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Abstract

Psychopathy is a disorder that occurs primarily in males. Offenders with psychopathic traits are responsible for a disproportionate amount of crime in society, particularly violent crime. Early childhood is a time when individual differences in empathy and guilt – key indicators of the construct of psychopathy – are first evident. A growing number of longitudinal studies have begun to investigate how factors in infancy and early childhood predict psychopathic-like traits in later childhood, adolescence, and adulthood. These studies suggest that parenting styles during infancy (parental sensitivity, maternal harsh intrusion, commenting on the emotional state of the child) as well as attachment styles are predictive of later psychopathic-like traits. In addition, child characteristics such as temperament and the functioning of biological systems such as the autonomic nervous system and HPA axis are predictive. Overall, studies suggest that at least some of the origins of psychopathic traits are present in infancy and early childhood, which is consistent with the perspective of psychopathy as a neurodevelopmental disorder. A recent evolutionary-developmental model provides hypotheses regarding how psychopathy may develop and why it is more common in males than females. This model, and its implications for intervention, is discussed in the context of the longitudinal studies that have been conducted on psychopathy.

Key words: psychopathy, infancy, parenting, genetics, hormones

Psychopathy is a personality disorder describing individuals who have high levels of a variety of traits, or characteristics. These include egocentricity, manipulativeness, pathological lying, a lack of guilt and empathy, callousness, sensation seeking, impulsivity, and irresponsibility. Individuals with high levels of these traits are thought to make up approximately 1% of the general population and account for 16% of the adult males who are in prison, jail, or on parole or probation (Kiehl & Hoffman, 2011). Individuals with psychopathic traits are 20 to 25 times more likely than non-psychopaths to be in prison. It has been estimated that psychopathy accounts for $460 billion per year in criminal social costs (Kiehl & Hoffman, 2011). Individuals with psychopathic traits are much more likely to recidivate after being released and are much more likely to commit violent crimes after release (Hart, Kropp, & Hare, 1988). One study found that offenders who score higher on psychopathy and exhibit better behavior in treatment are four times more likely to commit a new serious offense than other offenders once released (Barbaree, 2005).

Personality disorders are primarily only considered in adulthood because they are expected to be stable, enduring traits. However, research has demonstrated that the traits of psychopathy can be measured in adolescence, and that these traits seem to be stable into adulthood. In particular, the socioemotional components of psychopathy such as “callous-unemotional” traits, which are thought to be the core of psychopathy, are commonly measured in both children and adolescents. Callous-unemotional traits have been found to be highly stable from childhood to adolescence, and are strongly predictive of chronic and severe aggression (for more information about the concerns regarding using the term "psychopathy" to characterize children and adolescents, see Marcus, 2017). In early childhood, studies often refer to callous-unemotional *behaviors* (e.g., lack of guilt regarding transgressions, lack of empathy, low fear,

insensitivity to punishment, hypersensitivity to reward) in toddler- and preschool-aged children (Assary, Salekin, & Barker, 2015; Waller et al., 2012). The term "behaviors" is used to avoid implying that these are necessarily non-malleable traits. However, these behaviors, measured as early as age 3, predict more severe antisocial behavior and callous-unemotional traits at age 9.5, over and above other preschool antisocial behaviors (Waller et al., 2016). One study found that the two-year stability of callous-unemotional behaviors from ages 3 to 5 was similar to that of Attention Deficit Hyperactivity Disorder and Oppositional Defiant Disorder (Willoughby, Waschbusch, Moore, & Propper, 2011).

It is estimated that approximately one third of all children with conduct problems display high levels of CU behaviors (Frick, Bodin, & Barry, 2000). Accumulating evidence suggests that youth with psychopathic traits have an etiological background that is distinct from children with conduct problems more generally. For example, Viding et al. (2005) found that there was a stronger genetic influence on the conduct problems of 7-year-old children with high versus low levels of callous and unemotional traits. Because of the evidence regarding a distinct etiological pathway, and the fact that psychopathic traits predict more serious and severe problems, several features of psychopathy in children are now listed as a specifier for conduct disorder in DSM-V called "with limited prosocial emotions" (American Psychiatric Assocation, 2013).

Early Life Factors Predicting Later Psychopathic or CU Traits: Birth to Age 5

A large amount of research has now been conducted on CU traits in middle childhood and adolescent samples. Only recently has there been an increase in research examining the early life factors that are associated with the emergence of CU behaviors or traits at later time points. This work is particularly important because early childhood is the developmental period when individual differences in empathy and guilt begin to emerge (Grazyna Kochanska, Barry,

Jimenez, Hollatz, & Woodard, 2009; G. Kochanska, Koenig, Barry, Kim, & Yoon, 2010). Longitudinal studies have begun to examine factors ranging from environmental factors such as parenting styles and SES, to child characteristics such as temperament, genetic polymorphisms, or biological reactivity. In many cases these environmental and person-centered factors have been found to interact to predict CU traits or psychopathy at later time points. These studies range from examining CU behaviors a couple of years later, to examining psychopathic traits decades later in adulthood.

