

Developmental origin of environmental diseases



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Children as monitors and targets of environmental health: Developmental programming

*Has the fetus become the
unfortunate miners' canary
for human exposure to
toxicants in the
environment?*

Barry L. Johnson (1997)



Healthy Environments for Children

The children of today
are the adults of tomorrow.
They deserve to inherit a
safer, fairer and healthier world.

There is no task more important
than safeguarding their environment.

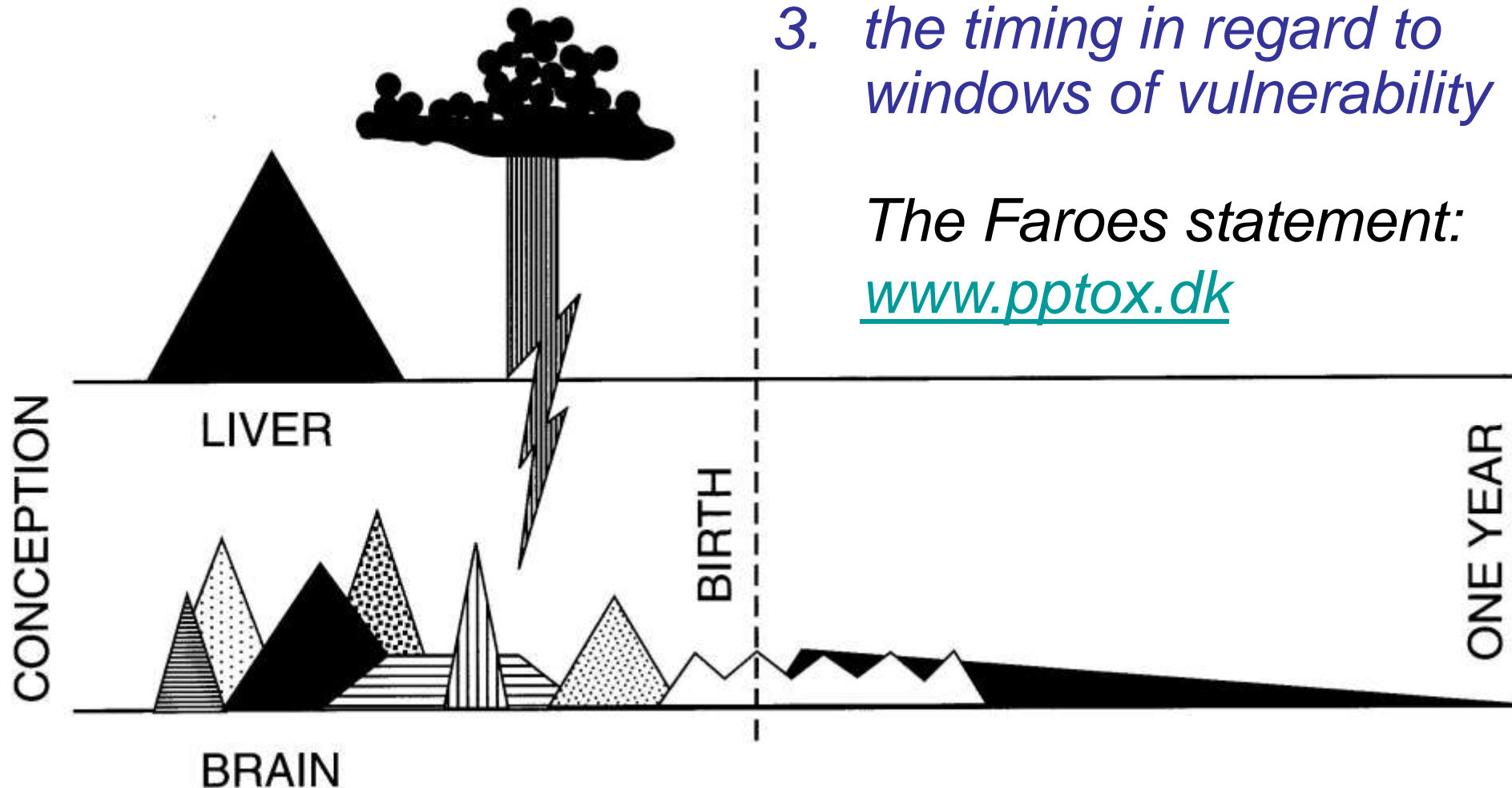
Our children can grow up to realize
both their human rights and
their full potential for
health and productivity.



Toxic effects are determined by:

1. the toxicant properties
2. the dose
3. *the timing in regard to windows of vulnerability*

The Faroes statement:
www.pptox.dk



CHECK YOUR BALLS
FOR IRREGULAR LUMPS

KEEP YOUR EYE ON THE BALL

Testicular cancer is the most common cancer to affect young men aged 15-45 years old. If caught early it is 99% curable.

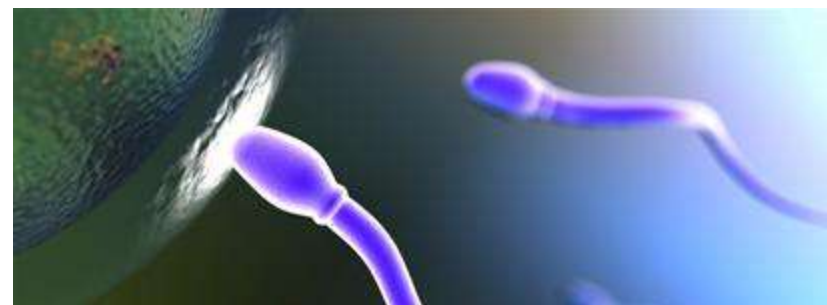
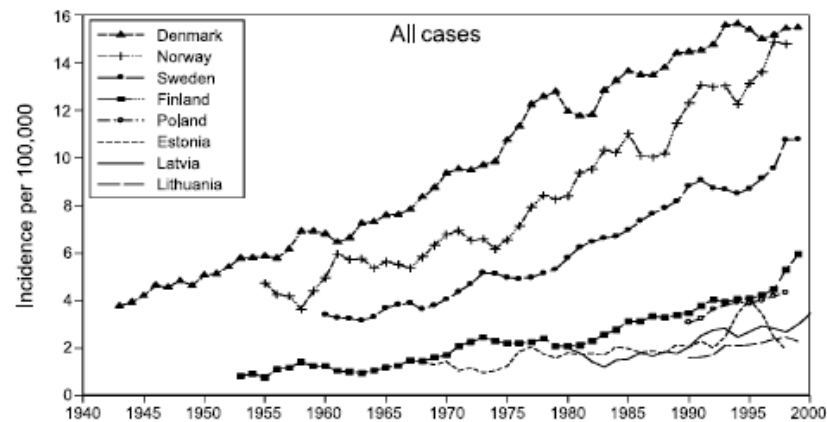
CHECK YOURSELF REGULARLY

