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GOLISANO
CHILDREN'S HOSPITAL

Welcome to ***The Effects of Lead on Learning:*** ***The Way Forward***

**A Collaboration of Health Care Professionals and
Educators Working Together to Help Children
Overcome the Effects of Lead Exposure**

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Primary Sponsor

Western New York Lead Poisoning Resource Center Rochester Office

Serving nine counties in
the Finger Lakes region

Toll Free Number: 877-352-5775

Web: Golisano.urmc.edu/lead-poisoning

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Other Sponsoring Organizations

Coalition to Prevent Lead Poisoning

Finger Lakes Coalition to Stop Lead Poisoning

Finger Lakes Children's Environmental Health Center

Monroe County Department of Public Health

Let's Work Together to Overcome the Silo Effect



Since lead poisoning is a problem that crosses disciplines affecting health, education, the environment, housing and the criminal justice system, it is not someone else's problem; it's everyone's problem.

Format of the Conference

Morning Presentations

- Dedication
- What We Know About Lead and Its Effects on the Brain
- Educational Interventions for Children Poisoned by Lead: A Summary of the CDC's 2015 Expert Panel Report
- Lessons from RI's Efforts to Support Local Education Agencies' Child Outreach (Child Find) with KIDSNET
- Panel Discussion: How Can We Implement the CDC's Expert Panel Report '*Educational Interventions for Children Affected by Lead*'?

Format of the Conference

Afternoon Presentations

- Assessing the Neurocognitive Effects of Brain Injury: Why Schools Fail Lead Poisoned Children
- Panel Discussion: How Can Schools Address the Needs of Individual Children Affected by Lead?
- Helping Lead Poisoned Children: New Directions and New Ideas

Dedication – In Memory of Dr. Marion Diamond



Marion Diamond – The Most Important Person Who You Never Heard Of



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What We Know About Lead and Its Effects on the Brain

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Primary Sources of Lead Exposure



- Lead-containing dust trekked or blown into homes
- Peeling or chipping residential paint
- Water contaminated by lead pipes or lead solder
- Contaminated soil
- Stationery industrial sources and airports
- Ceramic pottery
- Some imported foods and cosmetics
- Toys containing lead or painted with lead paint

What Have We Known for a Long Time About Lead Poisoning?

- Lead is a poison that has no useful role in the human body. It can cause seizures, mental confusion, coma and death if there is significant exposure.

“Lead makes the mind give way.”

-- Dioscorides – 2nd Century B.C.

- Significant environmental exposure can be harmful

A Plea for Painted Railings and Painted Walls of Rooms as the Source of Lead Poisoning Amongst Queensland Children

--J. Lockhart Gibson, *Australasian Medical Gazette*, April 20, 1904

- The U.S. was very slow to address the lead problem

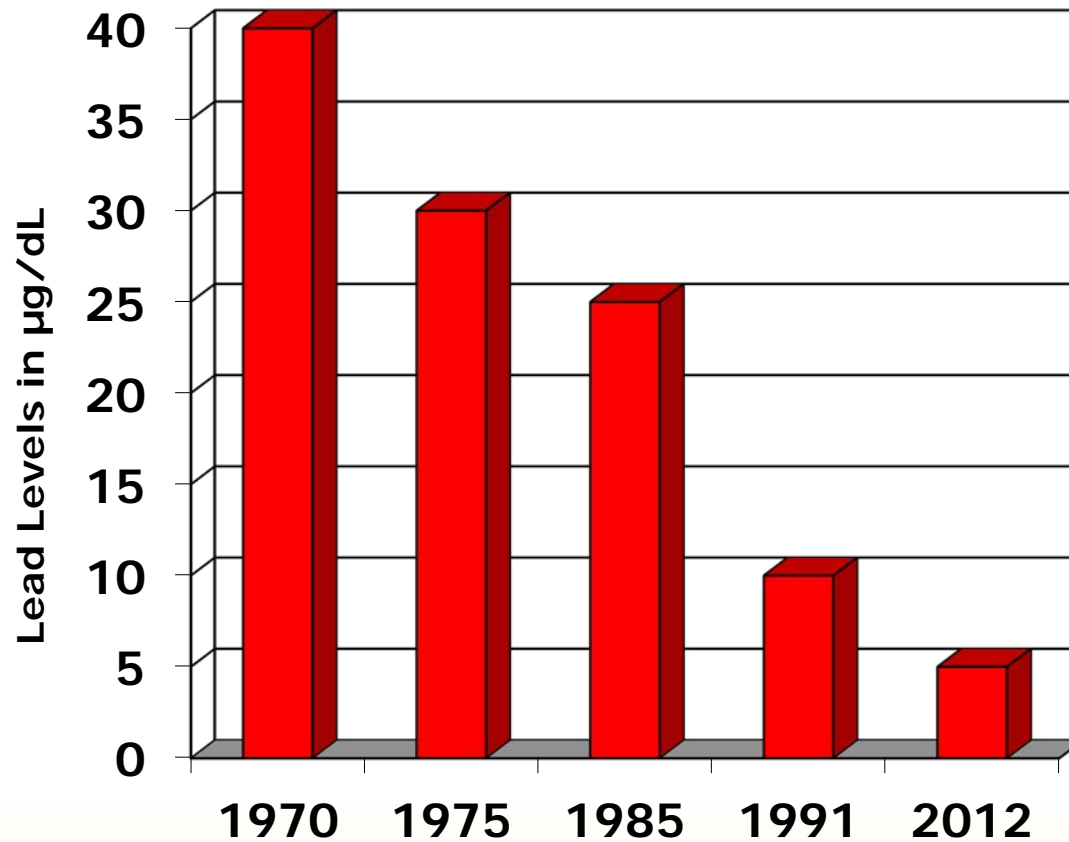


Lead paint was outlawed in most European countries in early 1920s after the League of Nations recommended it be banned in 1922 due to the danger of lead poisoning

Due to the influence of the lead, chemical and automobile industries, lead paint only outlawed in the U.S. in 1978

What is Considered an Elevated Lead Level?