Early Caregiving Experiences

A few studies suggest that factors during infancy predict psychopathic traits in adolescence or adulthood. Using data from the National Longitudinal Study of Adolescent Health (Add Health), Jackson and Beaver (2016) found that no exposure to breastfeeding during infancy and a shorter duration of breastfeeding significantly increased the risk for psychopathic personality traits in adulthood (ages 24-32) when controlling for sex, race, and socioeconomic status. Furthermore, neuropsychological deficits (specifically verbal skills) significantly mediated the relationship between exposure to breastfeeding and psychopathic personality traits in adulthood. Although interesting, it is not clear to what extent these findings are specific to psychopathy versus antisocial behavior or psychopathology more generally, or whether there may be confounding factors that could explain the relationship.

The other studies that assess early life predictors of psychopathic traits in adolescence or adulthood have examined how the behavior of parents during infancy may predict the development of psychopathic or CU traits, and how this may interact with characteristics of the child. The development of the person is thought to be a dynamic process involving a collaborative interplay between the developing child and their caregiver (Gottlieb & Halpern,

2002). Ideally caregivers would facilitate sensitive and supportive environments that meet the emotional needs of their children. This initial relationship is thought to affect the child's developing sense of self and guide them in interpreting future experiences and relationships.

Beaver, Hartman, and Belsky (2014) examined the early-life person-environment interactions that might explain variation in psychopathic personality traits in adolescent males. They found that male infants with an easy temperament (measured at 1 and 6 months) were the most affected by maternal and paternal sensitivity (measured over 7 time points from 6 months to third grade) when it came to predicting psychopathic traits in adolescence. Males with an easy temperament who were exposed to low parental sensitivity were most likely to have higher levels of psychopathic traits in adolescence, whereas those with an easy temperament who were exposed to high parental sensitivity had the *lowest* levels of psychopathic traits. Parental sensitivity was not related to adolescent psychopathic traits in infants with a difficult temperament. These findings suggest that the child's temperament may influence how sensitive the child is to environmental factors such as the quality of early caregiving experiences; some children may thrive in an environment with highly sensitive parents, but do especially poorly in the opposite environment.

These findings support the idea that some youth may be more sensitive to the environment, for better or for worse. This model of person-environment interaction is referred to as differential susceptibility (Belsky & Pluess, 2009; Ellis, Boyce, Belsky, Bakermans-Kranenburg, & van Ijzendoorn, 2011). It is based on an evolutionary analysis of developmental plasticity. The idea is that individuals who are especially sensitive to adversity are also especially likely to benefit from supportive environments. In other words, some individuals are generally more susceptible to environmental influences. This is in contrast to a diathesis-stress perspective,

which suggests that some individuals have a particular diathesis, or predisposition, that puts them at risk for poor outcomes in negative environments.

Nikitopoulos et al. (2014) similarly found that some infants may be differentially sensitive to parenting. They found that infants with one variant of the dopamine D4 receptor gene (DRD4 7r allele) who experienced less responsive and stimulating early maternal care exhibited higher levels of psychopathic traits at age 15. Infants with this same allele who were exposed to especially beneficial early caregiving showed the lowest levels of psychopathic traits. For those without the 7r allele, there was no relationship between maternal care and later psychopathic traits. This again is in line with the differential susceptibility model, as it indicates that infants with the 7r allele are more sensitive to quality of parenting than infants without this allele.

Parenting factors have been found to predict CU traits in middle childhood as well. It has been suggested that back-and-forth mirroring of emotions between parent and infant may facilitate emotional understanding and prevent the development of CU traits (Viding, McCrory, & Seara-Cardoso, 2014). Parental responsiveness is thought to promote the child's knowledge and concern about others. Centifanti, Meins, and Fernyhough (in press) examined the caregiver's tendency to comment appropriately on their 8-month old infant's putative thoughts and feelings (mind-related comments) and examined how this predicted CU traits at age 10. Controlling for maternal sensitivity, which they viewed as more general responsivity, they found that early appropriate mind-related comments were related to lower CU traits a decade later. This was mediated by increases in emotional understanding at age 4. Importantly, this effect remained significant when controlling for externalizing behavior in general. In this study, although maternal sensitivity predicted emotional understanding at age 4, no relationship was observed

between early maternal sensitivity and CU traits at age 10. Based on the studies described above, one possibility is that some infants are particularly affected by maternal sensitivity, whereas others are not.

In a separate study, Wagner et al. (2015) also found that less sensitive parenting at 24, 36, and 58 months predicted higher levels of CU behaviors in first grade when controlling for earlier measures of conduct problems and CU behaviors. This study was part of a series of studies using data from the Family Life Project, a birth cohort study of 1,292 children and families living in areas of high poverty, which examined how factors in infancy predict CU behaviors in first grade.