For more information call 0800 731 9468 or visit: www.keepyoureyeontheball.org.uk

A campaign run by:



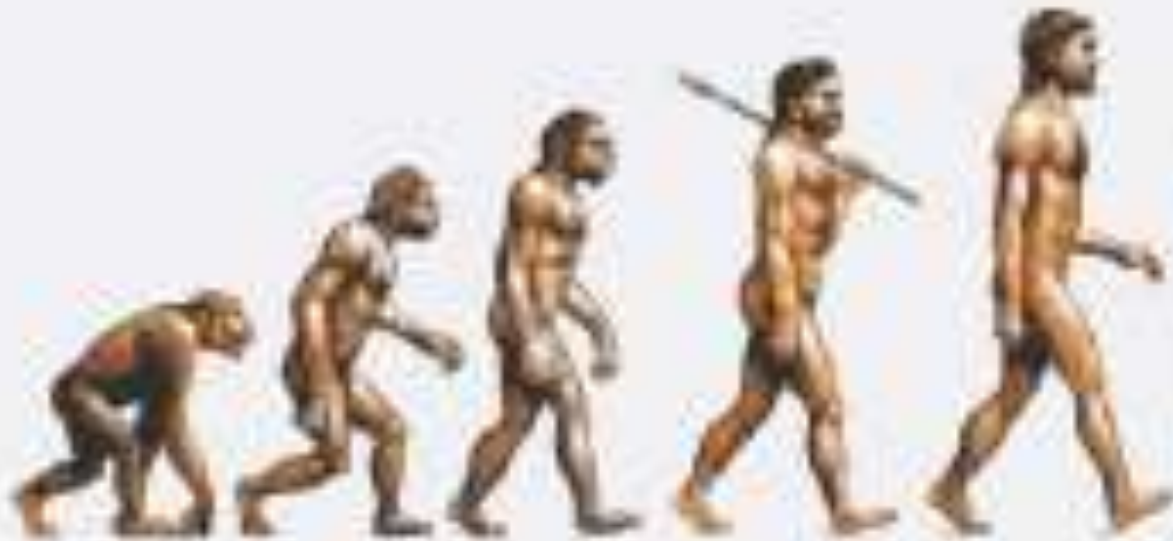
Early stages of testicular cancer have been demonstrated in fetal tissue – and this cancer in young adults keeps increasing in frequency



Decreased sperm quality may be a partial cause of low fertility in Europe

Evolution of human civilisation:

Obesity and diabetes are becoming more frequent, but the focus has been on diet and exercise



The mouse on the right was exposed in the womb to 1 ppb diethylstilbestrol (an experimental oestrogen).



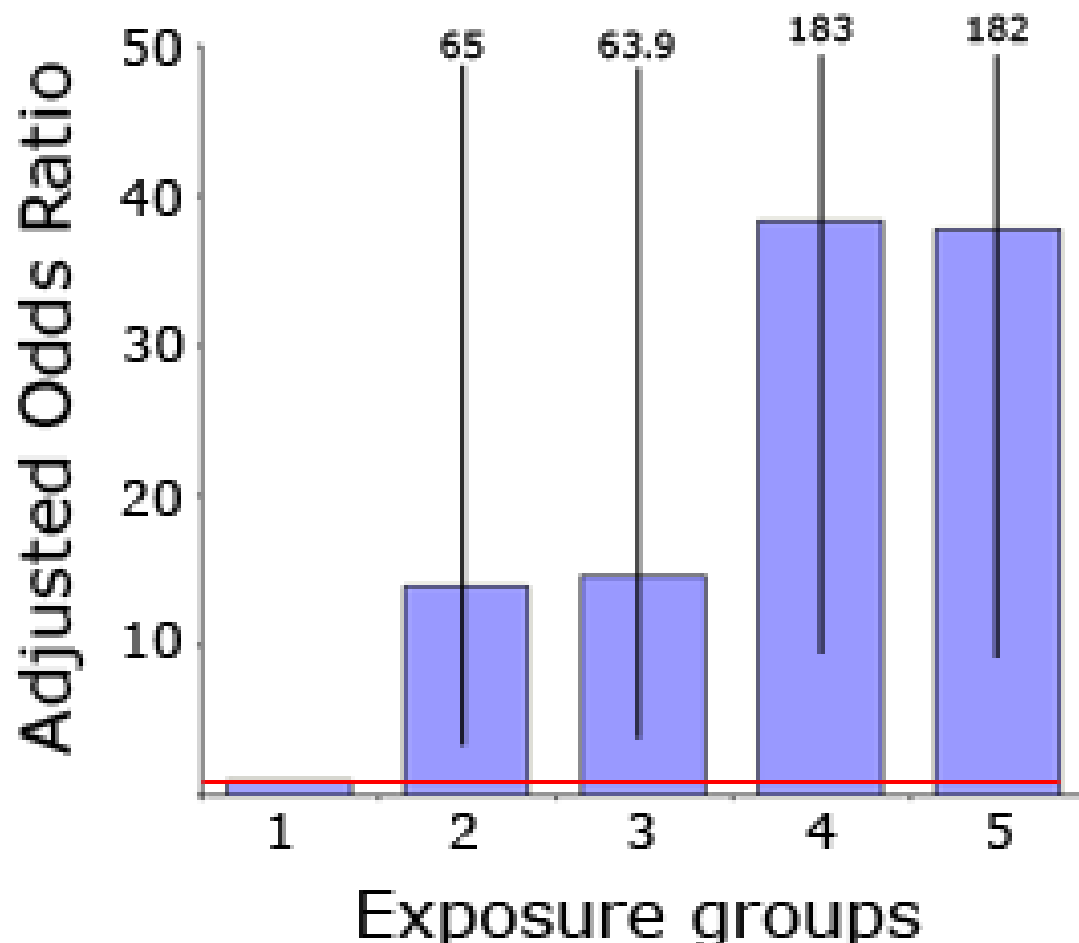
Photo: Retha Newbold, NIEHS

Polycarbonate bottles for infant beverages leach bisphenol A – a documented oestrogen



Diabetes – possible link to environmental chemicals

In a study of >2000 subjects of the US general population, of whom 217 had type 2 diabetes, people in the highest POP exposure group were almost 38 times more likely to have diabetes.



