In 1993 Terrie Moffitt published a paper that proposed a dual developmental taxonomy of antisocial behavior: life-course–persistent (LCP) and adolescent-limited (AL) antisocial behavior. This taxonomic theory was subsequently fully articulated for the first time in 1995 by Caspi and Moffitt. The initial paper and subsequent expansion triggered a cascade of research on types of criminal offending (Farrington, 2015), thereby making it one of the most researched and most influential of all developmental theories of antisocial behavior (Farrington & Ttofi, 2015; Piquero, Gonzalez, & Jennings, 2015). Moffitt's developmental taxonomic theory grew out of an effort to reconcile two robust empirical findings. Epidemiological studies suggested that the prevalence of involvement in antisocial behavior changed dramatically over the life course. The change became known as the age-crime curve which refers to the finding that crime in the aggregate increases during adolescence, peaks in the late teens or early twenties, and then gradually declines thereafter. This curve could result either from a few chronic offenders escalating their offending, or from large numbers of adolescents joining the ranks of the chronic offenders and then subsequently desisting within a few years. However, longitudinal studies pointed to impressive continuity of antisocial behavior in individual lives such as Robins' (1966) finding that adult antisocial behavior virtually required childhood antisocial behavior. Existing theories failed to explain both the peak in offending in late adolescence as well as the chronicity of antisocial behaviors that began well before adolescence. The dual developmental taxonomy provided an explanation by suggesting that the facts of chronic antisocial behavior and the age-crime curve could be accounted for by positing two distinct subgroups of antisocial individuals with different developmental trajectories and etiologies. The LCP subgroup was relatively small (5%–10%), almost exclusively male, and exhibited antisocial behavior beginning in childhood that persisted into midlife. LCP was hypothesized to emerge early in life from subtle cognitive deficits, difficult temperament, and hyperactivity caused by inherited or acquired neuropsychological variations. These difficulties were then hypothesized to be exacerbated by rearing in a high-risk environment characterized by disrupted attachment bonds, inadequate parenting, maltreatment and poverty. The AL subtype referred to a much larger group whose antisocial behavior was limited largely to adolescence. Their delinquent behavior was hypothesized to be caused by a maturity gap (such as a desire for autonomy) — not neuropsychological risk factors — which prompted youth to temporarily engage in social mimicry of LCP antisocial behaviors via peer reinforcement. As these youth matured, they outgrew their motivation for delinquency.

The silver anniversary (1995–2020) of the first full articulation of this enormously influential theory is a fitting time to review the accuracy of some of its most important predictions, as well new findings and what still needs to be learned. The focus will be on male LCP, since they are the “few, persistent and pathological” (Moffitt, 2006, p. 571) who account for a vastly disproportionate share of crime. And, as Moffitt noted in 1993, “researchers will learn more about the etiology of severe, persistent antisocial behavior if they single out childhood persistent cases for study and if they begin their studies during infancy, or
even prenatally, and follow the same individuals to adulthood” (Moffitt, 1993, p. 696). Female LCP (Odgers et al., 2008) will not be addressed as findings have not reached consensus (Moffitt, 2018), and what is known has been recently reviewed by Broidy and Thompson (2018). Also, given the voluminous literature on LCP, the review will need of necessity be selective, synthesizing the conclusions of reviews of the primary literature as well as integrating findings from recent research. The paper will begin by reviewing the evidence for Moffitt’s three key predictions regarding the LCP group. First, there will be a small group of males (<10%) who show extreme behavior during childhood that is sustained at a high level thereafter. Second, in contrast to the AL group, the LCP group’s antisocial behavior will be more pathological, e.g., engage in more violent crime. Third, the LCP group, in contrast to the AL group, will have the origins of its antisocial behavior in neurodevelopmental problems. Next, the paper will review the findings for early identification of the LCP group. Lastly, it will discuss what is one of most significant impacts of the theory, providing impetus to the early-years crime prevention movement (Moffitt, 2018). The review will substantially expand on Moffitt’s (2018) recent review of her theory by discussing topics that, given the goals of her review, received only minimal coverage: a) the finding that LCP is almost exclusively male and the reasons for such, b) the neurodevelopmental factors that contribute to the development of LCP, c.) early identification of LCP, d.) early preventative interventions.

1. LCP group

1.1. The few persistently antisocial individuals

Of all the research that has been conducted since Moffitt posited an LCP group, the most convincing evidence for such a group comes from the highly influential Dunedin Multidisciplinary Health and Development Study (Fairchild, 2018). The Dunedin study is a continuing longitudinal study of health and behavior in a complete one-year birth cohort (n = 1037, 52% males) in Dunedin New Zealand that began some 4 decades ago and has published over 1000 papers and reports (Poulton, Moffitt, & Silva, 2015). The study defined the LCP group as individuals who had histories of extreme childhood antisocial behavior that was both stable across time (at least three of the assessments ages 5, 7, 9, and 11) and pervasive across situation (i.e., home and school) and who self-reported extreme delinquency at an age-15 or age-18 interview (Moffitt, Caspi, Harrington, & Milne, 2002; Moffitt, Caspi, Rutter, & Silva, 2001). The LCP group so defined consisted of 10% of the males in the cohort, yielding a male to female sex ratio of 10:1 (Moffitt et al., 2001). This finding provided impressive confirmation of Moffitt’s original prediction of a larger male LCP prevalence and prompted her to describe LCP as “almost exclusively male” (Moffitt, 2006, p. 593). Follow-ups of the LCP males in the Dunedin study at ages 26, 32 and 38 found, as predicted, that as group they have demonstrated more persistence of antisocial behavior compared to groups with low levels of childhood antisocial behavior, childhood limited antisocial behavior, or adolescent onset antisocial behavior. For example, at age 26 compared to the other groups, the LCP group had a higher level of psychopathic traits, more drug-related and violent crime, and were 2-3 times more likely than the adolescent onset group to have been convicted as adults and for more serious offenses (Moffitt et al., 2002). At age 32, the LCP group who were identified using a group-based trajectory method were far more likely to have an official conviction for violence (32.7%) than the low antisocial group (0.4%), childhood-limited group antisocial group (6.0%), or adolescent-onset group antisocial group (10.2%) (Odgers et al., 2007). Most recently, approaching midlife (age 38), most LCP men had not desisted from crime: 55% were convicted between ages 26 and 38 years, versus 30% of all adolescent onset men, and 18% of all men in the cohort (Moffitt, 2018).

Moffitt (2018) estimated that, despite numerous variations in sampling, geographic area, historical period, length of observation period, and data sources, the findings of the Dunedin studies for a LCP group have been broadly confirmed by reviews of more than 100 longitudinal studies (e.g., Jennings & Reingle, 2012), as well as more recent studies (e.g., Carkin & Tracy, 2015; Widom, Fisher, Nagin, & Piquero, 2018). Indeed, some studies, having extended the follow-up period beyond the late 30s of the Dunedin study, have found a small group of individuals still being regularly convicted in their 40s, 50s, 60s and even as late as the 70s (Farrington, 2019; Moffitt, 2018). Thus, the argument of some that all defenders desist (e.g., Sampson & Laub, 2003) seems unlikely to be accurate (Farrington, 2019). The prevalence of male LCP offenders in the various studies ranged from 1.6% to 29.1%, largely due to differences in definition and measurement features of LCP (Farrington, Gaffney, Losel, & Ttofi, 2017). Nevertheless, the studies collectively indicate that LCP males comprise a small group comparable to Moffitt’s initial estimate of 5% to 10% (Russell & Odgers, 2015).

Lastly, although 25 years of research is broadly consistent with Moffitt’s initial formulation of a small group of individuals whose early starting antisocial behavior is LCP, two modifications should be noted. While the terms child-onset CD and LCP were initially used interchangeably, the Dunedin research group was subsequently surprised to find a group of males who had exhibited extreme, severe, and persistent antisocial problems during childhood, but whose continuing low to moderate antisocial behavior into adolescence was not extreme enough to meet criteria for LCP. Although it was initially thought that these individuals’ antisocial behavior was childhood-limited, having recovered from an antisocial beginning, subsequent research by Moffitt and others has found that these individuals do persist in their antisocial behavior at a low-level into adulthood (McGee & Moffitt, 2019; Moffitt, 2006). This third group, which may constitute as many as 50% to 70% of individuals with child-onset conduct problems (Fairchild, van Goozen, Calder, & Goodyer, 2013), has been labeled low level chronics (McGee & Moffitt, 2019; Moffitt, 2006). Lastly, it is important to note some males with early onset severe antisocial behavior can truly recover (McGee & Moffitt, 2019). For example, in the Dunedin study, 15% of the males in the combined LCP and low-level chronic group exhibited no adjustment problems measured in the study at age 26 and thus truly seemed to have recovered as adults (Moffitt, 2006).

