Understanding Social Role Contributions to Antisocial Behavior in Adolescence
and Adulthood: A Genetically Informed Approach


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## Dedication

This thesis is dedicated to Meg Aldrich and Chip Ward whose unwavering love and support gave me the courage and discipline to follow my dreams. I would also like to thank them for their incredible kindness, dedication, and patience, as manifested in reading this entire dissertation.

**Abstract**

Social role transitions (including marriage and parenthood) are putative factors thought to predict desistance from antisocial behavior. However, it is difficult to distinguish whether these social role transitions cause a reduction in antisociality or if individual differences in antisocial behavior lead to these differences prior to social role transition. We examined the relationship between antisocial behavior (ASB) and marriage and early adult parenthood in a longitudinal study with a genetically informative sample, including a large number of female subjects. Our study included assessment of antisocial behavior both before and after these social role transitions. We also used a co-twin control (CTC) design which controls for familial factors (genetics and environment), and estimated to what degree the married twin's antisociality resembles that of the unmarried co-twin (or the early parenting co-twin resembled the non-parenting co-twin). There was no evidence of pre-existing difference in the antisociality of members of twin pairs who later became discordant for marriage or early parenthood. However, after the social role transitions, married and early-parenting co-twins were less antisocial than their co-twins who did not undergo the social role transition. This is consistent with evidence of a causal role of social roles in reductions of antisocial behavior in adulthood.

We also explored the association between social role transitions and psychopathic personality traits, which are thought to underlie stable antisocial behavior. There are multiple dimensions to psychopathy, and these dimensions differ in their associations with other important characteristics. In particular, the affective and interpersonal factor of psychopathy, which is driven by low fear, may be adaptive in some contexts, whereas the

behavioral disinhibition factor is more consistently associated with risk and poor outcome. We examined the relationship between two factors, Fearless Dominance (FD) and Impulsive Antisociality (IA), and these social role transitions, and the timing of these transitions. IA consistently predicted less adaptive outcomes (lower likelihood of marriage, higher likelihood of divorce, earlier parenthood), and FD was more variable (higher likelihood of divorce in female subjects, later parenthood). We also evaluated gender differences and results were largely consistent across male and female subjects. These results suggest that the interpersonal/affective quality of psychopathy may be associated with both positive and negative development, whereas behavioral disinhibition is more consistently associated with poorer outcomes.

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# Chapter 1: Introduction and Overview

Antisociality comprises a wide-ranging set of behaviors that violate social norms and rules; this may include lying, cheating, vandalism, theft, assault, and manipulation. Antisocial behavior can begin in middle childhood, but often experiences a significant increase in frequency in early adolescence (Moffitt, 1993). The rise in antisocial behavior continues throughout adolescence, and begins to desist in young adulthood. Antisocial behavior is more commonly demonstrated by males, but females participate substantially and are particularly likely to develop antisocial behavior later (Marmorstein & Iacono, 2005; Silverthorn & Frick, 1999). Individuals tend to engage in antisocial behavior for at least several years after initiation, though the severity of their antisociality may fluctuate somewhat (Lahey, Loeber, & Hart, 1995).

Antisocial behavior has been associated with a wide number of outcomes across a broad variety of domains including cognitive factors (childhood IQ, attention), family factors (parent-child relationship quality, conflict, parental monitoring, sibling antisocial behavior), personality (early childhood temperament, sensation seeking in adolescence and adulthood), peer relationships (including delinquent peers and romantic partners), neighborhood variables (including access to drugs, community values, and safety), age, gender, etc. (Dodge & Pettit, 2003; Loeber, 1991). Some of these associations persist throughout the lifespan, while others appear to be transient in association. Research studies have struggled to differentiate causal antecedents, causal consequences, alternative manifestations of the underlying trait, and associated variables.

Understanding the causes of antisocial behavior and identifying risk variables that could be used to help reduce antisocial behavior are both of high importance. Developing

effective interventions for antisocial behavior is a priority for researchers, family members, school staff, and community leaders alike, as antisocial behavior can cause serious and expensive repercussions within a community or family. Designing and implementing effective interventions on a wide scale has remained difficult despite substantial research identifying significant and reliable correlates of antisocial behavior. However, it is difficult to assess why these variables co-occur. Some have argued that these represent diverse expression of a unitary trait, while others have argued that adverse environmental contexts causally increase these associations. Others have contended that, like antisocial behavior itself, many of the adverse environments are also influenced by genetics, and that this overlap may emerge from shared genetic liability. However, even if the covariance is caused by genes, it does not mean that the trait itself is fixed and unchangeable, or that interventions focused on the associated variable would not have any effect on antisocial behavior. As an example, parents and children share 50% of their genes, and some of the parent-child similarity in antisociality is genetically influenced. However, family-focused interventions have produced substantial long-term reductions in antisocial behavior (Yoshikawa, 1995).

*1.1 Desistance*

Desistance from antisocial behavior is defined as the reduction in antisocial behavior over a period of time. Normative data suggests that there is a large reduction in aggregate antisociality in late adolescence and early adulthood (Moffitt, 1993). The core goal of any antisocial behavior treatment program is to initiate or hasten desistance in an individual. Thus, understanding desistance is a core goal of prevention research. While desistance is characterized by significant individual differences, there are two typical

periods of desistance from antisocial behavior. The first period of reduced antisocial behavior occurs in early adolescence, as many individuals with high childhood levels of antisocial behavior reduce their antisociality. The second wave occurs during late adolescence and early adulthood, and is responsible for the large normative decreases in antisocial behavior. Factors that account for desistance likely vary by age, as the factors that encourage initiation of child and adolescent antisocial behavior differ (Loeber, 1991). In addition to these two particular waves, there is extensive heterogeneity in individual patterns of antisocial behavior in adolescence. Many people begin their desistance process earlier. In addition, there is a small group of people who wait until the normative desistance period to initiate antisocial behavior; that is, they engage in little or no antisocial behavior until early adulthood (Marmorstein & Iacono, 2005). This paper largely focuses on the contributions to desistance in the late adolescence/early adulthood period. The factors that promote persistence in middle adolescence are likely different than those in early adulthood, and thus deserve separate exploration.

*1.2 Measurement of Antisocial Behavior*

Operationalization of antisocial behavior varies considerably from study to study; some use diagnostic variables (including conduct disorder or antisocial personality disorder symptoms), others use ratings, and some use observational data. The focus of the antisocial behavior assessment may vary. Some focus on delinquency, some on aggression, and others on objective law breaking. Individuals are often thought to be the best reporters, especially as they age and have the opportunity to engage in antisocial behavior away from parents or teachers. Generally, the best practice is to include multiple informants.

*Developmental considerations:* Heterogeneity in findings may also emerge from difficulty in assessing antisocial behavior longitudinally; antisocial behavior is best characterized by heterotypic continuity, or the variation in manifestation of an underlying trait, which is particularly relevant across different development stages. Antisocial behavior is a set of actions that violate rules or social norms, and social norms change substantially over adolescence and adulthood. For example, drinking alcohol is a common and frequent practice in adults, but is rare and likely an indication of quite high risk in 10-year-olds. As individuals age, even before the legal drinking age, drinking alcoholic beverages becomes a less severe index of substance use. Heterotypic continuity may impede assessment of longitudinal and developmental change in contributions to antisocial behavior.

*Measurement issues specific to desistance:* Measuring desistance from antisocial behavior is a difficult matter. Desistance is defined as the absence or reduction of a particular behavior, generally in comparison to a previous time. There are no set standards for desistance, neither in terms of how much time has passed nor how much the behavior has decreased. There are natural variations in antisocial behavior, and an individual who has merely refrained from vandalism for several months may have done so out of lack of opportunity, rather than meaningful change in the latent trait. This is perhaps especially true for antisocial behavior, as longitudinal studies of antisocial behavior have often found some yearly variation in endorsed diagnostic symptoms. An individual may endorse a decrease in antisocial behavior one year, only to increase again the next (Lahey et al., 1995). Minor decreases in antisocial behavior, especially when using positively-skewed measures, may not represent meaningful or stable changes in the

underlying latent trait. Finally, serious consequences of antisocial behavior may interfere with opportunities for antisocial behavior (i.e. prison time), without actually reflecting change in the individual.

Additionally, desistance may not be complete; an individual may stop major acts of antisocial behavior, but continue to engage in more mild forms. Even incomplete desistance is usually associated with positive outcomes, and waiting until individuals have stopped engaging in all forms of antisocial behavior is too stringent. However, it is important to identify heterotypic continuity in antisocial behavior, and assess whether or not the new forms of antisocial behavior are similarly maladaptive. Studies assessing a narrow or severe form of antisocial behavior, such as criminal activity, may fail to identify individuals changing to different forms of antisocial behavior (such as a shift from vandalism to failure to complete occupational obligations). Furthermore, given that a drop-off in antisocial behavior is developmentally normative as individuals mature and highly likely even for individuals who continue to engage in antisocial behavior for long periods of time, factors influencing desistance are more predictive for rate of desistance, rather than desistance at all (Craig & Foster, 2013). Risk factors may prolong the levels of antisocial behavior, at the same or higher level, or they may merely reduce the slope of the change over time, increasing the time it takes for an individual to mature out of antisocial behavior. There is considerable variation in the steepness of desistance trajectories (Hussong, Curran, Moffit, Caspi, & Carrig, 2004; Loeber, 1991). Generally, people at the highest levels of antisocial behavior, who have engaged in antisocial behavior for the longest, take the most time to reduce their antisocial behavior. However, in short time periods of assessment, their trajectories of desistance often look steeper,

possibly simply due to regression toward the mean (Hussong et al., 2004)(Hussong et al., 2004). Therefore, the most accurate understandings of an individual's behavior change are more likely to result from a broad, comprehensive assessment of desistence, wherein antisocial behavior is measured over at least multiple years of time. Assessment of antisocial behavior ideally should include questions about diverse expressions of antisociality (criminal and delinquent behavior, manipulative behavior, violations of social norms).

*1.3 Causes of Individual Differences in Desistance*

Like all kinds of human behavior, there are considerable individual differences in the patterns, onset, and length of desistance processes. There are several main domains that have been theorized to predict desistance from antisocial behavior: substance use, individual characteristics like personality and intelligence, and social role transitions (including employment and marriage) (Hussong et al., 2004; Laub & Sampson, 2001). This paper focused on antisocial behavior and social role transitions, specifically family formation in adulthood.

*Social Role Transitions.* One of the key proposed mechanisms for desistance from antisocial behavior involves changes or shifts in identity that occur with changing roles. As one's occupational or social role identity shifts and demands more resources and attention from the individual, the individual will engage in antisocial behavior less frequently, perhaps because they are less peer-focused, and antisocial behavior is less suited to their new identity. Broadly, marriage, education, and employment are all associated with reduced levels of antisocial behavior, although not all studies have assessed females as well as males (Apel, Bushway, & Brame, 2007; Moffitt & Caspi,

2002; Sampson & Laub, 1993). Social role transitions and adult family formation, as the individual shifts from focusing on peers to focusing on romantic relationships, are thought to be especially salient. Marriage is one of the most commonly studied factors. People who get married have lower levels of antisocial behavior, and the research has focused on understanding whether or not this relationship reflects selection effects or causal processes (Laub & Sampson, 1993). The role of parenthood is also an important step in adult family formation, and may also relate to antisocial behavior.

*Theories of Desistance:* Researchers have posited several theoretical explanations for the developmental trend of desistance in late adolescence and early adulthood. Sampson and Laub's (1993) age-graded theory of informal social control argues that engagement in social commitments, such as marriage or employment, decreases interest in criminal and antisocial behavior. When an individual is invested in something (work or family) that provides structure, support, and opportunities for rewards, he or she is less likely to commit crime. Desistance may occur because of individual development in mental and physical processes, leading to changes in cognition, values, or beliefs that reduce antisocial behavior. Desistance may emerge as part of increased engagement in community or social institutions, including romantic relationships or education. The rewarding component of antisocial behavior may decrease, and thus antisocial behavior may no longer be the rational choice for the individual that it was in adolescence, when it served to increase peer connections or help acquire material goods. In contrast, Warr (1988) argued that the change in criminality is merely behavioral; that as people take on new roles, their time becomes more limited, leaving fewer opportunities to engage in antisocial behavior. The approach taken by Warr (1998) would predict that the time

demands of the roles, rather than the quality and commitment to these new obligations, would drive the reduction. And still others have argued that the relationship between social role transitions and antisocial behavior merely reflects shared liability; individuals who get married are quantifiably different from those who don't.

*1.4 Heterogeneity in Antisocial Behavior*

Research into antisocial behavior is characterized by significant heterogeneity in both the measurement of the phenotype and the pattern of associations. There is considerable variation both in how antisocial behavior is measured, and the strength of associations between propensity for antisociality and other risk factors. This may reflect heterogeneity in the underlying characterization of antisocial behavior. Antisociality may be best understood as multiple correlated but separate dimensions. Researchers have sought an organizational system that differentiates between types of antisociality.

Some studies have differentiated between rule-breaking and aggression, arguing that aggressive antisocial behavior is more severe, more predictive of adult antisocial behavior, and more heritable (S. Burt & Neiderhiser, 2009; Eley, Lichtenstein, & Stevenson, 1999). Others have argued that callous and unemotional personality traits are the key to understanding and predicting severity and persistence of antisocial behavior (Frick & White, 2008; Neumann, Barker, Koot, & Maughan, 2010). These studies differentiated between the interpersonal and affective traits that predispose an individual towards psychopathy, and the more impulsive, behaviorally driven constructs. These two components mirror a substantial literature differentiating between behavioral and personality components of psychopathy (Harpur, Hare, & Hakstian, 1989; Lilienfeld & Andrews, 1996). Finally, additional studies differentiate between overt and covert

antisocial behavior. Though these described approaches differ substantially, in the diverse operationalizations, the more interpersonally disruptive form is seen as more severe, suggesting that the more directly antisocial behavior impacts another person's welfare, the more severe this behavior is judged.

*1.5 Behavioral Genetics and Antisocial Behavior*

The field of behavioral genetics focuses on identifying genetic and environmental contributions to traits. Studying related individuals, such as twins, allows us to quantify genetic and environmental contributions to a particular trait. In the case of twin studies, monozygotic (MZ) or identical twins and dizygotic (DZ) or fraternal twins share rearing environments and genes. All traits and behaviors show at least some genetic and some environmental influence on individual differences. Antisocial behavior is notable for consistently demonstrating a shared environmental effect, particularly during adolescence, but becomes more heritable in adulthood (Rhee & Waldman, 2002). In particular, the stability of antisocial behavior across time is highly heritable (Krueger et al., 2002; Tuvblad, Eley, & Lichtenstein, 2005). Other behaviors, like social roles transitions such as marriage and divorce, are also heritable, likely reflecting genetic contributions to personality traits and behaviors that promote marriage or divorce (Johnson, McGue, Krueger, & Bouchard Jr., 2004). However, behavioral genetics can offer more to the study of psychopathology than simple estimates of genetic and environmental influence. It can also allow for a greater understanding of change or stability over time. In addition, it can test for the effects of environmental differences on outcomes, after controlling for shared genetics and rearing environment. The ability to account for genetic relatedness allows us to identify environmental events that may have

causal influences on outcomes, as well as to more strongly test hypotheses about human behavior.

*1.6 General Sample*

The studies in this dissertation all use the community-representative sample of twins and families from the Minnesota Center for Twin and Family Research (MCTFR). The MCTFR data set is a study of approximately 2800 twins from age 11 or 17 until age 29, with assessments completed every 3-4 years. There are two cohorts in the MCTFR. The older cohort of twins (male subjects born in the years 1972-1978 and female subjects born in the years 1975-1979) started their assessment at age 17-18. They have been followed every several years, completing assessments at the approximate ages of 17, 20, 24, and 29. The younger cohort of twins (male subjects born in the years 1977-1982 and female subjects born in the years 1981-1984) was first assessed at age 11-12, and has since been assessed every few years at the approximate ages of 14, 17, 20, 24, and 29.

Twins in the MCTFR were recruited using publicly available birth records; over 90% of families were successfully located and contacted. Families were excluded if they lived more than a day's drive from the Minneapolis metropolitan area, or if one of the twins had a cognitive or physical disability. Of the families contacted, 83% of the eligible families agreed to participate, and brief follow-up interviews/self- reports with non-participating families indicated that the study is largely representative of twins born in Minnesota at that time (Iacono, Carlson, Taylor, Elkins, & McGue, 1999). Consistent with Minnesota demographics, 98% of the twins were Caucasian. Twins were asked to come back for follow-ups. The families in the younger cohort were contacted when their twins reached the age of 11. The younger cohort of twins contains individuals born in

1978 to 1984. Males of the younger cohort have completed the 'age 17', 'age 20', 'age 24', and 'age 29' follow-ups, while the younger cohort females are in the process of completing the 'age 29' assessment. The families in of the older cohort, who were born in the years 1972-1979, were contacted when their twins reached the age of 17. The older cohort has completed all follow-ups, 'age 20', 'age 24', and 'age 29'. In each case, approximately 85-95% of the sample returned for each assessment. We assessed zygosity through a zygosity questionnaire administered to the parents, evaluation of physical similarity by MCTFR staff, and comparing twins on ponderal and cephalic indices and fingerprint ridge counts. We performed serological analysis when the assessments disagreed.

*1.7 General Methods:*

*Behavioral Genetics Methodology:* The study will take advantage of the genetically informative nature of the MCTFR dataset to assess genetic contributions to social role transitions and the relationship between social role transitions and adult antisocial behavior. Behavioral genetic studies with twins take advantage of natural experiments to understand individual differences in traits or behaviors (phenotypes). Behavioral genetic analyses are able to leverage the difference in the genetic relatedness of twins of different zygosity to identify sources of shared genetic, shared environmental and unique environmental contributions to variance. The so-called identical (MZ) twins share one hundred percent of their genes, and one hundred percent of their shared environment. The fraternal (DZ) twins share fifty percent of their genes and one hundred percent of their shared environment. Therefore, any differences between identical twins are due to unique

environment (and measurement error). If the identical twins are more similar to each other than the fraternal twins, then genetics must contribute to the variance of the trait.

*Discordant Twin Designs:* Another way to take advantage of the twin "natural" experiment is to evaluate the nature of discordance. While twins tend to be similar to each other, they still differ, seeking out different friends, academic options, occupational trajectories, romantic partners, etc. The discordant twin design compares twin pairs where members of the pair differ on a particular variable (a unique environmental experience), such as marriage or attending college. Comparing discordant twins is a powerful design, because it controls for genetics and shared environmental variables, allowing for a quasi-causal test of the relationship between the discordant variable and an outcome. For example, studies have demonstrated that college graduates make more money, but this may reflect a causal effect of college education, or differences in individuals who pursue higher education(Stanek, Iacono, & McGue, 2011). Stanek et al. (2011) used a discordant twin design and found that twins who differed on college attendance did not significantly differ in income, indicating that the relationship between college attendance and income reflects shared predisposition to higher education and higher earning, rather than a benefit of college education. This dissertation leveraged the discordant twin design to assess the impact of marriage and parenthood on antisocial behavior trajectories.

**Chapter 2: The Effect of Marriage on Antisocial Behavior**

Antisociality can be defined as the tendency to engage in behavior that violates the social contract, breaks laws or rules, or causes harm to others. Antisociality increases substantially in adolescence and begins to remit in early adulthood (Moffitt, 1993). Understanding desistance from antisociality is important because the societal and public health costs of antisocial behavior are substantial, and knowledge about desistance may help to further it. Facilitating desistance from antisocial behavior may reduce some of the deleterious consequences as well as promote positive outcomes in the individuals themselves. Social control theory posits that people become less antisocial as they embrace more mature roles, such as those associated with marriage, parenthood, and occupation (Sampson & Laub, 1993). An individual's investment in these adult roles makes engaging in antisocial behavior less appealing, in part because the consequences of such behavior often undermine successful role fulfillment. Adopting adult roles may reflect a person's readiness to embrace them, and as a consequence lead to desisting antisociality and increased maturity, qualities that are likely to further increase the likelihood of responsible behavior.

*2.1 Marriage and Antisocial Behavior.*

One of the most commonly studied factors contributing to the desistance of antisociality is marriage (Farrington, 1995). Marriage is related to lower levels of antisocial behavior; even when controlling for prior antisocial behavior and other related factors such as personality and intelligence, marriage has a strong and highly consistent protective association with antisocial behavior (Laub & Sampson, 2001; Sampson & Laub, 2005). The effect was consistent for male and female subjects. Marriage has a

strong and highly consistent negative relationship with antisocial behavior. This beneficial association may be specific to marriage, as some studies have failed to find a benefit of romantic non-married relationships (Magda Stouthamer-Loeber, Wei, Loeber, & Masten, 2004). Using the nationally representative Add Health sample, Craig and Foster (2012) found that marriage predicted reduced delinquency from adolescence to adulthood, even after controlling for other types of social bonding (bond to parents and teachers in adolescence), suggesting a unique role for marital relationships relative to other important relationships. Research has sought to investigate if the marriage effect is correlational or causal, often by statistically adjusting for confounding individual characteristics. Because marriage generally arrives after the age peak for antisocial behavior, of particular interest in understanding the association between marriage and antisociality is whether individuals are "selected" as mates because they are low in antisociality or low antisocial individuals are more interested in pursuing marital relationships, the act of marriage lowers their antisociality, or both processes are in play.

*2.1.1 Moderators of the Relationship between Marriage and ASB.* The benefit of marriage is related to the quality of the romantic relationship (Rhule-Louie & McMahon, 2007; Magda Stouthamer-Loeber et al., 2004). High quality marriages offered an additional protective effect beyond marriage itself in a sample of males followed from the 1940s to the 1960s (Laub, Nagin, & Sampson, 1998). Examining change in marital quality over time, Laub et al. (1998) found that the gap between individuals in strong/supportive and combative marital relationships widened—those in strong marriages became increasingly less antisocial relative to those in other marriages. In this study, it was not marriage itself that was protective, but rather the strong and supportive

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marital relationships that were associated with reduced antisocial behavior. However, spousal support and attachment is not always associated with positive outcomes. A longitudinal sample of institutionalized juvenile offenders (including both males and females) found that attachment to spouse provided no protective benefits to either sex in adulthood (Giordano, Cernkovich, & Rudolph, 2002). This study looked at high level offenders who had been institutionalized during adolescence for antisocial behavior and analyzed predictors of adult antisocial behavior. This suggests that for high-level offenders, spousal support does not provide sufficient protection to moderate behavioral outcomes. This may partially reflect the characteristics of spouses of highly antisocial individuals, who may themselves have antisocial tendencies.

Additionally, changes in peer relationships may possibly mediate this relationship. Relationships with peers change after marriage; married individuals spend less time with delinquent peers and more time with prosocial individuals, including romantic partners (Warr, 1998). This is likely to be especially true for males. Women generally have lower levels of antisocial behavior than men, thus a male in a heterosexual marriage spends more time with a partner that is likely to be less antisocial. As delinquent peers are one of the strongest and most consistently demonstrated risk factors for antisocial behavior, it is possible that committing to a strong marriage decreases opportunities to engage with antisocial peers, and thus reduces exposure to antisocial opportunities.

*2.1.2 Who Benefits from Marriage?* It is unclear if marriage benefits all individuals equally. Marriage may be more likely to reduce male antisocial behavior, as men have generally higher levels of antisocial behavior than women, and marriage increases their

connection to a less antisocial individual. Women, on the other hand, are more likely to marry men with higher levels of antisocial behavior than themselves. There is also assortative mating; antisocial individuals frequently date and marry each other (Krueger, Moffitt, Caspi, Bleske, & Silva, 1998). Individuals with a childhood history of conduct disorder are more likely to have antisocial partners; however, if they have a non-deviant partner, they are less likely to be convicted as an adult (Quinton, Pickles, Maughan, & Rutter, 1993).

There is some evidence that women are more influenced than men by negative partner characteristics (Simons, Stewart, & Gordon, 2002). Simons et al. (2002) found having antisocial friends and an antisocial romantic partner (through exclusive dating, cohabitation, or marriage) significantly predicted adult crime, and these effects were stronger for female subjects. Furthermore, the results suggested biased selection of partners for males (already antisocial males choose already antisocial females as partners), but not for females (average females choose more antisocial males as partners and were negatively influenced), indicating that females are more vulnerable to having an antisocial partner. Adolescents may be particularly vulnerable to modifying their behavior to match their partner's characteristics. The seriousness and quality of the romantic relationship, as well as the developmental stage, moderate the protectiveness of romantic relationships on antisocial behavior (Rhule-Louie & McMahon, 2007). In their review, having a committed romantic partner in adulthood was largely protective, but was a risk factor for adolescent antisocial behavior, emphasizing the importance of timing. Overall, there is more limited and mixed evidence of the benefit of marriage for female individuals, especially if they have an antisocial partner. However, marriage may provide

benefits to women in other, related domains(Prescott & Kendler, 2001). Prescott and Kendler (2001) found that marriage predicted reduced alcohol consumption in women, suggesting that marriage may moderate other female externalizing behaviors.