Children exposed to air pollution had deficient development of lung function

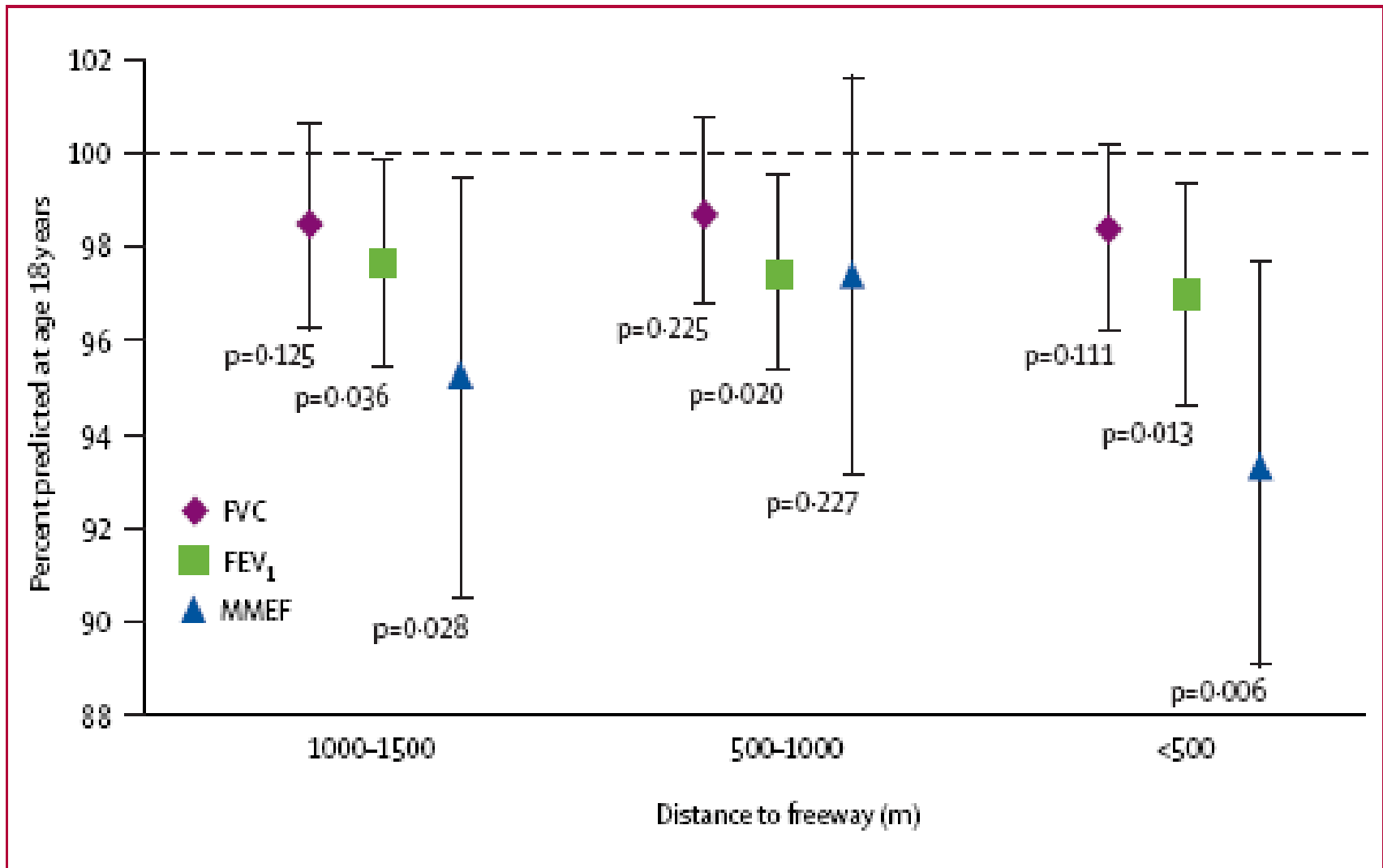
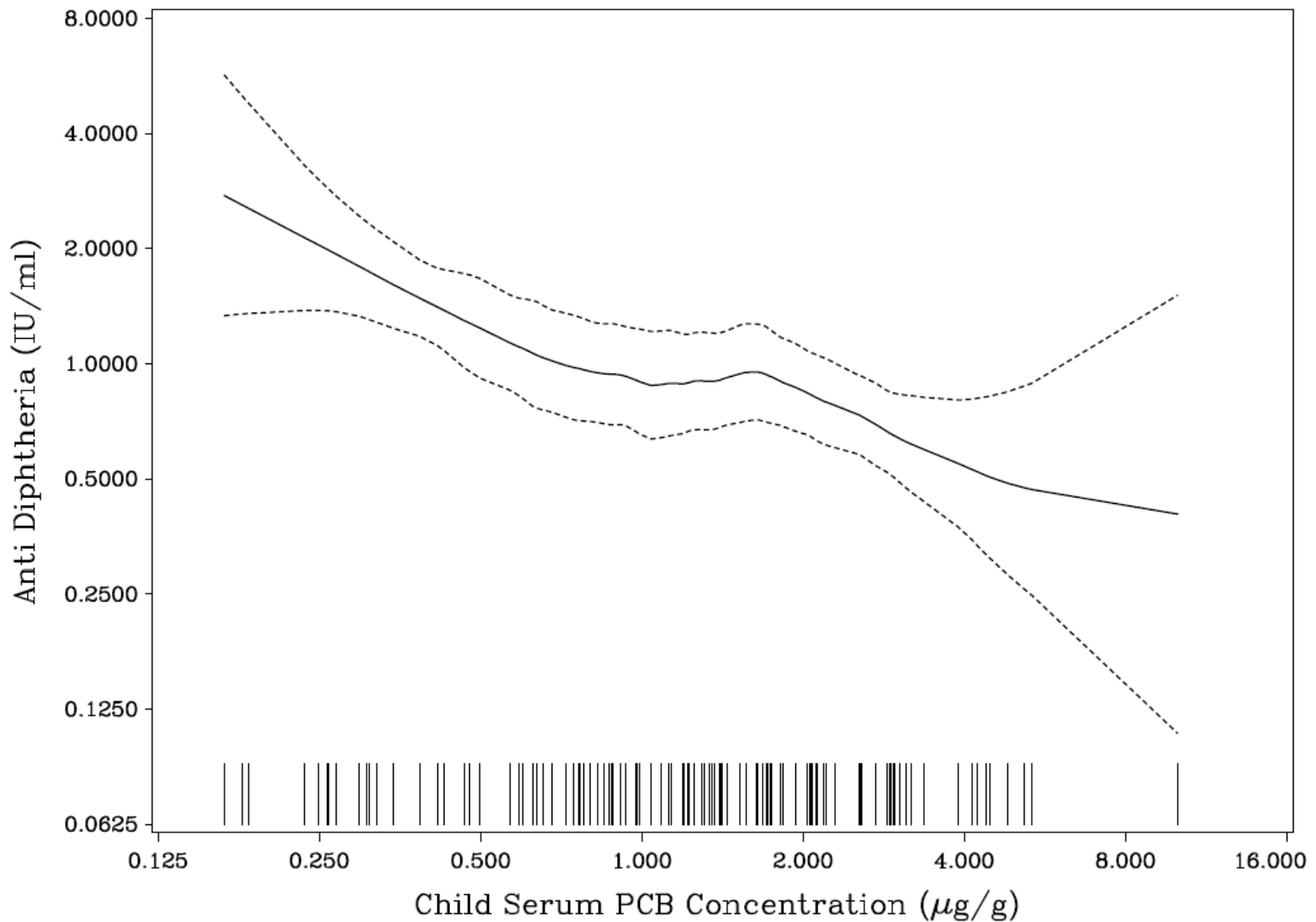


