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The other side of the coin: Exploring the effects of adolescent delinquency on young adult self-control

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A B S T R A C T

Purpose: Although there is robust support for low self-control as a predictor of delinquent behavior, the question of whether delinquent behavior impacts self-control has been largely ignored. We ask, after accounting for baseline group differences in impulsivity and self-control, can delinquency be associated with later group differences in self-control?

Methods: Utilizing data from the National Longitudinal Study of Adolescent to Adult Health we employed propensity score matching to create comparable groups (i.e., on self-control and other delinquency correlates) of youth who did and did not participate in delinquent behavior in adolescence and compared them on self-control and impulsivity in later waves.

Results: Despite baseline similarity, the groups identified as delinquent at Wave II differed significantly from non-delinquent groups on self-control and impulsivity at Waves III and IV. Both groups experienced improvement in self-control and impulsivity over time though improvement was more marked for the non-delinquent youth.

Conclusions: We have established preliminary evidence that delinquent behavior may be associated with later levels of self-control. Participation in delinquency may remove youth from normal developmental patterns in which self-control strengthens over time. Future research should attempt to replicate our findings and determine the specific mechanisms through which delinquent behavior may impact later self-control.

The state of research on self-control and delinquency provides robust evidence that individuals with lower self-control are more likely to participate in delinquent behavior (de Ridder, Lensvelt-Mulders, Finkenauer, Stok, & Baumeister, 2012; Pratt & Cullen, 2000; Vazsonyi, Mikuška, & Kelley, 2017). Grey areas remain, however, when it comes to fully understanding the longer-term nature and development of self- control and the nuances of its relationship to delinquency over time. Much of the research on self-control is limited to cross-sectional analysis (Vazsonyi et al., 2017), posing some uncertainty about the direction and pattern of relationships over time. Beyond the fact that low self-control predicts delinquent behavior, little is known about the ex- tent to which participation in delinquent behavior has an independent effect on self-control, (see exception, de Kemp et al., 2009) and the degree to which these concepts are interrelated over the life course. While we do not question the ubiquitous finding that levels of self- control impact deviant and related behaviors, we do find it interesting that few have questioned the possibility that participation in such behaviors may also impact self-control. We want to contribute to the understanding of self-control and delinquency by exploring the other side of the coin. Specifically, just as self-control influences delinquency, can delinquency also influence self-control?

The long-held stability assumption (Gottfredson & Hirschi, 1990) of self-control likely explains the lack of research into predictors, including delinquency, of self-control beyond childhood. Despite recent evidence that self-control is not, in fact, completely stable for all individuals (Burt, Simons, & Simons, 2006; Burt, Sweeten, & Simons, 2014; Hay & Forrest, 2006; Na & Paternoster, 2012), potential factors leading to instability have yet to be unpacked. We turn to delinquency because of its history of relationship to self-control and because it is not uncommon for developmental factors in adolescence to perform multiple roles, serving both as predictor and outcome (e.g., parenting and externalizing behaviors; Burke, Pardini, & Loeber, 2008; Choe, Olson, & Sameroff, 2013). Further, because self-control has been so consistently linked to measures of delinquency and criminal behavior (Pratt & Cullen, 2000; Vazsonyi et al., 2017), and because delinquency follows a varied, yet relatively predictable, pattern in the transition to adulthood (i.e., age-crime curve; Hirschi & Gottfredson, 1983; Sampson & Laub, 2003), it makes sense to explore whether self-control follows a

similar pattern of predictability (Pratt, 2016). Utilizing data that spans adolescence through young adulthood, we seek to contribute to the understanding of self-control and delinquency by exploring the role adolescent delinquency plays in the development of self-control in early adulthood. In what follows, we discuss self-control research and whether interrelated factors (i.e., delinquency) should impact the stability of between-person levels of self-control.

1. The general theory of crime and other models of self-control

Until recently, the primary theoretical framework associated with self-control in criminological research has been the general theory of crime (Gottfredson & Hirschi, 1990). Self-control was initially defined as the "relatively stable differences across individuals in the propensity to commit criminal (or equivalent) acts" (Gottfredson & Hirschi, 1990, p. 137) and later conceptualized as differences in the "tendency to consider the full range of potential costs of a particular act" (Hirschi, 2004, p. 543). According to the general theory of crime, self-control develops early in life in response to parental socialization efforts. Specifically, effective self-control is developed among children whose parents, successfully monitor, recognize and punish deviant behavior (Gottfredson & Hirschi, 1990; Perrone, Sullivan, Pratt, & Margaryan, 2004; Unnever, Cullen, & Pratt, 2003). According to Gottfredson and Hirschi (1990), however, parenting effects are constrained to the early years. Individuals may experience small improvements in absolute levels of self-control over time, but ranking on self-control in comparison to others is not expected to change after late childhood (Gottfredson & Hirschi, 1990). Gottfredson and Hirschi's model is similar to other models (e.g., delay of gratification, discounting model of impulsiveness; Ainslie, 1975; Mischel & Underwood, 1974) that de- scribe self-control as the ability to resist temptations of short-term re-wards and make decisions that favor more important, longer-term outcomes (de Ridder et al., 2012). So, while the general theory of crime has dominated criminological research over the past three decades, it is worth exploring briefly other models of "self-control" as they pertain to the stability of self-control across the life-course.

1.1. *Strength model of self-control*

The self-regulatory strength model (Baumeister & Heatherton, 1996) is more well-known in psychology than in criminology though recent research in the field has begun to acknowledge and incorporate this model as well (e.g., Burt et al., 2006; Meldrum, Barnes, & Hay, 2015; Muraven, Pogarsky, & Shmueli, 2006). A key difference from the general theory of crime is that the strength model describes self-control not as a stable trait but more similar to a muscle. When framed this way, people have limited energy resources in applying self-control in the short-term, yet individual self-control can also be shaped in response to training over time (Baumeister & Heatherton, 1996; Baumeister, Vohs, & Tice, 2007). In the short-term, self-control is thought to be a finite resource that can be depleted when accessed. In particular, if people have simultaneous and/or repetitive demands on their self- control, then they are more likely to experience self-regulation failure due to exhaustion of the limited resource (Baumeister & Heatherton, 1996; Baumeister et al., 2007; Hagger, Wood, Stiff, & Chatzisarantis, 2010). Experimental studies provide substantial evidence that people experience ego depletion, or exhaustion of self-regulation resources, which is indicated by poor performance on self-control-related tasks following prior exertion of self-control resources (Hagger et al., 2010; Muraven, Tice, & Baumeister, 1998). Further, multiple interventions have been associated with self-control improvement following efforts to practice and strengthen elf-control over time (Candelaria, Fedewa, & Ahn, 2012; Piquero, Jennings, & Farrington, 2010; Piquero et al., 2016; Walters, 2000).

While we do not directly test the strength model, the theoretical implications for our arguments are relatively straightforward. That is, in terms of delinquency's effect on self-control, we might expect that those who engage in serious amounts do so as a result of ego depletion (Muraven et al., 2006) and this delinquent involvement perpetuates continued depletion as one is unable to practice or “strengthen” the self-control muscle. Further, this period of ego-depletion during the formative years might have lasting effects.