Second, similar to the ostensibly childhood-limited group, many individuals in the AL group continue their antisocial behavior into adulthood, especially for difficulties related to substance abuse (Fairchild et al., 2013; Jennings, Rocque, Fox, Piquero, & Farrington, 2016; McGee et al., 2015; Moffitt, 2018). This has prompted the suggestion that the initial taxonomic group name of adolescent limited antisocial behavior, which implies desistence from criminal offending in young adulthood, should be changed to adolescent onset antisocial behavior (Odgers et al., 2007). Moffitt (2018) suggested that this delayed desistence from antisocial behavior initiated in adolescence is due to

---

Footnote continued

...the traditional method of using clinical definitions and algorithms to identify a LCP group in the 2001 study was replaced by group trajectory modeling in subsequent studies to identify LCP as well as other groups (Moffitt, 2018). The traditional method of analyzing data from longitudinal studies through a blend of analysis and insight “… is inevitably subjective… fraught with statistical dangers” (Nagin, 2005, p. 2). Formal statistical models were developed that overcome the limitations of traditional methods and were used in the ongoing Dunedin as well as numerous other longitudinal studies.

The failure of a recent review to find a difference in criminal offending outcome between LCP and AL groups is most probably due to the limitation acknowledged by the authors that “the age of outcome in the studies which we identified was quite low (mean age 22.5)” [Bevilacqua, Hale, Barker, & Viner, 2018, p. 1256].
delayed social maturation, a recent phenomenon not evident when she first formulated her theory. A second reason for the delayed desistence is anchored in the cardinal principle of developmental psychopathology that virtually all forms of psychopathology reflect an extreme expression on a continuum distributed dimension rather than expression of membership in a distinct category in which the individual either does or does not have a disorder (Hinshaw, 2017). This means that since antisocial behavior exists on a continuum from very well behaved to very poorly behaved juveniles and every gradation in between (Lahaye & Waldman, 2017), the LCP and AL groups are best understood not as a unique categories of antisocial behavior but as different developmental expressions of groups who differ only relatively, not absolutely in desistence.

1.1.1. Maleness
Moffitt et al. (2001) reported a very large male/female LCP sex of 10:1 in the Dunedin study. Subsequent findings from related reporting sex ratios ranging from 3:1 to 15:1 are broadly consistent with the Dunedin finding that LCP is almost exclusively male, i.e., ratio is approximately 10:1 (Broidy & Thompson, 2018; Moffitt, 2006; Russell, Robins, & Odgers, 2014). However, other findings would seem to challenge this conclusion. For example, using group trajectory modeling to assign individuals to the LCP class, a follow-up in the Dunedin study to age 32 reported a male LCP prevalence of 10.5% and a female prevalence of 7.5%, i.e., a sex ratio < 2:1 (Odgers et al., 2008). Other studies using similar group trajectory methods for classifying LCP have reported sex ratios ranging from 3:1 to 5:1 (Odgers et al., 2008).6 In short, as Russell et al. (2014) noted in their review of 47 trajectory studies “Females following early-onset persistent pathways are virtually absent … in population-based studies using official reports of crime, delinquency, or offending as the criterion” (p. 299). Similarly, lopsided sex ratios are also found in two types of antisocial behavior closely related to LCP: chronic criminal offending and chronic physical aggression (Jolliffe, Farrington, Piquero, MacLeod, & van de Weijer, 2017; Moffitt, 2006; Piquero, Carriaga, Diamond, Kazemian, & Farrington, 2012). Male/female sex ratios for chronic offenders range from 9:1 to 12:1 (DeLisi & Piquero, 2011). Regarding physical aggression, as early as 17 months, mothers report that 5% of boys frequently use physical aggression compared to 1% of girls, with a similar sex difference reported by teachers from school entry to adolescence (Tremblay, Vitaro, & Cote, 2018). By adolescence, approximately 5% of males engage in chronic physical aggression, whereas female cases are rare (Tremblay, 2010, 2014). Indeed, physical violence by females during adolescence is generally so rare that modeling their developmental trajectories fails (Tremblay, 2010). In short, sex is the fundamental correlate of crime (DeLisi, 2016) with men comprising 93.2% of the total world prison population as of 2015 (Walsmeiy, 2015) and accounting for 90% or more homicides worldwide (Mitis & Sethi, 2015).

Lastly, the foregoing discussion is not meant to diminish the importance of studying a female LCP class using less stringent criteria and a sex-specific cutoff. LCP females so defined are clearly at increased risk for mental and physical health problems and forms of violence such as partner and child abuse (Odgers et al., 2008). Rather, the purpose of the discussion was to document that 25 years of research has established that the relatively few individuals whose early starting severe conduct problems persist into adulthood and account for a fraction of crime that is vastly disproportionate to their prevalence in the population are almost exclusively male. This specific pathological outcome of the “few, persistent males” will be discussed next.

1.1.2. Pathological outcome
Moffitt predicted that the primary pathological outcome difference in adulthood would be that the LCP group would exhibit higher levels of antisocial behavior than the AL group. This prediction was strongly confirmed in the most recent follow-up of the Dunedin study at age 38. The few LCP males accounted for 53.3% of all convictions and had significantly more criminal convictions than those of the low antisocial group (LCP: 4.2 vs. Low 0.1), childhood-limited antisocial group (0.5), and adolescent onset antisocial group (0.9) (Rivenbark et al., 2018). Despite approaching midlife, most LCP men had not desisted from crime: 55% were convicted between ages 26 and 38 years, versus 30% of AL men and 18% of all men in the cohort (Moffitt, 2018). LCP men had high levels of conviction despite the fact that 25% had been incarcerated an average of 18 month per group member compared with 5% of AL men for 2 months on average (Moffitt, 2018). This outcome mirrored and added to the long standing finding that a small fraction of the male population accounts for a vastly disproportionate fraction of the crime. In 1972, the landmark Philadelphia birth cohort study of almost 10,000 boys born in 1945 found that 6% of the boys by age 18 accounted for 52% of all delinquencies, including 69% of aggravated assaults, 71% of homicides, and 73% of rapes (Wolfgang, Figlio, & Sellin, 1972). The study was replicated in 1990 using a 1958 birth cohort which found that 7.5% of the males committed 61% of the total delinquencies (Tracy, Wolfgang, & Figlio, 1990). Since then numerous

---

6 The sex difference in conviction rates cannot be attributed to a bias in decisions for conviction (Piquero, Brane, & Moffitt, 2005).

7 Although chronic offenders and LCP offenders are not identical, there is clearly overlap between the two groups in that LCP offenders are likely to become chronic offenders but chronic offenders may not be LCP offenders (Jolliffe, Farrington, & Piquero, 2016).

---

3 The National Longitudinal Survey of youth is a longitudinal study that follows the lives of a nationally representative sample of American youth (n = 8984) born between 1980 and 1984 who were between the ages of 12 and 17 when first interviewed in 1997.
studies have established that crime is concentrated among a small fraction of the male population (approximately 5%). These few males, beginning with severe antisocial behavior in early childhood, engage in crime pathologically and persistently, thereby accounting for more than half of all crime and an even larger percentage of the most violent offenses (DeLisi, 2016; Martinez, Lee, Eck, & SooHyun, 2017; Vaquhn, Salas-Wright, DeLisi, & Maynard, 2014). Thus, “it is axiomatic that criminal career extremity is inversely related to onset” (DeLisi, Neppi, Lohman, Vaquhn, & Shook, 2013).

Lastly, other pathological outcomes for the LCP group at age 38 in the Dunedin study were also observed. The LCP group accounted for 15% of all hospital bed nights, 16% of all emergency room visits, 21% of all prescription refills, 13% of all injury claims, and 25% of all welfare benefits (Rivenbark et al., 2018). Findings such as these, as well as similar findings from a longitudinal study that found that by age 28, individuals with childhood conduct disorder accumulated 10 times the public expenditures as those without conduct problems (Scott, Knapp, Henderson, & Maughan, 2001) prompted Burt et al. (2018) to declare LCP to be a public health crisis. In sum, Moffitt’s prediction regarding the pathological outcome of a male LCP group has been robustly confirmed.

1.1.3. Conclusion

Twenty-five years of research has provided resounding confirmation for Moffitt’s identification of a small group of males who exhibit extreme, pervasive, persistent antisocial behavior from early childhood into adulthood, thereby accounting for majority of violent crime. A LCP group has been acknowledged in other developmental typological theories of criminal behavior and has been identified in studies using group-based modeling methods to identify groups of individuals with different developmental trajectories of antisocial behavior (Morizot, 2018). It is regarded as “one of the most important findings in criminological history” (DeLisi, 2016, p. 56). The neurodevelopmental risk factors that Moffitt hypothesized contributed to the etiology of LCP will now be considered.