Figure: Percent-predicted lung function at age 18 years versus residential distance from a freeway
The horizontal line at 100% corresponds to the referent group, children living >1500 m from a freeway.

(Gauderman et al., 2007)

The more an infant is exposed to PCB, the less efficient the response to routine childhood immunisations (here the diphtheria antibody response at 18 months)



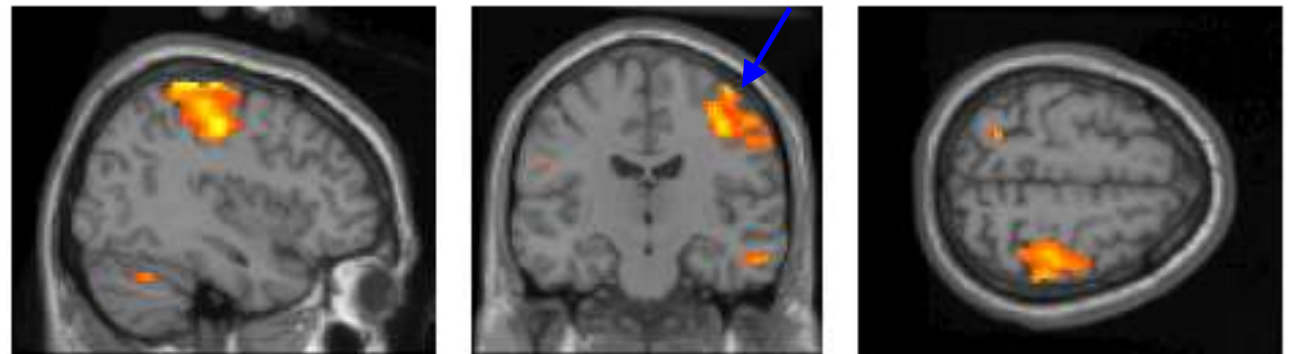
Modern imaging methods show that children with high prenatal pollutant exposure must activate brain regions not needed by controls

Finger tapping with the left hand activates motor cortex on right AND left

Increased prenatal exposure to MeHg + PCB (N = 3)

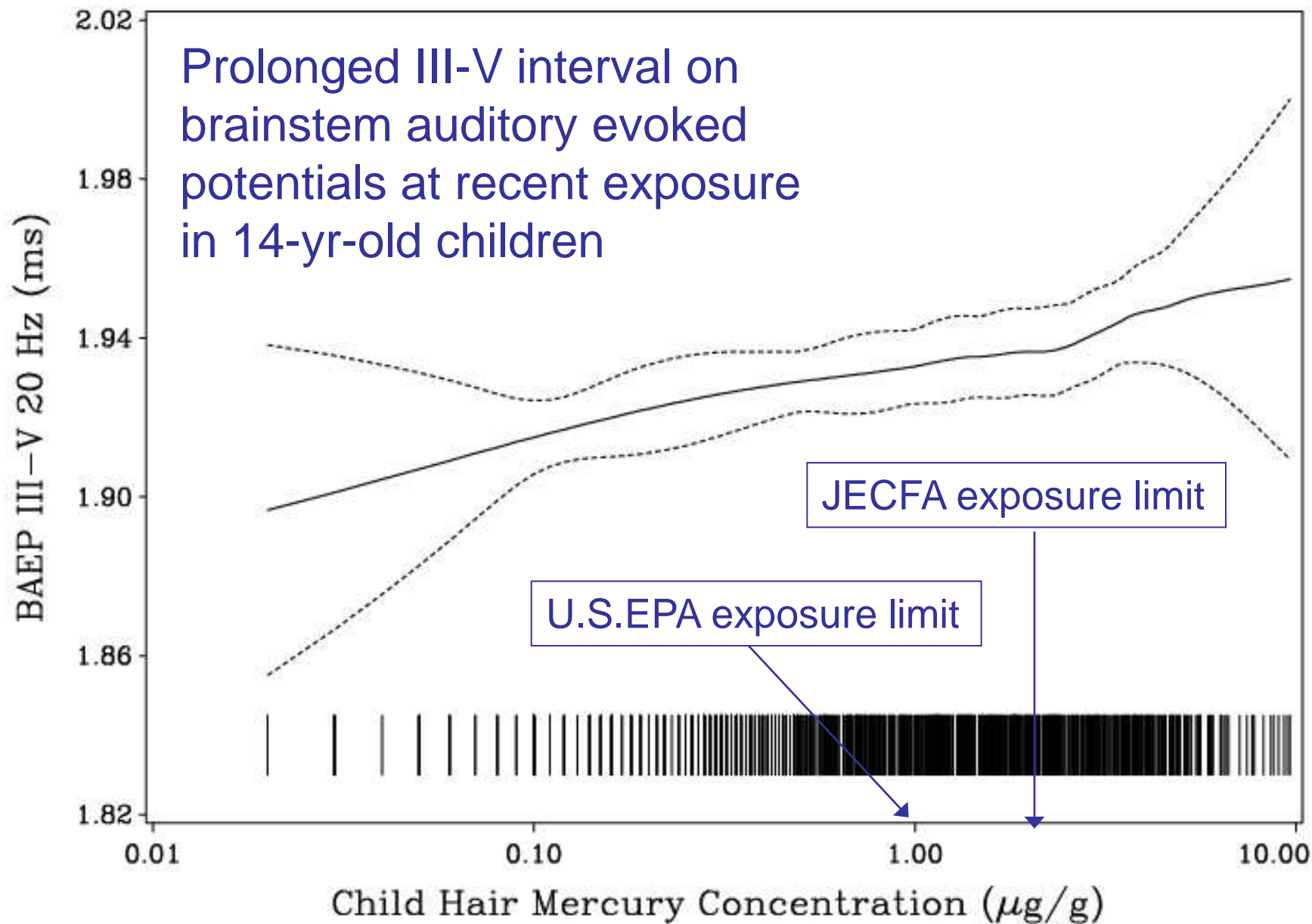
In non-exposed controls, only the right motor cortex is activated

