2019

Eyewitness Memory Recall in Adolescents with Callous-Unemotional Traits

Benjamin Dylan Thomas

West Virginia University, bjthomas@mix.wvu.edu

Follow this and additional works at: <https://researchrepository.wvu.edu/etd>

Part of the [Clinical Psychology Commons](#)

Recommended Citation

Thomas, Benjamin Dylan, "Eyewitness Memory Recall in Adolescents with Callous-Unemotional Traits" (2019). *Graduate Theses, Dissertations, and Problem Reports*. 4102.

<https://researchrepository.wvu.edu/etd/4102>

This Dissertation is protected by copyright and/or related rights. It has been brought to you by the The Research Repository @ WVU with permission from the rights-holder(s). You are free to use this Dissertation in any way that is permitted by the copyright and related rights legislation that applies to your use. For other uses you must obtain permission from the rights-holder(s) directly, unless additional rights are indicated by a Creative Commons license in the record and/ or on the work itself. This Dissertation has been accepted for inclusion in WVU Graduate Theses, Dissertations, and Problem Reports collection by an authorized administrator of The Research Repository @ WVU. For more information, please contact researchrepository@mail.wvu.edu.

Eyewitness Memory Recall in Adolescents with Callous-Unemotional Traits

Benjamin D. Thomas, M.S.

Dissertation submitted
to the Eberly College of Arts and Sciences
at West Virginia University

in partial fulfillment of the requirements for the degree of

Doctorate of Philosophy in
Clinical Psychology

Elisa Krackow, Ph.D., Chair
Cheryl McNeil, Ph.D.
Hawley Montgomery-Downs, Ph.D.
Karen Weiss, Ph.D.

Department of Psychology

Morgantown, West Virginia
2019

Keywords: eyewitness memory accuracy, adolescents, CU traits, psychopathy
Copyright 2019 Benjamin Thomas

ABSTRACT

Eyewitness Memory in Adolescents with Callous-Unemotional Traits

Benjamin D. Thomas

Individuals with high levels of psychopathic traits have been portrayed as having higher intelligence and better memory (Cleckley, 2015). In terms of developmental pathways for psychopathy, the strongest predictor of children and adolescents developing psychopathic traits in adulthood is high levels of callous-unemotional (CU) traits in childhood (Burke et al, 2007; Frick, 2009). Research has been mixed with regard to links between CU or psychopathic traits and memory performance in children and adults, with some studies finding that individuals with high levels of these traits demonstrated poorer memory performance (Bauer & Hesselbrock, 2001; Dolan & Fullam, 2005). This study examined the relation between CU traits and memory recall in adolescents, an important area of research as adolescents with higher levels of CU traits are more likely to be involved in criminal activity, and thus are likely to provide eyewitness testimony (Dolan & Fullam, 2010; Thornton et al, 2015). Fifty adolescents (ages 12 to 18) viewed a video about forensic science and were then asked to freely recall and answer questions about the video after completing distraction tasks for approximately 45 minutes. The results showed that intelligence, working memory, and age predicted amount of correct information freely recalled, while intelligence predicted amount of correct information remembered in cued recall. Working memory predicted amount of information incorrectly recalled during cued recall. CU traits were not predictive of accuracy in free or cued recall. Age, intelligence, and CU traits did not predict total information incorrectly recalled in either free or cued recall.

Keywords: eyewitness memory accuracy, adolescents, CU traits, psychopathy

Table of Contents

Title Page.....	i
Abstract.....	ii
Table of Contents.	iii
Introduction	1
Current Study.....	19
Method.....	22
Results.....	28
Discussion.....	35
References.....	42
Table 1.....	55
Table 2.....	58
Table 3.....	63
Table 4.....	64
Table 5.....	65
Table 6.....	66
Table 7.....	67
Figure 1.....	68

Eyewitness Memory Recall in Adolescents with Callous-Unemotional Traits

Psychopathy is characterized as a personality disorder (though it is not listed in the DSM-5 as such; American Psychiatric Association, 2013) that was first conceptualized by Cleckley (2015) as consisting of a conglomeration of personality traits including, but not limited to, “superficial charm and good ‘intelligence’, untruthfulness, lack of remorse or shame, antisocial behavior, poor judgment, pathological egocentricity and incapacity for love, and lack of affective reactions” (Cleckley, p. 355-56, 2015). Since Cleckley’s original conception of the construct of psychopathy, researchers have re-examined and re-conceptualized components of this disorder, though many current criteria map onto Cleckley’s original components of psychopathy (Hare, Hart, & Harpur, 1991). The modern conceptualization includes, but is not limited to, criteria such as “superficial charm, narcissism, lack of remorse and empathy, manipulateness, antisocial behavior, impulsivity and irresponsibility” (Hare, Hart, & Harpur, p. 392, 1991). Hare is credited with this current accepted conceptualization of psychopathy and its associated traits (Hare, Neumann, & Widiger, 2012).

Psychopathy is strongly associated with Antisocial Personality Disorder (ASPD) and not only do several of the criteria for both overlap (e.g., impulsivity, lack of empathy or remorse, irresponsibility, engagement in antisocial behavior), but they also are frequently comorbid (American Psychiatric Association, 2013; Hare, Hart, & Harpur, 1991). While both are strongly linked, psychopathy is distinguished due to some of its unique affective components (e.g., superficial charm, narcissism, manipulateness, callous/unemotional traits), while antisocial personality disorder subsumes primarily behavioral constructs (e.g., impulsivity, engagement in antisocial behaviors, lack of remorse for behaviors). Both disorders can only be diagnosed in adults, yet a pervasive childhood history of these personality patterns is expected or required to diagnose an individual (American Psychiatric Association, 2013).

Approximately 30 to 40% of children who demonstrate severe disruptive behavior disorders (i.e., oppositional-defiant disorder [ODD], conduct disorder [CD], which are marked by aggressive or defiant behaviors, violating the rights of others, and antisocial behaviors such as stealing and lying) develop either antisocial personality disorder or psychopathy (Lahey, Loeber, Burke & Applegate, 2005).

In an attempt to outline factors that impact presentation of symptoms of disruptive behavior disorders, studies have examined race and gender differences in children with ODD or CD. While studies examining racial differences in the presentation of symptoms of disruptive behavior disorders are limited, they generally support the notion that there are no significant racial or ethnic differences in terms of the presentation of ODD or CD in youth (Horan, Brown, Jones, & Haber, 2015; Wiesner, et al., 2015). These studies have primarily focused on differences in Black, Hispanic/Latino, and White youth, and it should be mentioned that a majority of the literature examining these disorders has been limited to white children and adolescents (Horan, Brown, Jones, & Haber, 2015).

More studies have examined gender differences in presentation of disruptive behavior disorders in youth. Initial studies, in support of a broader understanding of gender roles, presented conceptualizations of these disorders as more prevalent, with earlier onset, in male youth than female youth (Kjelsberg & Friestad, 2009; Webster-Stratton, 1996, McCabe, Rodgers, Yeh, & Hough, 2004). Research has demonstrated a difference in presentation of symptoms between male and female youth, with females being more likely to engage in covert or relational forms of aggression (e.g., spreading rumors) compared to males, who were more likely to engage in overt forms of aggression (e.g., physical fights; Lahey et al., 2000; Stickle, Marini, & Thomas, 2012). Additionally, research has supported the notion of a more internalized manifestation of disruptive behavior disorders in female youth, such that they have a higher

presentation of co-morbid anxiety or mood disorders (Berkout, Young, & Gross, 2011; Stickle, Marini, & Thomas, 2012). Importantly, some research has indicated that the presence of CU traits in both male and female youth has predicted more severity in presentation of symptoms of either ODD or CD (Euler et al., 2015, Orue, Calvete, & Gamez-Gaudix, 2016).

Researchers have also attempted to delineate subtypes of conduct disorder in an attempt to delineate differential developmental pathways for antisocial personality disorder compared to psychopathy (Frick & Ellis, 1999). The results from these research efforts indicated that callous/unemotional traits (i.e., lack of remorse, disregard for others, cold, apathy, etc.) were the strongest predictors of the presentation of psychopathic personality traits in adulthood, above and beyond engagement in antisocial behavior (Barry, Frick, DeShazo, McCoy, Ellis, & Loney, 2000; Burke, Loeber, & Lahey, 2007; Frick & Ellis, 1999; Frick, 2009). Research has also shown that the presence of callous/unemotional (CU) traits in children with conduct problems differentiates them from children with conduct disorder without these traits in terms of longterm outcomes, indicating that the presence of CU traits can be used as a marker for the presence of psychopathic personality beginning in childhood (Barry et al., 2000; Frick & Ray, 2015).

Research has indicated that psychopathic personality is a relatively stable construct across the life span. Lynam and colleagues (2007) conducted a longitudinal research study examining mother-reported psychopathic personality of children age 13 and psychopathic personality assessed at age 24. The results from this research demonstrated that psychopathic personality traits were stable and scores of psychopathy in childhood could be used to predict psychopathy in adulthood (Lynam, Caspi, Moffitt, Loeber, & Stouthamer-Loeber, 2007).

Overall, the research on youth psychopathy indicates that it is a relatively stable construct that can be predicted in adulthood by measuring callous/unemotional traits in children and adolescents (Burke, Loeber, & Lahey, 2007; Frick, 2009). While it is understood that

psychopathic personality traits can be assessed in childhood and adolescence, the origin of these traits is not well understood. Considering the demonstrated pathway of psychopathy development (Frick, 2009), it is important to examine aspects of cognitive functioning (i.e., intelligence, memory) as well as markers of psychopathy in youth with psychopathic personality traits to further expand what is known about the development and presentation of this construct. Furthermore, research has supported the concept that the presence of high levels of CU traits in adolescence predicts later criminal offending in adulthood (Kahn, Byrd, & Khadini, 2013; McMahon, Witkiewitz, & Kotler, 2010). Thus, it is important to understand how these traits may impact an individual's ability to recall events of a crime, as they are more likely to be involved in criminal activity (Thornton, Frick, Shulman, Ray, Steinberg, & Cauffman, 2015).

Intelligence and Psychopathy

Adults. Based largely on Cleckley's (2015) conceptualization of psychopathic individuals as having average to above average intelligence (IQ), a large body of research has examined whether or not psychopathic individuals truly demonstrate this hypothesized superior intellectual functioning. Overall, the results from many of these studies were inconclusive (Isen, 2010). In a study of sexual offenders compared to non-sexual offenders, Nijman, Merckelbach, and Cima (2009) found a 13-point verbal IQ deficit, which was most pronounced in non-pedophilic sexual offenders. These offenders demonstrated a significantly higher performance IQ, which was strongly correlated to higher levels of affective and interpersonal facets of psychopathy (Nijman, Merckelbach, & Cima, 2009). Another study examined the relationship between verbal IQ and psychopathy in a sample of 840 psychiatric patients, and the results indicated that when age, gender and SES were controlled, verbal IQ was unrelated to psychopathy (Delisi, Vaughn, Beaver, & Wright, 2010). However, some factors of both psychopathy and antisocial personality disorder (e.g., lacking empathy, irresponsibility,

impulsivity) were related to lower verbal IQ (Delisi et al., 2010; Dolan & Anderson, 2002). In contrast, some studies have found that the interpersonal factors (e.g., manipulativeness) of psychopathy were strongly positively correlated with verbal intelligence, while the behavioral factors (e.g., impulsivity) were negatively correlated (Copestake, Gray & Snowden, 2013). Copestake and colleagues (2013) also found that individuals with high levels of psychopathic traits had higher scores on emotional intelligence measures.

While the aforementioned studies examined intelligence and psychopathy in offenders, who are assumed to have higher levels of psychopathy and ASPD than the average population of non-offenders, several studies have examined the relationship between IQ and psychopathic personality traits in non-offender populations (Bate, Boduszek, Dhingra, & Bale, 2014; Wall, Sellbom, & Goodwin, 2013). The findings from these studies were equally inconclusive, but implied that intelligence may moderate the relation between psychopathy and other cognitive functions (e.g., emotional responsiveness; Bate et al., 2014). Specifically, individuals with low intelligence and high interpersonal psychopathic traits demonstrated less emotional responsiveness to emotional stimuli, while individuals with low intelligence but high levels of behavioral factors of psychopathy demonstrated elevated emotional responsiveness to emotional stimuli (Bate et al., 2014).

Another study found that intelligence moderated the relationship between psychopathic traits and engagement in antisocial behavior (Wall, Sellbom, & Goodwin, 2013). Specifically, individuals with high verbal IQ and high interpersonal psychopathic traits were less likely to engage in antisocial behaviors than those with low verbal IQ and high interpersonal psychopathic traits. Conversely, individuals with high performance IQ and high levels of behavioral psychopathic traits demonstrated more engagement in antisocial behaviors (Wall, Sellbom, & Goodwin, 2013). Finally, some findings mirrored results in offender populations (Copestake,

Gray, & Snowden, 2013) that certain facets of psychopathy (i.e., interpersonal components) were positively correlated to verbal IQ, while other facets (i.e., behavioral components) were negatively correlated to verbal IQ (Watts, Salekin, Harrison, Clark, Waldman, Vitacco, & Lilienfeld, 2016). However, a major limitation to these studies was the reliance on undergraduate students as participants, who have much lower psychopathy scores and more overall years of education (more years of education being positively correlated to higher verbal IQ performance due to a longer period of knowledge acquisition) than psychopathic offenders.

In summary, the research on the relation between psychopathic personality traits and intelligence in adults is inconclusive. Research demonstrates that some individuals with high levels of psychopathic personality traits display verbal IQ deficits (Nijman, Merckelbach, & Cima, 2009). However, another study indicates no significant relation between intelligence and psychopathic personality traits (Delisi, Vaughn, Beaver, & Wright, 2010). Finally, some research indicates that interpersonal facets of psychopathy are positively correlated with verbal IQ, or that intelligence serves a mediating role for the relation between psychopathic traits and engagement in antisocial behavior (Copestake, Gray & Snowden, 2013; Wall, Sellbom, & Goodwin, 2013; See Table 1).

Children and Adolescents. The research on the relationship between intelligence and psychopathy has been extended downward to children and adolescents who demonstrate antisocial behaviors (Isen, 2010; Kennedy, Richardson, Dixon, & Kelly, 2003;). There is a strong body of evidence suggesting that adolescents who engage in antisocial behavior (not just psychopaths, but conduct problems generally) demonstrate a greater performance IQ compared to verbal IQ, and that this verbal IQ deficit is likely due to antisocial behaviors (e.g., truancy) interfering with learning (Isen, 2010; Kennedy, Richardson, Dixon, & Kelly, 2003). However, these scholars have erroneously generalized these findings to children or adolescents with

conduct disorder but have not specifically examined the relationship between intelligence and child/adolescent psychopathy itself (Isen, 2010).