1.2. Neurodevelopmental risk factors

The reasons for the focus on neurodevelopmental rather than environmental risk factors for LCP are twofold. First, one of the most important contributions of Moffitt was to emphasize the role of such factors on the development of antisocial behavior. These factors had historically been neglected since the dominant model for understanding criminal behavior for most of the twentieth century was built almost exclusively on social and sociological models (Loebor, Byrd, & Farrington, 2015; Raine, 2013). Her work was an important influence in correcting this neglect as it is now recognized that these factors must be included in studies of developmental and life-course criminology (Farrington, 2018; Farrington & Tofii, 2015). Indeed, the importance of these factors is such that arguments are now being made that severe disruptive behavior in early childhood, childhood onset CD, and lifelong male violence should be conceptualized as neurodevelopmental disorders (Fairchil et al., 2019; McDonough-Caplan & Beauchaine, 2018; Raine, 2019b; Wakschlag et al., 2018). Second, neurodevelopmental risk factors were hypothesized to explain why early onset severe antisocial behavior was persistent and why it was almost exclusively male. A related issue is whether AL offenders share the same risk profile as LCP offenders (Moffitt, 2018). Moffitt (2018) has provided a clarification of the taxonomy’s conceptualization of risk in this regard. LCP offenders are conceptualized as evincing extreme risk on childhood risk factors, whereas AL offenders show population normative risk levels, but not zero risk. Her review of the literature, as well as those of others (Assink et al., 2015; Fairchild et al., 2013, 2016; Jolliffe et al., 2017) has found that while neurodevelopmental risks factors play a role in adolescent onset antisocial behavior, these factors are more common and more severe in LCP.

The neurodevelopmental risk factors were hypothesized to emerge from inherited or acquired neuropsychological variation which initially manifest as difficult temperament or cognitive deficits.

2. Inherited neuropsychological variation

2.1. Difficult temperament

It has long been known that from early infancy onward children differ from one another in early developing, biologically rooted behavioral and emotional reactions to the environment which have come to be known as temperament (Krieger & Stringaris, 2016; Rothbatt, 2012). Although Moffitt noted that inherited temperamental traits distinguished LCP children from AL adolescents, she did not explicitly discuss genes as an influence on temperament. It is now known that genes make a major contribution to individual differences in temperament (Knopik, Neiderhiser, DeFries, & Plomin, 2017) and genetic influences are stronger for LCP antisocial development compared with AL, thereby confirming her theory (Moffitt, 2018).

Abundant research has established that temperament influences the development of various forms of psychopathology, including externalizing behavior and criminality (Calkins, Dollar, & Wideman, 2019; DeLisi & Vaquhn, 2014; Frick & Morris, 2004; Krieger & Stringaris, 2016; Nigg, 2006; Rothbatt & Bates, 2006). Perhaps the most useful way to conceptualize this influence is to view temperament as a component in what becomes a dynamic process of transactions between the child and the environment, gradually producing different adjustment outcomes (Bates, Schermerhorn, & Petersen, 2014). At least seven different models have been proposed to explain how these complex transactions can result in the development of various disorders (Stiffer & Dollar, 2016). Among these various models, the vulnerability model incorporates many of the proposed links between temperament and psychopathology that have been posited by the other models (Martel, Gremillion, & Tackett, 2014; Stiffer & Dollar, 2016). This model, which is analogous to the classic, widely accepted diathesis-stress model of psychopathology (Stiffer & Dollar, 2016), proposes that extreme levels of temperamental dimensions place an individual at increased risk for developing various disorders because they render the individual more vulnerable to the pathogenic elements of whatever environments they are exposed to. In addition, additive effects are possible such that multiple temperamental vulnerabilities linearly increase the child’s risk for developing antisocial behavior.

Although debate persists over the precise dimensional structure of temperament, there is a convergence on three broad dimensions from which subdimensions emerge, two of which are most germane to understanding difficult temperament: Attention/Regulation and Emotionality (Bates et al., 2014; Chen & Schmidt, 2015; Krieger & Stringaris, 2016; Stiffer & Dollar, 2016). The relation of these dimensions to a “difficult temperament” and thus to a risk for LCP that research has identified since Moffitt’s initial formulation will be discussed. More specifically, the discussion will focus on three temperamental subdimensions of the two broad dimensions of difficult temperament identified as most relevant to the development of LCP: impulsiveness, negative emotionality, and fearlessness (Stiffer & Dollar, 2016; Thornberry & Krohn, 2019). After describing the temperamental dimension, the discussion will address the risk for antisocial behavior that an extreme level of the dimension confers, as well as a sex difference which helps explain the greater male prevalence of LCP.

2.2. Attention/regulation

Regulation can be defined as the ongoing, dynamic, and adaptive modulation of an internal state (emotion, cognition) or behavior (Nigg, 2017a). Regulation by oneself which emerges increasingly during development is self-regulation, a concept that holds “almost unparalleled importance” in understanding the emergence of various
psychopathologies, including antisocial behavior (Nigg, 2017a, p. 361). Because of the unparalleled importance of self-control or self-regulation (SR), which are equivalent terms for most authors from a diverse number of fields, there is a variety of terminology to describe self-regulation which has resulted in considerable definitional confusion and conceptual clutter (Eisenberg, 2017; McClelland, Geldhof, Cameron, & Wanless, 2015; Nigg, 2017a). This clutter has been addressed by Nigg (2017a) in an attempt to create a clear differentiation among the various constructs and to establish a standard terminology. One such construct is effortful control (EC).

EC designates temperamental self-regulation (Eisenberg, 2017) and was coined by personality scholars to describe the temperamental precursor to the personality trait of conscientiousness (McClelland et al., 2015). As defined by Nigg (2017a), EC is a dispositional trait-level representation to be able to employ top-down control to self-regulate. Because control is deliberate and therefore requires effort it was designated EC to distinguish it from more reactive forms of regulation (Stifter & Dollar, 2016). EC also includes the abilities to shift and focus attention when needed, and to inhibit inappropriate behavior or activate behavior when one does not want to do so (Eisenberg et al., 2013). In short, EC is the temperamental disposition to exercise SR when doing so is difficult (Diamond, 2013). EC feeds into and provides the core of higher levels of SR involving processing such as planning and coping strategies (Eisenberg, 2017; Nigg, 2017a).

2.2.1. Risk

A low level of SR is the temperamental risk factor most often linked to the development of antisocial behavior, even after controlling for other risk factors since by definition impairment in the ability to inhibit inappropriate impulses and follow societal norms is expected to increase the likelihood of antisocial behavior (DeLisi & Vaughan, 2014; Stifter & Dollar, 2016). Indeed, impaired SR may be the single most important variable in explaining the developmental origins of antisocial behavior (Moffitt, 2012; Moffitt et al., 2011). SR theory has been proclaimed the Tyrannosaurus rex of criminology that is poised to devour criminal justice theorizing (DeLisi, 2011). In terms of empirical tests of its theoretical ideas, citations, influence on the field, self-control theory is “peerless” (DeLisi, 2011, p. 103). Perhaps the most impressive empirical validation for the risk that impaired SR poses for LCP comes from the Dunedin Study found which impaired self-control evidenced in symptoms such as restless, fleeting attention, impertinent, restless, impulsive, emotionally labile, expresses negativity in children 3–5 years old, significantly predicted criminal convictions at age 32 after controlling for socioeconomic status and IQ (Moffitt et al., 2011; Slutske, Moffitt, Poulton, & Caspi, 2012).

The risk impaired SR poses for the development of criminal behavior is most clearly seen in hyperactive/impulsive and combined presentations of Attention-Deficit/Hyperactivity Disorder (ADHD) [Beauchaine, Zincer, & Sauder, 2017] and physical aggression (Denson, DeWall, & Finkel, 2012).

2.2.1.1. ADHD. ADHD is best understood as a global self-regulation disorder (Nigg, 2017b) that is “paradigmatic of problems in the domain of self-regulation” (Nigg, 2016, p. 593).

ADHD is associated with profound impairments in school readiness, academic and social functioning, and, in the longer term, delinquency and substance abuse (Daley & Van der Oord, 2018). As Beauchaine and colleagues (Beauchaine et al., 2017; Beauchaine, Constantino, & Hayden, 2018; Beauchaine & McNulty, 2013; Beauchaine, Shader, & Hinshaw, 2016; Neuhauß & Beauchaine, 2017) have repeatedly noted, for over 50 years since the publication of Robins’s (1966) landmark text, scientists across disciplines including sociology, psychiatry, and criminology have identified a developmental trajectory that begins with the hyperactive/impulsive and combined presentations of ADHD. In turn, ADHD in interaction and transaction with various environmental adversities, can progress to Oppositional Defiant Disorder, early-onset Conduct Disorder, Substance Use Disorder, culminating in juvenile delinquency and later offending. Beauchaine et al. (2017) suggest that this developmental pathway may account for most individuals who engage in lifelong criminal behavior. Not surprisingly therefore, the prevalence rate of ADHD among incarcerated males is approximately 25% (Baggio et al., 2018; Eme, 2018; Young, Moss, Sedgwick, Fridman, & Hodgkins, 2015).

