

Pollution



Chemical pollution is not a new phenomenon. Virtually all the industrial processes ever developed by humans have the capacity to contaminate the environment. However, since the industrial revolution the rate of pollution by industries from mining to agriculture has grown exponentially. The first environmental protection laws passed in the UK were the Alkali Acts of the late 19th Century, passed in order to restrict hazardous emissions from the chloralkali industries. In the last century the invention and rapid adoption of motorised transport created a new source of pollution in the air. In the 1950s it became increasingly apparent that smoke from coal burned at home, combined with the output from factories, was having a dramatic effect on the health of city-dwellers in the UK. At least 3500 people died in one notorious 1952 London smog. The passing of the Clean Air Acts (1956, 1968) in the UK marked a turning point in societal and governmental concern about pollution in the UK. This section discusses the psychological and health effects of some of the pollutants at the forefront of current concerns.

Common Pollutants

Air pollution in urban environments comes from a variety of sources including manufacturing industry, power stations and road traffic. Table 1 summarises the major sources and effects of some common air pollutants.

Whilst each of these pollutants can exert an individual effect on health, under certain conditions some of them can combine to produce **photochemical smog**. This is formed largely by the interaction of hydrocarbons, oxidants such as ozone and nitrogen dioxide in the presence of sunlight. Photochemical

smog forms when sunlight causes nitrogen dioxide decompose and produce oxygen atoms. These atoms then react with atmospheric oxygen to produce ozone, a highly oxidising molecule. Ozone and other photochemical oxidants attack the hydrocarbons to produce a large number of toxic and irritating compounds. The principle compounds are peroxyacetyl nitrate (PAN), methanal, propenal and acrolein. PAN is a particularly damaging compound known to cause eye irritation and breathing difficulties in humans and damage to vegetation, even at very low concentrations (Ramsden, 1994).

Pollutant	Major Sources	Direct Health Effects
Nitrogen oxides	Vehicle emissions	Irritates the lungs, exacerbates respiratory illnesses. Contributes to photochemical smog.
Sulphur dioxide	Industrial processes, coal burning in homes and power stations	As above. Increases the severity of asthmatic attacks.
Unburnt hydrocarbons	Vehicle emissions, incineration of refuse	As above. Carcinogenic.
Ozone	Results from interaction between nitrogen oxides and hydrocarbons from other sources	As above. Also contributes to photochemical smog.
Particulates	Industrial processes, vehicle emissions (particularly diesel engines)	Inflammation of lungs. Can exacerbate lung and heart conditions.
Carbon monoxide	Vehicle emissions, cigarette smoke. In the home, may come from poorly maintained gas appliances.	Reduces oxygen transport in blood. Particularly dangerous for those with heart conditions.

Of course, air pollution is only one possible source of pollutants in the environment. Psychological and health effects may come from a variety of other sources including water (e.g. pollution by heavy metals) the ground (e.g. radon gas from underground sources) and vegetation (e.g. residual pollution from insecticides on produce).

Effects of Pollution

When looking at the effects of pollution, research has tended to concentrate on its detrimental effects on physical health. However, an increasing amount of research has been conducted over the past 30 years or so into the effects that various pollutants may have on psychological functioning, particularly on children.

Pollution and Performance

Carbon monoxide from car exhausts, faulty gas appliances and cigarette smoke, has a measurable effect on performance. Short-term exposure leads to decreased ability to perform cognitive tasks such as mental arithmetic. However, once exposure is discontinued, recovery takes place and cognitive functioning returns to previous levels (Maynard and Waller, 1999). Longer term exposure to carbon monoxide seems to be associated with symptoms of headache and general lack of well being.

Generally, such symptoms cease once exposure stops although some researchers have recently suggested that some individuals may not recover fully following chronic exposure (Penney, 2000).

A great number of other pollutants are now known to adversely affect psychological functioning in children. For example, Raab et al (1990) showed that exposure to high levels of lead had a detrimental effect on children's general cognitive functioning. As a result, since much of the airborne lead in a child's environment came from car exhausts, lead was finally removed from most commercially available petrol in the UK in 2000. Similarly, Potasova (1992) reports a study comparing children from polluted

and non-polluted environments. Those from polluted environments showed a general deficit in cognitive performance including impaired working memory, shorter attention span and impaired sensorimotor skills. Williams (2000), in a large scale review of studies of the effects of pollution on psychological functioning, points out that the effects of environmental pollution can be cumulative and often interact with other problems. For example, children who, because of poor diet, have an iron deficiency are likely to take up greater volumes of lead. This, in turn, leads to a greater chance that their cognitive functioning will be impaired.

Pollution and Social Behaviour

In general, air pollution appears to act as a low level stressor. As such it may be linked to an increase in irritability that could affect the ways in which people interact with each other. For example, Rotton and Frey (1985) found that high ozone levels were associated with an increase in reports of household disturbances and Cunningham (1979) linked high levels of air pollution with a reduction in helping behaviours. Visual air quality appears to be important, too. High levels of atmospheric pollutants can lead to atmospheric haze that affects the clarity with which we view the environment (Corfidi, 1996). Studies have found that a reduction in visual air quality leads to increases in anxiety and depression (Zeidner and Shechter, 1988) and to higher levels of interpersonal aggression (Jones and Bogat, 1978).

Metal Pollution and Antisocial Behaviour

A body of research links increased antisocial behaviour with pollution by heavy metals such as lead and mercury. Lead has been linked in some studies with increase probability of delinquent behaviour in children. In the US, Needleman (1996) surveyed lead levels in the bones of 300 school children and found that higher lead levels were associated with increased antisocial tendencies as demonstrated by behaviours such as bullying, truanting

and vandalism. A further study compared lead levels in 216 convicted young offenders with those in a control group of 201 high school students. It was found that lead levels were significantly higher in the offenders (Needleman, 2000). Lead levels in the environment have dropped significantly since the introduction of lead-free and lead-replacement petrol. However, Needleman stresses that a variety of harmful lead sources remain in many children's environments, including old paintwork and old plumbing. Additionally, lead is not the only problematic contaminant. Some studies have linked increased levels of mercury, arsenic, cadmium and aluminium to behavioural disturbances in children (Marlowe et al, 1985) and others have suggested that high levels of manganese may play a role in violent criminal activity. For example, Casdorph (1995) reports three studies that found that hair samples from violent offenders in the US were likely to contain significantly higher levels of manganese than samples from non-violent offenders.

One important thing to consider, when assessing the impact of pollution on psychological functioning, is that pollution co-occurs with a variety of other factors known to affect behaviour. For example, pollution levels are likely to be higher on hot days when there is little or no wind. Since heat is known to facilitate aggression and inhibit helping (see above) this might account for the apparent relationship between air pollution and antisocial behaviour. Similarly, higher levels of industrial pollution generally occur in poorer areas. Because social deprivation is known to be associated with increased psychological symptoms (e.g. depression and anxiety) and with juvenile delinquency (Putwain and Sammons, 2002) it may be that poverty accounts for (or contributes to) the observed effect of lead pollution on behaviour.