Examining Executive Functioning Deficits in Juvenile Delinquents with a History of Trauma Exposure

by

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Abstract

We examined whether an early childhood history of trauma explains which juvenile offenders develop Executive Functioning (EF) deficits. One hundred and eighty-eight incarcerated adolescent males were evaluated for personal trauma history and EF, from which three latent factors were formed. Despite exhibiting below average EF performance, SEM showed that childhood maltreatment and delinquent status were not mediated by EF performance. Analyses indicated that specific trauma characteristics predict juvenile offending behavior, even after controlling for EF. Salient trauma characteristics include age of first victimization, relationship to perpetrator, and combined-type victimization (i.e., physical and sexual victimization). In particular, experiences with early victimization, incestuous trauma, and combined-type abuse are related to juvenile sex offending and may be stronger predictors of prognosis than other trauma characteristics (e.g., frequency, duration). Some individuals with a history of trauma exposure and some juvenile offenders may exhibit EF deficits; but poor inhibition, cognitive flexibility, or monitoring does not appear to explain the relationship between trauma and delinquency. Other theories regarding the long-term effects of childhood trauma and the etiology of delinquent behavior should be explored in order to identify protective factors and inform treatment. The need for refinement in EF conceptualization and measurement also continues.

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Introduction

For years, researchers have tried to identify the predictors of childhood behavioral problems and psychological disorders. In theory, if predictors can be accurately identified, psychologists and other mental health professionals might be able to prevent problems from arising or, at the very least, to intervene in a targeted and specific way. Many predictors have been identified for juvenile delinquency—which itself is a legal classification—including, but not limited to: decreased verbal abilities, low SES, and early childhood abuse or neglect. Some juvenile delinquents also demonstrate neurocognitive deficits in executive functioning (EF). In the past, researchers have been unable to identify the direct link between EF performance and delinquency. Given that decreased EF performance is often associated with psychological disorders such as Oppositional Defiant Disorder (ODD), Attention-Deficit/Hyperactivity Disorder (ADHD), and Post-Traumatic Stress Disorder (PTSD); functional difficulties in academic achievement; regulating emotions; and interpersonal problems, it is likely that indirect variables also contribute to the relationship between EF and juvenile offending. Researchers have speculated that the intermediary variables may be social maturity, ability to read social cues, impulsivity, or the presence of symptoms associated with ADHD. The purpose of this study is to examine another possible explanation for the relationship between EF and delinquency: early trauma exposure impairs the appropriate development of EF abilities and creates a subgroup of criminal offenders with EF impairment.

Executive Functions

EF is a multifaceted construct conceptualized as the cognitive processes that underlie, organize, and execute goal-directed or problem-solving behavior. Mediated by the prefrontal cortex (PFC) and associated interconnections, EF is instrumental in orchestrating activity across the brain that directs the identification of a goal, as well as the means to strategize and effectively accomplish the goal. Proper EF requires the ability to use cognitive processes such as memory, attention, reasoning, problem solving, and ultimately results in the self-regulation of emotions and behaviors. In sum, EF encompasses the processes and skills necessary for adaptive functioning in everyday life (Bergeron & Valliant, 2001; Best & Miller, 2010; Garcia-Barrera, Kamphaus, & Bandalos, 2011).

Components of executive functioning. Given its broad application to adaptive functioning, the construct of EF covers a wide array of different components and abilities. These varying cognitive components associated with EF are most easily understood via behavioral description. Note that researchers do not agree on a single conceptual model of EF and vary both the number and label of functional components. Thus, only a limited number of theories will be highlighted here. Garcia-Barrera and colleagues (2011) propose that the components of EF include problem solving, updating Working Memory (WM), attentional control, behavioral control, and emotional control. To aid conceptualization, basic behavioral descriptions of each component are as follows: (a) problem solving is the planning, decision making, and organizing of information in order to achieve a goal; (b) updating WM is defined as the ability to process and manipulate information in accordance with task demands; (c) attentional control is conceptualized as the ability to focus, sustain, and shift concentration and awareness at will; (d) behavioral control is the self-regulation of behavior, including inhibition or impulse control; and (e) emotional control, the ability to self-regulate affect in response to internal and external environmental cues (Garcia-Barrera et al., 2011).

Similarly, Roberts and Pennington (1996) propose that WM and inhibition are the central components of EF. Their definition of WM is similar to that which is described above. Inhibition is conceptualized as the suppression of behaviors that are irrelevant to the task-at-hand and protect the self from interference. To these components, the theory proposed by Miyake et al. (2000) would also add the component of shifting. Cognitive flexibility/set-shifting is defined as the ability to adapt or modify current strategies according to changing task demands.

As aforementioned, models describing the components of EF commonly include problem solving, updating WM, self-regulation (i.e., attentional/behavioral/emotional control), inhibition, and cognitive flexibility/set-shifting. Other notable EF theorists, including Barkley (1997a; 1997b), also include components such as internalized speech, reconstitution, decision-making, planning, organization, performance monitoring, verbal fluency, or goal establishment (Dick & Overton, 2010; McCaffrey, Lynch, & Westervelt, 2011).

Components measured in popular EF batteries. When attempting to describe and measure the components of EF, many of the concepts overlap, making it difficult to pin down just how many pure components of EF exist. Given this construct impurity, researchers and psychometricians turn to factor analysis to help determine which components are being assessed in popular EF batteries. Several popular EF batteries apply a three-factor model with high intercorrelations between components.

Behavior Rating Inventory of Executive Functioning (BRIEF; Gioia, Isquith, Guy, & Kenworthy, 2000). Parent-derived behavioral ratings of children aged 5-18 years old with various clinical diagnoses were used to analyze four competing models of the factor structure of the BRIEF. Confirmatory Factor Analysis (CFA) revealed that the best fit for the data was a three-factor model: Behavioral Regulation, Emotional Regulation, and Metacognition. All three factors were significantly correlated with each other in the moderate to strong range. The authors suggest that the high degree of intercorrelation demonstrates the unitary, but also fractional nature of the EF construct (Gioia, Isquith, Retzlaff, & Epsy, 2002).

Delis-Kaplan Executive Function System (D-KEFS; Delis, Kaplan, & Kramer, 2001). The D-KEFS is an EF test battery designed for children and adults, ages 8 to 89. The D-KEFS is purported to tap into constructs of cognitive-flexibility/set-shifting, inhibition, response generation, concept formation, categorization and effective use of feedback, deductive reasoning, integration of information into current memory systems, planning, and rule learning (Strauss, Sherman, & Spreen, 2006). To assess these theoretical components, in a study of normal children and adults, Latzman and Markon (2010) determined that the D-KEFS tasks are best conceptualized under a three-factor model which aligns with the Miyake et al. (2000) theory of EF: Conceptual Flexibility, Monitoring, and Inhibition. The Conceptual Flexibility and Inhibition latent variables are consistent with previous descriptions of the EF components. Monitoring is likened to Updating WM and is defined by the authors as the active process of evaluating new information with respect to the current task and including the new information into the individual's WM as needed (Latzman & Markon, 2010).

However, the results from factor analytic studies can be misleading. Assessing and analyzing the underlying components of EF may be a misrepresentation of the construct because conducting a factor analysis suggests that there are indeed distinct, separable components when, in reality, current measures of EF are plagued with task impurity (Dick & Overton, 2010). Indeed, EF is complex. Involving the orchestration of many cognitive processes, the very construct of EF implies interconnections within the brain's networks. Therefore, there may be many components of EF, not all of which are addressed in assessment batteries (For more thorough reviews see: Brocki & Bohlin, 2004; Miyake et al., 2000; Roberts & Pennington, 1996; Sergeant et al., 2002; Strauss et al., 2006).

Overall, despite assessment and methodological shortcomings, EF has been the focus of many studies and has been linked to many behavioral problems and psychological disorders throughout the lifespan (Pennington & Ozonoff, 1996; Willcutt, Doyle, Nigg, Faraone, & Pennington, 2005). Therefore, while researchers may not agree upon the components or how to best assess for EF, it is important to understand how EF develops and what happens when things go awry.

Development of executive functioning. Behavioral and neuroimaging research support the notion that foundational EFs develop during the preschool years, with many children exhibiting intact inhibition, WM, and set shifting prior to the age of 5. In their developmental review of EF, Best and Miller (2010) describe that preschool children make significant gains in these foundational EFs, with modest improvements made on more advanced and complex tasks (e.g., planning) as they age. In addition to performance-based growth, experimenters have also measured brain activity. When children and adolescents complete EF tasks in fMRI studies, the results typically reveal activity in the PFC at a young age. Older children (ages 9 to 11) demonstrated more localized, specific activation patterns according to task demands, which suggests that pre-teens exhibit less brain activation in regions of the PFC that are uncorrelated with requisite task performance. Therefore, after initially acquiring executive functioning abilities during childhood, adolescents exhibit increased efficiency in their neurocognitive abilities. Similarly, Diffusion Tensor Imaging (DTI) studies, which measure inter-neuronal connectivity, demonstrate increased myelination from other brain regions to the PFC with age. Increased myelination to the PFC indicate an increased efficiency of skills through adolescence and adulthood, suggesting that the related skills are likely used more frequently and with greater ease than during childhood (Best & Miller, 2010).

However, it should be noted that while neuroimaging studies reveal more specific and efficient neural activity with age, few gains in EF performance are observed. For example, when measuring inhibition via the Status task or Knock and Tap game, children show improved performance from ages 3 to 6 with no further significant improvements through age 12. In contrast, computerized tasks such as the Go-No Go task and the Continuous Performance Test (CPT) continue to show some improvement after age 8. Age related differences are confounded with task impurity and methodological errors such that one test may not measure a specific executive component, but rather a host of interrelated abilities. Additionally, methods of test administration may be more familiar to a certain subset of children and, thus, give them a performance advantage. For example, older children may be more familiar than young children with computer applications and would then benefit from gains in comfort and efficiency with a computerized test administration over paper-and-pencil formats (Best & Miller, 2010).

For tests of WM, researchers use tasks that require maintenance and manipulation of information in order to tap into "executive control," but this often requires inhibition and, sometimes, set-shifting as well. However, preschoolers demonstrate mastery over simple WM tasks including a one-back nonverbal facial recognition task. On more complex WM tasks requiring greater executive control, performance continues to improve with age until approximately 15 years. Finally, on tasks of set-shifting, preschool children between the ages of 3 and 4 can successfully shift between two rules. Yet, as with WM, while task demands increased, improvements were seen through adolescence and into young adulthood (Best & Miller, 2010).

Thus, children experience rapid development executive functioning abilities and other cognitive skills during preschool and early primary school years. Experts believe that between the ages of 3 and 7, children gain the ability to exercise mastery and control over their emotions and behavior. At this time, children begin to demonstrate advances in mental representation, mental flexibility, the ability to distinguish complex categories, and to take others' perspective (Grabell & Knight, 2009; Zelazo, Muller, Frye, & Marcovitch, 2003).

However, while the emergence of EF skills appears to be during early childhood, research also demonstrates that EFs are modified or improved to some degree until they reach maturity in adolescence. The process of EF and PFC maturation is in accordance with the way the brain develops globally. The CNS develops through a series of progressive steps and interrelated processes such that "the nervous system continues to remodel and change throughout the entire period of development in response to environmental influences and genetically programmed events" (Mendola, Selevan, Gutter, & Rice, 2002, p. 189).

The interdependent and continuous nature of brain development is critical to the understanding of EF such that interruptions to the early development of EF may prohibit or delay later maturation and successful skill acquisition. Insult or injury to the frontal cortex and crucial interconnections in early childhood may prevent the processes required for subsequently developing increased efficiency and more advanced problem solving abilities. Furthermore, while the frontal lobe and PFC are crucial to EF, the complex nature of EF-associated cognitive processes lends itself to interconnections with many other areas of the brain. Considering that the interconnections of the brain develop and strengthen with age, it is reasonable to assume that areas of the brain associated with EF may also suffer and fail to fully develop following an early insult or injury (Best & Miller, 2010).

Many diverse cognitive skills and their associated neuroanatomical regions must function together in order to produce the higher-order abstract thinking dictated by EF, including but not limited to abilities such as perception, language, memory, planning, and concept formation (Delis et al., 2001). Thus, executive dysfunction (ED) may influence a broad range of abilities and domains across development. EF deficits can influence such abilities as negotiating interpersonal relationships (Ozonoff, 2001), succeeding in academic tasks, inhibiting inappropriate thoughts or behaviors, and effectively managing one's emotions. ED may also contribute to the etiology of certain psychological disorders, or at least, may increase an individual's risk for developing disorders such as ADHD, Autism Spectrum Disorder (ASD), or PTSD (DePrince, Weinzierl, & Combs, 2009).

Beyond the increased risk for developing impairment and/or a psychological disorder, the complexity and multiplicities of EF are important to note because dysfunction may be the result of a breakdown at any point in the system throughout the course of development, which renders mild and/or specific impairments difficult to identify (Delis et al., 2001). Researchers have already identified a number of factors that predict neurodevelopmental and EF deficits, including: low socioeconomic status (SES), malnutrition, maternal substance use, neurotoxin exposure (e.g., methylmercury), maltreatment (physical, sexual, and/or emotional), and traumatic brain injury (TBI; Mendola et al., 2002; Sattler, 2008). However, because the exact process that disrupts the appropriate formation of EF is unknown, any number of other predictors may also exist.

Neuropsychological Deficits and Delinquency

In addition to clinical populations such as individuals with an ASD or ADHD, violent adult offenders have also reliably demonstrated neuropsychological deficits. Preliminary studies on neuropsychological functioning in offending populations indicated that death row inmates and homicidal offenders exhibit significant neurological deficits, along with hyperactivity, attention difficulties, and aggressive emotionality, when compared to non-offending peers (Lewis, Pincus, Bard, & Richardson, 1986; Santilla & Haapasalo, 1997; Veneziano, Veneziano, LeGrand, & Richards, 2004). In addition, more neuropsychological impairment is observed among individuals who have committed violent and non-violent sex offenses, as compared to non-sex offenders. Brain imaging studies corroborate these findings and demonstrate frontal lobe dysfunction among violent offenders and temporal lobe dysfunction among sex offenders (Pallone & Voelbel, 1998; Veneziano et al., 2004).

Beyond pure ED, many adult and adolescent offenders also demonstrate broad cognitive impairment, with particular difficulties on measures of verbal intelligence (Kelly, Richardson, Hunter, & Knapp, 2002). Experts hypothesize that pre-existing deficits in verbal intelligence, social skills, or other domains may be exacerbated by poor EF abilities. Neuropsychological deficits may further restrict social problem solving skills, inhibit effective processing of relevant environmental stimuli, or may limit internalized self-speech such that decision making skills are impaired and the immediate reward outweighs the potential long-term goal consequences (Bergeron & Valliant, 2001; Kelly et al., 2002).

However, while ED seems conceptually well evident, and despite the cognitive and neuropsychological deficits observed among adult offenders, research regarding the neuropsychological functioning of adolescents is inconclusive and results may be dependent on the types of measures used, as well as which intervening variables are accounted for or what subset of the delinquent population is being assessed. For instance, distinctions in EF performance can be made among lifecourse-persistent delinquents and adolescent-limited delinquents such that the former group demonstrates more EF deficits, including more impulsive temperaments and decreased cognitive abilities, especially in the verbal domain (Donnellan, Ge, & Wenk, 2000; Kennedy, Burnett, & Edmonds, 2011).

While compelling, when considered in tandem with other literature that seeks to examine the relationship between EF and delinquency, the results are hardly conclusive for any subset of adolescent offenders. Several early studies indicated that approximately one-third of juvenile delinquents demonstrate ED when tested using a battery of measures such as the Wisconsin Card Sorting Task (WCST), Porteus Mazes, Trails B, and Controlled Oral Word Association Test (COWAT) (Skoff & Libon, 1987). In contrast, other early studies failed to differentiate between delinquent and non-delinquent groups when analyzing EF performance on the same types of tasks (Appellof & Augustine, 1985).

More recently, Bergeron and Valliant (2001) conducted a study using similar EF measures as in the aforementioned seminal studies. Analyzing the neurocognitive delays and personality characteristics of adolescent and adult offenders, the researchers found that both offenders and their non-offending peers demonstrated ED on some measures of EF, but no deficits on other EF measures. In particular, offenders exhibited significantly poorer performance on the Qualitative Score of the Porteus Maze Test, which allegedly taps into the EF components of planning and foresight. They also performed more poorly than non-offending peers on the Conceptual Level score of the Paragraph Completion Method (PCM) which infers the individual’s abstract reasoning abilities, thinking style, and social competence. However, offenders and non-offenders performed similarly on the WCST, a popular EF measure of abstract reasoning and cognitive flexibility (Bergeron & Valliant, 2001).