2.2.1.2. Sex difference. Else-Quest, Hyde, Goldsmith, and Van Hulle (2006) reported a large sex difference in EC disfavoring males (d = −1.01), and greater male variability. Subsequent research supports this sex difference (Else-Quest, 2012). Similarly, males outnumber females for childhood ADHD in the general population by ratios ranging from 2.5:1 to 3:1 (Hinshaw, 2018; Owens, Cardoos, & Hinshaw, 2015). They also experience more severe symptoms of ADHD than females (Arnett, Pennington, Willcutt, DeFries, & Olson, 2015).

2.2.1.3. Physical aggression. Aggressive behavior can be defined as behavior through which individuals intentionally cause physical or psychological harm to others (Eisner & Malti, 2015). Examples of the most common physical aggressions in early childhood would include: hitting, slapping, kicking, biting, pushing, grabbing, pulling, shoving, beating, twisting (Tremblay, 2010). This aggression, in contrast to aggression this is proactive, i.e., deliberate and goal-directed, is mostly reactive/impulsive, i.e., involves responses to threats or provocations, is usually accompanied by emotions of fear or anger, and is defensive and retaliatory (Connor et al., 2019; Eisner & Malti, 2015). There is pervasive agreement from research conducted over the past 50 years that earlier appearing, frequent physical aggression predicts later aggressive, antisocial, violent and criminal behavior (Bushman et al., 2018; Eisner & Malti, 2015; Shaw, 2013; Shaw & Taraban, 2017; Tremblay, 2010, 2014; Tremblay et al., 2018; Wakschlag et al., 2014). Richard Tremblay, who has been studying chronic physical aggression for half a century and is arguably its foremost researcher, has noted that chronic physical aggression rarely onsets after early childhood and that the small group of males who increase in frequency and seriousness of physical aggression during adolescence were the ones on the highest trajectory in terms of frequency and seriousness since early childhood (Tremblay et al., 2018). Indeed, a longitudinal study of 332 males found the link between childhood aggression and adult criminality to be so robust that the authors wondered “...are all risk factors reflected in childhood aggressiveness?” (Huesmann, Eron, & Dubow, 2002, p.185).

2.2.1.4. Sex difference. As early as 17 months mothers report that 5% of boys frequently use physical aggression compared to 1% of girls, with a similar sex difference reported by teachers from school entry to adolescence (Tremblay et al., 2018). By adolescence, approximately 5% of males engage in chronic physical aggression, whereas female cases are rare (Tremblay, 2010, 2014). For example, in a recent study of the development of aggression subtypes from childhood to adolescence, the strongest risk factor for membership in the group of ‘high-chronic’ engagers in aggression was being male, “i.e., a staggering relative risk
ratio of 13.5” (Girard, Tremblay, Nagin, & Cote, 2019, p. 834). This sex difference may be partially explained by males having a higher genetic propensity for aggression than females (Barnes et al., 2019).

2.3. Emotionality

Emotionality, both positive and negative, describes intensive and temporal variations in emotion expression (Stifter & Dollar, 2016). The two temperamental traits most commonly linked to increased risk for antisocial behavior are negative emotionality which manifests as irritability (Calkins et al., 2019; DeLisi & Vaughn, 2014, 2015; Wakschlag et al., 2018) and low fearfulness (Beauchaine et al., 2017; Corr & McNaughton, 2016; Krieger & Stringaris, 2016).

2.3.1. Irritability

Emotion dysregulation can be defined as patterns of emotional experience that interfere with goal directed activity (Thompson, 2019). The robust indicator of emotion dysregulation that has been most closely linked to increased risk for disruptive or antisocial behavior is irritability which can be defined as a temperamental tendency to respond with anger to blocked goal attainment (Calkins et al., 2019; Wakschlag et al., 2018; Wakschlag et al., 2019). Reactive aggression can be seen as the most extreme manifestation of irritability (Leibenluft, 2017).

2.3.1.1. Risk. It is widely accepted that emotion dysregulation increases risk for a broad range of psychopathological outcomes (Beauchaine, 2015; Beauchaine & Cicchetti, 2019; Cole, Hall, & Hjal, 2017; McLaughlin, 2016), including criminality (DeLisi, Fox, Fully, & Vaughn, 2018; DeLisi & Vaughn, 2014, 2015; Sitnick, Galan, & Shaw, 2019). Clinically significant irritability in the form of being easily frustrated and engaging in destructive temper tantrums occurs in 3%–20% of children, with higher estimates in early childhood and is predictive of the development of Oppositional Defiant Disorder (ODD) (Wakschlag et al., 2018; Wiggins et al., 2018) which is a major risk factor for child-onset Conduct Disorder (CD) (Loober, Burke, & Pardini, 2009; Shaw, 2013; Shaw & Shelleby, 2014). Approximately 25% or more of children with ODD go on to develop CD (Kimonis, Frick, & McMahon, 2014; Lahey & Waldman, 2017). And, although the majority of children with ODD do not go on to develop CD (Loober et al., 2009), if childhood-onset CD develops, it is almost always preceded developmentally by ODD (Burke, Waldman, & Lahey, 2010).

Furthermore, it is important to note that emotion dysregulation is increasingly being recognized as a core symptom of ADHD with as many as 40–50% of children with ADHD having significant impairments caused by rages, irritability, or other manifestations of susceptibility to stress and anger (Barkley, 2015; Faraone et al., 2019; Graziano & Garcia, 2016; Mulroney, Stringaris, & Taylor, 2018; Ryckaert, Kuntsi, & Asherson, 2018). Symptoms of emotional dysregulation along with symptoms of inattention and impulsivity may constitute a subtype of ADHD (Kalandras et al., 2014; Musser & Nigg, 2019; Nigg et al., 2019). Indeed, Barkley (2015) has argued that the level of negativity and irritability that frequently is present in the combined type of ADHD is such that these children can be considered to be virtually borderline or subthreshold cases of ODD.

2.3.1.2. Sex difference. The few studies to date that have provided relevant data have yielded mixed results. Baillargeon et al. (2012) reviewed three studies of preschool children which found a sex difference favoring males, whereas two large population studies of preschool children found a sex difference favoring males in only one out of 22 items assessing irritability “breaks or destroys things during a temper tantrum, ‘fall-out,’ or melt down” (Wakschlag et al., 2018). Furthermore, there was no sex difference in a “tantrum composite” item (a combination of all items reflecting tantrum behavior) which is the most salient developmental indicator of irritability (Wakschlag, personal communication, 9/13/2019; Wakschlag et al., 2018). Overall, however, the big picture is that the question of a sex difference in irritability in early childhood has yet to be adequately investigated according to one of the foremost researchers on irritability, Lauren Wakschlag (personal communication, 9/11/2019).

When the question of a sex difference in irritability in early childhood is adequately studied, it would seem likely that a sex difference would be found favoring boys. This prediction is based on the finding of a sex difference in several disruptive behaviors (opposition-defiance, inattention, hyperactivity, physical aggression) favoring males that emerges as early as 17 months and increases in magnitude between 29 and 41 months (Baillargeon et al., 2012). Hence, one would expect that irritability, a core exemplar of disruptive behavior (Wakschlag et al., 2018), would exhibit a similar sex difference.

2.3.2. Low Fearfulness

Fear is not a unitary construct but has two components: threat reactivity which involves unconscious, automatic bodily reactions to imminent threat and the conscious experience of that threat (Hoppenbrouwers, Bulten, & Brazil, 2016). Although the difference between fear and anxiety has long been debated, there appears to be at least one core defining difference. Namely, fear involves a surge of physiological reactivity in response to clear and impending danger, whereas anxiety is a more diffuse emotion in which the threat is less certain and arousal is sustained, even after the removal of the threat (Hoppenbrouwers et al., 2016).

2.3.2.1. Risk. Temperamental fear is negatively associated with the development of antisocial behavior, with, for example, infants’ expression of fear in the laboratory predicting lower maternal reports of aggression when the children were 7 years old (Stifter & Dollar, 2016). In addition, Beauchaine et al. (2017) have reviewed the evidence that establishes trait anxiety as a moderator of the expression of trait impulsivity. Namely, depending upon whether an impulsive individual scores high or low on trait anxiety (rooted in temperament), their impulsivity may be amplified, resulting in progression to more severe antisocial outcomes, or mitigated. Moreover, there is “overwhelming evidence” (Raine, 2013, p. 117) for a fear deficit in antisocial individuals, especially psychopaths (Hoppenbrouwers et al., 2016). This deficit, at least with regard to psychopathy, is primarily in threat reactivity, as evidence for reduced subjective experience of fear is far less compelling (Hoppenbrouwers et al., 2016). Yet it is possible that the deficiency in threat reactivity indirectly leads to less intensive conscious experiences. The different explanations for how the fear deficit results in a vulnerability include impairments in the appropriate processing and responding to both threats and distress in others, and a weak defensive system which results in behavioral avoidance being less likely to occur in the presence of environmental cues signaling danger. Regarding the latter explanation, since moral socialization is partly dependent upon negative arousal (i.e., fear) evoked by potential punishment, a diminished fearful inhibition will make it more difficult for a child to internalize societal norms (Krieger & Stringaris, 2016). In turn, diminished fearful inhibition may be one temperamental precursor to callous-unemotional traits (Krieger & Stringaris, 2016; Viding & McCrory, 2015).