1.2. Low self-control as a brain-based disorder

Importantly, concepts similar to self-control (e.g., self-regulation, impulsivity, conscientiousness) are studied in relationship to behavior across a number of

disciplines (de Ridder et al., 2012). DeLisi (2015) argues that a common thread in these similar concepts, is that they are often described as brain-based attributes, or disorders (i.e., in the case of deficiency). Self-control is generally thought to be a part of the executive functioning processes which find their home in the orbitofrontal region of the prefrontal cortex (Beaver, Wright, & Delisi, 2007; Berger & Posner, 2000; DeLisi, 2015). Under this general perspective, neuropsychological deficits tend to be common among persons that share behavioral indicators such as aggression, criminal behavior, and other externalizing behaviors (Beaver et al., 2007; Moffitt, 1993; Moffitt & Henry, 1989; Moffitt, Lynam, & Silva, 1994; Ratchford & Beaver, 2009). Individuals with such deficits are less able to manage instinctual and emotionally-laden impulses and thus less likely to avoid negative outcomes (DeLisi, 2015).

A related line of research in biosocial criminology focuses on the interplay between environmental and biological factors with contributions from neuropsychology and genetics. Heritability studies suggest that a significant portion of self-control is heritable with estimates ranging from 52 to 64% (Beaver, Wright, DeLisi, & Vaughn, 2008). Further, Beaver and colleagues argue that a significant portion of both stability and change in self-control over time can be attributed to genetic factors (Beaver, Connolly, Schwartz, Al-Ghamdi, & Kobeisy, 2013; Beaver et al., 2008). Notably, brain-based research indicates that the prefrontal cortex, where self-control is located, continues to develop across adolescence and into early adulthood (Blakemore & Choudhury, 2006; Gogtay et al., 2004; Sowell, Thompson, Holmes, Jernigan, & Toga, 1999), which extends further into the life course than nearly all of the criminological research on self-control (see for exception, Burt et al., 2014). It is important to note that the continued development of executive functioning, which may include self-control, into adulthood is thought to happen around the same time period that criminologists have long argued that criminal behavior tends to begin declining (Blakemore & Choudhury, 2006; Hirschi & Gottfredson, 1983; Sampson & Laub, 2003, 2005; Sowell et al., 1999). Such findings have important implications for the stability postulate of self-control in the general theory of crime.

2. On stability in self-control

The stability postulate of self-control has likely limited full exploration of a conceivable reciprocal relationship between delinquency and self-control. Relative stability, according to Gottfredson and Hirschi (1990), implies that once self-control differences, or lack thereof, between people or groups are established, those between-individual relationships do not change over the life course. In other words, it is assumed self-control is relatively stable after about the age of 10, regardless of differences in socialization, environments, and experiences across the life course (Beaver et al., 2008; Gottfredson & Hirschi, 1990; Piquero et al., 2010; Turner & Piquero, 2002). The assumption of stability provides little incentive to explore possible changes and development in self-control beyond childhood.

Research on the stability of self-control suggests it is relatively stable for a significant portion of the population, though mounting evidence calls into question the presumed universality of stability in self-control (Burt et al., 2006; Hay & Forrest, 2006; Meldrum, Young, & Weerman, 2012; Na & Paternoster, 2012; Pratt, 2016). For example, Hay and Forrest (2006) found approximately 16% of their sample experienced changes in absolute stability and 46% experienced at least minor shifts in relative, or between-group, stability. Further, Burt et al. (2006) found that individuals moved between quartiles on measures of self-control across waves, that those in the middle changed groups more often than those at the extremes, and importantly, that self-control is sensitive to social influences beyond late childhood.

Stability research thus far generally seeks to answer the question, “Is self-control stable?” and the answer seems to be, “It depends”. Further, most of the research on stability fails to extend beyond the mid-to-late teenage years, thus obscuring changes that may happen during the late teen or early adult years. Based on recent findings and theoretical propositions in this area (Burt et al., 2006; Burt et al., 2014; Hay & Forrest, 2006; Na & Paternoster, 2012; Pratt, 2016), we approach the current study under the assumption that change is possible, and that more research is needed on factors related to that change (Beaver et al., 2008; Beaver et al., 2013; Clinkinbeard, 2014; Vazsonyi et al., 2017). Given the long history of the relationship between self-control and delinquency, we argue that it makes sense to ask whether it is possible that delinquent behavior itself could be related to some of that change.

Although, as a group, persons that participate in delinquency tend to have lower levels of self-control, low self-control does not guarantee delinquency nor does high self-control guarantee abstinence. Thus, it is plausible that two youth with similar levels of self-control and/or propensity to commit delinquency will have different experiences. One adolescent might spend a lot of time with delinquent friends and dabble in delinquency while another youth avoids it altogether; however, because they started with the same baseline levels of self-control, theory would tell us not to expect them to differ from one another later in life. That is, according to the predictions of the general theory of crime, the null between-group difference in self-control would remain, despite varying life experiences.

On the other hand, Gottfredson and Hirschi do admit that absolute levels of self-control may change, particularly, self-control may improve over time and there is evidence in the empirical literature that interventions can influence absolute self-control (Piquero et al., 2010; Walters, 2000). That said, it is possible that life circumstances influence changes in absolute stability differently between people, thus leading to changes in between-group (i.e., delinquent and non-delinquent) self- control. For example, it may be that youth who do not participate in delinquent behavior continue to accumulate self-control, which should theoretically lead to a slight improvement in absolute levels of self- control, whereas delinquent youth do not see the same improvement. In such a situation, even youth with initially equal levels of self-control would experience differential levels later on. We seek to explore whether delinquency impacts future levels of self-control, as might be expected from the longstanding relationship between the two concepts. While a test of the specific mechanisms that could lead to a reciprocal relationship between self-control and delinquency over time is beyond the scope of the current study, we briefly explore a few possibilities below.

3. Possible mechanisms of influence

3.1. Association with deviant peers

Outside of self-control, association with delinquent peers is perhaps the most robust predictor of delinquency in adolescence. Thus, delinquent participation may lead to changes in self-control as youth spend time with delinquent peers. In fact, other

scholars have recently found evidence of peer influences on self-control changes in adolescence (Burt et al., 2006; Meldrum et al., 2012). Youth who spend time with deviant peers are likely to be presented with multiple opportunities for deviant behavior, or multiple opportunities for giving into their desires for immediate gratification (e.g., Haynie & Osgood, 2005; Osgood & Anderson, 2004; Warr, 2002; Young, Barnes, Meldrum, & Weerman, 2011). Even if youth resist at first, being in- undated with opportunities and reinforcements to partake in deviant behavior may prevent growth in, or weaken, self-control, over time. Burt et al. (2006) argue that continued escalation and participation in illegal acts at the urging of peers may influence the weighing of costs and benefits of the behavior over time. While non-delinquent youth are experiencing developmentally appropriate practice and growth in self- control, those hanging around deviant peers and participating in delinquent behavior may be weakening their reserves of self-control or failing to practice it altogether. Such experiences may make youth more susceptible to engaging in delinquency and diminish their capacity to exert self-control in the future.

3.2. *Reciprocal effects of parenting, self-control, and delinquency*

Plenty of research indicates that parenting influences both self- control and delinquent behavior (e.g., Burt et al., 2006; Hoeve et al., 2009; Unnever et al., 2003). Further, despite Gottfredson and Hirschi's (1990) contention that parenting in the early years is important in the development of self-control, there is evidence that parenting may continue to influence self-control beyond those early years (Burt et al., 2006). Although the assumption is often that parenting impacts child behavior, there is also literature which suggests a child's temperament, personality, and behavior can impact parenting style and effectiveness (Brown, McBride, Bost, & Shin, 2011; Danzig, Dyson, Olino, Laptook, & Klein, 2015; Kiff, Lengua, & Zalewski, 2011; Stewart, Simons, Conger, & Scaramella, 2002). Parents dealing with youth that regularly participate in deviant behavior, disobey house rules, or are otherwise difficult to manage, despite parental attempts to curb such behavior, may ultimately throw their hands up and surrender or turn to less effective methods of parenting. Such changes in parenting behavior could have further negative effects on the adolescent's self-control,

thus representing one possible way in which delinquent involvement may indirectly influence self-control.