Bergeron and Valliant (2001) purported that the unstable EF performance among offenders was due to the primary brain region associated with each task (i.e., orbitofrontal-ventromedial vs. dorsolateral prefrontal). Additionally, they reported that the Porteus Maze and PCM tasks demonstrate task impurity within and outside the EF construct, and the authors suggest their battery, and the PCM in particular, may tap into measures of social judgment rather than pure neuropsychological evaluation. Thus, the inconsistencies in the EF scores for offenders are reflective of conceptual and methodological shortcomings rather than pure neurocognitive abilities, leading to few conclusions about ED among offending populations (Bergeron & Valliant, 2001).

Moffitt (1990) suggests that inconsistencies in EF performance among delinquents might be due to individual histories with ADHD. In support of this claim, one study demonstrated that delinquents with ADHD have more executive dysfunction than peers without a past history of ADHD symptomatology (Moffitt, 1990; Moffitt & Henry, 1989). Additionally, nearly 46% of juvenile delinquents are estimated to have problems with attention (O'Brien, Langhinrichsen-Rohling, & Shelley-Tremblay, 2007), which is much higher than the national average of 6 to 8% (Weis, 2008).

Conversely, in a study examining the relationship between aggression, executive functioning, and ADHD, Seguin and colleagues (1999) found that boys with a history of physical aggression demonstrated reliable ED in WM, even after controlling for an ADHD diagnosis. Thus, it is likely that the relationship between juvenile delinquency and EF cannot be explained completely by the presence of ADHD symptoms, especially for perpetrators of violent and aggressive crimes.

To examine whether there is something unique about individuals who commit particular types of crimes, researchers have attempted to discriminate between juvenile sex offenders

(JSOs) and non-sex offenders (NJSOs). Veneziano and colleagues (2004) compared the EF performance of JSOs and NJSOs, as measured by the WCST, COWAT, Tower of London, and Trail Making Parts A and B. Comparisons between the groups yielded mixed results, depending on the task and domain measured. Generally, on most measures of EF in their study, there was no statistically significant difference between the offender groups. However, NJSOs did demonstrate significantly better performance on the Part B of the Trail Making Test than their sex-offending peers, indicating more advanced cognitive set-shifting skills. The authors suggest that the improved cognitive flexibility demonstrated by the NJSOs may represent a better developed ability to identify stimuli within their environment and to use these cues more effectively when deciding a course of action (Veneziano et al., 2004). It seems imperative to investigate this claim more systematically and directly.

Furthermore, select individuals from both groups (i.e., JSOs and NJSOs) showed impairment on some EF tests, but not others. Both sets of boys demonstrated lower than average performance on the Tower of London task. Adolescent offenders required more Total Moves and had a lower Total Initiation Time than is typical, which suggests that offending youths take less time to think or plan before engaging in a behavior relative to their non-offending peers (Veneziano et al., 2004). Alternatively, engaging in less planning prior to task initiation may be reflective of increased levels of impulsivity or decreased motivation for successful task completion.

A lack of significant difference between JSOs and NJSOs on EF performance measures is contrary to the research conducted with adult offenders. However, Veneziano and colleagues (2004) reportedly used a sample of non-violent sex offenders. It is possible that decreased EF performance is associated with violent crimes, rather than the type of offense (sex vs. non-sex).

Alternatively, it is possible that precipitant stressors or early environmental variables, such as a history of trauma exposure, contribute more to the development of adverse outcomes and executive dysfunction than does the severity or type of offense (Farris, 2007; Mendola et al., 2002; Veneziano et al., 2004).

Overall, researchers are still unsure as to whether juvenile delinquents as a whole demonstrate neuropsychological deficits. In addition to the potential explanations described above, discrepancies between the juvenile and adult offender literature may also be due to differences in the type of task being assessed or age-related task invariance. Finally, variations in the relationship between EF and offending among juveniles and adults may be the result of natural heterogeneity and behavioral inconsistencies during adolescence. Fluctuations in behavior and thought patterns may occur because adolescence is often characterized by increased disinhibition and experimentation with different social roles, all of which may contribute to the occurrence of criminal offenses. Thus, it is reasonable to conclude that adolescents' performance on any psychological measure may be inconsistent. Variability in EF performance may be particularly common among adolescent offenders but not in adults, given that the brain is still developing and changing during this time period.

Neuropsychological Deficits and Psychopathology among Individuals Exposed to Trauma

Several other populations demonstrate poor cognitive and executive functioning performance, including individuals with a history of trauma exposure. Childhood exposure to trauma, such as physical, emotional, or sexual maltreatment, is associated with a number of undesirable outcomes, including neuropsychological deficits, subsequent psychopathology (i.e., depression, anxiety, PTSD), and decreased academic achievement (van der Kolk, 2003). In particular, children who experience traumatic maltreatment early in life are more likely than children who did not, to develop depression, PTSD, delinquency, aggressive tendencies, substance abuse disorders, and hypersexualized behaviors, among other maladaptive outcomes (Grabell & Knight, 2009). Children exposed to trauma may also be at risk for developing low self-esteem, suicidal ideation, guilt, and be at increased vulnerability for future victimization (Kendall-Tackett, Williams, & Finkelhor, 1993; Walker, Carey, Mohr, Stein, & Seedat, 2004).

The negative effects of trauma are also long term. Adult women who experienced either child physical or sexual maltreatment before age 17 continued to demonstrate elevations on measures of internalizing symptomatology, including depression and anxiety, as compared to individuals with no history of abuse (Wind & Silvern, 1992). Throughout their lifetime, trauma survivors of both sexes experience increased rates of mood disturbance, anxiety, disordered personality, maladaptive eating and substance use, ADHD, and oppositional defiant behavior (Walker et al., 2004).

Not surprisingly, one of the most common disorders to develop after a traumatic experience is PTSD. Research examining the neuropsychological functioning of adults with PTSD has demonstrated decreased cognitive/executive functioning such as concentration, learning, and WM. Poor EF performance among this population results in decreased reasoning and decision-making abilities, as well as poorer impulse and emotional control (Walter, Palmieri, & Gunstad, 2010). Research surrounding the neuropsychological performance of children with PTSD is less developed, but is critical to understand given the developmental consequences of neuropsychological deficits described above.

In a study of 14 children, Beers and De Bellis (2002) found that children with maltreatment-related PTSD performed more poorly in multiple cognitive domains, including learning and memory, visual-spatial functioning, problem solving, and attention, when compared to children who had not been maltreated. After Bonferroni correction, children with PTSD exhibited significant decreased performance in the areas of attention and abstract reasoning/executive functioning. Deficits in attention and EF are consistent with the theory that trauma in early childhood interrupts neuroanatomical development and processing, with particular detriment to the frontal lobe and its associated networks (Beers & De Bellis, 2002). However, due to their methodology, Beers and De Bellis (2002) were unable to compare the EF performance of children with maltreatment related PTSD to children who were exposed to trauma, but did not subsequently develop PTSD. Instead, the authors used a comparison group of non-trauma exposed children and were, thus, unable to disentangle the neuropsychological effects of trauma exposure from PTSD symptomatology.

Beers and De Bellis (2002) did report, though, that EF performance bared no relation to the type or severity of PTSD in children. Similarly, in a later study, Samuelson, Krueger, Burnett, and Wilson (2010) compared the EF performance of children with maltreatment-related PTSD (PTSD+) to children who had experienced a trauma, but did not show signs of PTSD (PTSD-). All children in the sample witnessed intimate partner violence at a young age. Both groups demonstrated below average performance on tasks measuring EF (e.g., WCST, COWAT, Trail Making B), attention (e.g., Stroop Color & Word Test), and intellectual ability (e.g., selected subtests from the WISC-III). Neither PTSD+ nor PTSD- children demonstrated WM deficits. A lack of WM impairment is contradictory to the adult literature, which indicates poor WM performance and decreased hippocampal volume among adults with PTSD, but is consistent with other studies of childhood PTSD (Beers & De Bellis, 2002; Samuelson et al., 2010). Overall, the relationship between trauma and EF in children appears to be mediated by the trauma experience itself, not PTSD symptomatology. Thus, PTSD symptomatology is not a focus in the present study except as a means of identifying a class of individuals with significant trauma history.

Salient trauma characteristics. Regarding trauma generally, DePrince, Weinzierl, and Combs (2009) examined EF among a community sample of trauma-exposed children. EF performance was measured as a composite variable, averaging performance on tasks of WM, inhibition, interference control, and processing speed. Children who experienced at least one familial trauma (i.e., sexual abuse, physical abuse, witnessing domestic violence) displayed poorer EF performance overall than children exposed to non-familial trauma (i.e., motor vehicle accident, natural disaster), suggesting that all trauma exposure is likely not equal.

In fact, the adverse outcomes of child abuse are mediated in part by the type, frequency, and severity of trauma (Kendall-Tackett et al., 1993; van der Kolk, 2003). As aforementioned, familial trauma, in particular, places children at an increased risk for EF-related difficulties. The heightened severity associated with familial-type trauma is particularly important given that authorities estimate that nearly 80% of all child abuse is committed by a child's parent, while another 10% is perpetrated by a close relative (van der Kolk, 2003). Additionally, DePrince et al. (2002) showed that the reported number of familial-trauma incidents contributed unique variance in the prediction of EF composite scores whereas the number of non-familial trauma incidents failed to predict EF performance. The unique predictive ability of the number of reported familial trauma incidents indicates that the frequency of severe trauma experiences may be an important factor in determining the prognosis of trauma-related difficulties and may help guide treatment decisions.

Trauma during sensitive periods of development. Adverse outcomes later in life are also predicted by the age at which the child was first traumatized. Grabell and Knight (2009) found that the occurrence of sexual abuse during specific developmental epochs predicted maladaptive, impulsive behaviors such as hypersexuality. However, the only epoch that served as a significant independent predictor was abuse onset between 3 to 7 years of age. The lack of significant findings for other developmental periods is particularly interesting given that sexual abuse occurring after age 11 was rated the highest in both frequency and intensity but still failed to predict sexual fantasy and psychopathology. Grabell and Knight (2009) suggest that interruptions in the development of the brain and executive processes during ages 3 to 7 may explain the poor inhibitory and impulsive nature of many juvenile sex offenders (JSOs), ultimately causing them to act more readily on their sexual fantasies.

One theory as to why the age of traumatic onset is so salient is because trauma may interrupt and delay the development of crucial cognitive and neuropsychological skills. Van der Kolk (2003) explains that trauma is believed to impact: (a) the development and full maturation of specific brain structures at particular ages, (b) the physiologic and neuroendocrine responses, and (c) the capacity to coordinate and regulate cognition, emotion, and behavior. Furthermore, as described earlier, different areas and skills of the brain develop at different rates. Given the advancements in frontal cortex functioning that occur during ages 3 to 7, children may be particularly sensitive to trauma and abuse during this period (Grabell & Knight, 2009).

Additionally, early theories on stage-specific victimization take a more Piagetian or Freudian approach, implying that trauma during a given developmental period may lead to fixation or an inability to master stage-specific tasks (Finkelhor, 1995). For example, self-regulation skills—including the ability to manage attention, affect, and arousal, such as in the behavioral and emotional regulation components of EF—have been identified as a critical task of infancy and childhood. Children exposed to maltreatment at an early age have demonstrated disruptions in self-regulatory behaviors including aggressive or disruptive tendencies, and emotional disturbance such as fear. According to teacher report, maltreated children are also less proficient in peer interactions than non-maltreated peers, a factor that may be important to future development of delinquent or other non-prosocial behaviors (Alessandri, 1991; Farris, 2007).

Ultimately, understanding the developmental neurobiology of trauma and abuse may help to explain why and how trauma exposure leads to adverse outcomes. More importantly, understanding the neurobiology of trauma may help identify protective and intervening variables that help to decrease the negative impact of trauma. Intervention will be especially effective if provided quickly and early in order to help negate any long-term neurobiological changes and reroute the brain's developmental course.

Trauma History among Juvenile Delinquents

In addition to the adverse outcomes of childhood trauma listed above, many juvenile delinquents report a history of childhood maltreatment. Experts estimate that approximately 26% of children who are maltreated before age 11 are later arrested as juveniles and approximately 29% of maltreated children are arrested as adults. Comparatively, individuals who were not maltreated as children were arrested at rates of 16% and 21%, respectively (Burkhart & Cook, 2010). Furthermore, in one study of 83 detained boys aged 12 to 17, as many as 95% of delinquent boys had experienced a prior trauma, with 20% meeting criteria for full or partial PTSD (Becker & Kerig, 2011).

When considering sex offenders in particular, children who are sexually abused are 4.7 times more likely to be arrested for a sex crime as adults. Additionally, JSOs self-report alarming rates of child maltreatment, including histories of physical and sexual abuse. Estimates of prior sexual victimization among JSOs reach as high as 79.4% (Burkhart & Cook, 2010).

Thus, with histories full of maltreatment, there is no ignoring the possibility that for some individuals, early traumatic experiences contribute to later delinquent behavior and thus should be evaluated when assessing and treating juvenile offending. Unfortunately, in light of the complex etiology of offending, the nature of the relationship between trauma and delinquency remains unclear.

Trauma as a Predictor of Neuropsychological Deficits and Offender Characteristics: The Present Study

Given the overlapping relationship between EF and both trauma and delinquency, neuropsychological deficits may play a mediating role and predict which subset of individuals who experience an early trauma later commit offenses consistent with juvenile delinquency status. It is possible that trauma during sensitive periods interrupts the development of the brain by impacting changes in neuroanatomical structures, neuroendocrine functioning, or neuropsychological control. Such changes may contribute to ED including impoverished abilities to regulate behavior and emotions. In turn, EDs may lead to behavioral outcomes such as poor academic performance, social skills deficits, impulsivity, hypersexuality, and delinquency. Thus, the primary question of this study is: could EF performance intersect the relationship between trauma and delinquency? In particular, a history of traumatic experience(s) during a sensitive period of development may explain which juvenile offenders develop ED and which do not.

Past studies that have evaluated the relationship between trauma and delinquency have not included measures of neuropsychological functioning that directly evaluate the executive and inhibitory control among JO/JSOs (Grabell & Knight, 2009). Using the data derived from the D-KEFS (Delis et al., 2001) and key variables from the ABSOP/DYS Mt. Meigs database, we can identify whether trauma experiences during early childhood are associated with true EF deficits.

We can also explore whether or not EF deficits are found across all juvenile delinquents, or whether there is a unique pattern of neuropsychological and cognitive skills among juvenile sex offenders. Admittedly, adolescent self-report of trauma with no external corroboration of abuse raises methodological concerns, but interesting findings may still arise and lead us to a better understanding of the complex etiology of executive functioning deficits, psychopathology, and juvenile delinquency. Findings may also guide future endeavors and indicate the use of more rigorous research methodology.

Ultimately, it is important for researchers and clinicians to better understand the etiology and maintenance of offending such that we may improve the efficacy and efficiency of treatment strategies to ensure positive outcomes and decrease recidivism. In particular, identifying which offenders have neuropsychological deficits is critical in that treatment of inattention, affective dysregulation, problem solving, or other EDs may serve as a crucial first line of defense that assists the individual throughout treatment.

To examine the indirect relationship between trauma and juvenile delinquency, we will use structural equation modeling (SEM) to estimate the paths between trauma, EF variables, and delinquency. We predict that neuropsychological deficits will provide a causal explanation for the relationship between trauma and delinquency, serving as a significant partial mediator. EF will be examined using the juveniles' scores on the D-KEFS, which will be organized into three latent variables (Conceptual Flexibility, Inhibition, and Monitoring) in accordance with the CFA conducted by Latzman and Markon (2010).

The experience of trauma will be delineated to mark the type, onset, and frequency of trauma as well as to indicate whether the perpetrator was related to the individual or not. We believe the most salient predictive indicator will be the age of traumatic onset, such that adolescents who first experienced trauma during infancy and preschool/early childhood will demonstrate poorer outcomes than those who first experienced trauma later in life. Analyses will be conducted on several models that highlight specific trauma characteristics in order to determine which aspects of traumatic experiences map most closely onto EF deficits and subsequent delinquency. Trauma characteristics to be evaluated include age of first traumatic experience, duration of trauma, frequency of trauma, type of trauma, and relationship of the perpetrator to the victim. Each characteristic will be examined as its own unique model in order to fully consider the significant direct or indirect pathways to delinquency. Models will be evaluated using the following fit indices: Chi-square, covariance residuals, Root Mean Square Error Approximation (RMSEA), Comparative Fit Index (CFI), and Tucker-Lewis Index (TLI). Iterative modifications to the models will be made explicit if indicated and theoretically appropriate. The model evaluated as the best will represent the characteristics of trauma that map onto EF deficits and will also indicate the most salient etiological pathway.