Several studies examining intelligence and psychopathy in children or adolescents found positive relations between high psychopathic traits and verbal IQ (Frick, O'Brien, Wootton, & McBurnett, 1994; Loney, Frick, Ellis, & McCoy, 1998; Salekin, Lee, Schrum Dillard, & Kubak, 2010; Salekin, Neumann, Leistico, & Zalot, 2004;). Specifically, these studies indicated that callous/unemotional traits or other interpersonal components of psychopathy were moderately positively correlated to verbal intelligence, compared to behavioral components of psychopathy (Loney et al., 1998, Salekin et al., 2004). However, other studies found that there was no significant relation between intelligence and psychopathic traits in children and adolescents (Allen, Briskman, Humayun, Dadds, & Scott, 2013). Other studies found, similar to adults, that IQ may moderate relations between psychopathic traits and other cognitive functions. In particular, studies demonstrated that high levels of psychopathy and intelligence led to engagement in more violent behavior and less emotional reactivity (Muñoz, Frick, Kimonis, & Aucoin, 2008), and children with a high IQ demonstrated a positive relation between narcissism and teacher reports of conduct problems (McKenzie & Lee, 2015).

In summary, the findings on the intelligence of children and adolescents who engage in antisocial behaviors (both psychopaths and non-psychopaths) are mixed, with some demonstrating verbal intelligence deficits (Dolan & Anderson, 2002; Isen, 2010; Kennedy et al., 2003), some demonstrating no significant relation between IQ and psychopathy (Allen et al., 2013; Delisi, Vaughn, Beaver, & Wright, 2010), and some indicating a positive correlation between psychopathy and verbal IQ (Copestake, Gray & Snowden, 2013; Loney et al., 1998, Salekin et al., 2004; Watts et al., 2016). This lack of consistency may have been due to use of various measures of intelligence (e.g., brief vs. more comprehensive measurement tools), various

populations being assessed (i.e., offenders versus non-offenders), and various measures of psychopathy (e.g., the Psychopathy Checklist – Revised [PCL-R] vs. Antisocial Processes Screening Device [APSD]; See Table 1).

In summary, several trends are clear and appear to be evident across the lifespan. In general, a majority of findings demonstrated that children with high levels of callous/unemotional traits and other interpersonal factors of psychopathy also had higher levels of verbal intelligence (Loney et al., 1998, Salekin et al., 2004). Several findings also indicated that psychopaths, compared to non-psychopaths, had higher verbal intelligence beginning in childhood and extending into adulthood. For example, individuals with high levels of interpersonal components of psychopathy demonstrated higher verbal intelligence, while those with higher levels of the behavioral components demonstrated impaired verbal intelligence (Copestake, Gray, & Snowden, 2013; Watts et al., 2016; See Table 1). This was an important finding because behavioral components of psychopathy are non-specific criteria, and are seen in ASPD as well (American Psychiatric Association, 2013; Hare, Hart, & Harpur, 1991). Thus, those factors more unique to the construct of psychopathy and used as predictors of developing psychopathy in children, such as callous-emotional traits, may be related to intelligence in some way.

Memory and Psychopathy

Executive Functioning and Working Memory in Adults. Memory is a complex cognitive process that is divided into various different components (e.g., short-term vs. long-term, working memory, verbal memory, autobiographical memory). Memory performance is also an important component of the contemporary conceptualization of intelligence, and aspects of memory are measured on various assessments of intelligence (e.g., Digit span subscale on the Wechsler intelligence scales). Some studies have indicated that executive functions, such as

working memory, were impaired in individuals who engage in antisocial behaviors (Dolan & Anderson, 2002; Gorenstein, 1982).

Extant research on memory and psychopathy has examined executive functioning memory tasks (e.g., Sequential Matching Memory task) and other executive functions (e.g., decision-making, risk assessment, etc.; Gorenstein, 1982, Hare, 1984). The findings on executive functioning in psychopaths are mixed. Several studies found that psychopathic individuals demonstrated impaired executive functioning compared to non-psychopaths, indicative of a frontal lobe deficit that may explain high levels of impulsivity (De Brito, Viding, Kumari, Blackwood, & Hodgins, 2013; Gorenstein, 1982). However, De Brito and colleagues (2013) found that offenders with ASPD and psychopathy and ASPD without psychopathy were both impaired on working memory tasks compared to non-psychopaths, indicating that shared behavior traits (e.g., impulsivity) may explain this shared deficit (De Brito et al., 2013). Other studies failed to support the findings that psychopaths demonstrate frontal lobe deficits in executive functioning (Dolan & Anderson, 2002; Hare, 1984). However, Dolan and Anderson (2002) found that psychopaths demonstrated deficits in logical memory (i.e., recall of information with either an emotional/social component).

Ishikawa and colleagues (2001) examined executive functioning, autonomic arousal and exposure to childhood stressors in a sample of criminal (i.e., those with a criminal record) and non-criminal (i.e., those without a criminal record) psychopaths. Participants were exposed to an autonomic arousal task, in which they were asked to present a two-minute speech discussing personal faults and weaknesses while they had their heart rate and skin conductance monitored. The results from the study demonstrated that non-criminal psychopaths had higher autonomic arousal than both criminal psychopaths and the control group. Criminal psychopaths demonstrated lower autonomic arousal than the control group. In addition, non-criminal

psychopaths demonstrated superior executive functioning compared to both criminal psychopaths and healthy controls when memory and estimated IQ were controlled (Ishikawa, Raine, Lencz, Bihrlé, & Lacasse, 2001).

In summary, the research findings examining working memory and executive functioning tasks are inconclusive in adults with psychopathic traits, who either demonstrated working memory and executive functioning deficits (De Brito, Viding, Kumari, Blackwood, & Hodgins, 2013; Gorenstein, 1982) or no deficits (Dolan & Anderson, 2002; Hare, 1984). Ishikawa and colleagues (2001) demonstrated that non-criminal psychopathic adults actually showed higher executive functioning than non-psychopaths (See Table 2).

Executive Functioning and Working Memory in Children and Adolescents. Research on executive functioning, including working memory, in individuals who demonstrate antisocial behaviors has been extended downward developmentally to examine children with disruptive behavior disorders and psychopathic traits. Several studies examining adolescents with behavioral disorders (e.g., conduct disorder) have supported the research findings with adults that individuals with psychopathic traits have executive functioning deficits that are related to a frontal lobe dysfunction (Bauer & Hesselbrock, 2001; Endres, Donkin, & Finn, 2014; Euler, Sturzer, & Stadler, 2014; Johnson, Kemp, Heard, Lennings & Hickie, 2015; Leuger & Gill, 1990; Saarinen, Fontell, Vuontela, Carlson, & Aronen, 2015; Shanmugan et al., 2016). In addition, Hummer and colleagues (2015) utilized magnetic resonance imaging (MRI) to examine structural differences between adolescents with behavior disorders and typically developing adolescents. The results indicated that some neurodevelopmental differences in brain structures (e.g., the anterior cingulate and the frontoparietal tracts) exist in youth with disruptive behavior disorders (Hummer, Wang, Kronenberger, Dunn, & Mathews, 2015).

Dougherty and colleagues (2003) utilized an immediate and delayed memory task (IMT/DMT) as a measure of executive functioning (specifically impulsivity), as opposed to just memory, in adolescents diagnosed with disruptive behavior disorders (i.e., ODD or CD). The immediate memory task (IMT) involved a presentation of five digits in a random order for a half second, followed by either the same sequence of numbers (a correct hit), a catch (all but one of the digits was the same as the previous sequence, considered a commission error if the participants responded) and a filler (a non-similar order of five digits). Immediately following presentation of each sequence, participants were asked to indicate when two consecutive groups of five digits were exactly the same. In the delayed memory task (DMT), participants were asked to do the same, but between each stimulus was a presentation of three sets of five digits (always "12345"; Dougherty, Bjork, Harper, Mathias, Moeller, & Marsh, 2003).

The results from the adolescents' performances on the IMT/DMT indicated that the tasks could be used as a measure of impulsivity in adolescents with disruptive behavior disorders. Adolescents with a history of aggressive behavior demonstrated more commission errors (i.e., responding that the two sequences were the same during a catch) than the group of adolescents with a behavior disorder without a history of aggressive behavior, which demonstrated more commission errors than the control group. The commission error rates on the IMT/DMT were also highly correlated to the other established measures of impulsivity, indicating that frontal lobe deficits can be utilized as measures of impulsivity in behavior disordered children (Dougherty et al., 2003).

While multiple studies have demonstrated frontal lobe deficits, particularly working memory deficits, in adolescents with disruptive behavior disorders, several have failed to demonstrate similar findings. Oosterlaan, Sheres, and Sergeant (2005) found that only children and adolescents with comorbid Oppositional-Defiant Disorder/Conduct Disorder (ODD/CD) and

Attention Deficit Hyperactivity Disorder (ADHD) demonstrated executive functioning deficits. However, children with only ODD/CD demonstrated enhanced performance on executive functioning tasks (Oosterlan, Sheres, & Sergeant, 2005). However, Saarinen and colleagues (2015) failed to replicate these findings, instead showing that children with ODD/CD with and without comorbid ADHD both demonstrated working memory deficits compared to typically developing children.

The research findings on working memory and executive functioning in children and adolescents with behavior disorders related to psychopathy were more cohesive than findings with psychopathic adults. Overall, a majority of research findings suggested children and adolescents with these disorders demonstrated major deficits in working memory and executive functioning (Bauer & Hesselbrock, 2001; Endres, Donkin, & Finn, 2014; Euler, Sturzer, & Stadler, 2014; Johnson, Kemp, Heard, Lennings & Hickie, 2015; Leuger & Gill, 1990; Saarinen, Fontell, Vuontela, Carlson, & Aronen, 2015; Shanmugan et al., 2016). However, one study indicated that adolescents with ODD/CD had enhanced executive functioning compared to controls (Oosterlaan, Sheres, & Sergeant, 2005). These findings demonstrated that working memory and executive functioning deficits might have been related to high levels of impulsivity associated with psychopathy (Bauer & Hesselbrock, 2001; De Brito, Viding, Kumari, Blackwood, & Hodgins, 2013; Endres, Donkin, & Finn, 2014; Euler, Sturzer, & Stadler, 2014; Gorenstein, 1982; Hare, Hart, & Harpur, 1991; See Table 2).

Memory and Emotion in Adults. Research on psychopathic personality traits, impulsive or antisocial behavior (ASPD in adults, ODD/CD in children), and memory has also examined the relationship between emotion and memory. Extant literature has demonstrated that emotion and memory are closely linked, and emotion can influence encoding for and recall of information (Cahill & McGaugh, 1995). The research investigating the relation between memory and

emotion in psychopaths has demonstrated impairment in recalling emotional stimuli compared to neutral stimuli, while non-psychopaths show improved recall for emotional stimuli (Christianson, Forth, Hare, Strachan, Lidberg, & Thorell, 1996; Dolan & Fullam, 2005).

However, some research has suggested that psychopaths demonstrate more accurate autobiographical memory of emotionally salient events over non-psychopathic offenders (Cooper, Hervé, & Yuille, 2007). Specifically, Cooper and colleagues (2007) examined violent offenders' and sexual offenders' memories for their own crimes, asking them to report details of an act of planned violence, an act of reactionary (i.e., due to provocation) violence, and a poorly remembered act of violence. Participants then rated their vividness, detail and accuracy for their reported memories. Overall, the results implied that psychopathic offenders had better self-reported memory (e.g., provided more details and vivid descriptions, reported feeling more confident in their recall) for crimes they committed, particularly reactionary crimes. In addition, psychopathic offenders, compared to non-psychopathic offenders, reported fewer instances of poorly remembered violent acts. However, recall accuracy could not be assessed because the research design only examined self-reported memories, which could not be verified (Cooper, Hervé, & Yuille, 2007).

Christianson and colleagues (1996) examined memory for emotional details in a sample of incarcerated psychopaths ($n = 25$) compared to non-psychopathic offenders ($n = 37$). Participants were randomly assigned to two conditions in which they were presented with a slide show consisting of 15 individually presented pictures, with one (the eighth slide) either a neutral picture (woman riding a bike and two cars driving by) or an emotional picture (woman lying in street with a head wound, and two cars). Each picture was presented for three seconds, followed by a two second inter-slide interval. After viewing the slide show, participants were asked to rate the pleasantness of each slide and pick the most emotion-provoking slide. All participants then

participated in a five-minute distraction task prior to being asked specific questions about the slides. First, participants were asked questions about the emotional slide (e.g., what color was the woman's coat?), then questions about neutral slides (e.g., what object was on the table in the first slide?), followed by forced-choice questions about five of the slides they had seen (one was the emotional slide). Participants were asked to pick, out of four simultaneously presented items, which one matched the original slide (Christianson, Forth, Hare, Strachan, Lidberg, & Thorell, 1996).

The results from this study indicated that psychopathic offenders did not demonstrate increased recall for central details (e.g., woman in the aforementioned example) of the emotional stimuli (Christianson et al., 1996). Non-psychopaths demonstrated a bias toward correctly remembering central details of the emotional stimuli compared to peripheral details, indicating that they attended more to the emotionally salient information. However, it was found that psychopaths do not attend to the emotionally salient details any more than the peripheral details, and thus recalled both types of details equally well. In addition, psychopaths rated the emotional slides as less emotion invoking than non-psychopaths (Christianson et al., 1996).

Dolan and Fullam (2005) examined memory for emotional stimuli in a sample of 88 adult male-offenders with antisocial personality disorder compared to a sample of 20 healthy control males. Participants were presented with the Cahill emotional memory task, a task involving 11 slides with a narrative about a boy being hit by a car, with the first four slides representing neutral information (e.g., the mother and her son are walking down the street), the middle four representing emotionally salient information (i.e., the boy gets hit by a car) and the final three again representing neutral information (e.g., the mother makes a phone call). Participants were then asked to freely recall information about the narrative 2 hours later, and were also asked cued recall questions (e.g., multiple choice questions). Cued recall is used to prompt an individual to

provide a correct answer by providing them with a cue (e.g., a word related to what is being asked), as opposed to free recall, in which an individual is asked to remember as much as they can about a specific event. The results from this study demonstrated that all incarcerated individuals demonstrated significantly less accurate free recall of the emotional information compared to controls. In addition, individuals with both low and high levels of psychopathic personality traits demonstrated less improvement in cued memory recall accuracy compared to control participants (Dolan & Fullam, 2005).

