, or it could be the case that the current study did not capture the specific forms of parenting that would produce different effects on males and females. The lack of sex differences is somewhat surprising given the previous research that has demonstrated differential sex effects (e.g., Chapple & Johnson, 2007; Chapple et al., 2010) and the emphasis placed on sex differences in predispositions to engage in impulsive or risky

behavior in evolutionary theories (Daly & Wilson, 1985; Ellis et al., 2012). Although it was the case that males reported higher levels of sensation seeking than females, it was not the case that males responded to socio-environmental experiences with greater levels of sensation seeking than females. That is, sex does not appear to moderate the relationship between the SST predictors included in the present study and levels of sensation seeking.

Policy Implications

Although this study was situated within a larger body of work on crime, the benefits of understanding the sources and malleability of impulsivity and sensation seeking are likely to be much broader than crime reduction. Impulsivity and sensation seeking have been linked to a host of additional negative outcomes including gambling (Slutske, Caspi, Moffitt, & Poulton, 2005), poor academic performance (Duckworth & Seligman, 2005), unprotected sex (Hoyle, Fejfar & Miller, 2000), self-injury (Lynam et al., 2011) and substance use (Sargent et al., 2010). The key findings of this dissertation speak to the nature of what are likely to be effective interventions to prevent/curb involvement in deviant behavior and these additional negative outcomes through a focus on altering trait levels.

As it was proposed, self-control theory provides bleak predictions regarding our ability to change offenders. According to Gottfredson and Hirschi (1990), if parents are not able to successfully monitor and correct child behavior by ages 8 to 10, then there is little we can do to alter individuals' criminal propensity throughout the life course. Similarly, other criminological theories that emphasize trait differences focus on the continuous effects these traits are likely to have throughout the life-course on criminal propensity (e.g., Moffitt's (1993) life-course persistent offenders and DeLisi and Vaughn's (2015a, 2015b) life-course offenders). Previous empirical evidence, combined

with the findings from this study, suggest that this bleak outlook is unwarranted. First, growing evidence, including the findings from the current study, suggests that traits are malleable. Significant within-individual changes in trait levels are observed, and interventions targeted at improving self-control or related traits have been successful (Piquero, Jennings & Farrington, 2010).

The current findings suggest that targeting some environmental conditions, especially enhancing supportive environmental conditions and reducing harsh environmental conditions, may affect levels of impulsivity and sensation seeking between the ages of 9 and 31. Given the significance of key SST concepts for predicting levels of impulsivity and sensation seeking in this study, it is important to consider the unique approach to interventions that SST implies. Specifically, SST views traits (in the form of schemas) as developmental adaptions. The source of individual variation in traits is located within environments and thus, effective interventions should be targeted at changing environments, not directly changing trait levels. The latter approach should be highly ineffective if individuals remain in their same environments. Specifically, this approach suggests that individuals adapt to their situations to "make the best of a bad situation." Individuals may respond to stressful environments with increased impulsivity and sensation seeking because it is economically rational in the short term, even if not in the long term. Thus, attempting to alter trait levels without appreciating the potential benefits of those traits given contextual pressures will likely be a futile endeavor.

Although some evidence has emerged for the independence of impulsivity and sensation seeking, specifically in terms of normative developmental patterns, sex differences, and relationships with key outcomes, the exploration into causes of impulsivity and sensation seeking in the current study suggests that trait-specific interventions may not be necessary. That is, programs and policies focused on enhancing

the supportiveness and predictability experienced by individuals will likely affect both impulsivity and sensation seeking. However, it could be the case that trait-specific developmental causes may be identified by future research. Importantly, neurobiological work demonstrates that the brain regions involved in these two traits have varying degrees of plasticity, with impulsivity being the trait that should be more amenable to change due to its basis in the prefrontal cortex. This section of the brain appears to develop slowest, deteriorate fastest, and change the quickest in response to environmental conditions while sensation seeking is associated with the lower-level brain systems that do not appear to be as amenable to change (Casey, Giedd, & Thomas, 2000). Thus, it could be the case that with different predictors we would have observed differential effects on impulsivity and sensation seeking. Thus, the conclusion that impulsivity and sensation seeking are generally influenced by the same social experiences should be limited to the social experiences directly captured in the current study.

Limitations and Future Directions

Although this study provides a first step in identifying factors that influence levels of and changes in two traits that are linked to deviant behavior, several limitations must be considered when interpreting the results.

First, this sample was limited by its focus on African Americans between the ages of 9 and 31. Given the documented disparities in street crime between black and white individuals (Hawkins, Laub, Lauritsen, & Cothern, 2000), it is important to consider how the elements of self-control, or traits generally related to offending, may lead to this disparity. Several studies have documented racial disparities in trait levels, but surprisingly, not always in the expected direction. That is, even though street crime is higher among African Americans, several studies have reported that self-control is

higher among African Americans (Chapple et al., 2004; Perrone et al., 2004; Pratt et al., 2004) and sensation seeking is lower (Pedersen et al., 2012; Winfree et al., 2006). These findings are surprising as Gottfredson and Hirschi (1990) would argue that the increased offending observed for African Americans would be due to this group's relatively lower levels of self-control. This suggests that other factors beyond the elements of self-control might be responsible for the racial disparity observed in offending. Not only have racial groups reported significantly different mean levels of self-control, but the mechanisms through which self-control develops may also vary by race. Pratt et al. (2004) explored the potential contribution of community context on the development of self-control. They found that adverse neighborhood conditions were related to parental supervision, but not universally; this relationship only existed for non-white children. Collectively, these studies suggest that more work is needed to understand the potentially complex ways in which the development of the elements of self-control vary across racial groups and how these traits may be differentially related to offending for the groups.

Although 20 years of observation is long relative to most longitudinal studies it could be the case that findings would be altered given a more complete observation period. This study could be failing to capture important developmental patterns during childhood, a period emphasized as highly important by developmental psychologists. Furthermore, the marker of when personality "stabilizes" has been pushed further into the life-course and it is important to explore how these traits continue to change in later life and perhaps relate to the observed tendency for most individuals to age out of crime. Despite initial arguments that personality generally stabilizes before 30 (Mccrae & Costa, 1994), recent studies are demonstrating that personality change continues throughout the life course (Caspi et al., 2005) and is perhaps just as malleable after 30 as before

(Scollon & Diener, 2006), even into the 9th decade of life (Mõttus, Johnson, & Deary, 2012; Mõttus, Johnson, Starr, & Deary, 2012). Thus, future studies should explore impulsivity and sensation seeking change in both earlier and later years than what was captured presently.

Another limitation comes from the nature and structure of some of the measures. Only self-report measures were available in the current data set and as such, the conclusions presented here depend on the assumption that respondents are accurately characterizing their own tendencies and correctly recalling and reporting their experiences. One potential issue is that we may develop self-images that remain stable despite our changing behavior. Thus, we may report our behavior as we think it fits into our view of ourselves, not as objective reality. This would serve to inflate stability estimates of personality traits. Furthermore, the effects of social factors that we identified may partially be observed due to information processing and memory processes that vary by the same traits we are predicting. For example, several studies have shown that individuals high on neuroticism are more likely to recall unpleasant experiences (Bradley & Mogg, 1994; Larsen, 1992; Martin, Ward, & Clark, 1983). The exact mechanism is unclear (whether individuals high on the neuroticism trait are more likely to remember negative events; whether they are more likely to encode negative events; whether they have more negative dispositions and concurrent negative dispositions increase reporting of previous negative events), but regardless of underlying mechanism, it could be the case individuals high in impulsivity (because it is often considered a lower-level component of neuroticism) are more likely to characterize their experiences as more negative, strengthening the relationship between impulsivity and negative social experiences. Finally, the self-report measures ask individuals to report what they think they do, in a calm, neutral situation. It could be the case that

expectations of behavior are different from actual behavior. Thus, findings could be altered with measures that capture impulsive and sensation seeking behavior directly in a variety of settings. For example, research shows that adolescents are more similar to adults when in emotionally "cool" contexts and less like adults when aroused and in the presence of peers. Some of the variation in impulsive and sensation seeking behavior over time could be missed by asking adolescents about their assumed behavior in hypothetical situations instead of directly observing it.

The measure of impulsivity employed in the present study is quite broad. More general measures of impulsivity may mask differences while specific forms of impulsivity may vary by sex. Cross et al. (2011) found that sex differences in impulsivity vary depending on how impulsivity is operationalized and captured (observed behavior versus self-report; general questions for situation-specific questions). It could be the case that specific forms of impulsive behavior, especially those related to deviant/criminal behavior are more likely among men than women, even if impulsivity, overall, does not show significant sex differences. Thus, the impulsivity construct used in the current study may not have been refined enough to capture these nuanced differences.

This study is also limited, as are most social scientific studies, by its inability to simultaneously capture and model all potentially important influences and causal pathways. I specifically focused on the association between two traits related to criminal behavior—impulsivity and sensation seeking— and environmental conditions and have operated with the assumption that these environmental conditions are influencing trait levels. As personality psychology scholars have noted, there are likely reciprocal relationships between individuals and environments such that traits are developed in part by social influences, but traits also guide exposure to certain environmental conditions—i.e. selection effects (Caspi et al., 2005; Costa & McCrae, 2006; Roberts &

Caspi, 1990). Thus, any observed associations could be due to socialization effects, selection effects, or both. Importantly, Gottfredson and Hirschi (1990) suggested that most negative outcomes associated with criminal behavior, including poor job and relationship experiences, should be considered *consequences* of underlying traits. That is, low self-control is a cause of both criminal behavior and other negative outcomes, and it is not the case that these negative outcomes contribute to sustained criminal behavior. However, this view is inconsistent with evidence presented in the current study and recent theories that recognize the malleability of traits over the life course, such as Simons and Burt's (2011) Social Schematic Theory.

One potential source of model misspecification lies in the inability of the current study to capture genetic influences. Recent research has demonstrated that genetic contributions to levels of self-control are significant, ranging from explaining between 20 and 95 percent of the variance in self-control or changes in self-control (Beaver et al., 2013, 2008; Beaver & Wright, 2007). Similar findings have been observed when the examination is limited to the trait of sensation seeking. Harden et al. (2012) explored the genetic contribution to changes in sensation seeking over time and concluded that 83% of individual changes in sensation seeking between ages 10-11 and 16-17 were due to genetic differences. Thus, attempts to replicate the findings of this study with genetically informed models would be worthwhile.

Finally, primary analyses assumed that effects were constant across the observation period and overlooked the potential for timing effects. It is likely, and partially confirmed by sensitivity analyses, that the effect of parenting on impulsivity and sensation seeking gets weaker over time as individuals leave home and peer/romantic relationships become relatively more important. Future studies should examine timing effects and consider including additional predictors that may be important during

specific developmental periods. Other factors that are worth examining, given evidence of their importance in both the personality literature and in writings on turning points within criminology include marriage, entering into a romantic relationship, having a child, and gaining or losing employment (Sampson & Laub, 1993).

A broad limitation of much of the academic scholarship on the current topic is the incredible lack of conceptual clarity regarding concepts such as self-control, self-regulation, impulsivity, disinhibition, sensation seeking, and risk taking. The lack of clarity makes drawing conclusions from the research on these topics nearly impossible and makes placing the findings of the current study in the context of existing work difficult. One common problem is that these traits are often conceptualized as multidimensional, capturing several lower level facets, yet the hierarchical structure varies dramatically from one scholar to another. For example, Whiteside and Lynam (2001) identified four facets of impulsivity which they labeled urgency, lack of perseverance, lack of premedication, and sensation seeking. Zuckerman, in his sensation seeking scale, identified four facets of sensation seeking, which he labeled experience seeking, disinhibition, boredom susceptibility, and thrill and adventure seeking. In still another approach, Lynne-Landsman et al. (2011) examined sensation seeking with a "a composite measure of self-control. . .and enjoyment of risky activities" (p. 51). The measure of self-control "was used as a proxy for disinhibition" and included items such as "I am easily distracted from my work" (p. 51). As a final example, Collado et al. (2014) examined three facets of disinhibition, which they labeled sensation seeking, risk taking, and sensation seeking.

A related problem that may be limited to criminology is the tendency to rely on phrases such as "low self-control" without any clear definition of the concept. Given the substantial revision Gottfredson and Hirschi's theory has undergone since its publication

(i.e. Hirschi changing the definition of self-control), invoking this term without a clear definition of self-control is problematic, yet this continues to be done in recent publications (e.g. Pratt, 2015). Furthermore, the layperson's definition of self-control is likely to be quite different from Gottfredson and Hirschi's original definition, which includes elements such as a preference for simple tasks and risk seeking. Moving forward, the field needs to work together to clarify and formalize definitions of these distinct, yet related concepts. One solution might be to group all of these factors into one higher order facet, but growing empirical evidence suggests that this would not be an ideal solution given the distinct associations with key outcomes that are observed when separately examining these various facets. For example, Littlefield et al. (2014) demonstrated that four different facets of impulsivity were uniquely related to different elements of problematic alcohol involvement, and as such, separation of these facets leads to a more comprehensive and informed understanding of the outcome of interest. Similarly, Byck et al. (2015) demonstrated that three separate subscales of sensation seeking varied in their ability to predict baseline levels and growth rates of conduct problems.

This study did not test whether levels of impulsivity and sensation seeking are related to criminal behavior, as this work has been done elsewhere, with this same data source (see Burt et al., 2014). Rather, the limited focus of this paper was on how two traits related to offending develop and change over time. Importantly, impulsivity and sensation seeking are not the only traits related to criminal behavior, and high levels of impulsivity and sensation seeking may not directly lead to criminal behavior. Explaining the full causal chain from development and possession of a certain level of a trait to the final criminal outcome likely requires the inclusion of many additional factors, and future research should continue to explore this full causal chain. In addition to exploring

additional sources of variation between- and within-individuals in these traits, questions that remain to be explored include those related to when and why high impulsivity and sensation seeking lead to deviant and criminal outcomes. It is likely that studies hoping to tackle these questions will need to incorporate a variety of additional situational (e.g., immediate context of the crime), environmental (e.g., structural conditions), and personal factors (e.g., values, goals, and additional traits). Several studies have already demonstrated how traits interact with additional factors to increase the likelihood of offending. For example Mann, Kretsch, Tackett, Harden, and Tucker-Drob (2015) found that the relationship between sensation seeking and adolescent delinquency was moderated by deviant peer associations and parental monitoring.

Conclusion

The questions of which traits are related to criminal behavior and whether or not they are malleable are highly important to criminologists, psychologists, and society in general. The answer to these questions will likely dictate how we respond to criminals—whether we continue to operate with our punitive criminal justice system or decide to devote more resources to prevention, intervention, and rehabilitation programs. This study contributes to the growing body of literature that suggests at least two personality traits related to criminal behavior, impulsivity and sensation seeking, should be thought of as independent traits that uniquely contribute to offending and are responsive to environmental input. Given the malleability of these traits, the most pressing task for future research is to identify which factors influence these traits and why. This study took an initial step towards this goal by examining whether the Social Schematic Theory, a theoretical perspective that views individual differences as practical adaptations to environmental conditions and constraints, could explain variation in these traits both between and within individuals. Although key factors from SST appear to be associated

with changes in impulsivity and sensation seeking, our explanation of the observed variation is far from complete and much work on this topic remains.

REFERENCES

Agnew, R. (2006). *Pressured Into Crime: An Overview of General Strain Theory*. New York, NY: Oxford University Press.

Agnew, R., Scheuerman, H., Grosholz, J., Isom, D., Watson, L., & Thaxton, S. (2011). Does victimization reduce self-control? A longitudinal analysis. *Journal of Criminal Justice*, *39*(2), 169–174. http://doi.org/10.1016/j.jcrimjus.2011.01.005

Akers, R. (1998). *Social Learning and Social Structure: A General Theory of Crime and Deviance*. Boston, MA: Northeastern Press.

Andrews, D. A., & Wormith, J. S. (1989). Personality and crime: Knowledge destruction and construction in criminology. *Justice Quarterly*, *6*(3), 289–309.

Arneklev, B. J., Cochran, J. K., & Gainey, R. R. (1998). Testing Gottfredson and Hirschi's "low self-control" stability hypothesis: An exploratory study. *American Journal of Criminal Justice*, *23*(1), 107–127. http://doi.org/10.1007/BF02887286

Arneklev, B. J., Grasmick, H. G., & Bursik, R. J. (1999). Evaluating the Dimensionality and Invariance of "Low Self-Control." *Journal of Quantitative Criminology*, *15*(3), 307–331. http://doi.org/10.1023/A:1007528515341

Arneklev, B. J., Grasmick, H. G., Tittle, C. R., & Bursik, R. J. J. (1993). Low Self-Control and Imprudent Behavior. *Journal of Quantitative Criminology*, *9*(3), 225–247.

Arnett, J. (1992). Reckless behavior in adolescence: A developmental perspective. *Developmental Review*, *12*(4), 339–373. http://doi.org/10.1016/0273-2297(92)90013-R

Arnett, J. (1995). The Young and the Reckless: Adolescent Reckless Behavior. *Current Directions in Psychological Science*, *4*(3), 67–70. http://doi.org/10.1111/1467-8721.ep10772304

Baron, S. W. (2017). Street Youth, Social Schemas, and Crime. *Criminal Justice and Behavior*, *44*(12), 1620–1638. http://doi.org/10.1177/0093854817726805

Beaver, K. M., Connolly, E. J., Schwartz, J. A., Al-Ghamdi, M. S., & Kobeisy, A. N. (2013). Genetic and environmental contributions to stability and change in levels of self-control. *Journal of Criminal Justice*, *41*(5), 300–308. http://doi.org/10.1016/j.jcrimjus.2013.07.003

Beaver, K. M., & Wright, J. P. (2007). The Stabilty of Low Self-Control From Kindergarten Through First Grade. *Journal of Crime and Justice*, *30*(1), 63–86. http://doi.org/10.1080/0735648X.2007.9721227

Beaver, K. M., Wright, J. P., DeLisi, M., & Vaughn, M. G. (2008). Genetic influences on the stability of low self-control: Results from a longitudinal sample of twins. *Journal of Criminal Justice*, *36*(6), 478–485. http://doi.org/10.1016/j.jcrimjus.2008.09.006

Bird, A. (2007). Perceptions of epigenetics. *Nature*, *447*(7143), 396–398. http://doi.org/10.1038/nature05913

Blackwell, B. S., & Piquero, A. R. (2005). On the relationships between gender, power control, self-control, and crime. *Journal of Criminal Justice*, *33*(1), 1–17. http://doi.org/10.1016/j.jcrimjus.2004.10.001

Bradley, B. P., & Mogg, K. (1994). Mood and personality in recall of positive and negative information. *Behaviour Research and Therapy*, *32*(1), 137–141. http://doi.org/10.1016/0005-7967(94)90095-7

Brezina, T., Tekin, E., & Topalli, V. (2009). Might not be a tomorrow: A Multimethods Approach to Anticipated Early Death and Youth Crime. *Criminology*, *47*(4), 1091–1129.

Buker, H. (2011). Formation of self-control: Gottfredson and Hirschi's general theory of crime and beyond. *Aggression and Violent Behavior*, *16*(3), 265–276. http://doi.org/10.1016/j.avb.2011.03.005

Burgess, R. L., & Akers, R. L. (1966). A differential association-reinforcement theory of criminal behavior. *Social Problems*, *14*(2), 128–147.

Burt, C. H. (2012). *Gottfredson and Hirschi's Conceptualization of Self-Control: A Critique of Measures and Proposals for Change*.

Burt, C. H., Lei, M. K., & Simons, R. L. (2017). Racial Discrimination, Racial Socialization, and Crime Over Time: a Social Schematic Theory Model. *Criminology*, *55*(4), 938–979. http://doi.org/10.1111/1745-9125.12164

Burt, C. H., & Simons, R. D. (2015). Heritabilty Studies in the Postgenomic Era: The Fatal Flaw is Conceptual. *Criminology*, *53*(1), 103–112. http://doi.org/10.1111/1745-9125.12060

Burt, C. H., & Simons, R. L. (2013). Self-Control, Thrill Seeking, and Crime: Motivation Matters. *Criminal Justice and Behavior*, *40*(11), 1326–1348. http://doi.org/10.1177/0093854813485575

Burt, C. H., & Simons, R. L. (2014). Pulling back the curtain on heritability studies: Biosocial criminology in the postgenomic era. *Criminology*, *52*(2), 223–262. http://doi.org/10.1111/1745-9125.12036

Burt, C. H., Simons, R. L., & Simons, L. G. (2006). A longitudinal test of the effects of parenting and the stability of self-control: negative evidence for the general theory of crime. *Criminology*, *44*(2), 353–396.