Controls (N = 3)

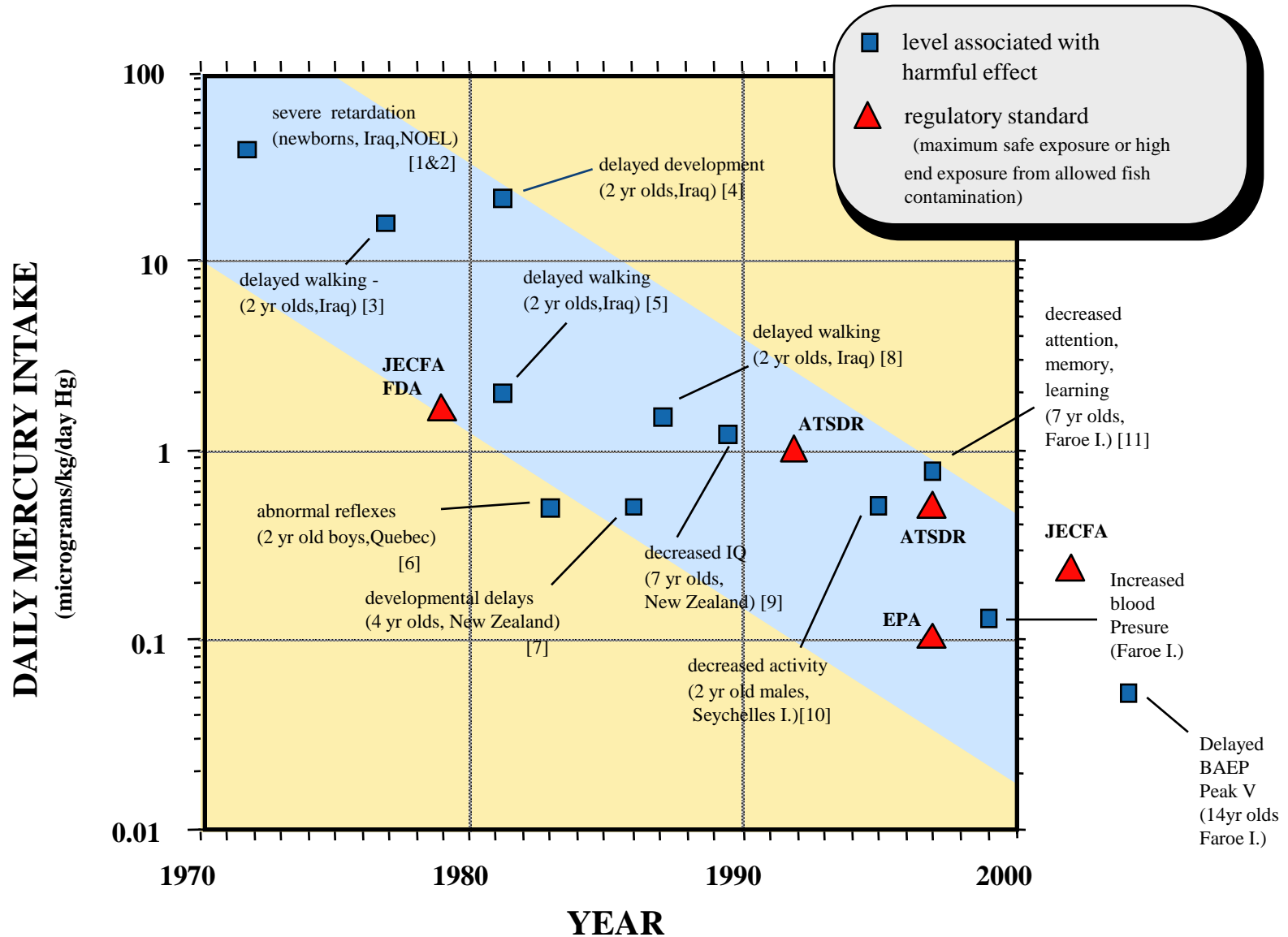


(R.F.White et al., submitted)