Using the data from the same project, Wagner et al. (2017b) also found that maternal sensitivity assessed during infancy (the average of assessments at 6 and 15 months) predicted lower levels of CU behaviors in first grade. Like the study by Centifanti et al. (2015), Wagner et al. also found that maternal mental state talk at 6 months predicted CU behaviors in first grade, above and beyond maternal sensitivity and harsh intrusion. Maternal harsh intrusion also predicted higher levels of CU behaviors, but not conduct problems, in first grade. The authors suggest that negative parenting styles in infancy may have a stronger influence on the emergence of CU-related constructs such as a lack of conscience, punishment sensitivity, and blunted fear responsivity than they do the emergence of aggression or defiance.

This study also found that maternal harsh intrusion at 6 months predicted fewer empathic-prosocial behaviors, a component of CU behaviors, in first grade, but only for infants who demonstrated high resting cortisol levels. The authors suggest that mothers who display harsh-intrusive parenting styles may inhibit the development of empathy and conscience that comes through sensitive and responsive mother-infant interaction patterns, particularly for

infants who demonstrate high stress responsivity. Unlike the studies discussed above, findings from this study did not support a differential susceptibility interpretation (i.e., those with high cortisol and low harsh intrusion did not show exceptionally high levels of empathic prosocial behaviors).

Also using data from the Family Life Project, Mills-Koonce et al. (2016) found that sensitive parenting from 6 to 36 months was moderately associated with CU behaviors in first grade, and that harsh intrusive parenting was uniquely and moderately associated with callousness. SES and household chaos (averaged from 6-, 15-, 24-, and 36-month home visits) were not directly related to CU traits measured in first grade, but were indirectly associated through their intermediate effects on observed parenting behaviors. Individual differences in parents' education levels, family income, household disorganization, and household instability were associated with CU traits in first grade via their associations with maternal sensitivity (measured via observed parent-child interactions at 6, 15, 24, and 36 months).

Kochanska and Kim (2012) examined data from two longitudinal studies in which participants were followed from infancy to early school age. They found evidence that insecure attachment in infancy may initiate a pathway associated with later maladaptive outcomes. In insecure mother-infant dyads, children who were anger prone or who had a difficult temperament at the toddler age led the parent to deploy power-assertive or heavy-handed control strategies, and those strategies led to more antisocial behavior problems, including CU traits rated by parents and teachers at age 6. This causal chain was absent in secure dyads, in which the anger proneness of the child was unrelated to power assertion by the parent and power assertion was unrelated to antisocial outcomes. The authors suggest that early insecure attachment may act as a catalyst for a mutually adversarial path toward antisocial outcomes.

Physiological Reactivity in Early Life

In adulthood, psychopathy is typically associated with blunted physiological reactivity. For example, psychopathic individuals have been found to demonstrate reduced skin conductance responses to facial expressions of sadness and fear (Blair, 1999; Blair, Jones, Clark, & Smith, 1997), imagined threat scenes (Patrick, Cuthbert, & Lang, 1994), anticipated threat (Hare, 1965, 1982; Hare, Frazelle, & Cox, 1978; Ogloff & Wong, 1990) and emotionally evocative sounds (Verona, Patrick, Curtin, Bradley, & Lang, 2004). In a meta-analysis of 28 studies, Lorber (2004) found psychopathy to be associated with reduced skin conductance activity during tasks as well as low resting electrodermal activity. Several studies have also found that adolescents and adults with psychopathic traits have lower resting levels of the stress hormone cortisol (Cima, Smeets, & Jelicic, 2008; Holi, Auvinen-Lintunen, Lindberg, Tani, & Virkkunen, 2006; Loney, Butler, Lima, Counts, & Eckel, 2006) and reduced cortisol reactivity to stressors (O'Leary, Loney, & Eckel, 2007), though see Glenn et al. (2011).

Recent studies have begun to examine whether differences in physiological responding are present very early in life in individuals who later show CU traits or psychopathy. In another study using data from the Family Life Project, Mills-Koonce et al. (2015) classified first-grade children into three groups: those with conduct problems with CU traits, conduct problems without CU traits, and no conduct problems, and then examined measures of fear and physiological responding that were collected at 6 and 15 months. No group differences were observed in the variables measured at 6 months of age. At 15 months, children with conduct problems and CU traits in first grade displayed greater high-intensity fear behavior in response to a scary mask task. They also showed higher levels of cortisol prior to the task and higher overall cortisol levels. These findings of hyperreactivity of the stress response system and greater

fearfulness are in contrast to the findings typically observed in adolescents and adults with psychopathic traits.

The study also found lower levels of heart period (HP) at 15 months in youth with CU traits in first grade. HP is a measure of the average interbeat interval, or time between heart beats), and is considered an index of the functioning of the autonomic nervous system. Low HP is reflective of increased autonomic functioning, again suggesting hyper- rather than hypo-reactivity at 15 months. The fact that differences were not present at 6 months suggests that the biobehavioral patterns of youth with CU traits may be emergent during the first two years of life as opposed to soon after birth. It also suggests that these youth may transition from being hyperreactive to stressors to hyporeactive sometime after 15 months (Mills-Koonce et al., 2015).

