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Typologies of Violence Exposure and Cognitive Processing in Incarcerated Male Adolescents

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Abstract

Incarcerated youth experience high rates of violence exposure (VE), cognitive processing (CP) deficits, and mental health (MH) problems. It is not clear whether VE combined with CP deficits are particularly salient risk factors for MH dysfunction. Male incarcerated youth offenders (n = 115) completed standardized self-reports of MH and VE. CP was measured with executive functioning tasks and academic assessments. Person-centered Ward's Squared Euclidian Distance cluster analysis was used to examine unique patterns of CP and VE. Cluster analysis defined five distinct profiles of MH functioning, CP, and VE rates within incarcerated adolescents. Two groups, with high rates of VE and CP deficits, showed high rates of MH problems. Linear techniques may obscure important differences within this population.

Keywords

Family Violence; Executive Function; Disability; Incarcerated Youth

Incarcerated populations have higher rates of problems in multiple domains including, social (Dembo & Schmeidler, 2003), academic (Alltucker, Bullis, Close, & Yovanoff, 2006; Traynelis-Yurek & Giacobbe, 1988) and mental health (MH; Brower & Price, 2001; Cockram, 2005; Murphy, 1986). Current functioning and later recidivism are likely influenced by these factors and the interdependence between them. Prior violence exposure (VE) may be a predisposing factor that influences these other factors.

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Exposure to Family Violence and Mental Health

Exposure to family violence has been shown to be a risk factor for later crime and MH problems in a number of at-risk populations (Lang & Stover, 2008). Recent research has shown that type of VE is less important than the severity, degree or extent of VE in children (Graham-Bermann & Perkins, 2010; Higgins, 2004). Using cluster analysis, several studies have explored MH problems in both normative and at-risk populations. Higher internalizing MH problems are related to higher rates of child abuse and tendency toward suicidal and borderline behavior (Scarborough, Glaser, Calhoun, & Stefurak, 2004). Within incarcerated groups, MH problems are associated with early starting of criminal behavior (Goethals, Willigenburg, Buitelaar, & Van Marle, 2008). It is not clear whether internalizing, externalizing or problems in both domains relate to worse outcomes. Still, risks for delinquency and aggressive behavior may include other factors, beyond exposure to violence, such as deficits in cognitive processing (CP).

Cognitive Processing in Incarcerated Populations

Incarcerated populations have significantly lower rates of achievement and higher rates of special education than the general population (Malmgren & Leone, 2000; Murphy, 1986; Traynelis-Yurek & Giacobbe, 1988). Incarcerated youth with learning disabilities are more likely to have failed a grade than other youth with learning disabilities (Bullis & Yovanoff, 2005) and late starters of criminal behavior are more likely to have a learning disability than early starters (Alltucker, Bullis, Close, & Yovanoff, 2006). In the 1980s, incarcerated populations had almost triple the rate of disabilities than non-incarcerated populations (Murphy, 1986; Westat, 2005); between 28% and 42% of incarcerated juvenile offenders have been diagnosed with disabilities, as compared to approximately 8.9% in the general population, and these rates have remained stable.

Few studies have examined CP, broadly construed as the mental operations used to learn and retain information, in incarcerated populations directly. However, it is reasonable to conclude that learning disabilities and achievement problems in this group would be associated with underlying CP deficits, such as decreased attention, worse memory or more impulsive decision-making that challenge the ability to acquire knowledge, recall and process information. One of the earliest studies found decreased attention in delinquent adolescents compared to control teens (Hurt & Naglieri, 1992). Later studies have suffered from difficulty in obtaining a control group appropriately matched to such a high-risk sample as incarcerated populations. Although, Hoaken, Allaby, and Earle (2007) found violent and non-violent offenders had worse memory and learning scores than controls. The non-offender control group in this study was younger and had significantly higher education levels, which were not controlled for in later analyses, making assessment of their findings difficult. During a decision making, task (the Iowa Gambling Task) offenders have been shown to make more impulsive decisions than age-matched controls (Yechiam et al., 2008), and Herrero, Escorial, and Colom (2010) reported comparative deficits in memory function in offenders. In both these studies there were intelligence quotient (IQ) differences between offenders and controls, which needs to be considered in interpretation of the findings.

Linking Cognitive Processing and Mental Health

Deficits in CP might be central to problems in functioning in both the academic and MH realms (Brower & Price, 2001), specifically in the domain of executive function (EF). As CP involves basic awareness, perception and storing of knowledge, higher order processes, such as EF presuppose the availability of that knowledge. EF is the ability to plan, flexibly sift cognitive sets, organize, and delay pre-potent responses to reach more complex goals. Children with maltreatment histories exhibit performance deficits in a number of EF domains (Beers & De Bellis, 2002) and show deficits in the medial prefrontal cortex (mPFC), which is an area involved in processing at the neuroanatomical level (Carrion, Garrett, Menon, Weems, & Reiss, 2008). These EF deficits may be associated with changes in neural substrates resulting from VE or may be a risk factor for behavioral change following VE. Among forensic patients, performance on tests of EF predicts aggression during the subsequent year (Foster et al., 1993), suggesting a link between cognition and behavior.

Summary

Incarcerated youth have multiple risk factors in related domains including prior VE, CP, and MH problems. Having multiple risk factors is associated with worse outcomes in achievement, social interactions, emotional processing, drug use and criminal behavior. Compounding matters, self-selection and placement in academic settings results in peer groups with both low achievement and high behavior problems. One mechanism that might partially account for these problems is a deficit in CP, specifically in the area of EF. Interactions among these three domains, VE, CP, and MH are unclear and have been given limited attention in both normative and incarcerated populations. Most studies to date report mean levels of various deficits for whole samples of delinquent or incarcerated adolescents. Yet it is undecided whether (and in what combination) these three domains represent these subjects. Probing person-centered typologies that are meaningfully different in this population could lead to more personalized intervention strategies for incarcerated and at risk youth. Cluster analysis is particularly useful for the study of complex interdependent phenomena that are frequently found in community-based research (Rapkin & Luke, 1993).