3.3. *Labeling*

de Kemp et al. (2009) found a reciprocal effect of delinquency on self-control among males, and they argued that labeling could be a possible explanation. If youth believe that others already see them as delinquent then they may have little reason to avoid delinquent peers and situations or to exercise self-control in response to temptations (de Kemp et al., 2009; Heimer & Matsueda, 1994; Xiaojia & Conger, 1999). In other words, a self-defeating cycle may exist in which youth think "Screw it, everybody thinks I'm delinquent so I might as well be!" In such a situation, youth who already struggle to see long-term rewards associated with exercising self-control may find even less incentive, as they are not likely to be recognized for their efforts.

3.4. *Alcohol and other substances*

A number of researchers have begun to explore the impact of early onset alcohol and substance abuse on adolescent brain development. Early research, primarily based on animal models, indicates that alcohol and substance use during adolescence may result in brain changes, including disrupted growth and neurocognitive deficits (e.g., Lisdahl, Gilbart, Wright, & Shollenbarger, 2013; A. M. White & Swartzwelder, 2005). Though not everyone agrees on the specifics in the relationship between alcohol and delinquency, there is plenty of evidence suggesting that the two often co-occur (e.g., Felson, Savolainen, Aaltonen, & Moustgaard, 2008; Fergusson, Lynskey, & Horwood, 1996; Miller et al., 2016; Stafström, 2007; H. R. White, Lee, Mun, & Loeber, 2012). Further, a number of studies suggest a similar co-occurrence between various drugs and delinquency, with a high prevalence of drug use disorders among incarcerated youth (e.g., DeLisi, Angton, Behnken, & Kusow, 2015; Domalanta, Risser, Roberts, & Risser, 2003; Sterrett et al., 2014; H. R. White, 1992; H. R. White & Hansell, 1998; H. R. White et al., 2012). It is possible that youth who participate in delinquency while also abusing alcohol or drugs could experience physiological changes that stunt the growth of their self-control muscles over time.

3.5. *Practice of self-control among non-delinquent youth*

A primary task of adolescence is to learn to navigate the world as a separate entity, independent from direct parental influence and monitoring. For most, this is not a process that happens overnight, but a slow process which involves alternating periods of autonomy and supervision. Youth develop and practice their skills for adulthood by attending school, participating in recreational and competitive activities, and by building relationships with teachers, coaches, and friends. While delinquent youth may be hanging out with deviant peers, using substances, and disengaging from school, non-delinquent youth are more likely participating in a wide range of prosocial activities that allow them to practice and strengthen their self-control related skills (Muraven, Baumeister, & Tice, 1999). For example, at least a couple of studies have found that participating in sports can improve self-control skills (Cecchini, Montero, Alonso, Izquierdo, & Contreras, 2007; Shachar, Ronen-Rosenbaum, Rosenbaum, Orkibi, & Hamama, 2016). Thus, to some extent, group differences could be a result of life course disruption in the sense that participation in delinquency can exclude youth from normal adolescent trajectories in which self-control skills naturally develop over time.

4. Current study

Building on research surrounding the general theory of crime and other models of self-control, we ask the following question: After accounting for baseline group differences in impulsivity and self-control, can participation in delinquency during the life course be associated with later group differences in self-control? Specifically, we were interested in whether two groups with matched levels of self-control and risk of delinquency in mid-adolescence would show differences in adult self-control following one group's participation in delinquent behavior. We hypothesized that youth who participated in moderate to high levels of delinquent behavior would have significantly higher levels of low self-control and impulsivity in adulthood than youth who reported little to no delinquent behavior.

Support for our predictions varies somewhat across models, though the general theory of crime is likely the most unambiguous. According to the general theory of crime, once a similar group baseline has been established we should not expect to see

later group differences, regardless of delinquent participation. In other words, any null-group difference should remain despite different life experiences.

The strength model of self-control, however, provides reason to believe self-control may change in response to delinquent behavior. Imagine a kid who tells his friends that he doesn't want to skip third period and also says he won't share the answers to the quiz but then has trouble saying no again when his friends want him to drink 40 s by the lake after school. Being faced with multiple situations that require the exercise of self-control can deplete resources and interfere with one's ability to continue to exercise it later (Baumeister & Heatherton, 1996; Baumeister et al., 2007). Further, if days like the one described occurred regularly and self-control resources were constantly being depleted with little reward, it is plausible that the youth might eventually find little incentive to continue to restrain himself, thus triggering atrophy of the self-control muscle. Alternatively, youth who do not participate in delinquent behavior may actually strengthen their capacity to use self-control, either through avoiding delinquent or deviant opportunities (and not depleting their resources) or by participating in prosocial activities that help build resistance (e.g., sports or academics).

Brain-based perspectives suggest that a certain amount of self-control is hereditary and likely stable over time, yet significant development in the prefrontal cortex during adolescence may influence how youth exercise self-control (Blakemore & Choudhury, 2006). Research has shown that the brain can be exercised in such a way that self- control and relevant behavioral indicators see improvement (Berkman, Graham, & Fisher, 2012; Denson, Capper, Oaten, Friese, & Schofield, 2011). Notably, adolescence and early adulthood is a time when youth experience greater independence and must begin to practice self-control with less parental influence. This time period may also expose youth to differential experiences that enhance or weaken development of self-control.

Our preliminary investigation adds to the self-control literature in two important ways. First, most of the investigations of stability fail to extend beyond the mid to late teen years, thus we still have much to learn about how these two concepts develop into adulthood. To ex- amine relative stability of self-control and impulsivity, we utilize nationally representative data that extends from adolescence through early adulthood.

Second, given the possibility of change in self-control over the life course, there is a need to identify factors that contribute to stability or change. Though researchers may explore several directions to identify such variables, we started with a variable (i.e., delinquency) that has a long history of association with self-control and impulsivity (de Ridder et al., 2012; Pratt & Cullen, 2000; Vazsonyi et al., 2017). Given the role of self-control in positive life outcomes such as good physical health, increased income, and better interpersonal relations (de Ridder et al., 2012; Galla & Duckworth, 2015; Moffitt et al., 2011), it is important to understand whether delinquent behavior has any lasting effects, even for youth with initially strong levels of self-control. If delinquency can impact later self-control and impulsivity then youth who participate in moderate delinquency during adolescence could suffer hangover effects later in life, even after offending has ceased.

5. Method

5.1. *Data and sample*

In the current study, we explore our research question using data from the National Longitudinal Study of Adolescent to Adult Health (Add Health), a nationally representative sample of adolescents transitioning into young adulthood. These data are advantageous compared to other adolescent-based samples because they provide detailed, longitudinal information spanning 14 years on the same individuals. This allowed for an examination of possible changes in the level of self- control from mid-adolescence through young adulthood, a period of significant growth and development during the life-course. Participants were selected using an unequal stratified sampling technique designed to ensure that the sample was representative of schools with respect to region, urbanicity, school size, school type, and ethnicity (Harris et al., 2003). The Add Health includes four waves of data from a number of sources, including an in-school student questionnaire, a school administrator questionnaire, four in-home questionnaires, and a parent questionnaire (Udry, 2003).