Individuals differ substantially in their likelihood of getting married, and the likelihood of getting married is predicted by lower antisocial behavior. If the benefit of marriage merely reflects pre-existing differences in antisocial behavior (less antisocial individuals are more likely to get married), then individuals who are unlikely to get married (because they are highly antisocial, not prone to forming stable relationships, etc.) will be less likely to benefit from marriage (if they do get married, as even some highly antisocial individuals will). Or marriage may have a causal impact on individual trajectories; individuals who are more antisocial (and less likely to get married), if they do get married, may benefit just as much as, or more, than their less antisocial peers. Blokland and Nieuwbeerta (2005) examined the relationship between trends of antisocial behavior (increasing, chronic, abstainers) and social role transitions on criminal offending. They found marriage predicted lower offending in all individuals, regardless of trajectory or history of severe antisocial behavior; the benefits of marriage were not only for individuals with low levels of antisocial behavior. Their study, a longitudinal study of delinquency in young adults assessed in the 1980s, used individual and social factors to identify individual's likelihood of marriage; important variables included in the likelihood of marriage score were work history, age, prior arrest, family marital history, family education, living location (rural vs. urban), orientation toward family, as well as numerous other variables. The score identified characteristics related to marriage; most individuals with high scores got married, and most individuals with low scores remained

unmarried; this method allowed the researchers to control for some confounding characteristics that might contribute to adult criminal behavior and likelihood of marriage. So, for example, educated individuals with married parents and no prior arrests tended to have a high likelihood of marriage; these subjects are given a high likelihood of marriage score even if they are not married, just as individuals with opposite characteristics were given a low likelihood of marriage score even if they did get married. However, some of those with low likelihood of marriage did get married, and when they did, they benefitted the most (King, Massoglia, & MacMillan, 2007). When the study stratified the sample by propensity to marry, antisocial men with the least likelihood of getting married were the ones most likely to benefit from marriage. Women with moderate propensity to marry benefited the most when they got married, and female subjects with the lowest propensity to marry did not seem to benefit from marriage. This difference suggests that marriage may benefit individuals differently: males with the smallest likelihood of getting married may experience the most cognitive or behavioral change after getting married. This is consistent with a causal, protective effect of marriage. However, this is not universal. Women may not benefit from marriage if their partners are also likely to offend, as was common for women with the lowest odds of marriage. King et al. (2007) suggested that the mid-propensity women received the most benefit, because they were engaging in some moderate antisocial behavior and thus had room to improve (relative to the high-propensity group), but were also less likely to choose highly antisocial partners (relative to the low-propensity group). This finding suggests that marriage may have a causal effect, but only if an individual marries a partner with less antisociality. Overall, this study found evidence that marriage was more

beneficial to men, and that the relationship between marriage and antisocial varies both by gender and by individual characteristics (propensity to marry).

*2.1.3 Is there evidence that marriage leads to diminished antisocial behavior?:* A fundamental question of this literature is discerning if the relationship between marriage and antisocial behavior represents a true change in the individual, directly attributable to marriage, or if individuals who get married were merely on less antisocial trajectories prior to marriage. Marriage is not a random event, and it may reflect characteristics that also account for low antisocial behavior. Indeed, individuals who get married are less likely to have high levels of antisocial behavior years prior to marriage. Individual with high levels of conduct problems are less likely to have supportive, strong relationships in adulthood (Quinton et al., 1993). The literature has long been aware of the non-random nature of antisocial individuals getting and staying married, and of its possible impact upon outcomes (Sampson, Laub, & Wimer, 2006). There is substantial evidence of self-selection into marriage by less antisocial individuals; the question is whether this accounts for all of the variation. To this end, many studies have attempted to discern the answer by rigorously controlling for many other putatively related variables, and then testing if marriage still offers a protective effect after taking into account these other constructs.

Sampson, Laub, and Wimer (2006) attempted to resolve the causality issue using inverse probability of treatment weighting, controlling for dozens of covariates in a longitudinal sample assessed in the 1940s-1960s. They accounted for a number of variables associated with antisocial behavior and marriage, including family background, intelligence, personality variables, self-control, and economic potential. Their study

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found that marriage had a protective effect on criminal behavior throughout adulthood (up until age 70), even after controlling for the previously mentioned characteristics. More recently, King et al. (2007) also used propensity score matching to control for pre-marriage differences in a study using the NYS sample (a longitudinal study examining change in delinquency in the 1980's). After controlling for previous offending, work history, family background, neighborhood structure, delinquent peers in adolescence, and orientation towards family and dating in adolescence, among other variables, marriage had a small but significant effect, and appeared to reduce adult criminal behavior for males (most of the effect was driven by long-standing differences); there was no marriage advantage for female subjects after controlling for these variables. Controlling for a number of important factors associated with marriage does not entirely reduce the association between marriage and antisocial behavior, at least for males. However, it is still possible that there are causal factors that are not being controlled for in these studies. Behavioral genetic methodology is able to provide even stronger tests by controlling for shared genetic and environmental background.

*2.1.4 Behavioral Genetic Studies:* Behavioral genetic methodology offers valuable understanding of traits and behavior as it can untangle genetic and environmental contributions to individual traits, and to the co-variation between relevant traits. Behavioral genetic studies, like propensity matching or other methods, seek to control for some of the shared liability that might underlie two variables, such as shared genetics or rearing variables. For example, both marriage and antisocial behavior are heritable, and the correlation between the two may merely indicate shared genetic liability, rather than a causal relationship. They might also share an environmental cause, such as childhood

socioeconomic status, or neighborhood factors. Behavioral genetic studies can quantify the genetic and environmental relatedness between individuals, such as siblings or twins, and assess how much variation is unique, and how much co-variation is due to genetic or environmental factors. The co-twin control design can partition variance into between-family effects (like shared genes, rearing conditions), and within-family effects (things that differ between members of the same family). This is a counterfactual design that allows for estimation of what individuals might have looked like if they had alternative outcomes (e.g. if an unmarried individual had gotten married) by comparing them to their family member who experienced the outcome

Furthermore, the discordant co-twin design can demonstrate causal effects, in either direction. The discordant co-twin design compares twins (MZ or DZ) who are discordant for a particular event or characteristic (such as marriage). This is particularly powerful when comparing discordant MZ twins, as they share all of their genetic material, and all of shared environment (rearing environment, such as family socioeconomic status, and other variables common to twins). If shared genes or environment entirely account for the covariation between marriage and antisocial behavior, then we would expect to see no difference between MZ twins discordant for marriage. However, if there is a difference between MZ co-twins, we can attribute it to non-shared environmental factors, such as the non-shared environmental factor we selected the twins to be discordant for (i.e. marriage). If discordant MZ twins look different on an outcome measure, then the difference was caused by something other than genes or shared rearing environment; it may be the variable upon which they are discordant. In this way, the discordant twin design allows researchers to control for genetic and shared environmental contribution to

covariation between traits, and offers a stronger, quasi-causal test of the research question. If there is no significant difference between MZ twin pairs, then the effect is entirely driven by shared variables, and is not consistent with a causal hypothesis.

A handful of genetically-informative studies have assessed the relationship between marriage and antisocial behavior in males, and have found some small benefit of marriage. One study found that the relationship between marriage and antisocial behavior was largely attenuated once controlling for characteristics common to members of the same family (such as genes, qualities of the rearing environment, and other environmental events shared by twins reared together), consistent with the notion that most of the association is driven by pre-existing characteristics that make an individual both less antisocial and more marriageable (Burt et al., 2010). There was some small evidence of a specific and perhaps causal benefit for males. Another study found that while controlling for genetic factors significantly attenuated the relationship between criminal behavior and marital status, there was still an association, suggesting that marriage may offer a unique benefit (Barnes & Beaver, 2012). Their study, using data from the Add Health sample, examined desistance from adolescent offending, and operationalized desistance as complete abstinence from illegal behavior in adulthood.

One study used twin pairs and siblings, including female subjects, in the American Add Health sample to demonstrate that the benefits of marriage (relative to cohabitation) on criminal behavior and alcohol use persisted after controlling for shared genetic and environmental factors (Horn, Xu, Beam, Turkheimer, & Emery, 2013). It is worth noting that this benefit was specific to marriage; individuals engaged in cohabitation relationships did not have lower levels of antisocial behavior. This suggests that the

benefit of marriage is not merely through a serious relationship, but through a specific, highly committed (i.e. marriage vs. cohabitation) type of relationship. Behavioral genetic studies have taken advantage of twins to get further insight into the covariation of marriage and antisocial behavior. These studies have confirmed that at least some of the association appears to be driven by shared genes and/or environment, and are not consistent with causal hypotheses. However, several studies have also found evidence that marriage may have a causal protective benefit on criminal behavior for males (Barnes & Beaver, 2012; Burt et al., 2010). Other behavioral genetic studies have found protective benefits of marriage using discordant co-twins, further strengthening the evidence that marriage can have a causal impact on outcomes. One use of the discordant twin design with MZ twins analyzed the relationship between marriage and economic earning, and found that marriage was associated with higher income, even among identical twins (Antonovics & Town, 2004).

*2.1.5 Unresolved Issues Regarding the Effect of Marriage on Antisociality:* While there is substantial research investigating the relationship between marriage and antisocial behavior, most of the studies have assessed the effect between marriage on criminal behavior (rather than antisocial behavior broadly) in largely male populations. There is considerably less work examining the protective effect of marriage in women. Additionally, many of the studies have operationalized antisocial behavior as merely criminal behavior, rather than taking a broad look at antisociality covering a range of behaviors. An individual might moderate expression of criminal behavior, but shift antisocial tendencies toward more manipulative/callous treatment of others. So, rather than necessarily representing desistance from antisociality, it might merely reflect

heterotypic continuity, as someone reduces criminal behavior but increases manipulation, lying, and cheating. Measuring change using a narrow definition of antisocial behavior might miss evidence of heterotypic continuity and mistakenly interpret results as due to desistance. Ideally, studies would include broad measures of antisocial behavior disposition, which include questions about both criminal and delinquent behavior, as well as willingness to lie, cheat, and manipulate, at multiple assessments. This would capture individuals who alter the specifics of their antisocial behavior, rather than desisting from one type.

Furthermore, some of the longitudinal studies have used samples from earlier times (marriage prior to 1960s). Patterns of marriage and divorce have changed substantially in the last half-century, and the divorce rate has more than doubled since 1960. Average age of marriage has risen, from 23 and 20 for males and females in the 1960s, respectively, to 27 and 25 in 2003 (Simmons & Dye, 2004). As marriage moves farther away from adolescence, its relationship to desistance from antisocial behavior may change. If the relationship between marriage and desistance is merely correlational, rather than causal, the changing age of marriage will mean that desistance rates remain steady and the association will no change. If marriage has a causal role, we might expect the association between marriage and desistance to weaken as marriage age increases, as more individuals desist prior to marriage. Therefore, it is prudent to re-examine the relationship between marriage and antisocial behavior , as some of the seminal work in this area is comprised of a study sample that reached adulthood in the late 1940s and 1950s (Sampson & Laub, 1993). Furthermore, behavior genetics methodology makes it possible to investigate the relationship more fully. As only a few studies have used

behavior genetic methodology to understand the causal effect of marriage on antisocial behavior, and only one used females, there is a need for a more thorough understanding. Additionally, many of these studies (including the one study including female subjects), assessed criminal behavior rather than broad antisociality.

*2.1.6 Current Study:* Our study assessed the effect of marriage on a broad measure of antisocial behavior, which encompasses rule-breaking behavior, physical and aggressive behavior, and callous behavior. Using a longitudinal and genetically informative sample, we assessed antisocial behavior in adolescence through adulthood, giving us prospective data about antisocial behavior before and after the onset of marriage. Our study differentiated between pre and post-marriage levels of antisocial behavior in adulthood. Lifetime levels of antisociality include behavior engaged in before the onset of marriage, likely by many years. The post-marriage assessment of antisocial behavior included only recent antisocial acts, rather than symptoms from across the individual's lifespan. We expected married individuals to have lower levels of lifetime antisocial behavior, prior to marriage, consistent with low antisocial individuals selecting into marriage. However, we expected marriage to provide additional benefit beyond long-standing individual differences in people who choose to get married. If marriage causally reduces antisocial behavior, we expected the benefit of marriage to be stronger for post-marriage antisocial behavior, as its benefit will provide an additional reduction in antisociality, beyond longstanding, pre-marriage differences in antisocial behavior. If marriage does not change an individual's trajectory, then we would expect to see the same association between marriage and for antisocial behavior both before and after marriage. We

expected to find that marriage is more strongly related to recent rather than lifetime levels of antisocial behavior, which is suggestive of a causal benefit of marriage in reducing antisociality. We had two post-marriage assessments, which allowed us to qualitatively examine the benefit of marriage over time. As many individuals start to desist from antisocial behavior in young adulthood, marriage may prove more beneficial earlier on, when there is more room for improvement.

We also made use of the co-twin control (CTC) design to more rigorously test our hypotheses. We differentiated between individual and family level exposure to marriage in twins, allowing us to identify if marriage was related to antisocial behavior after controlling for characteristics shared by twins. If the correlation between marriage and antisocial behavior is accounted for entirely by shared genetic or environmental causes, we would not expect the individual (or within-pair) effect to be significant (beyond the effect demonstrated by the family or between-pair effect). However, if marriage is causal, then there will be an additional effect of marriage, the within-pair effect, and unmarried co-twins will have higher antisocial behavior than their married co-twins. Our hypothesis is further strengthened using twin pairs discordant for marriage. Discordant twins offer the opportunity to run quasi-causal analyses; twins share a number of factors that may account for the association between marriage and antisocial behavior, such as genetic predisposition or familial rearing environment. If the association between marriage and antisocial behavior persists, even amongst discordant twins who share genes and environmental variables, this offers stronger support for the causal role of marriage. We identified twins where only one individual got married, and compared their antisocial behavior before and after marriage. This allows for a stronger test of the putative

variable, as MZ twins share all of their genes and their rearing environment, and fraternal twins share their rearing environment and half of their genes, controlling for many of the variables that may confound covariation between variables. If the association between marriage and ASB is attributable entirely to pre-existing differences, then we expect the twins within a pair discordant for marriage to have similar levels of antisocial behavior post-marriage. If marriage has a causal and beneficial effect, then after marriage, the married co-twin should be significantly less antisocial than the unmarried twin. We calculated the effect size of marriage between discordant twins, and compared that to the effect calculated in the entire sample. If there are long-standing differences, we expect the effect size to be significantly attenuated compared to the general sample. If the effect size is different from zero, it indicates that marriage offers a specific benefit, beyond shared familial factors that might drive the association between marriage and ASB. Our study has prospective data both before and after marriage, allowing us to identify when differences in antisociality emerged in our discordant twin pairs.

*2.2 Methods*

*2.2.1 Participants:* This study comes from the community-representative sample of twins and families at the Minnesota Center for Twin and Family Research (MCTFR). The MCTFR is a longitudinal study of twins and their families from adolescence to adulthood with assessments completed every 3-4 years. This study makes use of two cohorts in the MCTFR. The older cohort started assessment at age 17-18 of twins born in the years 1972-1984. They have completed assessments at the approximate ages of 17, 20, 24, and 29. The younger cohort of twins was first assessed at age 11-12, and has been assessed

every couple of years since, at the approximate ages of 14, 17, 20, 24, and 29. There are approximately 2850 twins in both cohorts.

Subjects in the MCTFR were recruited using publicly available birth records, as birth records include information about multiple births. Over 90% of families with multiple births in the specified age ranges were successfully located and contacted. Of the families contacted, 83% of the eligible families agreed to participate, and brief follow-up interviews/self-reports with non-participating families indicate that the study is largely representative of twins born in Minnesota at that time (Iacono et al., 1999). We excluded families if one or more of the children had a serious cognitive or physical disability, or if they lived more than a day's drive from the Twin Cities metropolitan area. The twins and their families are approximately 98% Caucasian, consistent with Minnesota demographics at the time of their birth. Zygosity was assessed through multiple means, including a zygosity questionnaire administered to the parents, evaluation of physical similarity by MCTFR staff, and comparing twins on ponderal and cephalic indices and fingerprint ridge counts. Serological analysis was performed when the assessments disagreed.

The younger cohort of twins contains individuals born in 1977 to 1984. Twins returned for follow-up assessments every 3-4 years. Males of the younger cohort have completed the 'age 20', 'age 24', and 'age 29' follow-ups, while the younger cohort females were in the process of completing the 'age 29' assessment at the time this study was undertaken. The families in of the older cohort, who were born in the years 1972 to 1979, were contacted when their twins reached the age of 17. The older cohort has

completed all follow-ups, 'age 20', 'age 24', and 'age 29'. In each case, approximately 85-95% of the sample returned for each assessment.

The study uses the older and younger twin cohorts at the age 20, age 24 and age 29 assessments. The older cohort contains 1252 subjects, 578 males and 674 female twins. The younger cohort comprised 1602 individuals, 748 males and 854 female subjects. Of these 2854 individuals who were assessed, 2751 were assessed at the age 20, age 24 or age 29 assessments. Inclusion criteria in our sample included having marriage data (provided at age 24 or age 29), ASB data before marriage (at age 20), and having ASB data post-marriage (at age 24 OR age 29). The number of individuals with the various measures, including the final singleton sample size (N=2291, comprised of individuals who met the outlined inclusion criteria), is presented in **Table 1**. To be included in the co-twin control analyses, we required individuals and their co-twins to meet our inclusion requirements (marriage data, pre and post-marriage ASB data, not divorced). Individuals were excluded largely for failing to complete assessments, but occasionally for completing part of an assessment but not completing the specific measure required for this study (such as reporting on antisocial behavior at age 20). We also excluded divorced individuals (and their co-twins in the co-twin control (CTC) analyses) as we wanted to limit our analysis to the effect of marriage. Individuals who were excluded from data analysis (for insufficient data) were largely comparable to individuals who were included in the final analyses (when data could be compared). Excluded individuals had higher levels of antisocial behavior at age 24 (p<.001), but did not have higher levels of antisocial behavior at age 20 or age 29. They were also not less likely to get married.

*2.2.2 Measures*

   *Antisocial behavior:* Trained clinical interviewers (with at least a bachelor's

degree in psychology) interviewed subjects about their history of mental health using

DSM-III-R criteria, using a modified version of the *Structured Clinical Interview for*

*DSM-III-R* (Spitzer, Williams, Gibbon, & First, 1990). Participants answered questions

about a wide range of disorders, including Antisocial Personality Disorder (APD).

MCTFR staff members reviewed interview answers and assigned symptoms in case

conferences with at least two independent reviewers. This study uses Adult Antisocial

Behavior (AAB) symptoms (DSM-III-R Criterion C items for APD symptoms, but

without requiring a history of Conduct Disorder before age 15, as the DSM-III-R does for

APD). Although 'AAB' is not an official diagnosis, previous studies from this sample

have used it as a diagnosis (largely the same as APD, but without requiring conduct

disorder symptoms before age 15), with the kappa inter-rater reliability above .75.

However, we used symptom counts, rather than diagnoses, in order to capture the trait

dimensionally and increase statistical power. Raters judged symptoms as full (clinically

significant in severity and frequency), half (clinically significant in severity OR

frequency), or absent (not clinically significant in severity or frequency), and symptoms

were coded as such (1, .5, or 0, respectively).

   *Pre-marriage vs. Post-marriage ASB:* This study measured antisocial behavior at

three assessments, age 20, age 24, and age 29, and used data from age 20 as pre-marriage

antisocial behavior, and data from age 24 and age 29 as post-marriage ASB. For the pre-

marriage analyses at age 20, interviewers asked subjects about the presence of a behavior

over their entire life span. When assessing post-marriage antisocial behavior at age 24

and age 29, interviewers asked about symptom endorsement since the previous assessment, to limit the span of assessment to time overlapping with the post-marriage time frame. For example, if during the age 29 assessment, a subject endorsed 'stealing with confrontation' at age 20, it would not count as a recent symptom. If a subject endorsed 'stealing with confrontation' at age 28, it would count as a recent symptom. We assessed lifetime symptoms at the age 20 assessment and recent symptoms at the age 24 and age 29 assessments. Twins reported recent antisocial behavior symptoms at age 29, and at age 24 for our younger cohort. The older cohort did not provide information on recent symptoms at age 24. However, we administered a supplemental form, the ASPD Interview, which asked for onset and offset ages for each symptom at the age 24 assessment for both the older and younger cohort, rather than simply reporting if they had engaged in a behavior since the last assessment. Using these data, we were able to estimate the presence of recent symptoms for both cohorts (whether or not the symptom had occurred since the previous assessment) for the age 24 assessment, and using the ages of onset/offset to cover the same timespan as the recent symptoms. This approximated assessment of recent symptoms with the ASPD interview correlated .92 with the original assessment of recent symptoms (both were available in the younger cohort), indicating that the two assessments were comparable.

*Determining Marriage Status:* The Social Adjustment Questionnaire assesses major social events (friends, romantic partners, education, major life events) at each wave. The questionnaire asks participants if they have ever gotten married, if they have been divorced, and if they are currently married. The Life Events Interview asks subjects if they have been married, engaged, or divorced recently, age at marriage, and the number

of times they have done so. We integrated the data from both assessments, and corrected

occasional incompatible data using our best estimate from other related questions. We

used data from the age 20, age 24, and age 29 assessments to identify married individuals

and estimate age at marriage. For the few (n=3) individuals who reported marriage, but

did not specify age at marriage, we reviewed other relevant data (age at engagement,

endorsement of marriage at previous assessments, age at first assessment the subject

reported marriage) to make a best estimate of marriage onset. We identified individuals

who were married by the age 24 and age 29 assessments, and who never got divorced,

and they were included as married at each relevant assessment. Individuals who married

later (after the age 24 assessment) were included as 'not married' in the age 24 analyses.

We also identified individuals who were married by the age 20 assessment, and excluded

them from the 'before marriage' analyses of age 20 antisocial behavior. We tracked

individuals who had never reported marriage, and those individuals were always included

in the "not married" group.

In our sample, 47% of males and 43% of females reported marriage by the age 29

assessment (in addition to the 5% of male and female subjects who got married and

divorced by age 29); basic sample sizes and percentages about marital status (never

married, married at age 24 assessment, married at age 29 assessment) and age of marriage

are provided in **Table 2**. The tabled values likely underestimate the proportion of females

married by age 30, as not all were assessed at the age 29 assessment (52% of females

who have completed their age 29 assessment were married at age 29). At the age 24 and

age 29 assessments, we identified individuals who had been married before the age 24 or

age 29 assessment. If an individual was married at age 23, he or she counted as married at

the age 24 and age 29 assessments. If an individual married at 26, he or she counted as married at the age 29 assessment, and not married at the age 24 analyses. About 5% of both male and female subjects reported ever being divorced in our sample, and they were excluded from the married/not married groups. For those subjects who married, average age of first marriage was 24.8 for males and 23.4 for females. This appears roughly consistent with national demographic data; in 2009, 46% of men and 59% of women aged 25-29 years had been married (U.S. Census Bureau, 2012, Table 3).

We also assessed concordance in twin pairs (if both twins were married at each assessment). The number of twins discordant for marriage (with data at each assessment) is presented in **Table 3**. For the pre-marriage analyses that were carried out with age 20 data to determine if those who later became discordant differed in ASB at age 20, we defined concordance as marriage at any point, so discordance at age 20 is based on the same criteria as discordance at age 29 (but more pairs have complete data at age 20). The post-marriage concordance counts (at age 24 and age 29) used current marital status, and twin pairs may have changed concordance from age 24 to age 29. For example, if one twin married at 22 and the other age 27, they were discordant at age 24 and concordant at age 29. All CTC analyses used age 20 data as the benchmark for pre-marriage ASB, regardless of onset of marriage age. The post-marriage analyses used age 24 and age 29 data.

*2.2.3 Statistical Analyses:*

We summed endorsed antisocial behavior symptoms at each wave, and log-transformed the symptom counts to reduce positive skew. Age (at assessment) and cohort effects were regressed out prior to analyses, although raw symptom counts are sometimes

presented visually for ease in interpretation (such as in **Figure 1** and **Figure 2**). In analyses that collapsed across males and females, sex was also regressed out of the variables.

