Pollution causes people to commit violent crimes --homicide, aggravated assault, sexual assault and robbery --according to new research by Roger D. Masters and co-workers at Dartmouth College.[1] Sociologists have known for a long time that violent crimes occur more in some places than in others. Some U.S. counties have only 100 violent crimes per 100,000 people per year; other counties have rates of violent crime that are 30 times as high. The question is why some places have high crime rates and others don't. Masters says pollution is part of the answer.

Masters has developed what he calls the neurotoxicity hypothesis of violent crime. According to this hypothesis, 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 factors to produce individuals who commit violent crimes.

Masters argues that, to be taken seriously, such a hypothesis must pass five tests. He then demonstrates how the neurotoxicity hypothesis meets all five, as follows:

1) It must be shown that individuals who engage in criminal behavior are more likely to have absorbed toxic chemicals than a comparable control population. Masters cites studies showing that low-level poisoning by lead, and by manganese, is associated with learning disabilities and attention deficit disorder, which are themselves associated with deviant behavior. (We reviewed some of this evidence for lead in REHW #529.) Masters cites seven other studies showing that violent prisoners have significantly elevated levels of lead, manganese, cadmium, mercury or other toxic metals, compared to prisoners who are not violent.

2) If it is valid, the neurotoxicity hypothesis must be able to predict future violent behavior of young people exposed to toxins. Masters cites two prospective studies (and suggests we need more) showing that lead uptake at age 7 is associated with juvenile delinquency and/or increased aggression in teenage and early adult years. (See also REHW #529.) The largest study, of 1000 black children in Philadelphia, showed that both lead levels, and anemia, were predictors of the number of juvenile offenses, the seriousness of juvenile offenses, and the number of adult offenses, for males.

3) Is there a biological basis for believing that lead, manganese and other toxic metals could cause a person to lose control over impulsive and aggressive behavior? Here Masters cites a wealth of studies showing how lead and manganese cause changes in the development of the brain, and in the functioning of neurotransmitters in the brain.

Different pollutants harm the brain differently. Lead in the brain damages glia, a kind of cell associated with inhibition and detoxification. Manganese has the effect of lowering levels of serotonin and dopamine, which are neurotransmitters associated with impulse control and planning. Masters notes that low levels of serotonin in the brain are known to cause mood disturbances, poor impulse control, and increases in aggressive behavior --effects that are increasingly treated with Prozac.

Masters emphasizes that children who are raised from birth on infant formula and who are not breast fed will absorb five times as much manganese as breast-fed infants. Calcium deficiency increases the absorption of manganese. A combination of manganese toxicity and calcium deficiency adds up to "reverse Prozac," Masters says.

Masters says toxic metals affect individuals in complex ways. For example, because lead diminishes a person's normal ability to detoxify poisons, lead may heighten the effects of alcohol and drugs.

4) For the neurotoxicity hypothesis to hold up, individuals must receive doses of toxic metals sufficient to be associated with violent behavior. Masters argues that, despite recent significant decreases in lead in the environment (because leaded gasoline and lead paint have been banned in the U.S.), in neighborhoods where automobile traffic has historically been high, and in towns where industries have released large quantities of toxic metals for years, many local soils still contain toxic quantities of lead, cadmium, and manganese sufficient to poison children who play in the dirt. He also argues that aging water delivery systems very likely contribute lead and manganese because lead pipes and even iron pipes contain these toxins.

Masters argues that (a) children absorb up to 50% of the lead they ingest (compared to 8% for adults); (b) even low exposures in the womb and in early childhood can have permanent effects on intelligence and behavior; (c) current lead levels are known to have direct effects on neurotransmitters that are known to affect cognition and to influence impulse control; and (d) the highest levels of lead uptake are reported in precisely the demographic groups most likely to commit violent crimes (inner city minority youths).

Masters emphasizes the importance of studies showing a synergistic effect (multiplier effect) between toxic metals and poor diet. For example, it has been thoroughly documented that uptake of lead is greatly increased among individuals who have a diet low in calcium, zinc, and essential vitamins. Similarly, as noted above, calcium deficiency greatly increases manganese absorption. Thus, Masters argues, amounts of lead and manganese that wouldn't harm a well-nourished individual may poison undernourished children.