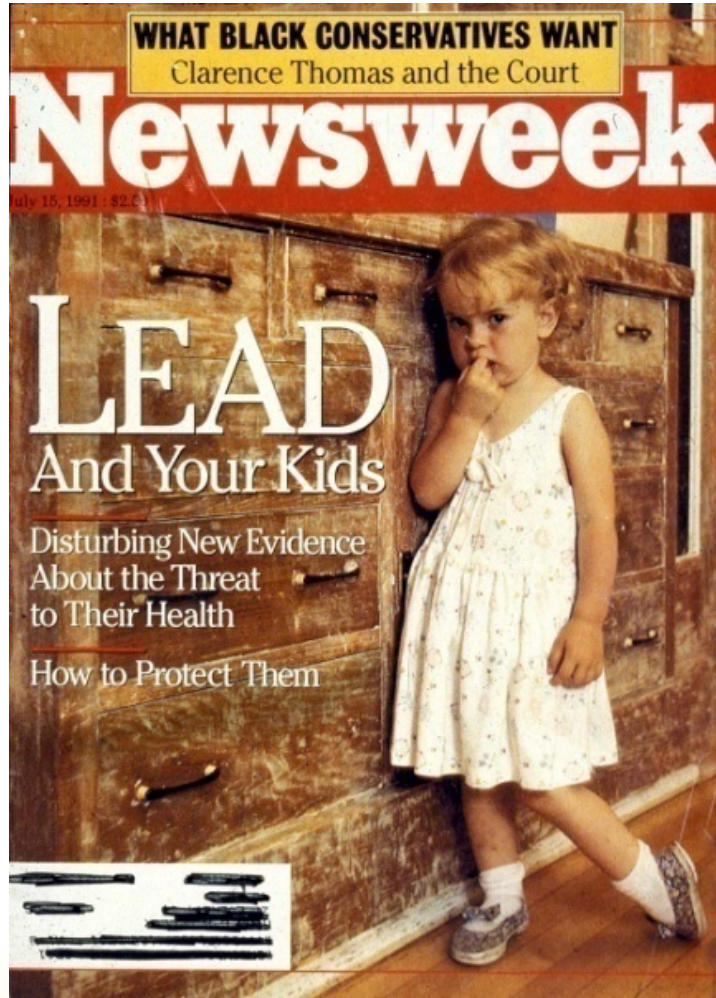
Blood Lead Cut-offs As Determined by the CDC



A Timeline of Important National Milestones in Addressing Lead Exposure Over the Past 40 Years

- 1976 – Unleaded gasoline goes on sale
- 1978 – Sale of household paint containing lead banned
- 1980 – No new vehicles sold that use leaded gasoline
- 1985 – CDC lowers blood lead level of concern to 25 µg/dL
- 1991 – CDC lowers blood lead level of concern to 10 µg/dL sparking new interest in the problem of lead poisoning
- 2003 – Rochester Lead Study shows that lead levels < 10 µg/dL can cause cognitive problems, spurring on additional research
- 2012 – CDC renames the 'blood lead level of concern' the 'reference level' and sets it at 5 µg/dL

New Interest in Lead Poisoning in 1991 When the CDC's Blood Lead Level of Concern Was Lowered to 10mcg/dL



- Lead exposure mostly targets low socioeconomic status inner city minority populations, especially children
- Lead exposure has affected multiple generations in these populations
- Increased knowledge about the harm caused by lead