Additionally, exploratory analyses will also be conducted on the relationship between additional trauma variables and more specific D-KEFS variables. Characteristics of delinquency will also be measured explicitly. We plan to examine the relationship between EF and different offense types and severities. We predict that both sexual and non-sexual offenders will demonstrate executive functioning deficits given their previous trauma histories. Additionally, those individuals who were sentenced for more serious offenses (i.e., violent crimes, repeat offenders) will demonstrate more deficits than those who committed less intense crimes.

Hypotheses

The models under investigation include a complement of trauma characteristics, behavioral measures of executive functioning, and delinquency characteristics. The overall models were derived in accordance with a chronological and theoretical basis. For subcomponents of the model and indirect pathways of particular interest, see model depictions in Figures 1.1 through 1.5. While numerous relationships are likely among the psychosocial variables within the model, in this study the hypotheses of interest include:

1) The adolescents' previous trauma histories were expected to influence delinquency status by way of executive functioning deficits, with Inhibition as a particularly salient predictor of delinquent characteristics.
2) Adolescents who committed sexual offenses will demonstrate more EF deficits relative to their non-sexually offending delinquent peers.
3) The age of traumatic onset is predicted to map more closely onto EF deficits and thus will represent the best fitting model when compared to the duration and frequency of trauma. In particular, adolescents who first experienced trauma during preschool/early childhood will demonstrate the most impairment. Extended frequency or duration of trauma will also result in more relative impairment than individuals who experienced a limited exposure.
4) Adolescents who experienced sexual trauma in childhood will demonstrate the most impairment compared to adolescents who experienced physical abuse, neglect, or other trauma.

Method

Site of Study

The current study was part of a larger research program conducted at the Mt. Meigs Complex, a residential facility for adjudicated juveniles operated by the Alabama Department of Youth Services (DYS). In order to be placed at Mt. Meigs, adolescents either pled guilty or were found to be guilty by a juvenile court judge. Mt. Meigs is also the DYS site designated for the treatment of all adolescents in the state of Alabama adjudicated for a sexual offense. In collaboration will several local universities, the Accountability Based Juvenile Sexual Offender Program (ABSOP) was developed to provide assessment and treatment services to the youths. Incarcerated juveniles range in age from 12 to 21 years, with the majority of boys ranging from age 14 to 18.

Participants

Participants in this study were 188 adjudicated delinquent male juveniles, aged 10 years, 8 months to 19 years, 2 months, who were convicted of various offenses. Adolescents included in this study were admitted into the facility during the period of time ranging from February 2005 to January 2008. Per self-report, juveniles were 51.1% Caucasian, 45.7% African American, 0.5% Hispanic, 2.1% Biracial, and 0.5% other. Participants were categorized into two groups, based on their offense type: 127 boys (68%) were adjudicated on a sexual offense and mandated to participate in sex offender specific treatment; sixty-one boys (32%) were adjudicated on non-sexual offenses and receiving treatment for anger management, substance abuse, impulse control training, and/or other psychological issues. For 49.8% of the juveniles, the incarceration at time of interview was their first commitment, and for 35.9% of those incarcerated, this was their first arrest.

Additionally, 42.3% of the boys received special education services. Estimates of Full Scale IQ were measured by the Wechsler Abbreviated Scale of Intelligence (WASI; Wechsler, 1999). The juveniles performed within a range of 53 to 125, with a mean score of 87.13 (SD = 13.6) and 50% of the boys scoring between 77.5 and 98.

Many participants also reported a history of abuse: 35.4% reported being the victim of sexual abuse, 26.5% reported being the victim of physical abuse, and 21.7% reported being the victim of neglect. Besides victimization, 12.2% of the boys reported witnessing a violent crime, 4.8% reported living through a natural disaster, and 4.2% reported surviving a serious accident (e.g., auto, fire). Experiencing such traumatic events may have been in addition direct sexual abuse, physical abuse, or neglect.

Measures

Clinical interview. Prior to entry into the treatment program, each adjudicated delinquent completed a semi-structured pre-treatment clinical interview, which takes approximately 2 to 3 hours to complete. The interview was created for on-going research at the site and was designed in accordance with the empirical literature regarding juvenile sex offender assessment and treatment. Information assessed in the interview results in 200 coded variables. Information gathered during the interview includes, but is not limited to historical data regarding the adolescents: demographics, early development, family, physical/mental health, relationships/social functioning, history of abuse/trauma, and sexual history. For a list of relevant variables utilized in analyses for this study, see Appendix.

Delis-Kaplan Executive Function System (D-KEFS). The D-KEFS (Delis et al., 2001) is a neuropsychological battery consisting of nine tests that cover a spectrum of verbal and nonverbal tasks and are appropriate for use with individuals aged eight to 89 years. Designed to measure higher level cognitive functioning and components of executive functioning, the D-KEFS taps into various domains such as inhibition, problem solving, cognitive flexibility, planning, impulse control, and abstract thinking. Tests are designed to assess skills in a game-like fashion by using a cognitive process approach such that both fundamental cognitive skills and higher-level cognitive functions are represented in each task. Additionally, there is no single score to represent overall EF because EF is multifarious in nature and multiple cognitive abilities (i.e., both fundamental and higher-level) are necessary for successful performance (Delis et al., 2001). Each subtest score is normed to a mean of 10 and standard deviation of 3. In this study, the following subtests were administered: Trail Making Test, Verbal Fluency Test, Color-Word Interference Test, Sorting Test, Word Context Test, and Tower Test. However, not all subtests were used in analyses. Subtests were selected for inclusion in a manner consistent with the factor structure model suggested by Latzman and Markon (2010) and appropriate for use among 8 to 19 year olds. Refer to Table 1 for a list of which subtests' primary measure scores were included for data analysis. Test-retest reliability coefficients vary across tests, ranging from low to high (see Table 1), but suggest that the skills assessed by most D-KEFS tasks are consistent over time. Additionally, convergent and discriminant validity also vary appropriately across subtests (Delis et al., 2001).

The Trail Making Test (TMT) is a visual cancellation task in which examinees complete a series of increasingly complex connect-the-circles tasks. TMT requires underlying component skills such as visual scanning, number and letter sequencing, and motor speed. In addition, the subtest included in the current analyses assesses for the higher-order EF task of flexibility of thinking (set shifting) with the Number-Letter Switching condition.

The Color Word Interference Test (CWI) assesses an individual's ability to inhibit an automatic, over-learned verbal response in order to generate a novel, conflicting response. Four conditions are presented: name colors on a page (Color Naming); read the printed name of a color (Word Reading); name the color of ink of the printed word, which is dissonant with the written color word (Inhibition); and switch back and forth from responding in a manner consistent with the ink name or the written word depending on the present governing rule (Inhibition/Switching). The latter two tasks were used in the current analyses to emphasize the primary executive functions of inhibition and cognitive flexibility measured by the Stroop procedure.

The Verbal Fluency (VF) subtest is a timed subtest that examines the ability to generate verbal responses in accordance with specified rules. Three conditions are presented: Letter Fluency and Category Fluency both assess for vocabulary, attention, semantic organization, initiation, and processing speed; Switching assess the individual's ability to contact the semantic network and rapidly retrieve information from memory, as well as to demonstrate cognitive flexibility while accurately alternating between rule-sets. All three conditions were used in the current analyses to tap into lexical and semantic fluency, and the ability to simultaneously shift between over-learned concepts.

Finally, the Sorting Test is akin to the WCST and assesses an individual's problem-solving abilities as they seek to identify novel groupings of stimuli. Stimuli can be organized according to verbal information or visual-spatial features. This subtest includes two conditions that require the participant to generate the groups and then to identify the categorical feature depicted in groups created by the examiner. Examinees are asked to describe the sorts, providing the examiner with an understanding into their conceptual-reasoning skills. According to Delis et al. (2001), the Sorting Test taps into the individual's problem-solving, abstract reasoning, and initiation skills. Additionally, in order to generate novel categories as well as to simultaneously assess verbal and visual-spatial patterns, cognitive flexibility is required.

Procedure

Each juvenile provided consent prior to participation and was provided with an explanation of the procedures in place to maintain confidentiality. Following this, participants were encouraged to respond openly and honestly to all interview questions. In instances where inconsistencies were detected, researchers tried to clarify with the adolescent directly, as well as to consult any records when available.

Participants were administered the clinical interview, diagnostic interview, several rating scales and self-report measures, and the D-KEFS. In total, the assessment protocol required approximately 10 to 14 hours to complete. The protocol was administered by a combination of advanced clinical psychology graduate students and undergraduate students, all of whom received extensive training and supervision specific to working with incarcerated juveniles. Furthermore, several training sessions were conducted by the supervising licensed psychologist to ensure a standardized administration of the D-KEFS, which was administered exclusively by the graduate students. In addition, each participant's protocol was reviewed to ensure scoring accuracy.

Computer scoring software was used when available. For those items in the protocol that required manual scoring, undergraduate students were trained on proper scoring procedures and graduate students checked for accuracy. Similar procedures were used for entering and coding information in the database.

Results

Overview of Analyses

From the total sample of 188 juvenile delinquents, a subsample of 92 (21% NJSO, 79% JSO) adolescents was identified and used strategically in specific analyses. The 92 boys were selected given their pertinent abuse history as each boy in the subsample reported at least one previous experience with physical or sexual abuse. Additionally, during the intake interview, only those boys who endorsed a history of sexual or physical victimization were asked follow-up questions about the details and specific nature of their abuse, including the age of first experiencing. Therefore, the amount of data available for use in the analysis of several questions and hypotheses was limited. For those boys who had not experienced abuse, we elected not to include them as dummy controls (coded as zeros) given that inclusion would skew the data and might over- or misrepresent the low end of traumatic experiencing. Furthermore, utilizing the trauma-only sample allowed us to examine the specific effects and unique characteristics of experiencing abuse more closely and more accurately. Ultimately, the reduced sample was used to analyze models pertaining to age of traumatic experiencing, duration of abuse, and relationship to abuse perpetrator.

For data analysis, raw data were submitted to SPSS 19.0 (IBM Corp., 2010) and Mplus 6.12 (Muthén & Muthén, 2011). Given the presence of a binary categorical variable (i.e., Group Membership) and the small sample size, the Mean-and-Variance Adjusted Weighted Least Squares (WLSMV) estimator was used (Flora & Curran, 2004; Yu, 2002).

Outliers and normality of data.

Full sample. Data for all variables were normally distributed, with acceptable skew (-0.76 to 2.25) and kurtosis (-1.59 to 3.09) values. For skew and kurtosis, values with an absolute value greater than 3 and 10, respectively, would be considered extreme (Curran, West, & Finch, 1997; Kline, 2011). Additionally, each variable within the dataset was combed for outliers beyond the range identified by the median ± two times the interquartile range. Several univariate and bivariate outliers were identified within the dataset, primarily for variables regarding the participants' age and D-KEFS scores. However, D-KEFS related outliers were on the upper end and thus likely represented true performance, and not a lack of motivation or effort. Additionally, given constraints of the data set (e.g., dummy coding, small sample size), the individuals with identified extreme scores are believed to be representative of the population and thus outliers were maintained for analysis. Similarly, several individuals were identified as a potential multivariate outlier with a *Mahalanobis distance* > χ^2 (18) = 42.31, $p < .001$. However, the existence of multivariate outliers is likely reflective of the aforementioned univariate and bivariate outliers. Therefore, all outliers and extreme scores were noted but ultimately retained in the dataset.

Subsample. Data for all variables were normally distributed, with acceptable skew (-1.47 to 2.66) and kurtosis (-1.16 to 8.25) values. Using a procedure similar to that outlined for the full sample, several univariate and bivariate outliers were identified within the dataset for variables regarding the participants' group membership, age, and duration of abuse. However, as aforementioned, given constraints of the data set (e.g., dummy coding, small sample size), the individuals with identified extreme scores are believed to be representative of the population and thus outliers were maintained for analysis. Similarly, one individual was identified as a potential multivariate outlier with a *Mahalanobis distance* > χ^2 (13) = 34.53, $p < .001$. However, the existence of this multivariate outlier is likely reflective of his scattered performance on the D-KEFS. It is impossible to determine whether his varied performance was reflective of a true deficit, lack of motivation, or other contributing factor. Therefore, his scores were noted but ultimately retained in the dataset.

Missing data.

Full sample. Within the sample, 181 individuals had complete data profiles. Among the seven individuals with incomplete data, there were five missing data patterns with less than 5% missing for any given variable. Little's MCAR test [χ^2 (47) = 45.55, $p = .53$] was non-significant, indicating that the data are missing completely at random. Subsequently, to handle missing information, data were evaluated using both pairwise deletion and multiple imputation. While the suggested method of handling missing data may be to use multiple imputation (Enders, 2010), the differences between results obtained using multiple imputation and pairwise deletion were very small. Furthermore, given that multiple imputation was not designed for use with non-normal or categorical data and significance testing cannot be conducted, pairwise deletion was utilized throughout analyses. Furthermore, pairwise deletion has been found to result in unbiased parameter estimates for MCAR data, such as is found within the full and subsamples used for this study (Brown, 2006).

Subsample. Within the subsample, 87 individuals had complete data profiles. Among the five individuals with incomplete data, there were four missing data patterns with less than 5% missing on any given variable. Little's MCAR test [χ^2 (42) = 36.42, p = .84] was non-significant, indicating that the data are missing completely at random. Pairwise deletion was also used to handle missing data in analysis of the subsample.

Model fit criteria. The following fit estimates were considered: Chi-square (χ^2), Root Mean Square Error of Approximation (RMSEA), Comparative Fit Index (CFI), Tucker-Lewis Index (TLI), and Weighted Root Mean Residual (WRMR). As an estimate of exact-fit, χ^2 examines the discrepancy between the observed and implied matrices. Good fit was evaluated using the following criteria: χ^2 with $p > .05$, RMSEA ≤ .05, CFI > .95, TLI > .95, WRMR < .90 (Brown, 2006; Hu & Bentler, 1999; Yu, 2002).

Overall model specification, identification, and modifications. In examining the defined structural model, causal pathways were determined in accordance with the aforementioned literature such that early traumatic experiencing is related to juvenile delinquency and the mechanism for this relationship is executive dysfunction. In particular, traumatic events may disrupt proper neurophysiological development, which can later manifest as behavioral deficits in executive functioning (e.g., poor inhibition) which, in turn, increases the likelihood of delinquent behaviors and subsequent adjudication. Additionally, JSOs are typically younger than NJSOs and, thus, to control for the effects of current age, the age of the adolescent at intake was included as a covariate.

All models were recursive and over-identified (Kline, 2011). However, when initially estimating and evaluating measurement model fit, the latent variable covariance matrix was not positive definite and several modifications were indicated. Specifically, the indicator representing Verbal Fluency: Free Sorting Description (SORT1B) was correlated with the Conceptual Flexibility latent factor at a value greater than one. According to Brown (2006), a non-positive definite model matrix is often likely within small samples and within models that contain a limited number of indicators (e.g., two or three) per each latent factor. Furthermore, non-positive definite models and out-of-bound correlations, in particular, can be caused by pairwise deletion, but, as previously mentioned, pairwise deletion was the missing data method of necessity because of the limitations of the WLSMV estimator. Ultimately, SORT1B was deleted from all models. Deletion of this variable was justified on account of its poor to adequate internal consistency ratings, marginal test-retest ratings (see Table 1), and its multicollinearity with other Conceptual Flexibility/Sorting Test indicators (for correlations, see Table 2.1).

Additionally, modification indices suggested that χ^2 would be improved by allowing correlated residual errors for variables representing Verbal Fluency: Category Switching Total Correct Responses (VF_CATSCO) and Verbal Fluency: Category Switching Total Accuracy (VF_CATSWIACC). Such a modification is conceptually indicated and also substantially improved model fit. Following the deletion of SORT1B and the correlation of VF_CATSCO and VF_CATSWIACC, the re-specified measurement model still satisfied all identification rules and statuses (Kline, 2011).

Qualifying for identification, analyses proceeded in accordance with two-step Modeling process. The measurement model was first specified as a Confirmatory Factor Analysis (CFA) prior to being analyzed as SEM. As a CFA with all possible factor correlations, all re-specified models had moderate to relatively good fit and authorized proceeding to the SEM pathway analyses.