Kiehl and colleagues (2001) failed to find the same deficit in recall for emotional stimuli in psychopaths when presented with affective words while brain activity was monitored using fMRI. However, psychopaths demonstrated less activity in limbic regions, which are implicated in affective and memory processing, compared to non-psychopaths (Kiehl, Smith, Hare, Mendrek, Forster, Brink, & Liddle, 2001).

Glass and Newman (2009) examined processing of emotional memory in a sample of 239 Caucasian male inmates, who were exposed to one of three experimental manipulations with neutral, positive and negative words. The first task involved the presentation of words, one at a time for two seconds each, followed by free recall and location recall five minutes later. In the second task, participants were presented with the same list of words, but for only 200 ms, and the words were surrounded by either a blue or yellow rectangle. After five minutes, the participants were then asked to recall both the word and the color of the rectangle. In the third task, participants were presented with the same list of words, but this time they were printed in either blue or yellow. After five minutes, the participants were asked to recall the words and the color in which they were printed. The results indicated that psychopathic individuals, like non-psychopathic individuals, demonstrated a bias for correctly recalling emotional words compared to neutral stimuli. However, psychopaths demonstrated a deficit in accurately recalling

contextual information (i.e., word location, rectangle color, word color, respectively) across the tasks, indicating that the bias for affective stimuli did not extend to contextual information associated with said stimuli (Glass & Newman, 2009).

Peace and Constantin (2016) examined the misinformation effect (i.e., incorporation of inaccurate details into memory through methods such as leading questions) in a sample of 334 undergraduate students assessed for levels of psychopathic personality traits. Participants were presented with three emotional stimuli (three pictures: a beach party, a strawberry field, and a man in a pool of blood) for 45 seconds each. The first two pictures were deemed positive, while the third picture was deemed negative in terms of emotional salience. Participants then filled out the Psychopathic Personality Index – Revised (PPI-R) for a 20-minute task delay. After this, participants (randomly assigned to condition) were asked a first round of ten questions per image, either misleading questions in the misleading condition (five leading, five not leading) or non-leading in the control condition (all ten were non-leading) about both central and peripheral details of the pictures. Participants then completed another 20-minute task, and finally were asked 15 open-ended questions about each of the pictures they saw and if they realized they had been misled (i.e., manipulation check; Peace & Constantin, 2016).

Peace and Constantin (2016) found that psychopathic personality traits were not related to accuracy, although there was a trend towards increased susceptibility to the misinformation effect in individuals with high levels of psychopathic traits. Contrary to past research, recall for central details (i.e., the focal point of the picture) was highest in positive pictures, and recall for peripheral details (i.e., background details of the picture) was highest in negative pictures. The findings demonstrated that the misinformation effect (i.e., reduced accuracy in recalling details of an episodic memory due to interference from additionally presented information) occurred equally across all three types of stimuli (Peace & Constantin, 2016).

In summary, research on memory performance in adults with psychopathic traits falls into two main categories: examination of working memory and other executive functioning tasks, or examination of memory and emotion. The research on emotion and memory indicates that adult psychopaths either demonstrated a deficit in recall for emotional memory (Christianson, Forth, Hare, Strachan, Lidberg, & Thorell, 1996; Dolan & Fullam, 2005) or did not, but still displayed impairment in recall of peripheral information or susceptibility to memory errors (Glass & Newman, 2009; Peace & Constantin, 2016). However, one study found that adult psychopathic offenders demonstrated better self-reported memory for crimes than non-psychopathic offenders, though this study was limited due to an inability to assess memory accuracy (Cooper, Hervé, & Yuille, 2007).

Memory and Emotion in Children and Adolescents. The relation between emotion and memory in individuals with high levels of psychopathy has also been examined in children and adolescents. Overall, the research on memory and emotion in children with disruptive behavior disorders or high levels of callous/unemotional traits is mixed. Dolan and Fullam (2010) found, similar to adults, that children with high levels of psychopathic traits showed impairment in recalling emotional stimuli. Specifically, incarcerated male adolescents (ages 14 to 18) were presented with a narrated slide show consisting of three phases. The first phase involved emotionally neutral material (e.g., the mother and her son are walking down the street), the second was emotionally charged material (i.e., a boy gets hit by a car), and the final phase was once again neutral material (e.g., mother of the boy makes a phone call). After a 2-hour period, the participants were asked to recall details from the story utilizing multiple-choice questions about the content of the narrative. The results indicated an inverse relationship between psychopathic trait severity and total amount of accurately recalled emotional stimuli, suggesting

that severity of psychopathic personality traits moderated recall of emotional stimuli (Dolan & Fullam, 2010).

Research conducted by Thijssen and colleagues (2012) resulted in contradictory findings to Dollan and Fullam (2010). Forty-two children (one group with high CU traits, $n = 24$, and one group with low CU traits, $n = 18$) between the ages of eight and twelve engaged in a peripheral memory task, in which they were presented with 20 emotional pictures (ten neutral and ten negative, with a central image and symbols in the borders) and instructed to pay attention to the entire picture. The stimuli were presented for a second, followed by ten seconds of a blank screen. The children were then presented with four options for the central image (assessing attention to the main picture) and instructed to pick the correct one. The same was then done for the peripheral detail (the symbol in the border). The results indicated that the children were more accurate at recalling the peripheral detail in neutral stimuli, while they were more accurate at recalling the central image in negative stimuli. However, there was no difference between the groups of children with high levels and those with low levels of callous/unemotional traits in terms of amount of information correctly recalled, indicating that children with high levels of these traits do not demonstrate deficits in emotional memory recall (Thijssen, Otgaar, Meijer, Smeets, & de Ruiter, 2012).

Krauel and colleagues (2008) found that children with ADHD had enhanced recall of both positive and negative stimuli compared to neutral stimuli (i.e., pictures of either positive, negative or neutral events or things, taken from the International Affective Picture System [IAPS]). However, children with comorbid ADHD and ODD/CD demonstrated superior recall for only negative stimuli, while recall of positive and neutral stimuli was well below that of typically developing children (Krauel, Duzel, Hinrichs, Rellum, Santel, & Baving, 2008). The researchers theorized that children with ODD/CD attend more to negative stimuli and thus have a

better recall for these. However, children were not assessed for level of callous/unemotional traits or other indicators of psychopathy.

D'Acremont and Van der Linden (2007) similarly found that adolescents with conduct problems showed improved recall for negative stimuli. They presented adolescents with a set of both happy and angry facial stimuli. The students were then later presented with neutral facial stimuli, asked if they had seen the face before, and if they had, determine if it was a happy or angry facial expression they had seen. The results implied that adolescents high in conduct problems and inattention/hyperactivity had better recognition of angry facial stimuli, and the investigators theorized that this was accounted for by increased attention to negative stimuli (i.e., they are more attentive and better recognize angry faces; d'Acremont & Van der Linden, 2007).

The research on emotional memory in children with ODD/CD or with psychopathic traits (e.g., CU traits) indicated that these children actually have enhanced recall of negative stimuli, because they attended more to negative information (d'Acremont & Van der Linden, 2007; Krauel et al., 2009). However, Dolan and Fullam (2010) found that high levels of psychopathic traits (i.e., CU traits) in children predicted poorer recall for emotional memory, similar to findings in adults (Dolan & Fullam, 2005). Thus, there appeared to be a discrepancy in the research on emotional memory performance between children and adults with psychopathic personality traits, indicating children with behavior disorders had enhanced recall of negative stimuli while adult psychopaths demonstrated emotional memory deficits. This is important because memory for a crime, simulated or real, would be expected to evoke an emotional response (Cooper, Hervé, & Yuille, 2007; Dolan & Fullam, 2005; See Table 2).

Current Study

The current study aims to examine the relation between psychopathy (i.e., measures of CU traits) and eyewitness memory accuracy in adolescents. The current study expands upon the

extant research relevant to eyewitness memory that investigated visual and verbal memory with emotional valence in both adults and adolescents with high levels of psychopathic traits (Dolan & Fullam, 2005; Dolan & Fullam, 2010) and memory for previously committed crimes in psychopathic offenders (Cooper, Hervé, & Yuille, 2007).

The extant research has shown that both adults and adolescents with high levels of psychopathic traits demonstrated impaired recognition of previously viewed visual stimuli compared to those with low levels of psychopathic traits (Dolan & Fullam, 2005; Dolan & Fullam, 2010). Only one study to date has examined the issue of differences in free recall with adults, but not adolescents, with psychopathic traits. The results indicated that adults with psychopathic personality traits demonstrated significantly poorer free recall of previously viewed emotional information compared to healthy controls. However, the research had major methodological limitations in that incorrect recall was not examined, and no information was provided about procedures for coding correct recall. Therefore, the results, both significant and non-significant, were not interpretable (Dolan & Fullam, 2005). Another study examined autobiographical memory for crimes in psychopathic compared to non-psychopathic offenders (Cooper, Hevré, & Yuille, 2007). The results indicated that psychopathic offenders had a significantly better self-reported memory for reactive violent crimes, and showed trends towards better self-reported memory for instrumental violent crimes and fewer poorly remembered crimes compared to non-psychopathic offenders. However, this study was limited in relying solely on self-reported accuracy for events and could not verify the veracity of the participants' recall for the actual event (Cooper, Hevré, & Yuille, 2007).

The current study builds upon the existing research by examining eyewitness memory quantity and accuracy as a function of level of CU traits in adolescents. This is important to provide a greater understanding of an adolescent's ability to accurately recall details of an event,

such as a crime, as research has shown that high levels of CU traits predict engagement in antisocial or criminal behavior (Kahn, Byrd, & Khadini, 2013; McMahon, Witkiewitz, & Kotler, 2010; Thornton et al., 2015). Additionally, research has indicated that children with CU traits have a tendency to affiliate with deviant peers, and thus may be bystanders to criminal activity (Gendreau, Little, & Goggin, 1996). Thus, these adolescents may be expected to testify about criminal events as part of their involvement in the juvenile justice system (McMahon, Witkiewitz, & Kotler, 2010; Thornton et al., 2015). Adolescents may also be expected to rely on memory if involved more directly in the juvenile justice system, such as evaluations of competency to stand trial (e.g., Do you remember what they said you did?).

Research Questions

The current study aims to answer the question of whether or not there is a relation between CU traits and eyewitness memory performance in adolescents. Due to the lack of research examining free or specific recall of information in adolescents with CU traits, no hypotheses were made about the relation between CU traits and accurate compared to inaccurate eyewitness memory recall. The extant research indicates that individuals with high levels of psychopathic personality traits are more susceptible to memory errors when recalling emotional information (Glass & Newman, 2009; Peace & Constantin, 2016). In addition, psychopathic offenders demonstrate a superior self-reported autobiographical memory for perpetrated crimes compared to non-psychopathic offenders. However, this research was limited in that the accuracy of recall could not be examined due to the method of relying solely on self-reported recall (Cooper, Hevré, & Yuille, 2007). Additional existing literature is limited in that procedures for coding free recall of information did not differentiate correct as compared to incorrect information, nor were the coding system and procedures described in enough detail to allow for evaluation of research methodology. Thus, no firm conclusions could be drawn about the relation

between accurate and inaccurate free or specific recall of narrative information and level of psychopathic or CU traits (Dolan & Fullam, 2005; Dolan & Fullam, 2010).

Method

Participants

Fifty-three adolescent participants ages 12 to 18 were recruited through an outpatient mental health treatment facility ($n = 4$), West Virginia University ($n = 9$), and local high schools and the general population in West Virginia and the Pittsburgh metropolitan area ($n = 40$; See Table 3). Participants were recruited via typical recruitment methods, including, but not limited to: flyers, attending community events, electronic advertisements, and word of mouth. Data from three participants was excluded due to their recall scores being more than three standard deviations above the mean, to ensure that the assumptions were met for the statistical analyses, or due to a large amount of missing data. All three of the participants were recruited from the community. Thus, the total number of community participants included in the analyses was 37. Two participants reported a diagnosis of attention-deficit/hyperactivity disorder (ADHD), but indicated that their symptoms were well managed on medication and did not demonstrate any difficulty attending to the study tasks. Thus, their data was included within the analyses. No participants endorsed diagnoses of autism spectrum disorder or a specific learning disorder.

Of the 50 participants included in the analyses, 22 were male (44%), while 28 were female (56%). Forty of the 50 participants were Caucasian (80%), while four identified as Asian or Asian American (8%), three identified as Hispanic/Latino (6%), and three identified as biracial (6%; See Table 3).

In terms of socioeconomic status, 25 of the participants (50%) came from families who earned over \$100,000 total income per year. One individual reported a total family income ranging from 90,000 to 100,000 (2%), and four reported a family income of 80,000 to 90,000

(8%). Three individuals (6%) endorsed a family income for each of the following income ranges: 20,000 to 30,000, 40,000 to 50,000, 50,000 to 60,000, and 70,000 to 80,000. Two individuals (4%) endorsed a family income ranging from 10,000 to 20,000. Six individuals (12%) chose not to disclose this information (See Table 3).

Seventeen of the participants' parents had a college education (34%). Two participants' parents had less than a high school education (4%), three participants' parents had a high school education (6%) while one had a high school equivalent educational level (GED; 2%). Seven participants' parents had a master's level education (14%), six participants' parents had a doctoral level education (12%), and one participant's parents attended a professional school of some form (2%). Data was missing or incorrect for 13 of the participants. This was in part due to researcher failure to emphasize that the question was aimed at obtaining parental level of education, and participants age 18 who completed the demographic questionnaire themselves often incorrectly responded to the question with their own level of education (See Table 3).

A priori power analyses were run to estimate necessary sample size based on desired effect size. Two power analyses were run for a fixed linear multiple regression model with one dependent variable, five control variables, the standard medium effect size of 0.15 and a larger effect size of 0.2 (both of which underestimate the observed effect size of 0.9 in prior research; Dolan & Fullam, 2005), while keeping the alpha error rate at 0.05 and power at 0.8. The results indicated that for an effect size of 0.15, 55 participants were required, while for an effect size of 0.2, 42 participants were required. Thus, an approximated average of these two yielded a total sample size of 50 for the current study and the study included enough participants to have adequate power to detect significant findings.