The current study utilizes data from the four in-home questionnaires (referred to here as Waves I–IV). While sample sizes varied across waves due to weighting strategies and attrition, nearly half of the respondents that provided valid information on

Table 1. Variable Descriptives.

Variables	Mean or % (SD)	Range
Outcomes		
Low self-control		
Wave III	−0.002 (0.660)	−1.310–3.185
Wave IV	−0.006 (0.664)	−1.382–2.761
Impulsivity		
Wave III	2.783 (1.176)	1–5
Wave IV	2.563 (1.038)	1–5
Treatment variables (Wave II)		
10% delinquency	11.04%	0–1
25% delinquency	24.85%	0–1
Matching variables (Wave I)		
Age	15.265 (1.611)	11–21
Male	45.42%	0–1
White	64.84%	0–1
Hispanic	15.37%	0–1
Supervision	14.134 (2.450)	5–17
Time w/ friends	1.971 (1.004)	0–3
Low Self-control	−0.004 (0.641)	−1.612–2.659
Parent bonds	4.801 (0.546)	1–5
School bonds	2.151 (1.004)	1–5
SES	9.38%	0–1
Peer delinquency	2.674 (3.320)	0–24

our primary constructs (i.e., self-control and impulsivity) at Wave I also provided information at Waves III and IV, therefore we restricted our sample to those 9382 participants assigned with the appropriate sampling weights. As with most national data sets, substantial missingness would result from the use of a listwise analytic procedure (approximately 10% of respondents had missing information on at least one of the key

variables) which can affect statistical power and representativeness. To retain our sample, we utilized the multiple imputation chained equations technique (*mi impute chained*) in Stata 14 (White, Royston, & Wood, 2010). The multiple imputation procedure assumes missing data are "missing at random" (MAR) or the probability of a particular value being missing is dependent only on the observed data. Because the current data meet this assumption, complete case analyses using listwise deletion would likely result in biased estimates making multiple imputation the preferred method for data retention. For the current study, we produced 10 imputed data sets with a random seed number. Post imputation ex- aminations revealed no substantial differences between the imputed and non-imputed data, suggesting bias-free estimates. Our final sample at Wave I was 45% male and 65% white. Mean age across our study ranged from 15.26 (SD = 1.61) at Wave I, 16.24 (SD = 1.63) at Wave II, 21.99 (SD = 1.77) at Wave III, to 28.48 (SD = 1.77) at Wave IV. Descriptives can be found in Table 1.

6. Measures

6.1. *Self-control and impulsivity*

Through this point, we have argued for the importance of examining whether delinquent involvement, especially greater levels of involvement, during adolescence influences future levels of self-control. While we have used multiple conceptualizations (e.g., self-regulation, impulsivity, self-control) to equally represent a singular version of self- control, it is possible this strategy confounds the theoretical and empirical relationship between delinquency and self-control. Indeed, the bulk of research examining the effect of self-control, especially in regards to self-control as a personality trait captured through attitudinal measures, has used regulation, control, and impulsivity almost synonymously (e.g., Burt et al., 2014; Simons, Burt, Barr, Lei, & Stewart, 2014; Thomas & McGloin, 2013). A recent article by Mamayek, Paternoster, and Loughran (2016) highlighted how unidimensional measurements of self-control can confound the empirical nature of one's "criminal propensity" (see also Burt & Simons, 2013). Mamayek and colleagues note that while Hirschi (2004) offers a new definition in line with the impulsivity literature, "he also seems to acknowledge that [self-control and impulsivity] are not synonymous and that self-control is actually the capacity to override one's

intuitive and impulsive actions" (Mamayek et al., 2016, p. 5).

Consider that the underlining assumption of control theories in general, is that the presence of certain factors, whether they be internal (self-control) or external (social bonds), are necessary to limit delinquent involvement. It might be problematic, then, to rely on one con- struct that combines self-regulatory measures, such as the ability to concentrate on difficult tasks, with measures capturing impulsivity. Scholars in fields outside of criminology have argued one's willingness to act without considering future consequences, or behave impulsively, overlaps with theories of sensation seeking, which are considered theories of motivation towards risky behavior (Horvath & Zuckerman, 1993; Katz, 1989; Mamayek et al., 2016; Stanford et al., 2009). In other words, some elements of Gottfredson and Hirschi's (1990) general theory of crime seem to promote restraint and regulation, which should protect against criminal involvement, while other elements promote impulsive desires and immediate gratification, which insinuate motivation towards offending.

It is important to note that the current paper does not seek to add to the argument for bifurcated self-control measures nor does it take an oppositional position. Rather, we concede that regulation and impulsiveness are both important components of human behavior, especially in regards to offending. In line with our current research hypotheses, we argue it is possible that concepts more closely related to Gottfredson and Hirschi's self-control (e.g., self-regulation and ability to concentrate) as well as theories of impulsivity (e.g., acting on the spur of the moment) are similarly related with offending over the life course, albeit in opposite directions (Burt & Simons, 2013; Mamayek et al., 2016). Therefore, we incorporate both types of measures, those constituting broader concepts of self-control (i.e. consisting of all or multiple elements of self-control) and those of narrower concepts focusing on impulsiveness, which has been used as a between-person indicator of criminal propensity.

Given the dearth of items approximating elements of self-control and impulsivity across all four waves of the Add Health data, we were limited in how we operationalized the two concepts compared to studies using only one or two waves of data. Nonetheless, we were able to operationalize *low self-control* as the average of three questions that ask respondents how often in the past week they "had trouble keeping

your mind on what you were doing" (0 = "never or rarely" – 3 = "most of the time or all of the time") and two questions asking respondents how much they agree or disagree that they "usually go out of your way to avoid having to deal with problems in your life" and "when making decision, you usually go with your "gut feeling" without thinking too much about the consequences of each alternative" (both items were coded 1 = "strongly agree" – 5= "strongly disagree").[2] The last two items, avoiding problems and going with gut feeling, were reverse coded to be consistent with the first item, trouble concentrating. We conducted a principal-components factor analysis in order to test the dimensionality of our low self-control scale at each wave. The results indicated that the items loaded together on one factor with the lowest loading being trouble concentrating (0.517) and highest being gut feeling (0.749); the eigenvalue was greater than one across all four waves with the minimum variance explained being 42%. Because the three items were not on the same metric, we standardized the items using the z-scores then averaged all three items so that higher scores represent lower levels of self-control. This process was repeated at all four waves.

Impulsivity was the response to the "gut feeling" item used above. While we recognize that the use of a single item may be worrisome, multiple studies have demonstrated the validity of this item compared to multi-item scales (Nagin & Pogarsky, 2004; Paternoster & Pogarsky, 2009; Thomas & Mcgloin, 2013). In fact, Nagin and Pogarsky (2004) argued that the "gut feeling" item is the most valid measure of impulsivity within the Add Health data set. Although this measure is used in the three-item self-control measure discussed above, we believe that unlike the other measures in the scale, this item has the ability to stand alone as a distinct representation of impulsivity, the element of the general theory of crime which has received the greatest amount of attention in the literature (Thomas & McGloin, 2013). We reverse coded the item so that high scores represent more impulsive respondents (1 = "strongly disagree" – 5 = "strongly agree").

[2] Unfortunately, after Wave II, Add Health has very little overlap in measures that represent the constructs of self-control due to a focus shift in the questions based on the age of the sample. In total, only three items commonly used in self-control scales spanned across all four waves of data. Due to our analytical strategy, we were restricted to these three items as the measure of self-control had to remain a constant at each point of measurement.