Burt, C. H., Sweeten, G., & Simons, R. L. (2014). Self-Control Through Emerging Adulthood: Instability, Multidimensionality, and Criminological Significance. *Criminology*, *52*(3), 450–487. http://doi.org/10.1111/1745-9125.12045

Burton, V. S., Cullen, F. T., Evans, T. D., Alarid, L. F., & Dunaway, R. G. (1998). Gender, Self-Control, and Crime. *Journal of Research in Crime and Delinquency*, *35*(2), 123–147.

Buss, D. M. (2009). Perspectives on Psychological Science How Can Evolutionary Psychology Successfully Explain Personality and Individual Differences ? *Perspectives on Psychological Science*, *4*(4), 359–366. http://doi.org/10.1111/j.1745-6924.2009.01138.x

Byck, G. R., Swann, G., Schalet, B., Bolland, J., & Mustanski, B. (2015). Sensation Seeking Predicting Growth in Adolescent Problem Behaviors. *Child Psychiatry and Human Development*, *46*(3), 466–473. http://doi.org/10.1007/s10578-014-0486-y

Cale, E. M. (2006). A quantitative review of the relations between the "Big 3" higher order personality dimensions and antisocial behavior. *Journal of Research in Personality*, *40*(3), 250–284. http://doi.org/10.1016/j.jrp.2005.01.001

Campbell, A. (1999). Staying alive: Evolution, culture, and women's intrasexual aggression. *Behavioral and Brain Sciences*, *22*, 203–252.

Campbell, A., & Muncer, S. (2009). Can 'risky' impulsivity explain sex differences in aggression ? *Personality and Individual Differences*, *47*(5), 402–406. http://doi.org/10.1016/j.paid.2009.04.006

Campbell, A., Muncer, S., & Bibel, D. (2001). Women and crime: An evolutionary approach. *Aggression and Violent Behavior*, *6*(5), 481–497. http://doi.org/10.1016/S1359-1789(00)00019-7

Carmichael, C. M., & McGue, M. (1994). A Longitudinal Family Study of Personality Change and Stability. *Journal of Personality*, *62*(1), 1–20. http://doi.org/10.1111/j.1467-6494.1994.tb00792.x

Carrasco, M., Barker, E. D., Tremblay, R. E., & Vitaro, F. (2006). Eysenck's personality dimensions as predictors of male adolescent trajectories of physical aggression, theft and vandalism. *Personality and Individual Differences*, *41*(7), 1309–1320. http://doi.org/10.1016/j.paid.2006.05.005

Casey, B. J., Giedd, J. N., & Thomas, K. M. (2000). Structural and Functional Brain Development and its Relation to Cognitive Development. *Biological Psychology*, *54*, 241–257.

Casey, B. J., Jones, R. M., & Hare, T. A. (2008). The adolescent brain. *Annals of the New York Academy of Sciences*, *1124*, 111–126. http://doi.org/10.1196/annals.1440.010

Caspi, A., Moffitt, T. E., Silva, P. A., Stouthamer-Loeber, M., Krueger, Robert, F., & Schmutte, P. S. (1994). Are some people crime-prone? Replications of the personaity-crime relationship across countries, genders, races, and methods. *Criminology*, *32*(2), 163–195.

Caspi, A., Roberts, B. W., & Shiner, R. L. (2005). Personality Development: Stability and Change. *Annual Review of Psychology*, *56*(1), 453–484. http://doi.org/10.1146/annurev.psych.55.090902.141913

Cauffman, E., Fine, A., Thomas, A. G., & Monahan, K. C. (2017). Trajectories of Violent Behavior Among Females and Males. *Child Development*, *88*(1), 41–54. http://doi.org/10.1111/cdev.12678

Cauffman, E., & Steinberg, L. (2000). (Im)maturity of judgment in adolescence: Why adolescents may be less culpable than adults. *Behavioral Sciences and the Law*, *18*(6), 741–760. http://doi.org/10.1002/bsl.416

Chapple, C. L., Vaske, J., & Hope, T. L. (2010). Sex differences in the causes of self-control: An examination of mediation, moderation, and gendered etiologies. *Journal of Criminal Justice*, *38*(6), 1122–1131. http://doi.org/10.1016/j.jcrimjus.2010.08.004

Cleckley, H. (1976). *The Mask of Sanity: An Attempt to Clarify Some Issues About the So-called Psychopathic Personality*. St. Louis: Mosby.

Cloninger, C. R., Svrakic, D. M., & Przybeck, T. R. (1993). A Psychobiological Model of Temperament and Character. *Archives of General Psychiatry*, *50*, 975–990.

Cochran, J. K., Wood, P. B., Sellers, C. S., Wilkerson, W., & Chamlin, M. B. (1998). Academic dishonesty and low self□control: An empirical test of a general theory of crime. *Deviant Behavior*, *19*(3), 227–255. http://doi.org/10.1080/01639625.1998.9968087

Collado, A., Felton, J. W., MacPherson, L., & Lejuez, C. W. (2014). Longitudinal trajectories of sensation seeking, risk taking propensity, and impulsivity across early to middle adolescence. *Addictive Behaviors*, *39*(11), 1580–1588. http://doi.org/10.1016/j.addbeh.2014.01.024

Conger, R. D., Conger, K. J., Elder, G. H., Lorenz, F. O., Simons, R. L., & Whitbeck, L. B. (1992). A Family Process Model of Economic Hardship and Adjustment of Early Adolescent Boys Published by : Blackwell Publishing on behalf of the Society for Research in Child Development Stable URL : http://www.jstor.org/stable/1131344 A Family Process Model of E. *Child Development*, *63*(3), 526–541.

Conner, B. T., Stein, J. A., & Longshore, D. (2009). Examining self-control as a multidimensional predictor of crime and drug use in adolescents with criminal histories. *Journal of Behavioral Health Services and Research*, *36*(2), 137–149. http://doi.org/10.1007/s11414-008-9121-7

Cooper, M. L., Wood, P. K., Orcutt, H. K., & Albino, A. (2003). Personality and the predisposition to engage in risky or problem behaviors during adolescence. *Journal of Personality and Social Psychology*, *84*(2), 390–410. http://doi.org/10.1037/0022-3514.84.2.390

Costa, P. T., Herbst, J. H., McCrae, R. R., & Siegler, I. C. (2000). Personality at Midlife: Stabilty, Intrinsic Maturation, and Response to Life Events. *Assessment*, *7*(4), 365–378.

Costa, P. T., & McCrae, R. R. (2006). Age changes in personality and their origins: Comment on Roberts, Walton, and Viechtbauer (2006). *Psychological Bulletin*, *132*(1), 26–28. http://doi.org/10.1037/0033-2909.132.1.26

Côté, S., Tremblay, R. E., Nagin, D., Zoccolillo, M., & Vitaro, F. (2002). The development of impulsivity, fearfulness, and helpfulness during childhood: Patterns of consistency and change in the trajectories of boys and girls. *Journal of Child Psychology and Psychiatry and Allied Disciplines*, *43*(5), 609–618. http://doi.org/10.1111/1469-7610.00050

Cross, C. P., Copping, L. T., & Campbell, A. (2011). Sex Differences in Impulsivity: A Meta-Analysis. *Psychological Bulletin*, *137*(1), 97–130. http://doi.org/10.1037/a0021591

Cross, C. P., Cyrenne, D. L. M., & Brown, G. R. (2013). Sex differences in sensation-seeking: A meta-analysis. *Scientific Reports*, *3*. http://doi.org/10.1038/srep02486

Cruise, K. R., Fernandez, K., Mccoy, W. K., Guy, L. S., Colwell, L. H., & Tanisha, R. (2008). The Influence of Psychosocial Offenders ' Delinquent Behavior. *Youth Violence and Juvenile Justice*, *6*(2), 178–194. http://doi.org/10.1177/1541204007313229

Cullen, F. T., Unnever, J. D., Wright, J. P., & Beaver, K. M. (2008). Parenting and Self-Control. In E. Goode (Ed.), *Out of Control: Assessing the General Theory of Crime* (pp. 61–74). Stanford, CA: Stanford University Press.

D. R. Lynam. (1996). The early identification of chronic offenders: Who is the fledging psychopath? *Psychological Bulletin*, *120*(2), 209–234. http://doi.org/10.1037/0033-2909.120.2.209

Daly, M., & Wilson, M. (1983). *Sex, Evolution, and Behavior: Adaptations for Reproduction*. Boston, MA: Willard Grant Press.

Daly, M., & Wilson, M. (1985). Competitiveness, risk taking, and violence: The young male syndrome. *Ethology and Sociobiology*, *6*, 59–73.

De Li, S. (2005). Race, Self-Control, and Drug Problems Among Jail Inmates. *Journal of Drug Issues*, *35*(4), 645–663.

De Vries, R., De Vries, A., De Hoogh, A., & Feji, J. (2009). More Than the Big Five: Egoism and the Hexaco Model of Personality. *European Journal of Personality: Published for the European Association of Personality Psychology*, *23*(8), 635–654.

Delisi, M., & Vaughn, M. G. (2014). Foundation for a temperament-based theory of antisocial behavior and criminal justice system involvement, *42*, 10–25.

Delisi, M., & Vaughn, M. G. (2015a). Ingredients for Criminality Require Genes, Temperament, and Psychopathic Personality. *Journal of Criminal Justice*, *43*, 290–294.

Delisi, M., & Vaughn, M. G. (2015b). Temperament as a biosocial construct for understanding antisocial behavior (pp. 331–335).

Diamond, B., Morris, R. G., & Piquero, A. R. (2017). Stability in the Underlying Constructs of Self-Control. *Crime & Delinquency*, *63*(3), 235–266. http://doi.org/10.1177/0011128715603721

Dodge, K. (2006). Translational science in action: Hostile attributional style and the development of aggressive behavior problems. *Development and Psychopathology*, *18*(3), 791–814. http://doi.org/10.1017/S0954579406060391

Dodge, K. A., Bates, J. E., & Pettit, G. S. (1990). Mechanisms in the Cycle of Violence. *Science*, *250*(4988), 1678–1683.

Duckworth, A. L., & Kern, M. L. (2011). A meta-analysis of the convergent validity of self-control measures. *Journal of Research in Personality*, *45*(3), 259–268. http://doi.org/10.1016/j.jrp.2011.02.004

Duncan, G. J., & Raudenbush, S. W. (1999). Assessing the Effects of Context in Studies of Child and Youth Development. *Educational Psychologist*, *34*(1), 29–41. http://doi.org/10.1207/s15326985ep3401

Eisenberg, N., Sadovsky, A., Spinrad, T. L., Fabes, R. a, Sandra, H., Valiente, C., … Shepard, S. a. (2005). The Relations of Problem Behavior to Children's Negative Emotionality, Effortful Control, and Impulsivity: Concurrent Relations and Prediction of Change, *41*(1), 193–211.

Eisenberg, N., Valiente, C., Spinrad, T. L., Cumberland, A., Liew, J., Reiser, M., … Losoya, S. H. (2009). Longitudinal Relations of Children's Effortful Control, Impulsivity, and Negative Emotionality to Their Externalizing, Internalizing, and Co-Occurring Behavior Problems. *Developmental Psychology*, *45*(4), 988–1008. http://doi.org/10.1037/a0016213

Ellis, B. J., Del Giudice, M., Dishion, T. J., Figueredo, A. J., Gray, P., Griskevicius, V., … Wilson, D. S. (2012). The evolutionary basis of risky adolescent behavior: Implications for science, policy, and practice. *Developmental Psychology*, *48*(3), 598–623. http://doi.org/10.1037/a0026220

Eysenck, H. J. (1970). *The Structure of Human Personality* (3rd ed.). London: Muthuen.

Eysenck, H. J. (1978). Crime and Personality. In *Royal Society of Medicine*.

Eysenck, H. J. (1996). Personality and crime: Where do we stand. *Psychology, Crime and Law*, *2*(3), 143–152. http://doi.org/10.1080/10683169608409773

Eysenck, S. B. G., & Eysenck, H. J. (1978). Impulsiveness and Venturesomeness: Their Position in a Dimensional System of Personality Description. *Psychological Reports*, *43*(3_suppl), 1247–1255.

Farrington, D. P. (1989). Early Predictors of Adolescent Aggression and Adult Violence. *Violence and Victims*, *4*(2), 79–100.

Fite, J. E., Goodnight, J. A., Bates, J. E., Dodge, K. A., & Pettit, G. S. (2008). Adolescent aggression and social cognition in the context of personality: Impulsivity as a moderator of predictions from social information processing. *Aggressive Behavior*, *34*(5), 511–520. http://doi.org/10.1002/ab.20263

Forrest, W., & Hay, C. (2011). Life-course transitions, self-control and desistance from crime. *Criminology and Criminal Justice*, *11*(5), 487–513. http://doi.org/10.1177/1748895811415579

Gibson, C. L., Sullivan, C. J., Jones, S., & Piquero, A. R. (2010). "Does it take a village?" assessing neighborhood influences on children's self-control. *Journal of Research in Crime and Delinquency*, *47*(1), 31–62. http://doi.org/10.1177/0022427809348903

Glueck, S., & Glueck, E. (1950). *Unraveling Juvenile Delinquency*. Cambridge, MA: Harvard University Press.

Gottfredson, M. R., & Hirschi, T. (1990). *A General Theory of Crime. Criminological theory Past to present*. Stanford, CA: Stanford University Press. http://doi.org/10.1177/0022427803256071

Grasmick, H. G., Tittle, C. R., Bursik, R. J., & Arneklev, B. J. (1993). Testing the Core Empirical Implications of Gottfredson and Hirschi's General Theory of Crime. *Journal of Research in Crime and Delinquency*, *30*(1), 5–29. http://doi.org/10.1177/0022427893030001002

Gullo, M. J., Ward, E., Dawe, S., Powell, J., & Jackson, C. J. (2011). Support for a two-factor model of impulsivity and hazardous substance use in British and Australian young adults. *Journal of Research in Personality*, *45*(1), 10–18. http://doi.org/10.1016/j.jrp.2010.11.002

Harden, K. P., Quinn, P. D., & Tucker-Drob, E. M. (2012). Genetically influenced change in sensation seeking drives the rise of delinquent behavior during adolescence. *Developmental Science*, *15*(1), 150–163. http://doi.org/10.1111/j.1467-7687.2011.01115.x

Harden, K. P., & Tucker-Drob, E. M. (2011). Individual differences in the development of sensation seeking and impulsivity during adolescence: Further evidence for a dual systems model. *Developmental Psychology*, *47*(3), 739–746. http://doi.org/10.1037/a0023279

Hare, R. D. (1975). Psychopathy. *Research in Psychophysiology*, 325–348.

Hawkins, D. F., Laub, J. H., Lauritsen, J. L., & Cothern, L. (2000). Race , ethnicity , and serious and violent juvenile offending. *Juvenile Justice Bulletin*, (June), 8. http://doi.org/10.1016/j.jsb.2012.06.009

Hay, C. (2001). Parenting, Self-Control, And Delinquency: A Test Of Self-Control Theory. *Criminology*, *39*(3), 707–736. http://doi.org/10.1111/j.1745-9125.2001.tb00938.x

Hay, C., & Forrest, W. (2006). The development of self-control: Examining self-control theory's stability thesis. *Criminology*, *44*(4), 739–774. http://doi.org/10.1111/j.1745-9125.2006.00062.x

Hay, C., & Forrest, W. (2008). Self-control theory and the concept of opportunity: The case for a more systematic union. *Criminology*, *46*(4), 1039–1072. http://doi.org/10.1111/j.1745-9125.2008.00135.x

Helson, R., Jones, C., & Kwan, V. S. Y. (2002). Personality change over 40 years of adulthood: Hierarchical linear modeling analyses of two longitudinal samples. *Journal of Personality and Social Psychology*, *83*(3), 752–766. http://doi.org/10.1037/0022-3514.83.3.752

Higgins, G. E., Jennings, W. G., Tewksbury, R., & Gibson, C. L. (2009). Exploring the Link Between Low Self-Control and Violent Victimization Trajectories in Adolescents. *Criminal Justice and Behavior*, *36*(10), 1070–1084. http://doi.org/10.1177/0093854809344046

Hirschfield, P. J., & Piquero, A. R. (2010). Normalization and legitimation: Modeling stigmatizing attitudes toward ex-offenders. *Criminology*, *48*(1), 27–55. http://doi.org/10.1111/j.1745-9125.2010.00179.x

Hirschi, T. (1969). *Causes of Delinquency*. New Brunswick, NJ: Transaction Publishers.

Hirschi, T. (2004). Self-control and crime. In R. F. Baumeister & K. D. Vohs (Eds.), *Handbook of self-regulation: Research, theory, and applications* (pp. 537–552). New York, NY: Guildord Press.

Hirschi, T. (2007). Self-control and Crime. In R. F. Baumeister & K. D. Vohs (Eds.), *Handbook of Self-Regulation: Research, Theory, and Applications* (pp. 537–552). New York, NY: Guildord Press.

Hope, T. L., Grasmick, H. G., & Pointon, L. J. (2003). The family in gottfredson and hirschfs general theory of crime: Structure, parenting, and self-control. *Sociological Focus*, *36*(4), 291–311. http://doi.org/10.1080/00380237.2003.10571226

Horvath, P., & Zuckerman, M. (1993). Sensation Seeking , Risk Appraisal , Behavior * and. *Personality and Individual Differences*, *14*(1), 41–52. http://doi.org/10.1016/0191-8869(93)90173-Z

Jiménez-barbero, J. A., Ruiz-hernández, J. A., Llor-esteban, B., & Waschgler, K. (2016). Influence of attitudes , impulsivity , and parental styles in adolescents ' externalizing behavior. *Journal of Health Psychology*, *21*(1), 122–131. http://doi.org/10.1177/1359105314523303

Johnson, W., Hicks, B. M., McGue, M., & Iacono, W. G. (2007). Most of the Girls Are Alright, but Some Aren't: Personality Trajectory Groups From Ages 14 to 24 and Some Associations With Outcomes. *Journal of Personality and Social Psychology*, *93*(2), 266–284. http://doi.org/10.1037/0022-3514.93.2.266

Jolliffe, D. (2013). Exploring the relationship between the Five-Factor Model of personality, social factors and self-reported delinquency. *Personality and Individual Differences*, *55*(1), 47–52. http://doi.org/10.1016/j.paid.2013.01.014

Jolliffe, D., & Farrington, D. P. (2019). Personality and Other Individual Influences on Offending. In D. P. Farrington, L. Kazemian, & A. R. Piquero (Eds.), *The Oxford Handbook of Developmental and Life-Course Criminology* (pp. 355–377). New York, NY: Oxford University Press.

Jones, B. L., Nagin, D. S., & Roeder, K. (2001). Jones et al (2001) SAS pocedure for developmental trajectories.pdf. *Sociological Methods & Research*, *29*(3), 374–393.

Jones, S. E., Miller, J. D., & Lynam, D. R. (2011). Personality, antisocial behavior, and aggression: A meta-analytic review. *Journal of Criminal Justice*, *39*(4), 329–337. http://doi.org/10.1016/j.jcrimjus.2011.03.004

Khurana, A., Romer, D., Betancourt, L. M., & Hurt, H. (2018). Modeling Trajectories of Sensation Seeking and Impulsivity Dimensions from Early to Late Adolescence: Universal Trends or Distinct Sub-groups? *Journal of Youth and Adolescence*, *47*(9), 1992–2005. http://doi.org/10.1007/s10964-018-0891-9

Kim, J., Siennick, S. E., & Hay, C. (2018). The Impact of Strain on Self-Control: A Longitudinal Study of Korean Adolescents. *Youth and Society*, 1–22. http://doi.org/10.1177/0044118X18773593

Krueger, R. F., Schmutte, P. S., Caspi, A., Moffitt, T. E., Campbell, K., & Silva, P. A. (1994). Personality Traits Are Linked to Crime Among Men and Women: Evidence From a Birth Cohort. *Journal of Abnormal Psychology*, *103*(2), 328–338. http://doi.org/10.1037/0021-843X.103.2.328

Landrine, H., & Klonoff, E. (1996). The schedule of racists events: A measure of racial discrimination and a study of its negative physical and mental consequences. *Journal of Black Psychology*, *22*, 144–68.