Materials

Eyewitness Video. The eyewitness video used as the to-be-remembered stimulus (i.e., information that participants were asked to recall after a brief delay), *The Forensic Laboratory: How Crime is Analyzed*, is a documentary discussing forensic science and ways that science is used to solve crimes (e.g., DNA analysis). Participants were asked to watch a 14-minute long excerpt from the documentary in which forensic methods of analyzing DNA, body decomposition, and skeletal remains were discussed (Discovery HD, 2016).

Wechsler Abbreviated Scale of Intelligence, Second Edition. The *Wechsler Abbreviated Scale of Intelligence, Second Edition* (WASI-II) is a brief intelligence test comprised of two subtests from the more comprehensive Wechsler Adult Intelligence Scale, vocabulary and matrix reasoning. The vocabulary subtest involves participants providing definitions of various words and is a predictor of acquired verbal intelligence. The matrix reasoning subtest involves identifying a response that best completes patterns with increasing complexity and predicts non-verbal intellectual functioning. The WASI-II is designed for use in individuals age 6 to 90, and takes approximately 15 minutes to complete, making it a more feasible measure of intelligence than a full-scale intelligence test (which often takes 90 minutes or more to complete) for the current study (McCrimmon & Smith, 2013). The WASI-II was standardized on a normative sample of 2,300 individuals, and demonstrated a reliability of 0.93 for children (Maccow, 2011). The WASI-II has been compared to other brief intelligence tests and has been shown to be a more valid measure of intelligence (Raggio, Scattone, & May, 2010). It has been utilized in previous research as a measure of intelligence with individuals demonstrating psychopathic personality traits (Copestake, Gray, & Snowden, 2013). In the current study, the WASI-II was used to assess participants' IQ.

Wechsler Adult Intelligence Scale- 4th edition (WAIS-IV) or Wechsler Intelligence Scale for Children – 5th edition (WISC-V)– Digit Span, Reverse Digit Span, and Sequencing Tests. The digit span, reverse digit span, and sequencing subtests of the *WAIS-IV* and *WISC-V* provide a measure of working memory capability (Foster et al., 2015). The digit span task involves participants being presented with a sequence of numbers that are repeated verbatim immediately after presentation. The number of digits, and thus level of difficulty placed on working memory to accurately repeat the digits, increases as the task progresses. The reverse digit span task involves participants being presented with a sequence of numbers that are repeated in reverse order after presentation. Again, the number of digits, and thus difficulty, increases as the task progresses. Finally, the sequencing task involves re-organizing a sequence of numbers in order from smallest to largest, with the number of digits increasing as the task progresses. The digit span, reverse digit span, and sequencing tests were used to assess participants' working memory capacity in the current study.

Inventory of Callous-Unemotional Traits (ICU). The ICU is a 24-item validated measure of CU traits in adolescents and young adults ranging from age 12 to age 20. The ICU yields three independent factors of CU traits: uncaring, callousness, and unemotional traits, and produces a score that can range from 0 to 72, with higher scores representing higher levels of CU traits (Kimonis et al., 2008). CU traits in adolescents have been shown to be the strongest predictor of psychopathic personality traits in adults (Frick & Ellis, 1999; Frick, 2009). In a sample of 687 undergraduates, the ICU demonstrated an adequate reliability with an inter-item correlation coefficient of 0.8. The ICU was moderately to strongly correlated with other measures of psychopathy, including the Psychopathic Personality Inventory, and negatively correlated with measures of general empathy (i.e., Questionnaire Measure of Empathic Tendency). It should be noted that this sample was comprised primarily of female undergraduate

students, where psychopathy base rates are expected to be lower than in the community (Kimonis, Branch, Hagman, Graham, & Miller, 2013). In a sample of 1,443 adolescents and a separate sample of 425 young adult males in the community, the ICU again had an inter-item correlation coefficient of 0.8, demonstrating adequate reliability. The ICU demonstrated significant correlations with other measures of psychopathy, as well as engagement in delinquent or antisocial behaviors. Though there is no clinical cut-off score for elevated levels of CU traits, the past research has shown that participants collected from a sample of incarcerated youth scored, on average, in the high 20's to low 30's, and those within a community sample scored closer to 20 (Byrd, Kahn, & Pardini, 2013; Essau, Sasagawa, & Frick, 2006; Kimonis et al., 2008). In the current study, the ICU was used to assess participants' level of CU traits. The ICU was found to have good internal consistency in the present study ($\alpha = 0.9$).

The Extended Cohn – Kanade Dataset (CK+). The CK+ was used as facial expression stimuli that participants were asked to label as a filler task to increase the time between video viewing and memory recall. The CK+ is a collection of pictures of 468 different sequences of facial expressions (i.e., anger, happiness, sadness, disgust, surprise, and fear) obtained from 97 models. The clips were converted into short videos, two to three seconds in length, displaying the action of a facial expression. Twelve clips were selected for viewing in the current study (two for each emotion). The creators of the CK+ database coded the emotional expression displayed in each clip using Ekman and Friesen's Facial Affect Coding System, indicating the correct response for each emotion that was being depicted (FACS; 1979; Kanade, Cohn, & Tian, 2000; Lucey, Cohn, Kanade, Saragih, Ambadar, & Matthews, 2010).

Demographic Questionnaire. The consenting parent, legal guardian or participant answered basic demographic questions. Participants or their parents were asked to answer

questions about gender, race, ethnicity, socioeconomic status (SES), parental education, and the presence of a diagnosis of ADHD, autism, or a learning disability for the participant.

Procedure

The study was initially piloted with three volunteer undergraduate participants to ensure the study did not need to be altered. No changes to the procedure were deemed necessary.

One parent or legal guardian of participants and the participants were presented with the details of the study and asked to provide informed consent either on paper or electronically, utilizing *Qualtrics*. Participants age 18 provided consent and then completed a brief demographic questionnaire themselves. For adolescent participants under the age of 18, the consent was reviewed with the parent or legal guardian in person, while they were asked to follow along, and then they completed a brief demographic questionnaire about the participant. Assent was reviewed with the adolescent participants, who were then asked to assent to participate in the current study. Participants were tested at the WVU Department of Psychology Memory and Law laboratory, at their homes, or at an outpatient mental health private practice. Participants were seated in front of a laptop and presented with the eyewitness video (i.e., *The Forensic Laboratory: How Crime is Analyzed*), which they watched for approximately 14 minutes. Upon completion of the video, participants' intelligence was assessed using the WASI-II, vocabulary and matrix reasoning subtests (approximately 15 minutes), and participants' working memory was assessed using the WAIS-IV or WISC-V digit span, reverse digit-span, and sequencing subtests (approximately 10 minutes). The participants were then administered the ICU to assess for self-reported callous-unemotional traits (approximately 5 minutes; See Figure 1).

Upon completion of these assessments, participants were presented, via computer, 12 short two to three second clips of models making a facial expression using the CK+ database. After each clip, participants were asked to identify which emotional expression they believed

they had seen by circling their answer out of the six possible emotions in a multiple choice question format (Kanade, Cohn, & Tian, 2000; Lucey, Cohn, Kanade, Saragih, Ambadar, & Matthews, 2010). Participants were presented with all six universal expressions of emotion: happiness, sadness, anger, disgust, fear and surprise. The stimuli were counterbalanced, such that each participant saw both a male and female model making each facial expression. The facial expression identification task took approximately five minutes to complete (see Figure 1).

After completing the aforementioned tasks and a delay of approximately 45 minutes, participants were asked follow-up questions about the eyewitness video excerpt. Participants were first asked to provide open-ended recall of the details of the eyewitness video, followed by prompts to exhaust recall using a discontinue rule of two consecutive denials of being able to provide more information (Krackow, 2011). Once participants indicated that they could not recall any additional information, participants were presented with 18 specific open-ended recall questions about aspects of the video (Krackow, 2017). The memory interview was audio recorded for the purpose of transcription and coding. Upon completion of the interview, participants received \$20 compensation for their participation (see Figure 1).

Results

Coding. Recorded free recall memory interviews were transcribed verbatim. The transcribed interviews were then cleaned to eliminate redundant or non-essential information (e.g., false starts such as “I saw...I remember seeing” or filler words, such as “like” or “Um”). There was 96.98% agreement between two independent raters (the author and the dissertation adviser) in terms of this information being removed. Data from the cleaned transcripts was analyzed using Rudy and Goodman’s (1991) coding technique for memory recall. This technique codes each unit of detail recalled for a specific event or memory as either correct or incorrect. For example, if in the to-be-recalled event a red car was shown, and a participant reports the car

was blue, then the response of a car was coded correct (i.e., accurate recall) while the response blue was coded incorrect (i.e., inaccurate recall). This data was then compiled into two scores, a score for total correct freely recalled information, and a score for total incorrect freely recalled information. The responses from cued recall were compiled into three composite scores: total correct responses, total incorrect responses, and total “I don’t know” responses.

Cohen’s K was used to compare two independent raters’ judgment of correct compared to incorrect units of information for free recall on a randomly selected sample of 16 of the transcripts (32% of the transcripts). There was strong agreement between the two raters’ coding, $K = 0.97, p < 0.001$. Specific recall questions were coded as total answered correctly, total answered incorrectly, and total answered with an “I don’t know” response (Krackow, Lynn, & Payne, 2005). Cohen’s K was used to compare two independent raters’ judgment of correct compared to incorrect units of information for specific recall on a randomly selected sample of 16 of the transcripts (32% of the transcripts). There was strong agreement between the two raters’ coding, $K = 0.82, p < 0.01$. Disagreements were resolved by discussion, and then the author coded the remaining transcripts.

Preliminary Analyses. Prior to running the primary statistical analyses, preliminary analyses were run to examine the descriptive statistics for the sample, including distribution of scores on the assessments, and to ensure that the sample met the assumptions for the statistical analyses being run (i.e., no issues of normality, homoscedasticity, or multicollinearity). After statistical assumptions were assessed, sample characteristics were examined. Participants ranged in age from 12 to 18 ($M = 16.05, SD = 2.09$). Of the fifty participants, 22 were male (44%), while 28 were female (56%). There were no significant differences in age between males ($M = 15.86$ years, $SD = 1.9$) and females ($M = 16.21$ years, $SD = 2.24$) in terms of age in years, $t(48) = -0.58, p = 0.57$ (See Table 3).

Participant scores on the ICU ranged from 4 to 46 ($M = 19.56$, $SD = 9.94$), and 30% of the study sample ($n = 15$) had elevated scores comparable to samples obtained from offender populations (i.e., scores greater than 25 on the ICU; Byrd, Kahn, & Pardini, 2013; Essau, Sasagawa, & Frick, 2006; Kimonis et al., 2008). On the WASI-II, participant scores ranged from 75 to 136 ($M = 107.92$, $SD = 13.75$). The mean WASI-II score in the current sample is higher than the standardization sample for the WASI-II ($M = 100$, $SD = 15$). The mean difference between the samples represents a moderate effect size in the current study ($d = 0.55$). On the WAIS-IV or WISC-V digit span, reverse digit span, and sequencing subtests, participant standard scores ranged from 5 to 19 ($M = 10.2$, $SD = 2.9$; See Table 4).

Correlations. Pearson's r correlations were run to examine the relations between accurate free recall, inaccurate free recall, accurate cued recall, inaccurate cued recall, and "I don't know" responses for cued recall composite scores, level of callous-unemotional traits (ICU total scores), IQ scores, working memory scores, age, socioeconomic status, race, gender, and parental education level. Of note, ICU scores were significantly negatively correlated with age. Thus, as age increased, callous-unemotional traits decreased. Total accurate free recall was significantly positively correlated to IQ, working memory, parental education, total incorrect free recall, and total correct cued recall. Total accurate free recall was negatively correlated to incorrect cued recall and "I don't know" responses to cued recall questions. Incorrect free recall was significantly positively correlated to working memory and correct cued recall, and was significantly negatively correlated to "I don't know" responses for cued recall. Correct cued recall was significantly positively correlated to IQ, while incorrect cued recall was significantly negatively correlated with working memory. Correct cued recall was significantly negatively correlated to both incorrect cued recall and "I don't know" responses to cued recall, which is

logical as they were measured on the same scale (i.e., dependent upon responses to 18 specific questions; See Table 5).

Several additional variables were also significantly correlated. Age was significantly negatively correlated with both IQ and working memory scores. Working memory was significantly positively correlated to IQ scores, which is consistent with theoretical conceptions of intelligence, as working memory is frequently a component of intellectual assessment instruments (Wechsler et al., 2008). Age was significantly negatively correlated to socioeconomic status. Socioeconomic status was significantly positively correlated to IQ scores, and parental level of education (see Table 5).

CU Traits and Free Recall. There were no issues with regard to normality (skew and kurtosis), homoscedasticity, or multicollinearity for any of the variables included in the regression analyses. Total units of information accurately recalled during free recall ranged from 42 to 846 units ($M = 336.16$, $SD = 207.75$), while total units of information incorrectly recalled during free recall ranged from 0 to 37 units ($M = 10.38$, $SD = 8.48$; See Table 4). There was missing data for one participant's working memory score due to the incorrect version of the working memory scale being administered, and thus they were not included in the analyses. Additionally, due to a large amount of missing data for SES (i.e., family income; 12% of participants had missing data for the variable), SES was not included in the regression models.

A multiple linear regression was used to determine if a participant's ICU score predicted their score for total accurately recalled information during free recall, while controlling for age, working memory performance, and IQ. The multiple linear regressions demonstrated that working memory scores, IQ, age, and ICU scores accounted for 37% of the variance in total information correctly recalled during free recall, which was significant, $R^2 = 0.37$, $F(4, 44) = 6.5$, $p < 0.001$. Examining each individual factor in the model revealed that higher scores on the

measure of working memory predicted more accurate information being recalled during free recall, $\beta = 0.48$, $t(44) = 3.57$, $p = 0.001$. Older age also predicted more accurate information being recalled during free recall, $\beta = 0.33$, $t(44) = 2.39$, $p = 0.02$. Higher IQ scores significantly predicted accurate free recall, $\beta = 0.29$, $t(44) = 2.14$, $p = 0.04$. Level of CU traits did not significantly predict amount of information recalled, $\beta = -0.04$, $t(44) = 0.82$, $p = 0.74$ (for every standard deviation increase in amount of correct information recalled, ICU scores decreased by 0.04 standard deviations; See Table 6).