The Rochester Lead Study

The NEW ENGLAND JOURNAL of MEDICINE

ESTABLISHED IN 1812

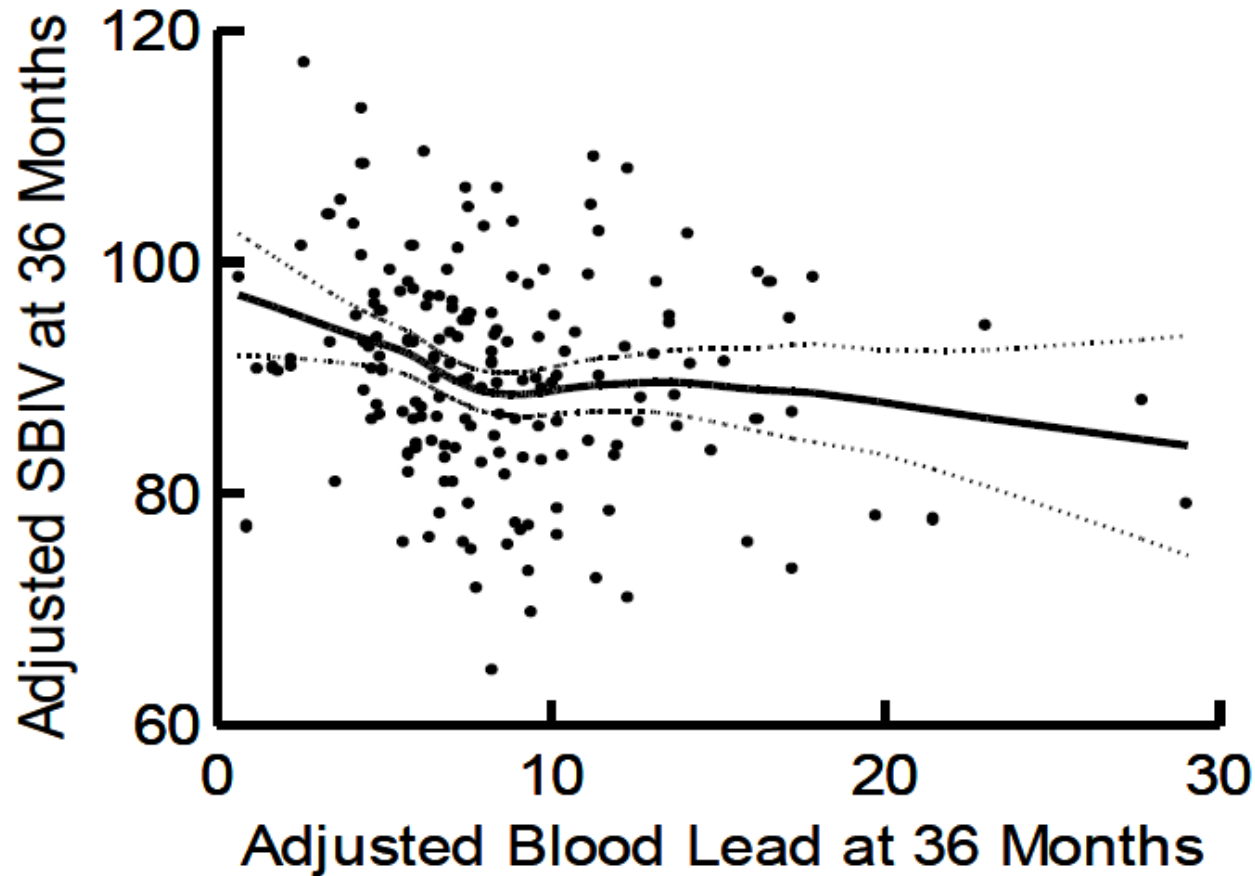
APRIL 17, 2003

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Intellectual Impairment in Children with Blood Lead Concentrations below 10 μg per Deciliter

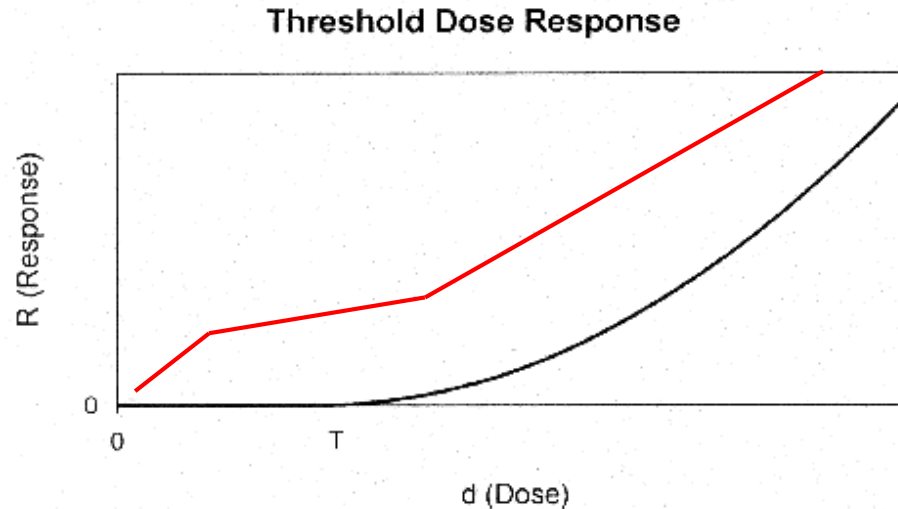
Richard L. Canfield, Ph.D., Charles R. Henderson, Jr., M.A.,
Deborah A. Cory-Slechta, Ph.D., Christopher Cox, Ph.D., Todd A. Jusko, B.S.,
and Bruce P. Lanphear, M.D., M.P.H.

The Effects of Low-Level Lead Exposure on IQ in Young Children



Canfield RL, Henderson CR, Cory-Slechta DA, Cox C, Jusko TA, Lanphear BP. *NEJM*. 2003;348:1517-1526

What Do We Now Know About Lead Poisoning?