Statistical power.

Full sample. To determine statistical power for evaluating the overall model, we analyzed our data according to the test of not-close fit (null hypothesis: fit is not excellent). Therefore, power is estimated as the probability of rejecting the null (i.e., rejecting poor model fit and accepting moderate to good fit) within our sample. For the full sample of 188 adolescents, power estimates for rejecting the not-close fit hypothesis were adequate to poor with less than .60 probability of correctly identifying a true effect (MacCallum, Browne, & Sugawara, 1996). Therefore, given the limited power but relatively good fit indices as described below, we can place confidence in our fit statistics and findings for models utilizing the full sample.

Subsample. With less than 100 adolescents, our power estimate for rejecting the not-close fit hypothesis was very poor with less than 0.22 probability of correctly identifying a true effect (MacCallum et al., 1996). Therefore, given the limited power but relatively good fit indices as described below, we can also place confidence in our fit statistics and findings for models utilizing the subsample.

Descriptive Statistics

Correlations between observed variables are presented in Tables 2.1 through 2.4. The means (*M*) and standard deviations (*SD*) for JSOs and NJSOs are denoted in Table 3. While follow-up analyses are needed to determine statistical significance, preliminary results generally reveal that (1) JSOs are younger at intake/incarceration than the NJSOs, (2) JSOs first experience trauma at a younger age than NJSOs, and (3) the delinquents' EF performance, as determined by their D-KEFS Scaled Scores, varies between the groups but is somewhat lower than expected for their peer group overall. More specifically, performance on the D-KEFS was below average for both JSOs and NJSOs (*M* scaled score JSOs = 8.01, NJSOs = 7.74). However, there was no statistically significant difference between groups [full sample: $t(179) = -.91$, $p = .37$]. Additionally, within our adolescent sample, approximately one-third of all boys reported being the victim of at least one count of sexual abuse, one-fourth reported being the victim of physical abuse, and one-fifth reported being the victim of neglect.

Evaluation of Model Fit

Age of first traumatic experience. For the model which analyzed the subsample of boys who experienced traumatic victimization, the discrepancy between the observed and implied model matrices was non-significant, χ^2 (44) = 37.23, $p = .76$. Therefore, we retain the exact-fit null hypothesis. Additional support for good model fit included the following estimates: RMSEA = .00 (90% CI: .00, .05), CFI = 1.00, TLI = 1.07, and WRMR = 0.47 (Brown, 2006; Kline, 2011; Yu, 2002).

Duration of traumatic victimization. For the model which analyzed the subsample of boys who experienced traumatic victimization, χ^2 (44) = 38.77, $p = .70$. Therefore, we retain the exact-fit null hypothesis. Additional support for good model fit included the following estimates: RMSEA = .00 (90% CI: .00, .06), CFI = 1.00, TLI = 1.05, and WRMR = 0.45.

Frequency of traumatic experiencing. For the model analyzing the full sample of delinquent adolescents, χ^2 (50) = 56.07, p = .26. Therefore, we retain the exact-fit null hypothesis. Additional support for good model fit included the following estimates: RMSEA = .03 (90% CI: .00, .06), CFI = 1.00, TLI = 1.07, and WRMR = 0.60.

Relationship to perpetrator of traumatic experience. For the model analyzing the full sample of adjudicated boys, χ^2 (50) = 51.50, p = .42. Therefore, we retain the exact-fit null hypothesis. Additional support for good model fit included the following estimates: RMSEA = .013 (90% CI: .00, .05), CFI = .99, TLI = .99, and WRMR = 0.56.

Type of traumatic victimization. For the model analyzing the full adolescent sample, χ^2 (56) = 64.37, p = .21. Therefore, we retain the exact-fit null hypothesis. Additional support for moderate to good model fit included the following estimates: RMSEA = .04 (90% CI: .00, .08), CFI = .93, TLI = .89, and WRMR = 0.59.

Evaluation of Direct and Indirect Effects

Age of first traumatic experience. Individual unstandardized and standardized factor loadings and path estimates are presented in Table 4.1; Figure 1.1 depicts the model with standardized loadings. All indicators loaded significantly onto the D-KEFS latent factors. However, a degree of caution is noted as the D-KEFS latent factors are all significantly correlated at $p \leq .01$.

For the direct pathway between age of traumatic onset and delinquent group membership (JSOs = 1, NJSOs = 0) a significant relationship exists: *StdYX* = -.31, $p < .01$. Furthermore, the relationship between age of first physical or sexual victimization and delinquent group membership was significant after controlling for the adolescents' age at intake. Previously, the mechanism for the relationship between age of first traumatic experience and juvenile delinquency was unclear. In the present study, the latent executive functions of Inhibition, Conceptual Flexibility, and Monitoring were predicted to partially mediate the relationship between age of traumatic onset and delinquent group membership. However, the sum of indirect effects was not significant ($p = .89$), nor was any specific indirect effect (Inhibition: PRODCLIN 95% CI unstandardized estimate = -0.05, 0.03; Conceptual Flexibility: -0.02, 0.02; and Monitoring: -0.03, 0.06; MacKinnon, Fritz, Williams, & Lockwood, 2007).

Duration of traumatic victimization. Individual unstandardized and standardized factor loadings and path estimates are presented in Table 4.2; Figure 1.2 depicts the model with standardized loadings. All indicators loaded significantly onto the D-KEFS latent factors. However, a degree of caution is noted as the D-KEFS latent factors are all significantly correlated at $p \leq .01$, indicating non-independent or not wholly separate constructs.

For the direct pathway between duration of victimization and delinquent group membership (JSOs = 1, NJSOs = 0), there was no significant relationship. It was believed that extended trauma exposure would increase the severity of impairment, manifesting as executive functioning deficits and delinquent behavior. However, neither the direct effect nor the sum of indirect effects was significant ($p = .64$). Additionally, there was no significant specific indirect effect (Inhibition: PRODCLIN 95% CI unstandardized estimate = -0.01, < 0.01; Conceptual Flexibility: < -0.01, < 0.01; and Monitoring: < -0.01, 0.01).

Frequency of traumatic experiencing. Individual unstandardized and standardized factor loadings and path estimates are presented in Table 4.3; Figure 1.3 depicts the model with standardized loadings. All indicators loaded significantly onto the D-KEFS latent factors.

However, a degree of caution is noted as the D-KEFS latent factors are all significantly correlated at $p \leq .01$.

A significant relationship between frequency of victimization (once, twice or more) and delinquent group membership (JSOs = 1, NJSOs = 0) exists for all boys who experienced trauma when compared to those boys who were not the victims of childhood physical or sexual violence. Adolescents convicted of sexual misconduct were more likely to have experienced trauma as compared to non-sexually offending delinquents (one traumatic experience: *StdYX* = .29, p = .003; two or more experiences: *StdYX* = .25, p = .01). Furthermore, the relationship between the frequency of physical or sexual victimization and delinquent group membership is significant even after controlling for the adolescents' age at intake. However, it should be noted that the relationship between frequency of traumatic experiencing and juvenile delinquency was not partially mediated by executive functioning. The sum of indirect effects was not significant (once: p = .82; twice or more: p = 1.00), nor was any specific indirect effect for one victimization experience (Inhibition: PRODCLIN 95% CI unstandardized estimate = -0.09, 0.10; Conceptual Flexibility: -0.17, 0.07; and Monitoring: -0.19, 0.22) or for two or more experiences (Inhibition: -0.18, 0.13; Conceptual Flexibility: -0.13, 0.19; and Monitoring: -0.18, 0.15).

Relationship to perpetrator of traumatic experience. Individual unstandardized and standardized factor loadings and path estimates are presented in Table 4.4; Figure 1.4 depicts the model with standardized loadings. All indicators loaded significantly onto the D-KEFS latent factors. However, a degree of caution is noted as the D-KEFS latent factors are all significantly correlated at $p \leq .01$.

The pathway between non-incestuous victimization and delinquent status was not significant (*StdYX* = .12, p = .17), suggesting that boys who were victims of non-incestuous abuse were equally likely to sexually offend as were boys who were not the victims of physical or sexual abuse. However, the pathway between the relationship of the perpetrator and the boys' delinquent group membership (JSOs = 1, NJSOs = 0) was significant for those adolescents who were abused by an immediate or distant relative. In particular, incestuous trauma was related to sexual misconduct (*StdYX* = .37, $p < .001$).

Furthermore, the relationship between incestuous victimization and group status was significant even after controlling for the adolescents' age at intake and was not significantly mediated by executive functioning. The sum of indirect effects was not significant (incest: p = .97; non-incest: p = .82). Similarly, there were no specific indirect effects for non-incestuous victimization (Inhibition: PRODCLIN 95% CI unstandardized estimate = -0.17, 0.13; Conceptual Flexibility: -0.16, 0.12; and Monitoring: -0.15, 0.17) or for incestuous abuse (Inhibition: -0.10, 0.10; Conceptual Flexibility: -0.12, 0.12; and Monitoring: -0.11, 0.13).

Type of traumatic victimization. Individual unstandardized and standardized factor loadings and path estimates are presented in Table 4.5; Figure 1.5 depicts the model with standardized loadings. All indicators loaded significantly onto the D-KEFS latent factors. However, a degree of caution is noted as the D-KEFS latent factors are all significantly correlated at $p \leq .01$.

For the direct pathway between type of trauma (physical, sexual, or combined) and delinquent group membership (JSOs = 1, NJSOs = 0), there are no significant direct relationships (physical: *StdYX* = .18, p = .11; sexual: *StdYX* = .22, p = .08; combined: *StdYX* = .15, p = .26). A priori correlations indicated that combined physical and sexual trauma was significantly related to JSO status. Therefore, the non-significant direct pathway suggests that executive functioning may partially mediate the relationship between type of trauma and delinquent offending.

However, it should be noted that there were no significant indirect effects when analyzing the relationship between type of traumatic victimization, juvenile delinquency, and executive functioning. The sum of indirect effects was not significant (physical: p = .64; sexual: p = .48; combined: p = .68). Likewise, there were no specific indirect effect for physical abuse (Inhibition: PRODCLIN 95% CI unstandardized estimate = -0.70, 0.34; Conceptual Flexibility: -.017, 0.29; and Monitoring: -0.36, 0.89) sexual abuse (Inhibition: -0.47, 0.24; Conceptual Flexibility: -0.20, 0.11; and Monitoring: -0.54, 0.22), or combined abuse (Inhibition: < -0.01, < 0.01; Conceptual Flexibility: < -0.01, < 0.01; and Monitoring: < -0.01, < 0.01).

Discussion

The current study sought to improve understanding of the etiology of juvenile offending behavior by analyzing two salient themes within the delinquency and clinical literature: traumatic experiencing and executive dysfunction (ED). Specifically, we hypothesized that executive functioning would serve as a partial mediator of trauma and delinquency—that adolescents' previous trauma histories would influence delinquency status by way of executive functioning deficits. We also predicted that the age of traumatic onset and severity of the type of trauma (i.e., sexual, combined) would be the most salient trauma characteristics, and as such, would map more closely onto EF deficits and delinquency than other characteristics of victimization (e.g., frequency, duration).

In order to examine our hypotheses more specifically and systematically, we evaluated five multiple-mediational models representing various trauma characteristics, including: the age of first experience, duration of victimization, frequency of experiencing, relationship to perpetrator, and type of victimization. All models were determined to be of moderate to good fit, but there were no significant indirect pathways. That is, even though EF performance contributed to the overall fit of the model, we found little to no evidence of EF mediation, and instead, verified the potency of childhood trauma. The findings for each trauma characteristic are discussed in turn below, followed by remaining implications pertinent to EF.

Overall, all models represented the data with moderate to good fit, indicating that we have accurately captured real clinical phenomenon. In particular, there seems to be an interesting relationship between specific characteristics of childhood sexual or physical trauma and delinquent offending. For example, the age of traumatic onset appears to be a predictor of sexual offending such that many JSOs first experience physical or sexual abuse prior to age 7. Additionally, boys who were the victims of a familial/incestuous abuse are also more likely to commit later sexual misconduct. Finally, children who experienced both physical and sexual victimization may be more likely to sexually offend. Therefore, it appears as though some specific characteristics of trauma offer significant predictive validity and help to explain the etiology of juvenile offending.

Age of First Traumatic Experience

In support of our hypothesis, age of traumatic onset was a salient predictor of the type of delinquent offense behavior. In particular, there was a negative relationship between age of experiencing and offense group status, suggesting that JSOs experienced trauma at a younger age than NJSOs. Follow-up analyses indicate that the modal age for onset of physical or sexual victimization among JSOs was five years of age (median = 7), whereas NJSOs most frequently reported experiencing trauma in late childhood or early adolescence (after age 10.5).

The potency of early traumatic experiencing is well-documented in the literature. For example, Grabell and Knight (2009) discovered that sexual abuse during crucial developmental epochs (i.e., ages 3 to 7) predicted maladaptive, impulsive behaviors. Additionally, Keiley and colleagues (2001) discovered that early childhood victimization was related to more negative outcomes across a number of domains than was victimization later in life. In particular, physical victimization prior to age five was associated with higher levels of both internalizing and externalizing symptomatology as perceived by parents and teachers, but later-victimization was associated with elevated levels of externalizing behavior problems only. Findings of both internalizing and externalizing problems among children abused earlier in life seem to relate to JSO, at least anecdotally. At DYS Mt. Meigs/ABSOP, JSOs are much different in temperament and presentation than NJSOs who were convicted of other delinquent crimes such as arson and drug possession and among whom higher levels of externalizing difficulties seem more characteristic.

However, despite potential externalizing disorders and contrary to our expectations, age of experiencing was not related to EF performance in either group of delinquents. There were no significant pathways between age of onset and Inhibition, Conceptual Flexibility, or Monitoring. Furthermore, EF factor scores did not impact the significant relationship between age of onset and delinquent behavior. Results indicate, then, that earlier traumatic experiencing may lead to juvenile offending, but offense behaviors are not directly related to EF deficits like self-regulation, attention, or otherwise maintaining goal directed behavior.

Rather than exhibiting ED and its associated behavioral or emotional control difficulties, impairments from early child abuse may manifest instead as internalized impairment such as hypersexuality, anxiety, depression, or difficulty navigating interpersonal relationships (Farris, 2007; Grabell & Knight, 2009). Many children who experience trauma early in life show immediate and delayed interpersonal skills deficits including poor attachments, poor perspective-taking abilities, and withdrawal from social situations (Alessandri, 1991; Fonagy & Target, 1997). Such interpersonal deficits may relate to delinquency or aggressive interpersonal violence, in particular, and should be examined more systematically.

Duration of Traumatic Victimization

The model representing the relationship between duration of trauma, EF, and delinquency was determined to be of good fit, but had no significant individual pathways. Therefore, it is likely that these three constructs are related, but only tangentially or partially. In particular, duration of trauma may be a pertinent indicator of outcome and prognosis, but it is not the most salient trauma predictor. The limited predictive power of the duration of traumatic experiencing is consistent with our hypothesis and with previous literature, which indicates that age of onset would be a more salient predictor than duration or frequency (Grabell & Knight, 2009).

Despite preliminary empirical support, this lack of significant findings is somewhat contradictory to lay expectations and alternative theories which propose that longer traumatic experiencing would have more negative implications, possibly resulting from interrupted stage-specific task acquisition or typical neuropsychological development (Finkelhor, 1995; van der Kolk, 2003). Similarly, finding limited impact for the duration of traumatic experiencing is somewhat contrary to previous findings which demonstrate that longer total duration of traumatic victimization results in more adverse consequences, particularly increased internalizing psychopathology and suicidality (Farris, 2007). However, one possible explanation is because simply experiencing any trauma at all may be a potent enough event to invoke adverse consequences. Increased duration or frequency may add little predictive validity above and beyond the initial experiential component.

Frequency of Traumatic Experiencing

Results indicate that the specific frequency of traumatic experiencing is not critical to understanding juvenile delinquency or executive functioning. Instead, similar to the model representing the duration of traumatic victimization, just one traumatic experience is more impairing than none and an increased number or lapse of experiences provide little additional predictive utility.

These findings are corroborated by other studies in which an array of traumatic experiencing, including physical or sexual assault and even traumatic bereavement, were associated with poor outcomes later in life such as subsequent psychopathology and social impairment when compared to individuals who experienced no trauma at all (Krupnick et al., 2004). Indeed, childhood exposure to abuse is linked to many deficits later in life including psychopathology, suicidal ideation, decreased academic performance, delinquency, aggression, and substance abuse, among other (Grabell & Knight, 2009; Kendall-Tackett et al., 1993; van der Kolk, 2003; Walker et al., 2004). However, the adverse consequences of trauma may supersede specific characteristics of the traumatic episode, such that children who experience direct victimization, who witness violence exposure, or who are subjected to other non-victimized traumas may all experience trauma-related impairment.