Larsen, R. J. (1992). Neuroticism and Selective Encoding and Recall of Symptoms: Evidence From a Combined Concurrent-Retrospective Study. *Journal of Personality and Social Psychology*, *62*(3), 480–488. http://doi.org/10.1037/0022-3514.62.3.480

Lehnart, J., Neyer, F. J., & Eccles, J. (2010). Long-Term Effects of Social Investment: The Case of Partnering in Young Adulthood. *Journal of Personality*, *78*(2), 639–670. http://doi.org/10.1111/j.1467-6494.2010.00629.x

Lewis, M. (2001). Issues in the Study of Personality Development. *Psychological Inquiry*, *12*(2), 67–83. http://doi.org/10.1207/S15327965PLI1202_02

Littlefield, A. K., Sher, K. J., & Steinley, D. (2010). Developmental trajectories of impulsivity and their association with alcohol use and related outcomes during emerging and young adulthood i. *Alcoholism: Clinical and Experimental Research*, *34*(8), 1409–1416. http://doi.org/10.1111/j.1530-0277.2010.01224.x

Littlefield, A. K., Stevens, A. K., & Sher, K. J. (2014). Impulsivity and Alcohol Involvement : Multiple, Distinct Constructs and Processes. *Current Addiction Reports*, *1*, 33–40. http://doi.org/10.1007/s40429-013-0004-5

Lockenhoff, C. E., Terracciano, A., Patriciu, N. S., Eaton, W. W., & Costa, P. T. (2009). Self-Reported Extremely Adverse Life Events and Longitudinal Changes in Five-Factor Model Personality Traits in an Urban Sample. *Journal of Traumatic Stress*, *22*(1), 53–59.

Lombroso, C. (1876). *The Criminal Man* (1st ed.). Milan: Hoepli.

Longshore, D., Turner, S., & Stein, J. A. (1996). Self-Control in a Criminal Sample: An Examination of Construct Validity. *Criminology*, *2*(34), 209–228.

Lynam, D., Moffitt, T., & Stouthamer-Loeber, M. (1993). Explaining the relation between IQ and delinquency: class, race, test motivation, school failure, or self-control? *Journal of Abnormal Psychology*, *102*(2), 187–196. http://doi.org/10.1037/0021-843X.102.4.552

Lynam, D. R., Caspi, A., Moffitt, T. E., Wikström, P.-O. H., Loeber, R., & Novak, S. (2000). The Interaction Between Impulsivity and Neighborhood Context on Offending: The Effects of Impulsivity are Stronger in Poorer Neighborhoods. *Journal of Abnormal Psychology*, *109*(4), 563–574.

Lynne-Landsman, S. D., Graber, J. A., Nichols, T. R., & Botvin, G. J. (2011). Is Sensation Seeking a Stable Trait or Does it Change Over Time? *Journal of Youth and Adolescence*, *40*, 48–58. http://doi.org/10.1007/s10964-010-9529-2

Magid, V., MacLean, M. G., & Colder, C. R. (2007). Differentiating between sensation seeking and impulsivity through their mediated relations with alcohol use and problems. *Addictive Behaviors*, *32*(10), 2046–2061. http://doi.org/10.1016/j.addbeh.2007.01.015

Mamayek, C., Paternoster, R., & Loughran, T. A. (2017). Self-Control as Self-Regulation: A Return to Control Theory. *Deviant Behavior*, *38*(8), 895–916. http://doi.org/10.1080/01639625.2016.1206730

Mann, F. D., Kretsch, N., Tackett, J. L., Harden, K. P., & Tucker-Drob, E. M. (2015). Person x Environment Interactions on Adolescent Delinquency: Sensation Seeking, Peer Deviance and Parental Monitoring. *Personality and Individual Differences*, *76*, 129–134. http://doi.org/10.1016/j.paid.2014.11.055

Marcus, B. (2003). An empirical examination of the construct validity of two alternative self-control measures. *Educational and Psychological Measurement*, *63*(4), 674–706. http://doi.org/10.1177/0013164403251329

Marcus, B. (2004). Self-Control in the General Theory of Crime: Theoretical Implications of a Measurement Problem. *Theoretical Criminology*, *8*(1), 33–55. http://doi.org/10.1177/1362480604039740

Martin, M., Ward, J. C., & Clark, D. M. (1983). Neuroticism and the recall of positive and negative personality information. *Behaviour Research and Therapy*, *21*(5), 495–503. http://doi.org/10.1016/0005-7967(83)90041-4

McCrae, R., Costa, P., Lima, M. De, Simoes, A., Ostendorf, F., Angleitner, A., … Chae, J.-H. (1999). Age differences in personality across the adult life span: Parallels in five cultures. *Developmental Psychology*, *35*(2), 466–477. http://doi.org/10.1103/PhysRevB.66.085421

McCrae, R. R., & Costa Jr, P. T. (1999). The five factor model of personality : Theoretical Perspective. *Handbook of Personality: Theory and Research*, (January 1996), 159–181. http://doi.org/10.1016/j.nedt.2008.10.002

Mccrae, R. R., & Costa, P. T. (1994). The Stability of Personality: Observations and Evaluations. *Current Directions in Psychological Science*, *3*(6), 173–175. http://doi.org/10.1111/1467-8721.ep10770693

McCrae, R. R., & Costa, P. T. (1987). Validation of the Five-Factor Model of Personality Across Instruments and Observers. *Journal of Personality and Social Psychology*, *52*(1), 81–90. http://doi.org/10.1037/0022-3514.52.1.81

McCrae, R. R., Costa, P. T., Hrebickova, M., Avia, M. D., Sanz, J., Sanchez-bernardos, M. L., … Smith, P. B. (2000). Nature Over Nurture : Temperament , Personality , and Life Span Development, *78*(1), 173–186.

McCrae, R. R., Costa, P. T., Terracciano, A., Parker, W. D., Mills, C. J., De Fruyt, F., & Mervielde, I. (2002). Personality trait development from age 12 to age 18: Longitudinal, cross-sectional, and cross-cultural analyses. *Journal of Personality and Social Psychology*, *83*(6), 1456–1468. http://doi.org/10.1037/0022-3514.83.6.1456

Meldrum, R. C. (2008). Beyond parenting: An examination of the etiology of self-control. *Journal of Criminal Justice*, *36*(3), 244–251. http://doi.org/10.1016/j.jcrimjus.2008.04.005

Meldrum, R. C., Young, J. T. N., & Weerman, F. M. (2012). Changes in self-control during adolescence: Investigating the influence of the adolescent peer network. *Journal of Criminal Justice*, *40*(6), 452–462. http://doi.org/10.1016/j.jcrimjus.2012.07.002

Miller, J. D., & Lynam, D. (2001). Structural models of personality and their relation to antisocial behavior: A meta-analytic review. *Criminology*, *39*(4), 765–794. http://doi.org/10.1111/j.1745-9125.2001.tb00940.x

Mischel, W. (1973). Toward a Cognitive Social Learning Reconceptualizaiton of Personality. *Psychological Review*, *80*(4), 252.

Mischel, W., & Shoda, Y. (2008). Toward a Unified Theory of Personality: Integrating Dispositions and Processing Dynamics within the Cognitive-Affective Processing System. In O. P. John, R. W. Robins, & L. A. Pervin (Eds.), *Handbook of Personality: Theory and Research* (3rd ed., pp. 208–241). New York, NY: The Guilford Press.

Mitchell, O., & MacKenzie, D. L. (2006). The Stability and Resiliency of Self-Control in a Sample of Incarcerated Offenders. *Crime & Delinquency*, *52*(3), 432–449. http://doi.org/10.1177/0011128705280586

Moffitt, T. E. (1993). Adolescence-limited and life-course-persistent antisocial behavior: a developmental taxonomy. *Psychological Review*, *100*(4), 674–701. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/8255953

Moffitt, T. E., Caspi, A., Rutter, M., & Silva, P. A. (2001). *Sex differences in antisocial behaviour: Conduct disorder, delinquency and violence in the Dunedin longitudinal study*. Cambridge, UK: Cambridge University Press.

Monahan, K. C., Steinberg, L., Cauffman, E., & Mulvey, E. P. (2009). Trajectories of Antisocial Behavior and Psychosocial Maturity From Adolescence to Young Adulthood. *Developmental Psychology*, *45*(6), 1654–1668. http://doi.org/10.1037/a0015862

Monahan, K. C., Steinberg, L., Cauffman, E., & Mulvey, E. P. (2013). Psychosocial (im)maturity from adolescence to early adulthood: Distinguishing between adolescence-limited and persisting antisocial behavior. *Development and Psychopathology*, *25*(4 PART 1), 1093–1105. http://doi.org/10.1017/S0954579413000394

Morenoff, J. D., Sampson, R. J., & Raudenbush, S. W. (2001). Neighborhood Inequality, Collective Efficacy, and the Spacial Dynamics of Urban Violence. *Criminology*, *39*(3), 517–559. http://doi.org/10.1111/j.1745-9125.2001.tb00932.x

Mõttus, R., Johnson, W., & Deary, I. J. (2012). Personality traits in old age: Measurement and rank-order stability and some mean-level change. *Psychology and Aging*, *27*(1), 243–249. http://doi.org/10.1037/a0023690

Mõttus, R., Johnson, W., Starr, J. M., & Deary, I. J. (2012). Correlates of personality trait levels and their changes in very old age: The Lothian Birth Cohort 1921. *Journal of Research in Personality*, *46*(3), 271–278. http://doi.org/10.1016/j.jrp.2012.02.004

Na, C., & Paternoster, R. (2012). Can Self-Control Change Substantially Over Time? Rethinking the Relationship Between Self- and Social Control*. *Criminology*, *50*(2), 427–462. http://doi.org/10.1111/j.1745-9125.2011.00269.x

Nagin, D. S. (2005). *Group-Based Modeling of Development*. Cambridge, MA: Harvard University Press.

Nagin, D. S., & Paternoster, R. (1993). Enduring Individual Differences and Rational Choice Theories of Crime Paternoster theory has developed along two separate theory rejects the as-. *Law & Society Review*, *27*(3), 467–496.

Newcomb, M. D., & McGee, L. (1991). Influence of Sensation Seeking on General Deviance and Specific Problem Behaviors From Adolescence to Young Adulthood. *Journal of Personality and Social Psychology*, *61*(4), 614–628. http://doi.org/10.1037/0022-3514.61.4.614

Neyer, F. J., & Lehnart, J. (2007). Relationships matter in personality development: Evidence from an 8-year longitudinal study across Young adulthood. *Journal of Personality*, *75*(3), 535–568. http://doi.org/10.1111/j.1467-6494.2007.00448.x

Nofziger, S. (2008). The "cause" of low self-control: The influence of maternal self-control. *Journal of Research in Crime and Delinquency*, *45*(2), 191–224. http://doi.org/10.1177/0022427807313708

Pedersen, S. L., Molina, B. S. G., Belendiuk, K. A., & Donovan, J. E. (2012). Racial Differences in the Development of Impulsivity and Sensation Seeking from Childhood into Adolescence and Their Relation to Alcohol Use. *Alcoholism: Clinical and Experimental Research*, *36*(10), 1794–1802. http://doi.org/10.1111/j.1530-0277.2012.01797.x

Perrone, D., Sullivan, C. J., Pratt, T. C., & Margaryan, S. (2004). Parental Efficacy, Self-Control, and Delinquency: A Test of a General Theory of Crime on a Nationally Representative Sample of Youth. *International Journal of Offender Therapy and Comparative Criminology*, *48*(3), 298–312. http://doi.org/10.1177/0306624X03262513

Piquero, A. R., & Rosay, A. B. (1998). The Reliability and Validity of Grasmick et al.'s Self-Control Sclae: A Comment on Longshore et al. *Criminology*, *36*(1), 157–173.

Plomin, R., DeFries, J. C., McClearn, G. E., & McGuffin, P. (2008). *Behavioral Genetics* (5th ed.). New York, NY: Worth Publishers and W.H. Freeman and Company.

Pratt, T. C., & Cullen, F. T. (2000). The empirical status of Gottfredson and Hirschi's general theory of crime: A meta-analysis. *Criminology*, *38*(3), 931–964. http://doi.org/10.1111/j.1745-9125.2000.tb00911.x

Pratt, T. C., Turner, M. G., & Piquero, A. R. (2004). Parental socialization and community context: A longitudinal analysis of the structural sources of low self-control. *Journal of Research in Crime and Delinquency*, *41*(3), 219–243. http://doi.org/10.1177/0022427803260270

Quinn, P. D., & Harden, K. P. (2013). Differential changes in impulsivity and sensation seeking and the escalation of substance use from adolescence to early adulthood. *Development and Psychopathology*, *25*(1), 223–239. http://doi.org/10.1017/S0954579412000284

Quinn, P. D., Stappenbeck, C. A., & Fromme, K. (2011). Collegiate heavy drinking prospectively predicts change in sensation seeking and impulsivity. *Journal of Abnormal Psychology*, *120*(3), 543–556. http://doi.org/10.1037/a0023159

Raudenbush, S. W., & Bryk, A. S. (2002). *Hierarchical Linear Models: Applications and Data Analysis Methods* (2nd ed.). Thousand Oaks, CA: Sage Publications.

Roberti, J. W. (2004). A review of behavioral and biological correlates of sensation seeking. *Journal of Research in Personality*, *38*(3), 256–279. http://doi.org/10.1016/S0092-6566(03)00067-9

Roberts, B. W. (1997). Plaster or Plasticity: Are Adult Work Experiences Associated with Personality Change in Women? *Journal of Personality*, *65*(2), 205–232. http://doi.org/10.1111/j.1467-6494.1997.tb00953.x

Roberts, B. W., & Bogg, T. (2004). A longitudinal study of the relationships between conscientiousness and the social-environmental factors and substance-use behaviors that influence health. *Journal of Personality*, *72*(2), 325–354. http://doi.org/10.1111/j.0022-3506.2004.00264.x

Roberts, B. W., & Caspi, A. (1990). Personality Continuity and Change across the Life Course. In L. A. Pervin (Ed.), *Handbook of Personality: Theory and Research* (pp. 300–326). The Guilford Press.

Roberts, B. W., Caspi, A., & Moffitt, T. E. (2003). Work Experiences and Personality Development in Young Adulthood. *Journal of Personality and Social Psychology*, *84*(3), 582–593. http://doi.org/10.1037/0022-3514.84.3.582

Roberts, B. W., Walton, K. E., Bogg, T., & Caspi, A. (2006). De-investment in Work and Non-normative Personality Trait Change in Young Adulthood. *European Journal of Personality*, *20*, 461–474. http://doi.org/10.1002/per.607

Roberts, B. W., Walton, K. E., & Viechtbauer, W. (2006). Patterns of mean-level change in personality traits across the life course: A meta-analysis of longitudinal studies. *Psychological Bulletin*, *132*(1), 1–25. http://doi.org/10.1037/0033-2909.132.1.1

Roberts, B. W., Wood, D., & Smith, J. L. (2005). Evaluating Five Factor Theory and social investment perspectives on personality trait development. *Journal of Research in Personality*, *39*(1 SPEC. ISS.), 166–184. http://doi.org/10.1016/j.jrp.2004.08.002

Robins, R. W., Fraley, R. C., Roberts, B. W., & Trzesniewski, K. H. (2001). A Longitudinal Study of Personality Change in Young Adulthood. *Journal of Personality*, *69*(4), 617–640. http://doi.org/10.1111/1467-6494.694157

Roth, M., Schumacher, J., & Brähler, E. (2005). Sensation seeking in the community: Sex, age and sociodemographic comparisons on a representative German population sample. *Personality and Individual Differences*, *39*(7), 1261–1271. http://doi.org/10.1016/j.paid.2005.05.003

Ruiz, M. A., Pincus, A. L., & Schinka, J. A. (2008). Externalizing Pathology and the Five-Factor Model: A Meta-Analysis of Personality Traits Associated with Antisocial Personality Disorder, Substance Use Disorder, and Their Co-Occurrence. *Journal of Personality Disorders*, *22*(4), 365–388. http://doi.org/10.1521/pedi.2008.22.4.365

Sampson, R. J., Morenoff, J. D., & Gannon-Rowley, T. (2002). Assessing "Neighborhood Effects": Social Processes and New Directions in Research. *Annual Review of Sociology*, *28*(1), 443–478.

Sampson, R. J., Raudenbush, S. W., & Earls, F. (1997). Neighborhoods and violent crime: a multilevel study of collective efficacy. *Science*, *277*(5328), 918–924. http://doi.org/10.1126/science.277.5328.918

Samuel, D. B., & Widiger, T. A. (2008). A Meta-Analytic Review of the Relationships Between the Five-Factor Model and DSM-IV-TR Personality Disorders: A Facet Level Analysis. *Clinical Psychology Review*, *28*(8), 1326–1342. http://doi.org/10.1016/j.cpr.2008.07.002.

Scollon, C. N., & Diener, E. (2006). Love, work, and changes in extraversion and neuroticism over time. *Journal of Personality and Social Psychology*, *91*(6), 1152–1165. http://doi.org/10.1037/0022-3514.91.6.1152

Shaw, C. R., & McKay, H. D. (1942). *Juvenile Delinquency and Urban Areas: A study of Rates of Delinquency in Relation to Differential Characteristics of Local Communities in American Cities*. Chicago, IL: University of Chicago Press.

Shoenberger, N., & Rocheleau, G. C. (2017). Effective Parenting and Self-Control: Difference by Gender. *Women and Criminal Justice*, *27*(5), 271–286. http://doi.org/10.1080/08974454.2016.1261071

Shulman, E. P., Harden, K. P., Chein, J. M., & Steinberg, L. (2014). The Development of Impulse Control and Sensation-Seeking in Adolescence : Independent or Interdependent Processes? *Journal of Rsearch on Adolescence*, *26*(1), 37–44. http://doi.org/10.1111/jora.12181

Shulman, E. P., Harden, K. P., Chein, J. M., & Steinberg, L. (2015). Sex Differences in the Developmental Trajectories of Impulse Control and Sensation-Seeking from Early Adolescence to Early Adulthood. *Journal of Youth and Adolescence*, *44*(1), 1–17. http://doi.org/10.1007/s10964-014-0116-9

Simons, R. L., & Burt, C. H. (2011). Learning To Be Bad: Adverse Social Conditions, Social Schemas, and Crime. *Criminology; an Interdisciplinary Journal*, *49*(2), 553–598. http://doi.org/10.1111/j.1745-9125.2011.00231.x

Simons, R. L., Burt, C. H., Barr, A. B., Lei, M.-K., & Stewart, E. (2014). Incorporating Routine Activities, Activity Spaces, and Situational Definitions into the Social Schematic Theory of Crime. *Criminology*, *52*(4), 655–687. http://doi.org/10.1111/1745-9125.12053.INCORPORATING

Simons, R. L., Murry, V., McLoyd, V., Lin, K.-H., Cutrona, C., & Conger, R. D. (2002). Discrimination, crime, ethnic identity, and parenting as correlates of depressive symptoms among African American children: A multilevel analysis. *Development and Psychopathology*, *14*(02), 371–393. http://doi.org/10.1017/S0954579402002109

Singer, J. D., & Willett, J. B. (2003). *Applied Longitudinal Data Analysis: Modeling Change and Event Occurrence. Applied Longitudinal Data Analysis: Modeling Change and Event Occurrence*. New York, NY: Oxford University Press. http://doi.org/10.1093/acprof:oso/9780195152968.001.0001

Smith, G. T., Fischer, S., Cyders, M. A., Annus, A. M., Spillane, N. S., & McCarthy, D. M. (2007). On the validity and utility of discriminating among impulsivity-like traits. *Assessment*, *14*(2), 155–170. http://doi.org/10.1177/1073191106295527

Specht, J., Egloff, B., & Schmukle, S. C. (2011). Stability and Change of Personality Across the Life Course: The Impact of Age and Major Life Events on Mean-Level and Rank-Order Stability of the Big Five. *Journal of Personality and Social Psychology*, *101*(4), 862–882. http://doi.org/10.1037/a0024950

Srivastava, S., John, O. P., Gosling, S. D., & Potter, J. (2003). Development of Personality in Early and Middle Adulthood: Set Like Plaster or Persistent Change? *Journal of Personality and Social Psychology*, *84*(5), 1041–1053. http://doi.org/10.1037/0022-3514.84.5.1041

Steffensmeier, D., & Allan, E. (1995). Gender, Age, and Crime. In *Handbook of Contemporary Criminology* (pp. 88–116). New York, NY: Wadsworth.

Steinberg, L. (2004). Risk taking in adolescence: What changes, and why? In *Annals of the New York Academy of Sciences*. http://doi.org/10.1196/annals.1308.005

Steinberg, L. (2005). Cognitive and affective development in adolescence. *Trends in Cognitive Sciences*, *9*(2), 69–74. http://doi.org/10.1016/j.tics.2004.12.005

Steinberg, L. (2008). A social neuroscience perspective on adolescent risk-taking. *Developmental Review*, *28*(1), 78–106. http://doi.org/10.1016/j.dr.2007.08.002

Steinberg, L. (2010). A dual systems model of adolescent risk-taking. *Developmental Psychobiology*. http://doi.org/10.1002/dev.20445

Steinberg, L., Albert, D., Cauffman, E., Banich, M., Graham, S., & Woolard, J. (2008). Age Differences in Sensation Seeking and Impulsivity as Indexed by Behavior and Self-Report: Evidence for a Dual Systems Model. *Developmental Psychology*, *44*(6), 1764–1778. http://doi.org/10.1037/a0012955

Steinberg, L., & Cauffman, E. (1996). Maturity of Judgment in Adolescence : Psychosocial Factors in Adolescent Decision Making. *Law and Human Behavior*, *20*(3), 249–272.