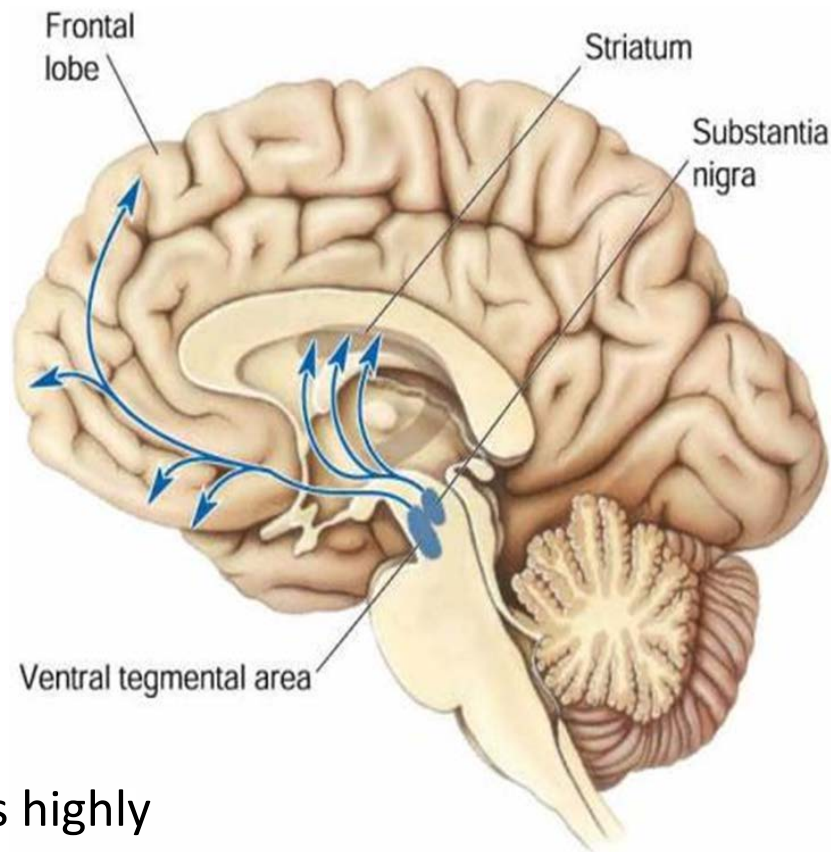


- Unlike most toxins, there is no known threshold exposure level below which the adverse effects of lead are not seen
- Even at very low levels, lead can cause harm, particularly for young children whose brains are developing
- The effect of lead is much more pronounced on males than on females
- Total lifetime average lead exposure or current BLL are the best predictors of IQ scores

Neurobiological Mechanisms: the Mesocorticolimbic Dopamine (DA) System as a Target of Lead

- Mesocorticolimbic system:

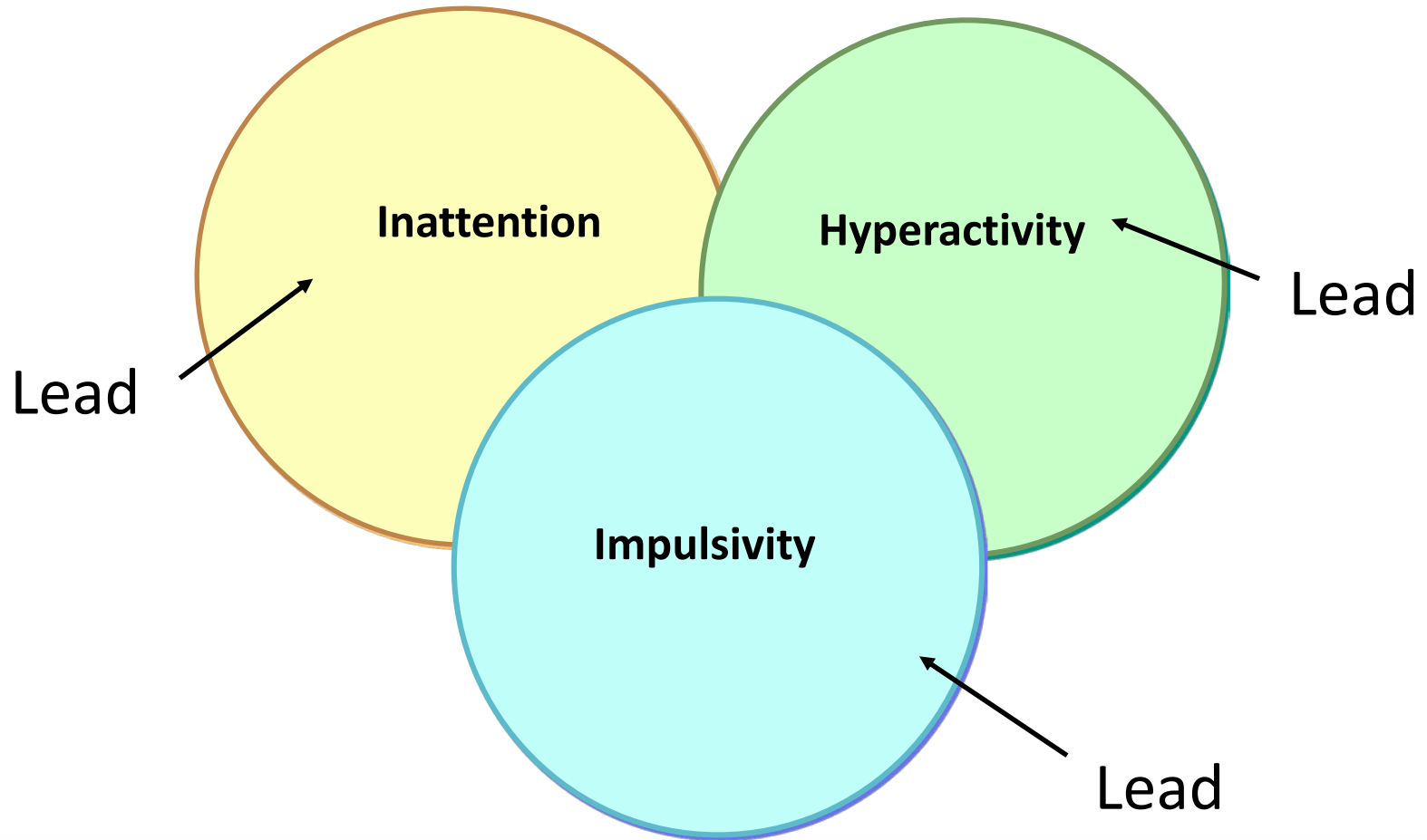
- ◆ Learning
- ◆ Executive Function
- ◆ Attention
- ◆ Decision-making
- ◆ Reward
- ◆ Addiction