For instance, Howard and colleagues (2012) suggest that children who have simply witnessed violence are more inclined to perpetuate abuse against others than children who were direct victims of abuse, indicating that the adverse consequences of trauma supersede specific characteristics of the episode. Similarly, Barroso and colleagues (2008) observed a number of negative outcomes such as drug use and gang affiliation among boys who were exposed to high levels of community violence. It is likely, then, that individuals who have either witnessed or experienced trauma early in life are subjected to interruptions in their typical developmental trajectory and are to later impairment. Along these lines, our results suggest that only one traumatic event appears to be necessary to interrupt the course of development in some manner and to lead to adverse outcomes.

Relationship to Perpetrator of Traumatic Experience

There was a significant pathway between the relationship of the perpetrator to the victim and juvenile delinquency status. In particular, incestuous trauma was related to sexual misconduct. Boys who were physically or sexually victimized by non-related (non-incestuous) individuals were equally likely to sexually offend as they were to commit other delinquent acts. As with other results from this study, no direct or indirect relationship with EF was indicated.

Previous research supports these findings and suggests the particularly adverse nature of incestuous trauma. In particular, experiencing incestuous trauma is related to a trajectory of interpersonal difficulties, general conflict, and internalizing symptomatology like depression. There is limited evidence of externalizing disorders among individuals who were victimized by a family member, and for those individuals who do exhibit problems with externalizing behaviors, the acting out tends to be sexual in nature and does not reflect general misconduct or a lack of self-regulation skills (Alexander & Anderson, 1997; Farris, 2007).

Additionally, Ullman (2007) reported that adults who experienced incestuous sexual victimization in childhood incurred more PTSD symptoms and disclosed the details of their abuse later than victims of non-relative sexual abuse, thus delaying the receipt of intervention services. Conflict about disclosing incestuous trauma is consistent with the betrayal theory of trauma in which children may forget or deny abuse in order to continue to have their emotional and survival needs met by caretakers or significant adults (Freyd, 1996). If a child feels betrayed by his caretaker or is otherwise not engaged in a successful and satisfying relationship with the parent figure, he may attempt to have these needs met elsewhere and may do so in socially inappropriate ways, such as through precocious or forced sexual activity (Kerig & Becker, 2010; Yates & Prescott, 2011).

Similarly, children who experience familial-perpetrated victimization may develop incongruous attachments or inappropriate models of social learning. Early attachment relationships influence an individual's internalized conceptualization of interpersonal relationships, providing a basis for perceptions and expectations of the self and others (Cicchetti & Howes, 1991). In other words, early attachment relationships lay the track for later interpersonal style and may determine whether an individual approaches relationships with trust and confidence or with an expectation to be rejected and hurt (Kerig & Becker, 2010). Furthermore, by traumatic exposure, children may also come to emulate the relational style and behaviors of their caretakers—directly recapitulating the caretaker's aggressive or abusive tendencies and transforming the child from victim to victimizer. Previous researchers have demonstrated correlations between sexually offending and early severe sexual abuse conducted by a close relative (Burton, Miller, & Shill, 2002).

Findings from our study corroborate the relationship between familial-induced traumatic victimization and sexual offending, but do not necessarily support the social learning and victim-to-victimizer hypothesis, given that JSOs and NJSOs both experienced traumatic physical and sexual victimization. Therefore, the specific reason why some victims of childhood maltreatment later victimize others is still to be determined and likely cannot be explained fully by attachment style, social learning theory, or ED. Research on the predictive ability of specific trauma characteristics should continue (Ryan, 2002).

Type of Traumatic Victimization

In this model, there are no statistically significant direct or indirect relationships.

However, there was an a priori correlation between combined-type trauma (i.e., physical and sexual victimization) and delinquent status that was no longer significant in the model. It was hypothesized that more intense trauma would result in more EF impairment and a more severe offense. The results provide preliminary support for this hypothesis, given that the a priori correlation between combined-type trauma and delinquency is no longer significant when controlling for ED. Therefore, it is possible that EF plays a mediating role in the relationship between type of trauma and type of delinquent offense. However, given the lack of a significant direct relationship with EF and no statistically significant indirect effects, there is only minimal evidence of mediation (Baron & Kenny, 1986). Similarly, no specific relationship with any one EF factor was identified, suggesting that analyzing ED overall may be relevant, rather than looking at specific facets of EF.

Previous literature demonstrated that combined physical and sexual child abuse predicted the highest incidence of PTSD symptomatology in adult women. No differences were found for the impairment and psychopathology of women who experienced only physical or only sexual abuse (Schaaf & McCanne, 1998). Similarly, Krupnick and colleagues (2004) identified a cumulative effect of trauma such that individuals who experienced multiple counts of sexual and physical trauma were more likely to experience PTSD, MDD, and substance abuse problems than individuals with no trauma history or with only a single instance of either physical or sexual assault.

While our study did not examine PTSD symptomatology directly, our preliminary analyses indicated an a priori correlation between combined abuse type and delinquent group membership. However, after completing the SEM analyses, there was no longer a significant relationship. Therefore, it is possible that EF mediated the relationship between combined abuse and delinquency, especially in light of the fact that individuals who experience combined-type abuse often experience more severe symptoms of PTSD and individuals with PTSD often exhibit EF deficits (Krupnick, 2004; Schaaf & McCanne, 1998; Walter et al., 2010). Therefore, future studies may wish to look at the relationship between trauma, EF, and various types of impairment both within and outside a delinquent population.

The Relative Contribution of Executive Functioning

Notably, though, while the models' results overall indicate an accurate fit to the data and an interesting effect, the depicted models may not be parsimonious. In particular, the relative contributions of EF are limited. It does not appear as though EF mediates the relationship between trauma and delinquency given that there were no significant indirect effects in any model tested. Thus, in light of the fact that the EF factors relate only loosely and non-significantly to all trauma characteristics and delinquency, the models may still be accurate if we pare or eliminate many of the EF pathways and retain only the trauma variables. The relationship between childhood trauma and delinquent behavior is strong enough to be evaluated independently.

Still, all models tested were determined to be of good fit with the inclusion of the EF factors and item loadings. Further investigation of the relationship between EF and trauma or EF and delinquency may be warranted, but would need to bare in mind several important considerations about EF conceptualization and measurement. Regarding EF deficits, we are left with the question as to why there were no significant findings as previous studies have demonstrated ED among delinquent individuals and trauma survivors alike (DePrince et al., 2009; Veneziano et al., 2004).

When first considering the intersection between trauma and EF, there may be natural variation in EF performance within our sample of victimized youths such that individuals who experience child maltreatment may or may not exhibit ED. As indicated in previous literature, trauma is believed to impact: (a) the development and full maturation of specific brain structures at particular ages, (b) the physiologic and neuroendocrine responses, and (c) the capacity to coordinate and regulate cognition, emotion, and behavior (van der Kolk, 2003). However, these anatomical or neuropsychological may not have specific effects on EF. Instead, interruptions in typical brain development may impact any number of interconnecting neural systems in which case the impairment would need to be severe in order to impact all coordinated systems and manifest as a pure EF deficit (Dick & Overton, 2010). Therefore, trauma may impact functioning via other less physiological developmental factors such as social learning, attachment styles, acquisition of stage-specific tasks, or any number of other social-behavioral systems (Finkelhor, 1995; Schaaf & McCanne, 1998).

Alternatively, the relationship between EF and trauma may intersect only at the crossroads of psychopathology. While individuals diagnosed with various Axis I disorders (e.g., ADHD, PTSD) often exhibit EF impairment (Grabell & Knight, 2009; Kendall-Tackett et al., 1993; Walker et al., 2004; Wind & Silvern, 1992), it is possible that EF deficits only manifest in cases of severe psychopathological and symptomatic distress. Within our sample of juvenile delinquents, many boys exhibit symptoms of ADHD and/or PTSD but may or may not carry a diagnosis. While children and adults with clinical levels of symptomatic distress-related PTSD have demonstrated EF impairment (Beers & De Bellis, 2002; Walter et al., 2010), there is some evidence to suggest that children with sub-clinical levels of PTSD do not show diminished EF performance and complete tasks as accurately as children without symptoms of post-traumatic stress (Carrion, Garrett, Menon, Weems, & Reiss, 2007). However, other studies suggest that all children with and without PTSD who witnessed domestic violence exhibited below average performance on tests of EF, attention, and cognitive ability (Samuleson et al., 2010). Thus, future comparative analyses of trauma and EF should seek to parse out the effect of pathological impairment, or at least should differentiate between clinical and sub- or non-clinical individuals.

The relationship between EF and trauma may also have been limited in this study by which EF factors were selected for inclusion. Factors of Inhibition, Conceptual Flexibility, and Monitoring are primarily cognitive and behavioral in nature. However, affective self-regulation skills are also considered by some theorists to fall under the umbrella of EF (Garcia-Barrera et al., 2011). Previous research indicates that individuals who experience childhood abuse often develop anxiety and mood disorders or otherwise exhibit high rates of internalizing symptomatology (Farris, 2007; Keiley et al., 2001; Wind & Silvern, 1992). The scope of this study may have been too narrow when defining EF and focused too heavily on factors related to externalizing disorders like ADHD, rather than analyzing factors which are more closely related to self-regulation and thus may be more closely related to internalizing disorders.

When considering the relationship between EF and delinquency, previous research within this population has demonstrated inconclusive and inconsistent findings that are highly dependent on study methodology (Bergeron & Valliant, 2001; Veneziano et al., 2004). Within our adolescent sample, many boys demonstrated ED as measured by the D-KEFS. Mean EF performance was below average for both JSOs and NJSOs, but despite this, there was no statistically significant difference between delinquent groups. Of note, the adolescents' below average EF performance may also have been impacted by their below average IQ scores and future studies may wish to control for the relative contribution of intellectual ability.

Nonetheless, similarities in overall EF performance across JSOs and NJSOs are consistent with the previous literature, which describes an inconsistent main effect for delinquent group (Veneziano et al., 2004). Therefore, ED may be exhibited among all adjudicated adolescents, suggesting that all juvenile delinquents—regardless of offense type—demonstrate relative skills deficits in domains like inhibition, cognitive flexibility, monitoring, problem solving, and emotional control.

EF performance may not be a function of delinquent offense type. Instead, EF performance may differ when comparing juvenile delinquents to a normative sample, when comparing aggressive to non-aggressive offenders, or when comparing first-time offenders to repeat offenders (Veneziano et al., 2004). Future researchers may wish to analyze other specific criminal profiles in order to glean more information about which delinquents exhibit EF deficits and which do not. Most likely, there is a range of EF performance within the delinquent population with some offenders demonstrating deficits in inhibition, planning, and self-regulation while other offenders have intact EF. Similarly, EF performance may be related to functional impairment and specific behavioral deficits, not necessarily to the characteristics of the adjudicated offense. For example, EF performance may be related to PTSD symptomatology and aggression, which may influence—but not cause—risk-taking or delinquent behavior (Grabell & Knight, 2009).

Considerations of the true domains of impairment affected by ED are reflective of issues with ecological validity. Many EF tasks are plagued by poor ecological validity such that there is incongruence between the task-measured performance and the construct that the task is intended to represent. For example, the Trail Making Test (Condition 4) is designed to assess for the higher-order EF task of cognitive flexibility/set-shifting (i.e., set-shifting). However, the task of drawing a line between numbers and letters is not one that the typical individual incurs in the real world and is, instead, a novel task contained within the assessment context. A more ecologically valid test of cognitive flexibility/set-shifting would require an individual to alter between various real-world rule sets, such as in a school setting when children must know when it is appropriate to talk aloud and when it is not. Rating scales such as the BRIEF (Gioia et al., 2000) or the new Delis Rating of Executive Function (D-REF; Delis, 2012) can also provide additional ecological validity by having multiple raters evaluate real-time behavior in various contexts.

Other issues in the measurement and conceptualization of EF also may have contributed to the lack of identifiable discrepancies in performance (Bernstein & Waber, 2007). For example, the tasks measured by the D-KEFS may not be appropriate for identifying specific EF deficits in an adolescent sample. While EF appears to emerge in early childhood, executive skills are still being refined and improved throughout adolescence (Best & Miller, 2010). In particular, adolescents have demonstrated linear improvement with age on tasks measuring advanced cognitive processes such as selective attention and problem solving, but demonstrated stable performance on planning tasks like the Tower of London (Blakemore & Choudhury, 2006). To elaborate, EF is often conceptualized and measured as a cognitive process construct in which both fundamental cognitive skills and higher-order cognitive functions are represented (Delis et al., 2001). Some theorists purport that the basic cognitive components and EF skills (e.g., WM) must be intact before an individual can develop and utilize more advanced neurocognitive skills (e.g., set-shifting; Best & Miller, 2010).

Thus, by measuring and combining scores on tasks that require both specific and advanced cognitive processes, the D-KEFS and other EF tests might be insensitive to the unique developmental patterns of EF and have limitations in specificity or other age-based invariance

(Goldberg et al., 2005; Latzman & Markon, 2010). More specifically, age related differences might be confounded with task impurity. One test may measure a host of interrelated abilities, not just one specific executive component even when tasks—such as those comprising the D-KEFS—were designed with the intention of parsing out fundamental and higher-order processes (Dick & Overton, 2010; Delis et al., 2001; Strauss et al., 2006). Using D-KEFS contrast scores may be indicated to better account for more basic skill deficits; however, contrast scores are accompanied by additional psychometric shortcomings. Therefore, given limitations in task impurity, there is no guarantee that D-KEFS performance captured each adolescent's true EF abilities. Performance on tasks of EF requires the coordination of many cognitive processes, not just executive skills (Dick & Overton, 2010). For example, Strauss and colleagues (2006) explain that unsuccessful performance on card sorting tasks such as the WCST or the D-KEFS Sorting Test could be the result of poor working memory, inadequate set-shifting abilities, an inability to process and incorporate feedback, visual processing deficits, or low motivation, and future research should seek to control for these more basic processes.

The relative contribution of motivation (Strauss et al., 2006) is a point well-taken as the immediate environment and stressors associated with recent incarceration may have precluded accurate, motivated performance on testing within our sample. At a biological level, pathways in the PFC are shared between tasks such as executive functioning and motivation, thus integrating the two processes. Increased motivation yields increased neural activity and improved performance. Motivation, therefore, can impact performance via behavioral engagement, but can also impact performance on a neurophysiological level (Taylor, Welsh, Wager, Phan, Fitzgerald, & Gehring, 2004). Thus, EF scores captured in this study may represent a restricted range or limited variability in true performance abilities due to individual differences in motivation to perform to the best of their abilities.

Furthermore, sensitivity to ED may be additionally blurred by the statistical properties of SEM. For one, the creation of latent factors can be misleading (Dick & Overton, 2010) as the provision of a concrete behavioral label can cause consumers to over-attribute neurocognitive processes to behavior, as well as to lose sight of issues with task impurity and ecological validity within the EF construct. Similarly, there is the possibility that the labels assigned to the established factor structure are misrepresentations of the measure's true EF component (Dick & Overton, 2010) and may have led to premature conclusions about the adolescents' inhibition, conceptual flexibility, and monitoring abilities. Another limitation with using latent factors in EF research is that interpreters of the D-KEFS lose some sensitivity in their ability to understand the specific cognitive processing deficits that contribute to ED. With the establishment of latent factors, the opportunity to analyze the unique contributions of fundamental and higher-order test conditions can be lost to the correlation and shared variance accounted for by the latent factor (Kline, 2011).

Finally, the factor structure of the D-KEFS utilized in this study was drafted after the development of the battery and thus does not represent strong, empirically validated theory. EF theorists suggest that research using factor analysis should be handled with caution as it may inflate the confidence we have in the notion of distinct but related constructs under the umbrella of EF (Bernstein & Waber, 2007). Therefore, the three-factor model (Latzman & Markon, 2010) utilized in this study may have been an inappropriate representation of the underlying constructs especially in light of the high correlations between the EF factors of Inhibition, Conceptual Flexibility, and Monitoring. An alternative factor structure (e.g., unitary factor) may be warranted and further confirmation of the appropriate factor structure for the D-KEFS should be sought. Alternatively, future researchers may wish to conduct analyses utilizing a more focused application of the D-KEFS variables and contrast scores.