Cluster analysis is a technique that derives meaningful groups from the data by creating groups where the association among members within groups is maximized and the association among groups is minimized. This approach is considered “person-centered” rather than variable centered because the focus is on underlying relationships among individuals in the dataset rather than on a priori groups determined by variables (such as demographic variables). Understanding subgroups in a population is important because it allows researchers to define groups of individuals seen in clinical or educational settings and predict diverse outcomes or understand particularly dangerous combinations of risk factors. In response to this need, there has been an upsurge of cluster analysis research in the last several years. Research has shown several ways in which incarcerated populations are diverse. Youth entering the justice system differ on the types of offenses committed, history of physical abuse and psychological and emotional functioning (Dembo & Schmeidler, 2003).

Study Hypotheses

History of VE is related to CP deficits and MH problems, particularly externalizing behavior, however, it remains to be determined if a history of VE combined with CP deficits is predictive of high rates of MH problems. Therefore, Hypothesis 1 is that higher incidence of VE combined with CP deficits will be associated with variance in MH problems. Here CP is defined as both academic achievement and EF.

Ascertaining the interdependence between VE, MH functioning, and CP in an incarcerated population is a problem that has received limited prior study. Cluster analysis is an appropriate method for examining this interdependence because there are likely different patterns of problems that may compound each other or act to counterbalance each other within different groups of adolescents. In the present study, achievement, CP and history of VE are used to ascertain whether different groups of adolescents with similar experiences can be successfully identified. Hypothesis 2 is that typologies of groups exist within this population in terms of VE, EF, and intellectual and academic functioning. Finally, the literature on the relation between VE and MH, academic achievement, and EF and MH outcomes does not suggest a clear pattern of causal relations. It may be that there are naturally occurring groups with different combinations of levels of VE and CP and that those groups have different levels and types of MH problems. Hypothesis 3 is that typologies derived from hypothesis 2 will differ in MH functioning.

Method

Design

The study was conducted at a boys' training school at a youth incarceration facility in Michigan. Institutional Review Board approval was received from the University of Michigan and the State of Michigan Department of Human Services. A Certificate of Confidentiality was obtained from the Department of Health and Human Services. Following IRB approval, consent was obtained for the study from parents or the court (for wards of the state) before asking the minors for assent to participate. Letters were sent to parents of all youth under 18 years with consent documents attached. If there was no response after two letters, and the juveniles were covered under Delinquency Act 150, we asked that the State Department of Human Services give permission for the youth to participate in the study. Legal adults (youth over 18 years old) were asked to sign participant consent. After parent/guardian, court, or Human Services permission was granted, each youth was contacted individually to obtain assent. The participation rate was approximately 75%. Youth were not compensated directly for participation in the study. Instead, a donation was made to the facility for the purchase of recreational equipment. The study design included survey data, individual cognitive and neuropsychological assessment, and educational records review.

Participants

The sample consisted of 115 males that ranged in age from 13 to 20 years with a mean age of 17 years (*SD* = 1.304). The participants were almost evenly split among African

American (28.3%), Caucasian (31.3%), and youth who self-identified as mixed ethnicity (36%). The last grade completed was seventh grade through the first year of college with a mean of 10th grade (*SD* = 1.562). Reading ability ranged from first grade to college reading level. Educational records showed that 74% had a current Individual Education Plan (IEP). Most of the boys (91%) were wards of the state, meaning that while in custody the state had taken over legal guardianship. Of the remainder, 6% were temporary court wards and the rest had some form of dual wardship. Fifty-two percent of the sample grew up in a two-parent home, 31% grew up with a single parent, and 13% in some other family configuration. Prior to current incarceration 90% of the sample reported that they had previously been in locked detention.

Procedure

Researchers explained that the study was voluntary and that no consequence positive or negative would result from participation or refusal to participate. If necessary, assistance with reading the surveys was provided. Each subject completed the cognitive tasks in groups of six using computers covered with privacy hoods. Normally cognitive tasks would be conducted in a private room, but this was not possible in the facility. The Wisconsin Card Sorting Test, intellectual assessment, and achievement measures were administered individually but in the same room where computerized cognitive tasks were being administered to other participants by other team members.

Measures

Family violence exposure—Family violence was measured using an adapted version of the Conflict Tactics Scale (CTS; Straus, 1990) to assess how conflicts in the family are handled on a five-point Likert Scale ranging from 1 (*never*) to 5 (*every day*) (Straus, 1990). The scale was amended to allow for more frequent abuse than more than 20 times a year. Our previous work has shown that some violence experiences occur daily. A measure of sibling violence was added in addition to maltreatment by parents and conflict between the parents (IPV). The scale was further adapted to query only the time prior to incarceration in two age groups, 6–12 years and 13–18 years. The number of scaled responses was diminished (from seven to six) for easier differentiation of responses over a longer recall period. Total scores were computed for each of the three types of violence by summing the scores across mild, moderate, and severe items. A combined total score also computed. All participants completed a larger survey including three dichotomous items assessing past physical, emotional, and sexual abuse, which were used to validate clusters.

Mental health—Behavior problems were assessed as part of the survey with the 118-item Youth Self-Report of the Child Behavior Checklist (Achenbach, 1991). Raw scores were converted to both broad-band (internalizing, externalizing, and total score) and narrow-band scales. Reliability of the eight narrow-band scales (Withdrawn, Somatic Complaints, Social Problem, Anxious/Depressed, Thought Problems, Attention Problems, Delinquency, and Aggression) ranged from α = .71 to .97. Converted T-scores were used in analyses.

Cognitive processing

Executive function: EF was assessed using the Behavior Rating of Executive Function – Self-Report (BRIEF-SR; Guy, Isquith, & Gioia, 2004), the Wisconsin Card Sorting Test Computerized Version 4 (WCST-CV4), and five computerized tasks: Go/No-Go, Anti-Saccade Arrows Task, Task Switching, the Flanker Task, and Shape Matching (Friedman & Miyake, 2004; Nigg, 2000; Rogers & Monsell, 1995).