Callous-unemotional traits (CU) reflect a lack of remorse or guilt, callous-lack of empathy, unconcerned about performance, and shallow or deficient affect (Frick, Ray, Thornton, & Kahn, 2014). They are included in DSM-5 as the core element “with limited prosocial emotions” specifier for CD (American Psychiatric Association, 2013). These traits characterize an especially severe, puerile form of antisocial behavior in youth as such youth have an earlier onset of antisocial behavior, are more likely to persist on an antisocial trajectory and to engage in more serious and destructive forms of antisocial behavior such as severe, premeditated instrumental aggression (Blair, Leibenluft, & Pine, 2014; Frick et al., 2014; Frick & Myers, 2018; Wakschlag et al., 2018). Even
after controlling for severity and age of onset of conduct problems, juveniles with CU traits have more antisocial outcomes in adulthood when compared to other children with conduct problems without CU traits (Frick et al., 2014; Frick & Ray, 2015; Golmaryami & Frick, 2016; Pardini, Byrd, Hawes, & Docherty, 2018; Viding & McCrory, 2015).

2.3.2.2. Sex difference. There is a considerable body of work indicating that women, beginning in childhood, are more fearful than men (Campbell, 2013, 2016). There is a small sex difference in fear among children, evident in infancy, with girls being more fearful than boys (d = 0.12) (Chaplin & Aldao, 2013). Evidence for this difference is based mainly on parent reports of their children’s distress or withdrawal from sudden changes or novelty (Chaplin & Aldao, 2013). This difference increases from kindergarten through 6th grade, when girls are twice as likely as boys to be rated by teachers (17.4% vs. 8.6%) as fearful, i.e., “fearful or afraid of new things; is worried, worries about many things; cries easily” (Cote, Tremblay, Nagin, Zoccolillo, & Vitaro, 2002). By adolescence and continuing into adulthood, the sex difference increases to d = 0.40 (Else-Quest, 2012), when women are twice as likely as men to have a phobia (American Psychiatric Association, 2013). This difference is even larger for situations that pose physical threats to bodily integrity, the type of fear most relevant to avoiding physical aggression (Campbell, 2013, 2016; Campbell & Cross, 2012).

Lastly, a sex difference is also found in CU traits. CU traits with and without the presence of CD are three to five times more common in boys than girls (Viding & McCrory, 2015). Boys score higher than girls on various measures of these traits from preschool to adolescence (Essau, Sasagawa, & Frick, 2006; Espeleta, Delaoasa, Granero, Penelo, & Domenech, 2013; Frick, Bodin, & Barry, 2000; Hunayun, Kahn, Frick, & Viding, 2014). They are also four times more likely than girls to be on a stable-high trajectory for the development of CU traits in middle childhood (Fontaine, Rijndijk, McCrory, & Viding, 2010).

3. Inherited neuropsychological variation

3.1. Cognitive deficits

Moffitt hypothesized that the cognitive deficits that increased risk for antisocial behavior were mild or subtle in contrast to the severe deficits seen in disorders such as autism or profound mental retardation which are usually identified and receive treatment. The deficient cognitive abilities listed by Moffitt involved reasoning, attention, language, learning, and memory. Because the mild/subtle level of the deficits rendered identification and treatment unlikely, the deficits could initiate an etiological chain of causality for severe antisocial behavior. For example, she noted that “The child with subtle cognitive deficits is not merely difficult to manage, he or she is sometimes difficult to love” (Caspi & Moffitt, 1995, p. 495). Subsequently, Moffitt posited that these deficits could result in academic failure with attendant frustration and humiliation that might prompt antisocial behavior and increase likelihood of associating antisocial peers. Since Moffitt’s initial formulation, abundant research has validated Moffitt’s hypothesis that subtle cognitive deficits in the form of low IQ, attention problems, and learning disabilities, all of which have substantial genetic influence (Fletcher, Lyon, Fuchs, & Barnes, 2018; Hinshaw, 2018; Knopik et al., 2017), adversely affects educational achievement (de Zeeuw, van Beijsterveld, Ehli, de Geus, & Boomsma, 2017; DuPaul & Langberg, 2015; Farrington, 2015; Fletcher et al., 2018), and thereby increases risk for antisocial behavior. Educational failure has been linked to increased risk for criminal offending through three mechanisms (Savage, Ferguson, & Flores, 2017; Wertz et al., 2018). First, school problems are likely to engender frustration and negative emotions which play a role in much aggressive and violent behavior. Second, these same problems are likely to weaken school attachment which has been found to protect against crime through commitment to school and its social norms. Third, less schooling may leave juveniles with fewer legitimate methods to achieve wealth or status, increasing incentives to pursue crime. Lastly, Farrington (2015) has suggested that cognitive deficits can increase risk for antisocial behavior because they impair the individual’s ability to foresee the consequences of their actions.

3.1.1. Sex difference

Males are at increased for all the aforementioned cognitive deficits. First, as previously discussed, boys are 2 1/2 times more likely to have ADHD than girls (Hinshaw, 2018). Similarly, males are about 1.6 times more likely to have a mild Intellectual Disability than females (Witwer, Lawton, & Aman, 2014), and there is a greater male:female sex ratio in all the LD domains reviewed by Fletcher et al. (2018) in the authoritative second edition of their book on learning disabilities: word reading, reading comprehension, mathematics, and written expression.

3.2. Acquired neuropsychological variation

Moffitt proposed that a second possible source of neuropsychological variation was a disruption in the development of the fetal brain which could be caused by various prenatal and postnatal factors resulting in neuropsychological impairments which contributed to the development of both difficult temperament and subtle cognitive deficits. She also noted that the link between neuropsychological impairment and antisocial outcomes was one of the most robust effects in the study of antisocial behavior. Since then the evidence linking numerous non-inherited biological factors to increased risk for antisocial behavior has increased dramatically, with birth complications, especially low birth weight (5 lb 8 oz or less at birth) and prematurity (born < 37 weeks), being the best documented (Choy et al., 2018; Graham, Glass, & Mattson, 2016; Pinsonneault, Parent, Castellanos-Ryan, & Sequin, 2016; Raine, 2013, 2018; Tibbetts & Rivera, 2015; Wolke, 2018). These complications, which have commonly been taken as proxy measures of exposure to an adverse prenatal environment (Van Den Bergh, Dahnke, & Mennes, 2018), are thought to index increased risk for disordered brain development and thus increased risk for subsequent neuropsychological impairments (Hornman, de Winter, Kerstjens, Bos, & Reijneveld, 2016; Joseph et al., 2016). The association between birth complications and antisocial behavior is stronger in the context of adverse social environments and stronger for more severe and violent types of antisocial behavior (van Hazebroek et al., 2019). Two of the most prominent impairments related to birth complications are low general intelligence and impaired executive functions which in turn have been robustly linked to increased risk for antisocial behavior (Farrington, 2015; Hornman et al., 2016; Joseph et al., 2016; Lim et al., 2018; Mathewson et al., 2017; Nigg & Song, 2018; Pinsonneault et al., 2016; Wolke, 2018).

3.2.1. Sex difference

Boys are not only more likely than girls to be exposed to a host of biological hazards during prenatal developmental, but they are also more likely than girls in many instances to suffer adverse effects from such exposures (DiPietro & Voeltline, 2017; Garstein & Skinner, 2018; Geary, 2010). This increased exposure coupled with increased vulnerability has been termed “double jeopardy” (DiPietro & Voeltine, 2017). For example, boys are more likely to be born preterm and/or of low birth weight; and when matched for gestational duration and/or weight at birth, boys are less likely to survive and are generally more likely to show poorer developmental outcomes (Anderson et al., 2016; Balara, Faerber, Spinner, & Feudtner, 2013; DiPietro & Voeltine, 2017; Joseph et al., 2016; Kent, Wrigth, & Abdel-Latif, 2012; Vu, Dickinson, & Kandasamy, 2018). Furthermore, since LBW and prematurity characterize a substantial portion of ADHD cases, making it

---

10 A recent notable exception to the typical finding of double jeopardy is the study by Kim et al. (2018) which found that sex did not moderate LBW risk for ADHD.
the single strongest known environmental risk factor for ADHD (Kim et al., 2018; Nigg & Song, 2018), this may partially explain the greater male prevalence of ADHD. Boys are more likely to experience a range of obstetric complications such as umbilical cord anomalies and maternal gestational diabetes, and are at higher risk for congenital anomalies and respiratory disorders associated with such complications (DiPietro & Voegtline, 2017). Boys experience greater deficits than females from prenatal exposure to various neurotoxins (e.g., alcohol, lead, marijuana, methylmercury, nicotine, opioids) [Ji et al., 2018; Lewis & Kestler, 2012; Terasaki, Gomez, & Schwartz, 2016]. Boys are more vulnerable than girls to infections, and malnutrition (Eriksson, Kajantie, Osmond, Thornburg, & Barker, 2010; Garstein & Skinner, 2018; Rutter, Caspi, & Moffitt, 2003). Boys are 20% more likely than girls to die in utero (Davis et al., 2007; Migeon, 2007). Boys are more likely than girls to develop externalizing problems in early childhood when exposed to maternal medical risks (e.g., diabetes, lung disease, renal disease) during pregnancy (Jackson & Vaughan, 2018). Lastly, the interaction of biological vulnerability conferred by birth complications and social risk factors are more strongly related to antisocial behavior in boys than girls (van Hazebroek et al., 2019).