6.2. *Delinquency*

In order to explore between group differences on self-control as a product of delinquency we needed to establish groups that differed in delinquency participation. We used two treatment categories to identify more serious offenders, those who scored in the top 25% and the top 10% of our Wave II delinquency scale. To form these groups, we first created a delinquency scale that took the average scores across eight delinquent behaviors. The scale included a range of behaviors, such as fighting, selling drugs, and stealing. The final delinquency scale took respondents average delinquency score across all items ranging from 0 to 3 so that higher scores represented a greater level of delinquent involvement ($\alpha = 0.76$). Two dummy variables were then created to re- present whether individuals were in the top 25% ($n = 2513$) and top 10% ($n = 1122$) of the delinquency scale.

6.3. *Matching covariates*

Several scholars have used Add Health data to inform various questions regarding adolescent involvement in delinquency, thus we identified several measures commonly used within these data that ap- proximate mainstream criminological explanations of delinquency (e.g., social bonds, differential associations, low self-control; see Daigle, Cullen, & Wright, 2007). In an attempt to account for any unobserved population heterogeneity argued to lead individuals towards delinquency, we matched respondents at Wave I on several theoretically informed measures commonly used as predictors (or covariates) of crime and delinquency in Add Health. In order to account for the effects of important social bonds, we included parental and school attachment measures. *Parental attachment* was a single item asking how much the respondent's parents cared about them. *School attachment* was a single item asking whether the respondent felt they were a “part” of their school. For both attachment items, higher scores represent greater levels of attachment. Additionally, we included *parental supervision*, which is the sum of three items asking respondents whether their mother and father were “home when I go to bed.” High scores represent greater supervision. We created two measures to account for potential opportunity and peer influence effects. *Hanging with friends* was a single item measure capturing the

amount of time individuals spend “just hanging out with friends” during an average week. We captured peer delinquency using a *differential associations* measure that combined four items asking the extent that the respondent's four best friends drink alcohol, smoke cigarettes, or use marijuana.[3] We also matched groups on *self-control/impulsivity* at Wave I. These measures were operationalized the same way as described above. *Age at Wave I*, *male*, *white*, *Hispanic*, and *SES* (whether the respondent's mother received some form of financial aid in the past year), were all included as they have demonstrated to be robust correlates of delinquent behavior.

7. Analysis

The most robust methodological approach to compare groups over time is to randomly assign individuals into an experimental, or treatment, group and a control group; however, it is often impossible or unethical to do so in practice. Such is the case with this study – it was not possible to randomly assign some youth to engage in delinquency. Yet, youth who engaged in high levels of delinquency were significantly different from non-delinquents along several characteristics, so a simple *t*-test comparison of youth in high and low delinquent groups would be biased from the outset. The best alternative approach, propensity score matching, was thus used to correct for selection bias between groups of youth by estimating the “conditional probability” of being in the more delinquent group (Rosenbaum & Rubin, 1983). Using logistic regression and baseline predictors of delinquency, we estimated a propensity score representing youths' propensity to be in the treatment group (i.e., to have engaged in a moderate to high level of delinquency during Wave II of the AddHealth study).[4] Youth who engaged in moderate to high levels of delinquency (i.e., those in the top 10% or 25%)[5] were then matched to youth who engaged in little to no delinquency.

[3] Some scholars have argued that perceptual measures of peer delinquency are flawed as persons tend to project their own delinquency onto their peers causing them to overestimate the involvement of delinquency of their peers. To account for this, we also estimated models with objective measures of peer delinquency created with network data captured during the in-school questionnaire. Unfortunately, the inclusion of this measure resulted in a substantial loss of data. Additionally, the results did not change from those presented here, ultimately supporting our decision to use the perceptual measure.

[4] The propensity score matching techniques used in this study are outlined in detail by Guo and Fraser (2010).

[5] Notably, the sample of AddHealth youth was not a highly delinquent group, though we have identified and separated the most delinquent youth from those who engaged in little to no delinquency. We included two indicators of level of delinquency to assess any potential differences in the groups based on who was included (i.e., the top 10% of delinquents vs the top 25% of delinquents), and we found little difference between either group.

Nearest neighbor one-to-one matching without replacement pro- vided a simple and effective method to balance Wave I covariates of each individual and match youth in each group according to proximity of their propensity scores. Matching covariates included baseline (i.e., Wave I) low self-control and impulsivity,[6] parental attachment and supervision, time spent with friends, peer delinquency, school attachment, family socioeconomic status, and demographics (age, sex, race, ethnicity). To correct for possible sampling bias resulting from stratification and oversampling in the Add Health sampling design, a grand sample weight was also used as a covariate in the propensity score model per guidelines outlined by Chen and Chantala (2014) and DuGoff, Schuler, and Stuart (2014).[7] It is important to note here that the inclusion of appropriate conditioning variables is essential for correct model specification and accurate estimation of propensity scores (Guo & Fraser, 2010; Heckman, Ichimura, & Todd, 1997). Therefore, it is possible that the matching covariates in this study do not completely account for differences between youth; however, this study is an initial step towards rigorously testing the stability of low self-control.

Matching was conservatively estimated using a caliper of approximately 0.25 times the standard deviation of the propensity score (Guo & Fraser, 2010), and the quality of the matching procedure was when I leave for school," "home when I return from school," and "home assessed.[8] After matching, it was possible to determine the effect of Wave II delinquency on levels of low self-control and impulsivity at Wave III and Wave IV. The estimate of these effects is referred to as the average treatment

[6] Low self-control and impulsivity were each tested separately to examine the influence and stability of propensity to engage in delinquency. The AddHealth study includes baseline measures of low self-control and impulsivity at Wave I and measures of low self- control and impulsivity in later life (at Wave III and Wave IV). We included both measures separately to explore the validity of each, and we found similar results regardless of which measure was used.

[7] In addition to concerns about sampling bias, the Add Health data set also includes data clustered by region and school, which may cause errors in estimation due to autocorrelation. Chen and Chantala (2014) note that, for a single-level model, the grand sample weight accounts for "all levels of clustered sampling," (p. 8). Thus, the inclusion of the grand sample weight in our analyses adequately factors in the clustered nature of the data.

[8] Two steps were taken to assess the quality of the matching procedure. First, a *t*-test was used to test for significant differences between the two groups of officers before and after matching. Secondly, a standardized bias statistic was calculated for each of the covariates. This statistic provides an alternative method to assess the quality of matching, and it is especially useful when small sample size may reduce the power necessary to compute the t-test because standardized bias does not rely on statistical significance. The Rosenbaum and Rubin (1983) formula was used to compute the standardized bias and absolute values were below 20 for each covariate indicating adequate balance.

effect on the treated (ATT), which is the average causal effect of a given variable on the dependent variable of interest (Guo & Fraser, 2010). A *t*-test determined the statistical significance of the ATT. Finally, sensitivity analyses revealed the robustness of the estimated model to determine how sensitive each model was to hidden bias.

Table 2
Results from pre- and post-matching *t*-tests and standardized bias statistics for youth in the top 10% and top 25%, matching on low self-control.