The BRIEF-SR is an 80-item self-report measure with two subscales of self-regulation: metacognition and behavioral regulation (Guy, Isquith, & Gioia, 2004). In the present study, raw scores were converted to a Global Executive Composite percentile with a score over 50% representing an above average level of problems adjusted for age.

The WCST-CV4 is a test of strategic planning and cognitive set shifting. This neuropsychological test is used in a variety of settings and is thought to have the capacity to differentiate individuals with the neurological soft signs of potential prefrontal cortical damage. This type of damage can result from mild traumatic brain injury, seizures, birth trauma, or other brain disorders (Kongs, Thompson, Iverson, & Heaton, 2000). A target card must be matched with one of four cards on shape, color, and number. Raw scores were converted to T-scores. The WCST-CV4 measures errors (M = 44.82, SD = 11.95), perseverative responses (M = 46.69, SD = 11.29), perseverative errors (M = 46.30, SD = 11.48), non-perseverative responses (M = 44.95, SD = 11.22), and conceptual level responses (M = 44.77, SD = 11.24). T-scores at or below the mild-moderately impaired range, according to the manual, were considered a clinical score. A continuous “total clinical scale” was created based on the total number of subscales where individuals’ scores were greater than the clinical cut-off (range: 0–5). Thirty-four percent of the sample had at least one score in the clinical range on the WCST-CV4.

Our computerized battery included measures of distinct psychological processes encompassed in EF including response inhibition, task switching, and distractor interference. Response inhibition is the ability to inhibit a prepotent response, such as in the Stroop task (Stroop, 1935) where color words (e.g., “red”) are shown in a colored font (e.g., blue font). The participant is instructed to say the color of the font, however, reading the word is a prepotent, learned, and easily facilitated response. Suppressing the prepotent response to read “red”, instead of responding with a determination of the font color (blue), requires inhibition. Task switching requires the learning of procedures for two or more tasks and switching between them following a cue. Finally, distractor interference tasks are measures of attentional control used to focus on a discreet task with extraneous information present.

The Go/No-Go and the Anti-Saccade Arrows Task are response inhibition tasks (Nigg, 2000). Go/No-Go requires a response to the majority of cues (to press a button), however, a less frequent cue requires a non-response, forcing the participant to inhibit a prepotent response to “Go” when a cue appears. The Anti-Saccade Arrows Task is a visual processing measure that requires oculomotor inhibition (Friedman & Miyake, 2004; Nigg, 2000). Participants are required to visually saccade away from a cue (look to the side) in order to see the stimulus arrow, which is masked after 150 milliseconds (ms). Task Switching requires the participant to switch mental sets between two different tasks (Friedman &

Miyake, 2004; Rogers & Monsell, 1995). Participants were presented with task cues for 1,500 ms. They were then presented with letter number pairs and cued to shift their attention between the letter information and the number information, depending on the preceding cue. The switch cost, or the increase in reaction time when the sets are switching, was calculated. The Flanker Task and Shape Matching require resistance to distracter interference (Friedman & Miyake, 2004). In the Flanker Task, additional cues were presented that were not relevant to the task and produced distractor interference. During the Shape Matching task participants were asked to determine if two shapes were the same while they were covered with an unrelated squiggle. Reaction time and accuracy were measured for all tasks.

Academic achievement: Intelligence was assessed using the Kaufman Brief Intelligence Test, Second Edition (K-Bit-2; Kaufman & Kaufman, 2004), which provides a quick assessment of verbal and non-verbal ability. Reading, spelling, and arithmetic achievement were assessed with the Wide Range Achievement Test (WRAT-3; Wilkinson, 1993). WRAT-3 and K-BIT-2 raw scores were converted to standard scores and percentiles.

Analyses

To test Hypothesis 1, that higher incidence of VE combined with CP deficits will be associated with increased risk of MH problems, a variable-centered approach was used (hierarchical regression analysis). Total VE, from the CTS, was entered at the first level. CP was defined as both academic achievement and EF. To avoid collinearity, full scale IQ was entered as a proxy for all achievement variables at the second level. Finally, the WCST-CV4 total score was used as a general measure of EF and was entered at the third level with MH outcomes.

To examine Hypothesis 2, that typologies exist within this population, cluster analysis was used to derive naturally occurring, person-centered groups based on our constructs of interest. Levels of VE, academic achievement, and EF constructs were used to hypothesize typologies within the incarcerated cohort. Clusters were derived based on three VE scales from the CTS (parent maltreatment, interparental violence, and maltreatment by sibling), five measures of intelligence and academic achievement (K-BIT-2 verbal and non-verbal IQ, and WRAT-3 reading, spelling, and arithmetic standard scores), and two measures of EF (WCST-CV4 and BRIEF-SR total clinical scale). Three clustering methods were examined to obtain stable clusters, Ward's, single linkage, and centroid linkage methods with Squared Euclidean Distance. Ward's method Squared Euclidean Distance measure of dissimilarity is presented in the results. Squared Euclidean Distance is a measure of the distance between two vectors within a multidimensional space. Ward's method is an iterative method where groups are defined based on the distance between scores on clustering variables (in this case 10 variables). These groups are merged at iterative steps until one cluster is formed.

One-way ANOVAs were used to determine if the clusters differed on clustering variables. To validate the clusters, the five computerized tasks (EF) and three dichotomous abuse items (VE) were examined using one-way ANOVAs as independent measures of clustering constructs. Finally, chi-square, one-way ANOVAs and Tukey's honestly significant difference (HSD) tests were used to characterize these groups demographically.

To answer Hypothesis 3, that the typologies derived for hypothesis 2 will differ based on MH, a series of one-way ANOVAs were performed with the eight Youth Self Report (YSR) subscale outcome measures. Tukey's HSD comparisons were made of the clusters in regard to MH.

