



CHEM*Trust*

Protecting humans and wildlife
from harmful chemicals

No Brainer

The impact of chemicals on children's brain development:
a cause for concern and a need for action





This briefing was produced by CHEM Trust, a UK-based charity working at UK, EU and International level to protect humans and wildlife from harmful chemicals.

CHEM Trust's particular concerns are related to hormone disruptors, the cocktail effect of chemicals and the role of chemical exposures in the early life of wildlife and humans.

CHEM Trust engages with scientific, environmental, medical and policy communities to improve the dialogue concerning the role of adverse effects of chemicals in wildlife and humans and to harness a wide coalition to drive improved chemicals policy and regulation.

For more about our work, including our regularly-updated blog, see www.chemtrust.org.uk

Further copies of this briefing can be downloaded from www.chemtrust.org.uk/brain

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About the Authors

The main review of the state of science was drafted by an experienced chemicals policy consultant, Dr Maricel V Maffini, and it was then peer reviewed by two of the most eminent scientists in this area, Prof Barbara Demeneix (Laboratory of Evolution of Endocrine Regulations, CNRS, Paris) and Prof Philippe Grandjean (Department of Environmental Medicine, University of Southern Denmark, Denmark & Department of Environmental Health, Harvard T.H. Chan School of Public Health, Boston, USA), who also provide answers in the Q&A section. The policy recommendations and advice for individuals are written by Dr Michael Warhurst and Dr Ninja Reineke of CHEM Trust, informed by the state of the science, the views of the scientists and our own experience of following chemicals policy development for more than two decades.

Dr Maffini, is an independent consultant based in Maryland, US. She has more than 20 years of research experience in the fields of carcinogenesis, reproductive biology and endocrine disruption. She has authored numerous peer-reviewed journal articles, including one in 2014 on *Brain drain: the cost of neglected responsibilities in evaluating cumulative effects of environmental chemicals*, as well as reviews and book chapters. Her current work focuses on environmental health issues related to chemical safety with special emphasis on chemicals in food, risk assessment and science policy. Her most recent position was as Senior Scientist with the US Natural Resources Defense Council; prior to NRDC she was a Research Assistant Professor at Tuft University School of Medicine.

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2 Executive summary

Science has shown that many thousands of people have been exposed to now mostly banned chemicals such as lead and PCBs at high enough levels to have had their brain development negatively affected. This report finds that there are other chemicals which are still in routine use in our homes where there is evidence of similar developmental neurotoxic (DNT) properties, and also identifies huge gaps in our knowledge of the impacts of other chemicals on brain development. It also points out the unpleasant reality that we are constantly exposed to a cocktail of chemicals, something which is still largely ignored by chemical safety laws.

In spite of the lessons of the past, regulators are continuing to only regulate after harm is caused, instead of acting to effectively protect the most precious of things; children's developing brains.

“Reported exposures to several neurotoxicants in the EU commonly exceed the levels that are associated with adverse effects on brain development.” Philippe Grandjean

In June 2007 CHEM Trust wrote the briefing *Chemicals Compromising Our Children*, which highlighted growing concerns about the impacts of chemicals on brain development in children. Almost 10 years later, CHEM Trust has revisited the issue with this report, which includes contributions from two of the most eminent scientists in this area, Professor Barbara Demeneix (Laboratory of Evolution of Endocrine Regulations, CNRS, Paris)

and Professor Philippe Grandjean (Department of Environmental Medicine, University of Southern Denmark, Denmark & Department of Environmental Health, Harvard T.H. Chan School of Public Health, Boston, USA), who also peer reviewed the report.

Our brain and its development

Our brains are astoundingly complex, made up of over 85 billion neurons, which have grown, developed and interconnected during our lives. The brain is the organ that takes the longest to develop, with initial stages of cell division, creation of neurons and their migration taking place from the first hours after fertilisation and throughout the foetus' time in the womb. However, brain development does not stop at birth – it's not until our twenties that neurons are fully developed with their myelin coats.

Throughout this complex developmental process a range of signalling chemicals and other processes operate in order to control what happens. The thyroid hormone system is intimately involved in brain development and function, yet it is well established that this system can be disrupted – for example by a lack of iodine (essential to make thyroid hormone) or by certain chemicals. If developmental processes are disrupted, this most often creates permanent problems.

“The report commissioned by CHEM Trust on developmental exposure to neurotoxic chemicals and correlated brain consequences is an excellent coverage of the literature.”
Barbara Demeneix

The complexity of brain development and function means that deficits can be very subtle – small reductions in IQ, disabilities that exist with a broad spectrum of seriousness such as autism, or in some cases conditions which do not have fully agreed diagnostic criteria.

Disruption of brain development by chemicals

We are all exposed to hundreds of man-made chemicals in our daily life, coming from everyday products including food, furniture, packaging and clothes. Many of these chemicals will have no negative effects on us, but it is now well established that some are able to disrupt normal development of the brain. Chemicals with long established DNT properties such as lead, PCBs and methylmercury, have been joined by others where DNT effects have been identified more recently, and which are being used in everyday products. There are also rising concerns about chemicals that are very similar to chemicals that have had their use restricted, but which we continue to use as there isn't sufficient information about their toxic effects. We know even less about thousands of other chemicals in routine use, which have had no testing for DNT properties.