	Unmatched sample					Matched sample				
	Del.	Non-del.	*SB*	*SB* (%)	*p*	Del.	Non-del.	*SB*	*SB* (%)	*p*
Top 10%										
Age	15.11	15.27	−11.91	−10.20	0.002	15.13	15.15	−1.59	−1.50	0.740
Male	0.66	0.43	31.43	47.10	0.000	0.65	0.69	−5.83	−7.20	0.092
White	0.64	0.64	0.00	−0.40	0.911	0.65	0.66	−1.45	−2.20	0.611
Hispanic	0.21	0.15	9.80	15.40	0.000	0.21	0.20	1.58	2.00	0.611
Supervision	13.84	14.17	−21.00	−13.40	0.000	13.84	13.89	−3.18	−2.00	0.651
Time w/ friends	2.25	1.94	33.59	31.90	0.000	2.26	2.28	−2.09	−2.10	0.614
Self-control	0.21	−0.03	28.75	36.40	0.000	0.20	0.19	1.25	2.30	0.602
Parent bonds	4.69	4.81	−15.69	−21.50	0.000	4.69	4.72	−3.74	−5.00	0.290
School bonds	2.37	2.13	21.47	22.90	0.000	2.35	2.39	−3.80	−3.10	0.501
SES	0.12	0.09	5.43	8.70	0.004	0.12	0.10	3.59	5.60	0.203
Peer delinquency	4.18	2.50	90.76	50.90	0.000	4.12	3.96	8.12	4.80	0.363
Top 25%										
Age	15.15	15.29	−10.29	−9.10	0.000	15.17	15.16	0.79	0.60	0.847
Male	0.60	0.41	27.71	39.70	0.000	0.60	0.61	−1.43	−2.00	0.489
White	0.64	0.65	−1.44	−2.20	0.347	0.65	0.64	1.44	2.40	0.424
Hispanic	0.18	0.15	6.58	9.30	0.000	0.18	0.17	1.62	1.20	0.699
Supervision	13.89	14.22	−21.04	−13.10	0.000	13.91	13.89	1.26	1.00	0.743
Time w/ friends	2.15	1.91	25.25	24.10	0.000	2.15	2.18	−3.08	−3.30	0.237
Self-control	0.13	−0.05	22.59	28.40	0.000	0.13	0.13	0.00	−0.10	0.981
Parent bonds	4.75	4.82	−8.02	−11.90	0.000	4.76	4.77	−1.30	−1.80	0.564
School bonds	2.30	2.11	17.78	18.80	0.000	2.28	2.27	0.97	1.40	0.635
SES	0.12	0.09	3.68	7.60	0.001	0.11	0.11	0.00	−0.60	0.850
Peer delinquency	3.69	2.35	73.33	40.50	0.000	3.60	3.53	3.62	2.10	0.529

8. Results

To test the stability of low self-control and impulsivity, we first corrected imbalances between youth who engaged in moderate to high levels of delinquency (i.e., those in the top 10% or 25%) and youth who engaged in little to no delinquency in Wave II of the Add Health study. Many factors are associated with delinquency, including early low self- control and impulsivity, low parental and school attachment, limited supervision, time spent with delinquent youth, low socio-economic status, and demographic characteristics. Propensity score analysis corrected for the confounding influence each of these variables on participation in delinquency.

Results from pre-/post-matching *t*-tests and standardized bias statistic (SBS) values including measures of early low self-control and impulsivity are presented in Tables 2–3. Prior to matching, youth in the top 10% and top 25% delinquent groups

were significantly different from those in the low-to-non-delinquent groups on every matching characteristic, except for race. After matching, no significant differences between groups remained and the SBS values were below 20 for each variable, which is considered an acceptable range for propensity score matching (Apel & Sweeten, 2010; Caliendo & Kopeinig, 2005).

Coefficient values for the average treatment effect on the treated (ATT) indicate the average effect of engaging in moderate to high levels of delinquency on the outcomes of interest (see Tables 4–5). Results from the first set of analyses using Wave I low self-control show significant effects for low self-control at Wave III and Wave IV. Youth who scored in the top 10% on a general delinquency scale reported significantly higher levels of low self-control than the non-delinquent group at Wave III (ATT = 0.13, $p < 0.001$) and Wave IV (ATT = 0.09, $p < 0.01$), despite being matched on Wave I self-control. Specifically, delinquent youth scored 13% and 10% higher than their non-delinquent counterparts at Waves III and IV, respectively.[9] Similarly, the top 25% delinquency group reported 10% higher levels of low self-control at Wave III (ATT = 0.10, $p < 0.001$) and levels that were 8% higher at Wave IV (ATT = 0.08, $p < 0.001$).

When a measure of impulsivity was used in place of low self-control, general findings remained the same. Impulsivity scores at Wave III and Wave IV were significantly different across matched groups. The top 10% of delinquent youth reported significantly higher levels of impulsivity at Wave III (ATT = 0.15, $p < 0.01$) and Wave IV (ATT = 0.11, $p < 0.05$). Specifically, the most delinquent group at Wave II reported impulsivity levels that were 15% and 11% higher than the non-delinquent group at Waves III and IV. The top 25% also had levels of impulsivity that were 19% higher at Wave III (ATT = 0.19, $p < 0.001$) and 9% higher at Wave IV (ATT = 0.09, $p < 0.01$).

[9] Few papers report the difference in ATT values as a percentage point, yet results presented by Becker and Caliendo (2007) suggest it is acceptable to do so. To aid interpretation, we provide both the ATT values and the percentage point difference in ATT values between the treated and control group.

ATT values for both groups are displayed visually in Fig. 1 and the differential effect of participating in delinquency is apparent. Notably, when the measure of low self-control was used as a matching covariate, the largest treatment effect was evident for those who engaged in the most delinquency (i.e., the top 10%), yet when impulsivity was used, the largest treatment effect was in the top 25% group. Overall levels of low self-control and impulsivity appeared to decline for both groups over time, though decreases in low self-control and impulsivity were more marked for the non-delinquent groups (see Fig. 1).

Finally, a sensitivity analysis was conducted following propensity score matching to determine how sensitive the models were to hidden bias, possibly from an unobserved covariate. Results revealed estimated upper and lower bounds remained significant for a wide range of gamma values across each outcome. This finding suggests the treatment effects are robust and do not appear to be overly sensitive to the possibility of a missing matching covariate.

9. Discussion

The extant literature leaves little question about the presence of an effect of self-control on delinquent behavior. Little is known, however, about if and how delinquency impacts self-control. While we do not wish to overstate our findings, the current study revealed preliminary support for the hypothesis that participation in delinquency may also influence self-control and impulsivity. After statistical similarity was established on measures of self-control and impulsivity at baseline, the groups identified as delinquent at Wave II differed significantly from non-delinquent groups on self-control and impulsivity at Waves III and IV. Our results are in line with findings from de Kemp et al. (2009) which indicated that higher delinquency participation in males resulted in poorer self-control. Further, our results provide additional evidence that self-control may not be completely stable across the life course (Burt et al., 2006; Burt et al., 2014; Hay & Forrest, 2006; Na & Paternoster, 2012). In particular, we found evidence of instability over the life course with regard to between-group differences.

Changes across waves indicated slight reductions in levels of low self-control and impulsivity, which suggests that both delinquent and non-delinquent youth likely

strengthened their self-regulation skills over time. This finding makes sense, developmentally, and seems to adhere to predictions both from the general theory of crime and the brain-based models of self-control. Though Gottfredson and Hirschi (1990) did not expect relative changes in self-control they did ac- knowledge that absolute levels were likely to improve over the life course. Further, impulsivity may decrease and self-control may improve over time as the frontal lobe and executive functions continue to develop across adolescence and into adulthood (Blakemore & Choudhury, 2006; Gogtay et al., 2004; Sowell et al., 1999).