- Dopamine neurotransmitter is highly sensitive to lead

Cory-Slechta DA. *Neurotoxicology & Teratology*. 1995;17:219-221.

Lead and ADHD



Lead and the Likelihood of ADHD Diagnosis

- Case-Control Study Done in China of 4-12 Year Old Children:
 - BLLs of 5-9 $\mu\text{g}/\text{dL}$ were 5.2x as likely to have been diagnosed with ADHD
 - BLLs ≥ 10 $\mu\text{g}/\text{dL}$ were 7.2x as likely to have been diagnosed with ADHD

Results were adjusted for:

Family Composition

Birth Weight

Family History of ADHD

Pregnancy, Labor and Delivery Complications

Medical History

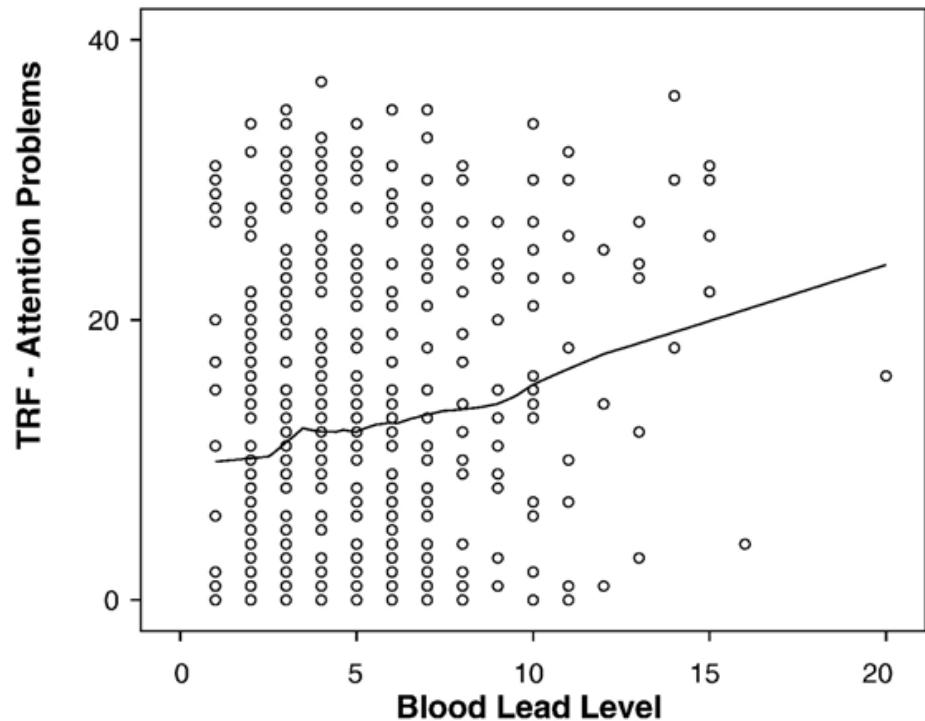
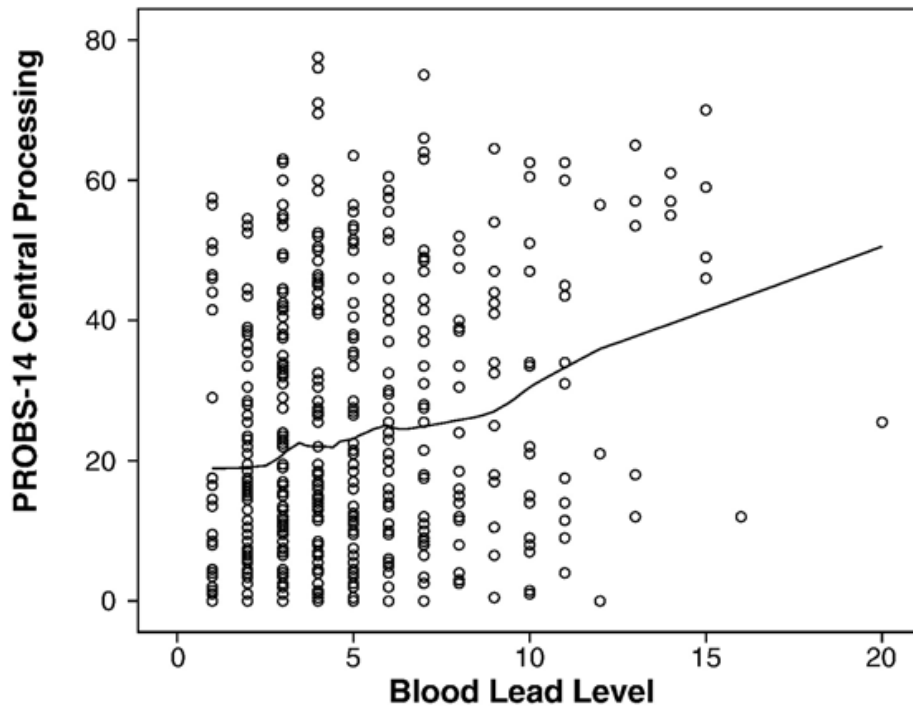
Maternal and Paternal Age and Education

Maternal Use of Alcohol and Tobacco During Pregnancy

Wang HL, Chen XT, Yang B, et. al. *Environmental Health Perspectives*. 2008; 116:1401-1406.