More in line with findings in older children or adolescents with psychopathic traits, Mills-Koonce (2015) also found lower levels of respiratory sinus arrhythmia (RSA) in 15-month-olds who were classified as having CU traits in first grade compared to children in the other two groups without CU traits. RSA is an indicator of parasympathetic nervous system functioning that refers to the ebbing and flowing of heart rate across the respiratory cycle. RSA is considered a valid and reliable peripheral marker of self-regulation, physiological flexibility, and the ability to adapt to environmental stressors (Beauchaine, 2015; Fabes & Eisenberg, 1997). In preschool children, higher baseline RSA has been associated with better attention regulation in response to angry emotion and higher levels of prosocial behavior (Clark, Skowron, Giuliano, & Fisher, 2016). Interestingly, in 9-16 year old boys, high RSA has been found to protect against the effects of maltreatment on aggressive behavior (Gordis, Feres, Olezeski, Rabkin, & Trickett, 2010). The findings from Mills-Koonce et al. (2015) of low RSA in 15-month-olds may suggest

that the tendencies for the dysregulation in response to environmental challenges and stressors are present early in life in youth who develop CU traits.

Several studies from the Durham Child Health and Development Study have also examined physiological responding during infancy as predictors of CU traits in first grade. This longitudinal study consisted of 206 families whose children were recruited at 3 months of age. The sample was 57% African American and 53% were low income. Home visits occurred at 3, 6, 12, 18, and 24 months, and in first grade. Willoughby et al. (2011) used clinically-informed groupings and found that infants high on both oppositional defiant disorder symptoms and CU behaviors at 36 months demonstrated heightened autonomic functioning at 3 and 6 months. This is consistent with the heightened autonomic functioning observed in the Mills-Koonce et al. (2015) study, but indicates that this is present much earlier in life (i.e., Mills-Koonce et al. (2015) found significant effects at 15 months but not 6 months).

In this same sample, Wagner et al. (2017a) found that CU behaviors measured in first grade were associated with lower baseline RSA, but not autonomic functioning, across the first two years of life. The authors suggest that parasympathetic functioning in the first two years of life may be more predictive of later CU behaviors than a broad measure of autonomic nervous system functioning. This is consistent with findings showing that adolescents high on disruptive and CU behaviors show lower levels of RSA, but not overall autonomic functioning, than adolescents without CU traits (de Wied, van Boxtel, Matthys, & Meeus, 2012). This is also similar to findings by Mills-Koonce et al. (2015) who also found larger effects for RSA than for HP in predicting CU traits in first grade in the Family Life Project sample. Parasympathetic functioning is additionally involved in exerting control over socially-oriented behaviors such as facial gestures and vocalizations. Low RSA may be associated with decreased sensitivity and

responsiveness to social cues that compromise spontaneous social behavior, social awareness, and affect expressivity (Porges, 2007). Interestingly, it has been suggested that infants' parasympathetic functioning likely plays an important role in establishing mutually positive and responsive interactions with caregivers. Thus, it is possible that the insecure attachment discussed in the study by Kochanska and Kim (2012) may partly result from low RSA in infancy.

In a 25-year longitudinal study, Glenn et al. (2007) found that individuals who scored higher in psychopathy at age 28 showed differences in physiological responding and temperament at age 3. These 3-year-olds were less fearful, more stimulation seeking, and less inhibited than individuals who later scored lower in psychopathy at age 28. Kochanska (1993) has suggested that children's fearfulness contributes to the development of moral emotions such as guilt, shame, and empathy; children who are more fearful tend to feel remorse after wrongdoing, are concerned with consequences related to their actions, and are generally deterred from future wrongdoings by feelings of discomfort compared to nonfearful children. However, the findings of Glenn et al. (2007) findings are inconsistent with those of Mills-Koonce et al. (2015) who found *increased* fearfulness at age 15 months in youth who showed CU traits in first grade. One possibility is that the transition from fearfulness to fearlessness occurs sometime between 15 months and 3 years. However, it is difficult to compare the findings from these studies because one measures psychopathic traits at age 28 and the other measures CU traits in first grade.

Despite showing behavioral fearlessness, Glenn et al. (2007) found that individuals scoring higher in psychopathy at age 28 showed increased autonomic arousal and skin conductance orienting at age 3, reflecting higher physiological reactivity. One potential

explanation for these findings is that increased arousal and orienting may be indicative of increased attentional vigilance at this age – a pattern that may shift toward less responsivity at a later time point in response to stressful unsupportive environments. This finding is consistent with the higher physiological reactivity observed in the Mills-Koonce et al. (2015) study.