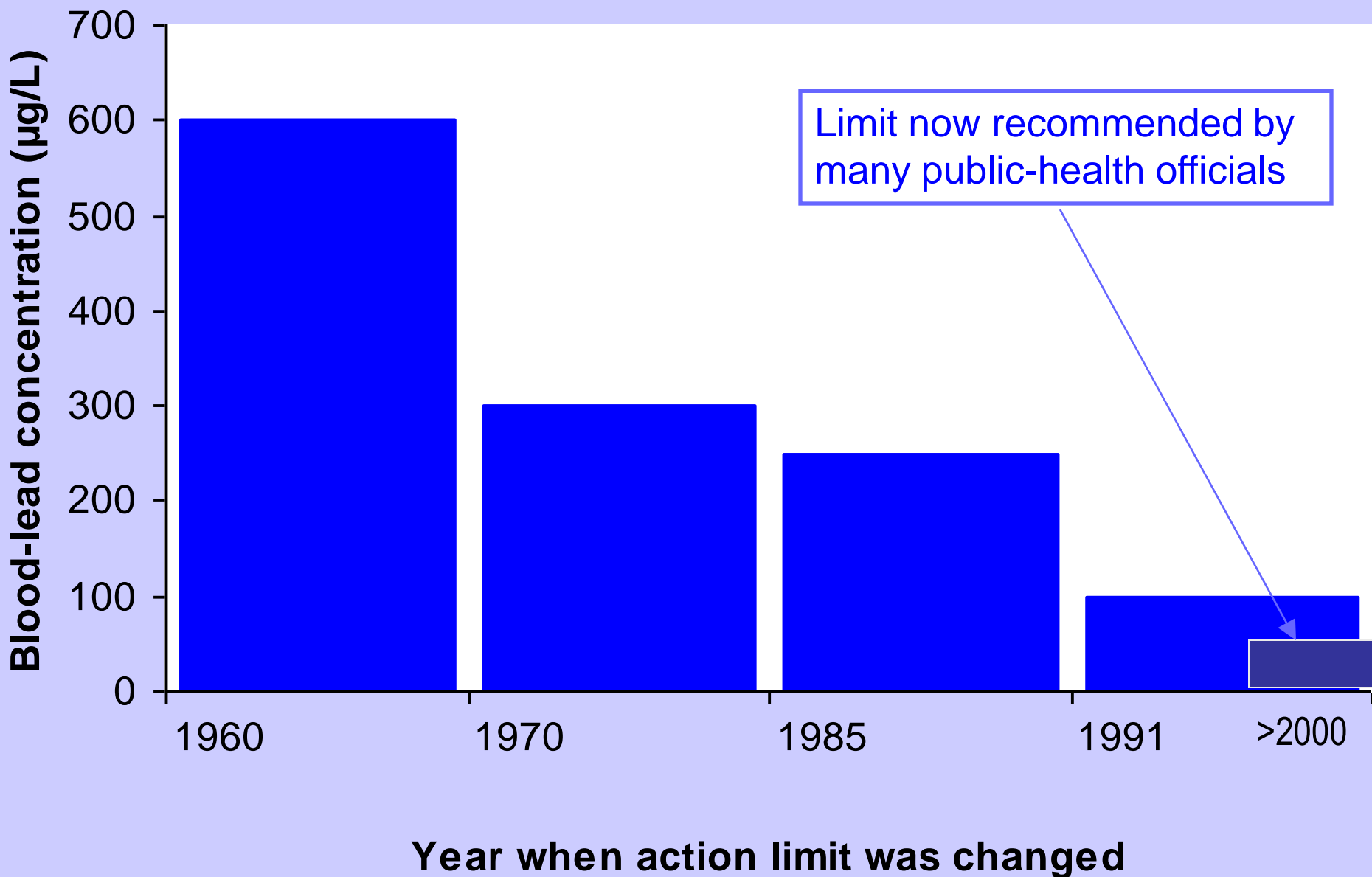
Electrical signals in the brain travel more slowly after exposure to methylmercury



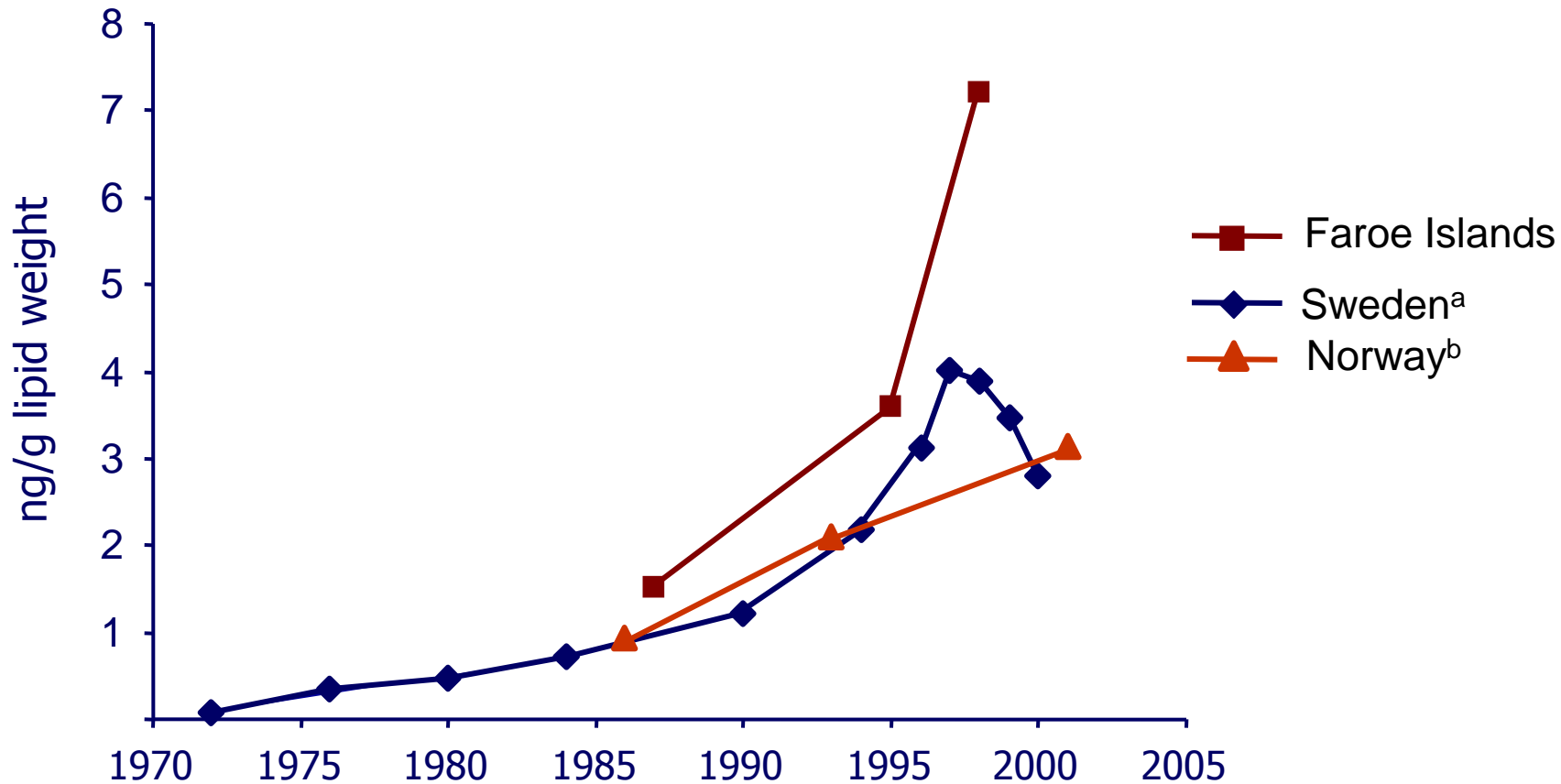
Thresholds decline due to better science