*Singleton Analyses.* The study ran linear mixed effects regressions using the 'lme4' package in R statistical environment (R Core Team, 2013, Bates, Maechler, Bolker, & Walker, 2014). We estimated the relationship between marriage and antisocial behavior (ASB) at multiple time points (pre-marriage at age 20 and post-marriage age 24, and age 29). We first ran the analyses treating the sample as singleton, without taking advantage of the familial nature of the data, to approximate previous research studies which have lacked twins. The use of mixed effects models accounts for the correlated nature of the data (i.e., the twin structure) to more accurately estimate parameters, including the effect of marriage in the general sample. This effect is important, as it approximates the findings from other studies, which did not use twin data. There were no significant sex interaction terms, and we used sex-corrected variables for our final analyses. We tested for the significance of the effect of marriage using null hypothesis significance testing.

The study assessed the relationship between marriage and ASB prior to marriage, to test if low antisociality in early adulthood predicted entry into marriage. A small number of twins (N=122, 5%) were already married at the age 20 assessment, and were excluded from the pre-marriage analyses. We first ran models looking at the association between marriage and antisocial behavior (pre-marriage at age 20 and post-marriage at age 24 and age 29.) For the general sample analyses, our full model included the following terms: marriage, sex, marriage*sex and zygosity. To further test the specificity of our findings, we included age 20 antisocial behavior in the age 24 and age 29 analyses,

to see if marriage predicted post-marriage antisocial behavior, beyond previous levels of ASB.

*Co-twin Control Analyses.* The co-twin control (CTC) model offers a way to quantify the between-pair effects (things that differ between sets of twins) and the within-pair effects (things that differ within twin pairs). Twin and family data are a specific type of clustered data, and characteristics common to a cluster may account for the associations between variables. In clustered data, researchers can differentiate between the cluster-level effect (in our sample, the between twin pair effect) and the individual-level effect (in our sample, the within twin pair effect), and the individual-level effect is the more accurate measure of the specific association between variables, and is a more rigorous test of the true measure of the association than failing to correct for cluster-level differences (Begg & Parides, 2003). The CTC uses the twin data to decompose the effect of marriage into a within-pair (Marr-W) and between-pair effect (Marr-B), which is analogous to the individual-level effect and cluster-level effect, respectively. The between-pair effect is similar to what other studies (without multiple members of a family) obtain, and the within-pair effect is the association of marriage with antisocial behavior after controlling for familial factors (such as genetics, shared rearing environment).

Twin pairs share a number of factors that make them similar, including genes (100% for MZ pairs, 50% for DZ pairs) and rearing environment (100% for MZ and DZ twins). The factors that twins share comprise the between-pair effect, and the experiences that differ between twin pairs are captured by the within-pair effect. The between-pair parameter measures the association between marriage and ASB, without correcting for confounding variables of shared genetics and rearing experiences. The within-pair

parameter is the more specific measure of the relationship between marriage and ASB, as it corrects for shared familial factors.

As MZ and DZ twin pairs share different amount of genes (100% vs. 50%) the within-pair effect may differ between MZ and DZ pairs, and thus we included an interaction term between zygosity and the within-pair parameter. The CTC analyses offer a quasi-causal test of the relationship between marriage and post-marriage ASB. If the association between marriage and ASB is driven by genetic confounding, then the Marr-W term would be significant for DZ twin pairs (who share only 50% of their genetics) but not MZ twin pairs (who share all of their genetics). If the association between marriage and ASB is caused by common environmental experiences, the Marr-W term would be non-significant for both MZ and DZ twin pairs. If the Marr-W is significant in both MZ and DZ twin pairs, this is consistent with a causal role of unique environmental experiences. We also ran analyses on marriage and pre-marriage ASB, as we wanted to assess twin similarity prior to the onset of marriage. If there is a within-pair effect at age 20 prior to the transition to marriage, then this would suggest the unique environmental event happened already. However, if there is no within-pair effect at age 20, but there is at age 24 or age 29, it suggests that something happened within that time frame to set the twins on divergent paths, and is again consistent with a causal effect of marriage. We were able to analyze post-marriage ASB at two time points, which allowed us to examine if the effect of marriage at two different ages in early adulthood, both when people are just starting to get married, and five years later when the rates of marriage have doubled.

We calculated the between-pair exposure to marriage and the within-pair difference scores for each individual twin. The between-pair parameter is the cluster's

mean level of a variable (Begg & Parides, 2003). In twin data, this is the proportion of twins in the pair who experienced marriage (Marr-B would be .5 for discordant twin pairs, 1 for twin pairs concordant for marriage, and 0 for twin pairs concordant for no marriage). The individual effect is operationalized by subtracting the cluster effect (Marr-B) from the individual's exposure. Individual exposure was coded as 0 for not married and 1 for married. For example, twins discordant would have a Marr-B parameter value of .5, the married individual's Marr-W would be .5 (1-.5), and the non-married co-twin's Marr-W value would be -.5 (0-.5). Other studies using our data set have used this weighting system to differentiate between the between-pair (cluster-level) effect and the within-pair (individual-level) effect (Burt et al., 2010; Huibregtse, Bornovalova, Hicks, McGue, & Iacono, 2011). We initially included interaction terms between the within-pair and between-pair terms and sex, but they were excluded from our final analyses as they were non-significant at all times. Our final model for the CTC included the following terms Marr-W, Marr-B, sex, zygosity, Marr-W*zygosity, and for the age 24 and age 29 assessment, age 20 ASB. We dropped non-significant parameters. To facilitate comparison between the singleton and CTC analyses, we calculated the effect size (using Cohen's d) between married and non-married people in both the general sample and the discordant twins (only between discordant twins). Comparing the singleton and CTC analyses allows us to demonstrate that 1) our singleton analyses are comparable to other studies of marriage and antisocial behavior, and are thus consistent with the literature and 2) demonstrate the utility of the CTC analysis in differentiating between familial and individual level associations.

*2.3 Results*

Consistent with expectations, male participants have higher levels of antisocial behavior than females at all assessments (all F values greater than 47, p< .001). In the following analyses in this paper, we included sex and an interaction term between sex and antisocial behavior; the interaction term between sex and marriage was not significant in any of our models (all p values >=.2). Therefore, we collapsed male and female subjects for all final analyses presented in this paper.

*2.3.1 Singleton Analyses:* We first looked at the association between marital status on pre-marriage antisocial behavior at the individual level, without accounting for familial factors. We graphed the raw ASB symptom counts by marital status at age 20 (presented in **Figure 1**) and at age 24 and age 29 (presented in **Figure 2**). Results from the singleton analyses are presented in **Table 4**. There was a significant association between marriage and antisocial behavior at all time points, prior to marriage (at age 20), and post-marriage (at age 24 and age 29). At all points, marriage was associated with lower antisocial behavior. Pre-marriage antisocial behavior was significantly associated with later marriage (*Age 20:* p<.001**)**, providing evidence of selection effects (that is, individuals were antisocial long before marriage, and their lower antisocial behavior likely facilitated marriage). There was no evidence of sex differences, and lower antisocial behavior was associated with greater likelihood of marriage for both men and women.

Marriage was also associated with lower antisocial behavior after the onset of marriage, at multiple time points in adulthood. At age 24 and age 29 assessments, marriage was associated with lower levels of recent antisocial behavior (*Age 24:* p<.001, *Age 29:* p<.001). However, as antisocial people are less likely to get married, it is possible that the low level of antisociality measured in married individuals after marriage

reflects little more than their being selected as desirable mates because of their low pre-existing antisociality. To rule out this explanation, these analyses were repeated using as a covariate each individual's level of antisociality prior to marriage. Even with this adjustment, the effects remained significant (*Age 24:* p<.001, *Age 29*: p<.001), indicating that the benefits of marriage at age 24 and age 29 were not accounted for by prior levels of antisociality. Furthermore, it also demonstrates that marriage can provide benefits at different multiple ages.

*2.3.2 Co-twin Control Analyses*: After establishing the relationship between marriage and antisocial behavior in the singleton analyses, we decomposed the effect of marriage into familial-level/between-pair (Marr-B) and individual-level/within-pair (Marr-W) effects, in the co-twin control analyses. The results for the co-twin models are presented in **Table 5**. As sex differences were not significant, we ran all analyses on both male and female subjects for all analyses. There was a significant difference between MZ and DZ twins in the pre-marriage analyses (p<.05), and thus we analyzed them separately. For MZ twins, there was a significant between-pair (Marr-B) effect of marriage, but the within-pair effect (Marr-W) was not significant (Marr-B p<.001, Marr-W p>.9). The between-pair effect provides evidence of shared confounding between antisocial behavior and marriage; characteristics that differ between families, rather than individuals, contribute to differences in both antisocial behavior and marriage. Among twin pairs discordant for marriage, the married twin was comparably antisocial at age 20, relative to their unmarried co-twin. This suggests that MZ twins who become discordant for marriage were highly similar prior to marriage. A different pattern emerged for DZ twins. For DZ twins, both the between-pair and within-pair effects were significant, meaning that DZ

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twins who become discordant for marriage were already different prior to marriage (Marr-B p<.05, Marr-W p<.05).

There were no significant differences between MZ and DZ twin pairs for post-marriage analyses, and they were analyzed together (the significance of the zygosity interaction was non-significant (p >.7) at both post marriage assessments). Both the within-pair and between-pair effects were significant in both post-marriage analyses, at age 24 and age 29 (*Age 24*: Marr-B p<.001, Marr-W p<.001, *Age 29*: Marr-B p<.001, Marr-W p<.001). Married individuals were less antisocial than non-married co-twins, suggesting that shared familial factors do not sufficiently account for the association between marriage and antisocial behavior after marriage. To further test the specificity of the effect, we also included a measure of pre-marriage antisocial behavior at age 20, and all significant terms were attenuated, but remained significant.

*2.3.3 Comparing Singleton and CTC Analyses.* To summarize and compare the general sample analyses and the co-twin control analyses, we graphed effect sizes for discordant co-twins (MZ and DZ) and the effect size of marriage from the singleton analysis in **Figure 3**. Negative effect sizes indicate protective association with marriage (i.e., married individuals are less antisocial). The first set of bars shows the association between marriage and antisocial behavior before marriage (or what is likely to be selection effects). (The number of discordant MZ and DZ co-twins (used to calculate the effect size) is available in **Table 3)**. There is a significant effect in the general sample between married and unmarried individuals, and between unmarried and (later) married DZ co-twins (Singleton Analysis d = -.26, Discordant DZ d = -.25). However, the difference between unmarried and (later) married MZ co-twins is very small and not significantly

different from zero (Discordant MZ d = -.02). After marriage, at age 24 and age 29

assessment, there is a significant difference between married and unmarried individuals,

both in the general sample and across the discordant co-twins (*Age 24*: Singleton

Analysis d = -.37, Discordant MZ d = -.38, Discordant DZ d = -.32, *Age 29*: Singleton

Analysis d = -.42, Discordant MZ d = -.35, Discordant DZ d = -.29). The effect sizes are

virtually identical at both post-marriage analyses, indicating that the benefits of marriage

are consistent at multiple time points, and are not isolated to one developmental period.

Of particular interpretative importance are the monozygotic twins. They provide

the strongest quasi-causal test of the association between marriage and antisocial

behavior, as a co-twin serves to control for shared genetic and environmental variables.

There is a significant difference between discordant co-twins at both age 24 and age 29,

suggesting that the association between differences in antisocial behavior between co-

twins is attributable to a non-shared environmental experience, possibly marriage. This is

strengthened by our longitudinal analysis, as the MZ twins were highly similar prior to

marriage (at age 20). Thus, the unique environmental experience that caused the

divergence in antisocial behavior trajectories occurred in young adulthood, and does not

simply reflect long-standing differences between co-twins. The within-pair benefit of

marriage is specific to post-marriage antisocial behavior, rather than pre-marriage

antisocial behavior, indicating that these identical co-twins were highly similar before

marriage, and became different after marriage, a pattern that is consistent with a causal

benefit of marriage. Furthermore, this benefit emerges in a relatively narrow span of time

(4-5 years between age 20 and age 24 assessments).

*2.4 Discussion*

Our results confirmed that marriage is related to antisocial behavior, and extended previous findings by providing evidence of the causal nature of marriage, in a sample that included male and females. Additionally, we demonstrated that the benefits of marriage show up in as a brief window of time (within several years of marriage) and appear consistent across different time points. People who got married were less antisocial prior to marriage, and once married, become even less antisocial.

We measured antisocial behavior broadly, including both illegal and aggressive/callous behavior, which contrasts with many other studies, which have focused on strictly criminal behavior. This provided evidence that the relationship is not just with criminal behavior, but with a broader phenotype. We did not find evidence for sex differences in the protective relationship between marriage and antisocial behavior. Many studies have focused on criminal behavior, and specifically criminal behavior in males, whereas our study assessed broader and more normative levels of antisociality. There were no significant interactions between sex and marriage's association with antisocial behavior in any analysis. The consistency of these findings underscored that these effects are generalizable, rather than unique to male offenders.

Consistent with other studies, getting married was associated with lower pre-marriage levels of antisocial behavior, even after controlling for familial effects and prior antisociality. This pattern was also consistent with the notion of selection effects, and with two other behavioral genetic studies that have looked at the relationship between marriage and antisocial behavior (Barnes & Beaver, 2012; Burt et al., 2010). However, our results also found evidence for a causal benefit of marriage on post-marriage antisocial behavior, in an even shorter time frame than other studies (within several

years). The within-pair effect was not significant in MZ twins for pre-marriage antisociality, meaning that MZ pairs who later became discordant for marriage were virtually identical at age 20. However, when we measured them again after marriage at age 24 and age 29, there was a significant within-pair effect for identical twins. MZ twins who were discordant for marriage did not differ on lifetime antisocial behavior symptom counts before marriage, but became different 4-9 years later, after one has gotten married. DZ twins also showed evidence of benefitting from marriage, as the within-pair effect is significant. However, it was also significant at age 20, prior to marriage, suggesting that these discordant twins differed on antisociality prior to marriage, and these differences did not reflect later marriage. As the DZ twins were already different prior to marriage, their post-marriage differences may have reflected these longstanding differences in predisposition to both marriage and antisocial behavior. As there was a significant within-pair effect for both MZ and DZ twins, in the post marriage analyses, and it did not differ between zygosity, it cannot be attributed to purely shared genes or rearing environment and this was consistent with a unique environmental exposure contributing to differences between twin pairs.

The patterns were consistent in both direction and magnitude and each time point, indicating that the age at marriage did not alter the benefits of marriage. Marriage continued to offer specific and perhaps causal benefits, even as individuals approached their fourth decade of life. The benefits of marriage persisted, even after individuals aged out of the developmental risk period for high levels of delinquency, indicating that the benefits of marriage may continue to offer advantages in later adulthood.

*2.4.1 Limitations.* Our study had a number of strengths (longitudinal assessment,

representative of the community, large number of female participants), but some limitations. The period of onset for marriage was not complete in our sample, and we expect a number of subjects will get married within the next decade. The protective effect of marriage on desistance from antisocial behavior may not apply to individuals who marry later in life. While our subjects were not out of the marital age window, we expected the role of marriage to be most influential during the 20-30 age range, when the desistance process is occurring. The effect of marriage on age 40 antisocial behavior may not mirror the effect at age 25.

Additionally, the study presented here did not examine marital quality or satisfaction, or partner's level of antisocial behavior, all of which are perhaps important moderators of the relationship between antisocial behavior and marital status. Having a tight, supportive relationship with a rule-abiding spouse may be a considerably different experience from a high-conflict and unstable relationship with someone with his or her own history of law-breaking. This study looked at marriage broadly, but differentiating between types of marriage (supportive, divorced, etc.), and by characteristics of the partner might provide show evidence of even stronger effects of good marriage on antisocial behavior trajectories.

Finally, while the co-twin control design has several strengths, it does not control for differences between twin pairs. Although identical twins are often similar, they can be quite different, despite sharing genes and many experiences. A criticism of this design argues that that discordant identical twins may merely be special cases of unusually different twins, and that the quasi-experimental claim of these designs is overstated, and propensity matching on a number of individual variables is necessary for interpretation.

However, if the variables included in a propensity score are part of the causal mechanism, this will obfuscate the true relationship. Furthermore, in this case, our discordant identical twins had very similar levels of antisocial behavior to each other in early adulthood (effect size = -.02), indicating that they were not merely twin pairs that have always been different. The twins differed only on post-marriage levels of antisocial behavior, not pre-marriage ASB, suggesting that this difference emerged after marriage and did not reflect long-standing differences. There was evidence of long-standing differences in discordant DZ twins, but this indicated that the association between marriage and antisocial behavior is partially driven by shared genes (as DZ twins do not entirely share their genes, like MZ twins do).

*2.4.2 Future Directions* In the future, other studies should continue to use genetically informative samples with a large number of women to continue to examine these effects, and to weigh the quality and outcome of the marital relationships. Using other measures of ASB that provide different information about antisociality at different trait levels may allow for a greater understanding of how marriage causally contributes to the desistance of antisocial behavior.

Overall, our data provided evidence that marriage can provide a causal protective effect on male and female subjects. The study demonstrated the protective effects of marriage are not limited to criminal behavior as has been examined in previous studies, but may relate to broader conceptualizations of antisociality, including aggressive and interpersonal domains as well. The use of identical and fraternal discordant twins allowed for a quasi-causal test of marriage effects on ASB, and made a strong case for the causal role of marriage. Furthermore, the different pattern of results between pre and post-

marriage antisociality provided further evidence that marriage does play a causal role in desistance from antisocial behavior in young adulthood. Further work may identify the mechanisms of this effect, such as focusing on individual characteristics of partners, assessing internal changes in identity, or reduced time with antisocial peers.

**Table 1: Number of Individuals with ASB Data and Marriage Data**

*Number of Individuals Assessed by Inclusion Criteria*

| Measure | Older Cohort | | Younger Cohort | | |
| --- | --- | --- | --- | --- | --- |
| | Male | Female | Male | Female | TOTAL |
| Assessed Ever | 578 | 674 | 748 | 854 | 2854 |
| Assessed at Age 20, 24, or 29 | 562 | 667 | 704 | 818 | 2751 |
| Pre and Post Marriage ASB Data | 475 | 613 | 570 | 644 | 2302 |
| Marriage Data (at Age 24 or Age 29) | 550 | 657 | 670 | 677 | 2554 |
| Complete Data (Marriage Data + Pre/Post ASB Data) | 475 | 613 | 570 | 644 | 2302 |
| Individuals and Co-twins with Complete Data | 456 | 594 | 526 | 624 | 2200 |
| *Non-Divorced Individuals* | | | | | |
| Complete (Marriage Data + Pre/Post ASB Data) | 454 | 657 | 547 | 633 | **2291** |
| Individuals and Co-twins with Complete Data | 435 | 549 | 503 | 612 | **2099** |

This table shows the number of individuals with available data by each criterion (assessed ever, assessed during our age assessments, pre and post-marriage ASB data, marriage data). We also excluded divorced individuals and their co-twins for the singleton and CTC analyses, respectively. The final sample sizes for the singleton and CTC analyses are in bold. For the CTC analyses were required both members of the twin pair to have complete data (whereas in the singleton analysis, we did not require both members of the pair to have complete data).

**Table 2: Descriptive Statistics of Marriage**

|  | Never Married N (%) | Divorced N (%) | Married by Age 24 N (%) | Married by Age 29 N (%) | Marital Age Mean (SD) |
|---|---|---|---|---|---|
| All | 1165 (51) | 114 (5) | 622 (27) | 1036 (45) | 24.1 (2.7) |
| Male | 506 (48) | 54 (5) | 229 (22) | 495 (47) | 24.8 (2.5) |
| Female | 659 (52) | 60 (5) | 393 (31) | 541 (43) | 23.4 (2.7) |

This table shows the number and proportion of individuals who never marry, marry by the age 24 assessment, or marry by the age 29 assessment. It also includes the means and standard deviations of marital age for all individuals in our sample. Note: some females do not yet have age 29 data, and so they are counted as 'never married' when they may later get married.

**Table 3: Number of Available Twin Pairs Discordant for Marriage**

| *Twin Pairs Discordant for Marriage* | | |
|---|---|---|
| | MZ | DZ |
| Age 20 | 199 | 140 |
| Age 24 | 171 | 107 |
| Age 29 | 136 | 95 |

This table shows the number of MZ and DZ twins pairs discordant for marriage (not married vs. married) who have data for both co-twins each assessment. The discordance at age 20 was calculated by ever-marriage status. At age 24 and age 29, it was based on current marital status (so some individuals were unmarried at age 24, and married at age 29, and this was updated accordingly. Note: some females do not yet have age 29 data, and so they are counted as 'never married' when they may later get married.

**Figure 1: Mean Pre-Marriage ASB at Age 20 by Later Marital Status**
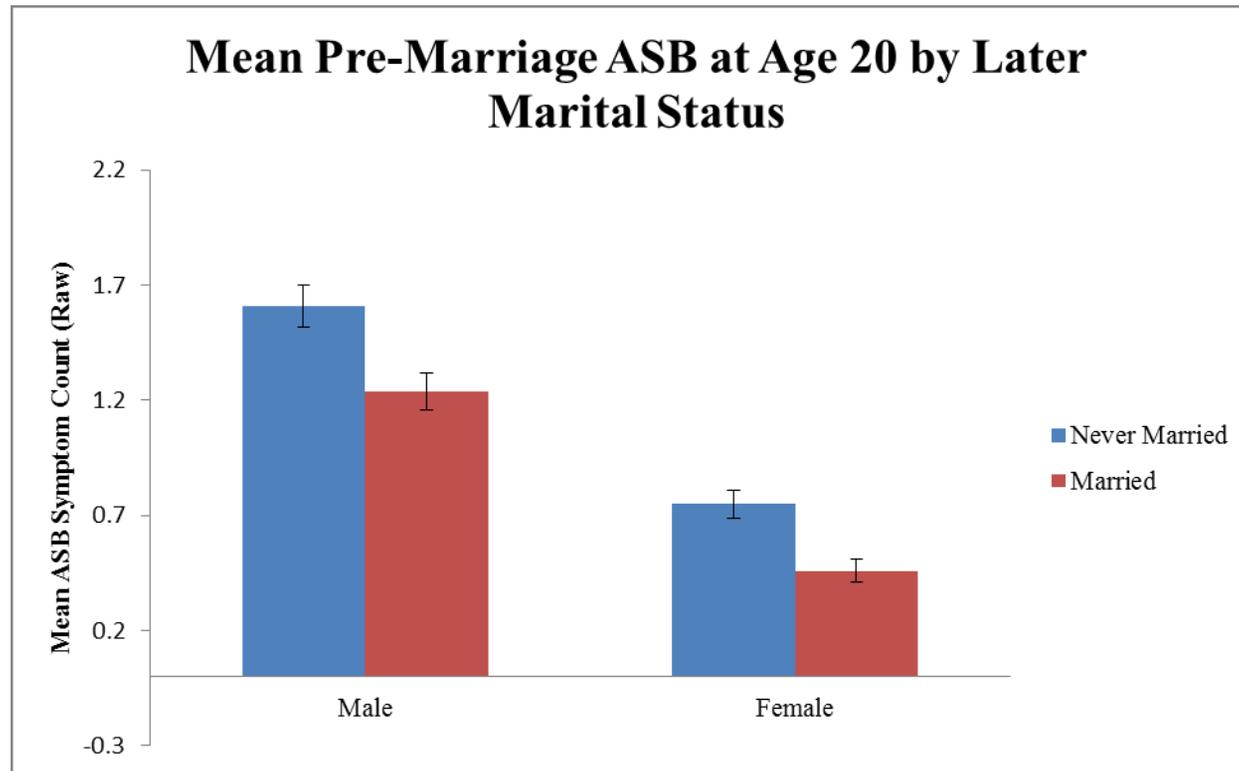


This figure graphs mean Adult Antisocial Behavior symptom counts, showing the difference between lifetime levels of antisociality (measured at age 20) and later marriage (measured at age 29). Males who later get married have lower levels of antisocial behavior at age 20, as do females, and both differences are significant (p<.001). Error bars, reflecting the standard error of the mean, were adjusted for the correlated nature of the data. Note: some females do not yet have age 29 data, and so they are counted as 'never married' when they may later get married.