Early Life Predictors of CU Behaviors in Toddler-Aged Children

A few shorter longitudinal studies have examined how early life factors may predict CU behaviors in children when they are 2.5 to 3 years old. Using an adoption cohort of 561 families, Hyde et al. (2016) found that the biological mother's self-reported history of severe antisocial behavior predicted CU behaviors at 27 months, despite having no or limited contact with the child. Adoptive mother positive reinforcement observed at 18 months protected against early CU behaviors and buffered the effects of heritable risk for CU behaviors. This study lends some support for the idea that CU traits are heritable, consistent with twin studies suggesting that CU traits in childhood are highly heritable (Viding & McCrory, 2012). However, it is also possible that there were differences in the prenatal environment that may contribute to these findings. The study also suggests that early positive parenting can protect against the genetic or prenatal risk for the development of CU traits.

Another study conducted using the Durham Child Health and Development Study found that observations of harsh-intrusive parenting in infancy (6 and 12 months) but not toddlerhood (24 and 36 months) predicted CU behaviors at age 3 (Willoughby, Mills-Koonce, Propper, & Waschbusch, 2013). Furthermore, this relationship was stronger for children with a polymorphism of the brain-derived neurotropic factor (BDNF) gene. The BDNF gene is associated with the release of BDNF, which is a growth factor that supports the survival of existing neurons and the growth and differentiation of new neurons. The particular

polymorphism found in this study results in decreased release of BDNF and has been implicated in fear conditioning and the ability to learn from punishment. Thus, children who had more of a genetic risk for difficulty learning from punishment and who were exposed to harsh-intrusive parenting in infancy were at increased risk of showing CU behaviors. Unlike other studies discussed here, parental sensitivity was not associated with CU behaviors. The authors suggest that in contrast to an insensitive and unresponsive parent who fails to support the emotional needs of the child, a harsh and intrusive parent may show inconsistent and inappropriate levels of controls and harsh and punitive behaviors, which may inhibit the child from developing a sense of contingency between child behavior and a harsh and controlling response from the parent.

Another longitudinal study examined how an infant's attention to faces is related to the development of CU behaviors two years later (Bedford, Pickles, Sharp, Wright, & Hill, 2015). Adolescents and adults with psychopathic traits have been found to have impaired emotion recognition, reduced responsiveness to others' distress, and a lack of guilt or empathy. It has been suggested that reduced attention to faces may contribute to these deficits (Dadds, Jambrak, Pasalich, Hawes, & Brennan, 2011). Bedford et al. (2015) found that lower preferential face tracking (preference to look at a face versus a red ball) at 5 weeks of age predicted higher CU behaviors at 2.5 years. Early social interaction is thought to facilitate bonding with and learning from the caregiver during postnatal development (Senju & Johnson, 2009). Less attention to faces may result in a reduced ability to develop optimal social communication and may also affect the development of the social brain. However, the etiology of this reduced face preference is unknown and could result from either genetic predispositions and/or environmental experiences pre- or postnatally.

Bedford et al. (2015) also found that higher maternal sensitivity at 29 weeks predicted lower CU behaviors at 2.5 years in girls but not boys. Of the studies reviewed here, this was one of the only studies to examine gender as a moderator; most included it as a covariate and one study examined males only (Beaver et al., 2014). Thus, there is little information about how early life factors may differentially affect boys and girls. However, behavioral genetics studies have found that CU traits are more highly heritable in boys than in girls (Fontaine, Rijsdijk, McCrory, & Viding, 2010; Viding et al., 2005), potentially suggesting that, in girls, early environmental factors play a greater role in the development of CU traits. A few additional studies have found that girls may be more affected by parenting factors. For example, Barker et al. (2011) found that parental warmth at age 4 was associated with a reduction in CU traits at age 13 in girls but not boys. Hawes et al. (2011) similarly found that positive parenting was negatively associated with CU traits in girls (ages 3-10). In this study, CU traits also accounted for change in parenting behaviors (inconsistent discipline, punishment, and parental involvement) 12 months later, and changes in parenting practices over time were related to changes in CU traits, suggesting the importance of examining bidirectional parent-child dynamics.

Summary of Early Life Factors Associated with Psychopathic or CU Traits: Birth to Age 5

Overall, a number of longitudinal studies have now demonstrated links between early features of both the environment and the child in predicting later CU or psychopathic traits, with predictions ranging from behavior two of years later in toddlerhood to decades later in adulthood. Parental sensitivity, harsh intrusion, and insecure attachment have all been associated with later CU traits, suggesting that parenting behavior may contribute to the development of these traits. Studies have also found that genetic and physiological factors can moderate the

effects of parenting, suggesting that some youth may be more affected by suboptimal parenting than others. Finally, there is very little research examining gender differences in early life predictors of CU or psychopathic traits. Additional research on this topic may provide information about the increased prevalence of these traits in boys.

Theories Concerning the Development of Psychopathic Traits

The studies reviewed above contribute to our understanding of how factors early in life may influence the development of psychopathic traits. However, additional empirical work examining both biological and environmental factors longitudinally is needed to clarify how these factors may interact, as well as how environmental factors at particular time points in development may differentially affect the development of these traits.

