THE INFLUENCE OF FAMILY AND FRIENDS ON GIRLS’ DELINQUENCY: A SOCIAL NETWORK ANALYSIS

BY

LISA DE LA RUE

DISSEPTION

Submitted in partial fulfillment of the requirements
for the degree of Doctor of Philosophy in Educational Psychology
in the Graduate College of the
University of Illinois at Urbana-Champaign, 2015

Urbana, Illinois

Doctoral Committee:

Professor Dorothy L. Espelage, Chair and Director of Research
Professor Carolyn Anderson
Professor James Rounds
Research Associate Mark J. Van Ryzin, Oregon Social Learning Center
Abstract

This study builds on research that has been conducted around predictive factors of girls’ delinquency by applying social network methodology to principles of adolescent development. Peers are an integral aspect of adolescent development and therefore the influence of peer relationships serves as an important area of exploration in delinquency research. While studies have documented the influence of peers on delinquency, these studies have been limited in that they rely on individual level self-reports and do not take into account the socialization process of peers. This study utilized Social Network Analysis (SNA), a technique that enables researchers to examine this socialization process by disentangling the effects of peer selection and influence.

Participants included 401 students from a high school in Illinois. The sample includes youth who predominantly identify as African American (32.4%) or White (38.7%). The aims of this study were to identify risk and protective factors that correlate with self-reported delinquency for adolescent girls, including family, individual, and peer level factors and to investigate whether and how peer group socialization of female delinquency can be captured/understood through SNA. The analyses included a longitudinal regression analysis utilizing imputed data to examine risk and protective factors that correlate with delinquency behaviors, and a SNA to explore the social network of the students in order to distinguish the effects of friendship selection and influence on girls’ delinquency.

The findings of this study provide additional insight into the etiology of delinquency and suggest pathways by which prevention programs might be optimized. Results of the regression analysis demonstrate previous levels of delinquency and substance use, and current feelings of anger and hostility and lower levels of parental monitoring are risk factors for increased levels of
delinquency for girls. Furthermore, the SNA analysis revealed that peer selection is an important component of delinquency engagement for youth after accounting for levels of anger and hostility and parental monitoring. Specifically, youth tend to select individuals as friends that are engaging in similar levels of delinquency as themselves.

The results of this study suggest interventions focused on changing behavior may lead to positive changes in the social network. With significant selection effects, when youth desist from engaging in delinquent behavior, it can be expected they will affiliate with different peers, and perhaps, with those peers engaging in less delinquency. As such, interventions that address risk factors including feelings of anger and hostility, and work to increase protective factors like parental monitoring, may help youth manage their concerns and support young people in changing their behaviors and subsequently shifting their peer networks to include friends who are engaged in lower levels of delinquency.
Acknowledgements

I would first like to thank my advisor and mentor, Dorothy Espelage. I have been so privileged to be able to work with Dorothy on amazing projects throughout the years, and I am so thankful that she believed in me and included me on these endeavors. It is due to her guidance and support that I have been able to complete my doctoral degree, and for that I am forever grateful. I look forward to being able to continue to learn from her. I would also like to thank Carolyn Anderson for her constant support and mentoring. Her patience during difficult analyses, and her thoughtful guidance was a great help. She has taught me so much about quantitative analyses, and made me feel more comfortable in this realm. I would also like to thank Mark Van Ryzin and James Rounds for their support, feedback, and thoughts on this dissertation. I appreciate the time they devoted to helping me, and the feedback they gave to make this dissertation stronger. I would also like to thank Helen Neville, a constant support and nurturer during all of my doctoral training. I would also like to thank Dr. Meyers, my undergraduate mentor who put me on the path to be able to pursue my doctorate.

I would also like to thank my family, including my Mom, Demond, and Andrew. In a sense they have had to endure the doctoral training right along side me, and I am grateful for their unwavering support and encouragement. Without them I would not have been able to accomplish this goal. I would also like to thank my Aunt Jane and Uncle Judd, my Aunt Linda and all of my family for their love and support, and for believing in me.

Finally I would like to acknowledge the funding granted to Dr. Espelage that made this dissertation possible. This includes funding from the Center for Disease Control (#1U01/CE001677; Espelage, PI) and from the National Institute of Justice (#2011-90948-IL-IJ;
Espelage, PI). I am grateful for them believing in the work that Dr. Espelage does, and for providing the opportunity to complete dissertations like this.
# Table of Contents

Chapter 1: Introduction ........................................................................................................... 1

Chapter 2: Literature Review ................................................................................................ 7

Chapter 3: Methods ................................................................................................................. 17

Chapter 4: Results ................................................................................................................... 35

Chapter 5: Discussion .............................................................................................................. 41

References ............................................................................................................................ 54

Tables .................................................................................................................................. 66
Chapter 1

Introduction

Girls’ delinquency has become an increasing concern in part because little research to date has focused on female juvenile delinquency (Zahn, Hawkins, Chiancone, & Whitworth, 2008). Since 1991, arrest of girls increased more (or decreased less) than arrest of boys for most offenses. In 1998, girls made up 27% of the 1.5 million arrests of youth, and by 2007 girls constituted 29% of the 1.2 million youth arrested (Krisberg, 2009). While the literature on male delinquency is extensive, it is unclear to what extent the risk factors associated with male delinquency explains delinquency for girls (Zahn et al., 2010). Many early attempts to understand and address female delinquency were based on male only samples, and took an “add-women-and-stir” approach (Belknap, Holsinger, & Dunn, 1997). These efforts did not adequately address the needs or concerns presented by girls, nor did they result in significant reductions for girls’ delinquency. As a result, the U.S. Office of Juvenile Justice and Delinquency Prevention founded the Girls Study Group in 2004 to develop a comprehensive research foundation for understanding and responding to girls’ delinquency. This group identified the following factors as being strong influences on girls’ delinquency: family dynamics, school factors, the neighborhood, early puberty, sexual abuse or maltreatment, depression and anxiety, romantic partners, and religiosity (Zahn et al., 2008). Notably absent from this list is the role of peers, and how friends serve to influence adolescent behaviors.

Developmental researchers have long recognized that friends and peers are an important part of a young person’s life. Adolescents spend a majority of time in school with peers, and these peers become a source of significant influence, both positive and negative. Criminologists
have also recognized the importance of peers. One of the single strongest predictors of criminal behavior known to criminologists is the number of delinquent friends an individual has (McGloin & Kirk, 2010). Peer relationships may be especially powerful for young girls. Gender socialization during adolescence emphasizes interpersonal relationships for girls (Werner & Silbereisen, 2003), and several researchers have documented that relationships play a strong role in females’ social development (Graves, 2007). Studies have also demonstrated that antisocial peers serve as a significant risk factor for girls’ delinquency (Simourd & Andrews, 1994) and aggression (Graves, 2007). In fact, a meta-analysis of 60 studies exploring factors related to girls delinquency found the most important risk factor was antisocial peers (Simourd & Andrews, 1994).

**Friendship Networks**

Researchers have declared, for boys and girls, that the connection between peer delinquency and a respondent’s delinquency is due to individuals selecting their friends based on shared characteristics (Young, 2011). Several theories have been forwarded to explain this phenomenon, including the homophily hypothesis (Cairns & Cairns, 1994; Espelage, Holt, & Henkel, 2003; Friedkin, 1998). However, previous research has been limited as researchers were testing whether individual characteristics predict having delinquent friends by utilizing attribute data to explore delinquency. Attribute data include measures that relate to attitudes and behaviors that are regarded as qualities that belong to an individual or group (Scott, 2013). This can be contrasted with measures that examine the strength or structure of the social relationship itself, in other words measures of the friendship network. Thus, previous studies cannot account for the ability of a peer group to influence a friend’s behavior, despite the recognition that peers are
important. Social network analysis (SNA), however, is an analytic tool that can examine the strength and structure of a social relationship, allowing researchers to move beyond only analyzing shared characteristics, to also examining specific aspects of the social relationships of youth who are tied together by their friendships.

SNA involves the use of relational data, which concerns the contacts, ties, and connections that relate one person to another and which, cannot be reduced to individual characteristics or attributes (Scott, 2013). Social network data are naturally non-independent, in that individuals within a network tend to interact on a regular basis and are similar in ways that can bias results. In the context of this study, a SNA approach implies that although individual and familial risk and protective factors are important influences on delinquency (attribute data), the socialization of a peer group confounds this result (relational data). As such, by not taking into account the interaction between individual factors and peers, changes in behavior (i.e., delinquency) are not fully understood. Thus, it is critical to use an analysis framework that can represent interdependent change in behaviors and take into account dependencies among individuals in the peer group (Snijders & Bosker, 2012).

Aims of the Present Study

The first aim of this study was to identify risk and protective factors that correlate with self-reported delinquency for adolescent girls, including individual and family factors. This study utilized a high school sample of adolescents, and extended previous research by exploring how risk and protective factors influence changes in levels of delinquency over time. By examining how delinquency changes over time, a clearer picture can start to emerge regarding the role of risk and protective factors.
The second aim was to investigate whether and how peer group socialization of female delinquency can be captured/understood through SNA. This second aim identified if (i) girls with similar experiences (e.g., individual and family factors) select each other as friends and also have a propensity to engage in delinquent behaviors or (ii) if girls who engage in delinquent behaviors influence their friends to engage in similar behaviors. Indeed, it could be a combination of the selection and influence effects, which can be captured within the SNA.

The distinction between selection and influence is important and provides insight as to how individual characteristics may influence delinquency. While recent research has aided in our understanding of girls delinquency, the field continues to struggle with clearly identifying how delinquency progresses for girls, which has slowed the development of intervention programs. Given the importance of social relationships for girls, examining their peer networks serves as a promising avenue to understand the trajectory of girls’ delinquency. SNA serves to clarify if girls who engage in delinquent behaviors choose similar friends, and additionally if girls are influenced by their peer groups to engage in delinquent behaviors. This aim still considers the risk and protective factors frequently noted in the literature, as the attributes and experiences a girl brings with her are indeed important; however, it focuses on the socialization influence a peer group has as opposed to solely focusing on the characteristics of the group members.

**Summary**

Females under 18 years of age constitute a fast growing segment of juvenile justice populations (Leve & Chamberlin, 2004). It is generally accepted that an accumulation of risk factors, including family dysfunction and maltreatment (Kroneman, Loeber, & Hipwell, 2004) and a history of physical and/or sexual abuse (Graves, 2007; McKnight & Loper, 2002; Wright,
Friedrich, Cinq-Mars, Cyr, & McDuff, 2004) are associated with delinquency and other antisocial behaviors for girls. Associating with delinquent peers also poses a risk (Fagan, Van Horn, Hawkins, & Arthur, 2007; Liu, & Kaplan, 1999). Indeed, extensive scholarship has documented the strong influence of peers on the development and maintenance of delinquency, with many of these studies strengthened by their longitudinal designs (Espelage, Wasserman, & Fleisher, 2007). While the strong influence of peers has been repeatedly noted in the literature, many previous studies have been limited by how delinquency and peer relationships were assessed. Participants were often asked to identify the individuals who are a part of their primary social group, and were then asked to report on their own delinquent behaviors, as well as the delinquent behaviors of their friends (Elliot, Huizinga, & Ageton, 1985). This approach tends to provide self-enhancing data, and often results in high correlations between behaviors reported for self and others (Crosnoe, Erickson, & Dornbusch, 2002; Espelage et al., 2007), where youth report their friend’s delinquency to be very similar to their own levels of delinquency. Social network analysis provides an alternative approach by allowing each respondent to self-report on his or her own characteristics, and includes an analysis of how the broader social group serves to influence delinquent behavior.