Steinberg, L., Icenogle, G., Shulman, E. P., Breiner, K., Chein, J., Bacchini, D., … Takash, H. M. S. (2018). Around the world, adolescence is a time of heightened sensation seeking and immature self-regulation. *Developmental Science*, *21*(2), 1–13. http://doi.org/10.1111/desc.12532

Sutherland, E. H. (1947). *Principles of Criminology* (4th ed.). Philadelphia: Lippincott.

Teasdale, B., & Silver, E. (2009). Neighborhoods and Self-Control: Toward an Expanded view of socialization. *Social Problems*, *56*(1), 205–222. http://doi.org/10.1525/sp.2008.56.1.205.SP5601

Tellegen, A. (1982). *Brief manual of the Multidimensional Personality Questionnaire.*

Terracciano, A., McCrae, R. R., & Costa, P. T. (2010). Intra-individual change in personality stability and age. *Journal of Research in Personality*, *44*(1), 31–37. http://doi.org/10.1016/j.jrp.2009.09.006

Thijs, P. E., Dijk, I. K. Van, Stoof, R., & Notten, N. (2015). Adolescent problem behaviour: The gender gap in European perspective. *European Journal of Criminology*, *12*(5), 598–615. http://doi.org/10.1177/1477370815578195

Turner, M. G., & Piquero, A. R. (2002). The stability of self-control. *Journal of Criminal Justice*, *30*, 457–471.

Turner, M. G., Piquero, A. R., & Pratt, T. C. (2005). The school context as a source of self-control. *Journal of Criminal Justice*, *33*(4), 327–339. http://doi.org/10.1016/j.jcrimjus.2005.04.003

Unnever, J. D., Cullen, F. T., & Pratt, T. C. (2003). Parental management , ADHD , and delinquent involvement : Reassessing ..., *20*(3), 471–500.

Vaidya, J. G., Gray, E. K., Haig, J. R., Mroczek, D. K., & Watson, D. (2008). Differential stability and individual growth trajectories of big five and affective traits during young adulthood. *Journal of Personality*, *76*(2), 267–304. http://doi.org/10.1111/j.1467-6494.2007.00486.x

Vaidya, J. G., Gray, E. K., Haig, J., & Watson, D. (2002). On the temporal stability of personality: Evidence for differential stability and the role of life experiences. *Journal of Personality and Social Psychology*, *83*(6), 1469–1484. http://doi.org/10.1037/0022-3514.83.6.1469

Van Gelder, J.-L., & De Vries, R. E. (2012). Traits and States: Integrating Personality and Affect Into a Model of Criminal Decision Making*. *Criminology*, *50*(3), 637–671. http://doi.org/10.1111/j.1745-9125.2012.00276.x

Vazsonyi, A. T., & Huang, L. (2010). Where Self-Control Comes From: On the Development of Self-Control and Its Relationship to Deviance Over Time. *Developmental Psychology*, *46*(1), 245–257. http://doi.org/10.1037/a0016538

Vazsonyi, A. T., & Ksinan, A. J. (2017). Understanding deviance through the dual systems model: Converging evidence for criminology and developmental sciences. *Personality and Individual Differences*, *111*, 58–64. http://doi.org/10.1016/j.paid.2017.01.030

Vazsonyi, A. T., Mikuška, J., & Kelley, E. L. (2017). It's time: A meta-analysis on the self-control-deviance link. *Journal of Criminal Justice*, *48*, 48–63. http://doi.org/10.1016/j.jcrimjus.2016.10.001

Vazsonyi, A. T., Pickering, L. E., Junger, M., & Hessing, D. (2001). An Empirical Test of a General Theory of Crime: A Four-Nation Comparative Study of Self-Control and the Prediction of Deviance. *Journal of Research in Crime and Delinquency*, *38*(2), 91–131.

Walton, K. E., Krueger, R. F., Elkins, I., D'Accordo, C., McGue, M., & Iacono, W. G. (2017). Personality Traits Predict the Developmental Course of Externalizing: A Four-Wave Longitudinal Study Spanning Age 17 to Age 29. *Journal of Personality*, *85*(3), 364–375. http://doi.org/10.1111/jopy.12245

Ward, J. T., Nobles, M. R., & Fox, K. A. (2015). Disentangling Self-Control from Its Elements : A Bifactor Analysis. *Journal of Quantitative Criminology*, *31*, 595–627. http://doi.org/10.1007/s10940-014-9241-6

Warr, M. (2002). *Companions in Crime: The Social Aspects of Criminal Conduct*. New York, NY: Cambridge University Press.

White, H. R., Marmorstein, N. R., Crews, F. T., Bates, M. E., Mun, E. Y., & Loeber, R. (2011). Associations Between Heavy Drinking and Changes in Impulsive Behavior Among Adolescent Boys. *Alcoholism: Clinical and Experimental Research*, *35*(2), 295–303. http://doi.org/10.1111/j.1530-0277.2010.01345.x

Whiteside, S. P., & Lynam, D. R. (2001). The five factor model and impulsivity: Using a structural model of personality to understand impulsivity. *Personality and Individual Differences*, *30*(4), 669–689. http://doi.org/10.1016/S0191-8869(00)00064-7

Winfree, L. T., Taylor, T. J., He, N., & Esbensen, F. A. (2006). Self-control and variability over time: Multivariate results using a 5-year, multisite panel of youths. *Crime and Delinquency*, *52*(2), 253–286. http://doi.org/10.1177/0011128705278012

Wood, P. B., Pfefferbaum, B., & Arneklev, B. J. (1993). Risk-taking and self-control: Social Psychological Correlates of Delinquency. *Journal of Crime and Justice*, *16*(1), 111–130.

Zuckerman, M. (1979). *Sensation Seeking: Beyond the optimal level of arousal*. New York: Lawrence Erlbaum Associates, Inc.

Zuckerman, M. (2007). *Sensation Seeking and Risky Behavior*. Washington, DC: American Psychological Association.

Zuckerman, M., Eysenck, S. B., & Eysenck, H. J. (1978). Sensation seeking in England and America: Cross-cultural, age, and sex comparisons. *Journal of Consulting and Clinical Psychology*, *46*(1), 139–149. http://doi.org/10.1037/0022-006X.46.1.139

Zuckerman, M., & Kuhlman, D. M. (2000). Personality and risk-taking: Common biosocial factors. *Journal of Personality*. http://doi.org/10.1111/1467-6494.00124

APPENDIX A

SUMMARY OF RELEVANT RESEARCH

Table 13. Research on G&H's (1990) Self-Control: Dimensionality, Stability, Developmental Sources, and Sex Differences

Article	Data/Sample Description	Sample n	Sample age/grade	Design	Operationalization of SC	Dimensionality	Stability	Sources	Sex[a]
Agnew (2011)	GREAT Survey: High risk Youth	839	grade: 6-7 to 10-11	5w: 1yr	8 items "Consistent with Grasmick" risk seeking and impulsive behaviors and attitudes only			x	
Arneklev et al. (1993)	Random Sample, Large Southwestern City	394	age: >18	CS	Grasmick Scale	x			x
Arneklev et al. (1998)	Convenience Sample, Undergraduates, Three Public Universities	127	age: 17-47 (m = 22.8)	2w: 4mo	Grasmick Scale	x	x		
Beaver & Wright (2007)	Early Childhood Longitudinal Study Kindergarten Class of 1998-99: Nationally Representative	17000	grade: k-1	4w: 6mo	Social Skills Rating System (SSRI) parent and teacher behavioral ratings seven subscales items "proxies to the grasmick scale": all elements except risk-seeker and self- centered captured		x		
Beaver et al. (2008)	Add Health, DZ and MZ twins only	741 twin pairs	grade 7-12 to age 18-26	3w: various	Items selected from Add Health to tap into six elements, especially bad temper, impulsivity, and self-centeredness. Added school relationship for Hirschi's redefined definition		x	x	
Beaver et al. (2013)	NLSY: Child and Young Adult Supplement, siblings only	2412 sibling pairs: 13 MZ, 1664 DZ, 257 ambiguous, 483 half-siblings	age: 4-17 to 8-21	3w: 2yrs	Behavioral Problems Index (BPI) mother report 19 items that capture: misbehavior, temper, impulsive, insensitive, self-centered, not liked by others		x	x	
Blackwell & Piquero (2005)	Random Sample, Oklahoma City	287	age: >18	CS	Grasmick Scale			x	x
Burt et al. (2006)	Family and Community Health Survey: African American	754	age: 10-12 to 12-14	2w: 2yrs	Similar to Grasmick Scale 39 items reflecting: impulsive, insensitive, physical (as opposed to mental), risk-taking, short-sighted, and nonverbal		x	x	x
Burt et al. (2014)	Family and Community Health Survey: African American	775	age: 10-25	6w: 2-3yrs	14 items, risk seeking and impulsive behaviors and attitudes only	x	x		
Chapple et al. (2010)	NLSY: Child Supplement	492	age: 10-11 to 12-13	2w: 2yrs	Behavioral Problems Index (BPI) mother report 10 items, examples include: child cheats or lies, is cruel to others, is impulsive, is not sorry after misbehaving			x	x
Cochran et al. (1998)	Convenience Sample, Undergraduates, University of Oklahoma	448	age: >18	CS	Similar to Grasmick Scale and Wood Scale 38 items that capture the six elements of self-control	x		x	x
Conner et al. (2009)	Treatment Alternatives to Street Crime, Five US cities, Drug-using Juvenile and Adult Male Offenders	317	age: 12-18	2w: 6mo	Modified version of Grasmick Scale, inlude mesures of all six elements: impulsiveness, preference for physical activities, risk seeking, self-centeredness, preference for simple tasks, volatile temper	x			

ABBREVIATIONS: CS = cross-sectional study; #w = number of waves in study followed by time between waves; *(continued)*

(continued)

Add Health: National Longitudinal Study of Adolescent Health, national, stratified random sample, 132 schools;
NLSY: National Longitudinal Survey of Youth, initial sample in 1979, added Child and Young Adult Supplements, oversampled disadvantaged;
GREAT Survey: Gang Resistance Education and Training 1995-1999, six cities, 22 schools in US

[a] An x in this column indicates that sex/gender is incorporated as an independent or control variable

Table 13 (continued).

Article	Data/Sample Description	Sample n	Sample age/grade	Design	Operationalization of SC	Dimensionality	Stability	Sources	Sex[a]
Diamond et al. (2017)	Simmons Longitudinal Study: Community, Youth, Public Schools	349	age: 5-26	7w: various	Behavioral Problems Index (BPI) mother report items capture impulsivity, self-centeredness, difficulty with interpersonal relations, attention regulation, emotion regulation, participation in noncriminal forms of deviance		x		
Forrest & Hay (2011)	NLSY: Child and Young Adult Supplement	2325	age: >15	2w: 2yrs	6 attitudial, self report items mostly capture impulsivity and risk-seeking tendencies		x	x	x
Gibbs et al. (1998)	Convenience, Undergraduates	262	age: 18-22	CS	40 items reflecting cognitive, affective, and behavioral aspects of tendences mentioned by G&H except physicality (impulsive, insensitive, risk-taking, short-sighted, and nonverbal) Some items come direclty from Grasmick or Wood Scales			x	x
Gibson et al. (2010)	PHDCN: Project on Human Development in Chicago Neighborhoods	2003	age: 7-16	CS	EASI Temperament Instrument primary caregiver behavioral report subscales include: inhibitory control, decision time, sensation seeking, and persistence			x	x
Grasmick et al. (1993)	Random Sample, Oklahoma City	389	age: >18	CS	Origin of Grasmick Scale	x			x
Hay (2001)	Adolescents from one public high school in Southwestern state	197	age: 14-18	CS	Modified version of Grasmick Scale, 19 items that inlude mesures of all six elements: impulsiveness, preference for physical activities, risk seeking, self-centeredness, preference for simple tasks, volatile temper			x	x
Hay & Forrest (2006)	NLSY: Child and Young Adult Supplement	3793	age: 7-15	5w: 2yrs	Behavioral Problems Index (BPI) mother report 19 items that appear to caputre impulsivity, self-centeredness, difficulty regulaitng attention and emotions, temper loss, lying and disobedience in school		x	x	x
Higgins et al. (2009)	GREAT Survey: High risk Youth	408	age: 12-16	5w: 1yr	Similar to Grasmick Scale yet only capture the impulsvie and risk-taking items		x		x
Hope et al. (2003)	All Pubilc High Schoolers and Junior High Schoolers, 1 Town in Arkansas	1139	grade: 9-11	CS	12 items: some taken from Grasmick Scale while other developed for this study Items capture immediate gratifictaion, risk-taking, insensitivity to others, temper			x	x
Jo & Bouffard (2014)	Korean Youth Panel Survey, Nationally Representative	2159	age: 10-14	5w: 1yr	6 items: impulsive, lacks persistence, thrill seeking, temper, lack discipline, enjoy teasing/harassing others		x	x	x
Longshore et al. (1996)	Treatment Alternatives to Street Crime, Five US cities, Drug-using Juvenile and Adult Male Offenders (RAND-UCLA)	623	age: unknown-64	CS	Modified Grasmick Scale (20 items, but all six elements remain captured)	x			x

(continued)ABBREVIATIONS: CS = cross-sectional study; #w = number of waves in study followed by time between waves;
(continued)
Add Health: National Longitudinal Study of Adolescent Health, national, stratified random sample, 132 schools;
NLSY: National Longitudinal Survey of Youth, initial sample in 1979, added Child and Young Adult Supplements, oversampled disadvantaged;
GREAT Survey: Gang Resistance Education and Training 1995-1999, six cities, 22 schools in US
[a] An x in this column indicates that sex/gender is incorporated as an independent or control variable

Table 13 (continued).

Article	Data/Sample Description	Sample n	Sample age/grade	Design	Operationalization of SC	Dimensionality	Stability	Sources	Sex[a]
Marcus (2003)	3 Convenience Samples: 1 & 2: Undergraduates, German University 3: Adult Employees of German Industrial Company	1: 214 2: 213 3: 76	1: age 19 to 47 2: age 20 to 41 3: unknown	CS	Two measures of self control used: 1--Grasmick Scale 2--original Retrospective Behavioral Self-Control Scale (RBS): 8 factors, all behavioral (school misconduct, property deviance, substance use, physical aggression, wastefulness, absenteeism/tardiness, traffic violations, social problem behavior)	x			
Meinert & Reinecke (2018)	German longitudinal study: Chances and Risks in the Life Course: 2 Cohorts	1423	age: 11-13 and 15-17	3w: 1yr	Draw from 3 elements of the Grasmick Scale: risk seeking (four), impulsivity (three items), temper (2 items).		x	x	x
Meldrum (2008)	National Longitudinal Study of Youth (NLSY79) Mohter Data and Child and Young Adult Supplement	unknown	age: 10-14 to 14-18	2w: 2yrs	6-item index capturing mostly child impulsivity and risk-seeking		x	x	x
Meldrum et al. (2012)	NSCR "School Project" Dutch, Relatively High Risk Students, Peer Network Data	1036	age: 12-17	3w: 1yr	12 items adapted from Grasmick Scale, mostly capture impulsivity, risk seeking, temper, and tendency to harm others		x	x	x
Mitchell & Mackenzie (2006)	Adult Male Offenders, Maryland Correctional Facility (half participating in boot camp)	207: 96 bootcamp, 113 control	age: >18	2w: 6mo	Grasmick Scale	x	x	x	
Na & Paternoster (2012)	JHU PIRC Field Trials: High Risk Sample of Students, Baltimore Public Schools	399	grade: k-12	7w: 6yrs between waves 1 and 2 and 1yr after	The Teacher Report of Classroom Behavior Checklist (TRCBC). Behavioral teacher reports Five "domains of self-control" captured: impulsivity, hyperactivity, concentration problems, oppositional-defiant behavior, and helplessness		x	x	
Nofziger (2008)	NLSY Mother, Child, and Young Adult	3627	age: 6-11	2w: 4yrs	Behavioral Problems Index (BPI) mother report 11 items capture the tendency to seek immediate and easy gratification, engage in high-risk behaviors, or indicate the subjects' level of temper, impulsivity, and self-centeredness			x	x
Perrone et al. (2004)	Add Health	13536	grade: 7-12	CS	5 items that tap into five of Gottfredson and Hirschi's six elements (missing risk taking/sensation seeking) Attitudinal and behavioral measures			x	x
Piquero & Rosay (1998)	Treatment Alternatives to Street Crime, Five US cities, Drug-using Juvenile and Adult Male Offenders (RAND-UCLA)	580	unknown	CS	Modified Grasmick Scale (19 items, but all six elements remain captured)	x			x
Pratt et al. (2004)	NLSY: Child and Young Adult Supplement	463	age: 10-12	2w: 2yrs	Behavioral Problems Index (BPI) mother report items recoded as dichotomous??why used all 32 items!! Why!! "cries too much" "is too dependent on others"			x	x

ABBREVIATIONS: CS = cross-sectional study; #w = number of waves in study followed by time between waves; *(continued)*
Add Health: National Longitudinal Study of Adolescent Health, national, stratified random sample, 132 schools;
NLSY: National Longitudinal Survey of Youth, initial sample in 1979, added Child and Young Adult Supplements, oversampled disadvantaged;
GREAT Survey: Gang Resistance Education and Training 1995-1999, six cities, 22 schools in US
[a] An x in this column indicates that sex/gender is incorporated as an independent or control variable

Table 13 (continued).

Article	Data/Sample Description	Sample n	Sample age/grade	Design	Operationalization of SC	Dimensionality	Stability	Sources	Sex[a]
Shoenberger & Rocheleau (2017)	NLSY: Child and Young Adult Supplement	862	unclear (age: 0-13?)	6w: 2yrs	Behavioral Problems Index (BPI) mother report 11 items capturing tendencies: disobedient, impulsive, restless, irritable, strong temper, destroys things, demands attention			x	x
Teasdale & Silver (2009)	Add Health	9171	age: 11-20	2w: 1yr	4 items tapping into three of G&H's elements: preference for simple tasks, physical activities, and impulsivity adds "insensitivity to normative expectations" attitudinal and behavioral measures			x	x
Turner & Piquero (2002)	NLSY: Mother and Child and Young Adult Supplement	513	age: 5-21	7w: 2yrs	Different measures used for different waves 1-4: Behavioral Problems Index (BPI) mother report 28 items to capture: antisocial, anxious/depressed, heastrong, hyperactive, dependent, peer conflicts 5-7: Attitudinal self-reports 6 items mostly capture impulsivity, sensation seeking		x		x
Turner et al. (2005)	NLSY and NLSY child-mother	463	age: 10	CS	Behavioral Problems Index (BPI) mother report 4 of the 6 subscales used to capture: antisocial, headstrong, hyperactive, peer conflicts			x	x
Unnever et al. (2003)	Public School Sample, Six Middle Schools in Metropolitan Area in Virginia	2437	grades: 6-8	CS	Modified Grasmick Scale (22 items, but all six elements remain captured)			x	x
Vazsonyi & Huang (2010)	National Institute of Child Health and Human Development (NICHD) Early Child Care Research Netwoek Study of Early Child Care: Families with Newborns from 10 Cites Across US	1155	age: 4.5-10.5	3w: 4yrs, 2yrs	Social Skills Rating System (SSRS) Parent ratings self-control subscale consisting of 10 behavioral items *scale copyrighted and items unknown, but see next entry		x	x	x
Vazsonyi & Jiskrova (2018)	National Institute of Child Health and Human Development (NICHD) Early Child Care Research Netwoek Study of Early Child Care: Families with Newborns from 10 Cites Across US	1159	age: 4.5-15	6w: various	Social Skills Rating System Mother ratings self-control subscale consisting of 10 behavioral items example items: "The child avoids situations that result in trouble" or "The child receives criticism well"		x		
Vazsonyi et al. (2001)	International Study of Adolescent Development: Representative Samples of Adolescents in Hungary, the Netherlands, Switzerland, and the US	6085	age: 15-19	CS	Grasmick Scale	x			x
Ward et al. (2015)	Florida Jail Inmates, Male and Female	2414	age: 18-84	CS	Grasmick Scale	x			x

ABBREVIATIONS: CS = cross-sectional study; #w = number of waves in study followed by time between waves; *(continued)*
Add Health: National Longitudinal Study of Adolescent Health, national, stratified random sample, 132 schools;
NLSY: National Longitudinal Survey of Youth, initial sample in 1979, added Child and Young Adult Supplements, oversampled disadvantaged;
GREAT Survey: Gang Resistance Education and Training 1995-1999, six cities, 22 schools in US
[a] An x in this column indicates that sex/gender is incorporated as an independent or control variable

Table 13 (continued).