Researchers have put forth different theories for how psychopathic traits may develop. For example, Dadds and Salmon (2003) have suggested that individual differences in fearlessness and punishment insensitivity, which characterize youth with CU traits, may represent early developmental outcomes stemming from the early experience of dysfunctional or suboptimal caregiving environments and may not represent a stable component of temperament that is evident from birth. They suggest that the temperamental profile of fearlessness and insensitivity to punishment in early childhood may represent a short-term adaptation to the experience of suboptimal caregiving experience that results in long-term risks for the development of CU behaviors.

There is some evidence in support of this from the studies reviewed above. Several studies found that children who developed CU behaviors in first grade showed more high-intensity fear behaviors, high autonomic arousal, and higher cortisol levels in infancy and early toddlerhood (Mills-Koonce et al., 2015; Wagner et al., 2017b; Willoughby et al., 2011), which is

in contrast to the fearlessness, low cortisol, and low autonomic arousal typically observed in children, adolescents, or adults with CU or psychopathic traits. As Dadds & Salmon propose, this suggests that these youth may not start out with a fearless temperament, but rather may shift their responsivity in the face of suboptimal caregiving experiences. Glenn et al. (2007) found fearlessness and risk-taking behaviors in 3-year-olds who developed psychopathic traits in adulthood, suggesting that the shift from high to low fearlessness could occur before the age of 3.

The Adaptive Calibration Model (ACM)

The Adaptive Calibration Model (ACM; Del Giudice, Ellis, & Shirtcliff, 2011) is a more elaborated model that expands on this idea that the development of CU traits may be adaptive. It also provides hypotheses about the developmental pathways that may lead to psychopathy. This model states that humans evolved to survive and reproduce in a variety of contexts, ranging from stressful to supportive. The authors of the ACM propose that different patterns of responding are adaptive responses to the developmental environment. In other words, in contrast to the idea that harsh developmental environments simply result in bad outcomes and that good environments result in good outcomes, the ACM suggests that the individual is optimally "calibrated" based on the characteristics of his or her environment.

The model focuses on two main types of responding. The first is stress responsivity – how the individual responds to stressors in the environment. The second is life history strategy, which is a biological construct describing the developmental schedule of an organism and its allocation of time and energy to different fitness-promoting activities such as mating and parenting. The ACM essentially incorporates information about life history theory with information about the development of stress responsivity patterns.

The ACM describes four different patterns of stress responsivity, one of which appears to be consistent with what we know about psychopathy.

ACM: Evolutionary Perspective

The ACM is an evolutionary-developmental theory of individual differences in stress responsivity. A number of researchers have suggested that psychopathy represents an evolutionary strategy, and that it may be adaptive at low frequencies in the population (da Silva, Rijo, & Salekin, 2015; Glenn, Kurzban, & Raine, 2011; Mealey, 1995). Individuals may be able to thrive by exploiting others and moving from place to place. In a common psychopathy measure, the Psychopathy Checklist Revised (Hare, 2003), this is referred to as a "parasitic lifestyle." This type of exploitative behavior is thought to be particularly advantageous in harsh environments such as those involving exposure to violence or dangerous ecological conditions (Del Giudice et al., 2011). Furthermore, it has been proposed that individuals with psychopathic traits demonstrate a "fast" life history strategy, in which the individual is focused on mating rather than parental efforts, and focused on immediate rather than long-term rewards (Harris, Rice, Hilton, Lalumiere, & Quinsey, 2007).

The authors of the ACM propose that highly threatening environments that cause frequent activation of the stress response system can shift life history strategies toward the fast end of the spectrum. They suggest that in extremely dangerous environments characterized by severe or traumatic stress, individuals shift toward low stress responsivity, especially for males who adopt a fast, mating-oriented life history strategy characterized by aggressive competition and extreme risk-taking. They argue that in order to adopt this strategy, the individual must become insensitive to dangers and threats, and also be impervious to social feedback and the social context (e.g., lacking feelings of shame and remorse, and unaffected by social rejection

and disapproval). Thus, being an individual who is unemotional and insulated from environmental signals of threat is an asset rather than a weakness. They argue that this particular pattern of generalized low responsivity, which they label "unemotional" in the ACM, is evolutionarily adaptive at the high-risk end of the environmental spectrum. Even though such a strategy has negative consequences for the social group as well as the individual's well-being, the strategy is fitness-maximizing in this environment, meaning that it facilitates survival and reproduction so that one's genes can be passed on.

The four profiles outlined in the ACM are depicted in Figure 1. The Unemotional (IV) pattern is most similar to the type of stress responsivity that is observed in individuals with psychopathic traits. It is marked by low stress responsivity and a fast life history strategy. It is also characterized by inhibition of social learning, low sensitivity to social feedback, low empathy, high impulsivity, risk-taking, and aggression.