Cognitive Realms Significantly Affected by Lead Exposure

Study of 246 inner-city African American children with BLLs assessed at 7.5 years of age.



Chiodo LM, Covington C, Sokol RJ, et al. *Neurotoxicology & Teratology*. 2007;29:538-546.

Auditory Processing Disorders

Auditory Processing Affects Learning

Spelling

Sound discrimination
Auditory memory
Apply sound/symbol relationship

Reading

Classify words by similarities
Combine sounds to make words
Integrate the spoken and written word

Note taking

Take notes from a lecture
Understand lectures
Apply what you have heard

Listening

Classify and associate information
Comprehend oral information
Build factual knowledge

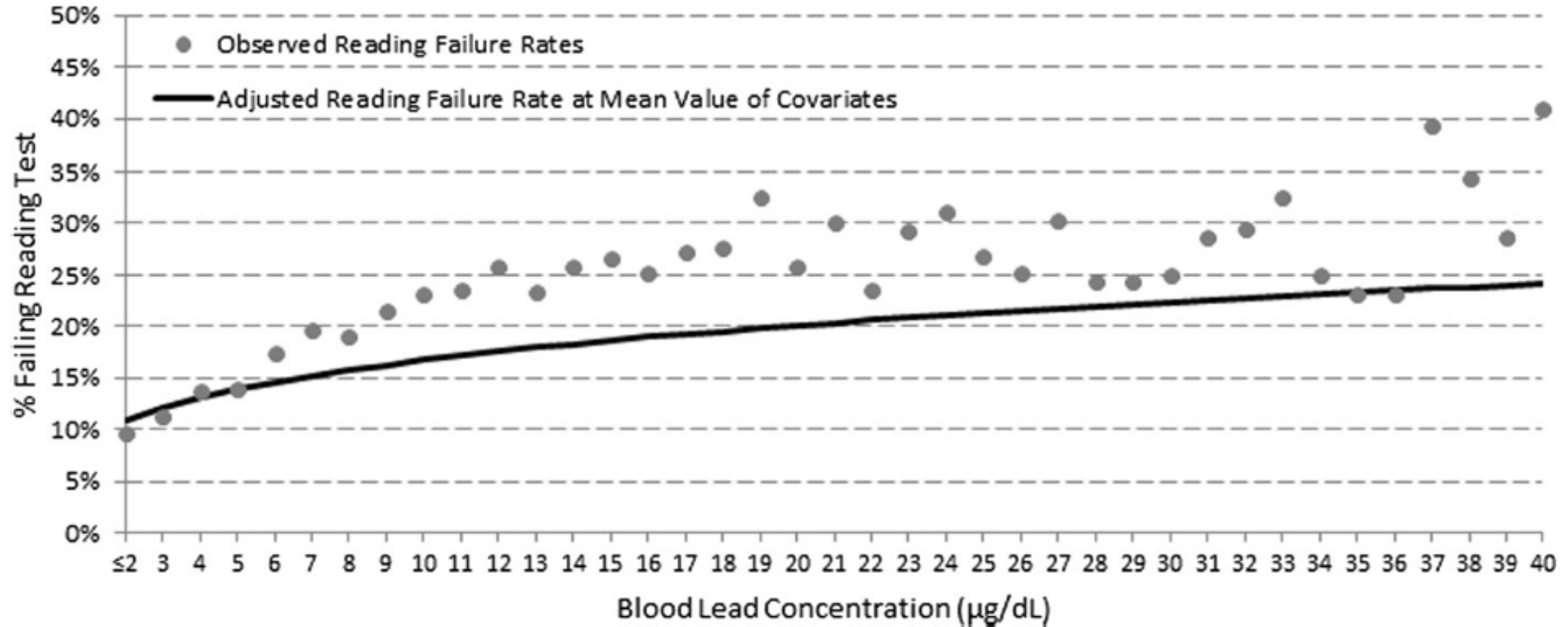
Speech

Speak clearly
Classify and associate information
Comprehend oral information

Attention

Pay attention when distractions are present
Follow conversations
Follow directions