Previous research utilizing SNA has expanded our understanding of the role of social influence on delinquency behaviors, including gang membership. SNA research with gang members has demonstrated that different types of violence result from different patterns of embeddness and shared relationships amongst members (Espelage et al., 2007). In other words, the more an individual is embedded in the gang, the greater the association with more violent behavior. Further, SNA research on mixed-sex delinquent groups has found evidence that older
males recruit girls, and those males hold a strong influence over the girls (Carrington, 2011). This body of research highlights the role that social networks can have in understanding the nature of behaviors. Given the interdependency among the behaviors of individuals in a social network, traditional analysis (e.g., regression) cannot account for this interdependency and will yield biased estimates (McGloin & Kirk, 2010). In contrast, SNA overcomes this limitation by modeling these interdependencies and explicitly examines the role of social relationships on delinquent behaviors.
Chapter 2

Literature Review

Girls' Delinquency

Adolescent girls commit less crime and engage in lower levels of delinquency than boys; however, it is important to evaluate the types of offenses each engage in. On the one hand, boys and girls commit similar types of offenses – adolescent boys and girls fight, steal, cheat, lie, vandalize, drink, use drugs, and engage in other delinquent acts (Schwartz & Steffensmeier, 2012). On the other hand, boys commit more severe offenses, they are more likely to be chronic offenders, and they engage in more visible forms of delinquency, including thefts of greater value, fights with greater victim injury, harder drug use and distribution, and greater predatory sexual deviance (Schwartz & Steffensmeier, 2012). As such, when less serious forms of delinquency and crime are considered the gap between boys and girls narrows.

Given that more boys are engaged in more serious forms of delinquency, much of the research focus has been on finding ways to address and prevent delinquency among boys. Despite this, there is an extensive body of literature that has explored antecedents and correlates of delinquency specific to girls. Literature reviews identified risk and protective factors for girls that span multiple domains (e.g., individual, family, community), with delinquency among girls increasing as risk factors increase. In an early meta-analysis, Simourd and Andrews (1994) found the strongest risk factors in descending order for females are antisocial peers or attitudes, temperament or misconduct problems, educational difficulties, poor parent-child relations, and minor personality variables. Although this review was conducted more than two decades ago, many of the same factors have been identified in more recent reviews. In a review of European
studies, significant individual, family, school and peer level factors were found to be related to
delinquency including internalizing problems, the social context, negative life events, and
physical abuse (Wong, Slotboom, & Bijleveld, 2010). A literature review for the Girls Study
Group, a federally funded project aimed at assessing the causes of girls’ delinquency, identified
risk factors that included associating with males, early onset puberty, neighborhood
disadvantage, and sexual assault victimization (Zahn, 2007). These authors also examined
protective factors, and found that school success and school attachment served as protective
variables for girls. Given that risk and protective factors span across multiple contexts it is
important to consider the multiple systems in which girls reside. Within the present study, the
risk and protective factors associated with girls’ delinquency at the individual and family level
are discussed, and then considered in conjunction with the peer network.

**Individual level factors**

Individual level factors include personality characteristics, attitudes and mental health
concerns. Mental health concerns have been found to be associated with a wide range of problem
behavior for girls. For instance, depression serves as a risk for delinquency (Wong et al., 2010)
with girls suffering from depression more likely to commit property crimes, crimes against other
people (Obeidallah & Earls, 1999), and violent crimes (Ritakallio, Kaltiala-Heino, Kivivuori, &
Rimpelä, 2005). Girls in the juvenile justice system also show greater mental health symptoms
(Mullis, Cornille, Mullis, & Huber, 2004) and even more so than incarcerated boys, including
high levels of internalizing symptoms (Espelage et al., 2003) such as anxiety, depression, and
low self-esteem (Cauffman, 2004) and substance abuse (Hart, O'Toole, Price-Sharps, & Shaffer,
2007). Girls detained in a juvenile facility also score higher on measures of anger-irritability,
depression-anxiety, and somatic complaints (Cauffman, Lexcen, Goldweber, Shulman, & Grisso, 2007).

**Family and interpersonal relationships**

Girls do not live isolated from others, so naturally their family, friends, and other individuals will serve to influence their behavior in positive and negative ways. Given that girls’ are socialized to be invested in interpersonal relationships, their relationships are especially salient, and indeed research has supported this notion. When controlling for general risk factors, when girls believe there was an adult who cared about them, they engaged in lower levels of delinquency (Hart et al., 2007) and had fewer status offenses, property offenses, engaged in less drug selling, simple assault and aggravated assault, and resisted gang membership (De La Rue & Espelage, 2014; Hawkins, Graham, Williams, & Zahn, 2009).

The role of the family is important for girls. Feeling loved and wanted is a significant protective factor (McKnight & Loper, 2002), and girls who feel connected with their families are less likely to engage in violent behaviors (Resnick, Ireland, & Borowsky, 2004). Girls who experience more positive family relationships (Werner & Silbereisen, 2003) and more parental supervision (Hart et al., 2007) are also less likely to associate with peers who engage in antisocial behaviors. While family serves as an important resource for girls, when there are concerns within the family environment this can be particularly devastating. Family dysfunction and maltreatment are believed to create a higher risk for concerning behaviors among girls as compared to boys (Kroneman et al., 2004). A dysfunctional family life predicts gang involvement for girls (De La Rue & Espelage, 2014; MOLIDOR, 1996) and a high risk for delinquency (Fagan, et al., 2007; Odgers et al., 2008; Wright et al., 2004; Zahn, 2007).
How parents manage and interact with their girls is a significant source of influence. Poor parent-child relationships (Simourd & Andrews, 1994) and low levels of parental support (Stevens, Morash, & Park, 2011) create a concern for delinquency, as does low parental monitoring (Stevens et al., 2011; Wong et al., 2010). Furthermore, harsh and inconsistent discipline is related to life-course persistent delinquency (Odgers et al., 2008).

**Adolescent Development and Gender Socialization**

The risk and protective factors associated with delinquency must be considered in conjunction with what is known about adolescent development. Developmental theorists have identified adolescence as an important transition period between childhood and early adulthood, a period that includes an increased frequency of peer interactions, the adoption of increasingly sophisticated interpersonal behaviors, new social roles, a motivation to establish a stable personal identity, and a reliance on peer feedback as a source of identity and self-evaluation (Brechwald & Prinstein, 2011). One of the hallmarks of adolescence is the move toward becoming an individual separate from one’s family, a process reflected in adolescents’ growing reliance on their peers, and a move towards developing a personal identity.

Gender affects how youth manage the many developmental challenges during adolescence, including how they form new relationships (Perry & Pauletti, 2011). While overall differences between boys and girls at this time are actually quite small, there is evidence to suggest that boys and girls follow different paths to delinquency (Crosnoe et al., 2002). The social-psychological development of girls places a high value on relationships and an emphasis on considering the needs of others within their moral development (Letendre, 2007). Indeed, girls tend to be more relationship-oriented and boys tend to be more oriented towards things (Su,
This conclusion is based on research that finds that girls spend more time in relationship activities and prefer people-oriented occupations as compared to boys (Perry & Pauletti, 2011). The family, peer group, and society all contribute to the socialization of gender and all emphasize the importance of building interpersonal connections. As a result, girls’ sense of self becomes deeply intertwined with connection to others (Letendre, 2007) and relationships become an important socializing agent as girls seek to maintain these connections. Thus, relationships with peers serve as both potential risk and protective factors for girls.

**Peers**

The reach of peer influence is broad, especially during the formative adolescent years as young people start to look to their peers to understand acceptable and desirable behaviors (Brechwald & Prinstein, 2011). Belonging to a peer group is especially important for adolescent girls because it can bolster confidence and reinforce their identity (Letendre, 2007). The structure, level of cohesion, and density varies across adolescent girl peer groups. In addition to having close friends, adolescent girls can be part of cliques, crowds, and larger networks of friends. Further, many best friend interactions occur in the presence of other friends who can serve to alter the potential of best friend socialization (Brechwald & Prinstein, 2011). In other words, although a single individual (i.e., best friend) may be especially important, girls are socialized by their immediate peer group and by the broader social context in which that peer group resides.

It has been well documented that peers and friends are a significant socializing agent for young people, especially when considering antisocial behaviors. Having delinquent friends is a significant risk factor for delinquency engagement among both boys and girls (Crosnoe et al.,
2002; Simourd & Andrews, 1994; Zahn, 2007) and subsequent association with delinquent peers also serves to maintain delinquent behaviors (Liu & Kaplan, 1999; Wong et al., 2010). There are multiple theories as to how antisocial peers serve to influence delinquency. For example, when girls associate with antisocial peers, connections to school figures and family members becomes disrupted (Mullis et al., 2004), which reduces the likelihood that social pressure from positive adults will be able to deter a girl from engaging in antisocial behaviors. Individual factors of girls are also used to explain the connection between peers and delinquency. Crosnoe and colleagues (2002) examined the influence of delinquent friends via friendship nominations, and found the relation between deviant friends and delinquency was strongest when girls were low academic achievers (Gorman-Smith & Loeber, 2005). Studies have also explored the link between self-reported delinquency, and the level of delinquency of one’s peer group. This has often been examined in the context of gang membership, with studies finding that simply associating with a gang increased youths’ involvement in delinquent behavior (Curry et al., 2002). Alternatively, there have been studies that find when controlling for other factors, (i.e., substance abuse, having a caring adult in their life, and attitudes not supportive of violence) associating with antisocial peers no longer becomes a significant predictor of delinquency for girls (Hart et al., 2007).

**Selection and Influence**

Given the importance of friendships and peer relationships in adolescence, there is significant value in considering how the social structure of friendships serves to influence behaviors. Research has consistently noted that adolescents’ behaviors and attitudes are very similar to the behaviors and attitudes of their friends (Brechwald & Prinstein, 2011), a phenomenon known as homogeneity bias (Steglich, Snijders, & Pearson, 2010). These individual
characteristics serve to influence the development of a particular social network and the behaviors the network members engage in, or it is also probable that the social network itself influences the behaviors. Taken together it is evident there is a natural interdependence between the social network structure and the individual characteristics of people (Steglich, Snijders, & West, 2006). This pattern is represented statistically as the network autocorrelation, the empirical finding that social ties occur more frequently among peers who are similar in demographics, attitudes and behaviors, in comparison to dissimilar peers (Steglich et al., 2006). Although the interdependence between social structure and individual characteristics is recognized, the process of how this unfolds is not fully understood, especially as it relates to delinquency among adolescent girls.

Some theories invoke selection mechanisms, including homophily effects to explain network autocorrelation, where others explore influence mechanisms and align with theories on socialization and coercion (Steglich et al., 2010). Homophily theories suggest similarities between adolescents and their friends are a result of the tendency to affiliate with friends who already possess similar behavioral proclivities and attitudes, and a tendency for adolescents’ and their friends’ behavior and attitudes to become more similar over time (Brechwald & Prinstein, 2011). For example, in the earliest studies of social networks, researchers showed substantial homophily by demographic and psychological characteristics (McPherson, Smith-Lovin, & Cook 2001). In the context of girls’ delinquency, this theory suggests adolescents tend to associate with peers who have similar attitudes and engage in similar behaviors, and as peers become less similar in these domains the relationships tend to disband (McPherson et al., 2001). The homophily principle states that it is easier or more rewarding to interact with peers who are
similar to oneself over those who are dissimilar. As such, friendships (network ties) tend to form when adolescents are similar on some attribute, and network autocorrelation emerges as a consequence of selection over time (Steglich et al., 2006).

