

As pointed out previously, recent research on the development of delinquent and criminal behavior has identified ADHD features, which appear to have a strong biological component. There are many other potential biopsychological factors that may contribute to the development of antisocial behavior. In the next section, we will consider some of them.

Biological Factors

Children are born with a range of genetic makeups, neurological predispositions, and temperaments. During the past two decades, researchers have made significant advances in discovering the many biological and neurological factors that may play important roles in the development of antisocial and violent behavior (see Raine, 2002, and Tremblay, Hartup, & Archer, 2005, for comprehensive reviews). Tremblay and Côté (2005) note that the increasing number of biopsychosocial studies appear to be largely due to the development of sophisticated biological measures that are relatively easy to use with humans. They use molecular genetics, brain scans, and radioimmunoassays of saliva as examples of the improved measuring techniques. For example, the latest neurodevelopmental imaging studies indicate that the brain is still growing and maturing well beyond adolescence (DeMatteo, 2005c). A recent National Institute of Mental Health (NIMH) investigation suggests that brain maturation may not peak until age 25 (Beckman, 2004).

One important point must be noted, however. Researchers have continually emphasized that biological or neurological factors do not act in isolation. Neurobiological development is continually influenced by the psychosocial and physical environment across the life span. For example, it is becoming increasingly apparent to behavioral scientists that a lack of physical contact, verbal stimulation, and social responsiveness from parents and caregivers can substantially alter the rate of intellectual, emotional, and social development in children (Dahlberg & Potter, 2001). Tremblay and Côté (2005) use the example of mothers who smoke during pregnancy as another environmental influence on the neurological and biological development of infants: "Children of mothers who smoked during pregnancy are at higher risk of numerous problems, including low birth weight, hypertension, hyperactivity, inattentiveness, impulsiveness and aggression" (p. 455). To add to the complexity of the biology-environmental issue, Tremblay and Côté also observe that women who smoke during pregnancy tend to have low education, to be poor, to have a history of psychological problems, and to have many of the same problems as their children.

Temperament

Developmental scientists have continually documented the strong association between a child's difficult **temperament** and the development of persistent antisocial behavior (e.g., Bates, Pettit, Dodge, & Ridge, 1998; Rubin, Burgess, Dwyer, & Hastings, 2003; Shaw, Owens, Giovannelli, & Winslow, 2001). According to the research literature, temperament is assumed to (1) have a constitutional or biological basis, (2) exist at birth and continue across the life span, and (3) be influenced by the psychosocial environment

(Else-Quest, Hyde, Goldsmith, & Van Hulle, 2006; Lahey & Waldman, 2003). Temperament is generally viewed as individual differences in emotional expression, motor activity, and sensitivity to stimulation. Ill-tempered or difficult children are often described by caregivers as impulsive, unmanageable, and poorly self-regulated.

An understanding of temperament is important, because heritable or biological predispositions may be a critical factor in the early formation of delinquency and crime. “Ill-tempered” children may be at higher risk to engage in antisocial behavior than “easy” children. Specifically, a smiling, relaxed, socially interactive child (easy) is apt to generate a different social response from caregivers than a fussy, tense, and withdrawn one (ill-tempered). A chronically ill-tempered child may become so frustrating and discouraging to his parents or caregivers that they feel overwhelmed and helpless in their ability to deal effectively with the child. The caregiver’s resulting frustration may feed into the behavior of the child in a reciprocal fashion, engendering a disruption in the caregiver–child relationship. This frustration may progress into physical or emotional abuse or neglect by the caregivers.

Genetic Influences

Over the past 30 years, more than 100 twin and adoption studies have examined the relationship between genes and aggression or violence (Pérusse & Gendreau, 2005). Not surprisingly, most scientists have concluded that both genetic and environmental factors are important in the development of antisocial behavior. Some scholars (e.g., Rhee & Waldman, 2002) have estimated that environment plays a significantly more important role in the development of antisocial behavior than does genetics. Moreover, some researchers have further suggested that genetics may play a more prominent role in the development of those who commit property crimes, and plays a less important role in the development of those who commit violent crimes (Pérusse & Gendreau, 2005). However, despite a fairly large quantity of research on the relationship between genetics and antisocial behavior, the evidence remains largely inconclusive.

Brain Chemistry

Earlier, we discussed self-regulation and executive functions and their involvement in antisocial behavior. Scientists have discovered that, to a large extent, these functions are found in the front parts of the brain, known as the frontal cortex. According to Pihl and Benkelfat (2005), “the frontal lobes are seen as responsible for planning, controlling, and verifying behavior in the presence of goals, working within a context and providing control over the more automatic subcortical systems” (p. 273). Moreover, the frontal cortex is one of the last parts of the brain to mature, probably as late as age 25 (Gogtay et al., 2004).

A biochemical that is found in heavy concentrations in this region of the brain is dopamine. Dopamine is actually one of the neurotransmitters, which are biochemicals involved in the transmission of neural impulses within the nervous system. Without neurotransmitters, communication within the mammalian nervous system would be impossible. The assumption by the scientific community is that low concentrations of

dopamine in the frontal cortex may be linked to poor self-regulation and faulty executive functions.

Another neurotransmitter that has been linked to poor impulse control and violent behavior is serotonin. Basically, many individuals who act aggressively or violently toward others may have abnormally low levels of serotonin (Coscina, 1997; Lesch & Merschdorf, 2000; Loeber & Stouthamer-Loeber, 1998). There is also some evidence that levels of serotonin may explain to some extent the differences in physical aggression between men and women (Verona, Joiner, Johnson, & Bender, 2006). Low levels of serotonin are also linked to depression and suicide (Pihl & Benkelfat, 2005).

Other neurotransmitters are believed to be associated with violence and antisocial behavior, such as norepinephrine and GABA. There will probably be many more as the research continues, but it is unlikely that research will discover that neurotransmitters are the sole causes of violent or aggressive behavior.

Hormones and Aggression

The two hormones that have been implicated in influencing physical aggression and antisocial behavior are the androgen testosterone and the stress hormone cortisol (Van Goozen, 2005). Several studies have found that antisocial children and adults often have low levels of cortisol. The evidence to date suggests that the more aggressive the behavior, or the more serious the antisocial behavior, the lower the level of cortisol (see Van Goozen, 2005, for a review). As with neurotransmitters, it is highly likely that many additional hormones will be linked to aggressive or antisocial behavior.

Other Social Developmental Influences

Many other developmental factors have been identified as contributing to a child's trajectory toward a life of committing serious crime and violence. The experience of physical abuse in early life significantly increases the risk of future antisocial conduct (Dodge & Pettit, 2003; Mayfield & Widom, 1996). On the other hand, warmth and appropriate behavioral management by parents have been found to have very positive outcomes on the developmental trajectories of their children (Dishion & Bullock, 2002; Dodge & Pettit, 2003). The amount of exposure that a child has to aggressive peers in day care or preschool also appears to have significant effects on the child's later aggressive behavior. In addition, children who spend large amounts of time in unsupervised afterschool self-care in the early elementary grades are also at high risk for participating in antisocial behavior (Sinclair, Pettit, Harrist, & Bates, 1994).

Poverty is also a powerful risk factor. Although many children who grow up poor do not engage in serious antisocial behavior or delinquency, poverty does create multiple barriers to healthy development. Communities under financial strain are often plagued by inadequate educational and health systems and often have a large number of families experiencing disruption brought about by limited occupational resources and family breakdown. In these areas, schools tend to be inadequate and day care services limited. Unsafe levels of lead and other toxic materials have been found in significantly higher amounts in economically deprived areas than in middle- or upper-income communities.