A second multiple linear regression was used to determine if a participant's ICU score predicted their score for total inaccurately recalled information during free recall, while controlling for age, working memory performance, and IQ. The multiple linear regression showed that working memory scores, age, IQ, and ICU scores did not significantly predict total inaccurate information recalled during free recall, and accounted for only about 2% of the variance in total information incorrectly recalled, $R^2 = 0.02$, $F(4, 44) = 0.19$, $p = 0.94$. When each variable was independently examined, IQ, working memory performance, and age did not significantly predict amount of incorrect information recalled. Level of CU traits did not significantly predict amount of information recalled, $\beta = 0.11$, $t(44) = 0.68$, $p = 0.5$ (for every standard deviation increase in amount of correct information recalled, ICU scores increased by 0.68 standard deviations; see Table 6).

CU Traits and Cued Recall. During cued recall, participants were asked to provide responses to 18 questions assessing their memory for the target stimuli. Total number of accurate responses ranged from 4 to 18 ($M = 13.1$, $SD = 3.02$), while total number of inaccurate responses ranged from 0 to 7 ($M = 2.64$, $SD = 1.87$). "I don't know" responses, which were coded separately from inaccurate responses, ranged from 0 to 11 ($M = 2.28$, $SD = 2.55$; See Table 4). There were no issues of normality (skew and kurtosis), homoscedasticity, or multicollinearity in

the variables included in the regressions. There was missing data for one participant's working memory score due to the incorrect version of the working memory scale being administered, and thus they were not included in the analysis. Due to a large amount of missing data for SES, SES was not included in the regression models.

A multiple regression was run to determine if a participant's ICU score predicted total number of accurate responses to cued recall questions, while controlling for age, IQ, and working memory performance. The multiple linear regression showed that working memory scores, age, IQ, and ICU scores did not significantly predict total accurate information recalled during free recall, and accounted for only 17% of the variance in total information accurately recalled, $R^2 = 0.17$, $F(4, 44) = 2.21$, $p = 0.08$. When each variable was independently examined, IQ significantly predicted accurate cued recall, $\beta = 0.32$, $t(44) = 2.1$, $p = 0.046$. Age did not significantly predict accurate responses to cued recall, $\beta = 0.29$, $t(44) = 1.85$, $p = 0.07$, nor did working memory performance, $\beta = 0.17$, $t(44) = 1.11$, $p = 0.27$. Level of CU traits did not significantly predict amount of information recalled, $\beta = 0.11$, $t(44) = 0.74$, $p = 0.46$ (for every standard deviation increase in correct information recalled during cued recall, ICU scores increased by 0.11 standard deviations; see Table 7).

Another multiple regression was utilized to examine if a participant's ICU score predicted total number of inaccurate responses to cued recall questions, while controlling for age, IQ, and working memory performance. The multiple linear regression demonstrated that working memory scores, age, IQ, and ICU scores did not significantly predict total inaccurate information recalled during cued recall, and accounted for only 16% of the variance in total information inaccurately recalled, $R^2 = 0.16$, $F(4, 44) = 2.14$, $p = 0.09$. When each variable was independently examined, a lower working memory performance predicted more inaccurate responses to cued recall questions, $\beta = -0.34$, $t(44) = -2.19$, $p = 0.03$. Age did not significantly

predict more inaccurate responses to cued recall questions, $\beta = -0.07$, $t(44) = -0.41$, $p = 0.68$, nor did IQ, $\beta = 0.01$, $t(44) = 0.03$, $p = 0.98$. Level of CU traits did not significantly predict amount of information incorrectly recalled, $\beta = -.28$, $t(44) = -1.88$, $p = 0.07$, which indicated that for every standard deviation increase in inaccurate cued recall, ICU scores decreased by 0.28 standard deviations (see Table 7).

A final multiple linear regression was utilized to determine if a participant's ICU score predicted total number of "I don't know" responses during cued recall, while controlling for age, IQ, and working memory performance. Though not originally proposed, due to a large number of "I don't know" responses, and the fact that memory research typically includes separate analyses for "I don't know" responses, this analysis was included (Krackow et al., 2005). The multiple linear regression revealed that age, IQ, working memory performance, and ICU scores did not significantly predict number of "I don't know" responses, $R^2 = 0.16$, $F(4, 44) = 2.16$, $p = 0.09$. These variables accounted for only about 16% of the variance in "I don't know responses." When each variable was independently examined, lower IQ significantly predicted a higher number of "I don't know" responses, $\beta = -.39$, $t(44) = -2.47$, $p = 0.017$. However, age did not significant predict number of "I don't know" responses, $\beta = -0.3$, $t(44) = -1.93$, $p = 0.06$, nor did working memory performance, $\beta = 0.04$, $t(44) = 0.23$, $p = 0.82$. Level of CU traits did not significantly predict "I don't know" responses to cued recall questions, $\beta = 0.07$, $t(44) = 0.5$, $p = 0.62$ (for every standard deviation increase in number of "I don't know" responses, ICU scores increased by 0.07 standard deviations; see Table 7).

Effect sizes for group differences in memory recall performance were examined as a function of location of the experimental procedure (i.e., lab vs. home) to determine if location impacted memory recall performance. For accurate free recall and "I don't know" responses to cued recall questions, participants demonstrated a slightly better performance within the lab ($d =$

-0.16, and $d = -0.32$, respectively). For inaccurate free recall, correct responses to cued recall, and incorrect responses to cued recall, participants demonstrated a better performance within their homes ($d = 0.45$, $d = 0.21$, and $d = 0.08$, respectively). However, none of the observed effect sizes were moderate, indicating that location of the study did not impact memory recall performance for either free or cued recall. Effect sizes were also examined to determine if there were differences in age or sex as a function of testing location. For sex, the effect size was miniscule and indicated there was no difference based on testing location between males and females ($d = 0.04$). The same comparison was done for age, and the effect size was miniscule, indicating that there was no difference based on testing location for age ($d = 0.23$).

Discussion

The results from the study revealed that higher IQ, better working memory performance (as measured through the digit span subtests of the WISC-V or WAIS-IV, depending on age), and older age all predicted increased accuracy of free recall of the target stimulus. For inaccurate free recall of information, none of the variables predicted amount of information inaccurately recalled. This could be attributed to the fact that participants provided much more accurate information than inaccurate information ($M = 336.16$ units of information for accurate recall, while $M = 10.38$ units of information for inaccurate recall). The finding that higher IQ and better working memory (a component of modern conceptualizations of intelligence; Wechsler et al., 2008) predicted increased accurate free recall was consistent with past literature examining the relationship between intelligence and accuracy in memory recall (Chae, Goodman, Eisen, & Qin, 2011; Eisen, Goodman, Qin, & Davis, 2002; Eisen, Goodman, Qin, Davis, & Crayton, 2007; Melinder, Alexander, Cho, Goodman, Thoresen, Lonnum, & Magnussen, 2010; Richardson & Kelly, 1995).

The finding that older age, within the adolescent age range, predicted more accurate recall is a major finding that further contributes to our understanding of memory development in childhood and adolescence. Past research has demonstrated that younger children (e.g., ages 3 to 5) tend to make more errors in memory recall, or provide less specific information in terms of reconstructive memory when compared to adolescents (e.g., ages 13 to 17) and adults (Eisen et al., 2007; Ghetti, Qin, & Goodman, 2002; Harris et al., 2016; McWilliams, Harris, & Goodman, 2014). However, these studies compared performance across age groups, as opposed to examining whether recall improves within the adolescent period. Additionally, the aforementioned research only examined autobiographical memory recall for child maltreatment or sexual abuse, rather than a more neutral, but forensically relevant stimulus, such as the present study. Thus, the current finding that older age predicted more accurate free recall of information lends support to the notion that memory improves throughout the adolescent developmental period, as brain development continues throughout adolescence into early adulthood (Simmonds, Hallquist, & Luna, 2017).

The results also demonstrated that higher IQ predicted more accurate responses to cued recall questions, while a lower IQ predicted more “I don’t know” responses to cued recall questions. Additionally, a poorer working memory predicted more inaccurate responses to cued recall questions. These findings are also in line with prior research findings that intelligence is predictive of eyewitness memory accuracy (Eisen et al., 2007; Melinder et al., 2010). Additionally, the strong negative correlation between incorrect responses and “I don’t know” responses to cued recall questions indicated that participants answered the cued recall questions even if they were unsure of the answer, and likely only provided “I don’t know” responses if they could not produce a response to the cued recall questions.

The strong negative correlation between CU traits and age indicated that older participants demonstrated lower levels of CU traits when compared to younger children. This finding is consistent with past research that moral development progresses in adolescence and increases through early adulthood, such that older adolescents and young adults show more empathy and increased prosocial (i.e., less antisocial or self-centered) behaviors as they get older, and thus, decreased behaviors that are consistent with high levels of CU traits (Krettenauer, Murua, & Jia, 2016).

CU traits did not predict accuracy or inaccuracy in free memory recall, nor did they predict accurate, inaccurate, or “I don’t know” responses to cued recall questions for the target stimulus. The finding that CU traits did not predict accurate or inaccurate free or cued recall is an important contribution to the literature examining the relationship between psychopathic or CU traits and memory performance. The extant literature was limited methodologically, in that incorrect recall was not examined, and the procedures for coding correct recall were not outlined (Dolan & Fullam, 2005; Dolan & Fullam, 2010). Thus, the current findings expand on some of the past findings examining the relation between CU or psychopathic traits and memory recall accuracy, which showed that there was no significant relationship between these personality traits and memory performance (Dolan & Anderson, 2002; Hare 1984; Peace & Constantin, 2016).

The lack of a significant relationship between CU traits and memory recall in the present study may be explained by either the fact that CU personality traits are unrelated to and thus offer no predictive value for estimating memory performance, or that the participant population of the study impacted the findings (discussed below). Participants’ scores on the ICU were broad and included a large portion of individuals considered elevated on CU traits (i.e., 30%), therefore the current research question of whether or not CU traits predicted eyewitness memory

recall was able to be answered. These negative findings are important and indicate that CU traits do not predict memory recall performance.

The participants were recruited from the community or an outpatient mental health practice, while past studies examining memory performance as a function of CU or psychopathic traits have frequently recruited from offender populations (e.g., incarcerated youth). Thus, other, unmeasured factors related to CU traits (e.g., criminal history) may have contributed to past findings that showed differentiation in memory performance. While this could have contributed to the lack of significant findings, it strengthened the current study by allowing for examination of the predictive value of CU traits alone, and not other factors frequently correlated with CU traits, such as a history of criminal behavior. It is possible that participants in the present study had legal involvement, but this was not assessed. This is a limitation to the present study, and it would be important in future studies to include questions that assess for engagement in antisocial or deviant behaviors (e.g., do you frequently get in trouble at school). Therefore, examining whether or not factors such as a history of legal involvement or criminal behavior predict accuracy in eyewitness memory recall above and beyond the level of CU traits may be an important area of future research.

One major limitation of the current study was that analyses did not examine the effects of CU traits on eyewitness memory performance while controlling for SES, or if SES predicted eyewitness memory recall. This was done due to a large amount of missing data for this variable (i.e., 6 individuals had missing data who would have been removed from the analyses, which would have reduced the power in the present study) and the fact that no specific hypotheses were made about the impact of SES on memory performance. Half of participants came from families with an annual income equal to or greater than \$100,000, which is a much larger percentage than is representative of the U.S. population (approximately 25% of U.S. families earn an annual

income of \$100,000 or more; Fontenot, Semega, & Kollar, 2018). However, this is consistent with the well-established fact that research participants overwhelmingly come from households with higher incomes.

The lack of significant findings for CU traits could be attributed to the fact that participants overwhelmingly came from families with a higher SES and thus, logically, increased access to better education and more stimulating environments that could result in better memory performance overall when compared to individuals from more impoverished backgrounds (Shaked et al., 2018). Thus, the higher SES of most of the participants may have resulted in a sample that overall had better memory performance than the population as a whole (e.g., the mean of accurate units of information was about 336, while the mean of inaccurate units of information was only about 10). This is consistent with the finding that the sample of the present study had a moderately higher group mean on the WASI-II ($M=107.92$, $SD = 13.75$, $d = 0.55$) when compared to the WASI-II standardization sample. Past research has shown that an individual's SES can impact not only intelligence, but also memory performance, and thus, future studies should aim to include this within analyses (Shaked et al., 2018).

Another limitation to the present research was the fact that many participants completed the study within their homes, which often resulted in uncontrolled variables (e.g., noise from a television) that may have impacted concentration or attention to the research study tasks. Though this increases the external validity of the findings (i.e., there may be distractions when individuals are asked to provide eyewitness accounts), it also may have impacted performance on several of the measures (e.g., working memory task). Anecdotally, the researchers observed that the greatest impact of distractions was on working memory scores, and the distractions were less impactful on the IQ test performance, video viewing, and subsequent memory interview. The scores obtained in the current study may underestimate the participants' true ability in terms of

IQ or working memory performance due to uncontrolled variables (i.e., distractions). However, examining effect sizes for group differences in memory recall performance based on location of the study (i.e., lab vs. home) demonstrated that there were not even moderate effects of location on accurate or inaccurate free recall, or accurate, inaccurate, or “I don’t know” responses to cued recall questions.

Future directions for research examining CU traits and eyewitness memory recall could expand on several facets of the current study. Given that many studies examining offender populations have found significant relations between memory performance and CU or psychopathic traits in the past, specifically that individuals with criminal histories who have more psychopathic traits have poorer accuracy in memory recall (Dolan & Fullam, 2010), the present study may demonstrate different findings with an offender population over the community sample examined. Additionally, more robust findings could result from replicating the current study within a more controlled environment (e.g., laboratory setting) to reduce the impact of distractions on intelligence test and working memory test performance.

A major strength of the current study was that the length of time between the presented stimulus and recall of the stimulus was relatively brief (45 minutes, compared to days), yet there were large individual differences in memory recall performance (e.g., total units of correct freely recalled information ranged from 42 to 846 [$M = 336.16$, $SD = 207.75$]). Additionally, the brief time delay allowed for a more accurate measure of memory performance, rather than measuring the rate of forgetting, as prior research has found that people have a tendency to forget more as time passes (Ricker, Spiegel, & Cowan, 2014). However, when individuals are asked to provide an eyewitness memory account, it can be a much longer delay, such as weeks to months after the to-be-remembered event occurred. Thus, an important area of future research would be to examine whether or not the present findings persist after a longer time delay, which would

expand on our knowledge about the accuracy of memory recall in situations more similar to those in which people are being asked to provide eyewitness testimony.