An alternate explanation that parallels socialization is the assimilation principle, where adolescents adapt their own individual characteristics to match those of the peers in their social network (Steglich et al., 2006). In a social influence theory, what a youth feels are appropriate or correct behaviors under particular circumstances emerges from a process of peer influence, in which an individual develops a shared attitude, and then behaves in a way to reduce the development of uncertainty and conflict (Friedkin, 2001). The young person engages in behaviors that allow her to be consistent with the peer group in order to preserve her identity, and to reduce conflict that may emerge from behaving inconsistently from one’s social network. This theory recognizes that influence from relationships is not an isolated event, but occurs among many influences, all of which need to be considered within the social structure (Friedkin, 1998). Here again, network autocorrelation emerges over time, but is now due to a process of social influence (Steglich et al., 2006).

Recent longitudinal network studies have been used to analyze the coevolution of networks and behaviors in an attempt to clarify selection and influence effects; however, the results have been mixed. Knecht and colleagues (2010) modeled selection and influence effects among a large sample of Dutch youth and found a significant peer selection effect for minor delinquency, but did not find a significant influence effect. Alternatively, Burk, Steglich and Snijders (2007) found a significant effect for influence on minor delinquent behavior, but this effect was small. Results from another study of Dutch students found no selection effects but
found modest support for influence effects, specifically a small effect for the average level of a friend’s delinquency level influencing changes in one’s own level of delinquency (Weerman, 2011).

The distinction between selection and influence is important to make, because each effect implies different processes. If selection (i.e., homophily principle) results in similarity, this suggests that behaviors remain the same but relationships change (Veenstra & Dijkstra, 2011). Alternatively, if influence is stronger (i.e., assimilation principle), then relationships remain stable but behaviors change. Given the recognition that both of these principles are part of peer networks, there needs to be a better understanding of the role of both selection and influence when considering how the peer group socializes delinquency among adolescent girls.

Summary

Previous research has demonstrated that an accumulation of risk factors increases the concern for girls engagement in delinquency; however, this body of research has not fully explored the role of peers in the progression of delinquency. Given the emphasis on social relationships for girls, it is important to consider this social context in more detail in order to enhance our understanding of girls’ delinquency. In an effort to clarify the role of risk and protective factors in conjunction with peer socialization, the present study utilized a longitudinal analysis that considered the risk and protective factors of girls’ delinquency and a social network analysis to examine the coevolution of delinquency behaviors and friendship networks. Specifically, this study will expand on previous social network studies that explored selection and influence effects (Burk et al., 2007; Knecht et al., 2010; Weerman, 2011) by including as covariates risk and protective factors found to be related to delinquency engagement among
adolescents. The social network analysis will elucidate the role of peers in the trajectory of girls' delinquency, teasing apart the selection and influence effects, while also considering the role of risk and protective factors.
Chapter 3

Methods

This study utilized a longitudinal design and included Illinois high school students who completed surveys in the spring of their 9th grade year (wave 1), the spring of 10th grade (wave 2), and again in the fall of 11th grade (wave 3). A 95% participation rate was achieved. Two analyses were conducted within this study; a regression analysis with waves 2 and 3 and a social network analysis including all three waves. The University of Illinois Institutional Review Board and the participating school district’s superintendent approved all study procedures.

Participants

This study was conducted with 401 students. The number of students included in the analyses reflects students who completed at minimum one wave of survey data, and who were also identified in the network panel data. While the experience of girls is the primary focus of this dissertation research, both boys and girls were retained for the social network analysis because there were a significant number of mixed-sex groups. The sample includes 201 girls (50.1%) and 200 boys (49.9%), with an average age of 14.74 years during the initial survey (spring of 9th grade). Students in the sample are comprised of youth who predominantly identify as African American (32.4%) and White (38.7%). Other students identified as multi-ethnic (13.5%), Asian/Pacific Islander (6%), Hispanic/Latino (4.7%) and other (1.7%). Three percent of students were missing information on race/ethnicity.

Procedures

Consent/assent procedures
Student participation was strictly voluntary. Parental consent materials were sent by mail and through email from the school principal. To ensure that participants understood their rights and risks, and in accordance with University policy, parents were provided with a parent information letter and given seven days to deny consent for their youth’s participation. In addition to sending parent information letters, an assent script was also read in the beginning of each survey administration to the students. Students were told that their answers would remain confidential and their identifying information would be removed before the data were entered.

**Survey administration**

This study included a secondary data analysis. In spring 2012, 9th grade students completed self-report surveys and peer nomination surveys. Students were recruited again in the spring of their 10th grade year to complete the same set of surveys, and then recruited a final time in the fall of their 11th grade year. The final survey was a condensed version of the previous two surveys. During administration, student surveys were covered with a colored sheet of paper and students were spaced apart. A survey reader and monitor made certain that students were not talking or looking at other students’ surveys. The final survey was administered on a computer with students completing surveys during class time in a computer lab at their school.

**Measures**

Measures included risk factors, protective factors and peer networks. Risk factor measures include anger and hostility, depression, substance use, and reports on friends’ delinquency. Protective factors include family social support and parental monitoring. The outcome measure was levels of self-reported engagement in delinquent behaviors. Demographic information was also collected, including, gender, age, and race/ethnicity. Students averaged
14.74 years old in wave 1 (range 14 – 16), 15.72 years old in wave 2 (range 14 – 18) and 16.34 years old in wave 3 (range 14 - 18).

Friendship Nomination Tasks

Based on previous studies of adolescent friendship networks (Ennett & Bauman, 1994), students were asked questions about their friends. Specifically, they were asked to list up to eight friends similar in age (but not siblings) with whom they hang out most often with in their school. Students were allowed to nominate as few or as many students as they wished, up to eight names. These names were then converted to participant numbers to identify friendship networks and matched with survey data to provide network attributes.

Risk Factors

Anger and Hostility. The 6-item hostility subscale from the Symptom Checklist-90 (Derogatis, Rickels, & Rock, 1976) was used to measure indicators of underlying hostility. The subscale items measure the extent to which individuals have feelings of aggression, irritability, rage, and resentment. Example items include, “Feel easily annoyed or irritated,” “Have urges to break or smash things,” and “Get into frequent arguments.” Response options include “Never”, “Once in a While,” “Fairly Often,” and “Most of the Time.” Higher scores represent more frequent hostile thoughts or feelings. In the present study Cronbach alpha was averaged to be .87 across the waves.

Depression. Depressive symptoms were assessed with the 6-item Orpinas Modified Depression Scale (Orpinas, 1993). Adolescents indicate how often they felt or acted certain ways in the previous 30 days. Examples include: “Did you feel happy”, and “Did you feel hopeless about your future”. Responses are recorded on a 5-point Likert-type scale with options ranging
from *Never* (1) through *Almost Always* (5). Scores are calculated by summing all responses, with a possible range of 6 to 30, with higher scores indicating more depressive symptoms. The Modified Depression Scale has demonstrated good internal consistency ($\alpha = .74$) when administered to adolescents aged 10 to 18 (Orpinas, 1993). In the current study good internal consistency reliability was found, as the average Cronbach alpha was .82.

**Substance use.** Eight items from the *Problem Behavior Frequency Scale* (Farrell, Kung, White, & Valois, 2000) were used, which asked students to report how many times in their lifetime they used alcohol and or drugs. The scale consists of items, such as “Smoked cigarettes”, “Drunk liquor”, and “Used inhalants.” Response options include “Never”, “1 or 2 times”, “3 or 5 times”, “6 or 9 times”, and “10 or more times.” A Cronbach’s alpha coefficient of .87 was found with a sample of urban adolescents and .88 with a sample of rural adolescents (Farrell et al., 2000). These authors also report positive correlations with risk behaviors such as self-reported delinquency, and negative correlations with positive behaviors and school attendance (Farrell et al., 2000). In the current study, an average Cronbach’s alpha coefficient of .90 was found across each wave of data collection.

**Friend Delinquency.** The Friend’s Delinquent Behavior measure from the Denver Youth Survey is a seven-item scale (Institute of Behavioral Sciences, 1987), which asks participants to report how many of their friends have engaged in delinquent behaviors (e.g., hitting or threatening to hit someone, damaging or destroying property, drinking alcohol) in the past year. Response options include “none”, “very few”, “some of them”, “most of them”, and “all of them.” A Cronbach’s alpha of .89 was found in the original study. In the current study, an average Cronbach’s alpha of .88 was found across the waves.
Protective Factors

Parental monitoring. The Parental Supervision subscale (4 items) from the Seattle Social Development Project (Arthur, Hawkins, Pollard, Catalano, & Baglioni, 2002) was used to measure respondents’ perceptions of established familial rules and perceived parental awareness regarding school work and attendance, peer relationships, alcohol or drug use, and weapon possession. Response options include “Never,” “Seldom,” “Often,” and “Always.” Example items include, “My family has clear rules about alcohol and drug use” and “My parents ask if I’ve gotten my homework done.” An average Cronbach’s alpha coefficient of .86 was calculated across the three waves for the present study.

Family Social Support. Family social support was measured using the family subscale from the Vaux Social Support Record. The VSSR is a 9-item questionnaire that is an adaptation of Vaux’s (1986) Social Support Appraisals (SSA), a 23-item scale that was designed to assess the degree to which a person feels cared for, respected, and involved (Vaux, Riedel & Stewart, 1987). The family subscale is three items, which measure the support available from the family, for example “There are people in my family I can talk to, who care about my feelings and what happens to me.” Scores range from 0 to 6, with higher scores indicating greater perceived support. The family social support subscale had an average Cronbach’s alpha of .80 in the present study.

Outcome Variable

Self-report delinquency. This 8-item scale is based on Jessor and Jessor’s (1977) General Deviant Behavior Scale and asks students to report how many behaviors listed on the measure they took part in during the last year. The scale consists of items such as, “Skipped
school,” and “Damaged school or other property that did not belong to you.” Response options include “Never,” “1 or 2 times,” “3 or 5 times,” “6 or 9 times,” and “10 or more times.” The original study by Jessor and Jessor utilized this scale in a longitudinal study of 432 largely white middle class students in 7th – 10th grades. A mean Cronbach’s alpha coefficient of .76 was reported across the 3-year study (1977). Since its development, this scale has been used numerous times resulting in Cronbach’s alpha coefficients ranging from .76 to .83 (Farrell, et al., 2000). In the current study, the scale had an average Cronbach’s alpha of .81.

**Hypotheses**

Two main hypotheses were identified for the present study: 1) Risk and protective factors are expected to predict delinquency engagement; 2) When considering the friendship network, *selection* effects and *influence* effects will be present for the behavioral outcome of delinquency. Specifically, above and beyond risk and protective factors, youth will select as their friends those who engage in similar levels of delinquent behavior. Additionally, above and beyond risk and protective factors, the friendship network will influence the level of youth delinquency engagement.

**Data Analysis**

Data analysis was conducted using SPSS 22.0 (IBM Inc., 2012), SAS 9.4 software (SAS Inc., 2013), and R 3.1.0 (R Development Core Team, 2014). In addition to standard significance tests, effect sizes were computed to evaluate clinical significance where appropriate. Variable structures were examined (e.g., skewness) and psychometric properties of each scale were evaluated. To address concerns with missing data, the data were multiply imputed using the Full Conditionally Specified procedure (Enders, 2010; van Buuren, 2007). Following the imputation
process, a regression analyses was conducted with the imputed data sets. The regression analysis made use of waves 2 and 3 (10th and 11th grade). The imputed data was only retained for the regression analysis. In the final step, a social network analysis was conducted with all three waves of the observed data to examine selection and influence effects on girls’ delinquency. The details of each step are discussed next.