Article	Data/Sample Description	Sample n	Sample age/grade	Design	Operationalization of SC	Dimensionality	Stability	Sources	Sex[a]
Winfree et al. (2006)	GREAT Survey: High risk Youth	965	grades: 6-11	5w: 1yr	8 items drawn from Grasmick Scale Impulsive and risk seeking items only	x	x	x	x
Wood et al. (1993)	Nonrandom Sample, Oklahoma High School Students, 4 Schools	975	age: 14-19	CS	Developed new scale, 24 items that capture six elements: risk taking, simplicity, anger, physicality, immediate gratification, self-centeredness	x		x	x
Wright et al. (2008)	Add Health, twins only	452 DZ 289 MZ	grade 7-12 to age 18-26	3w: 1yr, 5-6yrs	5 items that tap into five of Gottfredson and Hirschi's six elements (missing risk taking/sensation seeking) Attitudinal and behavioral measures			x	x

ABBREVIATIONS: CS = cross-sectional study; #w = number of waves in study followed by time between waves; *(end of table)*
Add Health: National Longitudinal Study of Adolescent Health, national, stratified random sample, 132 schools;
NLSY: National Longitudinal Survey of Youth, initial sample in 1979, added Child and Young Adult Supplements, oversampled disadvantaged;
GREAT Survey: Gang Resistance Education and Training 1995-1999, six cities, 22 schools in US
[a] An x in this column indicates that sex/gender is incorporated as an independent or control variable

APPENDIX B

ITEMS INCLUDED IN VARIABLE SCALES

IMPULSIVITY (Averaged)
Respondents were asked: Please tell me if the statement is not at all true, somewhat true, or very true for you:

1. When you promise to do something, people can count on you to do it.*
2. You have to have everything right away.
3. You have to be reminded several times to do things.
4. You could be described as careless.
5. You like to switch from one thing to another.
6. If you find that something is really difficult, you get frustrated and quit.
7. When you ask a question, you often jump to something else before getting an answer.
8. You stick with what you are doing until you finish with it.*
9. When you have to wait in line, you do it patiently.*
10. You usually think before you act.*

* Items are reverse coded

SENSATION SEEKING (Averaged)
Respondents were asked: Please tell me if the statement is not at all true, somewhat true, or very true for you:

1. You would do almost anything for a dare.
2. You enjoy taking risks.
3. You could do something most people would consider dangerous like driving a car fast.
4. Life with no danger would be dull for you.

PARENTAL HARSHNESS (Averaged)
Respondents were asked: During the past 12 months, how often did your [PC Relationship]… Was it always, often, sometimes, or never?

1. Get angry at you?*
2. Get so mad at you that [He/She] broke or threw things*
3. Criticize you or your ideas?*
4. Insult or swear at you?*

* Items are reverse coded

PARENTAL WARMTH (Averaged)
Respondents were asked: During the past 12 months, how often did your [PC relationship]. . . . Was it always, often, sometimes, or never?

1. Help you do something that was important to you?*
2. Let you know [He/She] really cares about you?*
3. Listen carefully to your point of view?*
4. Tell you that [He/She] loves you?*

*Items are reverse coded

MORBIDITY/MORTALITY (Variety Count)
Respondents were asked: In the past 12 months:

1. Did a friend die?
2. Did a parent, brother, or sister die?
3. Were you seriously ill or injured?
4. Was a close family member a victim of a violent crime?
5. Were you a victim of a violent crime?

INTERPERSONAL RACIAL DISCRIMINATION (Averaged)
Respondents were asked: In the last year how often…. Was it never, sometimes, often, or always?

1. Has someone said something insulting to you just because of your race or ethnic background?
2. Has a store-owner, sales clerk, or person working at a place of business treated you in a disrespectful way just because of your race or ethnic background?
3. Have the police hassled you just because of your race or ethnic background?
4. Has someone ignored you or excluded you from some activity just because of your race or ethnic background?
5. Has someone suspected you of doing something wrong just because of your race or ethnic background?
6. Has someone yelled a racial slur or racial insult at you just because of your race or ethnic background?
7. Has someone threatened to harm you physically just because of your race or ethnic background?
8. Have you encountered people who are surprised that you, given your race or ethnic background, did something really well?
9. Have you been treated unfairly just because of your race or ethnic background?
10. Have you encountered people who didn't expect you to do well just because of your race or ethnic background?
11. Has someone discouraged you from trying to achieve an important goal just because of your race or ethnic background?

ROMANTIC PARTNER WARMTH (Averaged)
Respondents were asked: During the past month, how often did your [romantic partner name]. . . . Was it always, often, sometimes, or never?

1. Act loving and affectionate toward you?*
2. Let you know that he or she appreciates you, your ideas, or the things you do?
3. Help you do something that was important to you?*

* Items are reverse coded

ROMANTIC PARTHER HOSTILITY (Averaged)
Respondents were asked: During the past month, how often did your [romantic partner name]. . . . Was it always, often, sometimes, or never?

1. Shout or yell at you because they were mad at you?*
2. Push, grab, shove, slap or hit you?*

* Items are reverse coded

DEVIANT PEERS (Averaged)
Respondents were asked: During the past 12 months, how many of your close friends have…..Is it none of them, some of them, or all of them?

1. Stolen something inexpensive (less than $25)
2. Hit someone with the idea of hurting them?
3. Attacked someone with a weapon of with the idea of hurting them?
4. Used alcohol (beer, wine, bourbon, vodka, etc.)?
5. Used drugs like marijuana?
6. Gotten high using drugs of some kind?
7. Drunk a lot of alcohol—3 or more drinks at one time?

APPENDIX C

WAVE SPECIFIC SAMPLE DESCRIPTIVES

Table 14. Wave Specific Sample Descriptives

	Total				Male				Female				
Variable Name	Mean/%	SD	Min	Max	Mean/%	SD	Min	Max	Mean/%	SD	Min	Max	Sig.
Dependent													
Impulsivity													
w1	1.65	0.36	1.00	2.70	1.65	0.35	1.00	2.70	1.66	0.36	1.00	2.60	
w2	1.67	0.34	1.00	2.80	1.67	0.34	1.00	2.70	1.68	0.35	1.00	2.80	
w4	1.56	0.30	1.00	2.60	1.54	0.31	1.00	2.40	1.57	0.30	1.00	2.60	°
w5	1.52	0.32	1.00	2.90	1.53	0.32	1.00	2.90	1.52	0.31	1.00	2.50	
w6	1.45	0.33	1.00	2.70	1.44	0.32	1.00	2.60	1.46	0.34	1.00	2.70	
w7	1.48	0.33	1.00	3.00	1.48	0.35	1.00	3.00	1.48	0.31	1.00	2.40	
Sensation seeking													
w1	1.52	0.43	1.00	3.00	1.55	0.44	1.00	3.00	1.50	0.41	1.00	3.00	
w2	1.47	0.45	1.00	3.00	1.52	0.47	1.00	3.00	1.44	0.43	1.00	3.00	*
w4	1.48	0.49	1.00	3.00	1.54	0.53	1.00	3.00	1.43	0.45	1.00	3.00	**
w5	1.53	0.44	1.00	3.00	1.63	0.46	1.00	3.00	1.47	0.41	1.00	3.00	***
w6	1.45	0.44	1.00	3.00	1.50	0.56	1.00	2.80	1.42	0.43	1.00	3.00	*
w7	1.46	0.49	1.00	3.00	1.58	0.53	1.00	3.00	1.40	0.45	1.00	3.00	***
Independent													
Sex (female = 1)													
w1	0.55												
w2	0.55												
w4	0.56												
w5	0.58												
w6	0.58												
w7	0.62												
SES	2.21	0.67	1.00	3.00	2.22	0.66	1.00	3.00	2.21	0.68	1.00	3.00	
Age													
w1	10.53	0.62	9.00	12.00	10.52	0.61	9.00	12.00	10.54	0.62	9.00	12.00	
w2	12.29	0.85	11.00	15.00	12.29	0.86	11.00	15.00	12.28	0.84	11.00	14.00	
w4	18.82	0.91	16.00	21.00	18.81	0.89	16.00	21.00	18.84	0.92	17.00	21.00	
w5	21.55	0.86	19.00	25.00	21.53	0.88	19.00	25.00	21.56	0.84	20.00	24.00	
w6	23.59	0.87	21.00	26.00	23.58	0.90	21.00	26.00	23.60	0.86	22.00	26.00	
w7	28.80	0.85	27.00	31.00	28.78	0.85	27.00	31.00	28.81	0.86	27.00	31.00	
PC Hostility													
w1	1.51	0.42	1.00	3.75	1.52	0.41	1.00	3.25	1.51	0.42	1.00	3.75	
w2	1.52	0.41	1.00	3.50	1.49	0.36	1.00	3.50	1.55	0.45	1.00	3.50	°
w4	1.54	0.46	1.00	3.50	1.49	0.39	1.00	3.25	1.59	0.51	1.00	3.50	**
w5	1.54	0.48	1.00	4.00	1.55	0.49	1.00	4.00	1.53	0.46	1.00	3.75	
w6	1.39	0.44	1.00	4.00	1.38	0.42	1.00	3.50	1.39	0.45	1.00	4.00	
w7	1.35	0.43	1.00	4.00	1.34	0.41	1.00	4.00	1.35	0.45	1.00	3.50	
PC Wamth													
w1	3.47	0.56	1.00	4.00	3.49	0.53	1.00	4.00	3.45	0.58	1.00	4.00	
w2	3.32	0.65	1.00	4.00	3.33	0.61	1.00	4.00	3.30	0.69	1.00	4.00	
w4	3.28	0.71	1.00	4.00	3.33	0.63	1.00	4.00	3.25	0.76	1.00	4.00	
w5	3.17	0.76	1.00	4.00	3.19	0.71	1.00	4.00	3.16	0.80	1.00	4.00	
w6	3.26	0.75	1.00	4.00	3.24	0.73	1.00	4.00	3.27	0.76	1.00	4.00	
w7	3.37	0.73	1.00	4.00	3.36	0.69	1.00	4.00	3.38	0.76	1.00	4.00	
PC Missing													
w1	0.00				0.00				0.00				
w2	0.00				0.00				0.00				
w4	0.01				0.00				0.01				
w5	0.06				0.04				0.07				°
w6	0.05				0.04				0.06				
w7	0.09				0.08				0.10				
Morbidity/Mortality													
w1	0.67	0.84	0.00	4.00	0.66	0.81	0.00	3.00	0.68	0.86	0.00	4.00	
w2	0.66	0.82	0.00	4.00	0.67	0.80	0.00	3.00	0.65	0.83	0.00	4.00	
w4	0.59	0.76	0.00	4.00	0.54	0.72	0.00	3.00	0.62	0.79	0.00	4.00	
w5	0.71	0.85	0.00	5.00	0.70	0.86	0.00	5.00	0.71	0.84	0.00	4.00	
w6	0.56	0.77	0.00	4.00	0.55	0.79	0.00	4.00	0.57	0.76	0.00	4.00	
w7	0.65	0.86	0.00	4.00	0.70	0.86	0.00	3.00	0.62	0.85	0.00	4.00	

NOTES: Sig. refers to significant differences in level between sexes (ttests and chi-squares); *(continued)*
° $p<.10$, *$p<.05$, **$p<.01$, ***$p<.001$ (two tailed tests)
ABBREVIATIONS: SD = Standard Deviation; w = wave; PC = Primary Caregiver

Table 14 (continued).

	Total				Male				Female				
Variable Name	Mean/%	SD	Min	Max	Mean/%	SD	Min	Max	Mean/%	SD	Min	Max	Sig.
Neighborhood Crime													
w1	1.38	0.48	1.00	3.00	1.38	0.50	1.00	3.00	1.38	0.47	1.00	3.00	
w2	1.30	0.40	1.00	3.00	1.28	0.39	1.00	3.00	1.31	0.41	1.00	3.00	
w4	1.25	0.39	1.00	3.00	1.26	0.43	1.00	3.00	1.24	0.36	1.00	2.67	
w5	1.29	0.41	1.00	3.00	1.32	0.43	1.00	3.00	1.26	0.38	1.00	3.00	°
w6	1.21	0.37	1.00	3.00	1.21	0.36	1.00	3.00	1.21	0.37	1.00	2.67	
w7	1.20	0.37	1.00	3.00	1.21	0.41	1.00	3.00	1.19	0.34	1.00	2.67	
Racial Discrimination													
w1	1.59	0.50	1.00	3.73	1.56	0.53	1.00	3.73	1.61	0.48	1.00	3.45	
w2	1.59	0.55	1.00	3.73	1.55	0.55	1.00	3.73	1.61	0.55	1.00	3.55	
w4	1.72	0.59	1.00	3.73	1.78	0.63	1.00	3.73	1.68	0.55	1.00	3.55	*
w5	1.61	0.54	1.00	3.64	1.71	0.56	1.00	3.64	1.55	0.52	1.00	3.64	***
w6	1.52	0.55	1.00	4.00	1.58	0.58	1.00	3.73	1.47	0.52	1.00	4.00	*
w7	1.44	0.63	1.00	4.00	1.51	0.70	1.00	4.00	1.40	0.57	1.00	4.00	*
RP Hostility													
w4	1.37	0.49	1.00	3.50	1.54	0.56	1.00	3.50	1.27	0.41	1.00	3.00	***
w5	1.44	0.51	1.00	4.00	1.57	0.57	1.00	4.00	1.34	0.43	1.00	4.00	***
w6	1.43	0.41	1.00	3.50	1.51	0.44	1.00	3.00	1.38	0.38	1.00	3.50	**
w7	1.35	0.41	1.00	3.00	1.43	0.45	1.00	3.00	1.30	0.38	1.00	3.00	**
RP Warmth													
w4	3.37	0.66	1.00	4.00	3.32	0.68	1.00	4.00	3.40	0.65	1.00	4.00	
w5	3.22	0.72	1.00	4.00	3.21	0.70	1.00	4.00	3.22	0.73	1.00	4.00	
w6	3.23	0.76	1.00	4.00	3.20	0.74	1.00	4.00	3.25	0.77	1.00	4.00	
w7	3.22	0.80	1.00	4.00	3.25	0.81	1.00	4.00	3.20	0.79	1.00	4.00	
RP Missing													
w4	0.47				0.53				0.43				**
w5	0.45				0.45				0.44				
w6	0.45				0.47				0.44				
w7	0.34				0.36				0.34				
Deviant Peer													
w1	1.24	0.28	1.00	2.43	1.27	0.29	1.00	2.29	1.22	0.26	1.00	2.43	*
w2	1.26	0.31	1.00	2.71	1.28	0.31	1.00	2.43	1.25	0.32	1.00	2.71	
w4	1.46	0.39	1.00	3.00	1.49	0.42	1.00	3.00	1.43	0.37	1.00	2.86	*
w5	1.54	0.37	1.00	2.71	1.59	0.35	1.00	2.71	1.51	0.37	1.00	2.71	**
w6	1.56	0.34	1.00	3.00	1.61	0.35	1.00	3.00	1.52	0.34	1.00	3.00	***
w7	1.44	0.31	1.00	2.50	1.49	0.32	1.00	2.50	1.41	0.30	1.00	2.30	**

NOTES: Sig. refers to significant differences in level between sexes (ttests and chi-squares); *(end of table)*
° $p<.10$, * $p<.05$, ** $p<.01$, *** $p<.001$ (two tailed tests)
ABBREVIATIONS: SD = Standard Deviation; w = wave; RP = Romantic Partner

APPENDIX D

PARTIAL CORRELATION MATRIX

Table 15. Partial Correlation Matrix

	Impulsivity						Sensation-Seeking						Various (Stabiilty Correlations)					
	W_1	W_2	W_4	W_5	W_6	W_7	W_1	W_2	W_4	W_5	W_6	W_7	W_1	W_2	W_4	W_5	W_6	W_7
Impulsivity$_{W_1}$	--												--	*0.43**	*0.36**	*0.26**	*0.26**	*0.07*
Impulsivity$_{W_2}$	**0.44***	--											*0.45**	--	*0.39**	*0.31**	*0.33**	*0.26**
Impulsivity$_{W_4}$	**0.28***	**0.37***	--										*0.17**	*0.34**	--	*0.59**	*0.52**	*0.39**
Impulsivity$_{W_5}$	**0.18***	**0.30***	**0.50***	--									*0.06*	*0.29**	*0.37**	--	*0.63**	*0.50**
Impulsivity$_{W_6}$	**0.21***	**0.31***	**0.51***	**0.61***	--								*0.13**	*0.28**	*0.50**	*0.58**	--	*0.45**
Impulsivity$_{W_7}$	**0.11***	**0.20***	**0.31***	**0.47***	**0.44***	--							*0.17**	*0.13*	*0.20**	*0.42**	*0.42**	--
Sensation-Seeking$_{W_1}$	**0.29***	0.15*	0.15*	0.14*	0.13*	0.12*	--						--	*0.32**	*0.23**	*0.17**	*0.18**	*0.08*
Sensation-Seeking$_{W_2}$	0.19*	**0.38***	0.18*	0.19*	0.25*	0.09*	**0.31***	--					*0.28**	--	*0.35**	*0.31**	*0.31**	*0.18**
Sensation-Seeking$_{W_4}$	0.07*	0.16*	**0.25***	0.26*	0.19*	0.08	**0.17***	**0.35***	--				*0.10*	*0.32**	--	*0.55**	*0.49**	*0.34**
Sensation-Seeking$_{W_5}$	0.11*	0.17*	0.15*	**0.34***	0.24*	0.18*	**0.18***	**0.35***	**0.54***	--			*0.17**	*0.38**	*0.51**	--	*0.52**	*0.40**
Sensation-Seeking$_{W_6}$	0.11*	0.17*	0.16*	0.20*	**0.28***	0.17*	**0.18***	**0.34***	**0.47***	**0.54***	--		*0.18**	*0.37**	*0.44**	*0.54**	--	*0.50**
Sensation-Seeking$_{W_7}$	0.00	0.08	0.07	0.16*	0.16*	**0.28***	**0.16***	**0.26***	**0.36***	**0.43***	**0.52***	--	*0.23**	*0.35**	*0.38**	*0.43**	*0.55**	--
PC Warmth$_{W_1}$	**-0.26***	-0.17*	-0.14*	-0.07	-0.13*	-0.09*	**-0.18***	-0.09*	-0.02	-0.03	-0.07	-0.03	--					
PC Warmth$_{W_2}$	-0.12*	**-0.23***	-0.14*	-0.11*	-0.12*	-0.04	-0.08*	**-0.18***	-0.08*	-0.08*	-0.11*	-0.08	**0.36***	--				
PC Warmth$_{W_4}$	-0.02	-0.08*	**-0.20***	-0.10*	-0.16*	-0.08	-0.05	-0.07	**-0.11***	-0.09*	-0.13*	-0.11*	**0.21***	**0.33***	--			
PC Warmth$_{W_5}$	-0.08	-0.09*	-0.19*	**-0.19***	-0.22*	-0.10*	-0.06	-0.12*	-0.11*	**-0.14***	-0.14*	-0.01	**0.30***	**0.30***	**0.46***	--		
PC Warmth$_{W_6}$	-0.05	-0.08	-0.16*	-0.13*	**-0.19***	-0.14*	-0.09*	-0.12*	-0.12*	-0.11*	**-0.14***	-0.09*	**0.23***	**0.27***	**0.39***	**0.49***	--	
PC Warmth$_{W_7}$	-0.05	-0.08	-0.08	-0.05	-0.12*	**-0.06**	-0.06	-0.09*	-0.16*	-0.15*	-0.18*	**-0.13***	**0.17***	**0.25***	**0.35***	**0.36***	**0.37***	--
PC Hostility$_{W_1}$	**0.33***	0.18*	0.16*	0.08*	0.09*	0.03	**0.20***	0.05	0.03	0.07	0.13*	0.04	--					
PC Hostility$_{W_2}$	0.23*	**0.27***	0.21*	0.20*	0.17*	0.12*	0.11*	**0.15***	0.01	0.12*	0.13*	0.03	**0.30***	--				
PC Hostility$_{W_4}$	0.07	0.14*	**0.26***	0.20*	0.18*	0.13*	0.05	0.08*	**0.15***	0.09*	0.12*	0.10*	**0.12***	**0.22***	--			
PC Hostility$_{W_5}$	0.12*	0.16*	0.16*	**0.26***	0.24*	0.23*	0.04	0.06	0.07	**0.16***	0.16*	0.13*	**0.10***	**0.20***	**0.41***	--		
PC Hostility$_{W_6}$	0.03	0.10*	0.17*	0.23*	**0.26***	0.21*	0.01	0.12*	0.12*	0.11*	**0.21***	0.19*	**0.14***	**0.22***	**0.38***	**0.45***	--	
PC Hostility$_{W_7}$	0.06	0.13*	0.19*	0.21*	0.19*	**0.20***	0.09*	0.04	0.08	0.08	0.10*	**0.16***	**0.06**	**0.14***	**0.30***	**0.30***	**0.40**	--
Morbidity/Mortality$_{W_1}$	**0.10***	0.07	0.05	0.13*	0.10*	0.08*	**0.08***	0.02	-0.04	0.01	0.03	0.01	--					
Morbidity/Mortality$_{W_2}$	0.02	**0.04**	0.06	0.10*	0.03	0.17	0.04	**0.02**	-0.02	0.03	0.02	0.02	**0.19***	--				
Morbidity/Mortality$_{W_4}$	0.00	-0.01	**0.03**	0.05	0.02	0.07	0.00	0.01	**0.05**	0.07	0.04	0.11*	**0.14***	**0.18***	--			
Morbidity/Mortality$_{W_5}$	0.04	0.03	0.06	**0.11***	0.11*	0.04	0.03	0.07	0.01	**0.07**	0.06	0.01	**0.05**	**0.13***	**0.13***	--		
Morbidity/Mortality$_{W_6}$	0.05	0.04	0.06	0.04	**0.10***	0.09*	0.09*	0.03	0.01	0.07	**0.05**	0.03	**0.08***	**0.14***	**0.20***	**0.29***	--	
Morbidity/Mortality$_{W_7}$	0.05	-0.01	0.04	0.04	0.08	**0.04**	0.08	0.01	0.09*	0.02	0.02	**0.02**	**0.10***	**0.18***	**0.20***	**0.14***	**0.26***	--

NOTES: Sex-specific impulsivity and sensation seeking stability coefficients are in the top right two boxes.
(continued)
Females are above the diagonal, male are below.
**p* <.05

Table 15 (continued).