[Insert Figure 1 here]

Based on life history theory, the Unemotional pattern is expected to be male biased because it is more adaptive for a male to pursue a fast life history strategy (Del Giudice et al., 2011). Trivers' parental investment theory suggests that the sex that is required to invest more in offspring will have a slower life history strategy (Trivers, 1972). In other words, women are biologically obligated to invest more in a child than men are and a lifestyle that involved risk-taking, moving from place to place, and less cooperation would be less fitness-maximizing for a woman. Del Giudice et al. (2011) predicts that only in high-risk environments would females reduce their parental investment in a male-like way, and that this would primarily involve reduced cooperation and parental investment rather than high-risk competition involving externalizing behavior.

ACM: The Role of the Stress Response System

The imperviousness to social and physical threat described above is achieved through a blunting of the stress response system, which includes the autonomic nervous system and the hypothalamic-pituitary-adrenal (HPA) axis. The autonomic nervous system facilitates the immediate fight-or-flight response whereas the HPA axis facilitates a more prolonged stress response and releases the hormone cortisol. As noted earlier, there is ample evidence suggesting that psychopathy is associated with blunted responses in these systems (Blair, 1999; Cima et al., 2008; Glenn et al., 2015; Lorber, 2004; O'Leary et al., 2007; Vaidyanathan, Hall, Patrick, & Bernat, 2011).

ACM: The Development of the Unemotional Pattern (Psychopathy)

The authors of the ACM hypothesize that there are two developmental pathways by which the "Unemotional" response pattern develops. First, as depicted in Figure 2 (Pathway 1), an individual who is responsive early in life may shift toward becoming less responsive in middle childhood following chronic, severe stress. Repeated stress may trigger a cascade of biological events that may alter gene expression and ultimately change hormone levels and responsivity of the sympathetic nervous system. The authors suggest that this shift would take place during middle childhood or adolescence. Importantly, this change is considered to be an adaptive response to environmental conditions (Del Giudice et al., 2011). Second, unresponsivity may develop even in environments with low stress because of genetic predispositions (Pathway 2). In this case, unresponsivity would already be observed in early childhood. An anecdotal example of this was provided in Robert Hare's book *Without Conscience* (1999) which describes a set of female twins who differ drastically. One twin grew up to be a lawyer with ambitious career prospects, while the other develops drug addiction, has numerous encounters with the law,

and demonstrates many of the traits of psychopathy. Despite years of intensive self-scrutiny, the twins' supportive and attentive mother cannot conceive of a way in which the girls might have been treated differently that could have resulted in such extreme behavior from one of them. In this case, despite sharing the same womb and being raised in the same nurturing family environment, the twins develop very different traits. They are fraternal twins, meaning that they share approximately half of their genes (unlike identical twins who share 100% of their genes). Although there are inevitably differences in the child-environment relationship between the two twins, this anecdote also suggests that genetic factors likely partially contributed to the differences between the twins.

[Insert figure 2 here]

To date, there is insufficient evidence to support the idea of Pathway 2 – that unresponsivity may develop even in low stress environments primarily because of genetic predispositions. The study finding that face processing at 5 weeks is altered in youth who develop CU behaviors two and a half years later suggests that some differences may be present soon after birth, though it is possible that this could have been influenced by prenatal or early postnatal factors (Bedford et al., 2015). In the studies reviewed involving specific genetic polymorphisms, both found that these polymorphisms interacted with negative parenting factors during infancy (Nikitopoulos et al., 2014; Willoughby et al., 2013), suggesting that they may just increase sensitivity to those environmental experiences rather than suggesting that they directly contribute to fearlessness or low arousal. Finally, the adoption study by Hyde et al. (2016) does suggest that genetic factors likely influence the early demonstration of CU behaviors at 27 months, although this study also does not rule out prenatal or early postnatal factors. Thus, given the evidence present, it is difficult to determine whether there may be a subgroup of youth who,

because of a strong genetic predisposition to developing these traits, show fearlessness or CU behaviors consistently across early childhood, rather than starting out more responsive and shifting toward a pattern of unresponsivity at some point in early or middle childhood.

Regarding the plausibility of Pathway 1, which suggests that an individual who is responsive early in life may shift toward becoming less responsive in middle childhood following chronic or severe stress, the evidence seems to be mixed. First, many of the studies reviewed suggest that individuals who develop CU or psychopathic traits have experienced negative environmental factors early in life that could potentially shift the trajectory. However, most of these focused on parenting behaviors rather than more severe forms of stress such as abuse or neglect. However, using retrospective measures of childhood maltreatment in a sample of adult sex offenders, one study did find that the frequency and the severity of physical abuse, in combination with emotional abuse, was the most significant predictor of psychopathic traits in these offenders (Daversa, 2010). Second, many of the studies find that some youth do show elevated levels of CU behaviors at early ages (i.e., from age 2 to first grade), suggesting that if a shift occurred, it was likely before middle childhood or early adolescence.