**Figure 2: Mean Post-Marriage ASB by Current Marital Status**
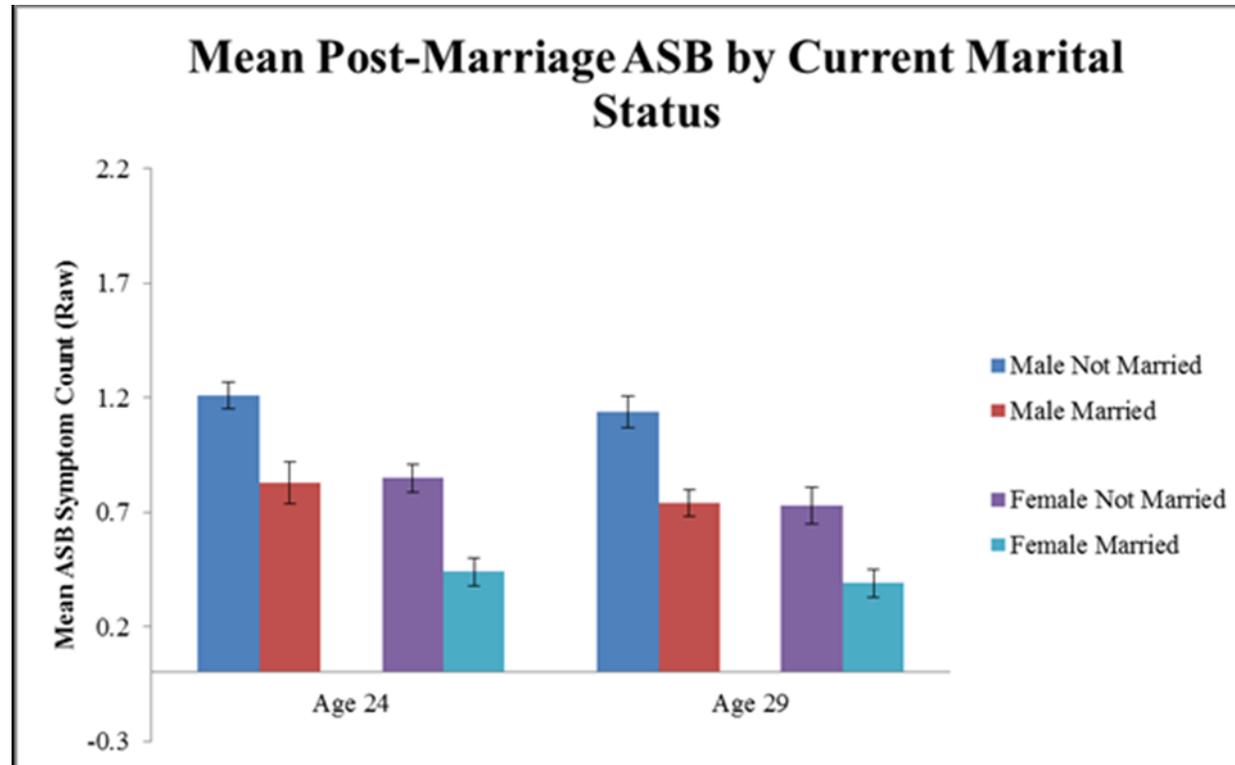


This figure graphs mean ASB symptom counts, showing the difference between post-marriage ASB (measured at age 24 and age 29) and current marital status (measured at age 24 and age 29, respectively). Males who get married have lower levels of antisocial behavior at age 24 and age 29, as do females, and all differences were significant (p<.001). Error bars, reflecting the standard error of the mean, were adjusted for the correlated nature of the data. Note: some females do not yet have age 29 data, and so they are counted as 'never married' when they may later get married.

**Table 4: Results Singleton Models of Marriage and Antisocial Behavior**

| | Pre Marriage | Post Marriage | |
| --- | --- | --- | --- |
| *Estimated Parameters of Marriage* | | | |
| | Age 20 | Age 24 | Age 29 |
| | N=2079 | N=1937 | N=1497 |
| Term | B(SE) | B(SE) | B(SE) |
| Marriage | -.25 (.06)*** | -.38 (.08)*** | -.44 (.06)*** |
| Marriage*Sex | .08 (.09) | .05 (.10) | .12 (.10) |
| | | | |
| *After Controlling for Age 20 ASB* | | | |
| | Age 20 | Age 24 | Age 29 |
| | | N=1937 | N=1497 |
| Term | B(SE) | B(SE) | B(SE) |
| Marriage | - | .21 (.07)** | .33 (.06)*** |
| Marriage*Sex | - | .08 (.10) | .01 (.09) |

This table shows the unstandardized parameter estimates (as indicated by asterisks) of the effect of marriage for the individual analyses. The first part shows the uncorrected association between marriage and ASB, and the second part shows the effect of marriage after controlling for age 20 ASB. Significant parameters are marked with an asterisk (* = $p<.05$, **=$p<.01$, ***=$p<.001$). Note: not all female co-twins have completed the age 29 assessment yet.

**Table 5: Results of Co-twin Control Models of Marriage and Antisocial Behavior**

*Estimated Parameters of Marriage*

| | Pre Marriage | | Post Marriage | |
| | Age 20 | | Age 24 | Age 29 |
| | MZ | DZ | MZ and DZ | MZ and DZ |
| | N=1192 | N=652 | N=1778 | N=1336 |
| Term | B(SE) | B(SE) | B(SE) | B(SE) |
|---|---|---|---|---|
| Marr-B | -.40 (.08)*** | -.32 (.12)** | -.44 (.07)*** | -.47 (.07)*** |
| Marr-W | -.01 (.08) | -.25 (.10)* | -.29 (.07)*** | -.34 (.07)*** |
| Zygosity*Marr-W | -.26 (.12)* | -.26 (.12)* | -.05 (.14) | .08 (.15) |

| *After Controlling for Age 20 ASB* | | | Age 24 | Age 29 |
| | | | MZ and DZ | MZ and DZ |
| | | | N=1778 | N=1336 |
| Term | | | B(SE) | B(SE) |
|---|---|---|---|---|
| Marr-B | - | - | -.21 (.06)*** | -.30 (.06)*** |
| Marr-W | - | - | -.21 (.06)** | -.31 (.07)*** |
| Zygosity*Marr-W | - | - | .08 (.13) | .14 (.14) |

This table shows the parameter estimates and significance (as indicated by asterisks) for the within-pair and between-pair effects calculated from the co-twin control analyses. MZ and DZ twins are analyzed separately at age 20, when there was a significant difference, as indicated by the 'Zygosity*Marr-W' term, allowing for examination of the different pattern of results. Note: not all female co-twins have completed the age 29 assessment yet. Significant parameters are marked with an asterisk (* = $p<.05$, **=$p<.01$, ***=$p<.001$)

**Figure 3: Comparison of Effect Size in Singleton vs. CTC Analyses**
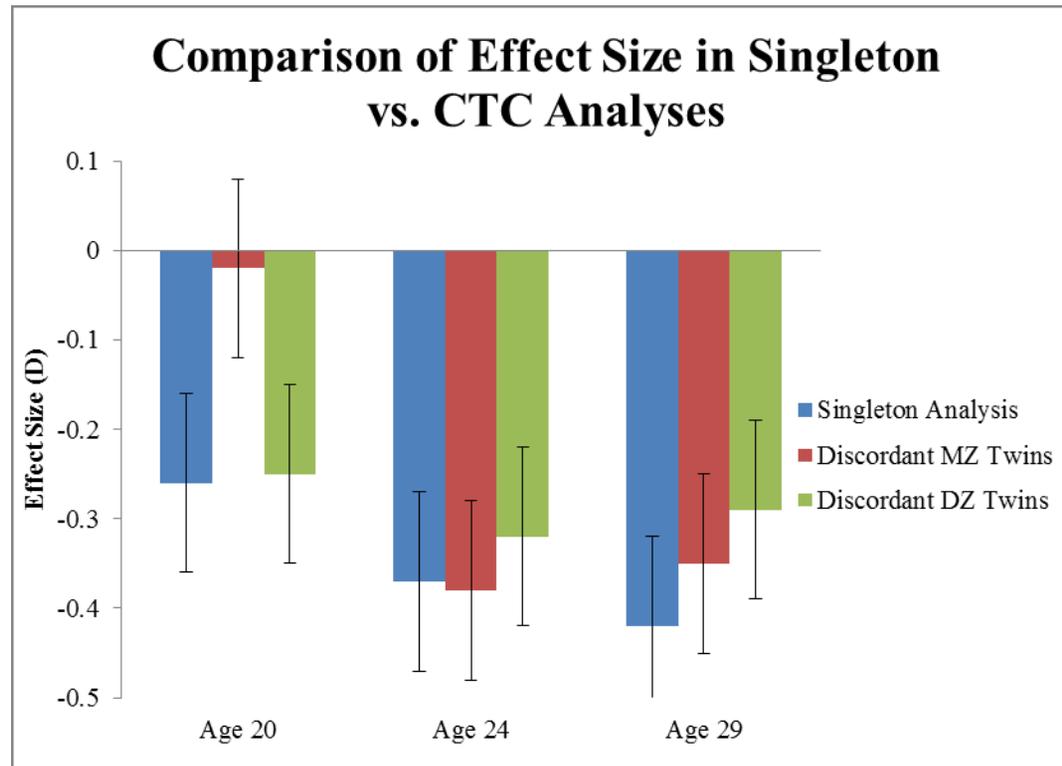


This figure plots the effect size of between married and unmarried individuals at different points in development (including before and after marriage). It plots the effect calculated in the singleton analyses, and between MZ and DZ twins discordant for marriage from the CTC analyses. The effect sizes are similar at all ages, with the exception for the age 20 analyses. At age 20, there is no significant effect of marriage for discordant MZ pairs and the difference between MZ twin pairs who are later discordant for marriage is almost zero. Error Bars indicate standard error of the mean.

**Chapter 3: The Effect of Early Parenthood on Antisocial Behavior**

The transition to parenthood, like the transition to marriage, is a social role change marked by taking on additional close relationships. Like marriage, it involves an expansion of the individual's family unit, and the development of an additional relationship that is likely not benefitted by antisocial behavior (i.e., spending time drunkenly carousing with friends will likely weaken the parent-child bond, rather than strengthen it). Furthermore, the pragmatic demands of parenthood may also reduce the opportunities for antisocial behavior (more demands and constriction on time, fewer available financial resources, likely involvement with a romantic partner to create the child). As spending time with children may reduce the time to spend time with antisocial peers, social modeling theory would predict a decrease of antisocial behavior after having children, provided that the parent modifies his or her behavior. Given dynamic social control theory, one would expect a beneficial relationship between the transition to parenthood and antisocial behavior.

*3.1 Adolescent Parenthood, Sexual Behavior, and Antisocial Behavior*

Many of the studies exploring the relationship between antisociality and parenthood studied individual parenting during adolescence, as adolescent pregnancy is a major public health concern. A longitudinal study focused on adolescent fathers (becoming parents before 19 years of age) in Pittsburgh found teenage fathers had higher levels of delinquency both prior to parenthood and afterwards (Stouthamer-Loeber & Wei, 1998). Teenage adolescents were also more likely to have delinquent peers, use a variety of substances, have worse academic outcomes, and come from families with greater socioeconomic status (SES) risk. Many of these variables began prior to the

initiation of fatherhood, and likely represent a general liability to a variety of disinhibited behaviors. Teenage fathers appeared to get more delinquent after onset of parenthood, even when compared to controls matched for prior levels of delinquency.

Hope, Wilder, and Watt (2003) found a significant difference between ever-pregnant and never-pregnant teens in the nationally representative Add Health sample on a measure of juvenile delinquency (which included illicit substance use and substance misuse, as well as illegal activities), but this association was moderated by pregnancy resolution (abortion, adoption, miscarriages, or parenting). Adolescents who parented had lower levels of delinquency than adolescents who did not complete pregnancy (abortion or miscarriage), or who did not parent their child (adoption). Adolescent females who raised their children had comparable levels of delinquency to never-pregnant adolescents. However, this study is cross-sectional, and it may be that there are delinquency differences by pregnancy outcomes that reflect premorbid individual differences. The paper offered a limited insight into longitudinal differences, and found that teenage adolescents who did not raise their children had higher pre-pregnancy rates of substance use. It's also important to note that the Add Health study is administered in schools, and only reflects teenage mothers who are still in school, and may be a group of mothers with additional support, or motivation to continue education while raising children.

Spears, Stein, and Koniak-Griffin (2010) studied a related externalizing construct, substance use, in a longitudinal sample of teenage parents (13-18 years old). They found that while pregnancy significantly reduced maternal use of substances, teenage mothers resumed moderate substance use after the child was born, although to lower levels than prior to pregnancy. This does suggest that teenage parents are 1) likely to significantly

change their behavior when it is a direct threat to the child (via prenatal exposure) and 2) capable of moderate reduction in substance use after the child is born. Given the overlap between substance use and antisocial behavior, similar patterns may emerge for adolescent antisociality.

One of the most rigorous methods of testing causality is using genetically informative samples. Genetically informative samples (with pairs of twins or siblings) can control for shared genetics or environmental influences, which may confound the relationship between parenthood and antisocial behavior. Indeed, these studies have often found different associations that non-behavioral genetics studies have found, and make valuable contributions to the literature, such as a study that examined adolescent pregnancy and adult criminal convictions in a sample of sisters drawn from a national Swedish sample (Coyne, Fontaine, Långström, Lichtenstein, & D'Onofrio, 2013). Adolescent motherhood was associated with greater likelihood of later criminal behavior, but the association disappeared after controlling for shared genetic and environmental risk (comparing siblings and half-siblings discordant for adolescent pregnancy). Shared genetic and environmental risk factors contributed to the association between adolescent pregnancy and adult criminal convictions.

The relationship between adolescent parenthood and antisocial behavior is somewhat derived from the literature on adolescent sexual behavior and antisociality. Adolescents engaging in early sexual behavior, particularly the non-planful high-risk sexual behavior that may lead to pregnancy, have higher levels of antisocial behavior (Biglan, Metzler, Wirt, & Ary, 1990). Behavioral genetic studies of adolescent sexual behavior and delinquency have suggested that common genes underlie both of these

predispositions (Harden, Mendle, Hill, Turkheimer, & Emery, 2008). In a study of over 500 twins, earlier sexual activity unexpectedly predicted lower delinquency within twin pairs. Earlier initiation of sexual activity predicted higher antisocial behavior across the entire sample and between twin pairs, but after adjusting for between family factors, sexual activity was a protective factor, rather than a risk factor. Another study of genetically informative data found that sexual activity within the context of a relationship predicted lower antisocial behavior, whereas non-relationship sexual activity predicted higher delinquency (Harden & Mendle, 2011). These 'unpredictable' findings (namely that early sexual activity may be a protective, rather than risk, factor) in genetically informative studies illustrate the need for caution when interpreting broad associations in samples, particularly in the domain of adolescent sexual behavior (and consequently parenthood) and delinquency. Variables may index risk when differentiating between families, but may index protective effects on individuals themselves.

By focusing on adolescents, these studies are assessing changes in antisocial behavior during a period of time in which antisocial behavior is normatively increasing. The role of parenthood may offer a different and protective role if it arrives during a different developmental period. Additionally, becoming a parent in adolescence may carry risks and challenges less prevalent in adult parenthood (stigma, lack of even a high school degree, reduced occupational opportunities, and incomplete brain development, as cognitive functioning, particularly the important domains of executive functioning, continue to develop until the mid-twenties). Teenage parents tend to come from families with lower SES, to come from single-parent households, to live in neighborhoods with more criminal behavior and disorganization (Coyne & D'Onofrio, 2012; Thornberry,

Smith, & Howard, 1997). Adolescent parents tend to treat their children differently than adult parents, are more likely to have poor parent-child relationships, and more likely to demonstrate inconsistent parenting practices (Coley & Chase-Lansdale, 1998; Ganem & Agnew, 2007). As having a child and taking on parental obligations are different, any protective effects of having a child may only result if the individual embraces this role (rather than refusing to care for and provide for the child). Studying adolescent parents may select for a group of individuals particularly unlikely to have the resources or inclination to embrace the role of parenthood. Teenage parents are characterized by significant individual, familial, and community risk, and their experiences may not generalize either to the process of becoming a parent in emerging or late adulthood.

*3.1.2. Adult Parenthood:* Studies of adult parents are more limited, and have also found varied results. Ganem and Agnew (2007) studied the relationship between parenthood and criminal behavior from a longitudinal, representative U.S. sample of young adults in their twenties. They examined the relationship between parenthood, parent-child-relationship, and later criminal behavior. They found that parenthood itself was not related to criminal behavior, but having multiple children was a risk factor for criminal behavior. However, high quality parent-child relationship predicted lower levels of criminal behavior. Furthermore, this relationship was partially mediated through antisocial peers; subjects who had high quality relationships with their children were less likely to spend time with antisocial peers, perhaps reflecting an overall change in social relationships and priorities. These findings were true for both genders, and persisted regardless of timing of parenthood (adolescent vs. adult onset). However, criminal

behavior is associated with affective and interpersonal qualities, and people who form high quality relationships with their children may be fundamentally different from people who do not, and this relationship may not be causal.

There was some evidence of sex differences in a study of the relationship between family formation and criminal offending in a sample of high-risk individuals (institutionalized for juvenile delinquency) in the Netherlands (Zoutewelle-Terovan, van der Geest, Liefbroer, & Bijleveld, 2012). Although adult parenthood was associated with a reduction in serious offending in both males and females after becoming a parent, it was only significant for men, and only if they had only one child. However, it did not matter if the fathers were in married relationships; having a child was related to significant reduction in criminal activity regardless of legal status of their relationships with the child's mother.

One study found that motherhood was associated with significant reductions in delinquency in a high risk Denver sample (Kreager, Matsueda, & Erosheva, 2010). This reduction in delinquency was comparable for both adolescent and young adult mothers. In this sample, marriage did not predict reductions in delinquency. Adolescent and young adult mothers also reduced their behavioral disinhibition across multiple domains, including fighting and substance use. Having additional children had no effect on delinquency outcomes. Blokland and Nieuwbeerta (2005) examined the relationship between social role transitions and criminal offending. They found that parenthood generally did not predict higher levels of offending, although single parenthood did index higher propensity for criminal behavior. Furthermore, these effects seem largely to relate to selection effects, rather than reflect changes because of the life transition.

Warr (1998) found that marriage but not parenthood predicted reduced time with antisocial peers—individuals who were married (either with children or without) reduced the time spent with delinquent friends, but unmarried individuals with children did not modify their behavior. If the social modeling/learning theory of antisocial behavior holds true, then this would not predict protective effects of parenthood.

Studies of early adult parenthood and antisocial behavior have inconsistently found a protective effect of parenting in males and females. This inconsistency may reflect diverse samples (clinical samples vs. population samples), or different operationalizations of antisociality (delinquency, criminal convictions). While adolescent parenthood sometimes indexes greater delinquency, and sometimes predicts reductions in antisocial behavior; adult parenthood rarely indexes worse outcomes in antisocial behavior, although it is substantially less studied. Studies have suggested that this relationship may be moderated by relevant outcomes: single parenthood, having multiple children, and having a poor relationship with the children all may index greater delinquency (Blokland & Nieuwbeerta, 2005; Ganem & Agnew, 2007). Many of these studies, even those focusing on adult parenthood and outcomes, have used disadvantaged samples and have measured antisociality through criminal behavior. This may not generalize to more normative samples, and may not provide us with an understanding of how general antisocial behavior changes (as opposed to criminal behavior). Criminal behavior tends to be quite severe, but may tap more into rule-breaking and behavioral disinhibition, rather than assessing some of the interpersonal/affective characteristics of antisocial behavior and psychopathy. It is possible that having children could alter an individual's expression of antisocial tendencies, by reducing criminal behavior, and shifting expression towards

more interpersonal forms of antisocial behavior. Most studies have not used broad measures of antisociality, and may fail to capture heterotypic continuity of antisocial behavior. Parenthood may decrease the opportunities for overt criminal behavior, but antisocial individuals may continue to lie, manipulate, or engage in smaller-scale criminal behavior (that escapes legal detection). Finally, almost no studies have controlled for genetic effects or shared rearing environments, which makes it more difficult to know if early parenthood truly predicts change in antisocial behavior, or if there are confounding variables.

*3.1.3 Current Study.* The present study focused on the relationship between early adult parenthood (EAP) and antisocial behavior (ASB), to examine if the risks associated with adolescent parenthood extend beyond adolescence into early adulthood (defined as parenthood reached before mid-twenties). This allowed for a test of the relationship between early adult parenthood and antisocial behavior measured both before and after the onset of early parenthood. We chose to study parenthood reached by early adulthood (at age 22 or earlier), as parents at this age are unlikely to have completed important developmental achievements such as college, significant vocational training, long-term partnership or marriage, etc., and are thus likely to experience some of the same obstacles that adolescent parents face. Additionally, brain development, particularly executive functioning, continues until mid-twenties, and individuals who become parents prior to brain maturation are likely to have greater difficulty tolerating the complex and demanding challenge of parenthood.

Our study had prospective, longitudinal data prior to the onset of early adult parenthood. This paper used a broad measure of antisocial behavior, which included both

rule-breaking symptoms of antisociality and affective/interpersonal symptoms (such as frequent lying or cheating). This allowed for a broader understanding of changes in antisociality, beyond criminal offending, in a normative and representative sample. This expanded the previous literature that has largely focused on criminal behavior, rather than broad antisociality. Antisocial behavior is associated with negative outcomes beyond the consequences of criminal behavior, and lying, cheating, and manipulation have important social consequences. Including a broad measure of antisociality allowed for a more comprehensive view of the relationship between early adult parenthood and antisocial behavior.

This study also included twins, allowing for a quasi-causal understanding of the relationship between antisocial behavior and early adult parenthood. Data with family members can control for the genetic and environmental causes that might contribute to both early parenthood and antisociality, and the behavioral genetic research in this area is limited. The one identified study with genetically informative sample only examined the relationship between adolescent parenthood and criminal behavior in women, and our sample included male parents, as well as a broader measure of antisociality. Our study included identical and fraternal twins, allowing for control for shared genetics and shared rearing environments. Using the co-twin control method, our study controlled for these shared risk factors, and tested for the specific effect of early adult parenthood on individual behavior.

The study expected a relationship between early adult parenthood and antisocial behavior throughout the lifespan in both males and females, in both pre-EAP and post-EAP levels of antisocial behavior. We expected that individuals who transitioned into

parenthood by early adulthood would have higher levels of antisocial behavior in adolescence (before parenthood) and in adulthood (after parenthood). We generally expected the association between early adult parenthood and antisocial behavior to mirror the literature on adolescent parenthood and antisocial behavior.

However, we predicted that this association between early adult parenthood and adolescent antisocial behavior would reflect common family risk factors, rather than a specific risk of early parenthood itself. Once we controlled for between family factors in the CTC design, we did not expect young parents to be more antisocial than their non-parenting twins, prior to parenthood, in adolescence. Specifically, regarding their ASB in adolescence, we expected twins who later became discordant for EAP to look similar to each other. However, we did expect differences after the onset of parenthood. Previous twin and family studies that controlled for between family differences demonstrated beneficial and protective associations between risky sexual behavior and antisocial behavior. Because of this research, we expected that a twin who became an early parent would become less antisocial after parenthood, and as a consequence, expected the parenting twin to be lower in antisociality than his or her non-parenting co-twin. Furthermore, we expected the benefits of early parenthood to persist over time; we were able to measure post-EAP antisocial behavior at multiple time points, and expected the benefits associated with EAP to represent stable change (rather than a temporary reduction).

*3.2 Methods*

*3.2.1 Participants* This study used data from the community-representative sample of twins and families at the Minnesota Center for Twin and Family Research (MCTFR). The MCTFR is a longitudinal study of twins and their families from adolescence to adulthood with assessments completed every 3-4 years. This study made use of two cohorts in the MCTFR. The older cohort, which started assessment at age 17-18, is comprised of twins born in the years 1972-1984. They completed assessments at the approximate ages of 17, 20, 24, and 29. The younger cohort of twins was first assessed at age 11-12, and has been assessed every couple of years since, at the approximate ages of 14, 17, 20, 24, and 29. There are approximately 2854 twins in both cohorts.

Subjects in the MCTFR were recruited using publicly available birth records, as birth records include information about multiple births. Over 90% of families with multiple births in the specified age ranges were successfully located and contacted. Of the families contacted, 83% of the eligible families agreed to participate, and brief follow-up interviews/self-reports with non-participating families indicate that the study is largely representative of twins born in Minnesota at that time (Iacono et al., 1999). We excluded families if they lived were excluded if one or more of the children had a serious cognitive or physical disability, or if they lived more than a day's drive from the Twin Cities metropolitan area. The twins and their families are approximately 98% Caucasian, consistent with Minnesota demographics at the time of their birth.