**Multiple Imputation and Regression Analysis**

Many of the scales of interests were missing participant data at one or more time points as a result of participants not being present in some waves. The percentage of missing values for each scale ranged from 23.9% to 29.1% across the three time points. The data were assumed to be missing at random (MAR). Missing data presents a concern as it reduces power, and also threatens the validity of the statistical inferences (Fichman & Cummings, 2003). To alleviate some of these concerns, missing values were estimated using a Full Information Maximum Likelihood (FIML) procedure.

Although there are a multitude of avenues available to handle missing data, including listwise and pairwise deletion, and single imputation methods, for the purpose of the present study a Multiple Imputation (MI) procedure was chosen to address the concerns with missing data. MI has been shown to be better than listwise and pairwise deletion because MI proceeds with the logic that plausible values for the missing data can be gathered from the observed data (Enders, 2010). This is in contrast to the deletion approaches, which do not capitalize on the available data to fill in missing values. Another commonly used missing data approach is the single imputation method, where missing values are replaced with an imputation leading to a single complete data set for use in subsequent analysis (Fichman & Cummings, 2003). Single
imputation works by inserting a mean value, or a value selected from similar respondents for the missing value. While this method is fairly easy to implement and makes the subsequent analyses straightforward, single imputation does not account for the variability introduced by the imputation process and as such can distort the variable distribution once the imputation is complete (Berglund, 2010).

Alternatively with MI, a data set composed of imputed values is observed \( m \) times, with each data set having the same observed values, but different imputations for the missing observations. This results in \( m \) sets of complete data being used in subsequent analysis. Multiple imputation techniques offer a benefit over single imputation methods given that that latter tends to underestimate standard errors since subsequent analyses treat the imputed values as “real data” (Enders, 2010). Alternatively, an MI method accounts for the uncertainty that arises from missing data by repeatedly filling in missing data to yield parameter estimates that average over a number of plausible replacement values (i.e., multiple imputation does not rely on a single set of imputations; Enders, 2010). As a result MI provides more valid estimates of the means, standard errors, and regression coefficients (Fichman & Cummings, 2003). Simulation studies have shown when analyzing only observed multivariate data under MAR conditions, the results are often biased; however, MI consistently moves the results in the right direction and often repairs the damage done by missing data (van Buuren, Brand, Groothuis-Oudshoorn, & Rubin, 2006).

The imputation process occurred in three phases: the imputation phase, the analysis phase, and the pooling phase. The imputation phase will be described first, followed by a discussion of the regression analysis that was conducted using the resulting 40 imputed data sets.
Then the pooling phase will be described, where the results from the 40 separate regression analyses were averaged for a final result.

**Imputation Phase**

In the imputation phase, multiple copies of the same data set are created that contain different estimates of the missing values (Enders, 2010). Because there were categorical and continuous variables in the dataset, a fully conditional specification (FCS) method was used for the multiple imputation. Within this process data are filled in variable-by-variable by specifying an imputation model for each variable (Enders, 2010). The imputation starts from simple guess values, and under FCS, iterations occur until all conditionally specified imputation models are complete (van Buuren, 2007). When the imputed variable was a discrete/categorical variable (i.e. gender), logistic regression was used as a building block and when it was a scale/numerical data, linear regression was used.

With a FCS approach, each regression model utilizes filled-in values from the previous sequence to generate imputation values for the next sequence. This process continues until all subsequent imputations are completed. Enders (2010) recommends a liberal approach when selecting which variables to include in these regression analyses, and suggests at a minimum the variables that will be included in subsequent analyses are included. For the present analysis, all variables included in the subsequent regression analysis were included. In addition, gender, race/ethnicity, and scales of bully perpetration and victimization, teen dating violence perpetration and victimization, fighting, family social support, school social support and school belonging were also included.
Earlier guidelines suggested that as little as 3 to 5 imputations were sufficient to obtain good statistical inference; however, more recent scholarship has suggested the number of imputations should be much larger, especially if there is a large amount of missing data (Graham, Olchowski, & Gilreath, 2007). In Graham and colleagues (2007) simulation study, the authors noted there could be concerns when a smaller number of imputations are used, leading to an unacceptable loss of power. Their simulations suggest that for most situations, 20 imputations would be sufficient. For the present study, 40 imputations were utilized given that the Fraction of Missing Information was somewhat higher, between 0.30 and 0.47. The fraction of missing information quantifies the missing data’s influence on the sampling variance of a parameter estimate (Enders, 2010). The larger number of imputations was intended to increase confidence in the statistical inferences given the amount of missing data.

**Analysis Phase – Regression analysis**

In the analysis phase, the filled-in data sets are analyzed, in this case, with a regression analysis. The aim of the regression analysis was to identify risk and protective factors that correlate with self-reported delinquency for adolescent girls. A multiple regression was used to examine the extent to which risk and protective factors distinguish between levels of delinquency. First, variables measured in 10th grade were included to control for previous levels: delinquency, the protective factors of parental monitoring, and family social support, and the risk factors of anger, depression, substance use, and friends’ delinquency. Next, variables captured during 11th grade were included: parental monitoring, anger, depression and friends’ delinquency. The outcome variable was 11th grade delinquency. In this phase, the regression analysis was completed on each of the 40 data sets, which resulted in 40 unique sets of
parameters estimates and standard errors. This information is then combined in the pooling phase.

**Pooling Phase**

In the pooling phase, the 40 parameter estimates and standard errors from each of the previous regression analyses are combined into a single set of results. This process synthesizes the results by producing means of the estimates of interests (means, parameters, regression coefficients, etc.) across the imputed date sets while also adjusting the variance and standard errors, thus accounting for the uncertainty introduced by the imputation process (Berglund, 2010). Without the pooling process the variability due to the imputation process would be underestimated. Rubin’s rules were used to combine the results of the regression analysis for the 40 imputed data sets (Graham et al., 2007). The point estimates of each regression coefficient represent the average parameter estimate divided by the \( m \) imputed datasets.

**Social Network Analysis**

The second aim of this study sought to discover if peer group socialization of delinquency could be captured/understood through social network analysis. This analysis examined if (i) youth with similar characteristics *select* each other as friends and also have a propensity to engage in delinquent behaviors and/or (ii) if youth who engage in delinquent behaviors *influence* their friends to engage in similar behaviors. The imputed data was not retained for the social network analysis, and instead the observed data was used. Techniques to utilize multiple imputed data are not readily available at this time for SNA. The basic data structure is a panel dataset that includes relationships and behavior, so that for a number of moments in time (in the present case, three), the entire network (friendship) and the behavior
(delinquency) of all the individuals in the group is recorded (Knecht, Snijders, Baerveldt, Steglich, & Raub, 2010).

To understand this, first a brief review of the definition of the actor-oriented models, called a Stochastic Actor-Based Model (SABM) is warranted (for further explanations see Snijders, 2001; Snijders et al., 2007, 2010). The Stochastic Actor-Based Model (SABM) approach accounts for dependencies among individuals in a sample that cannot be represented with conventional methods by modeling the network and behaviors simultaneously. Specifically, the analysis utilizes network panel data that includes at least two observations of a social network and of behaviors. The SABM is concerned with directed relationships, where each tie \( i \rightarrow j \) has a sender \( i \), who will be referred to as ego, and receiver \( j \), referred to as alter. The participants are referred to as actors in network analysis. The ties (connections between individuals/identifying someone as a friend) are then evaluated, under the assumption that ties are under the control of the sending actor (Snijders et al., 2010). Actor covariates are also included, which may be constant (e.g., ethnicity, gender) or subject to change (e.g., opinions, attitudes). The SABM approach models longitudinal data and can be implemented within the R package RSiena (Ripley, Snijders, Boda, Vörös, & Preciado, 2014). This approach is more generally referred to here as social network analysis (SNA).

The SNA proceeds in three main steps: data specification, model specification, and model estimation (for a full description of each step see Ripley et al., 2014). To start, four simplification assumptions are necessary (Snijders et al., 2010, pp.5; Snijders, Steglich, & Schweinberger, 2007). The first is the Markov assumption, which states that changes in the network ties and behaviors happen in continuous time and are measured at discrete time periods (i.e. the three
waves of data collection). As such the total difference between each time period is understood to be the result of many unobserved changes. The second assumption is that actors act independently of each other; in other words, simultaneous change is not possible (e.g. I will be your friend if you stop being friends with her). The third assumption is an extension of the second, and assumes that changes in network ties and actor behavior cannot occur simultaneously. In this way, the coevolution process is separated into a network change process and a behavior change process, which are mutually linked because the distribution of each process is determined by its own current state and the current state of the other coevolving process (Snijders et al., 2007). The final assumption is that in a specific moment an actor can make a change in either an outgoing tie or in the behavior. Thus, a change by an actor is either the creation or dissolution of a tie, or, an increase or decrease of one on the behavior variable (Snijders et al., 2007). These assumptions collectively assume actors engage in a series of micro steps, which are then measured at discrete time points.

**Data specification**

Participants who had information on at least one wave of survey data were retained for the network analysis. This resulted in 401 students comprising the network. During wave 1 there were 1,353 ties, 1,151 in wave 2 and 1,1018 in wave 3. The dependent actor-level variables are changing variables at the actor level, and are analyzed according to the networks and the behaviors. In other words, they change dynamically in mutual dependence with the changes of the network (Ripley et al., 2014). For the present analysis, delinquency was the dependent actor-level variable. Covariates are also included in the analysis; these variables can be constant covariates (e.g., gender) or covariates that change over time (e.g., anger). The changing
individual covariates play the role of independent variables (Ripley et al., 2014). Given the
gender differences in delinquency discussed previously, gender was included as a constant
covariate. Ethnicity was also included as a constant covariate. The variables of anger and
parental monitoring were including as changing covariates. Covariates in the RSiena package are
centered by the program. For individual covariates, the mean value is subtracted and for
changing covariates (anger and parental monitoring), the grand mean is calculated. The centered
values are then stored and all calculations use these centered variables (Ripley et al., 2014).

**Model specification**

The next step is model specification where the specific effects to include are identified.
Each model includes a rate function, an objective function, and model specific components. The
rate function describes the moments when an actor has the opportunity to make a decision, for
instance either to make a tie or to change a behavior. There is a rate function for the network and
for the behavioral dimension (Snijders et al., 2007). The rate functions depend on the actor
characteristics and on network characteristics in the specific time period.

Although the rate function characterizes the timing of actor decisions, the objective
function models which changes were made (Snijders et al., 2007). The objective function
contains two parts, a selection part and a behavior part. The selection part of the objective
function is intended to explain friendship formation and maintenance, and forms the basis for the
network objective function (Knecht et al., 2010). The basis for the behavior objective function is
the influence part of the model, capturing behavior change (Knecht et al., 2010). Theories of
influence can be captured here, with effects that characterize the focal actors’ behavior being
dependent on the behavior of her friends. There are different evaluation components available for
the network objective function, for the present analysis the evaluation component was utilized. The evaluation function is a measure of actor satisfaction with a given network-behavioral configuration, independent of how this configuration was arrived at and as such only depends on the new state of the configuration (Snijders et al., 2007). Another option is the endowment function, which is appropriate when downward changes in the network are expected (Snijders et al., 2007), for example when the loss of a terminating tie is of greater significance than the gain in creating a new one. The endowment function is specific only to the termination of ties, and not for their creation (Snijders et al., 2010).

