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An evaluation of the directional relationship between head injuries and subsequent changes in impulse control and delinquency in a sample of previously adjudicated males☆

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ABSTRACT

Research over the past decade has found that head injuries are associated with negative outcomes including lower levels of self-control and a greater prevalence of delinquent behavior. Despite this pattern of findings, previous research remains unclear as to whether head injuries influence subsequent levels of self-control and delinquency, or whether lower levels of self-control increase the likelihood of sustaining a head injury. The current study begins to address this gap in the literature by analyzing longitudinal data spanning from childhood to young adulthood on adolescent offenders from the Pathways to Desistance study. A series of cross-lagged autoregressive path models were estimated to examine the prospective associations between head injuries, changes in impulse control (a dimension of self-control), and delinquency while controlling for stability in all three constructs. Findings indicate: 1) impulse control and delinquency displayed significant levels of stability across the study period; 2) head injuries appear to occur prior to decreases in impulse control; 3) decreases in impulse control do not appear to systematically increase the odds of sustaining future head injuries; and 4) head injuries did not appear to result in systematic increases in delinquent behavior across the life course.

1. Introduction

There are few theoretical perspectives within the field of criminology that have received as much attention as Gottfredson and Hirschi's (1990) self-control theory. What is perhaps even more surprising than the overall volume of research focused on self-control theory is that the number of studies published examining various aspects of this theoretical perspective has continued to grow year after year (Vazsonyi, Mikuška, & Kelley, 2017). There are multiple explanations for criminology's continued interest in self-control theory, but perhaps the most convincing explanation is directly centered on the association between self-control and criminal behavior (or other forms of deviance). Findings from the extensive body of literature examining the association between self-control and antisocial behaviors are remarkably consistent, with findings showing that lower overall levels of self-control are significantly associated with various forms of antisocial behavior (de Ridder, Lensvelt-Mulders, Finkenauer, Stok, & Baumeister, 2012; Pratt & Cullen, 2000; Vazsonyi et al., 2017). Based on these findings, it comes as little surprise that self-control theory has quickly become a mainstay of criminological research.

The proliferation of research examining various aspects of self-control theory has also resulted in a well-developed body of literature examining the etiological development of self-control across the life-course. Collectively, findings from this line of research have identified a relatively broad range of factors that ultimately contribute to individual variability in self-control. Factors involved in creating differences in self-control include a sizable number of both environmental (Burt, Simons, & Simons, 2006; Gibson, Sullivan, Jones, & Piquero, 2010) and biological (Beaver, Wright, & DeLisi, 2007; Cauffman, Steinberg, & Piquero, 2005; DeLisi, 2014) influences. Directly in line

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with these findings, preliminary evidence from research outside of criminology points to head injuries as a potential environmental experience that may influence changes in neurobiological structure and function to produce variability in self-control (Steinberg, 2008). Despite this preliminary evidence suggesting that head injuries may serve as a substantive source of influence on the development of self-control, these findings are tempered by important methodological limitations. Most importantly, previous research is typically confined to a limited number of observation periods, resulting in potential selection bias whereby individuals with lower overall levels of self-control may simply be more likely to find themselves in situations where head injuries are more likely to occur (e.g., physical fights, car accidents). The current study aims to begin to address this limitation in the existing body of literature by examining the association between head injuries, delinquency, and a specific dimension of self-control—impulse control—in a sample of previously adjudicated youth from the Pathways to Desistance (Pathways) study (Mulvey et al., 2004). The Pathways study offers the unique advantage of a panel design with repeated observations that span a total of eight years of the life course—spanning from adolescence to early adulthood. This repeated panel design, along with the employed analytic strategy, allows for a more detailed examination of the longitudinal associations between head injuries, delinquency, and impulse control, by attempting to better establish temporal order and minimize selection bias.

2. The evolution of self-control in criminological research

The results of three separate systematic reviews of the literature have demonstrated the importance of self-control in the etiological development of antisocial behavior (de Ridder et al., 2012; Pratt & Cullen, 2000; Vazsonyi et al., 2017). In the now classic meta-analysis performed by Pratt and Cullen (2000), the authors examined studies from the decade following the publication of Gottfredson and Hirschi's (1990) book. The results of 21 studies and over 49,000 individual cases indicated that “low self-control consistently had an effect size that exceeded 0.20” (p. 951). Importantly, the observed effect size was robust to a wide range of potentially moderating influences including differences in measurement, sample characteristics, and the type of antisocial behavior examined. A more recent meta-analysis by de Ridder et al. (2012) examined the existing body of literature focused on self-control and antisocial behavior as well as a broad range of other potential outcomes (e.g., school success, well-being). The results revealed a pattern that closely aligned with findings presented by Pratt and Cullen (2000), with mean correlations for self-control and antisocial behavior ranging from 0.15 to 0.25. Finally, the most recent meta-analysis examining the self-control-antisocial behavior association was performed by Vazsonyi et al. (2017) and focused on research published in the decade following Pratt and Cullen's study (between 2000 and 2010). Once again, the overall pattern of results largely converged with both previous meta-analyses and revealed moderately sized effects for both cross-sectional ($r = 0.42$) and longitudinal ($r = 0.35$) studies. Collectively, the results of these systematic reviews reveal a robust and sizable association between low self-control and various forms of antisocial behavior, effectively demonstrating the importance of self-control in future research examining the etiological development of antisocial behavior.