The older cohort (born in 1972-1979) is comprised of 578 males and 674 female subjects. The younger cohort (born 1977-1984) is comprised of 748 males and 854 female subjects. Zygosity was assessed through multiple means, including a zygosity questionnaire administered to the parents, evaluation of physical similarity by MCTFR

staff, and comparing twins on ponderal and cephalic indices and fingerprint ridge counts. We performed serological analysis when the assessments disagreed.

*Inclusion criteria. The* study used the older and younger twin cohorts at the 'age 17', 'age 24', and 'age 29' assessments. There are 2854 subjects in the older and younger cohorts (male and female). Of these, 2590 had ASB data at age 17 (for the pre-EAP analyses). Of the original 2590, 2347 had ASB data at age 24 or age 29 (for post-EAP analyses). To keep our pre and post analyses as comparable as possible, we excluded individuals who did not have both pre and post ASB data available. All 2347 individuals also had sufficient information about parenthood (assessed at age 24 or age 29). To be included in the CTC analyses, we required both co-twins to meet inclusion criteria. Of the 2347 people with sufficient data, 2274 of these individuals had sufficient data about themselves and their co-twins. A more detailed and specific tracking of our sample size and data availability is depicted in **Table 6**, with number and percentages of subjects with specific types of data. Individuals who did not meet inclusion criteria had significantly higher antisocial behavior at age 29, but not other assessments (Age 29: p<.001).

*3.2.2 Measures*

*Antisocial Behavior.* All subjects were interviewed about their history of mental health using DSM-III-R criteria, using a modified version of the *Structured Clinical Interview for DSM-III-R* (Spitzer et al., 1990). Participants were asked about a wide range of disorders, including Antisocial Personality Disorder (APD). Subjects were interviewed by individuals with at least a bachelor's degree in psychology, and MTFS staff members reviewed interview answers and assigned symptoms in case conferences. Antisocial behavior symptom counts in adolescence and adulthood were calculated using endorsed

Adult Antisocial Behavior (AAB) items, which are based on the APD symptoms, but without the criteria of Conduct Disorder before Age 15, as specified in the DSM-III-R. At age 17, subjects were asked about lifetime history of adult antisocial behavior, and endorsement of any symptoms at any point in time. At age 24 and age 29, subjects were also asked about recent (in the last several years) symptoms of adult antisocial behavior. The older cohort did not provide information on current symptoms at age 24 via the standard interview. However, a supplemental form, the ASPD Interview, which asked for onset and offset ages at age 24, was administered to both the older and younger cohort. We were able to approximate assessment of current symptoms for both cohorts using this supplemental interview. The alternative assessment correlated highly (.92) with the original assessment of current symptoms (both were available in the younger cohort).

This study measured antisocial behavior in two different ways: lifetime and recent levels of antisocial behavior. For lifetime assessment, individuals were asked about endorsement over the entire lifespan. For recent assessment, individuals were asked about symptom endorsement within the last several years prior to assessment. Subjects endorsed lifetime symptoms at the age 17 assessment and recent symptoms at the age 24 and age 29 assessments. The use of lifetime antisociality at age 17 provides the most comprehensive overview of an individual's antisociality through adolescence. The use of recent symptoms in adulthood gives an understanding of an individual's current level of antisociality, which may have changed significantly from adolescence.

*Assessment of Parenthood.* Individuals were asked about major social events (friends, romantic partners, education, major life events) via the Social Adjustment Questionnaire at each assessment. Most of the sample has data at the age 24 and age 29

assessments, but the female twins in the younger cohort had not completed data

collection for age 29 at the time of this study, and their data were not yet available. The

questionnaire asks the subjects the number of biological children they have. The Life

Events Interview asked if a subject or their partner had given birth within several years

previously. Data from both the Social Adjustment Questionnaire and Life Events

Interview were collated, and occasional contradicting information (n=18, <1% of sample)

was reconciled using other data (answers at previous or later assessments, questions

about pregnancy). Data were consistent across both assessments in almost all cases

(reliability >.95 at all three assessments), and we thus felt confident using only one

measure if an individual only had one. Age of parenthood was assessed using reported

age of giving birth in Life Events. If there was substantial evidence of parenthood, but no

report of age of onset, we approximated age of parenthood by rounding down their age at

the first assessment they reported parenthood, as a best estimate. This estimate identified

the latest possible age of becoming parents, and was used in a small number (n=2) of

cases.

In our sample, 36.8 of males and 37.8% and females were parents. The numbers

and percentages of parents are presented in **Table 7.** These percentages underestimate the

proportion of females, as the younger cohort has not completed the later assessment. For

those individuals who became parents, mean age of parenthood was 25.2 for males, and

23.3 for females. As the study wanted to assess the risk of early adult parenthood, we

coded individuals who had an early onset of parenthood. Individuals who became parents

by age 22 were coded as early adult parents. Age 22 was chosen as the criterion because

it is still relatively early in adulthood, but also expanded significantly beyond the window

of adolescent pregnancy. Individuals who become parents at age 20 or 21 are less likely to have completed other young adult milestones (completing college, development into a vocational career, solid and established romantic partnerships), and thus early parenthood is likely to index risk similar to adolescent pregnancy. Additionally, the cutoff is several years prior to the age 24 assessment, meaning parents will report on their post-parenthood antisocial behavior, to cleanly differentiate between antisocial behavior prior to the onset of parenthood. In our sample, 10% of males and 19% of females were classified as early adult parents; females were significantly more likely to fall in the early parent category (two proportion z test: z=6.48, p<.001). **Table 7** presents the number and percentages of males and females subjects classified as early parents. As we were most concerned with the risks of early adult parenthood, and since many of our non-parents are likely to become parents (and are likely comparable individuals who became parents in their late 20s), we compared early adult parents to non-parents and late parents, treating the last two as one group.

*3.2.3 Statistical Analyses*

Antisocial behavior symptoms were calculated at each time point. The data were log-transformed to reduce positive skew, and age (at assessment) and cohort effects were regressed out prior to analyses. All antisocial behavior variables were standardized. In analyses that collapsed across males and females, sex was included as a covariate.

*Singleton Analyses.* We first ran analyses on the sample as singletons, to compare our findings to other studies, which cannot control for family factors. This provides a benchmark for comparison against the CTC studies. The study ran linear mixed effects regressions using the 'lme4' package in R to estimate the relationship between early adult

parenthood (EAP) and antisocial behavior (ASB) at multiple time points (pre-parenthood at age 17 and post-parenthood age 24, and age 29) (R Core Team, 2013, Bates, Maechler, Bolker, & Walker, 2014). The use of mixed effects models accounts for the correlated nature of the data (i.e. the twin structure) to more accurately estimate parameters, including the effect of early adult parenthood in the singleton sample (EAP-S). The study assessed the relationship between early adult parenthood and antisocial behavior prior to parenting (at age 17); a small number (N=61, <3%) of our sample were already parents at the age 17 sample, and were excluded from the pre-parenthood analyses. In our post-parenthood analyses, we included age 17 ASB, to further test the specificity of the relationship between EAP and adult ASB. For the singleton analyses, our full model included EAP, sex, and EAP*sex, as well as a family ID variable to account for the correlated nature of our data. For the post-parenthood analyses at age 24 and age 29, we also included age 17 ASB as a variable in follow-up analyses, to test if early adult parenthood predicted adult antisocial behavior beyond previous levels of antisocial behavior.

*Co-twin Control Analyses.* The co-twin control (CTC) model offers a way to quantify the between family effects (things that differ between sets of twins) and the within family effects (things that differ within sets of twins). Twin data are a type of clustered data, and qualities that are common to a cluster may account for the associations between variable. To more precisely measure a specific variable's association with an outcome, researchers can model both the cluster-level effect and the individual-level effect, and the individual-level effect (what remains after accounting for the characteristics of the cluster or group) is the more accurate measure of the association

(Begg & Parides, 2003). CTC is a specific application of this framework to twin data, and it uses the twin data to decompose the effect of early parenthood into a within family (EAP-W) and between family effect (EAP-B), which is analogous to the individual-level effect and cluster-level effect, respectively. Twins share both genes (100% for MZ, 50% for DZ) and rearing environment (100% for MZ and DZ twins). All of the factors that the twins share that make them similar will fall into the between family effect. However, twins also have some unique experiences, which may make them different, and these divergent experiences are captured by the within family parameter. The between family parameter measures the association between EAP and ASB, without correcting for confounding variables of shared genetics and rearing experiences. This parameter approximates the findings from non-family studies, in which participants differ on both individual and family level characteristics. The within family parameter is the more direct and specific measure of the relationship between EAP and ASB. As we were also interested in assessing whether or not MZ and DZ twin pairs differ, we included an interaction term between zygosity and the within family parameter. Taken together, the CTC analyses offer a quasi-causal test of the relationship between EAP and later ASB. If the association between EAP and later ASB is driven by genetic confounding, then the EAP-W term would be significant for DZ twin pairs (who share only 50% of their genetics) but not MZ twin pairs (who share all of their genetics). If the association between EAP and later ASB is driven by common environmental experiences, the EAP-W term would be non-significant for both MZ and DZ twin pairs. If the EAP-W is significant in both MZ and DZ twin pairs, this is consistent with a causal role of unique environmental experiences, such as EAP. We also ran analyses on EAP and pre-

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parenthood ASB, as we wanted to assess twin similarity prior to the onset of parenthood. If there is a within family effect at age 17, prior to the transition to EAP, then this would suggest the unique environmental event happened already. However, if there is no within family effect at age 17, but is at age 24 or age 29, it suggests that something happened within that time frame to set the twins on divergent paths, and is again consistent with a causal effect of EAP. We also qualitatively compared the effects at both post-parenthood assessment points, to see if the benefits were stable.

We conducted the co-twin control analyses by calculating the between family exposure to early adult parenthood (using data from both twins), and the within family difference scores (relative to the between pair exposure) for each individual twin. The between group parameter is the cluster's mean level of a variable (Begg & Parides, 2003). In twin data, this is operationalized as proportion of twins in the twin pair who experienced early adult parenthood (EAP-B would be .5 for discordant twin pairs, 1 for twin pairs concordant for EAP, and 0 for twin pairs concordant for no EAP). The individual effect is operationalized by subtracting the cluster effect (EAP-B) from the individual's exposure. For example, twins discordant would have an EAP-B parameter value of .5, the EAP parent's EAP-W would be .5 (1-.5), and the non-EAP parent's EAP-W value would be -.5 (0-.5). Previous studies have used this weighting system to differentiate between the familial level effect and the individual level effect in our sample (Burt et al., 2010; Huibregtse et al., 2011). Our full model for the CTC included the following terms EAP-W, EAP-B, sex, zygosity, EAP-W*sex, EAP-B*sex, EAP-W*zygosity. We also included age 17 ASB in follow-up analyses for the age 24 and age

29 analyses, to test the specificity of the association and if parameter retained

significance after accounting for prior antisocial behavior.

*3.3 Results*

*3.3.1 Sex Effects.* Males had substantially higher levels of antisocial behavior than

females in late adolescence ($F=69.02$, $p<.001$). In adulthood, males again had higher

levels of antisocial behavior at both time points, and both sexes decreased their current

levels of antisocial behavior over time (Sex differences: Age 24: $F=69.24$, $p<.001$, Age

29: $F=51.11$, $p<.001$. Change over time-Males: $F=5.80$, $p<.05$), Change over time-

Female: $F=4.90$, $p<.05$). There were no significant sex interactions in any models in the

singleton sample, suggesting that the relationship between early adult parenthood and

ASB is consistent across male and female subjects in both adolescence and adulthood. In

the CTC analyses, there was a significant sex interaction for the pre-parenthood analyses,

but not for the post-parenthood analyses. We analyzed male and female subjects together

for most analyses (except in the one instance of significant sex interaction).

*3.3.2 Singleton Analyses.* We examined the relationship between early adult parenthood

and antisocial behavior first in the singleton sample, without adjusting for between family

factors, or characteristics that are shared within a family. Results from the singleton

analyses are presented in **Table 8**. Adolescent antisocial behavior was significantly

associated with early adult parenthood in adulthood, indicating that high adolescent

antisocial behavior is a risk factor for early adult parenthood. Early adult parenthood was

associated with higher antisocial behavior at age 29, but not age 24. However, when we

included a measure of age 17 antisocial behavior, early adult parenthood was no longer

significant. While early adult parenthood may predict antisocial behavior in adulthood, it does not appear to predict it beyond prior levels of antisocial behavior.

*3.3.3 Co-twin Control Analyses.* We then examined the relationship between early parenthood and antisocial behavior using co-twin control analyses, to better control for shared common family factors (genetics and environment) that may obfuscate the association. The CTC analyses make it possible to partition the effects of early adult parenthood into group level (between family) and individual level (within family) effects. If the relationship between early adult parenthood and antisocial behavior is not causal, and merely indexes confounding variables, then we would expect to see an effect of between family EAP, but not individual level EAP (since the true causal variable would apply to both twin in a pair, regardless of which one becomes an early parent). At each assessment, we included terms for family level effects of EAP (between family EAP, noted as EAP-B) and individual level effects of EAP (within family EAP or EAP-W). We also included a zygosity interaction term with EAP-W to see if MZ and DZ twins were comparably similar to each other.

Results from the CTC analyses are presented in **Table 9**. At age 17, males and females were analyzed separately, as the sex interaction was significant (p<.001). However, the results from the analyses were largely consistent. For both males and females, EAP-B, or the characteristics that differ between families, significantly predicted antisocial behavior (Males: p<.001, Females: p<.001). This relationship was stronger for males than females, but the direction of the findings was the same. There was no significant effect of an interaction between sex and between family EAP. There was no significant effect of individual EAP, or characteristics that differ within families. Twin

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pairs were largely similar to each other in adolescence, regardless of future family status. Early adult parenthood indexes risky familial background in individuals associated with adolescent (pre-parenthood) antisociality, and this was especially true for males. The lack of significant within-family effect of early parenthood indicates that early adult parenthood does not index risk for individuals, beyond common familial factors.

A different pattern was observed for adult antisocial behavior. For both age 24 and age 29 models, both within-family EAP and between-family EAP parameters predicted antisocial behavior. However, family-level and individual-level EAP had opposite associations with antisocial behavior. Family-level EAP (EAP-B) predicted higher antisocial behavior at both age 24 and age 29 (Age 24: $p<.001$, Age 29: $p<.001$). However, individual EAP (EAP-W) predicted lower antisocial behavior at both age 24 and age 29 (Age 24: $p<.01$, Age 29: $p<.05$). When we included adolescent antisocial behavior in the model, all EAP-B and EAP-W parameter retained their significance, although the EAP-B parameters were attenuated. **Figure 4** compares the effect sizes of the association between early adult parenthood and antisocial behavior between the singleton and CTC analyses. There were significantly different pattern of results between the singleton and CTC analyses, demonstrating the importance of considering family factors when analyzing data. Specifically, pre-parenthood differences were no longer significant, and post-parenthood differences indicated protective (parenting co-twins had lower ASB) effects of early adult parenthood.

To summarize, individuals who belonged to a family that had early parenthood had higher levels of adult ASB, but the early parents had significantly lower levels of ASB compared to their co-twins. These early parents were not less antisocial (than their

co-twins) before becoming parents (as shown in the age 17 model), but became less antisocial after becoming parents (at age 24 and age 29). This finding is consistent with protective, and perhaps causal, benefits of early parenthood. There was no evidence of sex interaction, indicating that male and female early parents both reduced their antisocial behavior significantly more than their non-parenting co-twins. There was also no evidence of a zygosity interaction, indicating that MZ and DZ pairs had comparable associations between EAP-W and antisocial behavior in adulthood.

*3.4 Discussion*

The present study examined the relationship between antisocial behavior in adolescence and adulthood and the transition to parenthood in emerging adulthood, and focused in particular on the risks associated with early adult parenthood. In the singleton sample there was a significant association between early parenthood and higher levels of antisocial behavior (relative to non-parents and late parents) in adolescence. There was no relationship between early parenthood and antisocial behavior in adulthood (once the model included adolescent antisocial behavior). The high level of adolescent antisocial behavior predated the transition to parenthood, and indicates that high antisocial behavior predicts early adult parenthood. This extended the research on adolescent pregnancy, and indicated that adolescent antisocial behavior also predicts adult parenting outcomes. Although the singleton sample analyses provided information about broad associations between variables, the CTC analyses found a different pattern, and highlight the utility of twin and family studies in understanding mechanisms of development.

The CTC analyses divided the effect of early parenthood into family and individual effects. This offered a more precise understanding of the relationship between

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variables, and whether or not the variable was associated with specific outcomes at the individual level. In our sample, the use of the CTC model provided significantly different associations than the singleton sample analyses, and clarified the risks and benefits of early parenthood. At age 17, prior to the transition to parenthood, the between family effect, but not the within family effect, of early parenthood was associated with high antisocial behavior. Essentially twins that were discordant for early parenthood had indistinguishable levels of antisocial behavior in adolescence. This meant that the associated risk of early parenthood was consumed by family level effects (including genetics and/or shared rearing experience), but was not specific to early parenthood itself (as the early parenting co-twin was not more antisocial).

In contrast to the pre-parenthood analyses, there was evidence of both a between family effect and a within family effect of early parenthood after the transition to parenthood, at age 24, and age 29. At both age 24 and age 29, the between family effect was in the same direction as at age 17; families with early parenting members had higher levels of antisocial behavior, relative to families where no one became an early parent. However, the individual level effect was in the opposite direction of the familial effect, and actually protective. Twins who became early parents were less antisocial than their non-parenting co-twin. As the CTC design controlled for between family factors, this difference in antisocial behavior was attributable to something the twins do not share. Since the difference was not present at age 17, but was present at age 24 and age 29, it must have been a non-shared event that occurred between age 17 and age 24. The transition to early parenthood is thus a good candidate for causing this change between twin pairs. Furthermore, the effects were largely consistent at age 24 and age 29. This

indicates that the benefits of early parenthood are relatively stable, and likely represent long-term changes in an individual's behavior, up to seven years after the transition to parenthood.

There was no significant difference between MZ and DZ twins in the estimation of the individual early parenthood effect in the CTC analyses, meaning that results were consistent across zygosity. Interpretation of the significance of this non-difference should be made with caution, as there were a limited number of discordant twin pairs in our sample. However, the lack of an individual early parenthood effect for either MZ or DZ twin pairs at age 17 suggested that the relationship between adolescent antisocial behavior and early parenthood was driven at least somewhat by shared environmental experiences (as both MZ and DZ twins share those 100%). If it was driven by genetics, we would have expected a significant difference between DZ twins (as they do not share all of their genes). There was no zygosity interaction effect between the individual EAP effect in the post-parenthood analyses in adulthood, meaning that both MZ and DZ twin pairs benefitted similarly from early parenthood, consistent with a unique environmental effect (something that twins pairs do not share).

*Sex Differences:* In our samples, there was minimal evidence of significant difference between male and female subjects in the relationship between early parenthood and antisocial behavior. Although males had higher mean levels of ASB, and female participants were more likely to become early parents, the relationship between EAP and ASB was largely consistent. The only evidence of sex differences was at age 17 in the CTC model; the between family effect of EAP was stronger for male twins than female twins (but was a risk factor for both male and female twin families). Early

parenthood may especially index familial risk factors for males in adolescence. Previous literature has sometimes found male and female subjects to have similar associations between parenthood and antisocial behavior, and this was consistent with those studies.

*Importance of Genetically Informative Studies.* The CTC analyses found evidence of risk of familial EAP, and protective effects of individual EAP in adulthood, whereas analyses in the singleton sample found no risk or benefit of EAP in adulthood. This illustrated the value of the CTC model, in differentiating between association at the individual level and associations at the group level. In our sample, families where at least one member became an early parent were characterized by risk for antisociality in adolescence ant adulthood. The characteristics that make *twin pairs* more or less likely to become early parents also indexed risk for ASB at multiple time points in development. However, the characteristics that make an *individual twin* become an early parent appeared to offer protective effects in adulthood, post parenthood. This did not appear to reflect long-term differences between the twins, as the early-parenting co-twin was not less antisocial prior to parenthood. The opposite direction of the associations (between family and within family) likely accounted for the lack of significant association in the singleton sample. This provided a compelling reason for the use of genetically informative studies, as it can effectively differentiate between group and individual level effects. This allows for a more direct test of causal hypotheses, and can offer confirmatory support of causal models. Our longitudinal data, which included assessment prior to antisocial behavior, offered information about the onset of these differences and more evidence that early parenting may causally reduce antisocial behavior.

*Limitations.* There are several important limitations. First of all, we asked subjects about their children, but did not assess their actual parental duties (child support, child care, etc.). Theories about protective benefits of parenthood suggest that the change in role obligations shepherds changes in antisociality, but we did not directly measure if our individuals had significantly changed their social roles. Some of our early parents, particularly males, may have not been required to actually take on the obligations of parenthood, and may have lived their lives relatively uninterrupted by the birth of their child(ren). We also did not measure any parenting behavior, or the quality of the parent-child relationship, which previous work has suggested may be an important predictor of criminal behavior (Ganem & Agnew, 2007). Additionally, many of our subjects will experience these social role transitions later in life (in their 30s and even 40s). This study did not take into account the relationship between becoming a parent later in life and antisocial behavior. We would expect that becoming a parent at that stage would be associated with significantly lower levels of antisocial behavior throughout the lifespan, as that age of onset would likely be associated with good family planning skills and careful avoidance of pregnancy during earlier, less convenient times. We would not necessarily expect a decrease in antisocial behavior, as this would be after the major wave of antisocial behavior desistance has passed (in mid to late 20s). Furthermore, our study comprised a community sample, and most of our subjects did not have the high level of antisociality and psychopathology that characterize criminal samples. The protective benefits of early parenthood may not apply to all levels of antisocial behavior, and our study did not answer if the most highly antisocial individuals (e.g., incarcerated felons) benefit from the role transition of early parenthood. Finally, antisocial behavior is

merely one negative outcome, and we did not look at other possible changes (such as substance use, depression, or occupational achievement). Early parenthood may index risk in other areas, and the protective effect found for ASB may not generalize to other domains. Finally, it's possible that early parenthood was not the original discordant event, but merely the consequence of a previous discordant event. .

*Future Directions.* Our study found a protective effect of early parenthood on antisocial behavior, but it is unclear if this extends to other areas of externalizing behavior or substance use. It is also unclear how these individuals change in later adulthood. The protective benefit of early parenthood may dissipate, particularly as other, less antisocial, peers also become parents. However, the study, taken into context with other work suggesting protective effects for marriage, suggested that changes in social roles seem to significantly reduce individual's propensity for antisocial behavior, even after controlling for previous levels of antisocial behavior and genetic and shared environmental factors. Understanding why and how these changes in social roles lead to reductions in antisocial behavior is a meaningful target for intervention work. Creating opportunities for altered sense of identity and social obligations (outside the context of parenthood) may prove to be an effective means of facilitating desistance in antisocial young adults.

**Table 6. Number of Individuals with ASB Data and Parenthood Data**

*Number of Individuals in Singleton Analyses*

| Measure | Older Cohort Male | Female | Younger Cohort Male | Female | TOTAL |
|---|---|---|---|---|---|
| Ever assessed | 578 | 674 | 748 | 854 | 2854 |
| Age 17 ASB | 577 | 670 | 605 | 738 | 2590 |
| Age 24 or Age 29 ASB | 531 | 632 | 568 | 616 | 2347 |
| Parenthood Data, Age 17 ASB, and Age 24 or Age 29 ASB | 531 | 632 | 568 | 616 | 2347 |

*Number of Individuals in CTC Analyses*

| | Older Cohort Male | Female | Younger Cohort Male | Female | TOTAL |
|---|---|---|---|---|---|
| Parenthood Data, Age 17 ASB, and Age 24 or Age 29 ASB | 507 | 624 | 551 | 592 | 2274 |

This tracks the sample size and data availability by sex and cohort. The first row is the entire sample, anyone who was assessed in any of the four groups. We required individuals to have a baseline measure of ASB (at age 17), a post early parenthood measure of ASB (at age 24 or age 29), and parenting data (at age 24 or age 29).