The final part of the model specification is the components that can be included; these are referred to as effects and are added across subsequent model estimations as discussed next. Effects that depend only on the network are called structural effects, and can include covariates that are considered to be externally ascribed attributes (Snijders, et al., 2010). For models with one or more dependent behavior variable (i.e., models for the co-evolution of networks and behavior) the necessary network effects are the following: density, reciprocity, and transitivity or an alternative triadic effects (Snijders, et al., 2010). Additional effects specified in the model are added in stages.

As recommended by Snijders and colleagues (2010), the first model proposed was a simple model, and then model building proceeded with forward model selection. Forward model selection is recommended for two main reasons. First, computation time is considerable and the time required to estimate the models is linear in proportion to the number of parameters and waves of data (Snijders et al., 2007). Second, the data and model structures under consideration are complicated even in the simplest models and therefore starting with a complicated model and
then removing non-significant effects (backward model selection) can lead to difficulties with convergence (Snijders et al., 2007).

In the present study, the first model fit did not contain any effects representing friendship selection based on delinquency or influence effects of friends on delinquent behavior. This model corresponds with the null hypothesis that friendship and delinquency evolve independently and are not connected by selection or influence processes (Knecht et al., 2010). For the network objective, the model contained the effects of outdegree, reciprocity, transitivity, gender similarity, ethnic/racial similarity, and behavioral similarity. The density effect is used as a control for each of the other effects. The reciprocity effect is defined by the number of reciprocated ties and is considered a fundamental aspect of social relationships, especially friendships. The transitive effect is the number of transitive patterns (i.e., a friend of a friend is my friend) (Snijders, 2001). For categorical actor covariates (i.e., gender), the similarity effect measures the tendency to have ties between actors with exactly the same value (Snijders et al., 2010). Because same sex relationships are common in this age group, homophily based on gender was included as a same sex effect. Homophily of race/ethnicity was also included. For the behavioral objective the model included the effects of tendency towards delinquency (linear shape), tendency towards delinquency squared (quadratic shape) and the main effect of gender on delinquency.

In the second model, additional effects were included to explore the selection and influence processes. In the network objective, for each actor the three basic covariate effects of ego, alter, and similarity (Snijders et al., 2010) were included as covariates for delinquency. The ego effect measures if actors with higher values on delinquency tend to nominate more friends in
school, whereas, the alter effect measures if actors with high values on delinquency tend to be nominated by others. The similarity effect measures, above and beyond the effects of ego and alter, whether ties between individuals tend to occur more often when actors are similar on delinquency (the homophily effect). Collectively, these effects represent the selection process. For the behavioral objectives portion, the effects of average similarity and average alter were added, collectively representing the influence effects. In addition, a main effect for anger and a main effect for parental monitoring on delinquency were included. These effects were identified given their significance in the regression analysis.

**Model estimation**

In the next step, model parameters are estimated under the specifications given with the previous model specification. The Method of Moments (MoM) estimation procedure, which is the default, was used in the present analysis. The MoM estimation algorithm compares the observed network (given by the data files) to the hypothetical networks generated in the simulations (Ripley et al., 2014). The MoM procedure is based on the specification that the first observed network itself is not modeled, but instead is used as a starting point for the simulations (Snijders, van de Bunt, & Steglich, 2010) and then it is the change between adjacent time periods that is modeled.

To check for convergence of the algorithm, a preliminary step is to look at the *t-ratios for convergence*. The *t-ratios for convergence* provide information on the deviations between the simulated values of the *t* statistics and their observed values (Ripley et al., 2014). Ideally these values would be 0, however given the stochastic nature of the algorithm when the process has converged the values should be small but will not be exactly equal to 0. Convergence is deemed
to be excellent when these $t$-ratios are less than absolute value of 0.1, reasonable when less than 0.2, and moderate when they are less than 0.3 (Ripley et al., 2014). To test for “significance” the Wald-type test was used, the $t$-type test where the parameter estimate is divided by the standard error. Under the null hypothesis that the parameter is 0, the test will have an approximately standard normal distribution (Ripley et al., 2014). However, the test is carried out as a $t$-test with infinite degrees of freedom, so it should be regarded as rough approximation (Snijders, 2001).
Chapter 4

Results

Multiple Imputation Results

Forty complete data sets utilized in the regression analysis. An examination of the results of the multiple imputation leads to increased confidence in the use of the imputed data. Relative efficiency (RE) is a measure of the magnitude of a multiple imputation standard error relative to its theoretical minimum, and with an infinite number of imputations, the relative efficiency value would be 1 (Enders, 2010). The values for REs in the present analysis were all above .98, suggesting the use of 40 imputations was sufficient and yields an accurate representation of the observed data. Table 1 displays variance information for the multiple imputation and also includes the relative increase in variance and the fraction of missing information. An examination of the trace plots revealed no apparent trends, which lends further support for 40 imputations being sufficient for the data. Finally, the observed data used for the MI matched well with the resulting imputed data sets as the means of the observed data and the pooled means from the imputations were similar. Table 2 presents a series of descriptive information, including means and standard errors for the study variables for both the observed data and imputed data.

Regression Results

Using the imputed data sets, a regression analysis was fit to the data to examine the risk and protective factors that predict delinquency. The predictors included prior levels of delinquency, protective factors (including parental monitoring and family social support), risk factors (including anger, depression, substance use) and friend’s level of delinquency. The outcome was girls’ delinquency in 11th grade (Wave 3). Only the girls were included within this
analysis (N = 201). Forty regression models were run and the results were then averaged over the 40 models using Rubin’s (1987) rules.

Table 3 displays the regression coefficients for each predictor, averaged across the 40 waves of imputation. Across imputations $R^2$ was averaged to be 0.63. Eleventh grade delinquency was predicted by delinquency and substance use in 10th grade. Controlling for 10th grade risk and protective factors, 11th grade delinquency was predicted by lower levels of parental monitoring and greater feelings of anger and hostility. Furthermore, a greater level of friend’s delinquency engagement was predictive of one’s own self-reported levels of delinquency. Although this effect gives support to the important role that peers play in delinquency, when youth report on a friend’s level of delinquency it can lead to self-enhancing data where youth rate their friends to be more similar to them than they actually are. Therefore the social network analysis results discussed next will help clarify the role of friends.

**Social Network Analysis Results**

Because the estimation process is of a stochastic nature, the results can vary from one estimation to the next. Thus, as recommended by Ripley et al. (2014), the estimation process was repeated to confirm that the results of the algorithm were stable. The repeated estimation resulted in similar estimates; the results of the final estimation are presented. Initial descriptive information about the networks is presented in Table 4.

There were 401 actors included in the network, and represent the sample of students who completed at least one wave of the survey. There were 1,352 ties made during the first wave (9th grade), 1,149 during the second wave (10th grade) and 1,016 during the third wave (11th grade). The average number of nominated peers ranged between 2.53 and 3.37 over the three waves and
showed a moderate decrease over time. The networks were sparse (i.e., the density was well below 0.5), suggesting that actors were not likely to make ties with an actor that they did not share characteristics with. The tie changes are displayed in Table 5. The value of 0 indicates no tie and a value of 1 indicates a tie was made. For example, between waves one and two, 1,013 of the ties (value of 1) changed to no tie (value of 0), and 339 of the ties remained. In addition, 810 ties changed from a value of 0 to a value of 1. This collectively represents the 1,149 ties present in wave 2. The Jaccard coefficient, a measure of similarity of ties between waves, was 0.157 between wave 1 and 2, and 0.175 between wave 2 and 3. Jaccard values of .3 and higher are good, and lower than .2 indicates there could be concerns with convergence (Ripley et al., 2014); however, as reflected in the $t$-ratios for convergence, the models converged well.

The results of the initial model are displayed in Table 6. The convergence $t$-ratios obtained for the present analyses were all below 0.1 (or near so for gender ego), indicating the model converged well. This model corresponds with the null hypothesis that friendship and delinquency evolve independently and are not connected by selection or influence processes. There are a number of significant effects. As expected, the effect for gender similarity and racial/ethnic similarity were significant, demonstrating that boys tend to be friends with boys and girls tend to be friends with girls. In addition, youth of similar racial and ethnic backgrounds tend to be friends. This is consistent with previous research where gender and race/ethnicity are repeatedly found to play a major role in structuring friendship networks (McPherson et al., 2001). In the behavioral objective, the negative value of the quadratic component suggests the higher the delinquency behavior already is, the lower the tendency to increase the behavior further (Snijders et al., 2010). Alternatively, if there were a positive value on the quadratic
component this would suggest, for example an addictive behavior, where the behavior continues to increase even when already at high levels.

Table 7 presents the results obtained from the SIENA analysis with the full model. A majority of the convergence t-ratios were below an absolute value 0.1 and all were below .2, indicating acceptable convergence. Most of the effects in this model were significant, with parameter estimates that were more than 1.96 times their standard errors, indicating significance at the 5 percent level (Knecht et al., 2010). The specific effects are discussed next.

Network Objective

The outdegree effect was negative reflecting that the creation of and maintenance of friendship ties to arbitrary others is not common (Knecht et al., 2010). Reciprocity is a basic feature of most social networks, and usually the obtained values are high (e.g., between 1 and 2; Snijders et al., 2010) as was the case in the present analysis. This suggests that friendships are generally reciprocated. The positive value of the transitive triplet effect and the accompanying negative value for the 3-cycles effect suggest a tendency towards local hierarchy within the network (i.e., the network is not egalitarian).

The results for the selection process tested the hypothesis that youth tend to be friends with others who have similar levels of delinquency to their own and are captured by the alter, ego, and similarity effects. Results of the delinquency alter effect indicates that ties are more likely to be sent to youth with higher levels of delinquency ($\beta = 0.15, t = 3.00, p = .01$). In other words, youth with higher levels of delinquency are attractive as friends. The negative delinquency ego effect indicates that, as delinquency levels get larger, the fewer ties are sent ($\beta = -0.21, t = 3.00, p = .00$). In other words, youth with higher levels of delinquency are nominating
fewer friends in school. The delinquency similarity effects tests for friendship selection above and beyond the effects for ego and alter. This effect was significant at the $p < .05$ level ($\beta = 0.52, t = 1.93$), and suggests that a youth’s delinquency level is similar to that of his/her friends. Taken together, these effects suggest selection effects are important for adolescent delinquency engagement.

**Behavior Objective**

The results of the influence process tested the hypothesis that youth adjust their behavior in accordance with the average behavior of their friends. There was no support for this hypothesis; adolescents do not adjust their delinquent behavior in order to be similar to friends. There was also no support for a main effect of gender on delinquency levels ($\beta = -0.21, t = 0.53, p = .61$), and no support for a main effect of anger ($\beta = -0.04, t = 0.15, p = .87$) or parental monitoring ($\beta = -0.32, t = 0.97, p = .32$) on delinquency levels when the structure of the network is taken into consideration.