	Impulsivity						Sensation-Seeking						Various (Stabiilty Correlations)					
	W_1	W_2	W_4	W_5	W_6	W_7	W_1	W_2	W_4	W_5	W_6	W_7	W_1	W_2	W_4	W_5	W_6	W_7
NGH $Crime_{W_1}$	**0.12***	0.05	0.01	0.02	-0.01	0.00	**0.11***	0.04	0.06	0.07	0.03	-0.07	--					
NGH $Crime_{W_2}$	0.09*	**0.15***	0.03	0.09*	0.00	0.11*	0.02	**0.08***	0.02	0.01	-0.01	-0.01	**0.27***	--				
NGH $Crime_{W_4}$	0.03	0.01	**0.03**	0.06	0.05	0.03	0.02	0.07	**0.07**	0.03	0.02	0.05	**0.12***	**0.12***	--			
NGH $Crime_{W_5}$	0.02	-0.02	-0.02	**0.06**	0.06	0.02	0.06	-0.05	0.03	**0.08***	0.02	0.01	**0.12***	**0.13***	**0.25***	--		
NGH $Crime_{W6}$	0.03	0.08*	0.06	0.07	**0.10***	0.06	-0.01	0.03	0.07	0.07	**0.09***	0.05	**0.08***	**0.09***	**0.29***	**0.29***	--	
NGH $Crime_{W7}$	0.00	0.01	0.02	0.10*	0.05	**0.11***	0.04	0.05	0.08	0.12*	0.06	**0.05**	**0.04**	**0.09***	**0.18***	**0.18***	**0.12**	--
Racial $Discrimination_{W_1}$	**0.22***	0.15*	0.14*	0.14*	0.11*	0.10*	**0.15***	0.10*	0.02	0.08*	0.02	0.01	--					
Racial $Discrimination_{W_2}$	0.06	**0.13***	0.12*	0.16*	0.11*	0.02	0.04	**0.08***	0.05	0.09*	0.11*	0.10*	**0.43***	--				
Racial $Discrimination_{W_4}$	0.04	0.02	**0.14***	0.08	0.08*	0.05	0.03	0.07	**0.24***	0.12*	0.17*	0.13*	**0.24***	**0.35***	--			
Racial $Discrimination_{W_5}$	0.05	0.07	0.09*	**0.19***	0.13*	0.09	0.04	0.02	0.14*	**0.17***	0.17*	0.14*	**0.27***	**0.38***	**0.51***	--		
Racial $Discrimination_{W6}$	0.04	0.04	0.03	0.06	**0.12***	0.02	0.00	0.06	0.14*	0.15*	**0.20***	0.16*	**0.29***	**0.31***	**0.47***	**0.53***	--	
Racial $Discrimination_{W7}$	0.03	0.04	0.02	0.09*	0.12*	**0.10***	0.05	0.08	0.11*	0.14*	0.12*	**0.20***	**0.19***	**0.31***	**0.38***	**0.47***	**0.50***	--
RP $Warmth_{W_4}$	0.02	-0.07	**-0.12***	-0.03	-0.11	-0.09	0.00	0.00	**0.02**	0.01	-0.06	-0.07			--			
RP $Warmth_{W_5}$	-0.08	-0.16*	-0.13*	**-0.25***	-0.26*	-0.10	-0.07	-0.09	-0.03	**-0.04**	-0.17*	-0.02			**0.14***	--		
RP $Warmth_{W6}$	-0.03	-0.15*	-0.08	-0.11*	**-0.11***	-0.11	-0.08	-0.16*	-0.08	-0.04	**-0.11***	-0.04			**0.19***	**0.24***	--	
RP $Warmth_{W7}$	-0.01	-0.01	-0.05	-0.12*	-0.13*	**-0.15***	-0.00	0.03	-0.12*	-0.11*	-0.07	**0.01**			**0.11**	**0.23***	**0.30***	--
RP $Hostility_{W_4}$	0.10	0.12*	**0.22***	0.16*	0.14*	0.03	0.07	0.13*	**0.15***	0.06	0.06	0.06			--			
RP $Hostility_{W_5}$	0.07	0.14*	0.10	**0.27***	0.23*	0.13*	0.10	0.16*	0.15*	**0.14***	0.21*	0.12*			**0.31***	--		
RP $Hostility_{W6}$	-0.05	0.05	0.10	0.18*	**0.14***	0.08	0.06	0.08	0.10	0.08	**0.11***	0.12*			**0.12**	**0.17***	--	
RP $Hostility_{W_7}$	-0.04	0.05	0.02	0.14*	0.08*	**0.15***	0.08	0.10	0.06	0.07	0.01	**0.16***			**0.14***	**0.17***	**0.21***	--
Deviant $Peers_{W_1}$	**0.34***	0.19*	0.15*	0.09*	0.16*	0.12*	**0.23***	0.10*	0.09*	0.08*	0.11*	0.08*	--					
Deviant $Peers_{W_2}$	0.20*	**0.28***	0.15*	0.15*	0.15*	0.16*	0.08*	**0.28***	0.10*	0.09*	0.14*	0.10*	**0.26***	--				
Deviant $Peers_{W_4}$	0.13*	0.15*	**0.25***	0.25*	0.24*	0.12*	0.11*	0.22*	**0.28***	0.21*	0.21*	0.16*	**0.16***	**0.27***	--			
Deviant $Peers_{W_5}$	0.10*	0.14*	0.21*	**0.28***	0.24*	0.14*	0.11*	0.20*	0.22*	**0.33***	0.26*	0.22*	**0.08***	**0.17***	**0.49***	--		
Deviant $Peers_{W6}$	0.12*	0.14*	0.18*	0.29*	**0.35***	0.19*	0.12*	0.23*	0.24*	0.29*	**0.28***	0.19*	**0.13***	**0.18***	**0.42***	**0.52***	--	
Deviant $Peers_{W_7}$	0.07	0.10*	0.10*	0.20*	0.20*	**0.17***	0.14*	0.17*	0.22*	0.28*	0.27*	**0.20***	**0.12***	**0.13***	**0.32***	**0.44***	**0.49***	--
SES	0.06	0.03	0.03	0.05	0.06	-0.02	0.06	0.10*	0.05	0.06	0.06	0.02						

NOTES: *p <.05

(end of table)

APPENDIX E

SUPPLEMENTAL GROUP-BASED TRAJECTORY MODELS WITH CONFIDENCE INTERVALS AND SECOND-BEST MODELS (MALE IMP, MALE SS)