Chemical exposures are so ubiquitous that experts have recognized that babies are born "pre-polluted". Scientific paediatric and gynaecology & obstetrics societies have consistently warned about chronic health implications from both acute and chronic exposure to chemicals such as pesticides and endocrine disruptors.

The report identifies evidence of DNT properties for the following chemicals:

- **Bisphenol A (BPA)**; a chemical that was used to make baby bottles, is currently being phased out of till receipts (in the EU), but is still used in the making of food can linings and many polycarbonate plastics. There are also concerns about closely related chemicals that are not restricted, including Bisphenol S.
- **Brominated Flame Retardants (BFRs)**; a group of chemicals added to furniture, electronics and building materials. The evidence for neurodevelopmental effects is strongest for the PBDE (polybrominated diphenyl ether) group of BFRs, which are already banned or nearly banned in the EU, though they are still in furniture in our homes, and in dust. However, other BFRs are now being found in dust and human blood serum, with concerns that these BFRs might have similar effects.
- **Phthalates**; a group of chemicals used as plasticisers in PVC and in other products. Some chemicals in this group are now banned in the EU, but many others are still in use.
- **Per- and poly-fluorocarbons (PFCs)**; used as non-stick coatings or breathable coatings, are a large group of chemicals, a few of which are in the process of being restricted by the EU. There is evidence that some PFCs can disrupt the action of the thyroid hormone. PFCs are very persistent in the environment, and many of them can accumulate in our bodies – they are routinely found in blood.
- **Perchlorate**; a contaminant of food, related to the use of certain fertilisers and hypochlorite bleach, and is known to disrupt the thyroid hormone system.

“A variety of chemical agents can interfere with early brain development, and such chemical brain drain is most likely irreversible.” Philippe Grandjean

“Chemical exposure is now at unprecedented levels, is multiple, ubiquitous, and present from conception onwards.” Barbara Demeneix

Are we protected?

The EU has the most sophisticated regulations in the world for controlling chemical use. However, there are a number of key flaws in this system:

“From human poisoning cases, we know of at least 200 chemicals that can enter the human brain and cause damage to the nerve cells...I would think that virtually all of them can also harm the development of the human brain, most probably at much lower levels than those that cause adverse effects in adults. About half of these chemicals are commonly used... and therefore present a high potential for exposures.”
Philippe Grandjean

- There is often inadequate safety information about individual chemicals, including a lack of information about neurodevelopmental effects.
- The processes to ban chemicals are too slow, and the restrictions created often have big loopholes as a result of industry lobbying.
- Chemicals are addressed one at a time, so one chemical may have its use restricted, but closely related chemicals remain in use.
- We are always exposed to multiple chemicals, but regulations almost always assume we are only exposed to one at a time, even though numerous scientists have shown that chemical effects can add together in our bodies.

Policy recommendations

It is clear that our children are not currently being protected from chemicals that can disrupt brain development. We have identified a range of policy measures that could improve the situation, including:

- **Acting faster to ban chemicals of concern**, including addressing groups of similar substances, not just those where we have the most information.
- **Ensuring that any safety testing of chemicals** includes evaluation of DNT effects.
- **Ensuring better identification and regulation of neurodevelopmental toxic chemicals.**
- **Ensuring that all uses of chemicals are properly regulated**; for example there is a lack of effective regulation of chemicals in food packaging including paper, card, inks, glues and coatings.
- **The UK and Ireland should remove the requirement for an open flame test for furniture.** This test is not required in the rest of the EU, and leads to increased use of flame retardant chemicals.

Finally, it is important to note that EU regulations have already controlled a number of chemicals of concern, and that EU laws provide a tool to address these problems. We therefore think it is vital for the UK Government to work to stay aligned with EU chemicals laws, whatever the eventual outcome of the UK's Brexit process.

“The current generation has the responsibility to safeguard the brains of the future.” Philippe Grandjean

Though full protection will only come from proper regulation of chemicals, the report also includes a chapter with tips for reducing your and your family's exposures in daily life.

Chemical threat to brain development

BPA

Till receipts and tin cans



Phthalates/ BFRs

Household dust



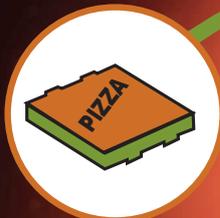
BFRs

Car upholstery, sofas, screens



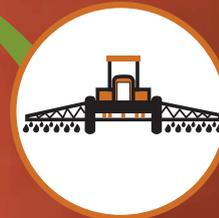
BPA/PFCs

Food containers like Pizza boxes



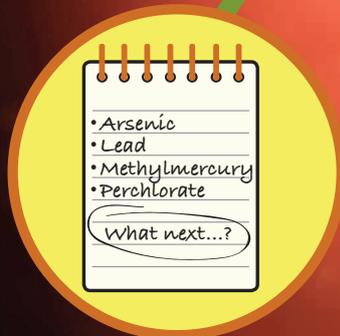
Pesticides

Agricultural pesticide sprays



PFCs

Waterproof clothing



For details: www.chemtrust.org.uk/brain