**Summary**

The results of the present analyses highlight the importance of considering risk and protective factors in the trajectory of delinquency, but also emphasize that beyond these factors peer networks play an important role in the maintenance of delinquency. While risk factors including feelings of anger and hostility and lower levels of parental monitoring predict girls’ engagement in delinquency, the peer network is important above and beyond these effects. Specifically, when controlling for anger and levels of parental monitoring peer selection is an important component of peer delinquency. Adolescents select friends who are engaging in
similar levels of delinquency, which serves to maintain continued engagement in these behaviors.
Chapter 5

Discussion

Research has consistently found that adolescents who are closely connected to each other tend to be similar on salient individual behaviors, including delinquency (McPherson et al., 2001). However, the dynamic process that gives rise to this similarity is not sufficiently understood. Some theories propose influence mechanisms as possible explanations (consistent with theories of socialization), while other theories propose selection mechanisms, or more specifically homophily (Steglich et al., 2010). The aim of the present analysis was to untangle selection and influence effects as it pertained to delinquency, while also considering the role of risk and protective factors. This was accomplished with a two-part analysis. First, a regression analysis predicting delinquency engagement from prior and concurrent risk and protective factors was conducted. Second, a social network analysis (SNA) was used to simultaneously evaluate the coevolution of peer networks and behavioral characteristics on the outcome of delinquency.

Results of the Regression Analysis

The regression analysis looked specifically at the girls included in the study across two waves (10th and 11th grade). The results support the first hypothesis proposing that higher levels of risk factors and lower levels of protective factors predict delinquency. Specifically, 10th grade levels of delinquency engagement and higher levels of substance use were predictive of delinquency in 11th grade. Furthermore, controlling for 10th grade levels, in 11th grade anger and hostility and lower levels of parental monitoring predicted delinquency engagement. In contrast
to previous studies (Wong et al., 2010; Zahn et al., 2008) depression was not found to be a significant predictor. Research with girls in juvenile correctional facilitates has found they score higher on measures of anger (Cauffman et al., 2007), and a significant proportion of offenses for which girls are arrested are associated with anger and anger-related behaviors, such as aggression (Goldstein et al., 2013). While girls in juvenile facilitates can assume to have engaged in more serious forms of delinquency than was captured in the present study, these findings collectively point to the importance of considering the emotional health of girls when examining their behaviors. It is possible that feelings of anger are a reaction to concerning events in the lives of girls, and when the feelings of anger and hostility are high enough, girls search for an outlet to address these feelings. Engagement in delinquent behaviors becomes one option to attempt to resolve feelings of frustration and anger. Indeed scholars have recognized the need for interventions that teach cognitive and behavior techniques to reduce the feelings of anger so as to prevent the negative effects of these feelings, including reducing subsequent aggressive behavior (Goldstein et al., 2013). This emphasizes the importance of addressing the underlying factors that contribute to the behavior, as opposed to solely focusing to change the delinquent behavior itself.

Previous research has also highlighted the importance of parental involvement for girls, with girls who have more parental supervision being less likely to engage in concerning behaviors (Hart et al., 2007; Stevens et al., 2011; Wong et al., 2010). While increasing autonomy from the family is an important hallmark of adolescent development, it is still important for caregivers to be aware of the activities of their girls and to know where they are spending their time. The predictor of current friend’s delinquency approached significance for predicting
current levels of delinquency engagement, however as noted previously the method of reporting on a friend's level of delinquency does lead to some concerns with the accuracy of the information (Crosnoe et al., 2002; Espelage et al., 2007). Therefore, the social network analysis can provide additional clarification on the role of peers and more generally further clarify the results of the regression analysis by unpacking the role of associating with delinquent friends and risk factors on the outcome of delinquency.

**Results of the Social Network Analysis**

The social network analysis used a statistical model regarded as a stochastic simulation model and represented the observed differences in networks and behavior at consecutive observation points by way of evaluating small changes occurring in between each of the three waves (Knecht et al., 2010). This model allows for an estimation of both selection and influence effects, while simultaneously controlling for each. In other words, the analysis is modeling networks in terms of how youth change their friendship in small steps, and also how they change their behaviors in small steps. The SNA also allows for the consideration of other effects that influence the friendship network and delinquency engagement. As related to the friendship network, it was important to control for gender and race and ethnicity homophily because previous research has shown that adolescent friendship groups tend to be highly gender segregated and racially segregated (McPherson et al., 2001). It was also important to control for the effects of anger and parental monitoring, as the previous regression analysis indicated these were significant influences of delinquency engagement. Taken together the SNA examined the selection and influence effects of the peer network on delinquency over and above these risk and protective factors.
Results of the SNA partially supported the second hypothesis that both peer selection and influence effects would be important factors above and beyond the risk factors noted. The results highlight the importance of considering peer relationships when examining delinquency engagement, specifically demonstrating the role of delinquency in selection mechanisms for adolescent friendships. The two selection effects of ego and alter in the network objective were significant. Youth engaging in delinquent behavior were seen as more attractive to nominate as friends, as indicated by the alter effect. In other words, youth were more likely to identify as their friends those students who were engaging in higher levels of delinquency. This is compared to the negative ego effect that was found, which indicates that those students who had higher levels of delinquency sent fewer ties; in other words, they identified fewer of the youth in their school as friends. However, the negative ego effect may reflect the tendency for youth who engage in higher levels of delinquency to have a social network that includes individuals outside of the school, as adolescents who are engaged in high levels of delinquency tend to form friendships with individuals outside of the school (Dishion, Andrews, & Crosby, 1995). Another possibility is that youth engaged in higher levels of delinquency might be associating with friends in higher grades, who would not have been captured within this analysis. SNA research on mixed-sex delinquent groups has found evidence that older males recruit and hold a strong influence over girls (Carrington, 2011), emphasizing the importance of considering friendships with older peers when examining girls’ delinquency.

The ego effect provides information about the actor’s preferences, whereas the alter effect is specific to who the target is or who an actor sees as a potentially appealing friend. The final selection effect included in the network objective, the similarity effect, extends the ego and
alter effects. The similarity effect found, above and beyond the effects of ego and alter, adolescents tend to make friends with peers who are engaging in similar levels of delinquency. This is consistent with homophily theory, which posits that the similarities between friends are a result of the tendency for friends who already possess similar behavior proclivities to become friends and for these behaviors to become more similar over time (Brechwald & Prinstein, 2011). This highlights the tendency for youth with similar levels of delinquency to be in a reciprocated friendship relationship and has been described with the proverbial expression “birds of a feather flock together” (McPherson et al., 2001). Taken together the ego, alter and similarity effects support a selection mechanism to explain why youth engaged in similar levels of delinquency become friends.

The findings of significant selection effects in the present study are consistent with findings from a large longitudinal study that examined the impact of peers on the trajectory of adolescent delinquency. Jennings and colleagues (2010) found that although the number of delinquent friends an adolescent had did influence their delinquency trajectory, it was specifically the selection of similarly delinquent friends at baseline that contributed to increases in delinquent behaviors over time. The results of the present SNA are consistent with previous social network studies that found significant selection effects for peer delinquency (Baerveldt et al., 2008; Knecht et al., 2010). However, other studies examining peer selection and influence effects on delinquency have found differing results (Burk et al., 2007). Weerman (2011), looking across two waves of data, did not find support for selection effects, but instead found modest support for delinquent peer influence. The present study did not find support for influence effects
relating to peer delinquency, suggesting that friends are less likely to be influencing their peers to engage in higher levels of delinquency.

In the SNA results, no main effect of gender on delinquency was found, but this is possibly a reflection of the specific behaviors that were included on the delinquency measure. More specifically, the measure captured less serious forms of delinquent behavior. Research has shown that adolescent boys and girls often engage in less serious forms of delinquency in similar rates, including stealing, lying, cheating and vandalizing property, but gender differences arise when considering more severe forms of delinquency, including thefts of greater value, fights with greater victim injury and harder drug use and distribution (Schwartz & Steffensmeier, 2012). Therefore, the nonsignificant main effect of gender for delinquency is consistent with previous research and it is likely if more serious forms of delinquency were considered, an effect of gender could be present.

The information from the social network analysis, in combination with the results of the regression analysis, offers a more complete picture of delinquency engagement among girls. The regression results demonstrate there are risk and protective factors that can place girls at increased risk of engaging in delinquent behaviors, and once girls are engaged in delinquent behaviors they are more likely to select as friends those peers who are also engaging in delinquent behaviors. The results of this study highlight the importance of interventions that focus on changing behavior with the goal of those behavior changes leading to positive changes in the social network. With significant selection effects present in a network, when a youth changes their level of delinquency (i.e., changes their behavior), it might be expected they will then change their peer network. As such, interventions that address risk and protective factors
and help youth manage these concerns may support young people changing their behaviors and subsequently shifting their peer networks to include friends who are engaged in lower levels of delinquency.

Limitations

There are several limitations of the study to be noted. First, the focus of the present study was friendships in schools and was limited to students who completed surveys during at least one of the three waves of administration. Given the construct of interest was delinquency, it is likely that this sample was missing some of the students who are engaged in the highest levels of delinquency either because they were not present in school or unable to participate in the survey. In addition, research has suggested adolescents who are engaged in high levels of delinquency tend to form friendships with individuals outside of the school (Dishion et al., 1995), and as such the complete networks of some of the youth would not be available. Indeed, relationships in the school will not represent the entire social network for many of the youth. Research that includes the broader community networks is needed so that an increased understanding can be achieved around the networks that influence the behavior trajectories of youth (Dishion, et al., 1995).

This study did not include information about the strength of the relationship, for instance by including a measure of “best friend.” As such, the strength or quality of the relationship was not assessed. This would likely be an important construct to consider as the strength of the interpersonal connection between friendships is likely to influence how much impact a peer has on their friend. Additionally, the measure of delinquency was not able to capture more serious forms of concerning behaviors. This is an area ripe for future research, especially given the
greater differences between boys and girls on more serious forms of delinquency. It is unknown whether selection effects will be retained when considering more serious offending populations.

Finally, important risk and protective factors noted within the literature on girls’ delinquency were not included in the present study. A history of abuse or interpersonal violence victimization are consistently noted risk factors for a large number of problematic behaviors for girls (Blum, Ireland, & Blum, 2003). A history of physical and/or sexual abuse has been shown to correlate with the use of aggression and violence (Graves, 2007) and girls involved in the juvenile justice system report higher incidences of sexual or physical abuse and neglect (Gaarder & Belknap, 2002). While these predictors were not available to incorporate in the present models, they are important factors to consider, and when included in future studies will likely clarify the results further. Despite these limitations the present study does provide additional clarity on the trajectory of delinquency among girls, and gives some direction to exploring possible intervention efforts.

Conclusions

The research specific to understanding the developmental pathways to girls’ delinquency is growing, yet there is still much to be learned about the path girls take in becoming involved with various kinds of delinquency (Huizinga, Miller, & Conduct Problems Prevention Research Group, 2013). To address problematic behavior, including delinquency, it will be important to use what is known about adolescent development to enhance understanding of the trajectory of concerning behaviors (Mulvey, 2014). The present study aimed to do this by exploring adolescent peer relationships and how these effect delinquency engagement. The results of the
present study highlight the importance of friendship selection, above and beyond risk and protective factors.

The strong role of peers is not surprising considering the developmental patterns noted during adolescence, where young people have a strong focus on differentiating themselves and moving towards individuation (Brechwald & Prinstein, 2011), which is partly accomplished by moving away from identification solely with the family and with primary caregivers, and towards a growing reliance on peers. As related to delinquency engagement, this growing reliance on peers is related to youth selecting friends who are engaging in similar levels of delinquency behaviors as themselves. But the question remains, how do youth become similar on levels of delinquency in the first place so that they might select into these similar peer groups?