Though levels of self-control and impulsivity improved for all groups over time, non-delinquent groups saw larger reductions in low self-control and impulsivity across adolescence and adulthood, leading to significant group differences at Waves III and IV. Further, it appears that the non-delinquent group saw most of their improvement in self-control by Wave III and started to level off. The more delinquent youth saw attenuated growth over time, in comparison, with the most improvement happening at Wave IV. Growth rates were similar between delinquency operationalizations (top 10% vs. top 25%) with a slight improvement edge for the more delinquent group (i.e., top 10%). Unlike the general theory of crime, the strength model and brain-based models allow for the possibility of changes in both absolute and relative stability of self-control over time. According to the strength model, differential life experiences, such as moderate practice of self-control or overexposure to situations requiring self-control, may either strengthen self-regulation capacity or lead to self-regulation failure caused by ego depletion (Baumeister & Heatherton, 1996; Baumeister et al., 2007). Further, biosocial and brain-based perspectives permit explanations of change in self-control across the life course, despite genetic predisposition (DeLisi, 2015). Research on neuroplasticity suggests that our brains continue to change and develop across the lifespan in response to targeted intervention and practice, various environmental stimuli, and physical injury (Lehr, 2010; Roman, 2010; Twardosz & Lutzker, 2010). Under both strength and the brain-based perspectives, then, participation in delinquent behavior could lead to a pattern of experiences and behaviors that impact the development of self-control and impulsivity.

Table 3
Results from pre- and post-matching *t*-tests and standardized bias statistics for youth in the top 10% and top 25%, matching on impulsivity.

	Unmatched sample					Matched sample				
	Del.	Non-del.	*SB*	*SB* (%)	*p*	Del.	Non-del.	*SB*	*SB* (%)	*p*
Top 10%										
Age	15.11	15.27	−11.91	−10.20	0.002	15.13	15.14	−0.79	−0.60	0.890
Male	0.66	0.43	31.43	47.10	0.000	0.65	0.66	−1.45	−1.40	0.746
White	0.64	0.64	0.00	−0.40	0.911	0.65	0.65	0.00	0.60	0.890
Hispanic	0.21	0.15	9.80	15.40	0.000	0.21	0.20	1.58	1.30	0.785
Supervision	13.84	14.17	−21.00	−13.40	0.000	13.84	13.85	−0.63	−0.40	0.931
Time w/ friends	2.25	1.94	33.51	31.90	0.000	2.26	2.30	−4.20	−4.80	0.245
Impulsivity	3.27	2.94	32.06	29.80	0.000	3.27	3.31	−3.79	−4.10	0.354
Parent bonds	4.69	4.81	−15.69	−21.50	0.000	4.69	4.69	0.00	0.20	0.974
School bonds	2.37	2.13	21.47	22.90	0.000	2.35	2.32	2.88	3.60	0.431
SES	0.12	0.09	5.43	8.70	0.004	0.12	0.13	−1.74	−4.40	0.350
Peer delinquency	4.18	2.50	90.76	50.90	0.000	4.13	3.94	9.67	5.70	0.273
Top 25%										
Age	15.15	15.29	−10.29	−9.10	0.000	15.17	15.15	1.58	1.00	0.733
Male	0.60	0.41	27.14	39.70	0.000	0.60	0.61	−1.43	−3.70	0.206
White	0.64	0.65	−1.44	−2.20	0.347	0.64	0.65	−1.44	−0.90	0.758
Hispanic	0.18	0.15	6.58	9.30	0.000	0.18	0.17	1.62	2.10	0.486
Supervision	13.89	14.22	−21.04	−13.10	0.000	13.91	13.89	1.26	0.70	0.805
Time w/ friends	2.15	1.91	25.25	24.10	0.000	2.15	2.17	−2.05	−1.50	0.587
Impulsivity	3.18	2.91	22.57	23.70	0.000	3.17	3.18	−0.95	−0.60	0.844
Parent bonds	4.75	4.82	−8.02	−11.90	0.000	4.76	4.78	−2.61	−3.20	0.286
School bonds	2.30	2.11	17.78	18.80	0.000	2.28	2.30	−1.93	−1.20	0.690
SES	0.12	0.09	3.68	7.60	0.001	0.11	0.11	0.00	0.70	0.813
Peer delinquency	3.69	2.35	73.33	40.50	0.000	3.60	3.47	6.73	3.80	0.256

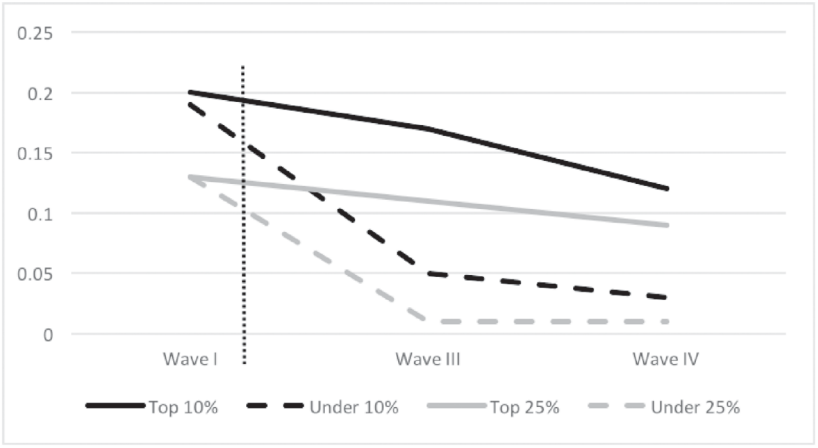
Table 4
Propensity score matching estimates for low self-control.

Dependent variable	Treated	Controls	ATT difference	SE	*t*-Test
Top 10%	(*n* = 1033)	(*n* = 8348)			
Wave III low self-control	0.17	0.05	0.13	0.03	4.28
Wave IV low self-control	0.12	0.03	0.09	0.03	2.97
Top 25%	(*n* = 2301)	(*n* = 7050)			
Wave III low self-control	0.11	0.01	0.10	0.02	5.13
Wave IV low self-control	0.09	0.01	0.08	0.02	3.96

Table 5
Propensity score matching estimates for impulsivity.

Dependent variable	Treated	Controls	ATT difference	SE	*t*-Test
Top 10%	(*n* = 1034)	(*n* = 8348)			
Wave III impulsivity	3.05	2.90	0.15	0.05	2.82
Wave IV impulsivity	2.77	2.66	0.11	0.05	2.39
Top 25%	(*n* = 2302)	(*n* = 7050)			
Wave III impulsivity	2.98	2.79	0.19	0.03	5.47
Wave IV impulsivity	2.72	2.63	0.09	0.03	2.99

a) Low Self-Control



b) Impulsivity

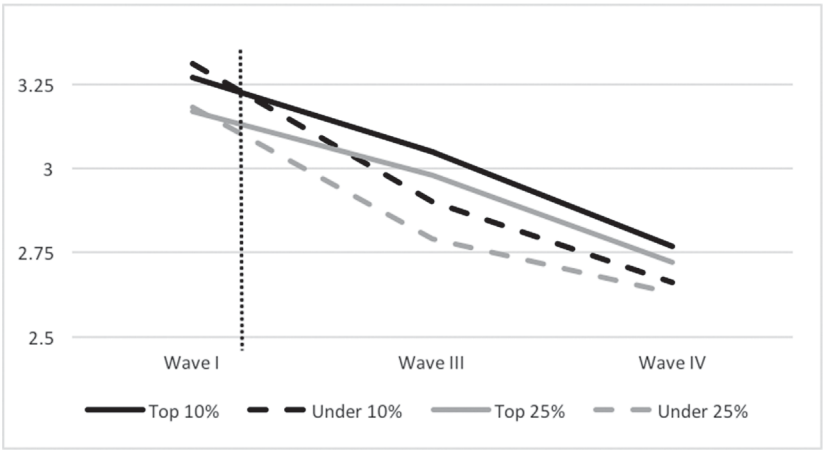


Fig. 1. Relative change in low self-control and impulsivity after treatment. Solid black lines represent respondents who participated in the top 10% of delinquency at Wave II and dashed black lines represent those under that threshold. Solid grey lines represent respondents who participated in the top 25% of delinquency and the dashed grey lines re- present those under that threshold. Dotted vertical line re- presents the period in which the treatment took place (i.e., when respondents were identified as either delinquent or not).