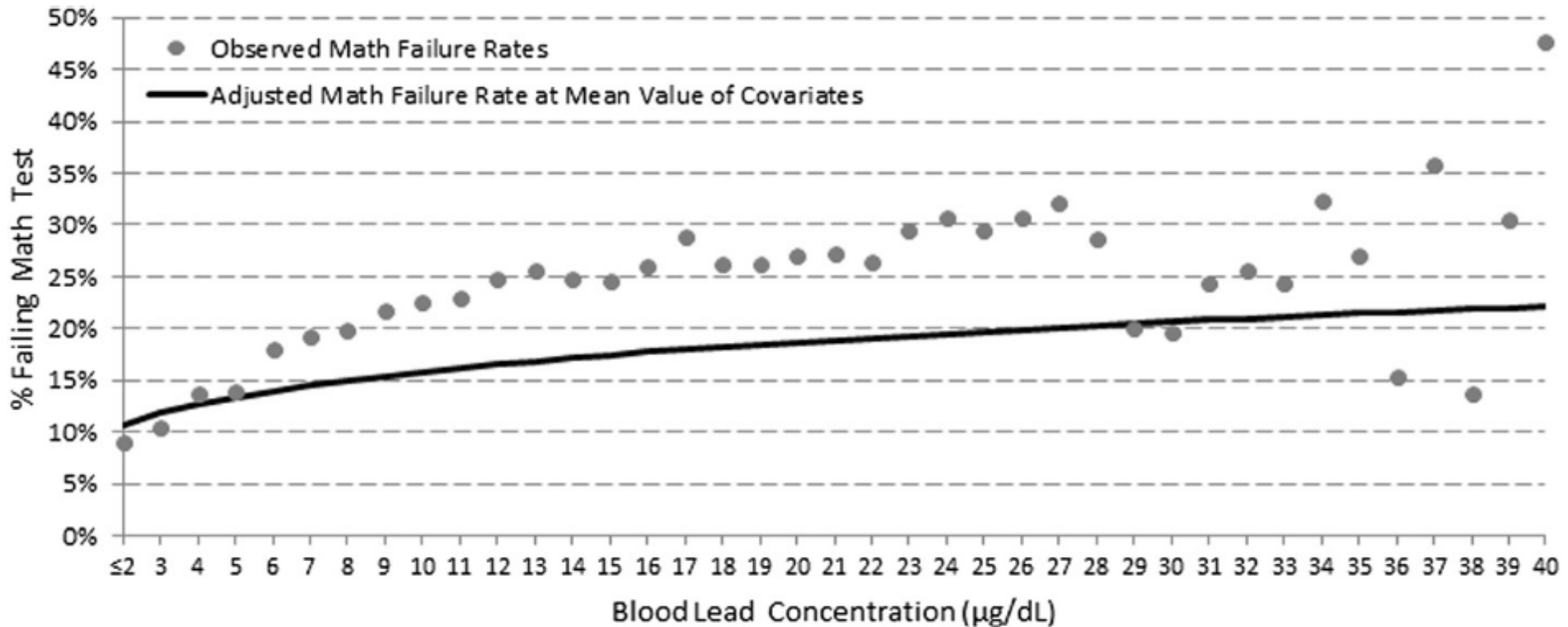
Observed & Adjusted 3rd Grade Reading Failure Rates by Blood Lead Levels



Covariates Adjusted For: Poverty, Race, Gender, Maternal Educational Attainment, Premature Birth

Evens A, Hryhorczuk D, Lanphear BP, et al. *Environmental Health*. 2015;14:21-30

Observed & Adjusted 3rd Grade Math Failure Rates by Blood Lead Levels



Covariates Adjusted For: Poverty, Race, Gender, Maternal Educational Attainment, Premature Birth

Evens A, Hryhorczuk D, Lanphear BP, et al. *Environmental Health*. 2015;14:21-30

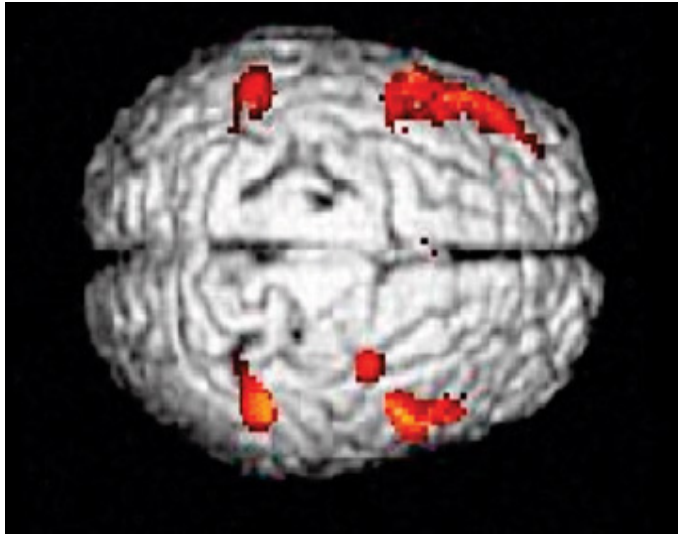
What About Executive Functioning?

Executive functioning includes:

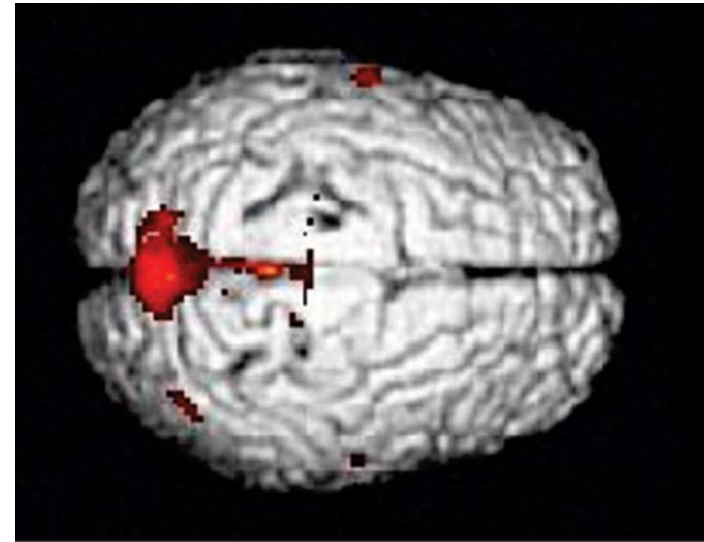
- Strategic planning
- Control of impulses
- Organized searching
- Flexibility of thought and action
- Self-monitoring of one's own behavior