Missing data—Thirty-eight participants had missing data on some of the measures. Collection of complete records on all participants was difficult. A total of 38 participants were released without notice. In most cases, data collection was almost complete. These participants may represent a sub-population and, hence, their missing data cannot be considered random. Participants with missing data were compared to participants with complete data across demographics and other key variables. Group differences were not significant. To avoid excessive missing data, means were imputed using an iterative procedure. Missing data were imputed using parameter estimates that were obtained by performing a linear regression of main variables with the variable of interest as the outcome measure. These parameter estimates were then used to impute missing data. For each iteration, a new regression was run to obtain new parameter estimates using imputed data.

Results

Violence Exposure and Mental Health

There is a high prevalence of VE, MH problems, and CP (academic and EF) deficits in this sample. Fifty percent of the sample reported that they were currently taking medication prescribed by a psychiatrist and over 60% reported currently being in a sex offender treatment program. More than half of all participants reported each of the three types of VE, as measured by the modified CTS (see Table 1). Total mean child maltreatment ranged from 1.00 to 4.89 from a possible range of 1–5. This represents an average response of approximately two times a year, with reports of up to daily maltreatment. The mean for IPV between parents was reported to range from 1.00 to 4.78. For sibling maltreatment of the youth, means ranged from 1.00 to 4.47. Using the YSR clinical cut-off scores, it was determined that 20% of the population exceed the clinical cut-off for one of the eight subscales, with another 27% exceeding the cut-off for two or more subscales.

Cognitive Processing

Mean verbal and non-verbal IQ among participants was 91.69 (*SD* = 14.03) and 96.77 (*SD* = 14.43), respectively. Mean IQ composite scores are presented in Table 1. The mean math standard score (84.56, *SD* = 15.27) was one standard deviation below the national mean of 100. Reading and spelling means were, similarly, lower than the national mean (reading *M* = 89.24, *SD* = 15.78; spelling *M* = 84.56, *SD* = 15.99).

Behavioral data for the five computerized EF tasks are reported in Table 1. Switch cost and difference in reaction time are the differences in response time after the task switches or in the Flanker Task condition. T-scores for the WCST-CV4 correspond to the 30th and 37th percentile for youth 17 to 18 years old. With the exception of the YSR Withdrawn scale and the K-Bit-2 non-verbal scale, all CTS variables were not significantly related to academic and EF outcome scores (see table 2).

Hypothesis 1

All eight subscales of the YSR were examined to determine whether higher incidence of family VE (CTS) combined with lower CP (academic and EF) is associated with increased risk of behavior problems (see Table 3). Due to the multicollinearity between CP variables, the K-BIT-2 standard score was used as a proxy for academic achievement and WCST-CV4 was used as a proxy for EF in these analyses. Results indicate that the Social Problems and Withdrawn scales were associated with VE, and the Thought Problems scale was associated at the trend level. The addition of CP measures did not increase the association between VE and MH outcomes for these or for any of the other MH outcome measures. IQ and WCST-CV4 scores were negatively associated with delinquency, however, there was no association between delinquency and VE in the linear model.

Hypothesis 2

Cluster creation—To explore the diversity within the population, typologies were formed based on levels of VE and CP (academic and EF). A cluster analysis was performed using continuous scores on measures of family violence (parental maltreatment, IPV, and maltreatment by sibling), academic achievement (verbal and non-verbal IQ, reading, spelling, and arithmetic standard scores), and EF (WCST-CV4 and BRIEF-SR total clinical scores). As violence has been shown to disrupt academic achievement and challenge executive functioning in other studies, the common experience of individuals within the whole sample may be identified by clustering variables representing these three constructs (violence, achievement, and EF). Denodograms, agglomeration schedules, group means on clustering variables, and histograms were examined for each clustering solution to determine the best cluster solution. The six-cluster solution was rejected because the final cluster had only one participant. The four-cluster solution was rejected because two clusters combined from the five-cluster iteration differed on a theoretically meaningful measure. The two clusters that were joined in the four cluster solutions were both low on measures of CP, however, one was high and one was low on VE. The five-cluster solution, derived from the clustering technique, was determined to best represent the distinct groups derived from the data. One-way ANOVAs of clustering variables were conducted to determine whether clusters significantly differed on cluster variables (see Table 4).

The five cluster solution had two multiple risk groups (clusters 1 and 2, both with high violence and low cognition), one group with relative strength (cluster 3), and two groups with significant cognitive deficits but little VE (clusters 4 and 5). The two multiple risk groups were High VE/Low CP (n = 47) and the Mal/V Low CP (n = 11). The Mal/V Low CP group exhibited mostly evidence of maltreatment, with average IPV and sibling violence, and was far below average on CP measures (see Table 4). Thus, violence within the family, particularly maltreatment by parents and siblings, was evident in the first two at-risk clusters and linked with low and very low CP ability.

Cluster 3, the relative strength group, exhibited lower than average VE and higher than average CP (Low VE/High CP; n = 12). In this cluster, the exposure to less violence was linked to greater processing ability. Still, exposure to violence was not a strong contributor to the other three clusters of adolescents with definite cognitive challenges. The two groups

with significant cognitive challenges were the Low VE/V Low CP (Cluster 4; $n = 21$) and the Low VE/Very Low EF (Cluster 5; $n = 24$). These two groups with significant cognitive challenges were very similar. Both had deficits in multiple areas of cognition, however, the latter group showed particularly high performance deficits on EF (WCST-CV4; F (4, 88) = 77.228, $p < .001$), a test of frontal lobe functioning.

Cluster validation—Measures representing the same constructs, but not used in clustering, were examined to ascertain whether the clustering technique adequately distinguished between groups. Tukey's HSD test examined differences between groups on performance scores for the five computerized tasks and on three dichotomous variables querying past abuse (see Table 5).

The two multiple risk groups differed from the relative strength cluster on accuracy on the Anti-Saccade Arrows Task, performing no better than chance. The Mal/V Low CP group had correct hits less than 80% of the time, but they did not differ statistically from the relative strength cluster on the Go/No-Go task. There were no significant differences on the other three computerized measures, however, the relative strength cluster performed better than average on all but Task Switching. For all three dichotomous measures of abuse, the High VE/Low CP group was more likely than expected to report abuse, and the Low VE/V Low CP group reported less than expected rates.