The regression analysis of the present study in conjunction with previous research can help answer this question. It may be the case that risk and protective factors set the stage for a young person to feel compelled to engage in delinquent behaviors, and then once in high school this becomes a distinguishing characteristic used for selecting friends. Future research will be needed to further clarify this potential, but taken together it highlights the importance of considering factors that place a young person at risk of starting to engage in delinquent behaviors since they are then likely to select friends who are also doing the same and therefore lengthen their period of engagement in delinquency. Therefore intervention efforts need to be focused on addressing risk factors so as to shift behaviors, while also being cognizant of the peer network.

**Intervention and Prevention Efforts**

There has been a growing call among scholars in the area of adolescent delinquency for gender specific programming to help prevent and reduce incidences of delinquency among girls.
Gender-specific programming highlights the importance of considering the unique needs specific to girls, for instance with interventions that address histories of victimization. Given the importance of interpersonal relationships for girls, programming to benefit them should include a focus on peer relationships in conjunction with considering risk factors. The social context is an important factor when considering girls’ problem behavior, and the ways in which interpersonal relationships serve as a conduit for girls’ behavior is important to consider (Hipwell & Loeber, 2006). Indeed, reviews of gender-specific programs in the juvenile justice system have found that programs for girls tend to be more successful when they focus on the relationships girls have with others (Bloom & Covington, 2001).

There is evidence that girls’ sense of self-worth is strongly linked to connections with others, and while this has traditionally been viewed as a deficiency, it is more appropriately viewed as a strength, where girls feel attuned to interpersonal relationships (Bloom & Covington, 2001). This strength can be capitalized on within intervention efforts that jointly acknowledge the concerns girls may bring, while also harnessing their potential to connect with others. The importance of peers does not negate the need to address the underlying concerns girls have, since girls who engage in delinquent behaviors are at heightened risk of co-occurring concerns (Hipwell & Loeber, 2006), but instead emphasizes the importance of intervention programs addressing risk factors in conjunction with capitalizing on the role of social relationships. For example, the Juvenile Justice Anger Management (JJAM) Treatment for girls, a manualized treatment developed to address concerns with anger and aggression, also includes a skill-building component to strengthen and repair relationships (Goldstein et al., 2013). This program has demonstrated successful outcomes for girls.
School-based interventions may also prove to be an especially important option in efforts to reduce delinquency engagement. In the present study it can only be speculated what the specific reasons are for why youth engaged in higher levels of delinquency nominated fewer school friends, but there is support for programs working to build positive connections in school. Girls who have been involved in the juvenile justice system report experiencing problems in school and feeling disconnected (Gaarder & Belknap, 2002). Alternatively when girls do feel connected to school they show lower levels of violent behavior (Resnick et al., 2004). Some research has proposed that associations with delinquent peers can serve to create ruptures in connections to school and with family members (Mullis et al., 2004), which reduces the likelihood that social pressure from positive adults will be able to deter a girl from engaging in antisocial behaviors. In addition, there is some evidence that girls who engage in aggressive or antisocial behavior are more likely to be rejected by their ‘prosocial’ peer group (Hipwell & Loeber, 2006). While continued research will be needed specific to the role of school engagement and social networks, interventions that promote girls involvement in school could prove a useful tool by working to change their behaviors, increasing feelings of academic competence and self-worth, and also providing them with opportunities to meet new friends who might fill a growing positive social network.

It is important to acknowledge there is some concern that group interventions for risk behaviors, including delinquency, can lead to increased engagement in the negative behavior. There is evidence that suggests interventions that aggregate at-risk peers together can provide iatrogenic effects given the increased opportunities to engage with delinquent peers and the subsequent possibility of deviancy training (Leve & Chamberlain, 2005). Indeed this is a major
concern within juvenile correction centers. Yet there has been support that this concern can be alleviated with thoughtful programming. Leve and Chamberlain (2005) found among serious offenders there was support for individual level interventions providing fewer opportunities to connect with delinquent peers resulting in fewer associations with delinquent peers months after treatment, however there was also support for group level interventions leading to decreased engagement with delinquent peers months after treatment despite being in a group with other antisocial peers. So while group level interventions do increase contact with antisocial peers, there is support that with thoughtful and strong programming the behavior of the girls can still change as a result of the intervention, which this study supports may lead to selecting friends who are engaged in lower levels of concerning behaviors.

**Conclusions**

If interventions are to be successful they need to be driven by theory and informed by evidence of the developmental pathways and correlates that exacerbate concerning behaviors or support positive behavior change (Hipwell & Loeber, 2006). The results of this study highlight the importance of peer relationships in adolescence, and show how peers may serve to exacerbate concerns with delinquency. Specifically the study demonstrated the importance of selection effects for adolescent delinquency (i.e., the homophily principle) where youth choose friends who are engaging in similar levels of delinquency as themselves. The selection mechanisms suggest that behaviors remain the same but relationships change (Veenstra & Dijkstra, 2011). Therefore intervention efforts need to focus on changing the behavior, in an effort to support the development of friendship networks that include peers engaged in lower levels of delinquency. To accomplish this, programs will need to address the risk factors that put
a girl at increased risk of delinquency engagement, while also giving attention to her interpersonal relationships.
References


Crosnoe, R., Erickson, K. G., & Dornbusch, S. M. (2002). Protective functions of family relationships and school factors on the deviant behavior of adolescent boys and girls:


http://dx.doi.org/10.1037/a0035492


### Table 1

#### Variance information and Relative Efficiency for the Multiple Imputation

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Variance Information</th>
<th>Relative Increase in Variance</th>
<th>Fraction Missing Information</th>
<th>Relative Efficiency</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Between</td>
<td>Within</td>
<td>Total</td>
<td>DF</td>
</tr>
<tr>
<td>Intercept</td>
<td>.035</td>
<td>.052</td>
<td>.088</td>
<td>14.62</td>
</tr>
<tr>
<td>10&lt;sup&gt;th&lt;/sup&gt; Grade Predictors</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Delinquency</td>
<td>.003</td>
<td>.004</td>
<td>.008</td>
<td>13.36</td>
</tr>
<tr>
<td>Parental Monitoring</td>
<td>.000</td>
<td>.001</td>
<td>.002</td>
<td>13.09</td>
</tr>
<tr>
<td>Family Social Support</td>
<td>.000</td>
<td>.000</td>
<td>.000</td>
<td>16.54</td>
</tr>
<tr>
<td>Anger</td>
<td>.001</td>
<td>.001</td>
<td>.002</td>
<td>15.99</td>
</tr>
<tr>
<td>Depression</td>
<td>.001</td>
<td>.002</td>
<td>.003</td>
<td>16.71</td>
</tr>
<tr>
<td>Cig. / Alcohol Use</td>
<td>.001</td>
<td>.001</td>
<td>.002</td>
<td>17.19</td>
</tr>
<tr>
<td>Friend’s Delinquency</td>
<td>.000</td>
<td>.001</td>
<td>.001</td>
<td>15.89</td>
</tr>
<tr>
<td>11&lt;sup&gt;th&lt;/sup&gt; Grade Predictors</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parental Monitoring</td>
<td>.001</td>
<td>.002</td>
<td>.003</td>
<td>15.44</td>
</tr>
<tr>
<td>Anger</td>
<td>.000</td>
<td>.001</td>
<td>.001</td>
<td>17.31</td>
</tr>
<tr>
<td>Depression</td>
<td>.000</td>
<td>.002</td>
<td>.002</td>
<td>17.48</td>
</tr>
<tr>
<td>Friend’s Delinquency</td>
<td>.001</td>
<td>.001</td>
<td>.002</td>
<td>16.29</td>
</tr>
</tbody>
</table>
Table 2

*Descriptive Information for Observed Data and Imputed Data for the Entire Sample and For Girls Only*

<table>
<thead>
<tr>
<th>Variable</th>
<th>Observed Data</th>
<th>Imputed</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Full Sample</td>
<td>Entire Sample</td>
<td>Girls Only</td>
<td>Girls Only</td>
</tr>
<tr>
<td></td>
<td>(N = 401)</td>
<td>(N = 401)</td>
<td>(N = 201)</td>
<td>(N = 201)</td>
</tr>
<tr>
<td>10th Grade Predictors</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Delinquency</td>
<td>1.36</td>
<td>1.40</td>
<td>1.39</td>
<td>0.04</td>
</tr>
<tr>
<td>Parental Monitoring</td>
<td>3.23</td>
<td>3.19</td>
<td>3.27</td>
<td>0.06</td>
</tr>
<tr>
<td>Family Social Support</td>
<td>2.31</td>
<td>2.32</td>
<td>2.27</td>
<td>0.06</td>
</tr>
<tr>
<td>Anger</td>
<td>1.61</td>
<td>1.63</td>
<td>1.74</td>
<td>0.06</td>
</tr>
<tr>
<td>Depression</td>
<td>2.17</td>
<td>2.19</td>
<td>2.35</td>
<td>0.04</td>
</tr>
<tr>
<td>Substance Use</td>
<td>1.33</td>
<td>1.36</td>
<td>1.35</td>
<td>0.05</td>
</tr>
<tr>
<td>Friends’ Delinquency</td>
<td>1.71</td>
<td>1.70</td>
<td>1.72</td>
<td>0.06</td>
</tr>
<tr>
<td>11th Grade Predictors</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parental Monitoring</td>
<td>3.25</td>
<td>3.22</td>
<td>3.30</td>
<td>0.05</td>
</tr>
<tr>
<td>Anger</td>
<td>1.56</td>
<td>1.57</td>
<td>1.67</td>
<td>0.06</td>
</tr>
<tr>
<td>Depression</td>
<td>2.15</td>
<td>2.16</td>
<td>2.36</td>
<td>0.05</td>
</tr>
<tr>
<td>Friends’ Delinquency</td>
<td>1.58</td>
<td>1.61</td>
<td>1.62</td>
<td>0.05</td>
</tr>
</tbody>
</table>
Table 3

Regression Parameters for Models Estimated using Imputed Data

| Parameter                | Estimate | Std Error | 95% Confidence Interval | DF  | t    | Pr >|t| |
|--------------------------|----------|-----------|-------------------------|-----|------|-----|-----|
| Intercept                | 0.61     | 0.30      | -0.02 - 0.02             | 14.62| 2.05 | 0.058 |
| 10th Grade Predictors    |          |           |                         |     |      |     |
| Delinquency              | 0.51     | 0.09      | 0.32 - 0.70              | 13.36| 5.77 | < .001 |
| Parental Monitoring      | 0.05     | 0.05      | -0.05 - 0.15             | 13.09| 1.14 | 0.274 |
| Family Social Support    | 0.01     | 0.04      | -0.06 - 0.09             | 16.54| 0.41 | 0.689 |
| Anger                    | 0.01     | 0.04      | -0.09 - 0.09             | 15.99| 0.10 | 0.922 |
| Depression               | -0.01    | 0.06      | -0.23 - 0.01             | 16.71| -1.92| 0.072 |
| Cig. / Alcohol Use       | 0.13     | 0.05      | 0.04 - 0.23              | 17.19| 2.98 | 0.008 |
| Friend’s Delinquency     | -0.01    | 0.04      | -0.08 - 0.07             | 15.89| -0.15| 0.882 |
| 11th Grade Predictors    |          |           |                         |     |      |     |
| Parental Monitoring      | -0.14    | 0.05      | -0.24 - -0.03            | 15.44| -2.68| 0.017 |
| Anger                    | 0.10     | 0.04      | 0.02 - 0.19              | 17.31| 2.66 | 0.016 |
| Depression               | 0.02     | 0.05      | -0.08 - 0.12             | 17.48| 0.41 | 0.688 |
| Friend’s Delinquency     | 0.10     | 0.05      | -0.00 - 0.19             | 16.29| 2.05 | 0.057 |
Table 4