Lead exposure limits have been decreased only slowly -
and a whole generation of children was endangered



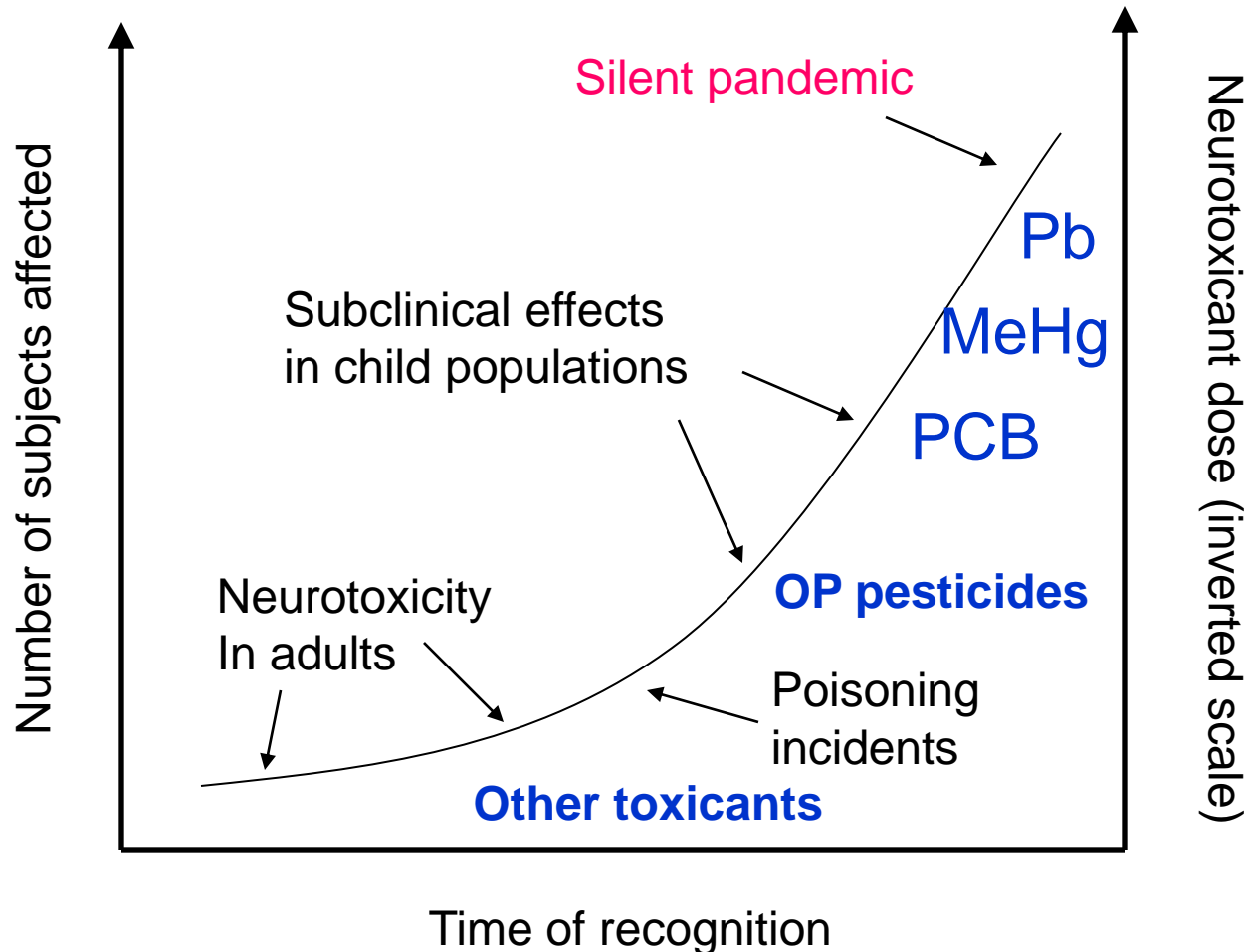
Some pollutants fade – new ones emerge: PBDE in human milk



Early science warnings 20-40 years ago

1968	Fetal alcohol syndrome first described
1971	Vaginal cancer discovered in girls whose mothers used diethylstilbestrol in pregnancy
1977	Forsdahl reports that infant mortality in a birth cohort is linked to adult mortality
1979	Needleman reports dose-related mental deficits in children with “background” lead exposure
1985	The Jacobsons report cognitive deficits in children exposed to PCB from Great Lakes
1987	Skakkebæk reports early cancer stages in fetal testicular cells

Emerging paradigm: Time course of recognition (developmental neurotoxicants as example)



