■ **prenatal substance exposure** Fetal exposure to maternal drug and alcohol use. Prenatal substance exposure can significantly increase a child's risk for developmental and neurological disorders.

High dietary intake of DHA and consumption of fish rich in omega-3 fatty acids may be related to less hostility in young adulthood.

of fish rich in omega-3 fatty acids may be related to lower likelihood of high hostility in young adulthood."[64] A 2007 study conducted in the United Kingdom found that antisocial behavior could be reduced in children through dietary supplementation with polyunsaturated fatty acids.[65]

Finally, a 2013 study reported in *Pediatrics*, a journal of the American Medical Association, revealed a clear link between the length of time a child is breast fed and later intelligence; with longer breast-feeding times being correlated with higher intelligence in the developing child.[66] The study controlled for environmental factors, including the mothers' intelligence and diet, and seemed to indicate that nutrients which are found only in breast milk, including fatty acids linked to brain development, are responsible for the observed increase in intelligence. Read more about diet and its possible contribution to criminal behavior at **Library Extra 5–4**.

Environmental Pollution

Various substances found in our environment have been shown to be linked to criminal behavior. In 1997, British researchers Roger D. Masters, Brian Hone, and Anil Doshi published a study purporting to show that industrial and other forms of environmental pollution cause people to commit violent crimes.[67] The study used statistics from the FBI's Uniform Crime Reporting Program and data from the U.S. Environmental Protection Agency's Toxic Release Inventory. A comparison between the two data sets showed a significant correlation between juvenile crime and high environmental levels of both lead and manganese. Masters and his colleagues suggested an explanation based on a *neurotoxicity hypothesis*. Another author stated, "According to this approach, toxic pollutants—specifically the toxic metals lead and manganese—cause learning disabilities, an increase in aggressive behavior, and—most importantly—loss of control over impulsive behavior. These traits combine with poverty, social stress, alcohol and drug abuse, individual character, and other social and psychological factors to produce individuals who commit violent crimes."[68] See the Crime in the News box for more information on lead exposure and its effects.

The largest study of lead contamination and its effects on behavior was an examination of 1,000 black children in Philadelphia. It showed that the level of exposure to lead was a reliable predictor of the number of juvenile offenses among the exposed male population, the seriousness of juvenile offenses, and the number of adult offenses. More recent studies, including many that Masters was unaware of, seem to support his thesis.[69]

The researchers reasoned that toxic metals affect individuals in complex ways. Because lead diminishes a person's normal ability to detoxify poisons, it may heighten the effects of alcohol and drugs. Industrial pollution, automobile emissions, lead-based paints, and aging water-delivery systems are all possible sources of lead contamination. In a recent interview, Roger D. Masters, Research Professor at Dartmouth College, noted, "The presence of pollution is as big a factor [in crime causation] as poverty. It's the breakdown of the inhibition mechanism that's the key to violent behavior."[70] When brain chemistry is altered by exposure to heavy metals and other toxins, people lose the natural restraint that holds their violent tendencies in check.

More recent studies have focused on **prenatal substance exposure** to substances like marijuana, tobacco smoke, and alcohol. In 2000, for example, L. Goldschmidt and colleagues reported the results of a ten-year study that monitored the development of children of more than 600 low-income women. The study, which began during the women's pregnancies, found that prenatal marijuana use was significantly related to increased hyperactivity, impulsivity, inattention, increased delinquency, and externalizing problems;[71] the findings remained significant even when researchers controlled for other lifestyle features.

In 1998, **David Fergusson** and colleagues, in a study of 1,022 New Zealand children who had been followed for 18 years, found that "children whose mothers smoked one pack of cigarettes or more per day during their pregnancy had mean rates of conduct disorder symptoms that were twice as high as those found among children born to mothers who did not smoke during their pregnancy."[72] The observed relationship was twice as strong among male teens as among females. Similar relationships between prenatal smoking and both aggression and hyperactivity in later life have been reported by Dutch researchers.[73] A similar 2006 meta-analysis by researchers at Washington State University found that smoking by pregnant mothers contributed slightly to their children's subsequent antisocial behavior.[74]

Prenatal alcohol exposure also seems to be linked to delinquency and psychiatric problems later in life. A 1999 study of 32 children by Tresa M. Roebuck and colleagues found that