While the findings of this study must be viewed as tentative until sufficiently replicated, we suggest that participation in delinquency may interrupt the life course in such a way that it can have long-term influences on self-control development. Our findings suggest that al- though most youth show improvement in self-control and impulsivity over time, those that had previously participated in delinquency saw less growth and that growth seemed to be delayed compared to non-delinquent youth. Because self-control is linked to a range of success indicators (e.g., physical health and health behaviors, increased income, and better interpersonal relations; de

Ridder et al., 2012; Galla & Duckworth, 2015; Moffitt et al., 2011), the long-term effects of engaging in delinquency could potentially bleed into other areas of life.

10. Limitations and future research

Our investigation of the relationship between delinquency and self-control has a number of strengths, including the use of a national data set, the examination of developmental changes over time, and the use of a sophisticated propensity score matching technique to mimic treatment (delinquent youth) and control (non-delinquent) groups. Further, though our results are preliminary, and require replication, we have outlined a number of plausible mechanisms (i.e., deviant peers, reciprocal influences of parenting, labeling, substance use, stunted development) through which delinquent participation could potentially impact later self-control and suggest that our findings, at a minimum, merit additional research on the matter.

In addition to exploring the mechanisms through which delinquent participation may impact later self-control, future research should also attempt to address the limitations of the current study. One possible limitation is that the matching covariates used to establish baseline equivalence do not completely account for differences between the two groups of youths. For example, it is possible that unaccounted for differences in genetics (Beaver et al., 2013) and/or rates of head injuries (Schwartz, Connolly, & Brauer, 2017) could have already set our groups on different trajectories of self-control growth, not captured in our data. That said, this study is an initial step in the exploration of delinquent participation effects on self-control. Further, sensitivity analyses suggested our findings are not likely to be overly sensitive to the possibility of a missing matching covariate.

As Hay and Forrest (2006) stated, the "…stability thesis is genuinely difficult to test, given the need for longitudinal data that contain repeated measures of self-control" (p. 741). A strength of our research is that we do have repeated measures over time, however, we were con-strained with regard to our specific indicators of self-control. Though there are a number of self-control related items in the Add Health, few are repeated across all four waves. We utilized both a 1-item measure of impulsivity and a 3-item measure of self-control and found similar results with both, though neither can

be considered a comprehensive coverage of the self-control dimensions. It is, of course, possible the between-group differences and changes in self-control over time were a reflection of measurement error, introduced by poor indicators or un- reliable self-assessments provided by delinquent youth (Sibley et al., 2010). Previous research, however, has found the relationship between self-control and delinquency to be robust across a number of different conceptualizations, measures, and methodological designs (Pratt & Cullen, 2000; Vazsonyi et al., 2017). Though our study is relatively unique in the exploration of delinquent behavior as a predictor of self-control, our findings of instability in between-group differences over time in self-control are not (Burt et al., 2006; Hay & Forrest, 2006). Although psychological research often predicts consistency in personality traits, it also finds that slight changes in personality across the life course can be expected (Caspi & Roberts, 2001; Helson, Jones, & Kwan, 2002). Further, findings of similar trends at two "post" waves (III and IV) using multiple measures and more than one delinquency cutoff add additional weight to our conclusions. Because the study spanned adolescence to adulthood (a significant period of developmental change), it is possible that youth could have interpreted the self-control items differently over time. Changes in interpretation of the instruments are only of serious concern, however, if those changes differed systematically across groups. Future research should utilize multiple measures and explore the relationship between delinquent participation and the various sub-components of self-control (e.g., risk-seeking, here-and- now orientation, intolerance for frustration, self-centeredness), perhaps utilizing other longitudinal data sets.

Delinquent behavior (i.e., the treatment) in the current study was represented by a single 12-month period in the life course. Future re- search should determine whether treatment effects vary according to length and severity of delinquent participation. For example, we might expect that sustained involvement in delinquency over a period of time would have stronger effects on adult self-control. Alternatively, it is possible that delinquent participation effects on later self-control are more or less pronounced among adolescent onset or adolescent-limited offenders in comparison to early-onset, persistent offenders.

Future research should also explore self-control development in relationship to

the age-crime curve. While the predictable age-linked pattern of development of, and desistance from, crime is considered something of criminological fact (Hirschi & Gottfredson, 1983; Pratt, 2016; Sampson & Laub, 2003, 2005) less is known about the development of self-control in relation to this pattern. The lifetime stability of self-control is not as taken for granted as it once was and if we accept that self-control can vary across the life course it would make sense to take a closer look at the co-development of self-control and delinquent or criminal behavior (Pratt, 2016). Though we did not set out to explore the question of self-control as it relates to aging and crime, we did find some support, that self-control appears to grow in strength during the same period of life that people begin to predictably desist from criminal behavior. Though there is some variation in the exact timing of peaks and declines according to crime type, "Aging out of crime is thus the norm—even the most serious delinquents desist [eventually]" (Sampson & Laub, 2003, p. 569). Because crime and self-control are so strongly linked it is plausible that there is a similar patterning of self- control, in the sense that everyone gets better, eventually. Future re- search should also explore this pattern even further into the life course. We saw that both delinquent and non-delinquent youth improved their self-reported self-regulation skills over time but that this growth was both attenuated and delayed among delinquent youth. Research that continues beyond the late 20s (where ours ended) might be able to tell us whether previously delinquent individuals eventually catch up with regard to self-control.

11. Conclusion

While previous studies have confirmed the link between low self- control, impulsiveness, and delinquency, research is only beginning to explore the likely reciprocal relationship between these variables. In our study, an examination of individual levels of self-control, impulsivity and participation in delinquency over four time periods pro- vides evidence that further research in this direction is warranted. Youth who were matched on levels of self-control and impulsivity re- ported significantly different levels of self-control/impulsivity later in life depending on whether or not they had engaged in delinquent activities. Such findings have important implications for theory and re- search. Future research should continue to test this relationship utilizing

measures that include all relevant dimensions of self-control and assess changes over time. In particular, research should seek to determine the specific mechanisms through which delinquent participation may impact later self-control. Identification of these mechanisms may illuminate potential turning points that alter a child's path towards a life-long pattern of delinquency and crime, or, alternatively, experiences that serve to protect youth from criminal activity and other negative outcomes. Consequently, there may be important practical implications of this study. While individual self-control and impulsivity are partially predetermined by genetics and relatively stable over the life course, findings from this study provide a more optimistic view of self-control. Findings suggest efforts to identify youth with low self- control and help them strengthen their capacity to self-regulate before they participate in delinquency may be useful preventative measures. Further, such efforts should continue even for youth that have begun to participate in delinquency in order to prevent attenuated growth in the development of self-control. Such outcomes would be positive for both youth and society.

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