Clinical Application

Beyond considerations of valid EF assessment, this study contributes to the literature regarding the best practices for treating children and adolescents who sexually offend against others (AACAP, 1999; Burkhart & Cook, 2010). In particular, our findings emphasize the importance of using a developmental framework and prioritizing individual needs in the treatment of offenders, and fully support the decision to reject “one size fits all” treatment protocols for delinquents (Wormith et al., 2007).

Given that those individuals with an early trauma history are at particular risk for developing personal psychological distress, even within the corrections system, treatment should be individualized and trauma-focused for those who exhibit PTSD or should be trauma-informed for individuals with no current clinical PTSD symptomatology. Studies of evidence-based treatment for childhood maltreatment have often failed to analyze the efficacy and applicability of these interventions for adolescent clientele and for youths in the juvenile justice system (Mahoney, Ford, Ko, & Siegried, 2004; Saunders, Berliner, & Hanson, 2003). On the other hand, programs designed for use within the juvenile justice system such as the Multisytemic Therapy (MST; Henggeler, Schoenwald, Borduin, Rowland, & Cunningham, 1998)—which relies less on core cognitive principles and includes more family-based, behavioral interventions—have shown relatively good results within the penal system to help address sub-clinical PTSD, self-regulation, and behavioral health with lower recidivism rates across time than was observed among those boys who received standard community care (Borduin, Schaeffer, & Heiblum, 2009; Mahoney et al., 2004; Timmons-Mitchell, Bender, Kishna, & Mitchell, 2006).

Ultimately, more research should be conducted on the specific treatment modalities that counteract some of the adverse consequences of child maltreatment, especially within the corrections system and unique population of juvenile delinquents. Similarly, the mechanisms by which trauma leads to undesired outcomes should be examined further in order to identify individuals who may be at particular risk and to help interrupt the pathway to delinquency, PTSD, or any other negative consequence. As identified in this study, early victimization, familial-based trauma, and combined physical/sexual abuse may be particularly potent. Therefore, clinicians should strive to help children and adolescents describe the nature and characteristics of their abuse, including their relationship with the perpetrator (Ryan, 2002), because it is clear that for those individuals who experience sexual and/or physical maltreatment at a young age, early intervention is necessary to help protect against a host of negative outcomes—including delinquency and risk of incarceration.

Additionally, despite the fact that pervasive group differences in EF performance were not observed in our study, clinicians and other mental health professionals should continue to consider the role of executive functioning for those individuals who demonstrate significantly weakened executive skills. While there may be no identifiable trends within the population, the relationship between delinquency and executive dysfunction should then be considered on a case-by-case basis to identify those individuals who may benefit from EF skills training. Treatment focusing on EF might highlight the importance of setting goals, identifying pathways to goal achievement, planning for barriers and roadblocks, and understanding the consequences of actions as they relate to long-term goals and values (Dawson & Guare, 2010). However, behavior health and executive skills training should likely be secondary treatment goals relative to addressing more salient pathology and developmental concerns.

Limitations and Future Directions

While interpreting our results, several limitations warrant consideration and future attention. Primarily, several limitations were identified as they related to study design and statistical analysis including: small sample size, limited power, reliance on self-report of information, reliance on performance based measures of EF exclusively, and lack of a non-delinquent control group. Ideally, future studies seeking to examine the relationships between trauma, EF, and delinquency will use larger samples with more equally distributed group membership and will also include non-delinquent peers. A larger sample size would have yielded greater power and model flexibility and thus may have been more likely to identify true significant effects. Future studies should also be designed to cross-validate self-report of trauma and EF with multiple informants, including parents, teachers, school records, and records on file with child and family protective services.

Cross-validation is also necessary for the final overall model to determine the appropriateness of modifications made to the model throughout data analysis. Furthermore, the final models are quite complex, estimating many possible pathways. Researchers should strive to achieve parsimony in their designated models. In our analyses, several residual covariances indicated over- or under-estimation of specific pathways; these residuals should be examined more closely and pathways should be trimmed appropriately in order to develop a more parsimonious model. Subsequent models should, of course, be cross-validated in independent samples.

Furthermore, model complexity is problematic given the vast possibility of equivalent models. For example, in the current study, correlations between latent factors could be replaced with direct effects, indicating that one EF construct caused another. This may be consistent with some researchers' theories of EF such that basic cognitive components and EF skills (e.g., WM) must be intact before an individual can develop and utilize more advanced neurocognitive skills (e.g., set-shifting; Best & Miller, 2010). In our model, Monitoring (i.e., Updating Working Memory) may predict Inhibition, which may in turn predict Conceptual Flexibility. While such a change would alter the model specification, theory and supporting literature, it would result in a mathematically equivalent model. Many other possible and plausible equivalent models may also exist. To avoid such a problem in the future, models should be generated following longitudinal design and data collection to assess for causal relationships.

It is possible that a different EF model and D-KEFS factor structure would have been more sensitive to identifying specific EF deficits. As discussed previously, the field of EF theory and measurement is controversial. Given that no gold standard has been identified, researchers have some latitude and should strive to have breadth and depth when measuring EF, including both performance and behavioral rating scales. Additionally, researchers should provide a strong justification for their selected EF measurement model.

Future research should also explore various definitions of delinquency. In our study, delinquency was specified as a binary variable depending on whether the adolescent was adjudicated for a sexual or non-sexual offense. Unique relationships between trauma, EF, and other characteristics of delinquent offending may exist such as acts of violence or aggression.

Ultimately, researchers should continue to examine the pathways that intercede the relationship between a history of victimization and juvenile delinquency. Researchers should examine a variety of proximal, distal, physiological, behavioral, and environmental variables (e.g., social cognition, IQ, attachment, psychopathology) in order to determine their relative protective or detrimental effects on the social and psychological well-being of children and adolescents who experience maltreatment. By understanding the long-term effects of childhood trauma and the etiology of delinquent behavior, practitioners will be better able to focus and tailor interventions for specific at-risk children and populations.

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Table 1

Psychometric Properties of Select D-KEFS Variables

D-KEFS Test/Variable	Type of Measure & Latent Variable Label	Internal Consistency for Ages 8-19	Test-Retest r_{12} for Ages 8-19
Trail Making Test			
Condition 4: Number-Letter Switching	Inhibition	Low (≤ .59)	Low (.20)
Verbal Fluency			
Letter Fluency	Monitoring	High (.68-.81)	Marginal (.67)
Category Fluency	Monitoring	Marginal (.53-.75)	Adequate (.70)
Category Switching Total	Monitoring	Marginal (0.53-.76)	Marginal (.65)
Category Switching Accuracy	Monitoring	Low (.37-.62)	Low (.53)
Color Word Interference			
Condition 3: Inhibition	Inhibition	*	Very High (.90)
Condition 4: Inhibition/Switching	Inhibition	*	High (.80)
Sorting Test			
Category 1: Free Sorting	Conceptual Flexibility	Adequate (.55-.82)	Low (.49)
Category 2: Free Sorting Description	Conceptual Flexibility	Adequate (.55-.80)	Marginal (.67)
Category 3: Sort Recognition	Conceptual Flexibility	Adequate (.62-.74)	Low (.56)

Note. *No information provided in D-KEFS Technical Manual regarding the Internal Consistency for indicated items due to item-interdependences and ability for examinees to adjust their performance according to feedback and rehearsal on previous components.

Table 2.1

Correlation Matrix for D-KEFS Variables as a Function of Sample

Subtest	1	2	3	4	5	6	7	8	9	10
1. TMT_CT4	—	.24*	.34**	.26*	.34**	.39**	.34**	.37**	.38**	.43**
2. VF_letter	.24**	—	.55**	.30**	.27**	.32**	.20	.32**	.33**	.34**
3. VF_catflu	.31**	.49**	—	.44**	.35**	.25*	.28**	.38**	.39**	.40**
4. VF_catsco	.23**	.31**	.42**	—	.86**	.25*	.20	.18	.22*	.25*
5. VF_catswiacc	.25**	.25**	.30**	.87**	—	.31**	.23*	.30**	.34**	.37**
6. CWIT3	.36**	.23**	.19**	.26**	.29**	—	.55**	.23*	.21*	.21
7. CWIT4	.30**	.11**	.15*	.20**	.25**	.53**	—	.17	.19	.24*
8. Sort1a	.34**	.23**	.33**	.22**	.29**	.25**	.18*	—	.96**	.69**
9. Sort1b	.34**	.27**	.35**	.25**	.32**	.24**	.20**	.95**	—	.74**
10. Sort2	.33**	.24**	.35**	.26**	.32**	.25**	.20**	.72**	.77**	—

Note. Correlations for victimized subsample of participants (*n* = 92) are presented above the diagonal, and correlations for the full sample of juvenile delinquents (*n* = 188) are presented below the diagonal. TMT_CT4 = Trail Making Test, Condition 4: Number-Letter Switching; VF_letter = Verbal Fluency, Letter Fluency; VF_catflu = Verbal Fluency, Category Fluency; VF_catsco = Verbal Fluency, Category Switching Total; VF_catswiacc = Verbal Fluency, Category Switching Accuracy; CWIT3 = Color-Word Interference, Condition 3: Inhibition; CWIT4 = Color-Word Interference, Condition 4: Inhibition/Switching; Sort1a = Sorting Test, Category 1a: Free Sorting; Sort1b = Sorting Test, Category 1b: Free Sorting Description; Sort2 = Sorting Test, Category 2: Sort Recognition.
*$p < .05$, **$p < .01$

Table 2.2

Correlation Matrix for Delinquent Offending and Trauma Variables

Characteristic	1	2	3	4	5	6	7	8	9	10	11
1. JSO vs. NJSO	—	-.41	-.31**	-.00	-.00	-.01	.19	-.19	-.13	-.02	.14
2. Age at Intake	-.38	—	.08	-.03	.03	.04	-.05	.05	.10	-.04	-.06
3. Age First Trauma	.09	.02	—	.34**	-.34**	-.36**	-.52**	.52**	-.06	.41**	-.40**
4. FreqOne	.17*	-.03	.70**	—		-.27**	-.36**	.36**	.20*	.57**	-.82**
5. FreqTwo	.12	.01	.22**	-.31**	—	.27**	.36**	-.36**	-.20*	-.57**	.82**
6. Duration of Trauma	.10	.02	.15*	.10	.41**	—	.37**	-.37**	.21*	-.38**	.21*
7. Incestuous	.27**	-.04	.39**	.31**	.56**	.53**	—		.23*	-.53**	.36**
8. Non-Incestuous	-.01	.02	.64**	.52**	-.07	-.13	-.30**	—	-.23*	.53**	-.36**
9. Type Physical	.03	.06	.29**	.40**	-.03	.34**	.43**	-.07	—	-.54**	-.37**
10. Type Sexual	.13	-.04	.65**	.72**	-.15*	-.06	.09	.65**	-.21**	—	-.58**
11. Type Combo	.18*	-.05	.12	-.27**	.85**	.35**	.52**	-.12	-.15*	-.22**	—

Note. Correlations for victimized subsample of participants (n = 92) are presented above the diagonal, and correlations for the full sample of juvenile delinquents (n = 188) are presented below the diagonal. FreqOne = Frequency of Traumatic Experience, Once; FreqTwo = Frequency of Traumatic Experience, Twice or More.
*$p < .05$, **$p < .01$

Table 2.3

Correlation Matrix for D-KEFS x *Offending and Trauma Variables for Full Sample*

Variable	JSO vs. NJSO	Age at Intake	Age First Trauma	FreqOne	FreqTwo	Duration of Trauma	Incestuous	Non-Incestuous	Type Physical	Type Sexual	Type Combo
TMT_CT4	.09	.03	.07	-.08	.19**	.10	.08	-.00	.04	-.10	.17*
VF_letter	-.02	.00	.03	-.06	.07	.00	.00	.01	.08	-.12	.07
VF_catflu	.04	-.01	-.04	-.20**	.20**	.06	.03	-.10	.07	-.21**	.14
VF_catsco	.07	-.05	.00	-.08	.01	-.02	-.09	.04	.00	-.07	-.02
VF_catswiacc	.04	.01	.01	-.07	.00	.03	-.04	-.00	.04	-.06	-.05
CWIT3	-.06	.12	-.00	.02	-.03	.07	-.04	.06	.10	-.04	-.05
CWIT4	-.07	.11	.03	-.02	-.02	.01	-.09	.09	.06	-.01	-.08
Sort1a	.18*	-.07	-.04	-.05	.02	-.06	-.01	-.01	.10	-.12	.02
Sort1b	.14	-.04	-.03	-.08	.06	-.10	-.01	-.01	.05	-.12	.04
Sort2	.09	-.02	-.02	-.05	.05	-.06	.02	-.02	.03	-.06	.04

Note. TMT_CT4 = Trail Making Test, Condition 4: Number-Letter Switching; VF_letter = Verbal Fluency, Letter Fluency; VF_catflu = Verbal Fluency, Category Fluency; VF_catsco = Verbal Fluency, Category Switching Total; VF_catswiacc = Verbal Fluency, Category Switching Accuracy; CWIT3 = Color-Word Interference, Condition 3: Inhibition; CWIT4 = Color-Word Interference, Condition 4: Inhibition/Switching; Sort1a = Sorting Test, Category 1a: Free Sorting; Sort1b = Sorting Test, Category 1b: Free Sorting Description; Sort2 = Sorting Test, Category 2: Sort Recognition. FreqOne = Frequency of Traumatic Experience, Once; FreqTwo = Frequency of Traumatic Experience, Twice or More.

*$p < .05$, **$p < .01$

Table 2.4

Correlation Matrix for D-KEFS x *Offending and Trauma Variables for Subsample.*

Variable	JSO vs. NJSO	Age at Intake	Age First Trauma	FreqOne	FreqTwo	Duration of Trauma	Incestuous	Non-Incestuous	Type Physical	Type Sexual	Type Combo
TMT_CT4	.09	.03	.01	-.25*	.25*	.10	.04	-.04	.01	-.20	.21*
VF_letter	-.02	.00	.09	-.12	.12	.01	.01	-.01	.12	-.21*	.11
VF_catflu	.04	-.01	-.02	-.31**	.31**	.11	.10	-.10	.11	-.29**	.22*
VF_catsco	.07	-.05	.14	-.06	.06	.01	-.09	.09	.04	-.05	.01
VF_catswiacc	.04	.01	.13	-.05	.05	.07	-.03	.03	.09	-.05	-.04
CWIT3	-.06	.12	.00	.04	-.04	.10	-.08	.08	.14	-.06	-.08
CWIT4	-.07	.11	.12	.00	-.00	.04	-.18	.18	.10	.01	-.12
Sort1a	.18*	-.07	-.02	-.06	.06	-.08	.00	-.00	.15	-.18	.05
Sort1b	.14	-.04	-.02	-.12	.12	-.10	.00	-.00	.11	-.17	.09
Sort2	.09	-.02	-.03	-.10	.10	-.10	.02	-.02	.60	-.11	.07

Note. TMT_CT4 = Trail Making Test, Condition 4: Number-Letter Switching; VF_letter = Verbal Fluency, Letter Fluency; VF_catflu = Verbal Fluency, Category Fluency; VF_catsco = Verbal Fluency, Category Switching Total; VF_catswiacc = Verbal Fluency, Category Switching Accuracy; CWIT3 = Color-Word Interference, Condition 3: Inhibition; CWIT4 = Color-Word Interference, Condition 4: Inhibition/Switching; Sort1a = Sorting Test, Category 1a: Free Sorting; Sort1b = Sorting Test, Category 1b: Free Sorting Description; Sort2 = Sorting Test, Category 2: Sort Recognition. FreqOne = Frequency of Traumatic Experience, Once; FreqTwo = Frequency of Traumatic Experience, Twice or More.