Overall, additional longitudinal studies that measure numerous environmental variables (including evidence of more severe stressors) along with physiological reactivity at multiple time points from birth through adolescence are needed to determine whether the developmental pathways proposed by the ACM are plausible.

Implications for Intervention

The idea that there may be two pathways by which the unemotional pattern or psychopathy develops has significant implications for treatment. In particular, Pathway 1 of the ACM suggests that some children may initially have adequate stress responsivity, but after

exposure to stressful environments they develop unresponsivity in middle childhood. The authors of the ACM postulate that individuals with a history of high responsivity may be able to revert to high responsivity levels if environmental conditions improve for a significant amount of time (i.e., even after the shift to unresponsivity has occurred). This opens the door for the potential treatment of a subset of individuals with psychopathic traits. In addition, it emphasizes the importance of attempting to intervene early to try to reduce the incidence of adverse childhood experiences that may cause an individual to shift to unresponsivity, or at least to try to reduce the negative effects of these experiences, to prevent the shift to unresponsivity in the first place.

One example of a study that demonstrates promise in this area is an intervention study conducted by Brotman et al. (2007). The researchers conducted a 22-week family-based intervention in preschool children at risk for antisocial behavior. They measured cortisol levels before and after a social challenge involving entry into an unfamiliar peer group. At the end of the intervention, during the social challenge, the cortisol levels of the children in the treatment group were significantly increased. A follow-up study found that the intervention's effect on aggression was largely mediated by the intervention's effect on the cortisol response (i.e., the degree to which cortisol levels increased was related to the degree to which aggression was reduced) (O'Neal et al., 2010). This study suggests that intervening early may have the potential to reverse the course of blunted stress responsivity.

In another study, Fisher et al. (2007) found that in a sample of 3-6 year-old foster children, a 12-month family-based therapeutic intervention was able to restore altered diurnal cortisol patterns to a level that became comparable to the patterns demonstrated by non-maltreated children. Similarly, Dozier et al. (2008) examined the effects of an attachment-based intervention on infants and toddlers (15 to 24 months) in foster care. The intervention involved

teaching parents to be very effective, responsive interpersonal partners – to be very responsive to their children's emotions and to use touch to help the child develop secure attachment and self-regulatory capabilities. Compared to foster children who received an intervention that focused on enhancing cognitive skills, the children who received the attachment-based intervention showed lower baseline cortisol levels, and their cortisol levels were similar to children who had not been in foster care. These studies suggest that specific types of interventions in early childhood may be capable of reducing the effects of harsh and stressful environments on the stress response system. In developing future interventions, it may be important to examine the factors that have been identified in the longitudinal studies predicting CU traits at later time points, such as encouraging the parent to engage in mind-related talk, in order to prevent the development of CU traits specifically.

One implication of the ACM is that some youth who may have genetic factors that contribute to blunted stress reactivity may be less amenable to intervention. This type of an effect was observed in a study by Bakermans-Kranenburg et al. (2008) who examined the effects of an attachment-based intervention on daily cortisol levels in a sample of one to three year old children screened for relatively high levels of externalizing behavior using the CBCL for 1.5- to 5-year-old children (Achenbach & Rescorla, 2000). They found that children in the intervention group showed lower cortisol levels, but only if they also had a particular variant of a dopamine receptor gene. This suggests that some youth may have genetic risk factors that reduce their sensitivity to the effects of interventions. However, this study did not rule out the potential role of epigenetic expression effects from the prenatal period.

Conclusions

Psychopathy is a disorder that significantly increases risk for violence. The study of young children is especially important because early-onset behavior problems are particularly predictive of future stable antisocial trajectories. Furthermore, interventions implemented at an early age may have greater effectiveness. The ACM outlines a testable model that proposes two distinct etiological pathways by which the blunted stress responsivity observed in individuals with psychopathic traits may develop. Although there is a growing number of longitudinal studies examining parenting behaviors and child characteristics early in life, the current evidence is insufficient to draw conclusions about the developmental pathways proposed by the ACM. On one hand, there is some evidence that individuals with psychopathic traits experience more environmental stressors early in life (Pathway 1). On the other hand, studies show that some youth show CU traits very early in life and that these traits show stability over time, suggesting that some individuals may be genetically predisposed to exhibit such traits (Pathway 2). The evolutionary component of the model also helps to explain why psychopathy may be more common in males – in harsh environments it may be adaptive for males to switch to a faster life history strategy involving more mating and less parental efforts. To accomplish this, it may be necessary to develop a pattern of responding that insulates the individual from social and physical cues and threats. Finally, intervention studies have already demonstrated that some psychosocial interventions administered in the early years of life can ameliorate the effects of harsh environments on the stress response system. In other words, by intervening in the early years of life, we may be able to alter the trajectory of some youth to reduce the likelihood of developing blunted stress reactivity, psychopathic traits, and engaging in violent behavior.

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