Based, at least in part, on these findings, studies have begun to examine other aspects of self-control theory, with studies beginning to focus on factors that ultimately contribute to variability in overall levels of self-control (Burt et al., 2006; Franken et al., 2016; Teasdale & Silver, 2009). While Gottfredson and Hirschi (1990) pointed to one specific source of influence (i.e., parental socialization) and provided a straightforward explanation of how these factors may be involved in creating differences in self-control, subsequent research has demonstrated that influences which ultimately culminate into variability in self-control are likely far more complex (Pratt, Turner, & Piquero, 2004). For example, while studies have demonstrated an overwhelming amount of support for Gottfredson and Hirschi's parental socialization thesis (Hay & Forrest, 2006; Pratt et al., 2004), additional research has also demonstrated that the parent-child interactions involved in the development of self-control are far more intricate (Brauer, 2016; Hay, 2001). In addition, a large, and continually developing, body of research has pointed to additional sources of influence that ultimately contribute to the development of self-control including peer interactions (Franken et al., 2016; Gardner & Steinberg, 2005; Meldrum & Hay, 2012; Meldrum, Young, & Weerman, 2012), school-based influences (Burt et al., 2006; Turner, Piquero, & Pratt, 2005), neighborhood characteristics (Gibson et al., 2010; Pratt et al., 2004; Teasdale & Silver, 2009), and even targeted interventions (for a recent systematic review see Piquero, Jennings, Farrington, Diamond, & Gonzalez, 2016). These findings have encouraged criminologists to explore a wider range of influences that contribute to the long-term development self-control across various stages of the life-course.

In addition to the proliferation of studies exploring additional social influences on the development of self-control, a related line of research focused on the biological factors involved in the development of self-control has also emerged (Beaver et al., 2009; Cauffman et al., 2005; Harden, Quinn, & Tucker-Drob, 2012). Drawing from studies demonstrating an intergenerational transmission of self-control from parents to offspring (Boutwell & Beaver, 2010; Meldrum, Verhoeven, Junger, van Aken, & Deković, 2016; Meldrum, Young, & Lehmann, 2015; Nofziger, 2008), additional research has focused on identifying relevant genetic and neurobiological influences (Beaver, Connolly, Schwartz, Al-Ghamdi, & Kobeisy, 2013; Connolly & Beaver, 2014; Schwartz, Rowland, & Beaver, 2014; Steinberg, 2008; Wright & Beaver, 2005) involved in creating individual differences in self-control. Findings from this line of research suggest that self-control is a brain-based construct, shaped by a complex combination of biological and environmental influences (Beaver et al., 2007; Beaver et al., 2009; Cauffman et al., 2005; DeLisi, 2014).

Most of the research in this area conceptualizes self-control as an *executive function*, which has been previously described as “a wide range of cognitive processes and behavioral competencies which include verbal reasoning, problem-solving, planning, sequencing, the ability to sustain attention, resistance to interference, utilization of feedback, multitasking, cognitive flexibility, and the ability to deal with novelty” (Chan, Shum, Toulopoulou, & Chen, 2008, p. 201). Importantly, results from two recent meta-analyses have linked executive functions to the structure and functioning of specific regions of the frontal lobes, including components of the prefrontal cortex (Alvarez & Emory, 2006; Yuan & Raz, 2014). First, Yuan and Raz (2014) performed a systematic review of studies examining structural aspects of the prefrontal cortex and executive functions. The results from 31 studies and over 3000 participants indicated that increased volume ($d = 0.31$) and cortical thickness ($d = 0.19$) in the prefrontal cortex was significantly associated with better executive function. Second, Alvarez and Emory (2006) performed a systematic review of the literature examining differences in executive functions between individuals who had sustained lesions to the frontal lobes and healthy controls. The results revealed stark differences between the two groups, with individuals who suffered damage to their frontal lobes performing significantly worse on measures of executive functions relative to their counterparts ($d = -0.78$). These findings suggest that: (1) self-control, and other executive functions, are tied to structural and functional characteristics of the frontal lobes (and, more specifically, the prefrontal cortex); and (2) damage to these specific regions of the brain may result in impaired executive function.

3. Head injuries and self-control

Directly in line with these findings, it stands to reason that sustaining a head injury may result in damage to the frontal lobes, which