$*p < .05$, $**p < .01$

Table 3

Descriptive Statistics as a Function of Delinquent Group Status for Full and Subsample of Delinquents

	Full			Subsample		
	Overall	JSO	NJSO	Overall	JSO	NJSO
Variable	*M* (*SD*)	*M* (*SD*)	*M* (*SD*)	*M* (*SD*)	*M* (*SD*)	*M* (*SD*)
JSO vs. NJSO	.68 (.47)	1.00 (0.00)	0.00 (0.00)	.79 (.41)	1.00 (0.00)	0.00 (0.00)
Age at Intake	194.07 (17.65)	189.42 (18.85)	203.75 (9.14)	193.66 (19.11)	189.66 (19.23)	209.05 (7.18)
Age First Trauma				8.30 (4.21)	7.64 (3.91)	10.84 (4.48)
FreqOne	.31 (.46)	.36 (.48)	.20 (.40)	.63 (.49)	.63 (.49)	.63 (.50)
FreqTwo	.18 (.39)	.21 (.41)	.11 (.32)	.37 (.49)	.37 (.49)	.37 (.50)
Duration of Trauma				34.24 (54.51)	34.03 (53.07)	35.05 (61.26)
Incestuous	.35 (.48)	.43 (.50)	.16 (.37)	.70 (.46)	.74 (.44)	.53 (.51)
Non-Incestuous	.14 (.35)	.14 (.35)	.15 (.36)	.30 (.46)	.26 (.44)	.47 (.51)
Type Physical	.13 (.34)	.13 (.34)	.11 (.32)	.26 (.44)	.23 (.43)	.37 (.50)
Type Sexual	.22 (.42)	.26 (.44)	.15 (.36)	.46 (.50)	.45 (.50)	.47 (.51)
Type Combo	.14 (.35)	.18 (.39)	.05 (.22)	.28 (.45)	.32 (.47)	.16 (.38)
TMT_CT4	6.63 (3.41)	6.83 (3.41)	6.20 (3.41)	6.89 (3.49)	7.04 (3.50)	6.32 (3.50)
VF_letter	8.37 (2.76)	8.34 (2.59)	8.44 (3.09)	8.37 (2.63)	8.32 (2.78)	8.58 (2.04)
VF_catflu	8.74 (2.98)	8.83 (3.11)	8.56 (2.69)	8.64 (3.31)	8.64 (3.40)	8.63 (3.06)
VF_catsco	8.12 (3.19)	8.27 (3.24)	7.82 (3.07)	7.89 (3.48)	7.92 (3.52)	7.79 (3.39)
VF_catswiacc	9.02 (2.94)	9.09 (3.04)	8.85 (2.73)	8.84 (3.29)	8.78 (3.33)	9.05 (3.24)
CWIT3	7.88 (2.90)	7.76 (3.05)	8.11 (2.58)	7.87 (3.09)	7.67 (3.29)	8.63 (2.09)
CWIT4	8.28 (2.98)	8.13 (3.06)	8.59 (2.82)	8.20 (2.96)	7.85 (3.00)	9.53 (2.44)
Sort1a	7.68 (2.82)	8.02 (2.79)	6.97 (2.91)	7.59 (2.91)	7.69 (2.94)	7.17 (2.83)
Sort1b	7.67 (2.98)	7.96 (2.94)	7.07 (3.01)	7.58 (3.09)	7.58 (3.18)	7.56 (2.81)
Sort2	6.43 (3.18)	6.62 (3.12)	6.03 (3.30)	6.40 (2.95)	6.41 (2.89)	6.39 (3.29)

Note. Values missing from table are inapplicable.

Table 4.1

Unstandardized and Standardized Path Estimates: Age of First Traumatic Experience

Pathway	Estimate	*SE*	*StdYX*	*p-value*
Inhibition				
by TMTCT4	na	na	.68	na
by CWIT3	.88	.28	.68	< .01
by CWIT4	.74	.24	.60	< .01
Conceptual Flexibility				
by Sort1a	na	na	.78	na
by Sort2	1.15	.26	.89	< .001
Monitoring				
by VFletter	na	na	.61	na
by VFcatflu	1.50	.34	.73	< .001
by VFcatsco	1.11	.30	.52	< .001
by VFcatswiacc	1.17	.32	.57	< .001
VFcatsco with VFcatswiacc	6.31	1.29	.80	< .001
Direct Effects				
Group Membership (NJSO vs. JSO) on AgeAbuse	-.11	.04	-.31	< .01
Group Membership on Age at Intake	-.05	.02	-.66	.02
Indirect Effects				
Inhibition on AgeAbuse	.03	.07	.06	.66
Flexibility on AgeAbuse	-.02	.06	-.03	.78
Monitor on AgeAbuse	.05	.05	.12	.37
Group Membership on Inhibition	-.14	.18	-.22	.44
Group Membership on Flexibility	< .01	.15	.01	.37
Group Membership on Monitoring	.15	.32	.16	.64
Latent Factor Correlations				
Inhibition with Flexibility	2.70	1.08	.50	.01
Flexibility with Monitoring	2.30	.66	.64	< .001
Monitoring with Inhibition	2.50	.94	.67	< .01

Note. Unstandardized loadings could not be provided for some indicators due to handling scale dependency and are indicated by “na.”

Table 4.2

Unstandardized and Standardized Path Estimates: Duration of Traumatic Victimization

Pathway	Estimate	*SE*	*StdYX*	*p-value*
Inhibition				
by TMTCT4	na	na	.69	na
by CWIT3	.87	.27	.68	< .01
by CWIT4	.75	.24	.61	< .01
Conceptual Flexibility				
by Sort1a	na	na	.79	na
by Sort2	1.14	.27	.89	< .001
Monitoring				
by VFletter	na	na	.62	na
by VFcatflu	1.48	.33	.74	< .001
by VFcatsco	1.07	.29	.50	< .001
by VFcatswiacc	1.13	.30	.56	< .001
VFcatsco with VFcatswiacc	6.60	1.22	.81	< .001
Direct Effects				
Group Membership (NJSO vs. JSO) on Duration	< .01	< .01	.02	.87
Group Membership on Age at Intake	-.05	.02	-.67	< .01
Indirect Effects				
Inhibition on Duration	< .01	< .01	.13	.35
Flexibility on Duration	< -.01	< .01	-.10	.42
Monitor on Duration	< .01	< .01	.14	.55
Group Membership on Inhibition	-.15	.16	-.26	.35
Group Membership on Flexibility	.06	.13	.10	.65
Group Membership on Monitoring	.08	.27	.09	.77
Latent Factor Correlations				
Inhibition with Flexibility	2.75	1.06	.52	< .01
Flexibility with Monitoring	2.36	.66	.65	< .001
Monitoring with Inhibition	2.52	.96	.66	< .01

Note. Unstandardized loadings could not be provided for some indicators due to handling scale dependency and are indicated by “na.”

Table 4.3

Unstandardized and Standardized Path Estimates: Frequency of Traumatic Experiencing

Pathway	Estimate	*SE*	*StdYX*	*p-value*
Inhibition				
by TMTCT4	na	na	.67	na
by CWIT3	.90	.20	.69	< .001
by CWIT4	.73	.18	.55	< .001
Conceptual Flexibility				
by Sort1a	na	na	.83	na
by Sort2	1.17	.19	.86	< .001
Monitoring				
by VFletter	na	na	.55	na
by VFcatflu	1.33	.25	.69	< .001
by VFcatsco	1.21	.24	.58	< .001
by VFcatswiacc	1.07	.22	.56	< .001
VFcatsco with VFcatswiacc	5.18	.74	.82	< .001
Direct Effects				
Group Membership (NJSO vs. JSO) on Freq Once	.80	.27	.29	< .01
Group Membership (NJSO vs. JSO) on Freq Twice+	.84	.32	.25	.01
Group Membership on Age at Intake	-.04	< .01	-.54	< .001
Indirect Effects				
Inhibition on Freq Once	-.06	.44	-.01	.89
Flexibility on Freq Once	-.29	.43	.03	.50
Monitor on Freq Once	-.52	.33	-.16	.11
Inhibition on Freq Twice+	.44	.58	.08	.45
Flexibility on Freq Twice+	.17	.57	.03	.77
Monitor on Freq Twice+	.30	.38	.08	.43
Group Membership on Inhibition	-.03	.09	-.05	.76
Group Membership on Flexibility	.11	.07	.20	.11
Group Membership on Monitoring	-.02	.15	-.03	.90
Latent Factor Correlations				
Inhibition with Flexibility	2.53	.71	.49	< .001
Flexibility with Monitoring	1.93	.43	.56	< .001
Monitoring with Inhibition	1.98	.58	.60	< .01

Note. Unstandardized loadings could not be provided for some indicators due to handling scale dependency and are indicated by "na."

Table 4.4

Unstandardized and Standardized Path Estimates: Relationship to Perpetrator of Traumatic Experience

Pathway	Estimate	*SE*	*StdYX*	*p-value*
Inhibition				
by TMTCT4	na	na	.66	na
by CWIT3	.88	.19	.68	< .001
by CWIT4	.72	.17	.55	< .001
Conceptual Flexibility				
by Sort1a	na	na	.83	na
by Sort2	1.17	.19	.86	< .001
Monitoring				
by VFletter	na	na	.55	na
by VFcatflu	1.34	.24	.58	< .001
by VFcatsco	1.22	.24	.58	< .001
by VFcatswiacc	1.08	.22	.56	< .001
VFcatsco with VFcatswiacc	5.12	.77	.82	< .001
Direct Effects				
Group Membership (NJSO vs. JSO) on Non-Incest	.44	.32	.12	.17
Group Membership (NJSO vs. JSO) on Incest	1.02	.28	.33	< .001
Group Membership on Age at Intake	-.04	< .01	-.53	< .001
Indirect Effects				
Inhibition on Non-Incest	.44	.57	.07	.44
Flexibility on Non-Incest	-.13	.52	-.02	.81
Monitor on Non-Incest	-.14	.43	-.03	.74
Inhibition on Incest	.02	.45	< .01	.96
Flexibility on Incest	-.01	.44	< -.01	.98
Monitor on Incest	-.14	.31	-.05	.65
Group Membership on Inhibition	-.02	.10	-.03	.84
Group Membership on Flexibility	.10	.07	.18	.14
Group Membership on Monitoring	-.03	.16	-.03	.87
Latent Factor Correlations				
Inhibition with Flexibility	2.57	.72	.49	< .001
Flexibility with Monitoring	1.96	.42	.56	< .001
Monitoring with Inhibition	2.03	.61	.60	< .01

Note. Unstandardized loadings could not be provided for some indicators due to handling scale dependency and are indicated by "na."

Table 4.5

Unstandardized and Standardized Path Estimates: Type of Traumatic Victimization

Pathway	Estimate	*SE*	*StdYX*	*p-value*
Inhibition				
by TMTCT4	na	na	.75	na
by CWIT3	.80	.22	.74	< .001
by CWIT4	.51	.18	.49	< .01
Conceptual Flexibility				
by Sort1a	na	na	.76	na
by Sort2	1.44	.36	.98	< .001
Monitoring				
by VFletter	na	na	.53	na
by VFcatflu	1.12	.29	.54	< .001
by VFcatsco	1.51	.45	.64	< .01
by VFcatswiacc	1.24	.39	.60	< .01
VFcatsco with VFcatswiacc	4.04	1.14	.73	< .001
Direct Effects				
Group Membership (NJSO vs. JSO) on Physical	.93	.59	.18	.11
Group Membership (NJSO vs. JSO) on Sexual	.86	.49	.22	.08
Group Membership (NJSO vs. JSO) on Combo	< .01	< .01	.15	.26
Group Membership on Age at Intake	-.06	.02	-.69	.01
Indirect Effects				
Inhibition on Physical	.96	1.40	.11	.49
Flexibility on Physical	.57	.98	.08	.56
Monitor on Physical	1.07	.66	.23	.11
Inhibition on Sexual	.63	.97	.09	.52
Flexibility on Sexual	-.49	.61	-.09	.42
Monitor on Sexual	-.58	.48	-.16	.23
Inhibition on Combo	< .01	< .01	.14	.32
Flexibility on Combo	< .01	< .01	.08	.48
Monitor on Combo	< .001	< .01	.02	.88
Group Membership on Inhibition	-.09	.12	-.16	.47
Group Membership on Flexibility	.05	.09	.06	.59
Group Membership on Monitoring	.16	.23	.14	.49
Latent Factor Correlations				
Inhibition with Flexibility	2.58	1.15	.46	.03
Flexibility with Monitoring	1.03	.50	.37	.04
Monitoring with Inhibition	2.28	1.01	.66	.02

Note. Unstandardized loadings could not be provided for some indicators due to handling scale dependency and are indicated by "na."

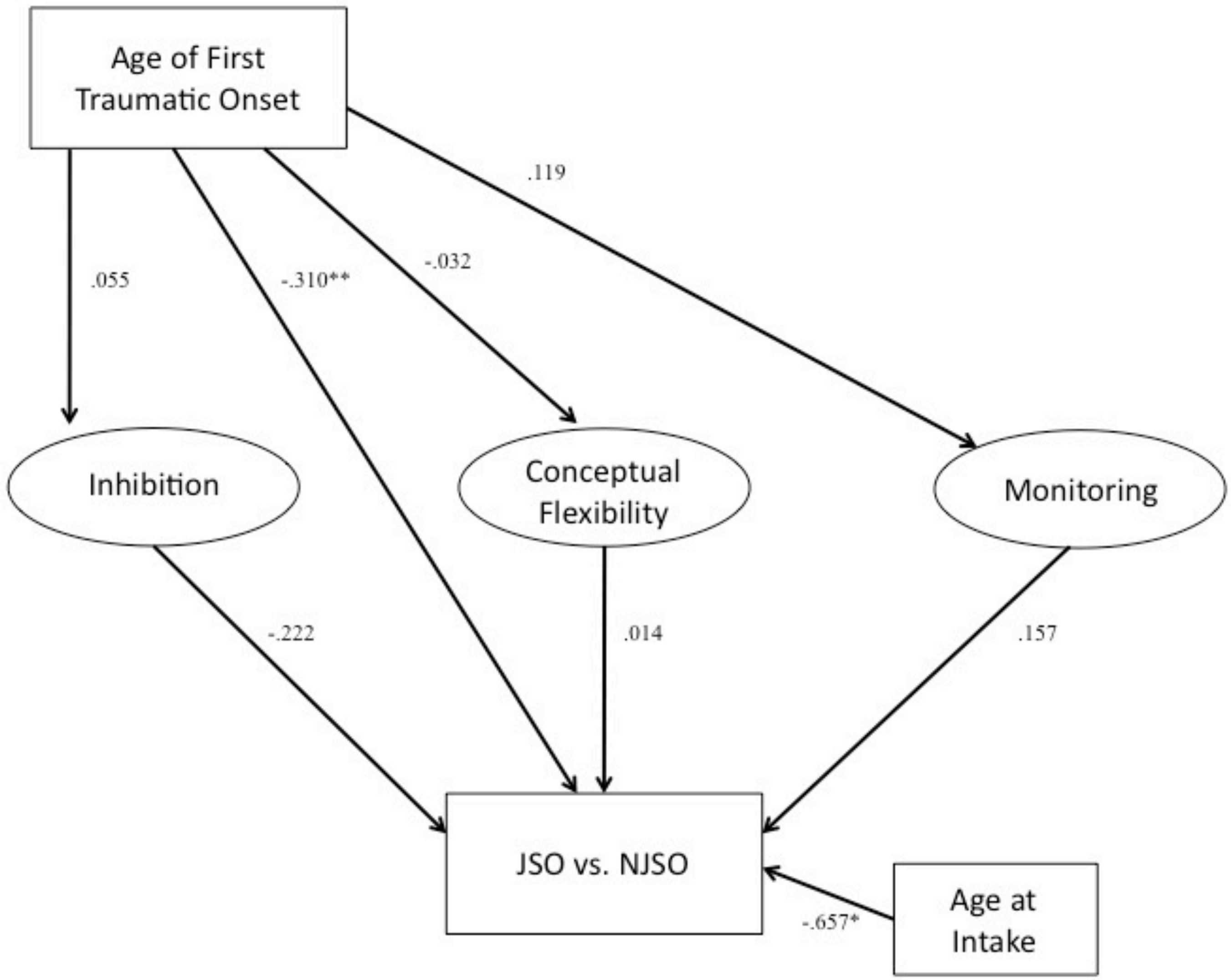

Figure 1.1. Age of first traumatic experience. Final model with standardized (*StdYX*) loadings. Latent variable item loadings, disturbance terms, and latent variable correlations not depicted. Estimates of latent factor correlations: Inhibition with Conceptual Flexibility *StdYX* = .504*, Conceptual Flexibility with Monitoring = .642***, Monitoring with Inhibition = .665**. For estimates of latent variable loadings, refer to Table 4.1.
*$p < .05$, **$p < .01$, or ***$p < .001$.