**Table 7. Descriptive Statistics of Parenthood and Early Parenthood**

|  | Ever Parents | | Age at Parenthood | | Early Parents | |
| --- | --- | --- | --- | --- | --- | --- |
|  | N | % | Mean | SD | N | % |
| Male | 404 | 36.8 | 25.3 | 3.1 | 110 | 10 |
| Female | 470 | 37.8 | 23.4 | 3.3 | 234 | 18.8 |
| All | 874 | 37.3 | 24.3 | 3.4 | 344 | 14.7 |

This table presents the descriptive statistics for early parenthood in our sample, for number of individuals who were early or ever parents, and mean age of parenthood in our sample. Note: some female subjects from the younger cohort have not been included in these analyses, as their data were not yet available, which explains why the proportion of male and female 'ever parents' is so comparable.

**Table 8. Results from Singleton Analyses**

*Parameters from Singleton Analyses*

|  | Age 17 | Age 24 | Age 29 |
|---|---|---|---|
|  | All | All | All |
|  | N=2286 | N=2005 | N=1666 |
|  | B | B | B |
| EAP-S | .41*** | 0.13 | .24* |
| EAP-S*Sex | -0.14 | 0.01 | -0.21 |

*Parameters when adolescent ASB included in model*

|  | Age 17 | Age 24 | Age 29 |
|---|---|---|---|
|  | - | All | All |
|  |  | N=2005 | N=1666 |
|  | - | B | B |
| EAP-S | - | -0.08 | 0.08 |
| EAP-S*Sex | - | 0.1 | -0.09 |

This presents the estimated unstandardized parameters for the singleton analyses for pre-parenthood (age 17) and post-parenthood (age 24 and age 29). Positive parameters indicate that it predicts higher levels of ASB, and negative parameters indicate it predicts lower ASB. Note: some female subjects from the younger cohort have not been included in these analyses, as their data were not yet available. Significance is denoted as such: *=p<.05, **=p<.01, ***=p<.001.

**Table 9. Results from CTC Analyses**

| *Parameters from CTC Analyses* | | | | |
|---|---|---|---|---|
| | Age 17 | | Age 24 | Age 29 |
| | Males | Females | All | All |
| | N=1052 | N=1192 | N=1892 | N=1624 |
| | B | B | B | B |
| EAP-B | 1.22*** | .48*** | .49*** | .53*** |
| EAP-W | 0.23 | -0.19 | -.26** | -.24* |
| EAP-W*Zyg | -0.18 | 0.21 | 0.21 | 0.07 |

| *Parameters when adolescent ASB included in model* | | | |
|---|---|---|---|
| | Age 17 | Age 24 | Age 29 |
| | - | All | All |
| | - | N=1892 | N=1624 |
| | | B | B |
| EAP-B | - | .17* | .33** |
| EAP-W | - | -.31*** | -.25** |
| EAP-W*Zyg | - | 0.23 | 0.06 |

This presents the estimated unstandardized parameters for the CTC analyses for pre-parenthood (age 17) and post-parenthood (age 24 and age 29) analyses. There was a significant sex interaction at age 17, and males and females are presented separately. Positive parameters indicate that it predicts higher levels of ASB, and negative parameters indicate it predicts lower ASB. Note: some female subjects from the younger cohort have not been included in these analyses, as their data were not yet available. Significance is denoted as such: *=p<.05, **=p<.01, ***=p<.001.

**Figure 4. Comparison of Effect Size in Singleton vs. CTC Analyses**
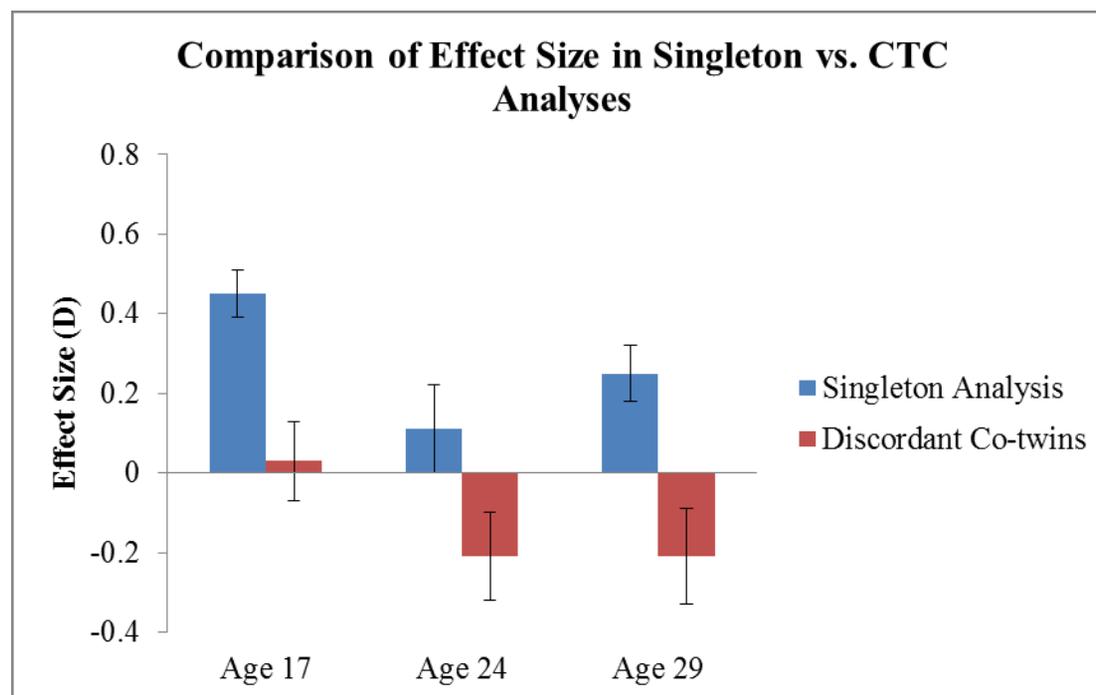


This figure plots the effect size of between EAP and non-EAP individuals at different points in development (including before and after early parenthood). It plots the effect calculated in the singleton analyses, and between co- twins discordant for EAP from the CTC analyses. (MZ and DZ twins were combined because there were no significant zygosity differences). The effect sizes are positive (indicating higher ASB) for the singleton analysis at all ages (albeit non-significant at age 24). The CTC analyses are negative (indicating lower ASB) at age 24 and age 29, and the effect was essentially zero at age 17. Error bars indicate standard error of the mean.

**Chapter 4: Psychopathic Traits and Social Role Transitions**

Previous chapters have established the relationship between marriage/parenthood and adult antisocial behavior, as well as between marriage/parenthood and adolescent antisocial behavior. However, it is unclear what drives these associations, particularly as recent reviews have demonstrated significant heterogeneity in antisocial behavior (S. Burt, 2009). Measurement and operationalization of antisocial behavior includes delinquency, callous/unemotional traits, psychopathic personality traits, overt and covert aggression, disorder symptom counts (Antisocial Personality Disorder, Conduct Disorder or Oppositional Defiant Disorder), and broad questionnaires of antisocial behavior (from teacher, caregiver, or self-reports) across one or more domains. There have been several different ways researchers have sought to organize antisocial behavior, including aggressive vs. non-aggressive delinquent behavior, and overt vs. covert acts. Other studies have focused on identifying personality traits, as these may be particularly relevant in understanding stable and persistent antisocial behavior (Frick & White, 2008). Antisocial personality disorder, and adult psychopathic personality traits, are some of the strongest predictors of long term antisocial behavior and criminality in adulthood, and are associated with higher rates of recidivism (Gendreau, Little, & Goggin, 1996).

Psychopathy is an important predictor of future antisocial behavior. Some have argued that assessing psychopathy, rather than antisocial behavior, allows for a better understanding of and prediction of stable antisocial behavior (Cooke & Michie, 2001). Psychopathy includes overt antisociality plus willingness to manipulate others, lack of empathy, fearlessness and social dominance. The Psychopathy Checklist (PCL) originally

conceived of a two-factor model; Factor 1 is characterized by an interpersonal style that is self-centered, lacks remorse, and takes advantage of others, while Factor 2 is characterized by unstable, maladaptive, and impulsive life choices (Harpur et al., 1989). Recent studies have suggested a three or four factor model may fit better in forensic samples, but two factor models still provide adequate fit and are used extensively in the research literature (Hill, Neumann, & Rogers, 2004). Others proposed that three dimensions comprise psychopathy: meanness, boldness, and behavioral disinhibition (Patrick, Fowles, & Krueger, 2009). They further suggested that low fear underlies meanness and boldness. Across studies with different measures or numbers of scales, psychopathic factors, particularly the interpersonal and/or affective factors, are not always associated with risk or poor outcomes (Marcus, Fulton, & Edens, 2013). Psychopathic traits may in fact, prove adaptive in some circumstances. Individuals with high levels of psychopathic personality traits may be able to function well in society; such as a politician or leader who is aided by social competence, little fear, and minimal anxiety. In fact, while the second factor of the PCL is associated with lower intelligence and more adverse family background, the first factor has smaller or reversed associations with these variables, indicating the heterogeneity in factors of psychopathy (Harpur et al., 1989).

*4.1 Factors of Psychopathy in Community Sample*

Although individuals high on psychopathy are often in criminal settings, there are meaningful individual differences in these two factors of psychopathy in the community. The Psychopathic Personality Inventory was developed to measure the components of

psychopathic personality traits in community samples, and its two higher order factors mirror the two principal components of the PCL-R (Lilienfeld & Andrews, 1996). The first factor, fearless dominance (FD), measures fearlessness, social potency, low anxiety, lack of concern for consequences, and the ability and desire to manipulate others. The second factor, termed impulsive antisociality (IA), measures recklessness, unconventionality, aggression, nonplanfulness, and a tendency to blame others. These two factors can be well-approximated from scales of the Multidimensional Personality Questionnaire (MPQ) (Benning, Patrick, Hicks, Blonigen, & Krueger, 2003). This has been demonstrated in both community and forensic samples, with male and females (Benning et al., 2003; Blonigen, Hicks, Krueger, Patrick, & Iacono, 2005; Patrick, Edens, Poythress, Lilienfeld, & Benning, 2006; Poythress, Edens, & Lilienfeld, 1998) Blonigen et al., (2005) examined MPQ traits in 17 year old male and female twins in the Minnesota Center for Twin and Family Research, a longitudinal sample of community representative twins. Both FD and IA were moderately heritable (~.5) in men and women. IA predicted a wide range of adult psychopathology (more depression, conduct disorder, drug and alcohol dependence, and externalizing behavior), whereas FD was associated with reduced anxiety, and slightly higher rates of externalizing in male, but not female, subjects.

Both FD and IA predict adult antisocial behavior, but have different correlations with individual's background and characteristics (Benning, Patrick, Blonigen, Hicks, & Iacono, 2005; Benning et al., 2003). IA has a strong association with antisocial behavior throughout the lifespan, as well as higher substance use, lower education outcomes, and

trait aggression (Benning et al., 2005; Patrick et al., 2006). FD has a small association

with adult antisocial behavior but is more weakly related to other externalizing behavior.

The two constructs provide different information about an individual's likelihood of

engaging in impulsive, aggressive or manipulative behavior. FD and IA also have

divergent correlations with personality. FD is associated with lower neuroticism and

agreeableness, and higher extraversion and openness. IA is also associated with lower

agreeableness, but is associated with higher neuroticism and lower conscientiousness

(Ross, Benning, Patrick, Thompson, & Thurston, 2009).

FD and IA are weakly correlated with each other (meta-analytic correlation = .12),

and are more orthogonal in forensic, vs. community, samples (Marcus et al., 2013). FD is

moderately correlated with lower negative emotionality, and higher positive emotionality,

sensation seeking, and most scales on other psychopathic measures (small correlations

with both scales of Psychopathy Checklist-Revised, moderate correlations with both

scales of Self Report Psychopathy-II, and a small correlation with the first factor of the

Levenson Self-Report Psychopathy Scales). IA is moderately correlated with lower

behavioral constraint, and higher negative emotionality, sensation seeking, and scales

from other psychopathic measures (small to moderate correlations with both scales of

Psychopathy Checklist-Revised, a moderate correlation with the second scale of Self

Report Psychopathy-II, and moderate correlations with both factors of the Levenson Self-

Report Psychopathy Scales). The meta-analysis also did not examine interactions

between FD and IA, and FD may be more maladaptive in the context of moderate to high

IA (when lack of fear might spur greater criminal activity, if an individual does not fear

retribution or punishment). These studies, especially those with forensic or clinical populations, tend to focus on male participants.

In fact, FD has been criticized as not being sufficiently associated with maladaptive outcomes to merit inclusion in the construct of psychopathy (Marcus et al., 2013; Miller & Lynam, 2012). However, theoretical conceptualizations have long acknowledged that there may be positive or adaptive consequences of psychopathic traits (Patrick et al., 2009). In particular, the 'adaptive' nature of FD may contribute to Cleckley's 'mask of sanity', or ability to present well, that is considered core in Cleckley's conceptualization of psychopathy (Lilienfeld et al., 2012). Additionally, while IA is more strongly related to measures of antisocial behavior than FD, fearless dominance also indexes risk of ASB in some circumstances. In a forensic sample, FD and self-centered impulsivity (an analogue to IA) interacted to predict predatory aggression in prison (Smith, Edens, & McDermott, 2013). FD has also been associated with a high sense of superiority, narcissism, and sensation seeking, and reduced empathy in community and non-clinical samples (Lilienfeld et al., 2012; Witt & Donnellan, 2008).

### 4.1.1 Social Roles and Adult Family Formation

Antisocial individuals are less likely to get married, and more likely to have children earlier, and some of this relationship is driven by shared risk for these variables with antisocial behavior (Chapter 2 and Chapter 3). However, it's not clear what underlies this predisposition, but psychopathic personality traits are a good candidate, as they encompass affective and interpersonal characteristics, which are relevant to social relationships. While there is a well-established literature studying the relationship

between broad antisocial behavior and marital status, less is known about how the first

factor of the PCL relates to marriage, particularly in community samples. Generally,

individuals (although most studies do not include women) with high levels of

delinquency are less likely to get married (Laub & Sampson, 2001). In a community

sample of young adult males, the first factor of the PCL was not significantly predictive

of marital status, although both related to prior arrest history and substance use in the

expected directions (Kahn, Byrd, & Pardini, 2013). Psychopathy generally is associated

with poorer marital outcomes (Black, Baumgard, & Bell, 1995). However, several studies

of young adults (including a large number of women) have found small but positive

relationships between FD and relationship satisfaction. Individuals with higher FD self-

reported higher levels of romantic relationship quality (r = .1, small but significant), in

contrast with IA, which predicted lower relationship quality and infidelity (Witt &

Donnellan, 2008). Another study found that FD was correlated with informant-reported

relationship quality (and IA predicted lower relationship quality); however, most of the

informants were not romantic partners, and were friends, parents or siblings, and most

students were in college, and thus unlikely to be married (Witt, Donnellan, Blonigen,

Krueger, & Conger, 2009). Given the social potency and charisma components of the

first PCL factor of psychopathy, it may be that this facilitates social relationships with

others, although it may also provide disadvantages over the course of the marriage. As

FD is associated with other negative interpersonal characteristics, like narcissism, vanity,

a sense of superiority and a sense of entitlement, it may also contribute to destabilization

of relationships (Lilienfeld et al., 2012; Witt & Donnellan, 2008).

Even less is known about the relationship between psychopathy and parenthood, and most research in this area focuses on sexual risk behavior, rather than parenthood. Adolescents with high callous/unemotional (C/U) traits (adolescent analogs to psychopathy) are at risk for risky sexual behavior and sexual offending (White, Cruise, & Frick, 2009). However, this risk is attenuated when conduct disorder symptoms are accounted for; high C/U traits did not index early or unprotected sex in individuals who engaged in low levels of delinquency (Wymbs, McCarty, & Baer, 2013). A number of studies have focused on antisocial behavior or callous/unemotional traits and adolescent pregnancy; less is known about how this relates to young adult outcomes. Fearless dominance predicted risky sexual behavior in men (which might consequently lead to parenthood) in a sample of college students; IA predicted risky sexual behavior in both men and women (Fulton, Marcus, & Payne, 2010). Overall, the research between antisocial personality characteristics and young adult outcomes is sparse, and the existing research generally does not examine separate dimensions of psychopathy. More research is needed to analyze not only the relationship between these outcomes and antisocial traits, but how factors of psychopathy relate to the developmental timing of these events.

*Timing of Social Role Transitions* There is limited research on the timing of social role transitions (marriage, parenthood) and psychopathy or antisocial behavior. This may be an important variable, as timing is an important characteristic of these social role transitions. Earlier marriage and parenthood are associated with less successful outcomes like education, mental health, and financial success (Bramlett & Mosher, 2002; Dahl, 2010; Hoffman, Foster, & Jr, 1993). This is particularly relevant in young adulthood

when individuals are altering their sense of identity, taking on adult roles (as parents or partners), and de-escalating their antisocial behavior in the same time period.

*4.1.3 Current Study.* As FD relates to interpersonal callousness and dominance more than delinquent behavior, it may have a different relationship with social role transitions than IA, and may thus help explain some of the heterogeneity in the antisocial behavior research. Differentiating between dimensions of psychopathy may clarify the nature of the relationships between antisocial behavior and social role transitions. This study looked at different types of psychopathic (FD/IA) traits in late adolescence and their relationship with social role transitions in young adulthood (marriage and parenthood). We analyzed these adult roles with respect to both occurrence (marriage, divorce, and parenthood), and timing of the social role transitions (age at first marriage or parenthood) in a longitudinal community-based sample. We expected FD/IA to predict both social roles and the timing of social roles, but that FD and IA would have a different pattern of associations, as they generally have different pattern of associations with other outcome variables (achievement, externalizing and internalizing psychopathology). As FD has been positively associated with relationship quality, and IA negatively associated with relationship satisfaction in young adults, we expected marriage, generally associated with relationship satisfaction, to have comparable associations, and to predict slightly higher levels of FD and lower levels of IA. In both male and female subjects, we expected married individuals to have higher levels of FD and lower levels of IA. We expected both FD and IA to predict divorce, as IA is associated with relationship infidelity, and FD is associated with narcissism, a sense of superiority, and low empathy. Individuals who are

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competent, able to manipulate others, and minimize consequences are likely able to charm others for periods of time, but it may not promote stability in long-term relationships.

We expected IA to be strongly associated with early parenthood, as early parenthood is more strongly associated with antisocial behavior than general parenthood (Chapter 3). We expected that individuals who become parents early in adulthood have higher levels of impulsive antisociality, but not necessarily have higher levels of fearless dominance, as we expect early parenthood to overlap with the behavioral disinhibition characterized by the second factor.

## 4.2 Methods

*4.2.1 Participants.* This study sample is a subset of the Minnesota Center for Twin and Family Research (MCTFR). The MCTFR is a longitudinal, community-based study of twins and their families. The twins are assessed every 3-4 years from adolescence to adulthood. This study examined adolescent antisocial behavior and young adult outcome and social roles. Twins and families were identified using publicly available birth records from select years, as birth records include information about multiple births. Over 90% of families with multiple births in the state were successfully located and contacted. Families were not invited to participate if one or more of the children had a serious cognitive or physical disability, or if they lived more than a day's drive from the Twin Cities metropolitan area. Approximately 83% of the eligible families agreed to join the study, and brief assessment of non-participating families found little difference between

participating and non-participating families (Iacono et al., 1999). The twins and their families are approximately 98% Caucasian, consistent with Minnesota demographics at the time of their birth.

Two cohorts of MCTFR twins have available data to examine the relationships, the 'older' cohort of twins and the 'young' cohort of twins. The older cohort, born in the years, 1972-1979, joined the study at approximately 17 years of age, and completed four assessments: age 17, age 20, age 24, and age 29. The younger cohort, born in 1977-1984, started assessments at age 11, and has completed six assessments including the age 17, age 20, age 24 and age 29 assessments. The female wave of the younger cohort is in the process of completing the age 29 assessment and some of their data is not yet available. There are 2854 twins in both cohorts. Approximately 85-95% of the sample returned for each assessment. The older cohort is comprised of 1252 subjects, 578 males and 674 female twins; all individuals in the older cohort completed assessment at age 17 as that was their first assessment. The younger cohort has an N of 1602, and 1388 of these individuals completed assessment at age 17, a requirement for our study design.

*Inclusion Criteria.* To be included in this study, we required participants to have antisocial personality data at the age 17 assessment, prior to the social role transitions. We also required participants to have completed data pertaining to social role transitions at either age 24 or age 29, to allow subjects sufficient time to reach young adult milestones. The number of male and female subjects with sufficient data is tracked in **Table 10**. Excluded participants were largely comparable to included subjects on our measured variables; women who were excluded from the marriage analyses had slightly

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higher levels of IA (assessment of IA described below), but this was the only significant difference. In our sample, 85% of individuals assessed at age 17 have sufficient data (age 17 FD/IA data, social role transition data) to be included in analyses.

*4.2.2 Measures*

*Antisocial Personality Traits:* Antisocial personality traits were assessed at age 17-18. We used MPQ data to approximate PPI scores. Subjects completed the MPQ at home, and returned the forms to staff. MPQ scores in certain domains overlap substantially with the PPI, and MPQ scores can capture individual differences analogous to those assessed by the PPI (Benning et al., 2003). Previous studies have used these scores to approximate PPI scores effectively in males and females in community samples, including this sample and similar samples (Benning et al., 2003; Blonigen et al., 2005). Previous studies have demonstrated these two factors are both associated with adult antisocial behavior in males, but also have a different pattern of associations with related constructs (Benning et al., 2003). The second factor (IA) has been shown to be significantly associated with substance abuse and timing of substance use initiation, as well as childhood antisocial behavior. The first factor (FD) was not significantly associated with these latter variables. We estimated factor scores on the PPI scales of Fearless Dominance (FD) and Impulsive Antisociality (IA), using regression weights calculated in a community sample (Benning et al., 2003). In our sample, both factors are correlated with adult antisocial behavior (as assessed via interview) in male subjects, but the correlation between the second factor (IA) and actual antisocial behavior is stronger and more robust. IA correlates 0.3 with adult antisocial behavior at age 29, and FD has a

more modest, albeit significant, correlation at 0.1. In the female subjects in our sample, the second factor (IA) correlated 0.3 with adult antisocial behavior at age 29, but IA did not have a correlation that significantly differed from zero. As there may be minor differences between male and female subjects and assessment of psychopathic personality traits, we tested for sex differences in all analyses.

*Social Role Transitions:* The Social Adjustment Questionnaire assesses major social events (friends, romantic partners, education, major life events) at each wave. The questionnaire asks participants if they have ever gotten married, if they have been divorced, and if they are currently married. The questionnaire also asks the subjects the number of biological children they have. The Life Events Interview asks subjects if they have been married, engaged, or divorced recently, and the number of times they have done so. We integrated the data from age 24, and age 29 assessments, and corrected occasional incompatible data using our best estimate from other related questions. Data from both the Social Adjustment Questionnaire and Life Events Interview were collated, and occasional contradicting information (<1% of sample) was reconciled using other data (answers at previous or later assessments, questions about pregnancy). Data was consistent across both assessments in almost all cases (reliability >.95 at all three assessments), and we used one measure if that was the only one available. Age of social role transitions was assessed in Life Events, via questions about age at birth or marriage. If there was substantial evidence of parenthood/marriage, but no report of age of onset, we rounded down their age at the assessment they first reported parenthood or marriage,

as a best estimate of their age at the role transition. This estimate identified the latest possible age of making the transition, and was used in a small number (n<10) of cases.

In our sample, 49% of males and 52% of females were married during our assessments; descriptive statistics are provided in **Table 11**. These numbers underestimate the number of females who will get married by age 30, as not all have been assessed yet. We compared two types of marital transitions: ever married vs. never married, and married vs. divorced. Approximately 4% of females and 5% of males in the sample got divorced. Average age of marriage was 24.8 for males and 23.4 for females. Our sample is consistent with demographic data from the 2010 Minnesota census (approximately 70% of all individuals over age 15 have been married) (U.S. Census Bureau, 2012).

In our sample, 36% of males and females are parents. For those individuals who became parents, mean age of parenthood was 25.3 for males, and 23.5 for females. **Table 11** presents the number and percentages of male and female subject classified as parents. For our analyses, we examined associations between FD/IA and both parenthood generally, and timing, as previous work has shown timing of parenthood to relate to adolescent and adult antisocial behavior (Chapter 3).