References

- Allen, J.L., Briskman, J., Humayun, S., Dadds, M.R., & Scott, S. (2013). Heartless and cunning? Intelligence in adolescents with antisocial behavior and psychopathic traits. *Psychiatry Research, 210*, 1147-1153.
<http://dx.doi.org/10.1016/j.psychres.2013.08.033>
- American Psychiatric Association. (2013). Diagnostic and statistical manual of mental disorders (5th ed.) Washington, DC.
- Andrew, J.M. (1982). Memory and violent crime among delinquents. *Criminal Justice and Behavior, 9*(3), 364-371.
- Barry, C.T., Frick, P.J., DeShazo, T.M., McCoy, M.G., Ellis, M., & Loney, B.R. (2000). The importance of callous-unemotional traits for extending the concept of psychopathy to children. *Journal of Abnormal Psychology, 109*(2), 335-340. doi: 10.1037//0021843X.109.2.335
- Bate, C., Boduszek, D., Dhingra, K., & Bale, C. (2014). Psychopathy, intelligence and emotional responding in a non-forensic sample: An experimental investigation. *The Journal of Forensic Psychiatry & Psychology, 25*(5), 600-612.
<http://dx.doi.org/10.1080/14789949.2014.943798>
- Bauer, L.O., & Hesselbrock, V.M. (2001). CSD/BEM localization of P300 sources in adolescents "at-risk": Evidence of frontal cortex dysfunction in conduct disorder. *Society of Biological Psychiatry, 50*, 600-608.
- Berkout, O.V., Young, J.N., & Gross, A.M. (2011). Mean girls and bad boys: Recent research on gender differences in conduct disorder. *Aggression and Violent Behavior, 16*, 503 – 511.
doi:10.1016/j.avb.2011.06.001

- Burke, J.D., Loeber, R., & Lahey, B.B. (2007). Adolescent conduct disorder and interpersonal callousness as predictors of psychopathy in young adults. *Journal of Clinical Child and Adolescent Psychology, 36*(3), 334-346.
- Byrd, A.L., Kahn, R.E., & Pardini, D.A. (2013). A validation of the inventory of callous unemotional traits in a community sample of young adult males. *Journal of Psychopathology and Behavioral Assessment, 35*, 20-34. doi: 10.1007/s10862-012-93154
- Cahill, L., & McGaugh, J.L. (1995). A novel demonstration of enhanced memory associated with emotional arousal. *Consciousness and Cognition, 4*, 410-421.
- Chae, Y., Goodman, G.S., Eisen, M.L., & Qin, J. (2011). Event memory and suggestibility in abused and neglected children: Trauma-related psychopathology and cognitive functioning. *Journal of Experimental Child Psychology, 110*, 520 – 538.
doi:10.1016/j.jecp.2011.05.006
- Chen, H., Cohen, P., & Chen, S. (2010). How big is a big odds ratio? Interpreting the magnitudes of odds ratios in epidemiological studies. *Communications in Statistics – Simulation and Computation, 39*(4), 860-864. doi: 10.1080/03610911003650383
- Christianson, S.A., Forth, A.E., Hare, R.D., Strachan, C., Lidberg, L., & Thorell, L.H. (1996). Remembering details of emotional events: A comparison between psychopathic and nonpsychopathic offenders. *Personality and Individual Differences, 20*(4), 437-443.
- Cima, M., & Oorsouw, K.V. (2013). The relationship between psychopathy and crime-related amnesia. *International Journal of Law and Psychiatry, 36*, 23-29.
<http://dx.doi.org/10.1016/j.ijlp.2012.11.004>
- Cleckley, H. (2015). *The mask of sanity: Second edition*. Mansfield Centre, CT: Martino Publishing.

Cooper, B.S., Herve, H., & Yuille, J.C. (2007). Psychopathy and memory for violence.

International Journal of Forensic Mental Health, 6(2), 123-135. doi:

10.1080/14999013.2007.10471257

Copestake, S., Gray, N.S., & Snowden, R.J. (2013). Emotional intelligence and psychopathy: A

comparison of trait and ability measures. *Emotion*, 13(4), 691-702. doi:10.1037/a0031746

D'Acremont, M., & Van der Linden, M. (2007). Memory for angry faces, impulsivity, and

problematic behavior in adolescence. *Journal of Abnormal Child Psychology*, 35, 313

324. doi: 10.1007/s10802-006-9092-1

De Brito, S.A., Viding, E., Kumari, V., Blackwood, N., & Hodgins, S. (2013). Cool and hot

executive function impairments in violent offenders with antisocial personality disorder

with and without psychopathy. *PLoS ONE*, 8(6), 1-12. doi:

10.1371/journal.pone.0065566

DeLisi, M., Vaughn, M.G., Beaver, K.M., & Wright, J.P. (2010). The Hannibal Lecter myth:

Psychopathy and verbal intelligence in the MacArthur violence risk assessment study.

Journal of Psychopathology and Behavioral Assessment, 32, 169-177.

doi:10.1007/s10862-009-9147-z

Discovery HD (2016). *The Forensic Laboratory: How Crime is Analyzed*. Documentary

retrieved from <https://www.youtube.com/watch?v=BsnGlGxqV6A>

Dolan, M.C., & Anderson, I.M. (2002). Executive and memory function and its relationship to

trait impulsivity and aggression in personality disordered offenders. *The Journal of*

Forensic Psychiatry, 13(3), 503-526. doi:10.1080/0958518021000019452

Dolan, M.C., & Fullam, R. (2005). Memory for emotional events in violent offenders with

antisocial personality disorder. *Personality and Individual Differences*, 38, 1657-1667.

doi: 10.1016/j.paid.2004.09.028

- Dolan, M.C., & Fullam, R. (2010). Emotional memory and psychopathic traits in conduct disordered adolescents. *Personality and Individual Differences, 48*, 327-331. doi: 10.1016/j.paid.2009.10.029
- Dougherty, D.M., Bjork, J.M., Harper, R.A., Mathias, C.W., Moeller, F.G., & Marsh, D.M. (2003). Validation of the immediate and delayed memory tasks in hospitalized adolescents with disruptive behavior disorders. *The Psychological Record, 53*, 509-532.
- Eisen, M.L., Goodman, G.S., Qin, J., Davis, S., & Crayton, J. (2007). Maltreated children's memory: accuracy, suggestibility, and psychopathology. *Developmental Psychology, 43*(6), 1275-1294. doi: 10.1037/0012-1649.43.6.1275
-
- Eisen, M.L., Qin, J., Goodman, G.S., & Davis, S.L. (2002). Memory and suggestibility in maltreated children: Age, stress arousal, dissociation, and psychopathology. *Journal of Experimental Child Psychology, 83*, 167 -212.
- Endres, M.J., Donkin, C., & Finn, P.K. (2014). An information processing/associative learning account of behavioral disinhibition in externalizing psychopathology. *Experimental and Clinical Psychopharmacology, 22*(2), 122-132. doi: 10.1037/a0035166
- Essau, C.A., Sasagawa, S., & Frick, P.J. (2006) Callous-unemotional traits in a community sample of adolescents. *Assessment, 13*, 454-469. doi: 10.1177/1073191106287354
- Euler, F., Jenkel, N., Stadler, C., Schmeck, K., Fegert, J.M., Kolch, M., & Schmid, M. (2015). Variants of girls and boys with conduct disorder: Anxiety symptoms and callous unemotional traits. *Journal of Abnormal Child Psychology, 43*, 773-785. doi 10.1007/s10802-014-9946-x

- Euler, F., Sterzer, P., & Stadler, C. (2014). Cognitive control under distressing emotional stimulation in adolescents with conduct disorder. *Aggressive Behavior*, 40, 109-119. doi:10.1002/ab.21508
- Fontenot, K., Semega, J., & Kollar, M. (2018). Income and poverty in the United States: 2017. *United States Census Bureau*, 60 -263. U.S. Government Printing Office: Washington, DC.
- Foster, J.L., Shipstead, Z., Harrison, T.L., Hicks, K.L., Redick, T.S., & Engle, R.W. (2015). Shortened complex span tasks can reliably measure working memory capacity. *Memory and Cognition*, 43, 226-236. doi: 10.3758/s13421-014-0461-7
- Frick, P.J., O'Brien, B.S., Wootton, J.M., & McBurnett, K. (1994). Psychopathy and conduct problems in children. *Journal of Abnormal Psychology*, 103(4), 700-707.
- Frick, P.J., & Ellis, M. (1999). Callous-unemotional traits and subtypes of conduct disorder. *Clinical Child and Family Psychology Review*, 2(3), 149-168.
- Frick, P.J. (2009). Extending the construct of psychopathy to youth: Implications for understanding, diagnosing, and treating antisocial children and adolescents. *The Canadian Journal of Psychiatry*, 54(12), 803-812.
- Frick, P.J., & Ray, J.V. (2015). Evaluating callous-unemotional traits as a personality construct. *Journal of Personality*, 83(6), 710-722. doi:10.1111/jopy.12114
- Gendreau, P., Little, T., & Goggin, C. (1996). A meta-analysis of the predictors of adult offender recidivism: What works! *Criminology*, 34, 575-607. doi:10.1111/j.1745-9125.1996.tb01220.x
- Ghetti, S., Qin, J., & Goodman, G.S. (2002). False memories in children and adults: Age, distinctiveness, and subjective experience. *Developmental Psychology*, 38(5), 705-718. doi: 10.1037//0012-1649.38.5.705

- Glass, S.J., & Newman, J.P. (2009). Emotion processing in the criminal psychopath: The role of attention in emotion-facilitated memory. *Journal of Abnormal Psychology, 118*(1), 229-234. doi: 10.1037/a0014866
- Gorenstein, E.E. (1982). Frontal lobe functions in psychopaths. *Journal of Abnormal Psychology, 91*(5), 368-379.
- Hare, R.D. (1984). Performance of psychopaths on cognitive tasks related to frontal lobe function. *Journal of Abnormal Psychology, 93*(2), 133-140.
- Hare, R.D., Hart, S.D., & Harpur, T.J. (1991). Psychopathy and the DSM-IV criteria for antisocial personality disorder. *Journal of Abnormal Psychology, 100*(3), 391-398.
- Hare, R.D., Neumann, C.S., & Widiger, T.A. (2012). Psychopathy. In Widiger, T.A. (Ed.), *The Oxford handbook of personality disorders* (478-504). Oxford: Oxford University Press.
- Harris, L.S., Block, S.D., Ogle, C.M., Goodman, G.S., Augusti, E.M., Larson, R.P., Culver, M.A., Pineda, A.R., Timmer, S.G., & Urquiza, A. (2016). Coping style and memory specificity in adolescents and adults with histories of child sexual abuse. *Memory, 24*(8), 1079-1090. doi: <http://dx.doi.org/10.1080/09658211.2015.1068812>
- Horan, J.M., Brown, J.L., Jones, S.M., & Aber, J.L. (2015). Assessing invariance across sex and race/ethnicity in measures of youth psychopathic characteristics. *Psychological Assessment, 27*(2), 657 – 668. doi: <http://dx.doi.org/10.1037/pas0000043>
- Hummer, T.A., Wang, Y., Kronenberger, W.G., Dunn, D.W., & Mathews, V.P. (2014). The relationship of brain structure to age and executive functioning in adolescent disruptive behavior disorder. *Psychiatry Research: Neuroimaging, 231*, 210-217. <http://dx.doi.org/10.1016/j.psychresns.2014.11.009>
- Isen, J. (2010). A meta-analytic assessment of Wechsler's P>V sign in antisocial populations. *Clinical Psychology Review, 30*, 423-435. doi: 10.1016/j.cpr.2010.02.003

- Ishikawa, S.S., Raine, A., Lencz, T., Bihle, S., & Lacasse, L. (2001). Autonomic stress reactivity and executive functions in successful and unsuccessful criminal psychopaths from the community. *Journal of Abnormal Psychology, 110*(3), 423-432. doi: 10.1037//0021-843X.110.3.423
- Johnson, V.A., Kemp, A.H., Heard, R., Lennings, C.J., & Hickie, I.B. (2015). Childhood- versus adolescent-onset antisocial youth with conduct disorder: Psychiatric illness, neuropsychological and psychosocial function. *PLoS ONE, 10*(4), 1-17. doi:10.1371/journal.pone.0121627
- Kanade, T., Cohn, J. F., & Tian, Y. (2000). Comprehensive database for facial expression analysis. Proceedings of the Fourth IEEE International Conference on Automatic Face and Gesture Recognition (FG'00), Grenoble, France, 46-53.
- Kennedy, J.P., Richardson, G.R., Dixon, L., & Kelly, T.P. (2003). Intellectual ability in adolescents with conduct disorder. *Perceptual and Motor Skills, 97*, 1089-1090.
- Kettenauer, T., Murua, L.A., & Jia, F. (2016). Age-related differences in moral identity across adulthood. *Developmental Psychology, 52*(6), 972-984. doi: <http://dx.doi.org/10.1037/dev0000127>
- Khan, R.E., Byrd, A.L., & Pardini, D.A. (2013) Callous-unemotional traits robustly predict future criminal offending in young men. *Law and Human Behavior, 37*(2), 87-97. doi: 10.1037/b0000003
- Kiehl, K.A., Smith, A.M., Hare, R.D., Mendrek, A., Forster, B.B., Brink, J., & Liddle, P.F. (2001). Limbic abnormalities in affective processing by criminal psychopaths as revealed by functional magnetic resonance imaging. *Biological Psychiatry, 50*, 677-684.
- Kimonis, E. R., Frick, P. J., Skeem, J. L., Marsee, M. A., Cruise, K., Munoz, L. C., & ... Morris, A. S. (2008). Assessing callous-unemotional traits in adolescent offenders: Validation of