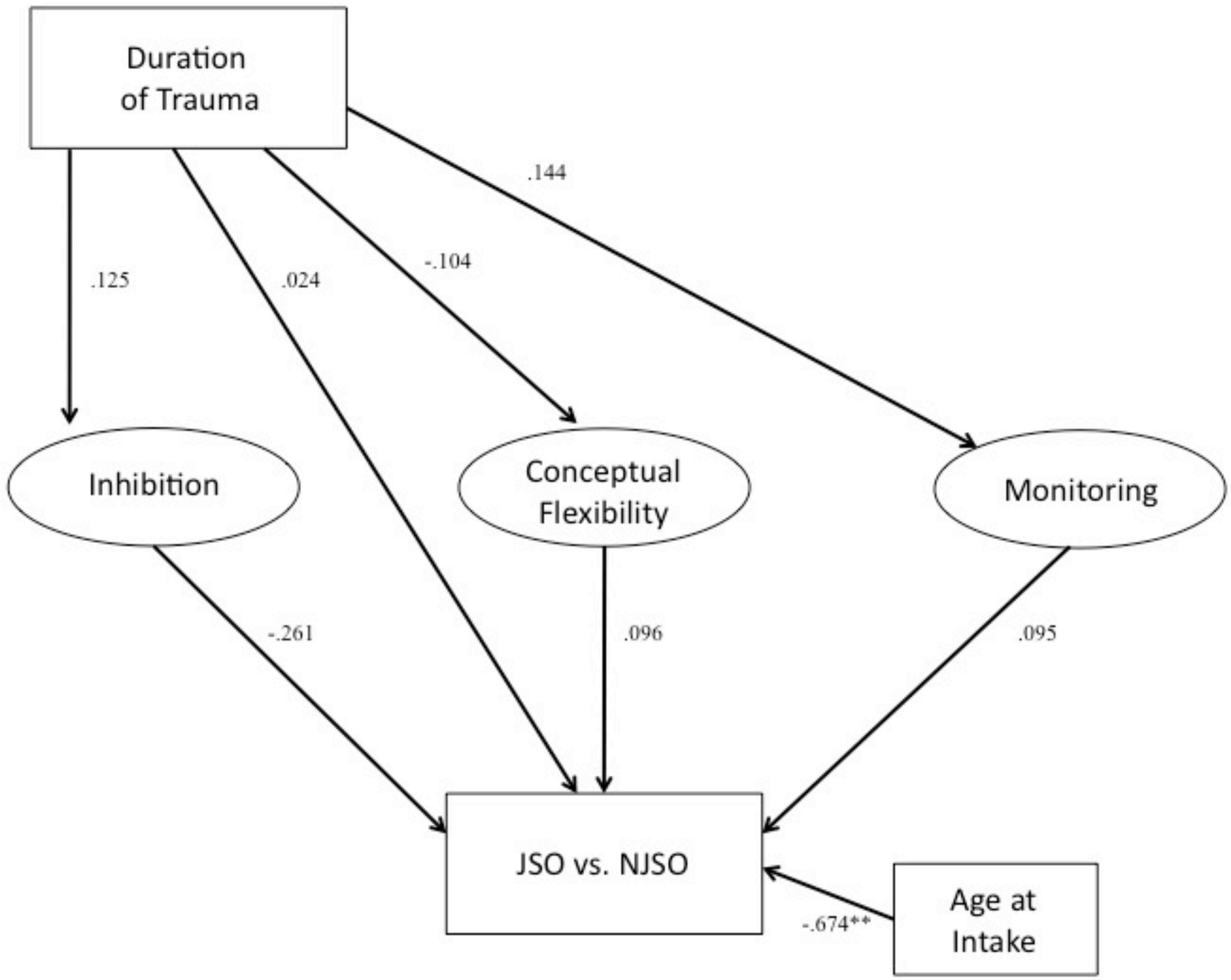

Figure 1.2. Duration of traumatic victimization. Final model with standardized (*StdYX*) loadings. Latent variable item loadings, disturbance terms, and latent variable correlations not depicted. Estimates of latent factor correlations: Inhibition with Conceptual Flexibility *StdYX* = .517**, Conceptual Flexibility with Monitoring = .647***, Monitoring with Inhibition = .662**. For estimates of latent variable loadings, refer to Table 4.2.
*$p < .05$, **$p < .01$, or ***$p < .001$.

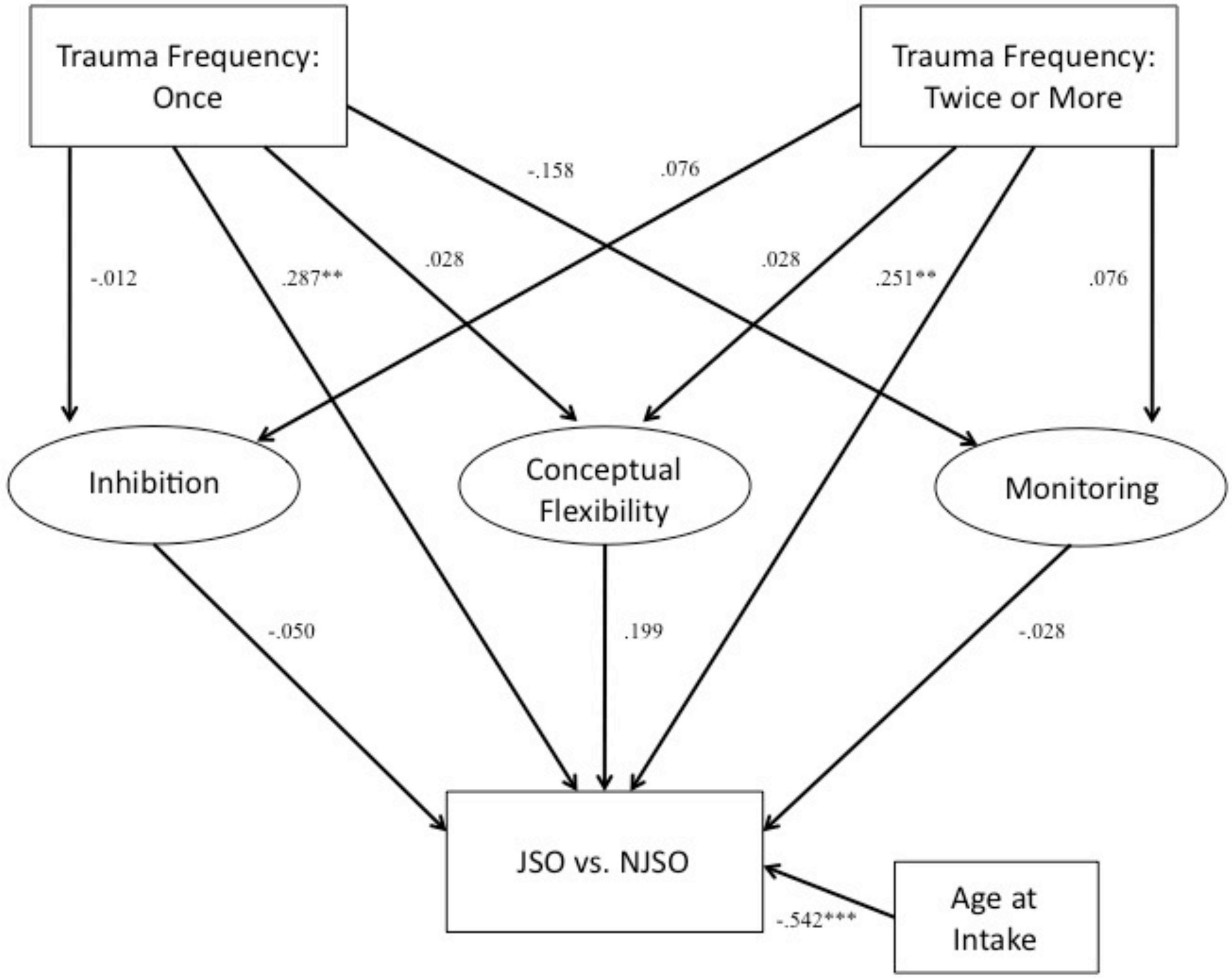

Figure 1.3. Frequency of traumatic experiencing. Final model with standardized (*StdYX*) loadings. Latent variable item loadings, disturbance terms, and latent variable correlations not depicted. Estimates of latent factor correlations: Inhibition with Conceptual Flexibility *StdYX* = .489***, Conceptual Flexibility with Monitoring = .555***, Monitoring with Inhibition = .601**. For estimates of latent variable loadings, refer to Table 4.3.
*p < .05, **p < .01, or ***p < .001.

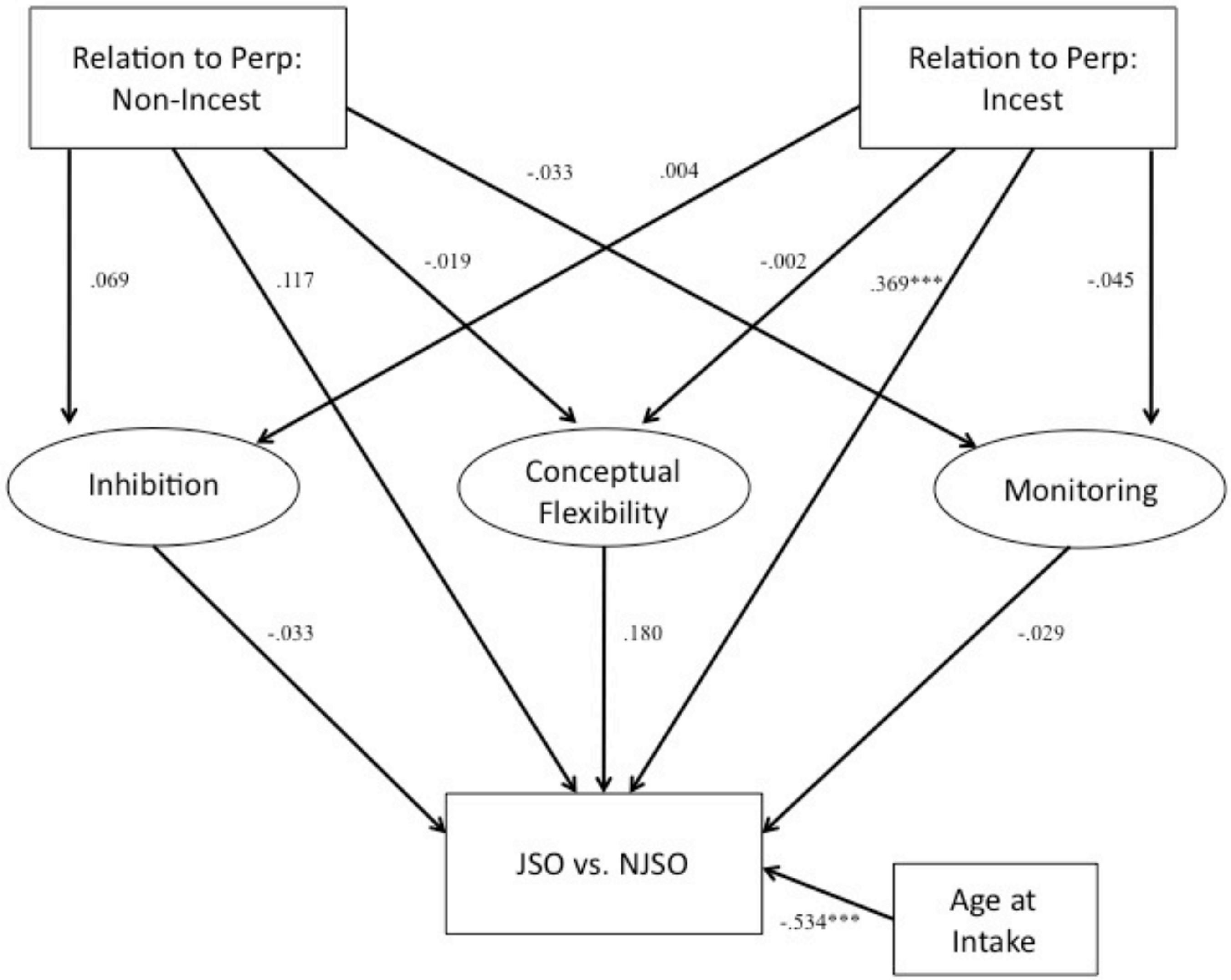

Figure 1.4. Relationship to perpetrator of traumatic experience. Final model with standardized (*StdYX*) loadings. Latent variable item loadings, disturbance terms, and latent variable correlations not depicted. Estimates of latent factor correlations: Inhibition with Conceptual Flexibility *StdYX* = .491***, Conceptual Flexibility with Monitoring = .558***, Monitoring with Inhibition = .603**. For estimates of latent variable loadings, refer to Table 4.4.
*p < .05, **p < .01, or ***p < .001.

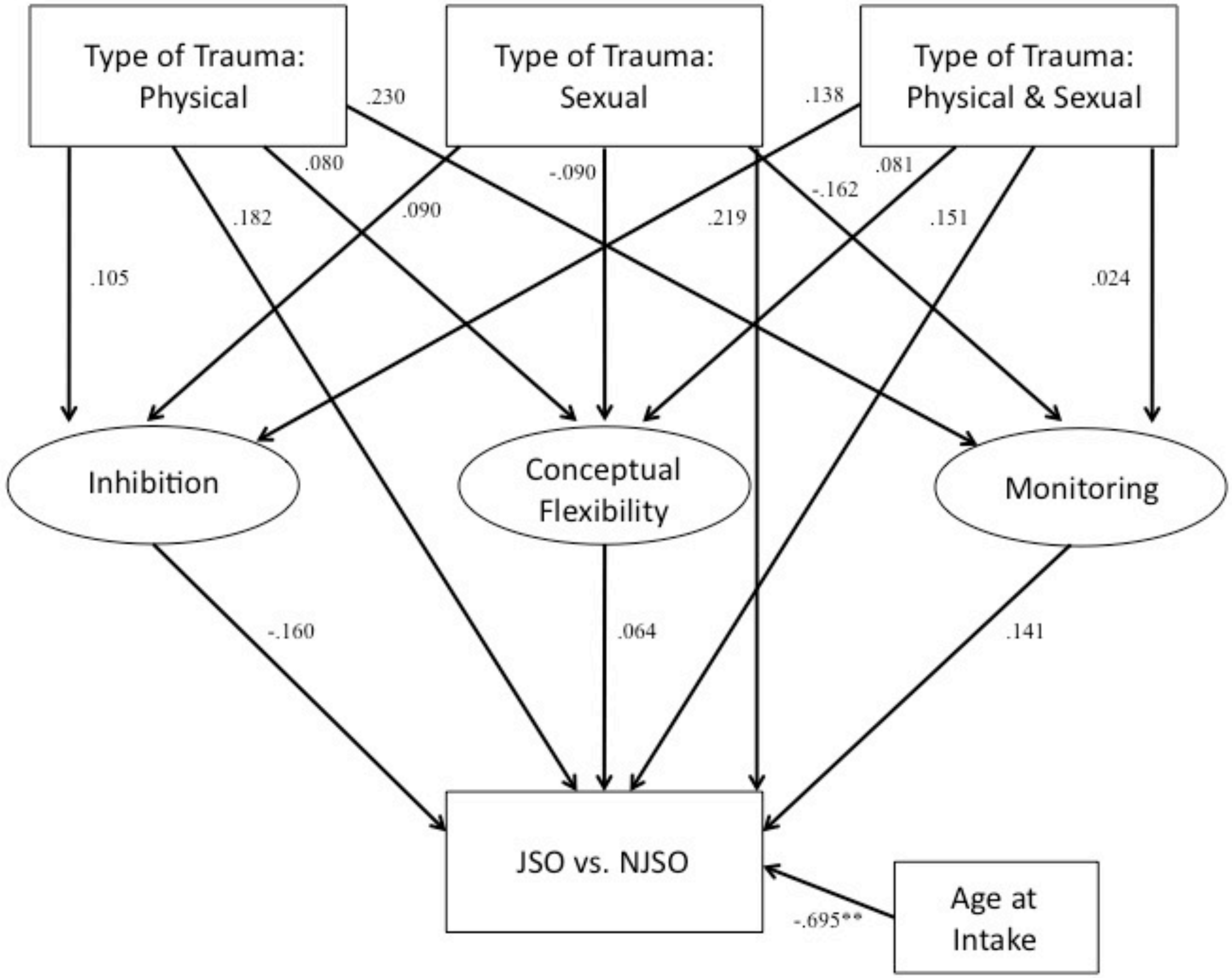

Figure 1.5. Type of traumatic victimization. Final model with standardized (*StdYX*) loadings. Latent variable item loadings, disturbance terms, and latent variable correlations not depicted. Estimates of latent factor correlations: Inhibition with Conceptual Flexibility *StdYX* = .462*, Conceptual Flexibility with Monitoring = .374*, Monitoring with Inhibition = .655*. For estimates of latent variable loadings, refer to Table 4.5.

*$p < .05$, **$p < .01$, or ***$p < .001$.