In short, compared to females, “Boys Live Dangerously in the Womb” (Eriksson et al., 2010, p. 330).

### 3.2.2. Biological Basis

Although the etiology of the greater male vulnerability to numerous prenatal and perinatal adversities is largely unknown, several mechanisms have been proposed to account for some of the findings (DiPietro & Voegtline, 2017).

**3.2.2.1. Maturational delay.** Schore (2017) has proposed that the stress-regulating circuits of the male brain mature more slowly than those of the female in the critical prenatal, postnatal, and perinatal periods. This maturational delay results in males being more vulnerable over time to toxins in the physical environment and stressors in the social environment, as it is a basic developmental principle that a less mature organism is more susceptible to deleterious effects of adverse events than a more mature organism (Tanner, 1990).

**3.2.2.2. Faster growth.** Boys grow faster than girls in the womb which makes them more vulnerable if their nutrition is compromised (Eriksson et al., 2010). This faster growth, at first glance, might seem incompatible with greater male developmental immaturity. However, note that developmental immaturity simply means that boys are not as close as girls to their final developmental status (Tanner, 1990). Thus, boys can be simultaneously larger and longer at birth than girls because of faster growth and also be less close than girls to their final developmental status.

**3.2.2.3. Prenatal androgen exposure.** As Hines (2015) has explained, at 6–7 weeks prenatally the Sry (sex-region determining) gene on the male Y chromosome induces differentiation of neutral gonads into testes. In the absence of the Sry gene, and with involvement of other genes, neutral gonads develop into ovaries at about 12 weeks. The testes begin to produce testosterone prenatally, whereas ovaries do not. This sex difference appears to be maximal between 8 and 24 weeks and then tapers off by birth. There is also a surge of testosterone during early postnatal development for males, peaking at about one to three months and declining to minimal levels at about 6 months where it remains until puberty. Male exposure to higher androgen levels during prenatal and early postnatal development leads to increased plasticity, i.e., increased responsivity to different environmental conditions (Del Giudice et al., 2018). Increased responsivity to harsh or poor prenatal conditions translates into greater male vulnerability to these conditions.

**3.2.2.4. Placenta.** The male placenta has been found to be more vulnerable than the female placenta to complications of pregnancy (Eriksson et al., 2010; Khalife et al., 2012; Nugent, O’Donnell, Epperson, & Bale, 2018; Ursini et al., 2018). One reason for this greater male vulnerability that has been identified is a sex difference in an X-linked gene that produces a placental enzyme that confers variation in vulnerability to prenatal insults (Nugent et al., 2018). This enzyme is expressed in higher levels in females most likely because of genes that escape X-inactivation (Nugent et al., 2018). In reflecting on the finding that the greater vulnerability of the male placenta to the stresses associated with complicated pregnancies is implicated in the etiology of schizophrenia (Ursini et al., 2018), the leader of the research team, Dr. Daniel Weinberger, observed “The missing link between complications during pregnancy and the development of the fetal brain has been hiding in sight for a long time. It is the placenta. We suggested that placentas of male fetuses seem to be more susceptible at the genetic level. I am very confident the same story is going to be there for autism, A.D.H.D. and other developmental behavior problems” (quoted by Mandavilli, 2018, D1, 2). Lastly, since all biological sex differences are the result of the inequality in effects of the sex chromosomes (male XY and female XX) [Arnold, 2017], and since it appears that XX and XY cells may do their molecular business a “bit differently from each other” (Page, 2017, p. 366), it may well be that the cause of the sex difference in prenatal vulnerability may reside in this ultimate source of all biological sex differences for reasons similar to their greater vulnerability than females to sex-linked disorders (Knopik et al., 2017; Migeon, 2007).

### 3.3. Early Identification

Moffitt’s identification of an LCP antisocial trajectory provided the impetus for the development of the early years crime prevention movement (Moffitt, 2018). Thus, there is now virtually unanimous agreement, that the prevention of the development of serious antisocial behavior should be initiated during early childhood, if not even earlier, i.e., during pregnancy (Fairchild et al., 2019; Raine, 2018; Shaw, 2013; Shaw & Taraban, 2017; Tremblay et al., 2018; Wakschlag et al., 2019). As a prerequisite of early intervention is early identification of children at high risk for LCP, this topic will be addressed first, followed by a discussion of some of the more common early interventions that have been implemented. As previously reviewed, children at high risk for LCP are characterized by: impaired self-control, physical aggression, irritability, callous-unemotional traits, and cognitive deficits. Importantly, and to reiterate, Moffitt also stipulated that numerous non-individual/environmental risk factors involving family and neighborhood influences also interact with these factors and obviously contribute to LCP risk. For example, factors identified by her as well as subsequent researchers include child rearing involving harsh punitive discipline, rejection, deficient parental supervision, maltreatment, parental criminality/substance abuse, maternal depression, and risky neighborhoods characterized by socioeconomic disadvantages, social disorganization, structural inequality, residential instability, and poverty which are indicative of general neighborhood disorder (Fagan & Benedini, 2018; Farrington, 2015; Jennings, Perez, & Gonzalez, 2018; Shaw, 2013; Shaw & Taraban, 2017).

The major challenge to early identification is to distinguish normal from abnormal manifestations of the previously discussed factors that mark a significant risk for developing antisocial behaviors (Biedzo & Wakschlag, 2019; Wakschlag et al., 2019). Fortunately, there is a consensus that good progress has been made in the past 25 years in meeting this challenge (Farrington, 2015; Shaw & Taraban, 2017; Wakschlag et al., 2018).
3.3.1. Impaired self-control/ADHD
Numerous studies have demonstrated that ADHD, the global disorder of impaired self-control, can be accurately diagnosed in early childhood, especially by focusing on the assessment of hyperactive-impulsive behaviors, rather than symptoms of inattention (Halperin & Marks, 2019). This assessment can be aided by the use of a normed instrument such as the ADHD Rating Scale IV: Preschool Version (McGoey, DuPaul, Haley, & Shelton, 2007). Children so diagnosed are at increased risk for criminal behavior. In what is one of the largest studies to date of ADHD begun in early childhood, Lahey et al. (2016) examined the stability and long-term consequence of ADHD of 125 children (107 boys) who were diagnosed with ADHD at 4–6 years and compared their development to a control group of 130 non-ADHD children. The participants were followed prospectively through age 18 years. During 15–18 years of age, more children with ADHD were arrested (based upon adolescent and parent report) at least once (30%) than were comparison children (9%). Indeed, only 10% of children diagnosed with ADHD at baseline were functioning within the normative range on all measures in adolescence. In particular, a higher number of hyperactivity-impulsive symptoms in preschool predicted abnormal functioning in adolescence.

3.3.2. Physical aggression
The salience of physical aggression probably makes it the easiest risk factor to identify (Tremblay, 2015). And, as with ADHD, well-normed instruments such as the Child Behavior Checklist (Achenbach & Ruffle, 2000) and the Multidimensional Assessment Profile of Disruptive Behavior (MAP-DB) (Wakschlag et al., 2014) can greatly assist in distinguishing normal versus abnormal manifestations of physical aggression. The value of using such instruments was demonstrated in a recent study (Kassing, Godwin, Loehman, & Cole, 2019). Using a large nationally-representative sample, the study found that a teacher screening instrument of externalizing behavior (e.g., “harms others,” “fights,” “breaks things”) of kindergarten children with high base rates of such behavior could accurately predict adult convictions by age 25.

3.3.3. Irritability
The previously mentioned MAP-DB can identify clinical levels of irritability in preschool. The scale uses a dimensional approach to assess the normal-to-abnormal spectrum of various preschool behaviors, including irritability, based upon maternal report. A recent study of 425 preschool children who were oversampled for irritability were followed from a mean age at baseline = 4.7 years to a mean age of 7.6 years (Wiggins et al., 2018). Of the 22 items measuring temper loss behavior, two MAP-DB items “easily frustrated” (i.e., occurs almost every day) and less frequently occurring “has destructive temper tantrums” (i.e., breaks/destroys) showed good predictive utility for ODD, as well as other irritability-related disorders such as disruptive mood dysregulation disorder, and depressive disorders.