*Descriptive Information of the Social Networks*

<table>
<thead>
<tr>
<th>Network Statistic</th>
<th>Wave 1</th>
<th>Wave 2</th>
<th>Wave 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ties</td>
<td>1352</td>
<td>1149</td>
<td>1016</td>
</tr>
<tr>
<td>Density</td>
<td>0.008</td>
<td>0.007</td>
<td>0.006</td>
</tr>
<tr>
<td>Avg. Degree</td>
<td>3.372</td>
<td>2.865</td>
<td>2.534</td>
</tr>
<tr>
<td>Centralization</td>
<td>0.029</td>
<td>0.028</td>
<td>0.031</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Dyad Counts</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Mutual</td>
<td>594</td>
<td>494</td>
<td>310</td>
</tr>
<tr>
<td>Asymmetric</td>
<td>1516</td>
<td>1310</td>
<td>1412</td>
</tr>
</tbody>
</table>

Note: The total number of possible ties for 401 actors is 160,400
Table 5

*Tie Changes Between Subsequent Observations*

<table>
<thead>
<tr>
<th>Tie Value</th>
<th>Distance</th>
<th>Jaccard</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wave 1 to 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>158238</td>
<td>810</td>
</tr>
<tr>
<td>1</td>
<td>1013</td>
<td>339</td>
</tr>
<tr>
<td>Wave 2 to 3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>158557</td>
<td>694</td>
</tr>
<tr>
<td>1</td>
<td>827</td>
<td>322</td>
</tr>
</tbody>
</table>
Table 6

*Estimates, Standard Errors and Convergence t-ratios for Initial Model*

<table>
<thead>
<tr>
<th>Model Parameter</th>
<th>Parameter (SE)</th>
<th>t</th>
<th>P value</th>
<th>Convergence t-ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Network Objective</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rate (Period 1)</td>
<td>22.70 (1.44)</td>
<td>15.77</td>
<td>&lt; .001</td>
<td>0.10</td>
</tr>
<tr>
<td>Rate (Period 2)</td>
<td>17.64 (1.59)</td>
<td>11.09</td>
<td>&lt; .001</td>
<td>0.02</td>
</tr>
<tr>
<td>Outdegree</td>
<td>-3.14 (0.03)</td>
<td>104.67</td>
<td>&lt; .001</td>
<td>0.03</td>
</tr>
<tr>
<td>Reciprocity</td>
<td>2.30 (0.07)</td>
<td>32.86</td>
<td>&lt; .001</td>
<td>0.06</td>
</tr>
<tr>
<td>Reactivity</td>
<td>0.73 (0.04)</td>
<td>18.25</td>
<td>&lt; .001</td>
<td>0.07</td>
</tr>
<tr>
<td>3-cycles</td>
<td>-0.75 (0.08)</td>
<td>9.38</td>
<td>&lt; .001</td>
<td>0.07</td>
</tr>
<tr>
<td>Gender Alter</td>
<td>-0.01 (0.04)</td>
<td>0.25</td>
<td>0.892</td>
<td>0.09</td>
</tr>
<tr>
<td>Gender Ego</td>
<td>-0.04 (0.04)</td>
<td>1.00</td>
<td>0.321</td>
<td>0.12</td>
</tr>
<tr>
<td>Gender Similarity</td>
<td>0.43 (0.04)</td>
<td>10.75</td>
<td>&lt; .001</td>
<td>0.04</td>
</tr>
<tr>
<td>Ethnicity Alter</td>
<td>0.04 (0.01)</td>
<td>4.00</td>
<td>&lt; .001</td>
<td>0.00</td>
</tr>
<tr>
<td>Ethnicity Ego</td>
<td>0.03 (0.01)</td>
<td>3.00</td>
<td>0.008</td>
<td>0.04</td>
</tr>
<tr>
<td>Ethnicity Similarity</td>
<td>0.26 (0.06)</td>
<td>4.33</td>
<td>&lt; .001</td>
<td>0.01</td>
</tr>
<tr>
<td>Delinquency Similarity</td>
<td>0.5 (0.20)</td>
<td>2.50</td>
<td>0.014</td>
<td>0.01</td>
</tr>
<tr>
<td><strong>Behavior Objective</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Delinquency Rate (Period 1)</td>
<td>0.94 (0.14)</td>
<td>6.71</td>
<td>&lt; .001</td>
<td>0.00</td>
</tr>
<tr>
<td>Delinquency Rate (Period 2)</td>
<td>0.68 (0.11)</td>
<td>6.18</td>
<td>&lt; .001</td>
<td>0.04</td>
</tr>
<tr>
<td>Shape: Linear</td>
<td>-0.10 (0.11)</td>
<td>0.91</td>
<td>0.370</td>
<td>0.04</td>
</tr>
<tr>
<td>Shape: Quadratic</td>
<td>-0.88 (0.20)</td>
<td>4.40</td>
<td>&lt; .001</td>
<td>0.00</td>
</tr>
<tr>
<td>Gender Effect Delinquency</td>
<td>-0.17 (0.22)</td>
<td>0.77</td>
<td>0.456</td>
<td>0.02</td>
</tr>
</tbody>
</table>
Table 7

Estimates, Standard Errors and Convergence t-ratios for Full Model

<table>
<thead>
<tr>
<th>Model Parameter</th>
<th>Verbal Descriptor</th>
<th>Parameter (SE)</th>
<th>t</th>
<th>P value</th>
<th>Convergence t-ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Network Objective</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rate (Period 1)</td>
<td>Rate of tie change between wave 1 &amp; 2</td>
<td>22.63 (1.96)</td>
<td>11.55</td>
<td>&lt;.001</td>
<td>0.01</td>
</tr>
<tr>
<td>Rate (Period 2)</td>
<td>Rate of tie change between wave 2 &amp; 3</td>
<td>17.78 (1.75)</td>
<td>10.16</td>
<td>&lt;.001</td>
<td>0.00</td>
</tr>
<tr>
<td>Outdegree</td>
<td>Density of friendship networks is low</td>
<td>-3.16 (0.04)</td>
<td>79.00</td>
<td>&lt;.001</td>
<td>0.04</td>
</tr>
<tr>
<td>Reciprocity</td>
<td>Friendships tending to be reciprocated</td>
<td>2.34 (0.08)</td>
<td>29.25</td>
<td>&lt;.001</td>
<td>0.00</td>
</tr>
<tr>
<td>Transitivity</td>
<td>Friendships display transitive closure</td>
<td>0.73 (0.03)</td>
<td>24.33</td>
<td>&lt;.001</td>
<td>0.04</td>
</tr>
<tr>
<td>3-cycles</td>
<td>Informal hierarchy in network</td>
<td>-0.73 (0.07)</td>
<td>10.43</td>
<td>&lt;.001</td>
<td>0.03</td>
</tr>
<tr>
<td>Gender Alter</td>
<td>(Actor-dependent covariate)</td>
<td>-0.00 (0.05)</td>
<td>0.00</td>
<td>0.968</td>
<td>0.11</td>
</tr>
<tr>
<td>Gender Ego</td>
<td>(Actor-dependent covariate)</td>
<td>-0.05 (0.05)</td>
<td>1.00</td>
<td>0.338</td>
<td>0.08</td>
</tr>
<tr>
<td>Ethnicity Alter</td>
<td>Homophily according to gender</td>
<td>0.43 (0.04)</td>
<td>10.75</td>
<td>&lt;.001</td>
<td>0.18</td>
</tr>
<tr>
<td>Ethnicity Alter</td>
<td>Send ties to similar ethnic/racial group</td>
<td>0.04 (0.01)</td>
<td>4.00</td>
<td>&lt;.001</td>
<td>0.05</td>
</tr>
<tr>
<td>Ethnicity Ego</td>
<td>Receive ties from similar ethnic/racial group</td>
<td>0.03 (0.01)</td>
<td>3.00</td>
<td>0.032</td>
<td>0.10</td>
</tr>
<tr>
<td>Ethnicity Similarity</td>
<td>Homophily according to ethnicity</td>
<td>0.25 (0.06)</td>
<td>4.17</td>
<td>&lt;.001</td>
<td>0.14</td>
</tr>
<tr>
<td>Delinquency Alter</td>
<td>Send ties to higher levels of delinquency</td>
<td>0.15 (0.05)</td>
<td>3.00</td>
<td>0.006</td>
<td>0.03</td>
</tr>
<tr>
<td>Delinquency Ego</td>
<td>Higher levels of delinquency send fewer ties</td>
<td>-0.21 (0.07)</td>
<td>3.00</td>
<td>0.002</td>
<td>0.02</td>
</tr>
<tr>
<td>Delinquency Similarity</td>
<td>Homophily according to delinquency</td>
<td>0.52 (0.27)</td>
<td>1.93</td>
<td>0.049</td>
<td>0.07</td>
</tr>
<tr>
<td><strong>Behavior Objective</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Delinq Rate (Period 1)</td>
<td>Rate of behavior change between wave 1 &amp; 2</td>
<td>1.12 (0.19)</td>
<td>5.89</td>
<td>&lt;.001</td>
<td>0.00</td>
</tr>
<tr>
<td>Delinq Rate (Period 2)</td>
<td>Rate of behavior change between wave 2 &amp; 3</td>
<td>0.83 (0.16)</td>
<td>5.19</td>
<td>&lt;.001</td>
<td>0.02</td>
</tr>
<tr>
<td>Shape: Linear</td>
<td>(Linear behavioral shape)</td>
<td>-0.41 (0.37)</td>
<td>1.11</td>
<td>0.273</td>
<td>0.04</td>
</tr>
<tr>
<td>Shape: Quadratic</td>
<td>(Quadratic behavioral shape)</td>
<td>0.87 (0.93)</td>
<td>0.94</td>
<td>0.347</td>
<td>0.01</td>
</tr>
<tr>
<td>Delinq Avg. Similarity</td>
<td>(Delinquency is assimilated to friends)</td>
<td>17.25 (18.02)</td>
<td>0.96</td>
<td>0.338</td>
<td>0.00</td>
</tr>
<tr>
<td>Delinq Total Similarity</td>
<td>(Delinquency levels is assimilated)</td>
<td>-0.97 (1.93)</td>
<td>0.50</td>
<td>0.616</td>
<td>0.04</td>
</tr>
<tr>
<td>Delinq Average Alter</td>
<td>(Influence effect of delinquency)</td>
<td>-4.54 (4.36)</td>
<td>1.04</td>
<td>0.299</td>
<td>0.02</td>
</tr>
<tr>
<td>Main effect Gender</td>
<td>(Main effect of gender on delinquency)</td>
<td>-0.21 (0.40)</td>
<td>0.53</td>
<td>0.608</td>
<td>0.07</td>
</tr>
<tr>
<td>Main effect Anger</td>
<td>(Main effect of anger on delinquency)</td>
<td>-0.04 (0.26)</td>
<td>0.15</td>
<td>0.868</td>
<td>0.05</td>
</tr>
<tr>
<td>Main effect Parent Monitor</td>
<td>(Main effect of parent monitor on delinquency)</td>
<td>-0.32 (0.33)</td>
<td>0.97</td>
<td>0.320</td>
<td>0.03</td>
</tr>
</tbody>
</table>
Note: Girls were coded as 0 and boys were coded as 1. Verbal descriptors in () give a general descriptor of the effect but do not offer specific interpretations given a non-significant effect.