- the inventory of callous-unemotional traits. *International Journal Of Law And Psychiatry*, 31(3), 241-252. doi: 10.1016/j.ijlp.2008.04.002
- Kimonis, E.R., Branch, J., Hagman, B., Graham, N., & Miller, C. (2013). The psychometric properties of the inventory of callous-unemotional traits in an undergraduate sample. *Psychological Assessment*, 25(1), 84-93. doi: 10.1037/a0029024
- Kimonis, E.R. (2017). *Emotion coaching and parent management training for children with callous-unemotional traits: A treatment development study*, The Society for Research in Child Development Biennial Conference, Austin, TX.
- Kjelsberg, E., & Friestad, C. (2009). Exploring gender issues in the development from conduct disorder in adolescence to criminal behaviour in adulthood. *International Journal of Law and Psychiatry*, 32, 18-22. doi:10.1016/j.ijlp.2008.11.004
- Krackow, E.M., Lynn, S.J., & Payne, D.G. (2005). The death of Princess Diana: The effects of memory enhancement procedures on flashbulb memories. *Imagination, Cognition, and Personality*, 25(3), 197-219. <http://dx.doi.org/10.2190/FBCF-T8VG-L5LJ-N8VL>
- Krackow, E.M. (2011). The effects of writing on memory for a forensically relevant event. *Imagination, Cognition, and Personality*, 31(4), 313-326.
<http://dx.doi.org/10.2190/IC.31.4.e>
- Krackow, E.M. (2017). Specific recall questions. *Personal intellectual property*.
- Krauel, K., Duzel, E., Hinrichs, H., Rellum, T., Santel, S., & Baving, L. (2008). Emotional memory in ADHD patients with and without comorbid ODD/CD. *Journal of Neural Transmission*, 116, 117-120. doi: 10.1007/s00702-008-0154-0
- Lahey, B.B., Loeber, R., Burke, J.D., & Applegate, B. (2005). Predicting future antisocial personality disorder in males from a clinical assessment in childhood. *Journal of Consulting and Clinical Psychology*, 73(3), 389-399. doi: 10.1037/0022-006X.73.3.389

- Lahey, B.B., Schwab-Stone, M., Goodman, S.H., Waldman, I.D., Canino, G., Rathouz, P.J....& Jensen, P.S. (2000). Age and gender differences in oppositional behavior and conduct problems: A cross-sectional household study of middle childhood and adolescence. *Journal of Abnormal Psychology, 109*(3), 488 – 503. doi:10.1037//0021-843X. 109.3.481
- Loney, B.R., Frick, P.J., Ellis, M., & McCoy, M.G. (1998). Intelligence, callous-unemotional traits, and antisocial behavior. *Journal of Psychopathology and Behavioral Assessment, 20*(3), 231-247.
- Lucey, P., Cohn, J. F., Kanade, T., Saragih, J., Ambadar, Z., & Matthews, I. (2010). The Extended Cohn-Kanade Dataset (CK+): A complete expression dataset for action unit and emotion-specified expression. *Proceedings of the Third International Workshop on CVPR for Human Communicative Behavior Analysis (CVPR4HB 2010)*, San Francisco, USA, 94-101.
- Lueger, R.J., & Gill, K.J. (1990). Frontal-lobe cognitive dysfunction in conduct disorder adolescents. *Journal of Clinical Psychology, 46*(6), 696- 706.
- Lynam, D.R., Caspi, A., Moffitt, T.A., Loeber, R., & Stouthamer-Loeber, M. (2007). Longitudinal evidence that psychopathy scores in early adolescence predict adult psychopathy. *Journal of Abnormal Psychology, 116*(1), 155-165. doi: 10.1037/0021-843X.116.1.155
- Maccow, G. (2011). *Overview of WASI-II* [PowerPoint slides]. Retrieved from <http://images.pearsonclinical.com/images/PDF/Webinar/WASI-IIHandoutOct2011.pdf>
- McCabe, K.M., Rodgers, C., Yeh, M., & Hough, R. (2004). Gender differences in childhood onset conduct disorder. *Development and Psychopathology, 16*, 179-192. doi: 10.1017/S0954579404044463

- McCrimmon, A.W., & Smith, A.D. (2013). Review of Wechsler abbreviated scale of intelligence, second edition (WASI-II). *Journal of Psychoeducational Assessment*, 31(3), 337 – 341. <http://dx.doi.org/www.libproxy.wvu.edu/10.1177/0734282912467756>.
- McKenzie, M.E., & Lee, S.S. (2015). Cognitive ability and psychopathic traits: Independent and interactive associations with youth conduct problems. *Journal of Abnormal Child Psychology*, 43, 761-771. doi: 10.1007/s10802-014-9932-3
- McMahon, R.J., Witkiewitz, K., & Kotler, J.S. (2010). Predictive validity of callous-unemotional traits measured in early adolescence with respect to multiple antisocial outcomes. *Journal of Abnormal Psychology*, 119(4), 752-763. doi: 10.1037/a0020796
- McWilliams, K., Harris, L.S., & Goodman, G.S. (2014). Child maltreatment, trauma-related psychopathology, and eyewitness memory in children and adolescents. *Behavioral Sciences and the Law*, 32, 702-717. doi: 10.1002/bsl.2143
- Melinder, A., Alexander, K., Cho, Y.I., Goodman, G.S., Thoresen, C., Lonnum, K., & Magnussen, S. (2010). Children's eyewitness memory: A comparison of two interviewing strategies as realized by forensic professionals. *Journal of Experimental Child Psychology*, 105, 156 – 177. doi:10.1016/j.jecp.2009.04.004
- Muñoz, L.C., Frick, P.J., Kimonis, E.R., & Aucoin, K.J. (2008). Verbal ability and delinquency: Testing the moderating role of psychopathic traits. *The Journal of Child Psychology and Psychiatry*, 49(4), 414-421. doi: 10.1111/j.1469-7610.2007.01847.x
- Nijman, H., Merckelbach, H., & Cima, M. (2009). Performance intelligence, sexual offending, and psychopathy. *Journal of Sexual Aggression*, 15(3), 319-330. doi: 10.1080/13552600903195057

- Oosterlaan, J., Scheres, A., & Sergeant (2005). Which executive functioning deficits are associated with AD/HD, ODD/CD, and comorbid AD/HD+ODD/CD? *Journal of Abnormal Child Psychology*, 33(1), 69-85. doi:10.1007/s10802-005-0935-y
- Orue, I., Calvete, E., & Gamez-Gaudix, M. (2016). Gender moderates the association between psychopathic traits and aggressive behavior in adolescents. *Personality and Individual Differences*, 94, 266-271. Doi: <http://dx.doi.org/10.1016/j.paid.2016.01.043>
- Peace, K.A., & Constantin, K.M. (2016). Misremembering events: Emotional valence, psychopathic traits, and the misinformation effect. *Journal of Police and Criminal Psychology*, 31, 189-199. doi: 10.1007/s11896-015-9178-1
- Raggio, D.J., Scattone, D., & May, W. (2010). Relationship of the Kaufman brief intelligence test – second edition and the Wechsler abbreviated scale of intelligence in children referred for ADHD. *Psychological Reports*, 106(2), 513 – 518. <http://dx.doi.org/www.libproxy.wvu.edu/10.2466/PR0.106.2.513-518>
- Richardson, G., & Kelly, T.P. (1995). The relationship between intelligence, memory and interrogative suggestibility in young offenders. *Psychology, Crime & Law*, 1, 283-290.
- Ricker, T.J., Spiegel, L.R., & Cowan, N. (2014). Time-based loss in visual short-term memory is from trace decay not temporal distinctiveness. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 40(6), 1510-1523. doi: <http://dx.doi.org/10.1037/xlm0000018>
- Rudy, L., & Goodman, G.S. (1991). Effects of participation on children's reports: Implications for children's testimony. *Developmental Psychology*, 27(4), 527-538. doi: 10.1037/0012-1649.27.4.527

- Saarinen, S., Fontell, T., Vuontela, V., Carlson, S., & Aronen, E.T. (2015). Visuospatial working memory in 7- to 12-year-old children with disruptive behavior disorders. *Child Psychiatry and Human Development*, 46, 34-43. doi: 10.1007/s10578-014-0449-3
- Salekin, R.T., Neumann, C.S., Leistico, A.M.R., & Zalot, A.A. (2004). Psychopathy in youth and intelligence: An investigation of Cleckley's hypothesis. *Journal of Clinical Child and Adolescent Psychology*, 33(4), 731-742.
- Salekin, R.T., Lee, Z., Dillard, C.L., & Kubak, F.A. (2010). Child psychopathy and protective factors: IQ and motivation to change. *Psychology, Public Policy, and Law*, 16(2), 158-176. doi:10.1037/a0019233
- Shaked, D., Katzel, L.I., Seliger, S.L., Gullapalli, R.P., Davatzikos, C., Erus, G., Evans, M.K., Zonderman, A.B., & Waldstein, S.R. (2018). Dorsolateral prefrontal cortex volume as a mediator between socioeconomic status and executive function. *Neuropsychology*, 32(8), 985-995. doi: <http://dx.doi.org/10.1037/neu0000484>
- Shanmugan, S., Wolf, D.H., Calkins, M.E., Moore, T.M., Ruparel, K., Hopson, R.D... & Satterthwaite, T.D. (2016). Common and dissociable mechanism of executive system dysfunction across psychiatric disorders in youth. *American Journal of Psychiatry*, 173(5), 517-526.
- Simmonds, D.J., Hallquist, M.N., & Luna, B. (2017). Protracted development of executive and mnemonic brain systems underlying working memory in adolescence: A longitudinal fMRI study. *NeuroImage*, 157, 695 – 704. doi: <http://dx.doi.org/10.1016/j.neuroimage.2017.01.016>
- Stickle, T.R., Marini, V.A., & Thomas, J.N. (2012). Gender differences in psychopathic traits, types, and correlates of aggression among adjudicated youth. *Journal of Abnormal Child Psychology*, 40, 513-525. doi: 10.1007/s10802-011-9588-1

- Thijssen, J., Otgaar, H., Meijer, E.H., Smeets, T., & de Ruiter, C. (2012). Emotional memory for central and peripheral details in children with callous-unemotional traits. *Behavioral Sciences and the Law*, 30, 506-515. doi: 10.1002/bsl.2021
- Thornton, L.C., Frick, P.J., Shulman, E.P., Ray, J.V., Steinberg, L., & Cauffman, E. (2015). Callous-unemotional traits and adolescents role in group crime. *Law and Human Behavior*, 39(4), 368-377. doi: <http://dx.doi.org/10.1037/lhb0000124>
- Wall, T.D., Sellbom, M., & Goodwin, B.E. (2013). Examination of intelligence as a compensatory factor in non-criminal psychopathy in a non-incarcerated sample. *Journal of Psychopathology and Behavioral Assessment*, 35, 450-459. doi: 10.1007/s10862-013-9358-1
- Watts, A.L., Salekin, R.T., Harrison, N., Clark, A., Waldman, I.D., Vitacco, M.J., & Lilienfeld, S.O. (2016). Psychopathy: Relations with three conceptions of intelligence. *Personality Disorders: Theory, Research, and Treatment*, 7(3), 269-279. <http://dx.doi.org/10.1037/per0000183>
- Webster-Stratton, C. (1996). Early-onset conduct problems: Does gender make a difference? *Journal of Consulting and Clinical Psychology*, 64(3), 540 – 551.
- Wechsler, D., Psychological Corporation., & PsychCorp (Firm). (2008). WAIS-IV technical and interpretive manual. San Antonio, Tex: Pearson
- Wiesner, M., Elliot, M.N., McLaughlin, K.A., Banspach, S.W., Tortolero, S., & Schuster, M.A. (2015). Common versus specific correlates of fifth-grade conduct disorder and oppositional defiant disorder symptoms: Comparison of three racial/ethnic groups. *Journal of Abnormal Child Psychology*, 43, 985 -998. doi:10.1007/s10802-014-9955-9

Table 1.

Summary of findings examining intelligence and psychopathic traits

Study	Sample	Measures	Findings
<i>Nijman, Merckelbach, & Cima (2013)</i>	133 adult inpatients (mean age was 34.3)	PCL-R (clinician-report); WAIS-R/WAIS III	Higher Performance IQ was related to higher affective components of psychopathy (e.g., lack of remorse)
<i>Delisi, Vaughn, Beaver, & Wright (2010)</i>	840 adult inpatients (ages 18 to 40, $M = 29.85$)	PCL-SV (clinician-report); WAIS-R	Lower verbal IQ related to higher remorselessness, lacking empathy, failure to accept responsibility for one's actions, impulsivity
<i>Copestake, Gray & Snowden (2013)</i>	57 convicted male offenders (ages 22 to 66, $M = 38$)	PCL-R (clinician-report) and PPI-R (self-report); Mayer-Salovey-Caruso Emotional Intelligence Test, WASI	IQ negatively correlated to behavioral factors of psychopathy, and positively to interpersonal factors of psychopathy (e.g., lack of empathy). High psychopathy positively related to high scores on emotional intelligence when IQ was controlled
<i>Bate, Boduszek, Dhingra, & Bale, (2014)</i>	50 university students (ages 18 to 41, $M = 22.64$)	LSPD (self-report); Raven's standard progressive matrices	No direct relationship between IQ and psychopathy; IQ served moderating role between psychopathy and emotional responding, with lower IQ predicting more emotional responsiveness
<i>Wall, Sellbom, & Goodwin (2013)</i>	372 undergraduate students (ages 17 to 32, $M = 18.72$)	PPI-R (self-report); Shipley-2	IQ moderated relationship between components of psychopathy and engagement in antisocial behaviors (high verbal IQ

			and high fearless-dominance less likely to engage in antisocial behaviors; higher performance IQ and self-centeredness more likely to engage in antisocial behaviors)
<i>Watts, Salekin, Harrison, Clark, Waldman, Vitacco, & Lilienfeld (2016)</i>	1,257 undergraduate students ($M = 19.32$)	PPI-Short Form (self-report); Shipley, STAT, Emotional Quotient Inventory	Weak correlations between IQ and psychopathic traits; higher overall traits correlated to lower intelligence
<i>Kennedy, Richardson, Dixon, & Kelly, 2003</i>	195 adolescents (age not reported)	Wechsler Intelligence Scales	No significant differences in IQ among different types of offenders
<i>Loney, Frick, Ellis, & McCoy (1998)</i>	117 children (ages 6 to 13, $M = 8.48$)	DISC 2.3, PSD (parent and teacher report); WISC-R	Children with ODD/CD and low CU traits scored lower on Verbal IQ than those with high CU traits, who scored lower on performance IQ than controls
<i>Frick, O'Brien, Wootton, & McBurnett (1994)</i>	92 children receiving treatment for behavior problems (ages 6 to 11, $M = 8$)	PSD (parent and teacher report), DSM-III diagnostic criteria for conduct problems; WISC-R	Lower intelligence was correlated to higher conduct problems in kids low on CU traits
<i>Salekin, Neumann, Leistico, & Zalot (2004)</i>	122 incarcerated children and adolescents (ages 11 to 18, M	PCL-YV; K-BIT and STAT	Interpersonal and Behavioral components of psychopathy were positively correlated to verbal IQ, Affective components were negatively correlated to overall IQ

<i>Salekin, Lee, Schrum Dillard, & Kubak (2010)</i>	140 adolescents (ages 11 to 18, $M = 15.25$)	Childhood Psychopathy Scale, K-BIT	Higher psychopathy related to higher verbal IQ
<i>Allen, Briskman, Humayun, Dadds, & Scott (2013)</i>	361 community adolescents (ages 9 to 18, $M = 14.56$)	WASI; ASPD (parent-report)	Psychopathic traits were unrelated to IQ; Narcissism was related to lower non-verbal IQ
<i>Muñoz, Frick, Kimonis, & Aucoin (2008)</i>	100 incarcerated male youth (13 to 18, $M =$	APSD, ICU; Peabody Picture Vocabulary Test	CU traits moderated relation between engagement in violent behaviors and IQ, with higher verbal IQ and CU traits leading to more engagement in violent behavior
<i>Dolan & Anderson (2002)</i>	60 inpatient adults and 27 healthy adults (ages 18 to 50, $M = 30$) Meta-analysis of 131 studies; $n = 20,234$ including adults and children (specific age ranges not provided)	DSM-III diagnostic criteria for psychopathic personality; WAIS-R	Individuals with high psychopathic personality traits had lower verbal IQ
<i>Isen (2010)</i>		WISC, WAIS, WASI (various versions); met diagnostic criteria for ASPD or CD	Performance IQ > Verbal IQ in all age groups, most pronounced in adolescents (6 point difference)
<i>McKenzie & Lee (2015)</i>	221 children (ages 6 to 9, $M = 7.86$)	DBD rating scale (Parent and Teacher Versions), APSD (Parent and Teacher Versions); DISC-IV-P; WISC-IV	IQ moderated relation between Disruptive behavior and narcissism, with higher narcissism being positively correlated to ODD or CD symptoms in children with higher IQ

Table 2.