3.3.4. Callous-unemotional behaviors
As with physical aggression and irritability, the MAP-DB has a scale that assesses for CU behaviors in preschool children by items that measure low concern for others such as “not seem to care about others' feelings,” “enjoy making others mad” (Wakschlag et al., 2018). A study by Rhee et al. (2016) found that a similar measure of CU behaviors in preschool children, especially high disregard for others (i.e., responding to others' distress with active, negative responses such as anger and hostility), predicted conduct problems in adolescence.

3.3.5. Cognitive deficits
As with identifying behaviors that are truly atypical, the biggest challenge to identifying preschool children with subtle/mild cognitive deficits is that, by definition, the subtlety of these deficits makes their detection difficult. Children with mild intellectual disability, attention problems, or learning disabilities typically exhibit no obvious cognitive differences from normally developing children until they enter structured school settings (American Psychiatric Association, 2013; Fletcher et al., 2018; Halperin & Marks, 2019). However, there is an important exception to this challenge with regard to detecting low IQ, which is the cognitive deficit which poses a great risk for LCP (Farrington, 2015). In instances when children have already been identified as exhibiting high risk behavior, the possibility that low IQ might be a contributing factor can be ascertained with a high degree of accuracy by one of several intelligence tests11 with excellent nationally representative norms. The possibility of low IQ can be screened for by using a combination of a few subtests from these instruments with the highest correlations with full scale IQ, followed by full administration of the test if warranted. Scores obtained on such tests in preschool correlate a remarkable 0.60 with general intelligence at age 15 (Mackintosh, 2011).

3.3.6. Conclusion
To reiterate, good progress has been made since Moffitt’s initial formulation in identifying preschool children who present with high risk factors for LCP. Thus, the primary challenge for the prevention of LCP is not early identification, but implementation of effective interventions for those children so identified (Shaw & Gilliam, 2017).

3.4. Prevention of LCP
As previously mentioned, Moffitt’s landmark publications provided the impetus for the development of the early years crime prevention movement as the problematic behavior of children at high risk for LCP along with parenting practices associated with its origin and persistence appears to be more malleable earlier than later (Shaw, 2013; Shaw & Taraban, 2017). Thus, the vast majority of programs have focused on enhancing the quality of parenting in early to middle childhood (Fairchild et al., 2018). The prevention programs have either been universal (aimed at the general population), selective (aimed at children at high risk for developing serious antisocial behavior), or indicated (aimed at children with subclinical levels of conduct problems). The focus will be on selective and indicated prevention programs as they are most relevant to the prevention of LCP.

The effectiveness of various early intervention programs for the prevention of LCP constitutes a vast literature that has been the subject of numerous articles and reviews (e.g., Brennan & Shaw, 2015; Dekovic et al., 2011; Dodge et al., 2015; Farrington, Kazemian, & Piquero, 2018; Kazdin, 2018; Menting, de Castro, & Matthys, 2013; Piquero et al., 2016; Raine, 2018; Sandler et al., 2014; Shaw, 2013; Shaw & Gilliam, 2017; Shaw & Taraban, 2017; Tremblay et al., 2018; Welsh & Zane, 2018; Zych & Farrington, 2018). This literature has yielded two broad conclusions. First, these programs can produce small to moderate effects on reducing antisocial behavior over the short term (i.e., 1 to 3 years), although a sizeable group of children (1/5 to 1/3) fail to improve (Brennan & Shaw, 2015; Kazdin, 2018; Piquero et al., 2016; Sandler et al., 2014). Second, the vast majority of the studies of these programs have not been sufficiently long term to evaluate their effectiveness in preventing delinquency or later offending. The few studies that have examined long-term outcome have yielded mixed results because initial effects fade, studies provide inconsistent findings, or effects are too small to be of practical benefit (Brennan & Shaw, 2015; Ferguson, 2009). These conclusions will now be fleshed out.

3.4.1. Immediate or short-term outcome
The vast majority of early intervention studies have evaluated outcome either immediately after the intervention ended or after a short-term follow-up. Their results have been thoroughly evaluated in several systematic reviews and meta-analyses. Menting et al. (2013)

---

11 Stanford-Binet Intelligence Test-V; Wechsler Preschool and Primary Test of Intelligence-IV; Woodcock-Johnson Tests of Cognitive Ability-IV.
examined the effectiveness of the Incredible Years parent training program for disruptive and prosocial child behavior in a meta-analysis of 50 studies with children whose mean age ranged from 3 to 9.2 years. The effect sizes for outcome measured immediately after the intervention were $d = 0.13$ for selective prevention studies and $d = 0.20$ for indicated prevention. Since long term effects were not examined, there is no evidence that this highly popular parent management training (PMT) is effective in preventing LCP.

The effectiveness of a similarly popular PMT program, Triple P-Positive Parenting Program, was investigated in a systematic review and meta-analysis of 110 studies, most of which were RCT (Sanders, Kirby, Tellegen, & Day, 2014). The mean age of the children was 5.8. Significant medium long-term effects (range was 2–36 months) were found for children's social, emotional and behavioral outcomes $d = 0.52$. No delinquency outcomes were studied.

Comer, Chow, Chan, Cooper-Vince, and Wilson (2013) conducted a meta-analytic examination of 36 controlled trials of psychosocial treatments for disruptive behaviors problems (externalizing behavior, aggression oppositionality/non-compliance, hyperactivity/impulsivity) for children they designated very young (mean age 4.7; range 2.0–7.7). Medium to large effects sizes were found for reducing hyperactivity/impulsivity (Hedges $g = 0.61$), oppositionality/non-compliance (Hedges $g = 0.76$), general externalizing behaviors (Hedges $g = 0.90$) that were sustained for an average follow-up interval of 2.7 years. However, since the average age of the children at follow-up was 8–9, there was no evidence for prevention of either adolescent delinquency or later offending.

Sandler et al. (2014), as part of an overview of meta-analyses of the prevention of mental health, substance abuse, and conduct problems, identified 9 meta-analyses of prevention of aggressive, violent, or antisocial behaviors in studies which included youth from birth to age 18. Small effect sizes ranging from 0.12 to 0.19 for criminal/antisocial behavior were found for outcomes up to one year.

Van Aar, Leijten, de Castron, and Overbeek (2017) conducted a systematic review and meta-analysis of 40 randomized controlled trials for parenting intervention for disruptive child behavior (ages 2–9) with follow-up assessments up to three years after intervention ended (follow-up was between 18 and 36 months for 7% of the trials). Although small to moderate treatment effects were found, since the follow-up was at most 3 years for a few studies, no evidence for the prevention of adolescent delinquency or later offending.

Hendriks, Barrels, Collins, and Finkenauer (2018) provided a synthesis of reviews and meta-analyses on nonpharmacological interventions for childhood aggression (ages 6–12). Small to medium immediate effects were found for reducing aggression in children who had an elevated risk for developing aggression, or showed behaviors associated with childhood aggression, but did not meet diagnostic criteria. No evidence was presented for follow-up effects.

Lastly, it is important to note Hendriks et al. (2018) caution of a likely source of bias in the studies they reviewed that applies equally to all reviews and individual studies of interventions that typically rely primarily, if not exclusively, on parental report to evaluate success. Namely, since it would be only natural for parents who had invested a lot of time and effort in parent training to overemphasize its beneficial effects (Sonuga-Barke et al., 2013), the effect sizes are probably spuriously inflated to an unknown extent. For example, in a review of the success of psychological treatments for ADHD based upon reports by teachers (who were probably blinded to treatment status and therefore unlikely to be biased), no evidence was found for treatment efficacy, in contrast to positive findings based upon parental reports (Sonuga-Barke et al., 2013).

### 3.4.2. Long-term follow-up

Welsh and Farrington (2006) conducted a review of 11 high-quality randomized controlled trials of PMT programs aimed at reducing delinquency and later offending by children and adolescents. Of the eleven programs, only five involved early interventions with children. The other six involved adolescents, most of whom were either already adjudicated delinquent or psychiatrically hospitalized. A meta-analysis of these programs yielded $d = 0.31$, which corresponds to a non-significant 15% reduction in delinquency (Welsh & Zane, 2018). Of the five early invention programs, three produced statistically significant results, with one of the two ineffective programs (Cambridge-Somerville Youth Study) being found to significantly increase risk for criminal behavior at the age 45 follow-up (Farrington & Hawkins, 2019; Tremblay, Welsh, & Sayre-McCord, 2019). Of the three effective programs, two were not replicated by subsequent comparable programs and one reported mixed results, as the following discussion will document.