Figure 8. GBTM of Male Impulsivity with Confidence Intervals

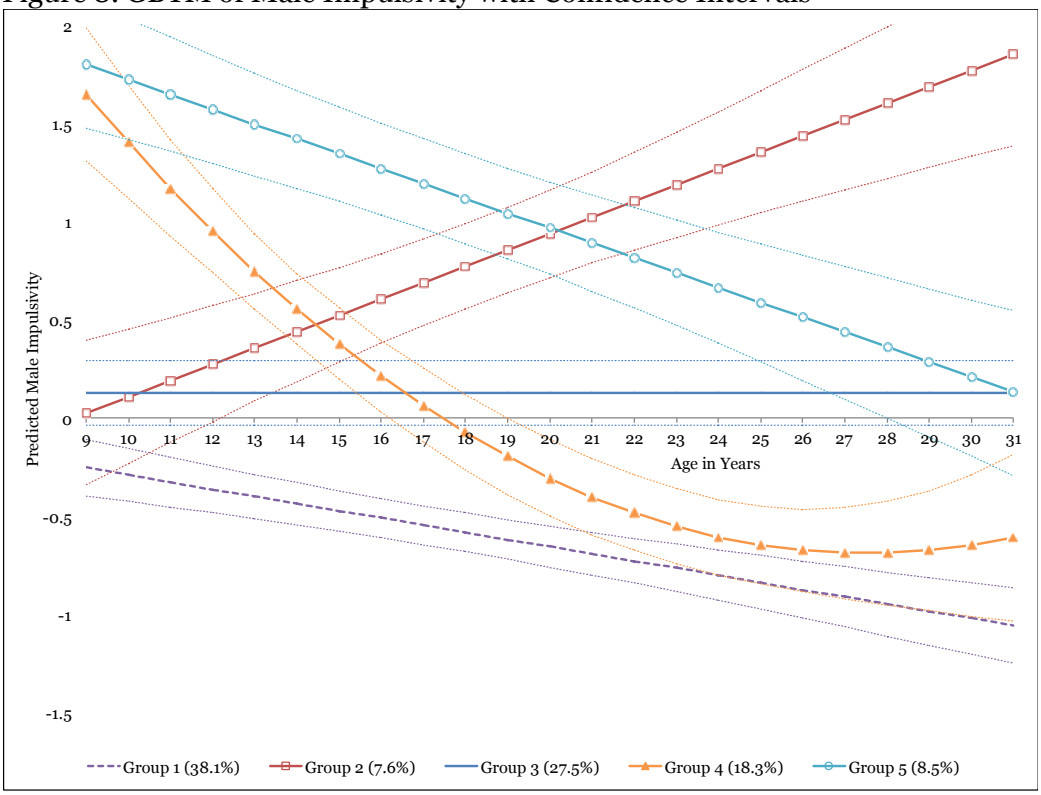


Figure 9. GBTM of Female Impulsivity with Confidence Intervals

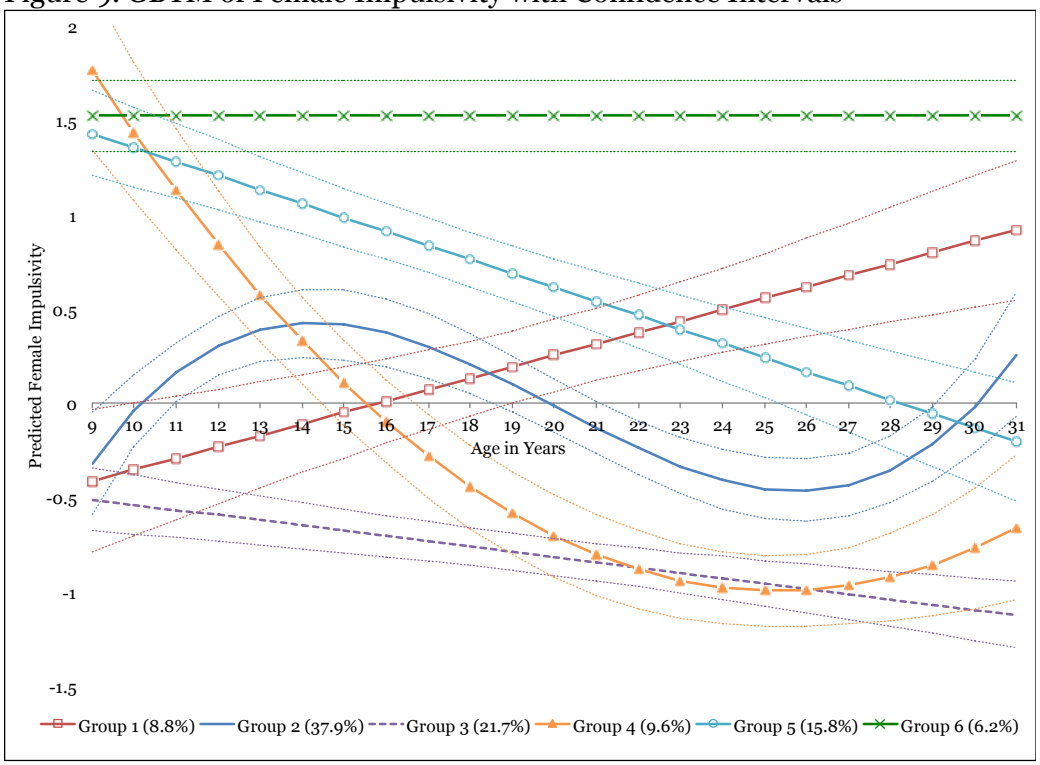


Figure 10. GBTM of Male Sensation Seeking with Confidence Intervals

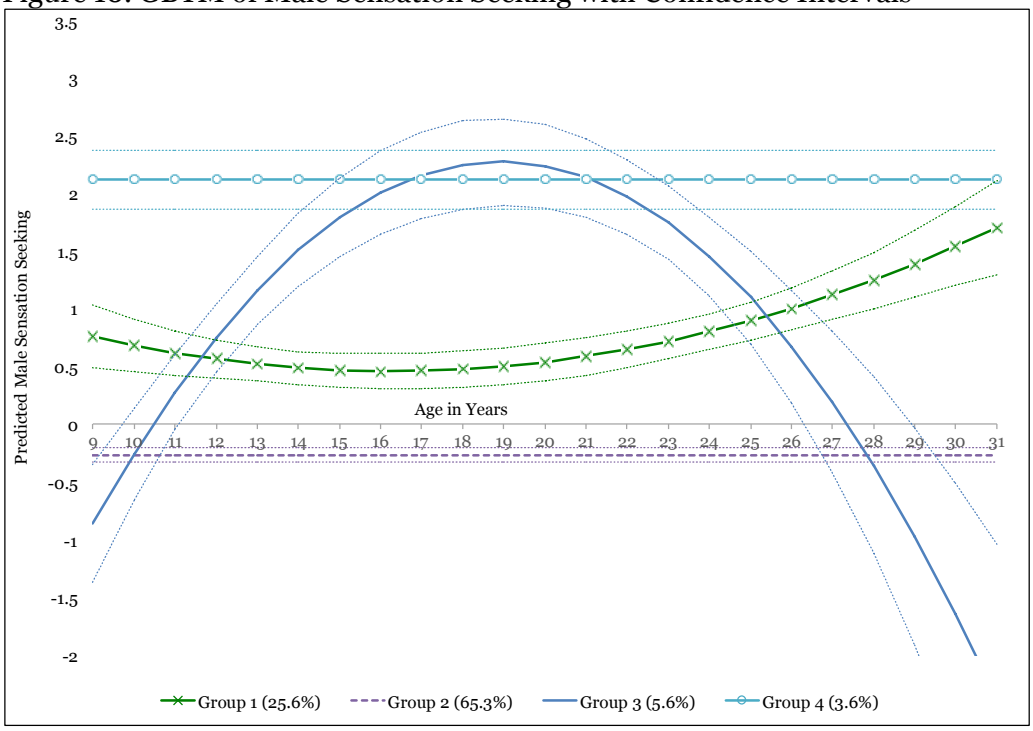


Figure 11. GBTM of Female Sensation Seeking with Confidence Intervals

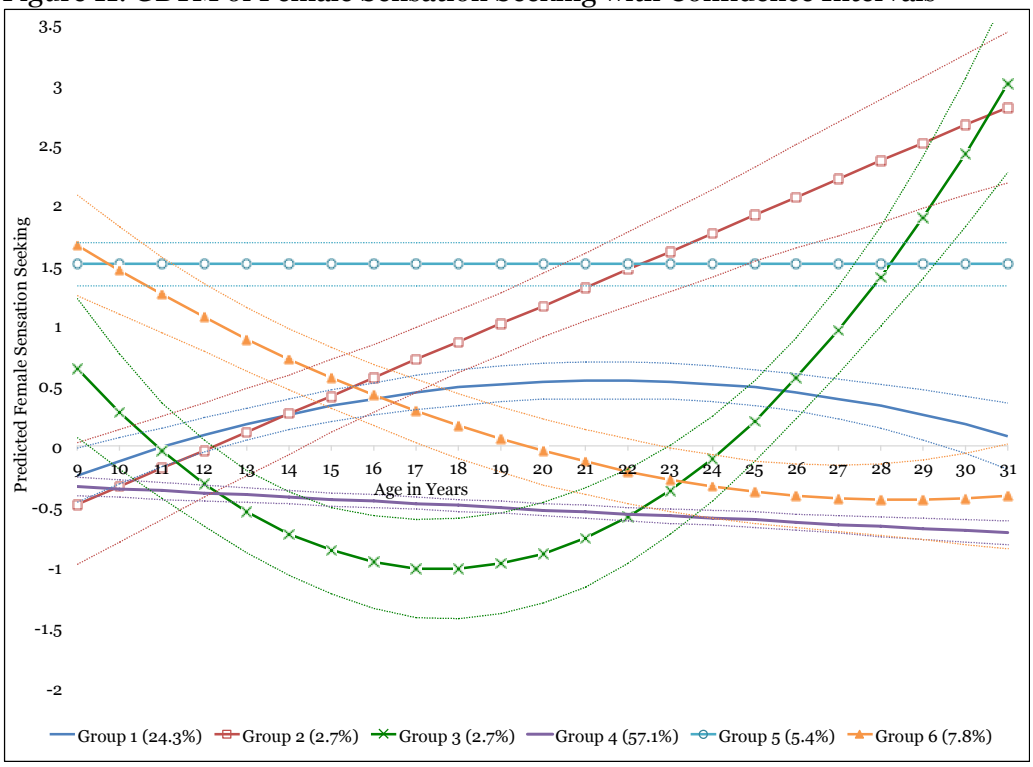


Figure 12. Alternate Male Impulsivity GBTM

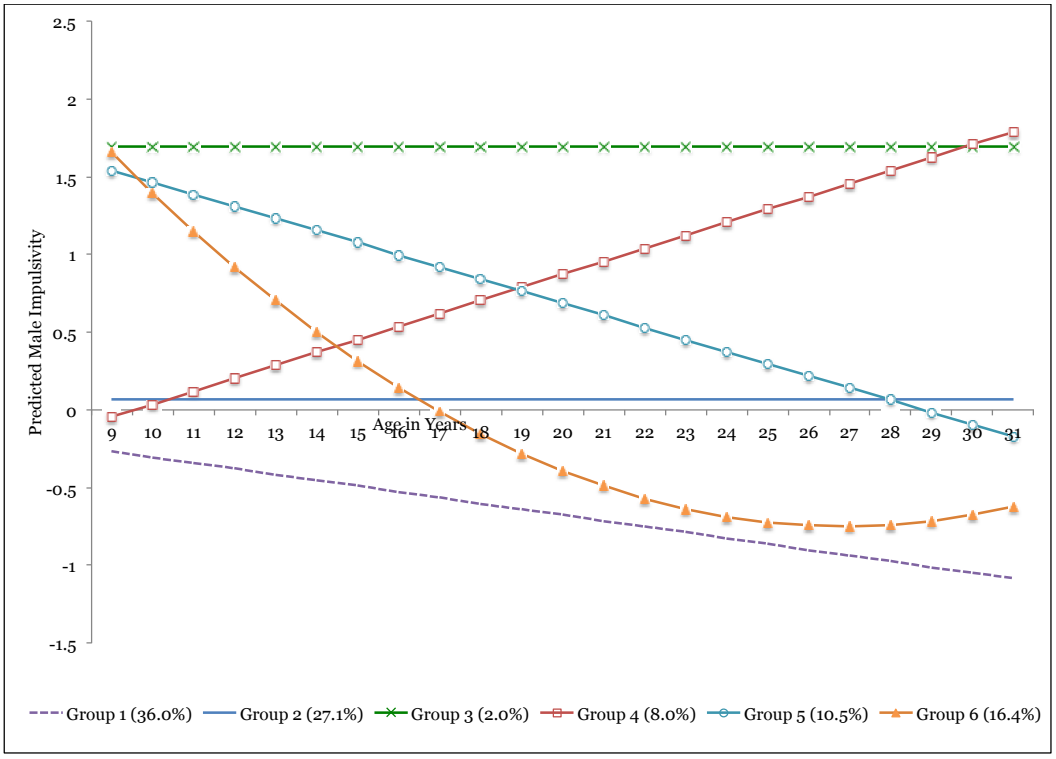


Figure 13. Alternate Male Impulsivity GBTM with Confidence Intervals

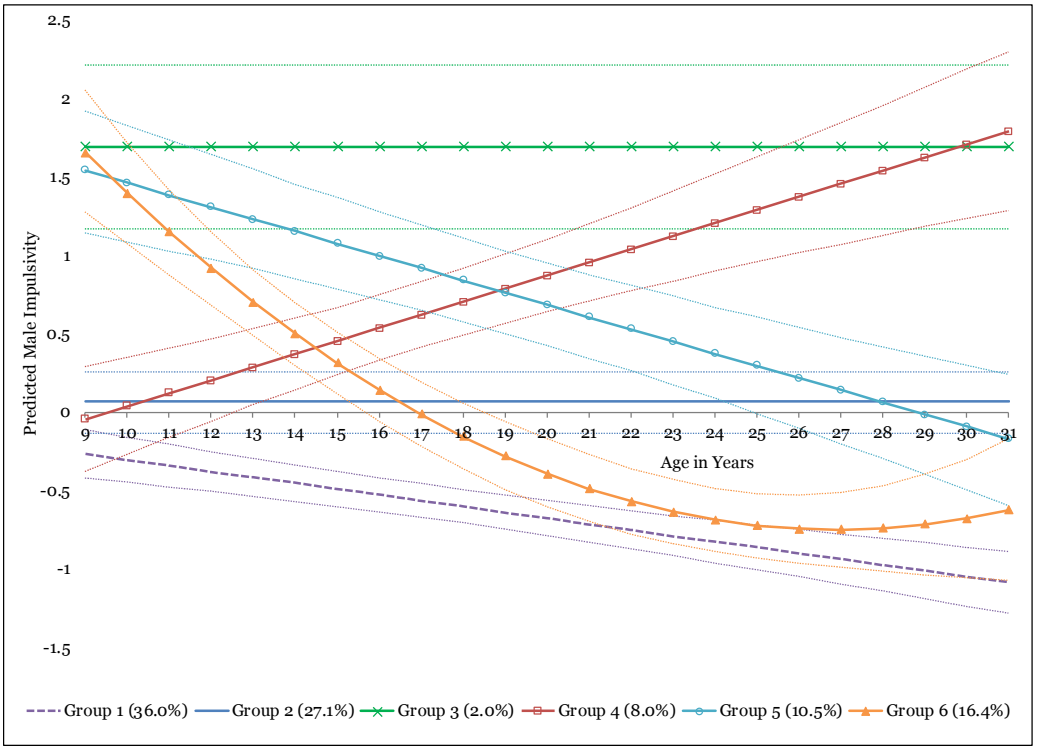


Figure 14. Alternate Male Sensation Seeking GBTM

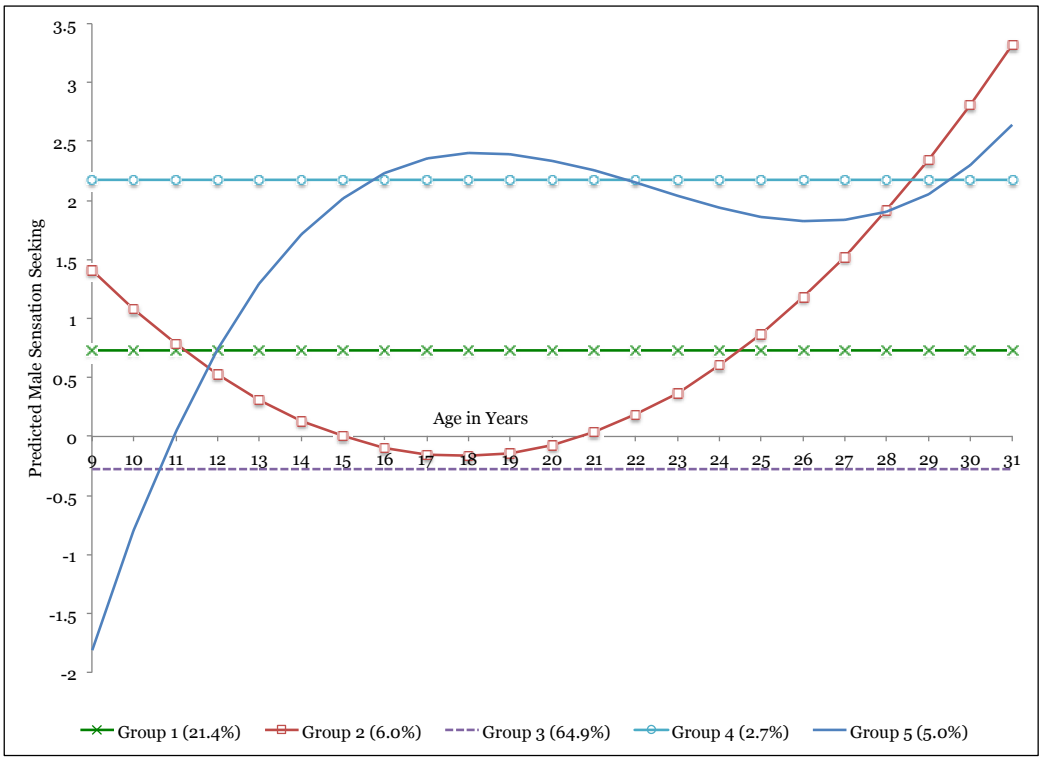
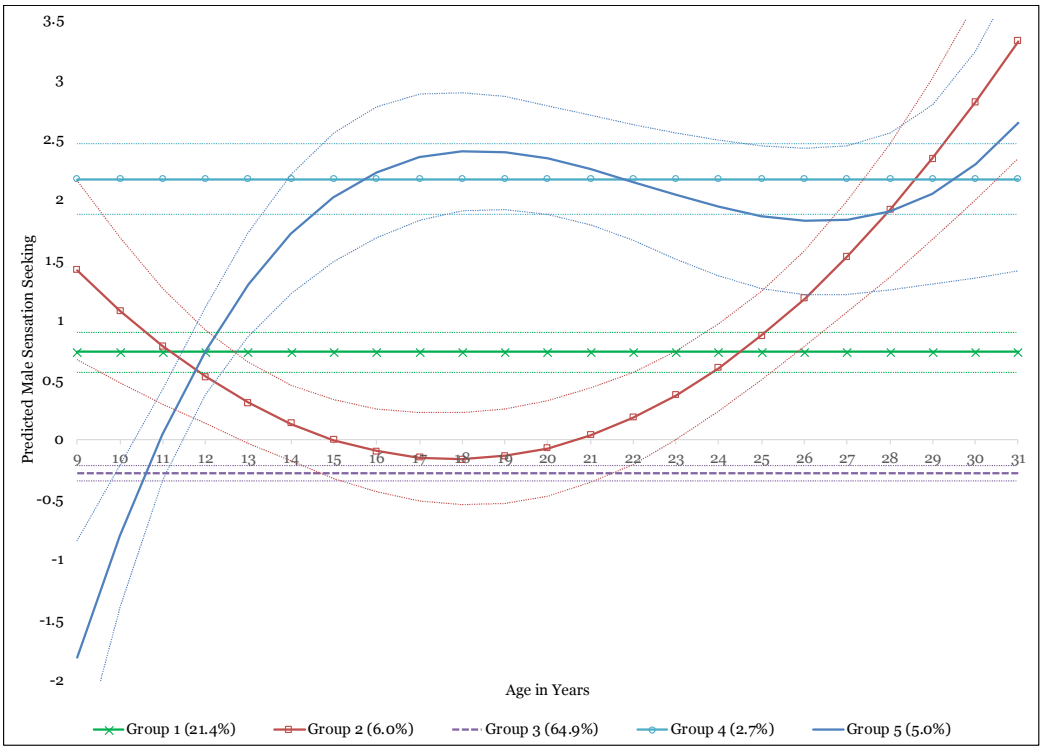


Figure 15. Alternate Male Sensation Seeking GBTM with Confidence Intervals



APPENDIX F

SENSITIVITY ANALYSES

PARENTING: AGE INTERACTIONS, IMPULSIVITY

imp	Coef.	Std. Err.	z	P>|z|	[95% Conf. Interval]	
age2	-.0041291	.0008704	-4.74	0.000	-.0058351	-.0024231
age3	.0001484	.0000262	5.66	0.000	.000097	.0001997
cmmorbmort	.0092842	.0175163	0.53	0.596	-.0250471	.0436155
wmorbmort	-.0040854	.0060427	-0.68	0.499	-.0159289	.0077581
cmnghcrime	-.0515261	.0321485	-1.60	0.109	-.114536	.0114838
wnghcrime	.021105	.0124898	1.69	0.091	-.0033746	.0455847
cmracdisc	.0102762	.0206333	0.50	0.618	-.0301642	.0507166
wracdisc	.0370301	.0107342	3.45	0.001	.0159914	.0580687
cmrphostility	.0201445	.0591974	0.34	0.734	-.0958803	.1361693
wrphostility	.036968	.0169176	2.19	0.029	.00381	.0701259
cmrpwarm	-.0357563	.0342086	-1.05	0.296	-.102804	.0312913
wrpwarm	-.0093218	.010638	-0.88	0.381	-.0301719	.0115283
mERP	-.0259755	.09286	-0.28	0.780	-.2079778	.1560268
wERP	-.0081878	.0285567	-0.29	0.774	-.0641579	.0477823
age9c	.0128118	.0079861	1.60	0.109	-.0028407	.0284644
cmpchost	.2557222	.0442191	5.78	0.000	.1690545	.34239
c.age9c##c.cmpchost	-.0030346	.0033869	-0.90	0.370	-.0096728	.0036035
wpchost	.1024429	.0235402	4.35	0.000	.056305	.1485808
c.age9c##c.wpchost	-.0043005	.0020619	-2.09	0.037	-.0083416	-.0002593
cmpcwarm	-.0629482	.0248148	-2.54	0.011	-.1115843	-.0143122
c.age9c##c.cmpcwarm	.0017139	.0018507	0.93	0.354	-.0019135	.0053413
wpcwarm	-.1014401	.0155161	-6.54	0.000	-.1318512	-.071029
c.age9c##c.wpcwarm	.0059377	.00128	4.64	0.000	.0034289	.0084465
mEPC	.0511562	.0859316	0.60	0.552	-.1172666	.2195789
wEPC	.0592537	.040442	1.47	0.143	-.0200112	.1385185
cmdevpeer	.3095838	.0386308	8.01	0.000	.2338688	.3852988
wdevpeer	.1021794	.0167208	6.11	0.000	.0694072	.1349516
SESproxy	.0256947	.0105958	2.42	0.015	.0049274	.0464621
_cons	1.670768	.0655561	25.49	0.000	1.54228	1.799255

PARENTING; AGE INTERACTIONS, SENSATION SEEKING

ss	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
cmmorbmort	-.0593463	.0249687	-2.38	0.017	-.108284	-.0104086
wmorbmort	.004228	.0086445	0.49	0.625	-.0127148	.0211708
cmnghcrime	.0113911	.0454765	0.25	0.802	-.0777412	.1005233
wnghcrime	.0234104	.0177747	1.32	0.188	-.0114273	.0582481
cmracdisc	.0655098	.0294217	2.23	0.026	.0078443	.1231752
wracdisc	.0774639	.0151609	5.11	0.000	.0477491	.1071787
cmrphostility	.0854763	.0843955	1.01	0.311	-.0799359	.2508885
wrphostility	.0366045	.0244374	1.50	0.134	-.0112918	.0845008
cmrpwarm	.0460198	.0489713	0.94	0.347	-.0499621	.1420017
wrpwarm	.0257586	.0152857	1.69	0.092	-.0042008	.055718
mERP	.2630253	.132782	1.98	0.048	.0027774	.5232732
wERP	.1090118	.0410967	2.65	0.008	.0284637	.1895599
age9c	-.0006594	.0014175	-0.47	0.642	-.0034377	.0021189
cmpchost	.0143071	.056129	0.25	0.799	-.0957037	.1243179
c.age9c#c.cmpchost	.0071085	.0044284	1.61	0.108	-.001571	.0157881
wpchost	.0937353	.0327621	2.86	0.004	.0295228	.1579478
c.age9c#c.wpchost	-.0026846	.0028886	-0.93	0.353	-.0083461	.0029769
cmpcwarm	-.082947	.0317194	-2.62	0.009	-.1451159	-.020778
c.age9c#c.cmpcwarm	.0026683	.0024284	1.10	0.272	-.0020912	.0074278
wpcwarm	-.059745	.0216841	-2.76	0.006	-.1022451	-.0172449
c.age9c#c.wpcwarm	.0024807	.001819	1.36	0.173	-.0010845	.0060459
mEPC	-.0375534	.1242221	-0.30	0.762	-.2810243	.2059175
wEPC	-.077464	.0575516	-1.35	0.178	-.1902631	.035335
cmdevpeer	.468011	.0550261	8.51	0.000	.3601618	.5758603
wdevpeer	.1427681	.0233078	6.13	0.000	.0970856	.1884506
SESproxy	.0436267	.0151131	2.89	0.004	.0140056	.0732477
_cons	1.274918	.0911184	13.99	0.000	1.09633	1.453507

PARENTING: WAVES>4, IMPULSIVITY

imp	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
age9c	-.1278684	.2087634	-0.61	0.540	-.5370372	.2813004
age2	.0044285	.0133231	0.33	0.740	-.0216843	.0305412
age3	-.0000229	.0002786	-0.08	0.934	-.000569	.0005231
cmmorbmort	.0352974	.0224467	1.57	0.116	-.0086973	.0792922
wmorbmort	-.0026867	.0087015	-0.31	0.758	-.0197412	.0143679
cmnghcrime	-.0716187	.0424243	-1.69	0.091	-.1547689	.0115314
wnghcrime	.0165363	.0187853	0.88	0.379	-.0202822	.0533549
cmracdisc	.0096074	.026351	0.36	0.715	-.0420396	.0612544
wracdisc	.026489	.0160411	1.65	0.099	-.0049509	.0579288
cmrphostility	.1109986	.0771774	1.44	0.150	-.0402664	.2622636
wrphostility	.021787	.0210856	1.03	0.301	-.0195401	.0631141
cmrpwarm	-.084515	.0441966	-1.91	0.056	-.1711387	.0021087
wrpwarm	-.0053929	.0126094	-0.43	0.669	-.0301068	.0193211
mERP	-.1505433	.120779	-1.25	0.213	-.3872658	.0861791
wERP	.0158612	.0340607	0.47	0.641	-.0508966	.0826191
cmpchost	.1923507	.0395642	4.86	0.000	.1148064	.2698951
wpchost	.0370818	.0182022	2.04	0.042	.0014061	.0727576
cmpcwarm	-.0354544	.0222822	-1.59	0.112	-.0791268	.008218
wpcwarm	-.009329	.0114525	-0.81	0.415	-.0317754	.0131174
mEPC	.0524792	.1110088	0.47	0.636	-.1650941	.2700526
wEPC	.048508	.047514	1.02	0.307	-.0446178	.1416338
cmdevpeer	.3130537	.0503758	6.21	0.000	.214319	.4117883
wdevpeer	.0857904	.0258501	3.32	0.001	.035125	.1364557
SESproxy	.0264953	.0134948	1.96	0.050	.0000459	.0529447
_cons	2.515462	1.078435	2.33	0.020	.4017687	4.629156

PARENTING: WAVES>4, SENSATION SEEKING

ss	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
age9c	-.0020501	.0028882	-0.71	0.478	-.007711	.0036107
cmmorbmort	-.0442933	.0318426	-1.39	0.164	-.1067037	.018117
wmorbmort	-.0001133	.0124722	-0.01	0.993	-.0245584	.0243318
cmnghcrime	-.0477936	.0597871	-0.80	0.424	-.1649743	.069387
wnghcrime	.0263242	.0269923	0.98	0.329	-.0265798	.0792282
cmracdisc	.1051241	.0372956	2.82	0.005	.032026	.1782221
wracdisc	.0860209	.0232085	3.71	0.000	.0405331	.1315087
cmrphostility	-.0631635	.1095183	-0.58	0.564	-.2778154	.1514885
wrphostility	.0435784	.0303775	1.43	0.151	-.0159604	.1031173
cmrpwarm	.0057134	.0626712	0.09	0.927	-.11712	.1285467
wrpwarm	.0198704	.0181863	1.09	0.275	-.0157741	.0555149
mERP	.1165722	.171413	0.68	0.496	-.2193911	.4525355
wERP	.082466	.049042	1.68	0.093	-.0136545	.1785865
cmpchost	.1325895	.0561087	2.36	0.018	.0226184	.2425605
wpchost	.0560262	.0260965	2.15	0.032	.004878	.1071743
cmpcwarm	-.045662	.0315032	-1.45	0.147	-.1074073	.0160832
wpcwarm	-.0204579	.0165403	-1.24	0.216	-.0528762	.0119604
mEPC	.0020389	.1575379	0.01	0.990	-.3067298	.3108076
wEPC	-.0842961	.0686127	-1.23	0.219	-.2187744	.0501823
cmdevpeer	.5237335	.0714308	7.33	0.000	.3837317	.6637352
wdevpeer	.0762323	.0368378	2.07	0.039	.0040316	.1484329
SESproxy	.0366421	.0191046	1.92	0.055	-.0008023	.0740865
_cons	1.403127	.1239187	11.32	0.000	1.16025	1.646003

PARENTING: LEAVE MISSING, IMPULSIVITY

imp	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
age9c	.0235791	.0093127	2.53	0.011	.0053265	.0418317
age2	-.0047157	.0008855	-5.33	0.000	-.0064513	-.0029802
age3	.0001596	.000027	5.91	0.000	.0001066	.0002126
cmmorbmort	.0055625	.0175973	0.32	0.752	-.0289276	.0400526
wmorbmort	-.004624	.0061991	-0.75	0.456	-.0167741	.007526
cmnghcrime	-.0549121	.0326036	-1.68	0.092	-.118814	.0089898
wnghcrime	.0224074	.0127526	1.76	0.079	-.0025874	.0474021
cmracdisc	.0122004	.0207688	0.59	0.557	-.0285056	.0529064
wracdisc	.0392038	.0110585	3.55	0.000	.0175295	.0608781
cmrphostility	-.0012133	.0597033	-0.02	0.984	-.1182297	.115803
wrphostility	.0294867	.0173918	1.70	0.090	-.0046006	.0635739
cmrpwarm	-.0297105	.0345056	-0.86	0.389	-.0973402	.0379192
wrpwarm	-.0032907	.0110449	-0.30	0.766	-.0249383	.0183568
mERP	-.0147821	.0934573	-0.16	0.874	-.197955	.1683908
wERP	-.0039169	.0296538	-0.13	0.895	-.0620373	.0542035
RPmiss	.0424369	.0334935	1.27	0.205	-.0232092	.108083
cmpcwarmM	-.046476	.0170847	-2.72	0.007	-.0799613	-.0129907
wpcwarmM	-.039355	.0083113	-4.74	0.000	-.0556449	-.0230651
cmpchostM	.2144025	.0296316	7.24	0.000	.1563257	.2724794
wpchostM	.0638722	.0126374	5.05	0.000	.0391033	.0886412
cmdevpeer	.3103115	.0388644	7.98	0.000	.2341387	.3864844
wdevpeer	.1123037	.0170971	6.57	0.000	.0787941	.1458133
SESproxy	.025461	.0106602	2.39	0.017	.0045673	.0463546
_cons	1.595838	.0783309	20.37	0.000	1.442313	1.749364

PARENTING: LEAVE MISSING, SENSATION SEEKING

---

ss	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
age9c	.0010817	.0022185	0.49	0.626	-.0032664	.0054299
cmmorbmort	-.0570938	.0251604	-2.27	0.023	-.1064074	-.0077803
wmorbmort	.0064826	.0088617	0.73	0.464	-.0108861	.0238512
cmnghcrime	.0127524	.0462164	0.28	0.783	-.07783	.1033348
wnghcrime	.0170141	.0181182	0.94	0.348	-.0184969	.0525251
cmracdisc	.0644753	.0297877	2.16	0.030	.0060926	.1228581
wracdisc	.0827083	.0156017	5.30	0.000	.0521295	.1132872
cmrphostility	.0728084	.0854876	0.85	0.394	-.0947441	.240361
wrphostility	.0340667	.025088	1.36	0.174	-.0151049	.0832384
cmrpwarm	.0349452	.049681	0.70	0.482	-.0624278	.1323183
wrpwarm	.0196268	.0158683	1.24	0.216	-.0114745	.0507281
mERP	.2259724	.1344584	1.68	0.093	-.0375613	.4895061
wERP	.084635	.0426615	1.98	0.047	.0010201	.1682499
RPmiss	.0301812	.0275945	1.09	0.274	-.0239029	.0842654
cmpcwarmM	-.0587	.0244845	-2.40	0.017	-.1066889	-.0107112
wpcwarmM	-.0332926	.0118081	-2.82	0.005	-.0564361	-.0101491
cmpchostM	.0783158	.0422601	1.85	0.064	-.0045125	.1611442
wpchostM	.0698566	.017947	3.89	0.000	.0346811	.1050321
cmdevpeer	.462649	.0556631	8.31	0.000	.3535513	.5717467
wdevpeer	.1524298	.0240426	6.34	0.000	.105307	.1995525
SESproxy	.0454128	.0152886	2.97	0.003	.0154478	.0753779
_cons	1.268344	.0959867	13.21	0.000	1.080213	1.456474