Summary of findings examining psychopathy and memory

Study	Sample	Measures	Findings
<i>Gorenstein (1982)</i>	20 psychopath ($M = 26.5$) and 23 non-psychopath ($M = 29.3$) psychiatric patients, 18 controls (college undergraduates; ages 18 to 20)	California Psychological Inventory and DSM Criteria for APSD; WCST, Stroop Task, SMMT, Necker Cube Task, Anagram Task	Psychopaths demonstrated more deficits in frontal lobe tasks compared to both non-psychopaths and college students
<i>De Brito, Viding, Kumari, Blackwood, & Hodgins (2013)</i>	17 psychopathic offenders, 28 non-psychopathic offenders, 21 controls (non-offenders; all adults, age not provided)	Digit span – backward task, spatial alternation task, probabilistic response reversal task, gambling task, and a passive avoidance learning task	Both offender types had deficits in working memory compared to controls
<i>Hare (1984)</i>	46 incarcerated males (age $M = 32$)	California Psychological Inventory and DSM Criteria for APSD; WCST, SMMT, Necker Cube Task	No differences in frontal lobe tasks as a function of psychopathic traits

<i>Dolan & Anderson (2002)</i>	60 inpatient adults and 27 healthy adults (ages 18 to 50, $M = 30$)	DSM-III diagnostic criteria for psychopathic personality; WCST, Stroop Task, Trails, Barratt Impulsivity Scale, logical memory and visual reproduction task	Psychopaths had worse performance on logical memory (i.e., recalling verbal information with emotional component), but not visual reproduction compared to controls
<i>Ishikawa, Raine, Lencz, Bihrlé, &</i>	55 community adult males (ages 21 to 45)	PCL-R; WCST, the logical memory and visual reproduction subtests from the WMS	Non-criminal psychopaths had better working memory than both controls and criminal psychopaths
<i>Bauer & Hesselbrock (2001)</i>	158 adolescents and young adults (ages 14 to 20,	History of conduct problems; Sternberg Memory Scanning Task	Reduced prefrontal cortex activation in youth with conduct problems
<i>Endres, Donkin, & Finn (2014)</i>	510 young adults (age $M = 21.2$)	History of externalizing behavior problems; Go/No-Go Task, Auditory Consonant Task	Higher levels of externalizing behavior problems were associated with poorer performance on working memory tasks
<i>Euler, Sturzer, & Stadler (2014)</i>	22 outpatient and 22 control adolescents (ages 11 to 17)	Diagnosis of Conduct Disorder; Stroop Task, recall of emotional stimuli	Adolescents with conduct disorder had more deficits in working memory performance
<i>Johnson, Kemp, Heard, Lennings &</i>	43 children, adolescents, and young adults (ages	DSM-IV-TR diagnosis of	Children and adolescents with CD demonstrated

<i>Hickie (2015)</i>	12 to 21, $M = 15.31$)	Conduct Disorder; WTAR; WMS-III; CANTAB; COWAT; RCFT; RAVLT	working memory and executive functioning impairments
<i>Leuger & Gill (1990)</i>	21 inpatient and 20 control adolescent males (ages 13 to 17)	Diagnosis of Conduct Disorder; PPVT, WCST, Auditory Verbal Learning Test, SMMT, Trail Making Test	Adolescents with conduct disorder had impaired executive functioning/frontal lobe performance
<i>Saarinen, Fontell, Vuontela, Carlson, & Aronen (2015)</i>	26 inpatient and 26 control children (ages 7 to 12)	K-SADS-PL, CBCL; N-Back Tasks	Children with disruptive behavior disorders had poorer working memory performance than controls
<i>Shanmugan et al. (2016)</i>	1,129 children and adolescents (age $M = 15.5$)	DSM-IV-TR criteria for disruptive behavior disorders; <i>n</i> -back task	Behavioral disorders were associated with impaired executive functioning
<i>Oosterlaan, Sheres, & Sergeant (2005)</i>	99 children (ages 6 to 12, $M = 10.3$)	DSM-IV-TR criteria for ODD/CD; CBCL; Verbal Fluency Task, Tower of London, SOPT, WISC-R	Children with ODD/CD had better executive functioning performance than typically developing children
<i>Christianson, Forth, Hare, Strachan, Lidberg, & Thorell (1996)</i>	62 incarcerated males (age $M = 28.9$)	PCL-R; Cued recall for pictures	Non-psychopaths had bias for remembering central details (i.e., emotionally salient components); Psychopaths demonstrated equal recall for central and peripheral details

<i>Dolan & Fullam, (2005)</i>	88 incarcerated adult males (18 to 45) and 20 community controls (mean age 31.65)	PCL-SV; Cahill Emotional Memory Task	All offenders (regardless of psychopathic traits) demonstrated deficits in free recall of emotional stimuli
<i>Glass & Newman, (2009)</i>	239 incarcerated adult Caucasian males under age 45	PCL-R; Recall for emotionally neutral, negative, or positive words with varied peripheral information (e.g., color of words)	No difference in recall for words as a function of psychopathy; Psychopaths demonstrated deficit in recall for peripheral information
<i>Peace & Constantin (2016)</i>	334 undergraduate students (ages 17 to 55, $M = 20.7$)	PPI-R; Recall of emotionally salient pictures	Psychopathy was unrelated to recall of emotional stimuli
<i>Cooper, Hervé, & Yuille (2007)</i>	150 male violent offenders (age $M = 34.93$)	PCL-R; Memory Characteristics Questionnaire (self-report)	Psychopathic individuals had better memory recall of violent crimes compared to non-psychopathic offenders
<i>d'Acremont & Van der Linden (2007)</i>	86 community adolescents (ages 13 to 17, $M = 14.31$)	UPPS Impulsive Behavior Scale; Strengths and Difficulties Questionnaire (Teacher Report); Emotional Face Memory Task	Adolescents with higher levels of behavioral problems demonstrated better recall of negative stimuli
<i>Krauel et al. (2009)</i>	55 male children (age $M = 13.5$)	K-SADS-PL; International	Children with ODD/CD had

		Affective Picture System	improved recall for negative stimuli, but poorer recall of positive and neutral stimuli when compared to controls
<i>Dolan and Fullam (2010)</i>	84 incarcerated male youths (ages 14 to 18, $M = 16.3$)	PCL:YV; Cahill Emotional Memory Task	Adolescents with high psychopathic traits demonstrated poorer recall of emotional stimuli
<i>Kiehl, Smith, Hare, Mendrek, Forster, Brink, & Liddle (2001)</i>	8 incarcerated psychopathic males (mean age 33.9), 8 incarcerated non-psychopathic males (mean age 37.1), and 8 community control males (mean age 31.9)	PCL-R; 8 trials of memory for 12 words (half neutral, half negative)	No difference in recall of emotionally negative words between psychopaths and non-psychopaths
<i>Dougherty, Bjork, Harper, Mathias, Moeller, & Marsh (2003)</i>	22 inpatient adolescents and 22 control adolescents (ages 13 to 17)	Diagnosis of ODD or CD; IMT/DMT; Trail Making Test	Adolescents with behavior disorders had impaired performance on working memory tasks
<i>Thijssen, Otgaar, Meijer, Smeets, & de Ruiter (2012)</i>	42 children (ages 8 to 12, $M = 10.1$)	APSD; Peripheral Memory Test	No differences in recall of emotional memory as a function of CU traits

Table 3.

Demographic Variables

Variable	Total number (%)	Mean	Standard Deviation
<u>Recruitment Location</u>			
Outpatient Mental Health Facility	4 (8%)		
Undergraduate Population	9 (18%)		
Community	37 (74%)		
<u>Age</u>		16.05	2.09
Male		15.86	1.9
Female		16.21	2.24
<u>Gender</u>			
Male	22 (44%)		
Female	28 (56%)		
<u>Race/Ethnicity</u>			
Caucasian	40 (80%)		
Asian or Asian American	4 (8%)		
Hispanic/Latino	3 (6%)		
Biracial	3 (6%)		
<u>Socioeconomic Status</u>			
10,000 to 20,000	2 (4%)		
20,000 to 30,000	3 (6%)		
40,000 to 50,000	3 (6%)		
50,000 to 60,000	3 (6%)		
70,000 to 80,000	3 (6%)		
80,000 to 90,000	4 (8%)		
90,000 to 100,000	1 (2%)		
100,000+	25 (50%)		

Table 4.

Distribution of Scores on Study Measures

	Minimum	Maximum	Mean	Standard Deviation
<u>Measure</u>				
Inventory of Callous-Unemotional Traits (ICU)	4	46	19.56	9.94
Wechsler Abbreviated Scale of Intelligence – 2 nd Edition (WASI-II)	75	136	107.92	13.75
WAIS-IV/WISC-V digit span, reverse digit span, and sequencing working memory test	5	19	10.2	2.9
Total Units of Correct Information (free recall)	42	846	336.16	207.75
Total Units of Incorrect information (free recall)	0	37	10.38	8.48
Total Correct Responses (cued recall)	4	18	13.1	3.02
Total Incorrect Responses (cued recall)	0	7	2.64	1.87
Total “I don’t know” Responses (cued recall)	0	11	2.28	2.55

Table 5.

Pearson's r correlations for measured variables

<u>Variables</u>	Age	Gender	Race/Ethnicity	Socioeconomic Status	Maternal Level of Education	IQ	Working Memory	CU Traits	Correct Free Recall	Incorrect Free Recall	Correct Cued Recall	Incorrect Cued Recall	"I don't Know"
Age	1												
Gender	0.08	1											
Race/Ethnicity	-0.02	-0.08	1										
Socioeconomic Status	-0.42**	0.15	0.31*	1									
Maternal level of education	0.17	0.05	0.01	0.52**	1								
IQ	-0.35*	-0.21	0.07	0.33*	0.22	1							
Working Memory Score	-0.31*	-0.14	-0.17	0.26	-0.0	0.38**	1						
CU Traits	-0.31*	-0.2	0.06	0.26	0.31	0.19	-0.04	1					
Correct Free Recall Total	0.09	-0.11	-0.07	0.17	0.37*	0.35*	0.49**	-0.11	1				
Incorrect Free Recall Total	0.06	-0.21	-0.11	0.12	0.3	0.18	0.36*	-0.07	0.62**	1			
Correct Cued Recall Total	0.09	0.08	-0.25	0.16	0.22	0.31*	0.2	0.08	0.58**	0.32*	1		
Incorrect Cued Recall Total	0.12	0.07	0.14	-0.22	-0.1	-0.16	-0.31*	-0.24	-0.37**	-0.14	-0.56**	1	
"I don't know" Cued Recall	-0.2	-0.14	0.2	-0.01	0.09	-0.25	-0.02	0.09	-0.43**	-0.28*	-0.79**	-0.07	1

Note. * $p < 0.05$, ** $p < 0.01$

Table 6.

Multiple linear regression analyses for free recall

Variable	R^2	F	<u>Correct Free Recall</u>		β
			B	$SE (B)$	
Model	0.37	6.5**		172.02	
Age			2.7	1.13	0.33*
IQ			4.36	2.04	0.29*
Working Memory			34.4	9.63	0.48**
CU Traits			-0.91	2.69	-0.04
	R^2	F	<u>Incorrect Free Recall</u>		β
			B	$SE (B)$	
Model	0.02	0.19		0.03	
Age			0	0	-0.09
IQ			0	0	0.06
Working Memory			0	0	-0.03
CU Traits			0	0	0.11

Note. * $p < 0.05$, ** $p < 0.01$

Table 7.

Multiple linear regression analyses for cued recall

<u>Correct Cued Recall</u>					
Variable	R^2	F	B	$SE (B)$	β
Model	0.17	2.21		2.88	
Age			0.04	0.02	0.29
IQ			0.07	0.03	0.32*
Working Memory			0.18	0.16	0.17
CU Traits			0.03	0.05	0.11
<u>Incorrect Cued Recall</u>					
	R^2	F	B	$SE (B)$	β
Model	0.16	2.14		1.79	
Age			-0.01	0.01	-0.07
IQ			0	0.02	0.01
Working Memory			-0.22	0.1	-0.34*
CU Traits			-0.05	0.03	-0.28
<u>"I don't know" Responses</u>					
	R^2	F	B	$SE (B)$	β
Model	0.16	2.16		2.4	
Age			-0.03	0.02	-0.3
IQ			-0.07	0.03	-0.39*
Working Memory			0.03	0.13	0.04
CU Traits			0.02	0.04	0.07

Note. * $p < 0.05$, ** $p < 0.01$

Figure 1.

Flow chart of procedure.