Number of environmental toxicants

Known neurotoxic to humans during development, $N = 5$

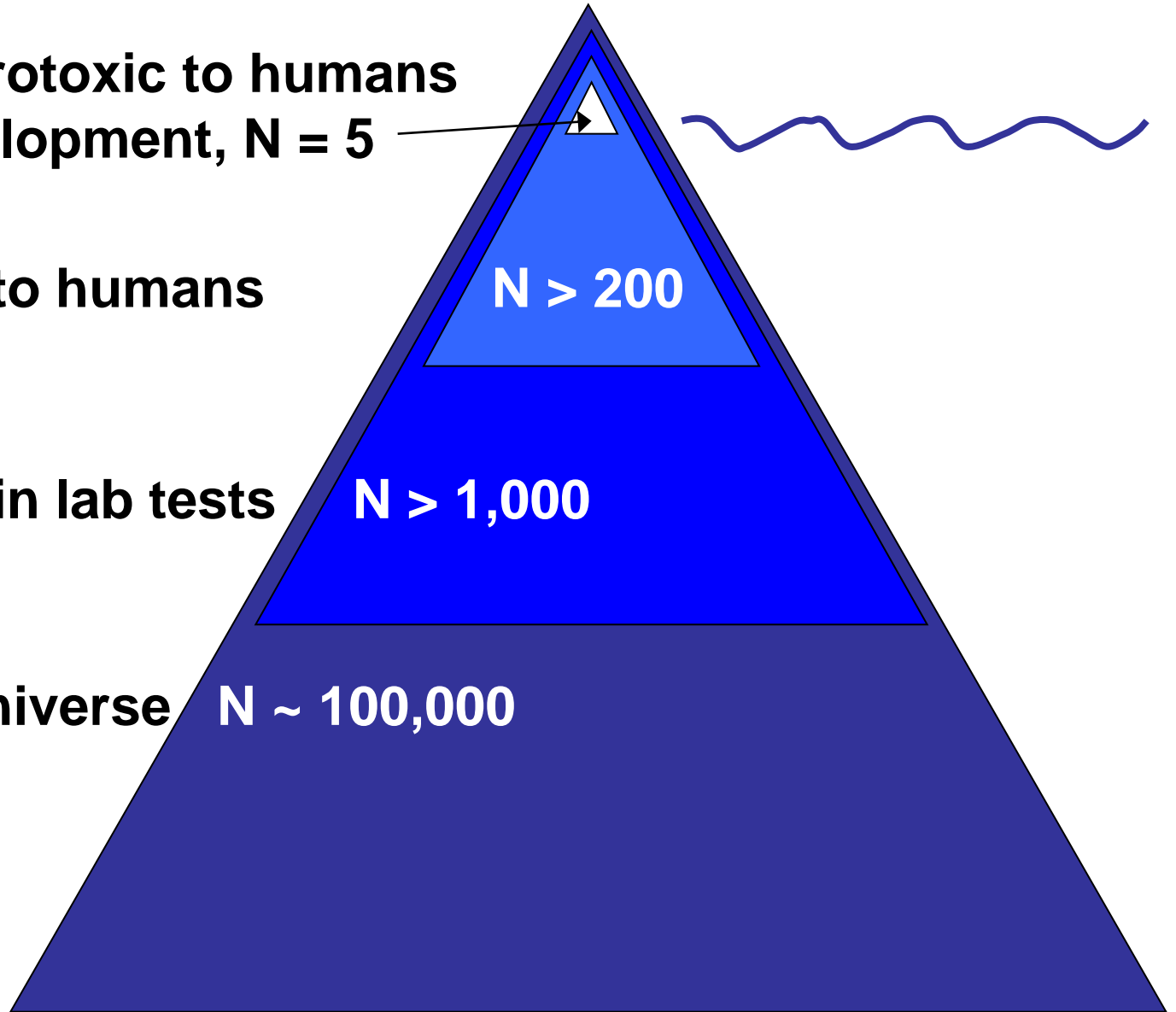
Neurotoxic to humans

$N > 200$

Neurotoxic in lab tests

$N > 1,000$

Chemical universe $N \sim 100,000$

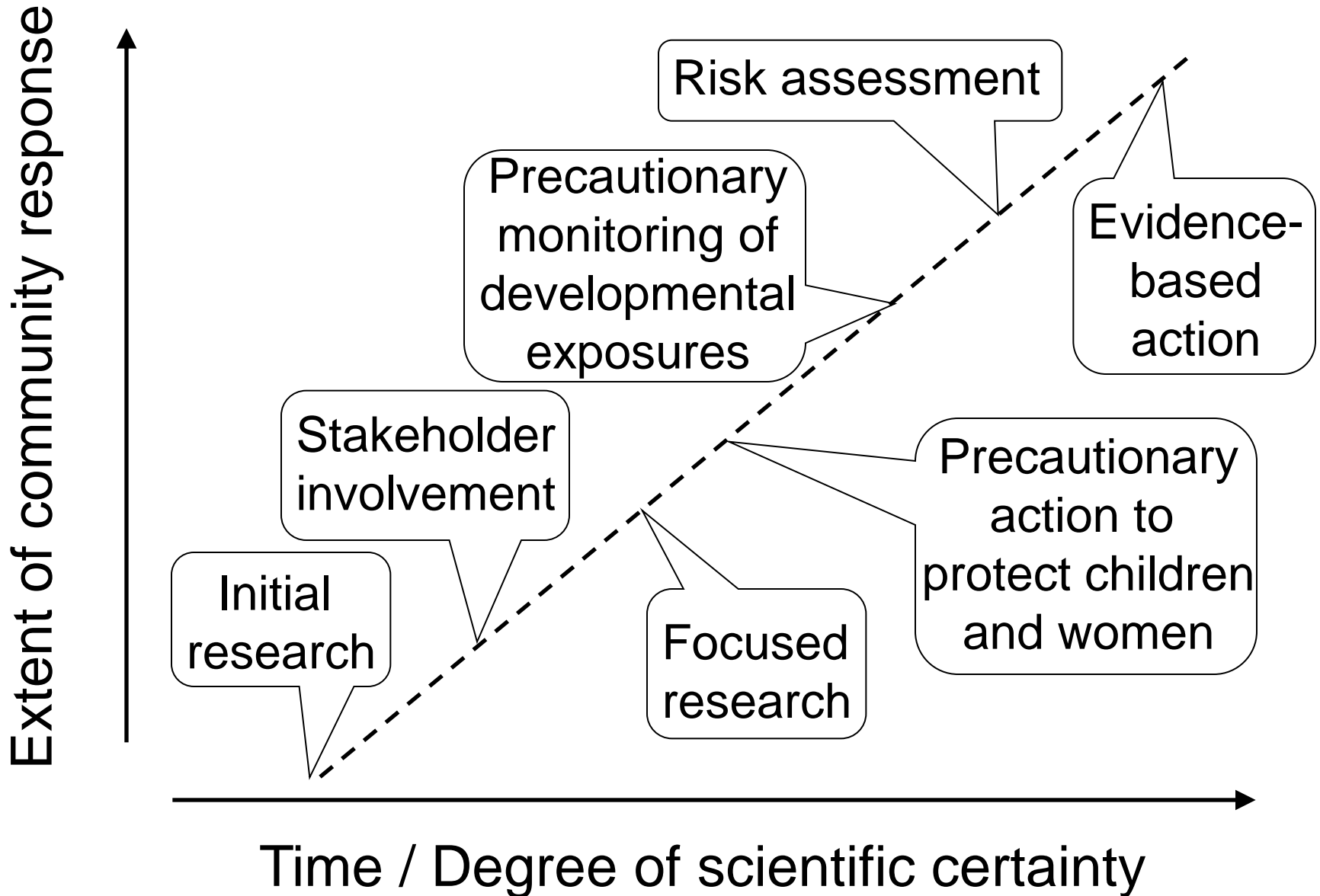


Need for new science to inspire precautionary decision-making

- Limit replication
- Explore uncertainties
- Identify groups at increased risk
- Involve stakeholders
- Link research to intervention



Need for new science-policy interface



The way forward

- Focus research on the developmental origin of human health, organ function, and disease
- Life-time exposures in epidemiological studies must include early development
- Include developmental exposure in standard testing of chemicals
- Aim at protecting early development as the most vulnerable life stage