*Adolescent Antisocial Behavior:* Subjects completed a psychopathology history interview based on DSM-III-R criteria, using a modified version of the Structured Clinical Interview for DSM-III-R (Spitzer et al., 1990). Subjects were interviewed by individuals with at least a bachelor's degree in psychology, and MTFS staff members reviewed interview answers and assigned symptoms in case conferences. Antisocial

behavior symptom counts in adolescence were calculated using endorsed Adult Antisocial Behavior (AAB) items, which are based on the Antisocial Personality Disorder symptoms, but without the criteria of Conduct Disorder before Age 15, as specified in the DSM-III-R. At age 17, subjects were asked about lifetime history of adult antisocial behavior, and endorsement of any symptoms at any point in time, providing a thorough and comprehensive measure of the lifetime history of antisocial behavior.

*4.2.3 Statistical analyses:* The goal of this study was to differentiate between types of psychopathy and adult role transitions and the timing of transitions. The study ran generalized estimating equations using the 'gee' package in R to explore the individual levels association between adolescent antisocial behavior and dichotomous adult outcomes and social role transitions (marriage, divorce, parenthood) (R Core Team, 2013, Carey, Lumley, & Ripley, 2012). We ran linear mixed effects models using the 'lme4' package in R on continuous outcomes (age of marriage, age of parenthood) (Bates, Maechler, Bolker, & Walker, 2014). Both types of models accounted for the correlated nature of the data (i.e. the twin structure) to more accurately estimate parameters. We also tested for gender differences by looking at the interaction between sex and adolescent psychopathic traits. We included terms for FD, IA, FD*IA, sex interaction terms for FD and IA, as well as several covariates. To further test the robustness and specificity of our findings, we added a measure of adolescent antisocial behavior (ASB) from the age 17 assessment to the best fitting GEE model for each adult outcome, to see

if FD and IA parameters retained their significance, and provided unique predictive power, beyond a behavioral measure of antisociality.

*4.3 Results*

*Sex Interactions:* We analyzed all models for sex interaction terms, as there were slight differences between male and female subjects and the association between FD and adult antisocial behavior. For the analyses of marriage and FD and/or IA, interaction terms were significant only for divorce. For the parenthood analyses, there was a significant interaction term with sex for the timing of parenthood. For theses analyses, we analyzed male and female subjects separately. For all analyses without evidence of sex differences, we analyzed them jointly (using sex corrected variables).

*Marriage, FD, and IA:* We tested the predictive power of FD and IA for three marital analyses: ever marriage, divorce, and timing of marriage. Final results for the three analyses are presented in **Table 12**; positive parameter values indicate greater likelihood of occurrence, and significance is indicated with asterisks. We ran analyses including a measure of age 17 antisocial behavior (that is correlated with IA but not FD in our sample), to test the specificity of our findings, if IA and FD offer predictive power beyond antisocial behavior.

Lower IA predicted higher likelihood of marriage, and higher FD trended (non-significantly) towards predicting likelihood of marriage; there was no evidence of an interaction between FD and IA. When we included age 17 ASB in the model, IA remained significant (p<.05), and FD was not significant (p=.1). Neither FD nor IA

predicted age of marriage, indicating that adolescent personality traits related to marriage itself, but not timing, at least within our study's developmental window.

We also analyzed the relationship between adolescent personality characteristics and divorce. In contrast to marriage, there was a significant sex interaction term ($p<.05$), so analyses were conducted separately for male and female subjects. Estimated parameters for male and females subjects are presented in **Table 12**; positive values indicate higher likelihood of divorce. For male subjects, IA significantly predicted divorce, whereas FD was not significant. For female subjects, IA and the FD*IA interaction term were significant. Higher IA increased likelihood of divorce for female subjects. FD increased odds of divorce in the context of high IA, but did not independently predict divorce in female subjects. When we included a measure of age 17 antisocial behavior, the female analyses remained unchanged; both IA and the IA*FD interaction term were significant (IA: $p<.001$, FD*IA: $p<.05$) and predictive of divorce. However, for the male subjects, IA was not significant when age 17 antisocial behavior was included in the model. IA and FD are related to likelihood of divorce, but offered more robust and unique predictive power for female subjects.

*Parenthood, FD, and IA*: Results from parenthood analyses presented in **Table 13;** male and female subjects were analyzed separately for onset of parenthood, but analyzed together for timing of parenthood. Men who are higher on FD and women who are higher on IA are both more likely to become parents. When we added age 17 ASB, FD was still significant for male subjects, but IA no longer predicted parenthood for female subjects.

Higher IA and lower FD predicted earlier age at parenthood in both male and female subjects. When we included age 17 ASB in our model, high IA and low FD continued to predict earlier parenthood in all subjects (IA: p <.01, FD: p<.05). This indicates that FD and IA are strong and robust predictors of timing of parenthood. *Summary of Findings:* We depicted the direction of significant associations in **Table 14**, showing whether or not high FD and IA were associated with increased likelihood of the outcome, or increased age at onset. Notably, male and female subjects were remarkably consistent in the direction of their effects, even though they occasionally differed in magnitude. This suggested that FD and IA operate similarly in forming social relationship in male and female subjects.

*4.4 Discussion*

Overall, this study demonstrated that different components of psychopathy may have different relationships with social role transitions. We examined two personality dimensions that contribute to psychopathic behavior, fearless dominance and impulsive antisociality. As these two components predict different components of psychopathic behavior, we expected they would have a different relationship with young adult outcomes. Fearless dominance in late adolescence was only weakly related to marriage and divorce in our sample. FD non-significantly trended toward a positive association with marriage; people who get married had slightly higher levels of fearless dominance in their late teens. This preliminary finding was especially interesting as FD is associated with adult antisocial behavior in male subjects, and antisocial behavior has the opposite

association with marriage. This social potency and low anxiety that are characteristic of FD may make it easier to develop and sustain romantic relationships. Additionally, in our female subjects FD indexed risk for divorce in conjunction with high IA; it did not independently predict divorce. There was again preliminary and suggestive evidence of risk of divorce for male subjects with high FD, but it was not significant in our sample. This result may grow more robust over time, as more marriages end in divorce, and is an important target of future analyses.

Adolescent personality traits also provided information about the likelihood of parenthood and timing of parenthood. In males in our sample, higher FD predicted greater likelihood of parenthood, whereas higher IA predicted parenthood in females. Our sample is still within the developmental time frame for having children, and many of our sample will go on to have children in the future, and these associations may not hold true for individuals who delay parenthood until their 30s. When we looked at timing of the transition to parenthood, we also found evidence of an association between both FD and IA. For both male and female subjects, high FD and low IA delayed the onset of parenthood. Earlier parenthood was associated with higher levels of antisocial behavior in adolescence, and earlier onset of parenthood is considered a more risky outcome, as individuals are less likely to have established solid relationships or careers. IA, which is more strongly associated with antisocial behavior, predicted earlier parental timing. In contrast, FD helped individuals delay onset. Individuals with low FD, despite reduced social potency, were still able to form relationships sufficient to create children, although these individuals were also less likely to get married (as the high FD and low IA

combination predicts marriage as well). This suggested that low FD and high IA may be particularly risky, as it is likely to predispose individuals to unmarried or single parenthood. This offered further evidence that FD may be adaptive in the development of social role transitions, even as it also predicts adult antisocial behavior.

*FD and Social Role Transitions:* Overall, there was evidence in our study that FD may be protective for men and women, as FD predicted later parenthood. Delayed parenthood is associated with favorable outcomes, including reduced likelihood of divorce or marital instability, limited educational and occupational opportunities, and (MD Bramlett & Mosher, 2002; Dahl, 2010; Hoffman et al., 1993; Lehrer, 2008). However, FD was not entirely without consequence in our sample, as it was associated with higher likelihood of divorce in female subjects (in the context of high IA). This demonstrated the complex interplay between psychopathic personality traits and social roles, as it may contribute both to forming and destabilizing relationships. There has been preliminary evidence of FD promoting general relationship quality. One study found that FD was correlated with informant reported relationship quality (Witt et al., 2009). However, most of the informants were not romantic partners, and the association between FD and non-marital or even non-romantic relationships may not generalize to marital relationships, as we had in our sample. Individuals with higher FD self-reported higher levels of romantic relationship quality (r = .1, small but significant), in contrast with IA, which predicted lower relationship quality in a (Witt & Donnellan, 2008).

High levels of FD are perhaps more likely to be adaptive generally, particularly in the absence of high levels of IA in females, and serve as a reminder that psychopathic

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personality traits offer some advantages, even in interpersonal relationships. Previous studies have found FD to be positively correlated with measures of well-being, achievement, and cognitive ability (Benning et al., 2003; Patrick et al., 2006). It is not entirely positive, as it is correlated with greater adult antisocial behavior, narcissism, entitlement, sense of superiority, and thrill seeking, as well as reduced empathy (Benning et al., 2005, 2003; Witt & Donnellan, 2008).This is reminiscent of the notion of the 'successful psychopath' or an individual who is able to use their psychopathic personality traits in ways that bring occupational or relational success, but also retain some characteristics that likely interfere with relationship intimacy, such as narcissism or lack of empathy.

*IA and Social Role Transitions:* Impulsive antisociality was generally more strongly related to differences in social role transitions than fearless dominance in our sample. The effects were consistent across all social role transitions, and were generally more robust. Males and females who get married had lower levels of adolescent IA across the board. When differentiating between marital outcomes, divorce was associated with higher levels of IA, relative to those who were still married in both males and females. Individuals who get married have lower levels of antisociality, and individuals who have good marriages and relationships have even lower levels (Rhule-Louie & McMahon, 2007). Individuals who become parents early had substantially higher levels of IA for both males and females in our sample. This relationship was likely driven by the failure to plan ahead and carelessness that characterize IA. Individuals who are impulsive and careless are likely less likely to use birth control, and are perhaps more

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likely to end up parents in young adulthood. Consistent with other finding of IA and FD as demonstrated by Marcus et al., (2013), IA appeared to more strongly and consistently predict other environmental risk factors, and was less likely to be associated with purely positive outcomes. The associations between IA and social role transitions in our sample were also generally consistent with the larger research between antisocial behavior and marriage/parenthood.

*FD vs. IA:* IA and FD had different and diverging patterns for marriage and parenthood in our sample. They are both important components of psychopathic personality structure, and these constructs have been validated as representing meaningful differences in antisociality within our sample. Therefore, their divergent pattern of results is a reflection of different associations between components of antisocial tendencies. This underscored the need to carefully assess psychopathy and antisocial tendencies when researching the relationship between antisociality and other variables. A study that measured antisocial behavior as predominantly delinquent behavior would likely find different results than a study that assessed manipulation and callous/unemotional style. This is consistent with other research that there are different components to delinquent and criminal behavior, and thus has different implications for adult outcomes, including social role transitions (Burt, 2009; Frick & White, 2008). Generally, in our study, IA was more strongly associated with adult family formation, and was largely consistent with the broad literature of antisocial behavior and social role transitions. This suggested that fearless dominance, or primary psychopathic personality tendencies, may have adaptive qualities, particularly when combined with lower levels of

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impulsive antisociality / secondary psychopathic personality characteristics. This also suggested there is value in psychopathic personality traits, as it promoted development of desirable social role transitions. Understanding how these two dimensions work together and separately is an important step in understanding psychopathic personality and its relationship to external variables.

*Gender Differences.* We found limited evidence of some sex differences between psychopathic personality traits and social role transitions. As **Table 14** shows, the effects of FD and IA on social role transitions were largely in the same direction. There were some minor differences in divorce and parenthood (FD predicted parenthood in men, and IA predicated parenthood in women). Overall, the findings were consistent, and suggested that FD/IA associate with adult social roles comparably in men and women.

*Limitations.* Our sample was still in early adulthood, and not everyone who will hit these milestones has done so yet (more of our sample will get married, have children, get divorced, etc.). While this paper provided an important look at the transition from adolescence to adulthood, it will be important in the future to assess the relationship between adolescence and later adult outcomes. Furthermore, while it is an asset that our sample was representative of the larger population, we had a smaller number of people with high levels of psychopathy than a clinical sample would contain. Our results may not generalize to a forensic sample. Additionally, we assessed the presence of adult family formation, rather than the quality of adult family formation (via assessment of the marital relationship, presence of domestic violence, quality of the parent-child

relationship, time spent with family). These may be important moderators of the

relationship between adolescent personality traits and adult social role transitions.

*Future Directions.* Future research would benefit from following individuals for a

longer period of time, to see how it relates to social role transitions over a longer period

of adulthood. It would also be beneficial to assess how these individuals approach new

roles as parents or partners, such as assessing quality of the marital relationship,

infidelity, divorce (over a longer period of time), time spent interacting with or caring for

children, quality of the parent-child relationship, parenting style, etc. These would allow

a more refined analysis of these correlations, and allow greater understanding how these

personality characteristics in adolescence may aide or interrupt adult relationships. It

would also be of significant interest to know if the social role transitions had a later

benefit on these aspects of psychopathy, such as if marriage, particularly successful

marriage, reduces FD. This paper provided an important understanding of adult outcomes

of adolescent psychopathic personality in a community-representative sample, and the

complex and sometimes variable associations between FD/IA and social role transitions.

**Table 10: Number of Individuals with ASB Data and Social Role Transitions Data**

*Sample Size by Inclusion Criteria*

| Measure Added | Older Cohort | | Younger Cohort | | |
| | Male | Female | Male | Female | TOTAL |
| --- | --- | --- | --- | --- | --- |
| Assessed at age 17 | 578 | 674 | 639 | 749 | 2640 |
| Age 17 FD/IA data | 501 | 614 | 587 | 709 | 2411 |
| Data at age 24 or 29 | 490 | 604 | 564 | 600 | 2258 |
| *Final N by Social Role Transition* | | | | | |
| Marriage Data | 484 | 602 | 560 | 593 | 2239 |
| Divorce Data | 278 | 398 | 250 | 179 | 1105 |
| Parenthood Data | 486 | 603 | 563 | 600 | 2252 |

This table tracks the sample size and data availability by sex and cohort. The first row is the entire sample assessed at age 17. We required individuals to have a FD/IA symptoms (at age 17), complete assessment at either age 24 or age 29, and social role transition data (marriage, divorce or parenthood data). The last three columns are the number of people (by sex and cohort) available for each analysis.

**Table 11: Social Role Transitions Descriptive Statistics**

*Number of Married, Divorced, and Parenting Individuals*

|  | Marriage | Divorce | Parenthood |
|---|---|---|---|
|  | N (%) | N (%) | N (%) |
| Men | 516 (49) | 56 (5) | 372 (36) |
| Women | 618 (52) | 41 (4) | 424 (36) |

*Timing of Social Role Transitions*

|  | Mean (SD) |  | Mean (SD) |
|---|---|---|---|
| Men | 24.8 (2.5) | - | 25.3 (3.1) |
| Women | 23.5 (2.7) | - | 23.5 (3.3) |

This table presents the number and percentage of male and female subjects who reach the three social role transitions (marriage, divorce, and early parenthood). Marriage is the most common social role transition, followed by parenthood, and then divorce. Mean and standard deviations of timing of marriage and parenthood are also presented.

**Table 12: Results from Associations of Marriage Variables and FD/IA**

| | Marriage-Ever | Marriage-Divorce | | Marriage Timing |
|---|---|---|---|---|
| *Estimates of FD/IA Parameters* | | | | |
| | All | Males | Females | All |
| FD | 0.09 | 0.33 | -0.11 | 0.06 |
| IA | -0.16* | 0.46* | 0.65*** | -0.03 |
| FD*IA | 0.02 | -0.11 | 0.40* | -0.07 |
| | | | | |
| *Parameters when adolescent ASB included in model* | | | | |
| FD | 0.1 | 0.25 | -0.13 | 0.07 |
| IA | -0.14* | 0.23 | 0.56*** | 0.01 |
| FD*IA | 0.02 | -0.1 | 0.38** | -0.06 |

This table presents the estimated parameters from the marriage models (first with just FD and IA, and then with FD, IA, and age 17 ASB). Model parameters are provided separately for male and female subjects for analyses with significant differences between sexes (divorce). Significance is denoted with asterisks (p<.1=*, p<.05=*, p<.01= **, p<.001).

**Table 13: Results from Associations of Parenthood Variables and FD/IA**

| | Parenthood-Ever | | Parenthood Timing |
|---|---|---|---|
| *Estimates of FD/IA Parameters* | | | |
| | Males | Females | All |
| FD | 0.12* | 0.02 | 0.26* |
| IA | -0.04 | 0.15* | -0.54*** |
| FD*IA | 0.02 | 0.00 | 0.13 |
| | | | |
| *Parameters when adolescent ASB included in model* | | | |
| FD | 0.12* | 0.01 | 0.31** |
| IA | -0.1 | 0.07 | -0.38** |
| FD*IA | 0.00 | 0.01 | 0.13 |

This table presents the estimated parameters from the parenthood models (first with just FD and IA, and then with FD, IA, and age 17 ASB). Model parameters are provided separately for male and female subjects for analyses with significant differences between sexes (parenthood). ($p<.1=$*, $p<.05=$*, $p<.01=$ **, $p<.001$).

**Table 14. Summary of Associations between FD/IA and Social Role Transitions**

*Relationships between FD/IA and Social Role Transitions*

| Social Roles Transitions | High FD | | High IA | |
|---|---|---|---|---|
| | Male | Female | Male | Female |
| Marriage | . | . | ↓ | ↓ |
| Timing of Marriage | . | . | . | . |
| Divorce | . | ↑(*i*) | ↑ | ↑ |
| Parenthood | ↑ | . | . | ↑ |
| Timing of Parenthood | ↑ | ↑ | ↓ | ↓ |

This table summarizes the associations between FD and IA and social role transitions (including timing of social role transitions). Positive correlations are indicated by up arrows (indicating increased likelihood of outcome, or later onset of transition), and negative correlations are indicated by down arrows. Non-significant associations are indicated by '.', and '(i)' indicates an interaction. Generally male and female subjects have the same pattern of associations.

## Chapter 5: Concluding Remarks

The studies presented in the dissertation provide a greater understanding of the relationship between antisocial behavior and social role transitions in a community sample, which includes a substantial number of females. As studies in this domain have focused on delinquency, they over-sample males and provide limited information on how the relationship between antisocial behavior and social role transitions functions throughout the entire range of the population. Furthermore, the genetic nature of our sample also allowed a strong quasi-causal test of the association, by comparing twins who were discordant for these social role transitions, controlling for genetic and shared environmental contributions to both. Twins are a natural experiment, and this study was able to make use of this to provide evidence toward the causal contribution of these events.

*5.1 Marriage, Antisocial Behavior, and Psychopathic Personality traits:*

The first study in this dissertation examined the relationship between marriage and adult antisocial behavior. Individuals who get married have lower levels of antisocial behavior throughout the lifespan, starting years before they get married, providing evidence that some of the association between marriage and antisocial behavior is driven through selection effects (i.e. people who are less antisocial to begin with have a greater predisposition to marriage). This pattern of results is comparable across males and females. However, this did not entirely explain the association. The difference in antisociality between married and non-married individuals increased over time, possibly suggesting a role for marriage. This hypothesis was further supported by the discordant

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twin design, as individuals got married had significantly lower levels of antisocial behavior than their single co-twins, at both points in adulthood. This was true for both MZ and DZ twins. Prior to marriage, there was no significant difference in antisocial behavior for MZ twins (but not DZ twin pairs), indicating that these differences had emerged in early adulthood, around the time of marriage. The data was consistent with evidence of a causal benefit of marriage for both male and female subjects.

However, antisocial tendencies may be better understood by distinguishing between callous and unemotional traits and impulsive and disinhibited traits. Differentiating between two psychopathic personality dimensions allowed for greater insight into the association between antisociality and marriage, as presented in study 3 of this dissertation. Married individuals tended to have higher levels of fearless dominance, and lower levels of impulsive antisociality, suggesting that not all dimensions of psychopathy have the same direction of relationship with marriage. The social competence component of fearless dominance likely drives this relationship, and provides some understanding of the adaptive and beneficial contributions of psychopathic personality traits. Married individuals were lower on the impulsive antisociality dimension, and this relationship likely drives the association found in study 1. These competing correlations offer some insight into the heterogeneity in the marriage and antisociality literature, particularly when studying it in forensic samples that have higher levels of psychopathic personality traits. Future studies would possibly find stronger effects if they differentiated between components of psychopathy/antisociality.

*5.2 Antisocial Behavior and Parenthood:*

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The second study of this dissertation examined the relationship between general adult antisocial behavior and parenthood, focusing on early adult parenthood, reached by age 22. This provided an important contribution to the literature, as studies focusing on the relationship between antisocial behavior and parenthood have often focused on adolescent parenthood, and neglected the contribution of early adult parenthood, that onsets prior to the completion of college education or serious occupational engagement. This study found, like marriage, there was a significant association between antisocial behavior in adolescence and early parenthood. Early parenthood was associated with higher levels of adolescent antisocial behavior for both males and females. Like marriage, the presence of the association before the onset of parenthood provided evidence of long-standing individual differences in antisocial behavior prior to the social role transition. The association between adult, post-parenthood antisocial behavior and early parenthood was more muted; it is not significant after accounting for prior levels of antisocial behavior. Sex interactions were not significant, indicating comparable associations for male and female subjects.

The CTC analyses provided evidence of substantially different associations between early parenthood and adult antisocial behavior. There was evidence of protective benefits of early parenthood within discordant twin pairs; the early-parenting co-twin had significantly lower antisocial behavior than the non-EAP parent. In contrast, early parenthood was associated with higher antisocial behavior between families; i.e. families that had at least one early-parenting twin had higher level of antisocial behavior than families without an early parenting member. In essence, the between-family and within-

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family effects were in direct opposition to each other. The most direct measure of the effect of early parenthood is the within-family estimate, as it measures the association between early parenthood and antisocial behavior after accounting for shared genes and rearing environment. It also highlights the need for genetically informative samples, as it can illuminate associations that would be hidden otherwise.

The results from study 3 suggest that this relationship is driven by impulsive antisociality dimension of psychopathy, not fearless dominance. Timing of parenthood was correlated with both FD and IA; FD predicted later onset to parenting and IA predicted earlier onset. Both male and female early parents had higher levels of impulsive antisociality at age 17 (before most of the early parents had become parents), suggesting that this may drive behavior that leads to early parenthood. In contrast, parenthood generally, rather than early parenthood, was associated with higher FD in male parents and lower IA in female parents.

*5.3 Future directions*:

While these studies have a number of strengths, including longitudinal, prospective assessment of a community-based sample that is genetically informative, there were a number of limitations. First of all, while it is important to assess individual differences in antisociality or psychopathy in a community-based sample, these findings may not apply to a forensic sample. As there is assortative mating with antisocial behavior, individuals who are highly antisocial or psychopathic may choose comparable mates, and the effect of these individuals as partners or co-parents may not be as protective as more average individuals. Secondly, while this sample was representative of the state of Minnesota, it

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was not representative of the demographics of the United States, particularly in terms of the ethnic and racial identity of our participants. There is considerable variation in marriage rates by socioeconomic status and racial identity, and this may moderate our findings (Michael & Tuma, 1985). Additionally, though we measured the life events and family formation events of our participants, we did not assess how important they saw these events or transitions. An individual might have become a parent, but if they do not have custody, it may not necessitate behavioral modification or the tempering of behavior that we see in custodial parents. Some individuals might have been in long-term stable, married-like relationships for a long period of time, prolonging the actual marriage for financial, rather than emotional or behavioral reasons. It might serve future studies to assess attitudes towards these relationships, to understand if they have incorporated these changes into their identity.

Our findings suggested that there is a protective effect of social role transitions and adult family formation. Our CTC findings are particularly strong evidence, as they controlled for shared genes and environment. However, the social role transitions had stronger relationships with the impulsive, behaviorally driven component of antisocial behavior, rather than fearless dominance. It is also likely that some components of psychopathy are adaptive in human relationships, and facilitate people entering into marital relationships, or delaying parenthood. Failing to differentiate between dimensions of antisocial behavior may obscure important findings. It would also be interesting to examine the different dimensions together---to look at how being high on both traits differs from being high on only one trait.

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The studies presented also illustrate the value of genetically informative samples to the study of individual differences and antisocial behavior. The early parents in our sample had higher levels of post-parenthood antisocial behavior when we compared them to the rest of the group, but lower levels of antisocial behavior when we compared them to their co-twins. The presence of shared risk factors, both genetic and environmental, may obscure the true associations between variables if not properly accounted for. Other studies often control for a considerable number of important and relevant variables, but the discordant co-twin design is particularly powerful at controlling for background risk factors. Although this sort of data may not be available in forensic-based studies, it offers a powerful level of analysis of the relationship of individual differences and social role transitions, and should be used when possible. Most of the delinquency and marriage literature has not emphasized the possible contribution of genetics to this association, though longitudinal behavioral genetic studies offer tremendous opportunities to study the nature of individual changes over the lifespan. Furthermore, while males and females often had similar patterns in our data, and suggest that the association between antisocial behavior and social role transitions is largely similar between male and female subjects.