Cluster demographics—The five groups differed with respect to age (F (4, 105) = 2.663, $p < .05$). Tukey's HSD post hoc test revealed that the High VE/Low CP group was older than the youngest group, the Low VE/Very Low EF group, at the trend level (see Table 6). These groups differed in age by almost a year. A chi-square test indicated that there was a group difference in racial/ethnic background (χ^2 (8, $N = 106$) = 14.82, $p < .01$). Crosstabs were examined for expected counts, and adjusted residuals indicated that the two low VE groups differed in the observed count from the expected count. The Low VE/High CP group had a greater observed count of Caucasian youth than expected, and the Low VE/V Low CP group had fewer Caucasian youth than would be expected given the overall racial distribution of the sample. There was a difference in the percentage of youth who reported prior locked detention (χ^2 (4, $N = 99$) = 10.46, $p < .05$).

Hypothesis 3

Due to both the small number of participants in the Mal VE/Very Low CP group ($n = 11$) and the theoretical similarity between clusters 1 and 2, this group was combined with the High VE/Low CP group for further analyses. The following analyses were examined both separately and with this combined VE/Low CP group. Combining these two groups did not affect the results. The Low VE/High CP group had few participants as well ($n = 12$), however, this group had a distinct, theoretically meaningful profile and was kept as a separate group.

Cluster differences—The VE/Low CP group reported high scores for Externalizing, Internalizing, and YSR Total score. These scores were all above the clinical cut-off set by the Achenbach System for Behavioral Assessment (see Table 7). This group differed from

the Low VE/Very Low CP group on the YSR total score (F (3, 105) = 2.758, $p < .05$), the Internalizing Scale (F (3, 100) = 3.385, $p < .05$), and the externalizing scale at a trend level (F (3, 103) = 2.340, $p = < .10$). This group also differed on three of the eight subscales, in the direction of having more mean problems: YSR Aggression (F (3, 105) = 3.355, $p < .05$), YSR Attention Problems scale (F (3, 105) = 4.083, $p < .01$), and Withdrawal (F (3, 105) = 3.128, $p < .05$). There was a trend at the cluster level for this group, reporting higher Anxiety/Depression (F (3, 105) = 2.567, $p < .10$).

Discussion

Our first hypothesis that VE combined with CP deficits relates to MH problems was unsupported by the linear approach. Variable centered analysis of VE combined with CP was not associated with increased risk of MH problems. However, person-centered approaches did delineate a group where high VE combined with low CP was related to MH problems. This person-centered approach defined two particularly interesting groups, one with low VE and higher CP skills and one with low VE and very low EF skills, which are not widely discussed in the literature on incarcerated populations. With the variable-centered approach, only thought problems and withdrawn behavior were associated with VE, while delinquency was associated with lower intellect and EF skills. Using a person-centered approach we can further explore interactions between VE, CP, and MH to delineate subgroups within our population for whom there is a stronger relation between these constructs.

This study supports the second hypothesis that incarcerated adolescents differ in their CP (IQ, achievement, and EF) and VE. Five distinct typologies emerged from the sample including a group with higher CP skills and lower exposure to violence and a group with particularly low levels of functioning on the WCST-CV4. The former group is interesting as it had the highest rate of class 2 and 3 sexual offenders. The latter group is both younger and had the fewest prior locked detentions.

Findings from these groups also support Hypothesis 3, which posited that MH outcomes would differ based on VE and CP levels within groups. The largest subgroup, approximately half of the overall sample, had both high level of VE and low CP. This group showed significantly higher levels of MH problems, suggesting that the combination of VE and low CP in this population is a particularly risky combination for MH development. This supports the work of Beers and De Bellis (2002), DeBellis (2001, 2005), Cicchetti (1996), and others that document diminished neurocognitive function in maltreated children. The directionality of this relation cannot be revealed with our cross-sectional data. This may also be indicative of higher rates of VE among children with learning disabilities (Sullivan, 2009) or resulting from damage associated with VE (for a review see Perkins, 2012). Conversely, we find that lower levels of VE even with low CP were not associated with deficits in MH function. This suggests that VE is related to MH problems regardless of CP functioning (Perkins, Cortina, Smith-Darden, & Graham-Bermann, 2012; Perkins & Graham-Bermann, 2012).

This study found a high prevalence rate of VE and MH problems throughout the sample. Confirming prior research with incarcerated populations (Brower & Price, 2001; Cockram,

2005; Murphy, 1986), we found half of the sample reported use of psychotropic medication, and close to half exceeded the clinical cut-off on one or more subscales of the youth self report. VE is also high in this sample, reported by over half of participants. Consistent with other studies (Alltucker, Bullis, Close, & Yovanoff, 2006; Bullis & Yovanoff, 2005; Traynelis-Yurek & Giacobbe, 1988), findings indicate a significant degree of academic problems within this incarcerated group, which are much higher than those found in a normative sample. At the time of the study, 70% had current Individual Education Plans (IEP) with a lifetime rate of 76%. This is almost double the rate found by Murphy (1986) in her review of studies on incarcerated youth; this difference might be accounted for by the additive effect of multiple disabilities being studied or increased rates of special education use nationwide. Another factor to consider is that our rates included emotional disturbance.

There was also evidence of high rates of CP deficits in the population, which supports other work (Herrero et al., 2010; Hoaken et al., 2007; Hurt & Naglieri, 1992; Yechiam et al., 2008). Results from the WCST-CV4 were consistent with prior studies showing that incarcerated youth (Yechiam et al., 2008) with maltreatment histories perform worse than healthy controls on measures of CP (Beers & De Bellis, 2002). Perseverative scores in the Beers PTSD sample were approximately 38 compared to 14 for healthy controls. In our sample perseverative scores were even higher (46.67) supporting other studies that show high levels of CP deficits in incarcerated groups.

A strength of this study is the diversity of the population both ethnically and in family history. Increasingly, many Americans are self-identifying as being multi-ethnic. Researchers must allow participants to self-identify multiple ethnicities. Using this approach, we found over a third self-identified as multi-ethnic. In addition we found high rates of disabilities and CP deficits (Perkins et al., 2012), suggesting that appropriate control groups for this type of study would have to include multiple risk youth. Lack of a control group limits results of this and others' studies, but an inappropriately matched control group may bias findings as well.