The Infancy Nurse Home Visitation program, which is the best-known intervention targeting pregnant women at high risk of having LCP children and which continued through the child's second birthday, found reduced arrests at the 19-year follow-up for female, but not male offspring (Eckenrode et al., 2011). This finding was not replicated in a similar more recent multicomponent early intervention program providing education and social support to pregnant women living in low socioeconomic conditions. The program, which continued until the child was 4 or 5, had no effect on reducing the risk of a child belonging to a high externalizing trajectory (Cote, Orri, Tremblay, & Doyle, 2018).

The Perry Preschool Program (PPP) is commonly cited in reviews (e.g., Raine, 2018; Tremblay et al., 2018; Zych & Farrington, 2018) as the best example of various preschool programs for socially disadvantaged children “shown to improved academic success in the short term and to prevent arrests and court referrals in the long term” (Tremblay et al., 2018, p. 397). This finding was not replicated in the Carolina Abecedarian Project (ABC), which is the most intensive and lengthy preschool education program to date (Reynolds & Temple, 2008). ABC was conducted in the 1970s and provided full-day day-care and educational intervention from infancy-5 years for 55 African American children with a control group of 54 (Campbell & Ramey, 1995). In contrast to the findings of the PPP, at the age 30 follow-up the percentages of the program group and control group with a self-reported criminal conviction were virtually identical: 27% and 28% (Campbell et al., 2012). Lastly, even if these legacy interventions (PPP, ABC) had proven highly successful in preventing criminality, their current relevance is questionable. As Dodge (2018) noted, these interventions were conducted with low-income mothers who stayed at home, whereas today almost all mothers, including low-income mothers, are trying to work outside the home.

The third successful program cited by Welsh and Farrington (2006) was the Montreal Longitudinal-Experimental Study which began as a regular longitudinal study of 1061 boys from low socioeconomic environments and subsequently added a multimodal preventative intervention component when the boys entered second grade (Tremblay et al., 2019). From ages 10 to 15 the program group had significantly lower self-report delinquency scores than the control, but were only slightly less likely to have a juvenile court record (7% in contrast to 9%). At the age 28 follow-up, the program group had significantly lower self-reported rates of property violence than the control group but there was no difference in personal violence between the groups (Vitaro, Brendgen, Giguere, & Tremblay, 2013). Among the possible reasons for the program’s failure to reduce personal violence was the failure to reduce physical aggression in childhood which is a predictor of personal violence (Vitaro et al., 2013).
In 2010 Manning, Homel, and Smith conducted a meta-analysis of the effects of 11 early developmental programs (i.e., intervention began before the child started school) in at risk populations on adolescent outcomes in seven different domains. The effect size for involvement in criminal justice was \( d = 0.24 \).

A little over a decade after the 2006 review, Farrington et al. (2017) identified 50 systematic reviews of the effectiveness of developmental prevention programs in reducing delinquency, aggression and bullying, 2 of which evaluated for delinquent outcome. Lösel and Beelmann’s (2007) review of social skills training programs reported an effect size of \( d = 0.17 \) for reducing delinquency. Alford and Derzon’s (2011) review of school-based programs reported an effect size of \( d = 0.08 \) for reducing delinquency.

The disappointing results from these studies suggest that if early interventions are to have a lasting effect, they will require continued contact with families over the long term (Brennan & Shaw, 2015). The best test of this proposition to date is the Fast Track program. The Fast Track program is a randomized controlled study that targeted a large sample of children (n = 979) at high risk for LCP who were selected from each of 3 kindergarten cohorts (Dodge et al., 2015). The program had 6 components and lasted for 10 years from grades 1 through 10. Reviews of the study reported mixed results (Brent & Loeb, 2015; Dodge et al., 2015; Zych & Farrington, 2018). There was a small effect size (\( d = 0.15 \)) on externalizing behavior with the intervention subjects being 10% less likely to have any externalizing, internalizing, or substance use disorder (59% compared to 69% for the control group). Assignment to intervention significantly decreased a severity-weighted violent crime conviction index by 31% for two cohorts, but had an opposite non-significant effect for a third cohort. There was no significant effect for self-reported offenses or significant overall-effect on adult arrests based on court records.

Lastly, in addition to the problems of mixed results, there remains the critical question of whether the magnitude of the reported effect sizes for positive findings are of “practical” significance or benefit, i.e., large enough to bring about a meaningful change in individuals’ lives (Durlack, 2009; Ferguson, 2009; Pogrow, 2019). While there is no agreement on what magnitude of effect is necessary to establish practical significance, Ferguson (2009) has made a strong case for a minimum effect size of 0.41 (anchored to a minimum of \( r = 2 \)) for Cohen’s “d” or Hedge’s “g” for practical significance. None of the reviewed programs reviewed which evaluated results in terms this metric met this standard.

### 3.4.3. Conclusion

As Tremblay et al. (2018, p. 399) aptly observed regarding prevention efforts, “we are far from having the impact we would like to have.” If early interventions are to have a strong impact on preventing the development of serious antisocial behavior several challenges will have to be met. First, perhaps the steepest challenge is that of implementing programs of proven short-term effectiveness at scale because of the cost and length of commitment required by the program (Brennan & Shaw, 2015; Dodge et al., 2015; Kazdin, 2018; Tremblay et al., 2018). Second, a psychosocial system of care needs to be developed in which each child in a community attends well-baby health care visits where they are screened for incipient problematic behavior and referred to specialists for intervention (Dodge, 2018). Wakschlag et al. (2019) suggest that this challenge can be met by embedding the identification and intervention for high-risk children in pediatric primary care since this provides the earliest and easiest point of contact with health professionals for the vast majority of children. Third, since parents of high-risk children report barriers to referrals for intervention such as perceived intervention demands, perceived relevance of intervention, and obstacles in relation to the individual providing the intervention, this will require the development of novel methods of delivery to overcome (Kazdin, 2018). Fourth, the content of intervention programs will need to be modified to fit the risk profile of at-risk families and the effective ingredients in multicomponent programs will need to be identified (Brennan & Shaw, 2015; Dodge et al., 2015).

### 3.5. Future directions

Twenty-five years of research has provided overwhelming support for a male LCP antisocial trajectory. These few, persistent, pathological males who account for the majority of criminal violence as well as other adverse outcomes pose a public health crisis. If this public health crisis is ever to be adequately met, the next 25 years of research should address at least three salient issues.

First, despite compelling evidence that neurodevelopmental deficits are more characteristic of LCP than AL, a decisive test of this hypothesis is lacking (Moffitt, 2018). Similarly, Raine (2019a) notes there is a deficit in research on whether early impairments in the neural circuitry underlying moral decision making, which are hypothesized to be more characteristic of LCP than AL groups, predict later offending. These research deficits are due to the need to combine neural imaging research in a longitudinal design which is both difficult to implement and very costly. Both Moffitt (2018) and Raine (2019a) offer ways of addressing this steep challenge.

Second, very little research has been done on the characteristics of those individuals with early, severe, pervasive conduct problems who do not become LCP (McGee & Moffitt, 2019). Although these males are at risk for becoming low-level chronic offenders, this outcome is far less serious than an LCP outcome. Identification of the factors that influence a less severe antisocial outcome despite what appears to be an equally ominous beginning would provide valuable information to guide early intervention efforts. For example, research might focus on suggestions that this group may have risk factors intermediate between those who exhibit low or no antisocial behavior across development and an LCP group (Russell & O’Dougher, 2016), or may have off-putting personal characteristics that exclude them from peer groups where most delinquency happens (Moffitt, 2006).

Third, the most important and pressing research issue is meeting the previously discussed challenges of designing and implementing interventions that can substantially reducing LCP. Given the consensus that there are parent management interventions of proven effectiveness over the short-term (Kazdin, 2018; Shaw, 2013; Shaw & Taraban, 2017; Zych & Farrington, 2018), it can be argued that the all-encompassing challenge is, as Kazdin (2018) has contended, one of scalability/reach. Scalability refers to improving the number and proportion of at-risk children who receive treatment. Reach refers to connecting with children in neglected populations. In short, how, beginning in pregnancy, can parenting management interventions be initiated and sustained with families at high risk for having LCP males. Regarding scalability, Shaw and Taraban (2017) note that outreach programs for high risk children/families already exist in Head Start Centers and in Woman, Infants, and Child Nutritional Supplement Centers. These programs could be scaled up and extended to primary care centers such as maternity and pediatric units where parents might be open to receiving behavioral health services because of the trust they typically have for physicians. Regarding reaching neglected populations, the Cambridge Study in Delinquent Development12 reported that 63% of boys with a convicted parent were themselves convicted up to age 40 (Farrington, 2015). Given the magnitude of this risk, it is quite surprising that to the author’s knowledge, there is no research on childhood interventions with these at-risk males.

---

12 This is a prospective longitudinal study of 411 London males who comprised the complete population in six state primary schools aged 8 to 9. They were originally studied in 1961. Their criminal records have been searched repeatedly up to age 61 and their self-reported offending was measured up to age 48. Parents were also interviewed once a year when the boys aged 8 to 15 (Farrington, 2007, 2019).