While desistance from antisocial behavior is an important area of study, it is important to properly measure and differentiate dimensions of antisociality, as well as provide appropriate comparison groups. This set of studies was able to differentiate between types of psychopathic personality traits, and to look at the association between social role transitions and antisocial behavior in genetically-informative samples that included females. This allowed us to add significant understanding to how antisocial and

psychopathic individual differences look in a larger range of the population, and provides

us with important understanding for how to design future studies.

## Bibliography

Antonovics, K., & Town, R. (2004). Are All the Good Men Married? Uncovering the Sources of the Marital Wage Premium. *The American Economic Review, 94*(2), 317–321 CR – Copyright &#169; 2004 American Econo. doi:10.1257/0002828041301876

Apel, R., Bushway, S., & Brame, R. (2007). Unpacking the relationship between adolescent employment and antisocial behavior: a matched samples comparison*. *Criminology, 45*(1), 67–97. doi:10.1111/j.1745-9125.2007.00072.x

Barnes, J. C., & Beaver, K. M. (2012). Marriage and Desistance From Crime: A Consideration of Gene–Environment Correlation. *Journal of Marriage and Family, 74*(1), 19–33. doi:10.1111/j.1741-3737.2011.00884.x

Begg, M., & Parides, M. (2003). Separation of individual- level and cluster- level covariate effects in regression analysis of correlated data. *Statistics in Medicine, 22*(16), 2591–2602. doi:10.1002/sim.1524

Benning, S. D., Patrick, C. J., Blonigen, D. M., Hicks, B. M., & Iacono, W. G. (2005). Estimating facets of psychopathy from normal personality traits: a step toward community epidemiological investigations. *Assessment, 12*(1), 3–18. doi:10.1177/1073191104271223

Benning, S. D., Patrick, C. J., Hicks, B. M., Blonigen, D. M., & Krueger, R. F. (2003). Factor structure of the psychopathic personality inventory: validity and implications for clinical assessment. *Psychological Assessment, 15*(3), 340–350. Retrieved from http://psycnet.apa.org.ezp-prod1.hul.harvard.edu/journals/pas/15/3/340/

Biglan, A., Metzler, C., Wirt, R., & Ary, D. (1990). Social and behavioral factors associated with high-risk sexual behavior among adolescents. *Journal of Behavioral Medicine, 13*(3), 245–261. Retrieved from http://link.springer.com.ezp-prod1.hul.harvard.edu/article/10.1007/BF00846833

Black, D. W., Baumgard, C. H., & Bell, S. E. (1995). A 16- to 45-year follow-up of 71 men with antisocial personality disorder. *Comprehensive Psychiatry, 36*(2), 130–140. doi:10.1016/S0010-440X(95)90108-6

Blokland, A., & Nieuwbeerta, P. (2005). The effects of life circumstance on longitudinal trajectories of offending. *Criminology, 43*(4), 1203–1240. doi:10.1111/j.1745-9125.2005.00037.x

Blonigen, D. M., Hicks, B. M., Krueger, R. F., Patrick, C. J., & Iacono, W. G. (2005). Psychopathic personality traits: heritability and genetic overlap with internalizing and externalizing psychopathology. *Psychological Medicine*, *35*(5), 637–648. doi:10.1017/S0033291704004180

Bramlett, M., & Mosher, W. (2002). Cohabitation, marriage, divorce, and remarriage in the United States (series 23, number 22). *National Center for Health Statistics:*, *23*(22), 1–32. Retrieved from http://scholar.google.com.ezp-prod1.hul.harvard.edu/scholar?q=author%3Abramlett+cohabitation&btnG=&hl=en&as_sdt=0%2C22&inst=1896398670060433590#4

Bramlett, M., & Mosher, W. (2002). Cohabitation, marriage, divorce, and remarriage in the United States. Vital and Health Statistics, 23 (22) Hyattsville, MD: National Center for Health. Retrieved from http://scholar.google.com.ezp-prod1.hul.harvard.edu/scholar?q=author%3Abramlett+cohabitation&btnG=&hl=en&as_sdt=0%2C22&inst=1896398670060433590#7

Burt, S. (2009). Are there meaningful etiological differences within antisocial behavior? Results of a meta-analysis. *Clinical Psychology Review*, *29*(2), 163–178. doi:I: 10.1016/j.cpr.2008.12.004

Burt, S. A., Donnellan, B., Humbad, M. N., Hicks, B. M., McGue, M., & Iacono, W. G. (2010). Does marriage inhibit antisocial behavior?: An examination of selection vs causation via a longitudinal twin design. *Archives of General Psychiatry*, *67*(12), 1309–15. doi:10.1001/archgenpsychiatry.2010.159

Burt, S., & Neiderhiser, J. (2009). Aggressive versus nonaggressive antisocial behavior: Distinctive etiological moderation by age. *Developmental Psychology*, *45*(4), 1164–1176. doi:10.1037/a0016130

Coley, R., & Chase-Lansdale, P. (1998). Adolescent pregnancy and parenthood: recent evidence and future directions. *American Psychologist*, *53*(2), 152–166. Retrieved from http://psycnet.apa.org.ezp-prod1.hul.harvard.edu/journals/amp/53/2/152/

Cooke, D., & Michie, C. (2001). Refining the construct of psychopathy: towards a hierarchical model. *Psychological Assessment*, *13*(2), 171–188. doi:10.1037//1040-3590.13.2.171

Coyne, C. A., Fontaine, N. M. G., Långström, N., Lichtenstein, P., & D'Onofrio, B. M. (2013). Teenage childbirth and young adult criminal convictions: A quasi-experimental study of criminal outcomes for teenage mothers. *Journal of Criminal Justice*, *41*(5), 318–323. doi:10.1016/j.jcrimjus.2013.06.015

Coyne, C., & D'Onofrio, B. (2012). Some (but not much) progress toward understanding teenage childbearing: A review of research from the past decade. *Advances in Child Development and Behavior*, *42*, 113–152.

Craig, J., & Foster, H. (2013). Desistance in the transition to adulthood: The roles of marriage, military, and gender. *Deviant Behavior*, *34*(3), 208–223. doi:10.1080/01639625.2012.726173

Dahl, G. (2010). Early teen marriage and future poverty. *Demography*, *47*(3), 689–718. doi:10.1353/dem.0.0120

Dodge, K., & Pettit, G. (2003). A biopsychosocial model of the development of chronic conduct problems in adolescence. *Developmental Psychology*, *39*(2), 349–371. Retrieved from http://psycnet.apa.org.ezp-prod1.hul.harvard.edu/journals/dev/39/2/349/

Douglas Bates, Martin Maechler, Ben Bolker and Steven Walker (2014). lme4: Linear mixed-effects models using Eigen and S4. R package version 1.1-6. http://CRAN.R-project.org/package=lme4

Eley, T., Lichtenstein, P., & Stevenson, J. (1999). Sex differences in the etiology of aggressive and nonaggressive antisocial behavior: Results from two twin studies. *Child Development*, *70*(1), 155–168. Retrieved from http://onlinelibrary.wiley.com.ezp-prod1.hul.harvard.edu/doi/10.1111/1467-8624.00012/abstract

Farrington, D. (1995). The development of offending and antisocial behaviour from childhood: Key findings from the Cambridge Study in Delinquent Development. *Journal of Child Psychology and Psychiatry*, *36*(6), 929–964. doi:10.1111/j.1469-7610.1995.tb01342.x

Frick, P., & White, S. (2008). Research review: The importance of callous- unemotional traits for developmental models of aggressive and antisocial behavior. *Journal of Child Psychology and Psychiatry*, *49*(4), 359–375. doi:10.1111/j.1469-7610.2007.01862.x

Fulton, J., Marcus, D., & Payne, K. (2010). Psychopathic personality traits and risky sexual behavior in college students. *Personality and Individual Differences*, *49*(1), 29–33. doi:10.1016/j.jcrimjus.2007.09.008

Ganem, N., & Agnew, R. (2007). Parenthood and adult criminal offending: The importance of relationship quality. *Journal of Criminal Justice*, *35*(6), 630–643. doi:10.1016/j.jcrimjus.2007.09.008

Gendreau, P., Little, T., & Goggin, C. (1996). A Metaanalysis of the Predictors of Adult Offender Recidivism: What Works. *Criminology*, *34*(4), 575–608. doi:10.1111/j.1745-9125.1996.tb01220.x

Giordano, P., Cernkovich, S., & Rudolph, J. (2002). Gender, Crime, and Desistance: Toward a Theory of Cognitive Transformation1. *American Journal of Sociology*, *107*(4), 990–1064. doi:10.1086/343191

Harden, K., & Mendle, J. (2011). Adolescent sexual activity and the development of delinquent behavior: The role of relationship context. *Journal of Youth and Adolescence*, *40*(7), 825–838. doi:10.1007/s10964-010-9601-y

Harden, K. P., Mendle, J., Hill, J. E., Turkheimer, E., & Emery, R. E. (2008). Rethinking Timing of First Sex and Delinquency. *Journal of Youth and Adolescence*, *37*(4), 373–385. doi:10.1007/s10964-007-9228-9

Harpur, T., Hare, R., & Hakstian, A. (1989). Two-factor conceptualization of psychopathy: Construct validity and assessment implications. *Psychological Assessment*, *1*(1), 6–17. doi:10.1037//1040-3590.1.1.6

Hill, C., Neumann, C., & Rogers, R. (2004). Confirmatory factor analysis of the psychopathy checklist: screening version in offenders with axis I disorders. *Psychological Assessment*, *16*(1), 90–95. doi:: 10.1037/1040-3590.16.1.90

Hoffman, S., Foster, E., & Jr, F. F. (1993). Reevaluating the costs of teenage childbearing. *Demography*, *30*(1), 1–13. doi:10.2307/2061859

Hope, T. L., Wilder, E. I., & Watt, T. T. (2003). The relationships among adolescent pregnancy, pregnancy resolution, and juvenile delinquency. *Sociological Quarterly, 44*(4), 555-576. doi: 10.1111/j.1533-8525.2003.tb00525.x

Horn, E. E., Xu, Y., Beam, C. R., Turkheimer, E., & Emery, R. E. (2013). Accounting for the physical and mental health benefits of entry into marriage: a genetically informed study of selection and causation. *Journal of Family Psychology*, *27*(1), 30–41. doi:10.1037/a0029803

Huibregtse, B. M., Bornovalova, M. A., Hicks, B. M., McGue, M., & Iacono, W. (2011). Testing the role of adolescent sexual initiation in later-life sexual risk behavior: a longitudinal twin design. *Psychological Science*, *22*(7), 924–33. doi:10.1177/0956797611410982

Hussong, A. M., Curran, P. J., Moffit, T. E., Caspi, A., & Carrig, M. M. (2004). Substance abuse hinders desistance in young adults' antisocial behavior.

*Development and Psychopathology*, *16*(04), 1029–1046. doi:10.1017/S095457940404012X

Iacono, W. G., Carlson, S. R., Taylor, J., Elkins, I. J., & McGue, M. (1999). Behavioral disinhibition and the development of substance-use disorders: Findings from the Minnesota Twin Family Study. *Development and Psychopathology*, *11*(04), 869–900. doi:10.1017/S0954579499002369

Johnson, W., McGue, M., Krueger, R. F., & Bouchard Jr., T. J. (2004). Marriage and personality: a genetic analysis. *Journal of Personality and Social Psychology*, *86*(2), 285–294. doi:10.1037/0022-3514.86.2.285

Kahn, R., Byrd, A., & Pardini, D. (2013). Callous-unemotional traits robustly predict future criminal offending in young men. *Law and Human Behavior*, *37*(2), 87–97. doi:10.1037/b0000003

King, R., Massoglia, M., & MacMillan, R. (2007). The context of marriage and crime: gender, the propensity to marry, and offending in early adulthood*. *Criminology*, *45*(1), 33–65. doi:10.1111/j.1745-9125.2007.00071.x

Kreager, D., Matsueda, R., & Erosheva, E. (2010). Motherhood and criminal desistance in disadvantaged neighborhoods. *Criminology*, *48*(1), 221–258. doi:10.1111/j.1745-9125.2010.00184.x

Krueger, R., Hicks, B., Patrick, C. J., Carlson, S. R., Iacono, W. G., & McGue, M. (2002). Etiologic connections among substance dependence, antisocial behavior and personality: Modeling the externalizing spectrum. *Journal of Abnormal Psychology*, *111*(3), 411–424. doi:10.1037/0021-843X.111.3.411

Krueger, R., Moffitt, T., Caspi, A., Bleske, A., & Silva, P. (1998). Assortative mating for antisocial behavior: Developmental and methodological implications. *Behavior Genetics*, *28*(3), 173–186. doi:10.1023/A:1021419013124

Lahey, B., Loeber, R., & Hart, E. (1995). Four-year longitudinal study of conduct disorder in boys: patterns and predictors of persistence. *Journal of Abnormal Psychology*, *104*(1), 83–93. doi:10.1037/0021-843X.104.1.83

Laub, J., Nagin, D., & Sampson, R. (1998). Trajectories of change in criminal offending: Good marriages and the desistance process. *American Sociological Review*, *63*(2), 225–238. doi:10.2307/2657324

Laub, J., & Sampson, R. (1993). Turning points in the life course: Why change matters to the study of crime. *Criminology*, *31*(3), 301–325. doi:10.1111/j.1745-9125.1993.tb01132.x

Laub, J., & Sampson, R. (2001). Understanding desistance from crime. *Crime and Justice*, *28*(1), 1–69. doi:10.1007/s11417-006-9015-7

Lehrer, E. (2008). Age at marriage and marital instability: revisiting the Becker–Landes–Michael hypothesis. *Journal of Population Economics*, *21*(2), 463–484. doi:10.1007/s00148-006-0092-9

Lilienfeld, S., & Andrews, B. (1996). Development and preliminary validation of a self-report measure of psychopathic personality traits in noncriminal population. *Journal of Personality Assessment*, *66*(3), 488–524. Retrieved from http://www.tandfonline.com.ezp-prod1.hul.harvard.edu/doi/abs/10.1207/s15327752jpa6603_3

Lilienfeld, S. O., Patrick, C. J., Benning, S. D., Berg, J., Sellbom, M., & Edens, J. F. (2012). The role of fearless dominance in psychopathy: confusions, controversies, and clarifications. *Personality Disorders*, *3*(3), 327–40. doi:10.1037/a0026987

Loeber, R. (1991). Initiation, escalation and desistance in juvenile offending and their correlates. *Journal of Criminal Law and Criminology*, *82*(1), 36–59. doi:10.2307/1143789

Marcus, D., Fulton, J., & Edens, J. (2013). The two-factor model of psychopathic personality: Evidence from the Psychopathic Personality Inventory. *Personality Disorders: Theory, Research, and Treatment*, *4*(1), 67–76. doi:10.1037/a0025282

Marmorstein, N., & Iacono, W. (2005). Longitudinal follow-up of adolescents with late-onset antisocial behavior: a pathological yet overlooked group. *Journal of the American Academy of Child & Adolescent Psychiatry*, *44*(12), 1284–1291. doi:10.1097/01.chi.0000181039.75842.85

Michael, R., & Tuma, N. (1985). Entry into marriage and parenthood by young men and women: The influence of family background. *Demography*, *22*(4), 515–544. doi:10.2307/2061586

Miller, J., & Lynam, D. (2012). An examination of the Psychopathic Personality Inventory's nomological network: a meta-analytic review. *Personality Disorders: Theory, Research, and Treatment*, *3*(3), 305–326. doi:10.1037/a0024567

Moffitt, T. (1993). Adolescence-limited and life-course-persistent antisocial behavior: a developmental taxonomy. *Psychological Review*, *100*(4), 674–701. Retrieved from http://psycnet.apa.org.ezp-prod1.hul.harvard.edu/journals/rev/100/4/674/

Moffitt, T., & Caspi, A. (2002). Males on the life-course-persistent and adolescence-limited antisocial pathways: Follow-up at age 26 years. *Development and Psychopathology*, *14*(01), 179–207. doi:10.1017/S0954579402001104

Neumann, A., Barker, E. D., Koot, H. M., & Maughan, B. (2010). The role of contextual risk, impulsivity, and parental knowledge in the development of adolescent antisocial behavior. *Journal of Abnormal Psychology*, *119*(3), 534–545. doi:10.1037/a0019860

Patrick, C., Fowles, D., & Krueger, R. (2009). Triarchic conceptualization of psychopathy: Developmental origins of disinhibition, boldness, and meanness. *Development and Psychopathology*, *21*(03), 913–938. doi:10.1017/S0954579409000492

Patrick, C. J., Edens, J. F., Poythress, N. G., Lilienfeld, S. O., & Benning, S. D. (2006). Construct validity of the psychopathic personality inventory two-factor model with offenders. *Psychological Assessment*, *18*(2), 204–8. doi:10.1037/1040-3590.18.2.204

Poythress, N., Edens, J. F., & Lilienfeld, S. O. (1998). Criterion-related validity of the Psychopathic Personality Inventory in a prison sample. *Psychological Assessment*, *10*(4), 426–430. doi:10.1037/1040-3590.10.4.426

Prescott, C., & Kendler, K. (2001). Associations between marital status and alcohol consumption in a longitudinal study of female twins. *Journal of Studies on Alcohol and Drugs*, *62*(5), 589–604. Retrieved from http://www.jsad.com.ezp-prod1.hul.harvard.edu/jsad/link/62/589

Quinton, D., Pickles, A., Maughan, B., & Rutter, M. (1993). Partners, peers, and pathways: Assortative pairing and continuities in conduct disorder. *Development and Psychopathology*, *5*(04), 763–783. doi:10.1017/S0954579400006271

R Core Team (2013). R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. URL http://www.R project.org/.

Rhee, S., & Waldman, I. (2002). Genetic and environmental influences on antisocial behavior: a meta-analysis of twin and adoption studies. *Psychological Bulletin*, *128*(3), 490–529. doi:10.1037/0033-2909.128.3.490

Rhule-Louie, D., & McMahon, R. (2007). Problem behavior and romantic relationships: Assortative mating, behavior contagion, and desistance. *Clinical Child and Family Psychology Review*, *10*(1), 53–100. doi:10.1007/s10567-006-0016-y

Ross, S. R., Benning, S. D., Patrick, C. J., Thompson, A., & Thurston, A. (2009). Factors of the psychopathic personality inventory: criterion-related validity and relationship to the BIS/BAS and five-factor models of personality. *Assessment*, *16*(1), 71–87. doi:10.1177/1073191108322207

Sampson, R., & Laub, J. (1993). Structural variations in juvenile court processing: Inequality, the underclass, and social control. *Law and Society Review*, *27*(2), 285–311. Retrieved from http://www.jstor.org.ezp-prod1.hul.harvard.edu/stable/3053938

Sampson, R., & Laub, J. (2005). A life-course view of the development of crime. *The Annals of the American Academy of Political and Social Science*, *602*(1), 12–45. doi:10.1177/0002716205280075

Sampson, R., Laub, J., & Wimer, C. (2006). Does marriage reduce crime? A counterfactual approach to within individual causal effects. *Criminology*, *44*(3), 465–508. doi:10.1111/j.1745-9125.2006.00055.x

Silverthorn, P., & Frick, P. (1999). Developmental pathways to antisocial behavior: The delayed-onset pathway in girls. *Development and Psychopathology*, *11*(1), 101–126. doi:10.1017/S0954579499001972

Simmons, T., & Dye, J. (2004). What Has Happened to Median Age at First Marriage Data? In *Annual Meeting of the American Sociological Association*. San Francisco. Retrieved from http://www.census.gov/acs/www/Downloads/library/2004/2004_Simmons_01.pdf

Simons, R., Stewart, E., & Gordon, L. (2002). A test of life course explanations for stability and change in antisocial behavior from adolescence to young adulthood. *Criminology*, *40*(2), 401–434. doi:10.1111/j.1745-9125.2002.tb00961.x

Smith, S., Edens, J., & McDermott, B. (2013). Fearless dominance and self-centered impulsivity interact to predict predatory aggression among forensic psychiatric inpatients. *International Journal of Forensic Mental Health*, *12*(1), 33–41. Retrieved from http://www.tandfonline.com.ezp-prod1.hul.harvard.edu/doi/abs/10.1080/14999013.2012.760186

Spears, G. V., Stein, J. A., & Koniak-Griffin, D. (2010). Latent growth trajectories of substance use among pregnant and parenting adolescents. *Psychology of Addictive Behaviors, 24*(2), 322-332. doi: 10.1037/a0018518

Spitzer, R., Williams, J., Gibbon, M., & First, M. (1990). Structured Clinical Interview for DSM-III-R—Non-Patient Edition (SCID-NP, Version 1.0). Retrieved from http://scholar.google.com.ezp-prod1.hul.harvard.edu/scholar?q=author%3Aspitzer+structured+clinical+interview&btnG=&hl=en&as_sdt=0%2C22&inst=1896398670060433590#6

Stanek, K. C., Iacono, W. G., & McGue, M. (2011). Returns to education: what do twin studies control? *Twin Research and Human Genetics*, *14*(6), 509–15. Retrieved from /pmc/articles/PMC3359051/?report=abstract

Stouthamer-Loeber, M., & Wei, E. (1998). The precursors of young fatherhood and its effect on delinquency of teenage males. *Journal of Adolescent Health*, *22*(1), 56–65. doi:http://dx.doi.org/10.1016/S1054-139X(97)00211-5

Stouthamer-Loeber, M., Wei, E., Loeber, R., & Masten, A. S. (2004). Desistance from persistent serious delinquency in the transition to adulthood. *Development and Psychopathology*, *16*(4), 897–918. doi:http://dx.doi.org/10.1017/S0954579404040064

Thornberry, T., Smith, C., & Howard, G. (1997). Risk factors for teenage fatherhood. *Journal of Marriage and the Family*, *59*(3), 505–522. doi:http://dx.doi.org/10.2307/353942

Tuvblad, C., Eley, T., & Lichtenstein, P. (2005). The development of antisocial behaviour from childhood to adolescence. *European Child & Adolescent Psychiatry*, *14*(4), 216–225. Retrieved from http://link.springer.com.ezp-prod1.hul.harvard.edu/article/10.1007/s00787-005-0458-7

U.S. Census Bureau. (2012). Minnesota, DP02, Selected social characteristics in the United States. *2007-2011 American Community Survey 5-Year Estimates*. Retrieved June 5, 2013, retrieved from http://factfinder2.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_11_5YR_DP02

Vincent J Carey. Ported to R by Thomas Lumley and Brian Ripley. (2012). gee: Generalized Estimation Equation solver. R package version 4.13-18. http://CRAN.R-project.org/package=gee

Warr, M. (1998). Life Course Transitions and Desistance from Crime. *Criminology*, *36*(2), 183–216. doi:10.1177/1748895811415579

White, S., Cruise, K., & Frick, P. (2009). Differential correlates to self-report and parent-report of callous–unemotional traits in a sample of juvenile sexual offenders. *Behavioral Sciences & the Law*, *27*(6), 910–928. doi:10.1002/bsl.911

Witt, E. A., Donnellan, M. B., Blonigen, D. M., Krueger, R. F., & Conger, R. D. (2009). Assessment of Fearless Dominance and Impulsive Antisociality via normal personality measures: convergent validity, criterion validity, and developmental change. *Journal of Personality Assessment*, *91*(3), 265–76. doi:10.1080/00223890902794317

Witt, E., & Donnellan, M. (2008). Furthering the case for the MPQ-based measures of psychopathy. *Personality and Individual Differences*, *45*(3), 219–225. doi:10.1016/j.paid.2008.04.002

Wymbs, B., McCarty, C., & Baer, J. (2013). Callous-Unemotional Traits and Conduct Disorder Symptoms as Prospective Risk Factors for Adolescent Sexual Activity. *Journal of Clinical Child and Adolescent Psychiatry*, *42*(5), 693–699. doi:10.1080/15374416.2013.796858

Yoshikawa, H. (1995). Long-term effects of early childhood programs on social outcomes and delinquency. *The Future of Children*, *5*(3), 51–75. Retrieved from http://www.jstor.org.ezp-prod1.hul.harvard.edu/stable/1602367

Zoutewelle-Terovan, M., van der Geest, V., Liefbroer, A., & Bijleveld, C. (2012). Criminality and Family Formation: Effects of Marriage and Parenthood on Criminal Behavior for Men and Women. *Crime & Delinquency*. doi:10.1177/0011128712441745