Missing data may have biased our results. However, participants with missing data did not differ from those with complete data on a variety of measures. Iterative imputation was used to maximize individuation of imputed data and participants with missing data were compared to those without and it was determined that missingness was unlikely to affect results. Normally cognitive data are collected individually, which was impossible in the confines of a juvenile detention facility. Multiple participants in one room most likely extended average reaction times and diminished accuracy. Our method of administration likely limits the interpretation of the results. Other measures that were used in this study had strong reliability and validity; however, none of the norming samples included incarcerated adolescents. Finally, these data are also limited because of the self-report nature of the measures. Even in the best circumstances, accurate recall of rates of VE during periods of cognitive growth is difficult to establish. Incarcerated populations may have ulterior motives for misrepresenting history of VE.

Our person-centered approach suggests that there is a subgroup within incarcerated youth groups that is both younger and has particularly low functioning on the WCST-CV4, which

can be considered indicative of frontal lobe dysfunction (Anderson, Damasio, & Jones, 1991). Further research into both congenital and acquired neurological dysfunction in this population is warranted.

One group defined by the current study has both low levels of prior VE and average cognitive ability. This group, while not statistically different from other groups, had higher rates of class 2 and 3 sexual offenses. Previous work suggests that among sexual offenders, prior VE is related to the severity of non-sexual offense (Burton, Leibowitz, Eldredge, Ryan, & Compton, 2011). This very small group of sexual offenders with average intelligence and less VE is worthy of further study. Although this group report average VE on the CTS over 75% reported physical and sexual abuse when asked dichotomously. Given that the CTS queries more specific conduct by parents and siblings, it may be that these youth either experienced one or more instances of abuse outside of the nuclear family (for example, a number of these youth were products of the foster care system and experienced numerous out-of-home placements where maltreatment and/or abuse occurred), or that they have reason to report abuse but cannot respond to specific queries. Additionally this group is relatively mental well, meaning that they do not have particularly high levels of MH problems, possibly representative of higher functioning. Perhaps they are more sophisticated or predatory sexual offenders, or they have specific stories that do not neatly categorize. Replication in large data sets would help to answer that question.

Our data suggest that the majority of males within incarceration facilities are part of a group with both high rates of prior VE and low CP. This group also has the highest rate of MH problems suggesting that some incarcerated youth may benefit from trauma-informed interventions. These youth may well require a perspective that is grounded in the understanding of interpersonal trauma and complex trauma and its effects that impact EF and the ability to cognitively process. One clear implication of our study is that CP and MH functioning are linked. There are over 100,000 children serviced in residential placement throughout the country, and a renewed focus on CP problems in this population is warranted. Our work supports a view that there exists significant diversity in incarcerated populations and a one-size-fits-all policy toward educational and MH intervention is likely to miss key subgroups such as those with high CP and those with low CP and significant violence/trauma histories.

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Table 1

Violence and Cognitive Measure Means, Standard Deviations, and Scale Reliability

Measure	*N*	*Mean*	*SD*	*α*
CTS Total Maltreatment by Parents	97	1.97	0.70	0.80
CTS Total Interparental Violence	92	1.95	0.76	0.82
CTS Total Maltreatment by Sibling	99	1.95	0.76	0.93
K-Bit-2 Composite Standard Score	88	93.35	14.54	0.67
WRAT-3 Reading Standard Score	93	89.24	15.78	0.90
WRAT-3 Spelling Standard Score	95	90.23	15.99	0.80
WRAT-3 Math Standard Score	96	84.53	15.27	0.83
WCST-CV4 - Total Errors*	89	44.82	11.95	N/A
WCST-CV4 - Perseverative Errors*	89	46.30	11.47	N/A
BRIEF-SR - Global Composite Percentile	95	59.83	30.89	0.93
Anti-Saccade Arrows Task Correct Response	78	0.54	0.29	N/A
Go/No-Go Correct Hits	93	0.89	0.16	N/A
Task Switching - Switch Cost	93	248.41	464.21	N/A
Flanker Task Reaction Time Difference†	98	350.31	323.69	N/A
Shape Matching Reaction Time Difference†	96	178.81	647.67	N/A

Note. CTS = Conflict Tactics Scale; K-BIT-2 = Kaufman Brief Intelligence Test, Second Edition; WRAT-3 = Wide Range Achievement Test; WCST-CV4 = Wisconsin Card Sorting Task – Computerized Version 4; BRIEF-SR = Behavior Rating of Executive Function – Self-Report;

* T score;

† milliseconds;

α = Chronbach's alpha for reliability.

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Table 2

Correlation Matrix for Clustering and Outcome Measures

	CTS Sib	CTS IPV	CTS Mal	K-Bit-2 Verbal	K-Bit-2 NV	WRAT-3 Read	WRAT-3 Spell	WRAT-3 Math	WSCT-CV4	BRIEF-SR	Withdrawn	Somatic	Anx-Dep	Social	Thought	Attention	Delinq	Aggres
CTS Sibling	1																	
CTS IPV	.228*	1																
CTS Maltreatment	.373**	.544**	1															
K-Bit-2 -Verbal	.021	.027	.115	1														
K-Bit-2 -Non-verbal	−.212*	−.203*	−.181	.534**	1													
WRAT-3 Reading	.015	−.035	.038	.580**	.369**	1												
WRAT-3 Spelling	−.009	−.063	.005	.442**	.278**	.724**	1											
WRAT-3 Math	−.154	.017	−.108	.600**	.500**	.466**	.498**	1										
WSCT-CV4	−.123	−.002	−.164	−.260**	−.211*	−.154	−.073	−.195*	1									
BRIEF-SR	−.025	−.094	.012	.092	.101	−.088	−.039	.142	−.154	1								
YSR Withdrawn	.198*	.039	.224*	.042	−.013	−.050	−.030	−.01	−.001	.223*	1							
YSR Somatic	.134	−.101	.092	.013	−.089	.013	−.029	−.096	−.032	.206*	.608**	1						
YSR Anxious Depressed	.135	−.070	.180	−.026	−.033	−.022	.115	−.062	.084	.384**	.752**	.616**	1					
YSR Social	.154	.012	.126	.078	−.051	−.029	−.006	−.064	.074	.359**	.684**	.604**	.766**	1				
YSR Thought	.135	.056	.104	.077	−.023	.019	.054	−.046	−.034	.251**	.607**	.627**	.694**	.648**	1			
YSR Attention	.187	−.047	.137	.086	−.052	−.017	.017	−.092	.058	.486**	.550**	.558**	.748**	.793**	.619**	1		
YSR Delinquency	.051	−.085	.101	−.045	−.203*	−.123	−.077	−.134	−.144	.210*	.436**	.526**	.453**	.380**	.471**	.465**	1	
YSR Aggression	.167	.025	.153	.133	−.064	.083	.115	−.021	−.105	.366**	.576**	.612**	.648**	.596**	.693**	.663**	.724**	1