ROMANTIC PARTNER: WAVES>2, IMPULSIVITY

imp	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
age9c	.1000439	.0740108	1.35	0.176	-.0450146	.2451025
age2	-.0098893	.0052844	-1.87	0.061	-.0202464	.0004679
age3	.0002709	.0001211	2.24	0.025	.0000334	.0005083
cmmorbmort	.0240393	.020241	1.19	0.235	-.0156324	.0637109
wmorbmort	-.0042074	.0072625	-0.58	0.562	-.0184415	.0100268
cmnghcrime	-.0854261	.0376415	-2.27	0.023	-.1592021	-.01165
wnghcrime	.0040806	.0155996	0.26	0.794	-.0264941	.0346553
cmracdisc	.0115792	.0239162	0.48	0.628	-.0352957	.0584541
wracdisc	.03906	.0131062	2.98	0.003	.0133724	.0647477
cmrphostility	.0743241	.0692375	1.07	0.283	-.0613789	.2100271
wrphostility	.03518	.0170107	2.07	0.039	.0018395	.0685204
cmrpwarm	-.0686916	.0399341	-1.72	0.085	-.1469611	.0095779
wrpwarm	-.0085096	.0105269	-0.81	0.419	-.029142	.0121229
mERP	-.0902359	.1085316	-0.83	0.406	-.302954	.1224822
wERP	-.0126938	.0282901	-0.45	0.654	-.0681413	.0427537
cmpchost	.2084858	.0356016	5.86	0.000	.138708	.2782635
wpchost	.0500357	.0150097	3.33	0.001	.0206172	.0794541
cmpcwarm	-.0414105	.0201945	-2.05	0.040	-.080991	-.00183
wpcwarm	-.0150998	.0094986	-1.59	0.112	-.0337168	.0035172
mEPC	-.0074359	.0994722	-0.07	0.940	-.2023978	.187526
wEPC	.0682457	.0405992	1.68	0.093	-.0113274	.1478188
cmdevpeer	.2835959	.0451149	6.29	0.000	.1951723	.3720194
wdevpeer	.0723717	.0203419	3.56	0.000	.0325024	.112241
SESproxy	.024973	.0122542	2.04	0.042	.0009552	.0489908
_cons	1.294342	.3421416	3.78	0.000	.6237568	1.964927

ROMANTIC PARTNER: WAVES>2, SENSATION SEEKING

ss	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
age9c	.0020586	.0023322	0.88	0.377	-.0025124	.0066297
cmmorbmort	-.0733274	.0304715	-2.41	0.016	-.1330504	-.0136044
wmorbmort	.0034909	.0106455	0.33	0.743	-.0173738	.0243556
cmnghcrime	-.0301247	.0567891	-0.53	0.596	-.1414293	.0811799
wnghcrime	.0216745	.0228948	0.95	0.344	-.0231984	.0665475
cmracdisc	.1213086	.0360045	3.37	0.001	.0507411	.191876
wracdisc	.0898386	.0192243	4.67	0.000	.0521597	.1275175
cmrphostility	.0405211	.1043162	0.39	0.698	-.1639349	.2449772
wrphostility	.0331219	.0248964	1.33	0.183	-.0156741	.0819179
cmrpwarm	.0400653	.0602453	0.67	0.506	-.0780134	.158144
wrpwarm	.0168098	.0154647	1.09	0.277	-.0135005	.0471201
mERP	.2533467	.1636629	1.55	0.122	-.0674266	.57412
wERP	.0768564	.041547	1.85	0.064	-.0045742	.1582869
cmpchost	.104471	.0536121	1.95	0.051	-.0006068	.2095488
wpchost	.0710843	.0220398	3.23	0.001	.0278872	.1142815
cmpcwarm	-.0393173	.0304177	-1.29	0.196	-.098935	.0203004
wpcwarm	-.0188214	.0139196	-1.35	0.176	-.0461033	.0084606
mEPC	.0129709	.1497777	0.09	0.931	-.280588	.3065298
wEPC	-.0838525	.0600113	-1.40	0.162	-.2014724	.0337674
cmdevpeer	.4706163	.0679517	6.93	0.000	.3374333	.6037993
wdevpeer	.1231708	.0291941	4.22	0.000	.0659514	.1803902
SESproxy	.0357102	.0184511	1.94	0.053	-.0004534	.0718738
_cons	1.250236	.1155146	10.82	0.000	1.023832	1.476641

ROMANTIC PARNTER, LEAVE MISSING, IMPULSIVITY

imp	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
age9c	-.0182253	.1003679	-0.18	0.856	-.2149426	.1784921
age2	-.0020526	.0071289	-0.29	0.773	-.0160251	.0119198
age3	.000103	.0001626	0.63	0.526	-.0002157	.0004218
cmmorbmort	.0332026	.0235487	1.41	0.159	-.0129521	.0793573
wmorbmort	.0014588	.0096128	0.15	0.879	-.0173819	.0202996
cmnghcrime	-.0344798	.0445739	-0.77	0.439	-.1218431	.0528835
wnghcrime	.0186359	.0208244	0.89	0.371	-.0221792	.0594509
cmracdisc	.0003436	.0276772	0.01	0.990	-.0539028	.05459
wracdisc	.0176191	.0178345	0.99	0.323	-.017336	.0525742
cmrphostilityM	.0840798	.0300187	2.80	0.005	.0252443	.1429152
wrphostilityM	.0345242	.0198384	1.74	0.082	-.0043584	.0734067
cmrpwarmM	-.0146707	.0177897	-0.82	0.410	-.0495378	.0201965
wrpwarmM	-.0261274	.0124316	-2.10	0.036	-.050493	-.0017618
cmpchost	.1750075	.0416427	4.20	0.000	.0933893	.2566258
wpchost	.0310405	.0202535	1.53	0.125	-.0086557	.0707367
cmpcwarm	-.0708486	.023769	-2.98	0.003	-.1174349	-.0242622
wpcwarm	-.01978	.0128415	-1.54	0.123	-.0449489	.0053888
mEPC	-.11945	.1135359	-1.05	0.293	-.3419762	.1030762
wEPC	.0676237	.0549581	1.23	0.219	-.0400923	.1753396
cmdevpeer	.2431512	.052953	4.59	0.000	.1393652	.3469373
wdevpeer	.0564766	.0282643	2.00	0.046	.0010796	.1118736
SESproxy	.0335531	.0142046	2.36	0.018	.0057126	.0613937
_cons	1.80429	.4550394	3.97	0.000	.9124294	2.696151

ROMANTIC PARTNER, LEAVE MISSING, SENSATION SEEKING

ss	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
age9c	.0020949	.0029029	0.72	0.471	-.0035948	.0077846
cmmorbmort	-.0707598	.0356088	-1.99	0.047	-.1405517	-.0009679
wmorbmort	.0315027	.0138604	2.27	0.023	.0043367	.0586686
cmnghcrime	-.0125523	.0673927	-0.19	0.852	-.1446396	.1195351
wnghcrime	.0393936	.0300802	1.31	0.190	-.0195625	.0983496
cmracdisc	.0834688	.0419303	1.99	0.047	.0012868	.1656507
wracdisc	.092819	.0256102	3.62	0.000	.0426238	.1430141
cmrphostilityM	.0519543	.0452473	1.15	0.251	-.0367288	.1406374
wrphostilityM	.0317226	.0283638	1.12	0.263	-.0238695	.0873147
cmrpwarmM	.0357525	.0268693	1.33	0.183	-.0169104	.0884154
wrpwarmM	.0174481	.0177597	0.98	0.326	-.0173603	.0522564
cmpchost	.0657794	.063076	1.04	0.297	-.0578473	.1894061
wpchost	.0517159	.0291749	1.77	0.076	-.0054659	.1088976
cmpcwarm	-.0383189	.0360161	-1.06	0.287	-.1089092	.0322715
wpcwarm	-.0268249	.0185127	-1.45	0.147	-.0631091	.0094594
mEPC	-.0029842	.1716118	-0.02	0.986	-.3393371	.3333686
wEPC	-.1561446	.0792892	-1.97	0.049	-.3115485	-.0007407
cmdevpeer	.5596745	.0801578	6.98	0.000	.4025681	.716781
wdevpeer	.1074923	.0401137	2.68	0.007	.028871	.1861137
SESproxy	.0440311	.0215371	2.04	0.041	.0018192	.086243
_cons	1.376899	.0502468	27.40	0.000	1.278417	1.475381

ROMANTIC PARTNER: HAPPINESS SCALE, IMPULSIVITY

imp	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
age9c	.0230658	.0092879	2.48	0.013	.0048618	.0412698
age2	-.0045754	.0008731	-5.24	0.000	-.0062867	-.0028641
age3	.000154	.0000264	5.83	0.000	.0001022	.0002059
cmmorbmort	.0088303	.0175789	0.50	0.615	-.0256236	.0432842
wmorbmort	-.0053349	.0060736	-0.88	0.380	-.0172389	.0065691
cmnghcrime	-.0511903	.0323331	-1.58	0.113	-.114562	.0121813
wnghcrime	.0219632	.0125434	1.75	0.080	-.0026213	.0465477
cmracdisc	.009379	.0207736	0.45	0.652	-.0313365	.0500945
wracdisc	.0404774	.0108427	3.73	0.000	.0192261	.0617287
cmrpfull	-.0222634	.0179232	-1.24	0.214	-.0573923	.0128655
wrpfull	-.0032259	.0050806	-0.63	0.525	-.0131836	.0067319
mERP	.0201793	.0407107	0.50	0.620	-.0596122	.0999708
wERP	-.0096783	.0137149	-0.71	0.480	-.036559	.0172024
RPmiss	.0452664	.033327	1.36	0.174	-.0200534	.1105863
cmpchost	.2222758	.030344	7.33	0.000	.1628027	.281749
wpchost	.0636053	.0125028	5.09	0.000	.0391003	.0881103
cmpcwarm	-.0433829	.0173743	-2.50	0.013	-.077436	-.0093298
wpcwarm	-.0389418	.0082486	-4.72	0.000	-.0551088	-.0227749
mEPC	-.0089598	.0848734	-0.11	0.916	-.1753086	.1573889
wEPC	.0251565	.0382243	0.66	0.510	-.0497616	.1000747
cmdevpeer	.3181688	.0379848	8.38	0.000	.24372	.3926175
wdevpeer	.1082801	.0167774	6.45	0.000	.0753969	.1411632
SESproxy	.0264424	.0106638	2.48	0.013	.0055417	.047343
_cons	1.570492	.0554541	28.32	0.000	1.461804	1.67918

ROMANTIC PARTNER: HAPPINESS SCALE, SENSATION SEEKING

ss	Coef.	Std. Err.	z	P>|z|	[95% Conf. Interval]	
age9c	.0012267	.00217	0.57	0.572	-.0030264	.0054798
cmmorbmort	-.0586358	.0249474	-2.35	0.019	-.1075319	-.0097398
wmorbmort	.002605	.0086691	0.30	0.764	-.0143861	.0195962
cmnghcrime	.0102412	.0455305	0.22	0.822	-.0789969	.0994793
wnghcrime	.0216551	.0178049	1.22	0.224	-.0132419	.056552
cmracdisc	.0634777	.0295001	2.15	0.031	.0056586	.1212968
wracdisc	.0817271	.0153076	5.34	0.000	.0517246	.1117295
cmrpfull	-.0089238	.0254768	-0.35	0.726	-.0588575	.0410099
wrpfull	.0035891	.0072909	0.49	0.623	-.0107007	.0178789
mERP	.1085256	.0577763	1.88	0.060	-.0047138	.221765
wERP	.0367619	.0196805	1.87	0.062	-.0018111	.0753349
RPmiss	.027188	.0270512	1.01	0.315	-.0258314	.0802074
cmpchost	.0719501	.043049	1.67	0.095	-.0124243	.1563245
wpchost	.0726959	.0177329	4.10	0.000	.03794	.1074518
cmpcwarm	-.0544404	.024674	-2.21	0.027	-.1028006	-.0060802
wpcwarm	-.0342765	.0117101	-2.93	0.003	-.0572279	-.011325
mEPC	-.0598286	.1216273	-0.49	0.623	-.2982136	.1785565
wEPC	-.1110677	.0537479	-2.07	0.039	-.2164117	-.0057237
cmdevpeer	.476485	.0539175	8.84	0.000	.3708087	.5821613
wdevpeer	.1499112	.0235787	6.36	0.000	.1036979	.1961246
SESproxy	.0433487	.0151467	2.86	0.004	.0136617	.0730357
_cons	1.348012	.0526115	25.62	0.000	1.244895	1.451129

FULL SAMPLE: DECOMPOSED MORB/MORT

ss	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
age9c	.001427	.0021637	0.66	0.510	-.0028138	.0056678
cmdeath	-.1114389	.0405684	-2.75	0.006	-.1909516	-.0319262
wdeath	.0113248	.0129597	0.87	0.382	-.0140758	.0367254
cmillness	.0594586	.0596255	1.00	0.319	-.0574053	.1763224
willness	.0037327	.0191242	0.20	0.845	-.03375	.0412153
cmvictim	-.0854439	.059689	-1.43	0.152	-.2024321	.0315443
wvictim	-.0108822	.0178958	-0.61	0.543	-.0459574	.024193
cmnghcrime	.0147312	.0455895	0.32	0.747	-.0746227	.104085
wnghcrime	.0218178	.017785	1.23	0.220	-.0130402	.0566757
cmracdisc	.0673413	.0293644	2.29	0.022	.0097881	.1248944
wracdisc	.0792571	.0152901	5.18	0.000	.0492891	.1092251
cmrphostility	.0679035	.0844732	0.80	0.421	-.097661	.233468
wrphostility	.0374405	.0243425	1.54	0.124	-.0102699	.0851509
cmrpwarm	.0423123	.0488762	0.87	0.387	-.0534833	.1381079
wrpwarm	.0264898	.0152526	1.74	0.082	-.0034048	.0563845
mERP	.2389681	.1327696	1.80	0.072	-.0212554	.4991917
wERP	.1047434	.0410275	2.55	0.011	.024331	.1851559
RPmiss	.0291865	.0270481	1.08	0.281	-.0238268	.0821998
cmpchost	.0638731	.0435502	1.47	0.142	-.0214838	.14923
wpchost	.0695166	.0177062	3.93	0.000	.0348132	.1042201
cmpcwarm	-.0574144	.0249517	-2.30	0.021	-.1063187	-.0085101
wpcwarm	-.0330865	.011665	-2.84	0.005	-.0559495	-.0102236
mEPC	-.0741644	.1216139	-0.61	0.542	-.3125232	.1641944
wEPC	-.1107176	.0535776	-2.07	0.039	-.2157278	-.0057074
cmdevpeer	.474628	.0553008	8.58	0.000	.3662405	.5830155
wdevpeer	.1453666	.0235488	6.17	0.000	.0992117	.1915215
SESproxy	.0429358	.0151025	2.84	0.004	.0133355	.0725361
_cons	1.261059	.0946213	13.33	0.000	1.075604	1.446513

MALE: DECOMPOSED MORB/MORT

ss	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
age9c	.0052482	.0036986	1.42	0.156	-.002001	.0124973
cmdeath	-.2270158	.0664307	-3.42	0.001	-.3572177	-.096814
wdeath	.0287148	.0220797	1.30	0.193	-.0145607	.0719902
cmillness	.0370947	.094219	0.39	0.694	-.1475711	.2217605
willness	.0035626	.0302055	0.12	0.906	-.0556391	.0627643
cmvictim	-.0591875	.1020677	-0.58	0.562	-.2592364	.1408615
wvictim	.0292294	.0308794	0.95	0.344	-.0312931	.0897518
cmnghcrime	.0163687	.0696803	0.23	0.814	-.1202023	.1529396
wnghcrime	.0420713	.0279828	1.50	0.133	-.0127739	.0969165
cmracdisc	.084993	.0485691	1.75	0.080	-.0102007	.1801867
wracdisc	.0783753	.023207	3.38	0.001	.0328904	.1238602
cmrphostility	.012384	.1267904	0.10	0.922	-.2361205	.2608886
wrphostility	.0170138	.0373589	0.46	0.649	-.0562083	.0902359
cmrpwarm	.0359076	.0869999	0.41	0.680	-.134609	.2064242
wrpwarm	.0220032	.0257462	0.85	0.393	-.0284584	.0724648
mERP	.1181945	.2329056	0.51	0.612	-.3382921	.5746811
wERP	.0381839	.0695926	0.55	0.583	-.0982151	.1745829
RPmiss	.0761376	.045119	1.69	0.092	-.012294	.1645692
cmpchost	.0984535	.078535	1.25	0.210	-.0554722	.2523792
wpchost	.0835922	.0285869	2.92	0.003	.0275628	.1396215
cmpcwarm	-.0128227	.0439641	-0.29	0.771	-.0989907	.0733453
wpcwarm	-.0303898	.0191882	-1.58	0.113	-.0679979	.0072183
mEPC	.2254414	.2329029	0.97	0.333	-.2310399	.6819228
wEPC	-.1451362	.0997901	-1.45	0.146	-.3407213	.0504489
cmdevpeer	.3801276	.0902511	4.21	0.000	.2032386	.5570165
wdevpeer	.1500536	.0365657	4.10	0.000	.0783862	.2217211
SESproxy	.032286	.025484	1.27	0.205	-.0176618	.0822338
_cons	1.333889	.1683478	7.92	0.000	1.003934	1.663845

FEMALE: DECOMPOSED MORB/MORT

ss	Coef.	Std. Err.	z	P>|z|	[95% Conf. Interval]	
age9c	-.0012882	.0026298	-0.49	0.624	-.0064425	.0038661
cmdeath	-.0168272	.0488856	-0.34	0.731	-.1126412	.0789869
wdeath	-.0011405	.0156971	-0.07	0.942	-.0319061	.0296252
cmillness	.0763071	.0751638	1.02	0.310	-.0710113	.2236255
willness	.0024861	.0245728	0.10	0.919	-.0456758	.050648
cmvictim	-.0856958	.0707152	-1.21	0.226	-.224295	.0529033
wvictim	-.0362178	.0214933	-1.69	0.092	-.0783438	.0059082
cmnghcrime	.028613	.0587602	0.49	0.626	-.0865566	.1437793
wnghcrime	.0056948	.0228056	0.25	0.803	-.0390034	.050393
cmracdisc	.0511713	.0355535	1.44	0.150	-.0185123	.120855
wracdisc	.0779604	.0205302	3.80	0.000	.0377219	.1181989
cmrphostility	-.0764899	.1245602	-0.61	0.539	-.3206233	.1676435
wrphostility	.038495	.033144	1.16	0.245	-.026466	.103456
cmrpwarm	.0336078	.0560941	0.60	0.549	-.0763346	.1435503
wrpwarm	.0237605	.0186621	1.27	0.203	-.0128165	.0603375
mERP	.2137349	.1564799	1.37	0.172	-.0929601	.5204299
wERP	.1311864	.0500529	2.62	0.009	.0330846	.2292881
RPmiss	-.0047743	.0334633	-0.14	0.887	-.0703611	.0608126
cmpchost	.0599752	.050751	1.18	0.237	-.039495	.1594454
wpchost	.0568085	.0224816	2.53	0.012	.0127453	.1008717
cmpcwarm	-.0780578	.0287981	-2.71	0.007	-.1345011	-.0216145
wpcwarm	-.0379274	.0146321	-2.59	0.010	-.0666058	-.009249
mEPC	-.1925275	.135654	-1.42	0.156	-.4584044	.0733495
wEPC	-.1080072	.0631376	-1.71	0.087	-.2317546	.0157402
cmdevpeer	.5353508	.0681812	7.85	0.000	.4017182	.6689834
wdevpeer	.1363267	.0305695	4.46	0.000	.0764115	.1962419
SESproxy	.052446	.0177197	2.96	0.003	.0177162	.0871759
_cons	1.27826	.109698	11.65	0.000	1.063256	1.493264