Masters cites federal studies of nutrition to make the point that black teenage males consume, on average, only about 65% as much calcium as whites. The calcium needs of pregnant or breast-feeding women are higher than average, which creates a particular problem for minority women. And non-Hispanic black women get only 467 milligrams of calcium per day (mg/d), compared to 642 mg/d for white women, government studies show.

Because of increased manganese absorption by babies who drink infant formula and who are not breast fed, Masters considers infant formula toxic. He emphasizes that poor mothers tend not to breast-feed their babies. By 1986-87, 73 percent of infants born to mothers with more than 12 years of education were breastfed compared with 49 percent of infants born to mothers with 12 years of education, and 31 percent of mothers with less than 12 years of education. Furthermore, white infants are more than three times as likely to be breast fed as black infants. "The effects of manganese toxicity associated with infant formula are thus greatest for the poor, for ethnic minorities, and for those with little education," Masters says.

Masters cites studies showing that alcohol increases the uptake of toxic metals, at least in laboratory animals, and probably has a similar effect on humans.

5) If the neurotoxicity hypothesis is valid, then measures of environmental pollution should correlate with higher rates of violent crime.

To test his hypothesis, Masters acquired data from the FBI for violent crimes in all counties of the U.S. He correlated this with data on industrial releases of lead and manganese into the environment of each county, using data from the U.S. Environmental Protection Agency's TRI [toxic release inventory] database. He also examined other variables for each county --population size, population density, housing built before 1950, number of police officers per person, number of school dropouts and high school dropouts, educational achievement, unemployment rate, race and ethnicity [white, black, hispanic], persons below the poverty level, number of people on welfare, infant deaths per 1000 live births, all alcohol-related causes of death, and all causes of
Masters split all U.S. counties into six groups -- those with and without industrial lead releases; those with and without industrial manganese releases; and those with higher-than-average or lower-than-average rates of alcohol-related deaths. After controlling for all the conventional measures of social deterioration (poverty, school dropouts, etc.), Masters found that counties having all three measures of neurotoxicity -- lead, manganese, and high alcohol -- have rates of violent crime three times the national average.

In other words, environmental pollution and alcohol have a strong effect on violent crimes, completely independent of any of the "traditional" predictors of violent crime (poverty, poor education, etc.).

As Masters says, neurotoxicity is only one of many factors contributing to violence, but he believes it may be especially important in explaining why violent crime rates differ so widely between geographic areas and by ethnic group. Masters says that traditional sociological approaches to crime cannot explain why the availability of handguns or drugs triggers violent behavior in only a small proportion of the population, a proportion that varies greatly from place to place. Part of the explanation may be the way the physical environment affects brain chemistry and behavior, Masters says.

"The presence of pollution is as big a factor as poverty," Masters said recently in an interview in NEW SCIENTIST magazine. "It's the breakdown of the inhibition mechanism that's the key to violent behavior," he says. When our brain chemistry is altered by exposure to toxins, we lose the natural restraint that holds our violent tendencies in check, Masters believes.

Former U.S. Surgeon General C. Everett Koop has said, "Regarding violence in our society as purely a sociologic matter, or one of law enforcement, has led to an unmitigated failure. It is time to test further whether violence can be amenable to medical/public health interventions." [3]

For decades, researchers have focused on the human health consequences of toxic metals -- mainly asking, do they cause cancer? This new research seems to be telling us that we should also be looking at the way these pollutants are affecting human BEHAVIOR.

--Peter Montague (National Writers Union, UAW Local 1981/AFL-CIO)


The particular crimes are defined as follows:

Muder and nonnegligent manslaughter: the willful (nonnegligent) killing of one human being by another.

Forcible rape: carnal knowledge of a female forcibly and against her will. Assaults or attempts to commit rape by force are also included; however, statutory rape (without force) and other sex offenses are excluded.

Robbery: taking or attempting to take anything of value from the care, custody, or control of a person or persons by force or by threat of force or violence and/or by putting the victim in fear.

Aggravated assault: unlawful attack by one person upon another for the purpose of inflicting severe or aggravated bodily injury.


Descriptor terms: crime; lead; manganese; homicide; aggravated assault; sexual assault; robbery; toxic heavy metals; human behavior; roger d. masters; dartmouth college; cadmium; mercury; violence; aggression; glia; serotonin; dopamine; prozac; infant formula; breast feeding; nutrition; calcium deficiency; poverty.