Note. CTS = Conflict Tactics Scale; IPV = Interparental Violence; K-BIT-2 = Kaufman Brief Intelligence Test, Second Edition; WRAT-3 = Wide Range Achievement Test; WCST-CV4 = Wisconsin Card Sorting Task – Computerized Version 4; BRIEF-SR = Behavior Rating of Executive Function – Self-Report; YSR = Youth Self-Report of the Child Behavior Checklist.

* $p < .05$;

** $p < .01$

Table 3

Results of Hierarchical Regression for Violence Exposure, Intelligence, and Executive Function on Mental Health

Variable	Model 1			Model 2			Model 3		
	B	*SE(B)*	β	*B*	*SE(B)*	β	*B*	*SE(B)*	β
Aggression	10.13	2.13		3.32	5.67		4.98	6.26	
Total CTS	0.02	0.01	0.18	0.02	0.01	0.21	0.02	0.01	0.20
IQ Standard Score				0.07	0.05	0.15	0.05	0.06	0.12
WCST-CV4							−0.32	0.51	−0.08
Delinquency	7.30	1.37		10.93	3.66		14.31	3.94	
Total CTS	0.01	0.01	0.03	0.00	0.01	0.01	0.00	0.01	−0.02
IQ Standard Score				−0.04	0.03	−0.12	−0.06	0.04	−0.21~
WCST-CV4							−0.66	0.32	−0.24*
Attention	5.84	1.24		4.64	3.33		3.10	3.66	
Total CTS	0.01	0.01	0.06	0.01	0.01	0.07	0.01	0.01	0.08
IQ Standard Score				0.01	0.05	0.03	0.01	0.05	0.03
WCST-CV4							0.30	0.30	0.12
Thought Problems	1.79	0.95		0.03	2.54		−0.30	2.82	
Total CTS	0.01	0.01	0.20~	0.01	0.00	0.21~	0.01	0.04	0.22~
IQ Standard Score				0.02	0.02	0.08	0.02	0.03	0.10
WCST-CV4							0.07	0.23	0.03
Social Problems	2.42	0.91		0.78	2.44		−0.75	2.66	
Total CTS	0.01	0.01	0.25*	0.01	0.01	0.27~	0.01	0.01	0.29~
IQ Standard Score				0.02	0.02	0.08	0.03	0.02	0.14
WCST-CV4							0.30	0.21	0.16
Anxiety Depression	6.53	1.91		5.13	5.15		2.13	5.64	

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Variable	Model 1			Model 2			Model 3		
	B	***SE(B)***	**β**	***B***	***SE(B)***	**β**	***B***	***SE(B)***	**β**
Total CTS	0.01	0.01	0.12	0.01	0.01	0.12	0.01	0.01	0.14
IQ Standard Score				0.01	0.05	0.03	0.04	0.05	0.09
WCST-CV4							0.58	0.46	0.15
Somatic Complaints	3.27	1.08		2.87	2.89		3.30	3.20	
Total CTS	0.00	0.01	0.05	0.00	0.01	0.06	0.00	0.01	0.05
IQ Standard Score				0.00	0.03	0.02	0.00	0.03	0.00
WCST-CV4							−0.08	0.26	−0.04
Withdrawn	2.43	0.85		0.28	2.28		−0.31	2.52	
Total CTS	0.01	0.01	0.26*	0.01	0.01	0.28*	0.01	0.01	0.29*
IQ Standard Score				0.02	0.02	0.11	0.03	0.02	0.14
WCST-CV4							0.11	0.20	0.66

Note. CTS = Conflict Tactics Scale; IQ = Intelligence Quotient; WCST-CV4 = Wisconsin Card Sorting Task – Computerized Version 4. Model 1: Total violence exposure; Model 2: Total Violence exposure and WCST-CV4; Model 3: Total Violence exposure, WCST-CV4, and Computerized battery.

*$p < .0500$;

~$p < .1000$

Table 4

Means for Clustering Variables: Violence Exposure and Cognitive Processing

Cluster Number	**1**	**2**	**3**	**4**	**5**	
Cluster Name	**High VE/Low CP**	**Mal VE/Very Low CP**	**Low VE/High CP**	**Low VE/Very Low CP**	**Low VE/Very Low EF**	**Total**
N	**47**	**11**	**12**	**21**	**24**	**115**
CTS Maltreatment by Parents	$2.59_{a, c}$	2.17_{c}	$1.70_{b, d}$	1.38_{d}	$1.58_{b, d}$	1.97
CTS Interparental Violence	2.09_{a}	1.47	1.61	1.26_{b}	1.53_{b}	1.68
CTS Maltreatment by Sibling	2.49_{a}	1.99	1.39_{b}	1.68_{b}	1.68_{b}	1.95
Verbal IQ†	40.17_{b}	16.13_{c}	77.58_{a}	19.17_{c}	17.48_{c}	33.38
Non-Verbal IQ†	44.62_{b}	34.64_{b}	78.42_{a}	35.00_{b}	35.55_{b}	44.19
Reading †	$39.40_{a, b}$	9.97_{c}	54.92_{a}	$26.31_{b, c}$	$24.96_{b, c}$	32.15
Spelling†	35.90	20.42_{b}	56.75_{a}	28.74_{b}	29.56_{b}	33.93
Arithmetic†	18.46_{b}	14.85_{b}	75.08_{a}	13.39_{b}	11.81_{b}	22.58
WCST-CV4	0.31_{b}	0.38_{b}	0.00_{b}	0.06_{b}	3.45_{a}	1.07
Self-Regulation	0.00_{b}	1.00_{a}	0.33_{b}	0.00_{b}	0.00_{b}	0.13

Note. VE = violence exposure; CP = cognitive processing; EF = executive function; CTS = Conflict Tactics Scale; IQ = Intelligence Quotient; WCST-CV4 = Wisconsin Card Sorting Task – Computerized Version 4. Means in the same row that do not share a subscript differ at $p < .05$ in the Tukey's honestly significant difference comparison.

†percentile.

Table 5

Cluster Means for Validation Variables: Executive Function and Violence Exposure

Cluster Number	**1**	**2**	**3**	**4**	**5**	
Cluster Name	**High VE/Low CP**	**Mal/Very Low CP**	**Low VE/High CP**	**Low VE/Very Low CP**	**Low VE/Very Low EF**	**Total**
N	**47**	**11**	**12**	**21**	**24**	**115**
Go/No-Go Correct Hits Percent	88.81%	77.33%	95.40%	86.11%	91.73%	88.57%
Anti-Saccade Arrows Task Percent Correct	49.90% $_{b}$	37.07% $_{b}$	79.03% $_{a}$	52.87%	51.45%	53.82%
Task Switching - Switch Cost	184.60	226.47	175.85	160.81	202.69	187.68
Flanker Task Reaction Time Difference	105.65	89.71	76.00	69.44	95.90	91.28
Shape Matching Reaction Time Difference	360.57	349.24	346.53	179.92	51.83	248.41
Physically Abused	78.7%*	54.4%	75.0%	23.8%*	65.2%	63.2%
Sexually Abused	93.6%*	63.6%	75.0%	42.9%*	65.2%	73.7%
Emotionally Abused	70.2%	63.6%	58.3%	28.6%	69.6%	60.5%

Note. VE = violence exposure; CP = cognitive processing; EF = executive function. Means in the same row that do not share a subscript differ at $p < .05$ in the Tukey's honestly significant difference comparison.

*Significantly differs from expected values.

Table 6

Cluster Means for Outcome Measures: Demographics

Cluster Number	**1**	**2**	**3**	**4**	**5**	
Cluster Name	**High VE/Low CP**	**Mal/Very Low CP**	**Low VE/High CP**	**Low VE/Very Low CP**	**Low VE/Very Low EF**	**Total**
N	**47**	**11**	**12**	**21**	**24**	**115**
Age	17.73	16.82	17.17	17.05	16.83	17.26
Race/Ethnicity						
Caucasian	45.0%	63.6%	81.8%*	23.8%*	34.8%	44.3%
African American	25.0%	18.2%	9.1%	33.3%	43.5%	28.3%
Multi-racial	30.0%	18.2%	9.1%	42.9%	21.7%	27.4%
Foster Care	73.0%	50.0%	70.0%	90.0%	73.9%	74.0%
Prior Locked Detention	97.1%	80.0%	100.0%	90.5%	72.7%*	88.9%
Sexual Offender Treatment	64.9%	40.0%	90.9%*	45.0%	65.2%	61.4%
Violent Class 1 or 2	14.7%	12.5%	.0%	18.8%	7.1%	12.3%
Violent Class 3	8.8%	25.0%	11.1%	18.8%	14.3%	13.6%
Violent Class 4	8.8%	12.5%	11.1%	6.3%	7.1%	8.6%
Sexual Class 1	14.7%	25.0%	22.2%	12.5%	28.6%	18.5%
Sexual Class 2 or 3	44.1%	25.0%	56.6%	31.3%	28.6%	38.3%
Property	8.8%	.0%	.0%	12.5%	14.3%	8.6%

Note. VE = violence exposure; CP = cognitive processing; EF = executive function. Means in the same row that do not share a subscript differ at $p < .05$ in the Tukey's honestly significant difference comparison.

*Significantly differs from expected values.

Table 7

Cluster Means for Outcome Measures: Mental Health

Cluster Number	**1 & 2**	**3**	**4**	**5**	
Cluster Name	**VE/Low CP**	**Low VE/High CP**	**Low VE/Very Low CP**	**Low VE/Very EF**	**Total**
N	**58**	**12**	**21**	**24**	**115**
YSR Total Raw Score	93.43_{a}*	82.14*	69.19_{b}*	77.30*	83.85*
YSR Externalizing Raw Score	23.79*	22.45*	18.19	17.48	21.13*
YSR Internalizing Raw Score	20.73_{a}*	15.27	11.00_{b}	16.57	17.36
YSR Aggression Raw Score	15.68_{a}	13.67	10.57_{b}	11.17	13.46
YSR Delinquency Raw Score	7.82	7.41	7.62	6.30	7.40
YSR Attention Problems Raw Score	7.39_{a}	6.11	3.86_{b}	6.52	6.36
YSR Thought Problems Raw Score	4.02	3.50	2.33	3.39	3.49
YSR Social Problem Raw Score	4.86	4.63	3.10	4.61	4.43
YSR Anxiety Depression Raw Score	10.46_{a}	7.32	5.81_{b}	8.87	8.84
YSR Somatic Complaints Raw Score	4.35	3.08	2.94	3.65	3.77
YSR Withdrawn Raw Score	5.20_{a}	3.85	2.95_{b}	4.04	4.35

Note. VE = violence exposure; CP = cognitive processing; EF = executive function; YSR = Youth Self-Report of the Child Behavior Checklist. Means in the same row that do not share a subscript differ at $p < .05$ in the Tukey's honestly significant difference comparison.

*Score higher than clinical cut-off set by Achenbach System