Effects of Lead on Impulse Control

Functional MRIs showing areas of brain function after tasks requiring impulse control were given to adults

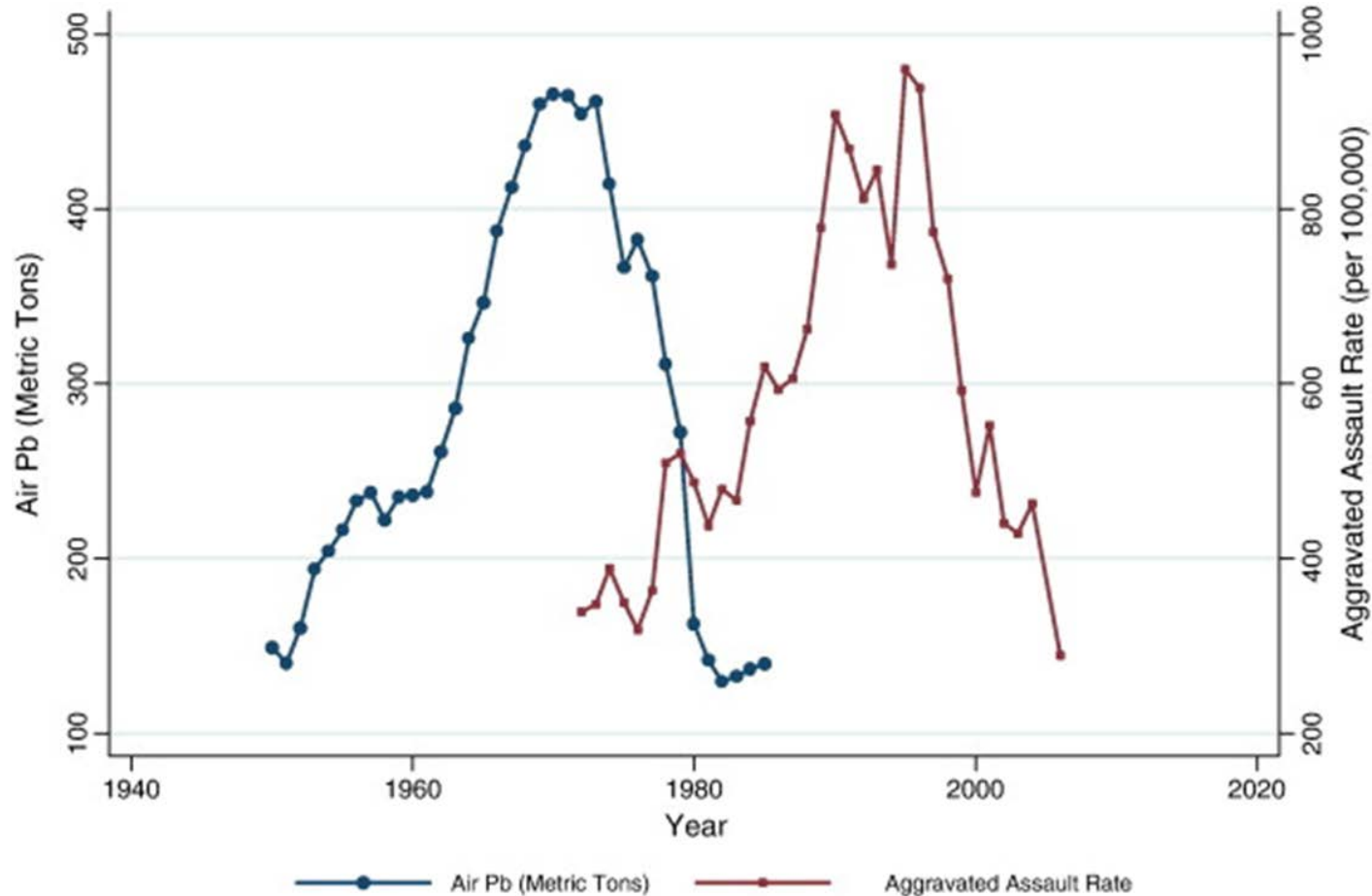


Brain of an adult who was not exposed to lead as a child



Brain of an adult who was exposed to lead as a child

Air Lead Concentrations and Aggravated Assault Rates

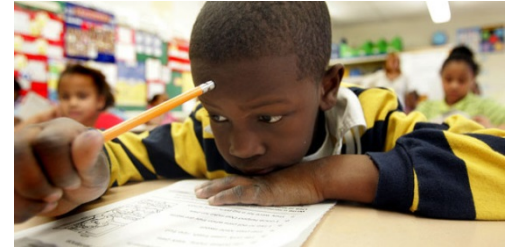


Mielke and Zahran. *Environment International*. 2012;43:48-55

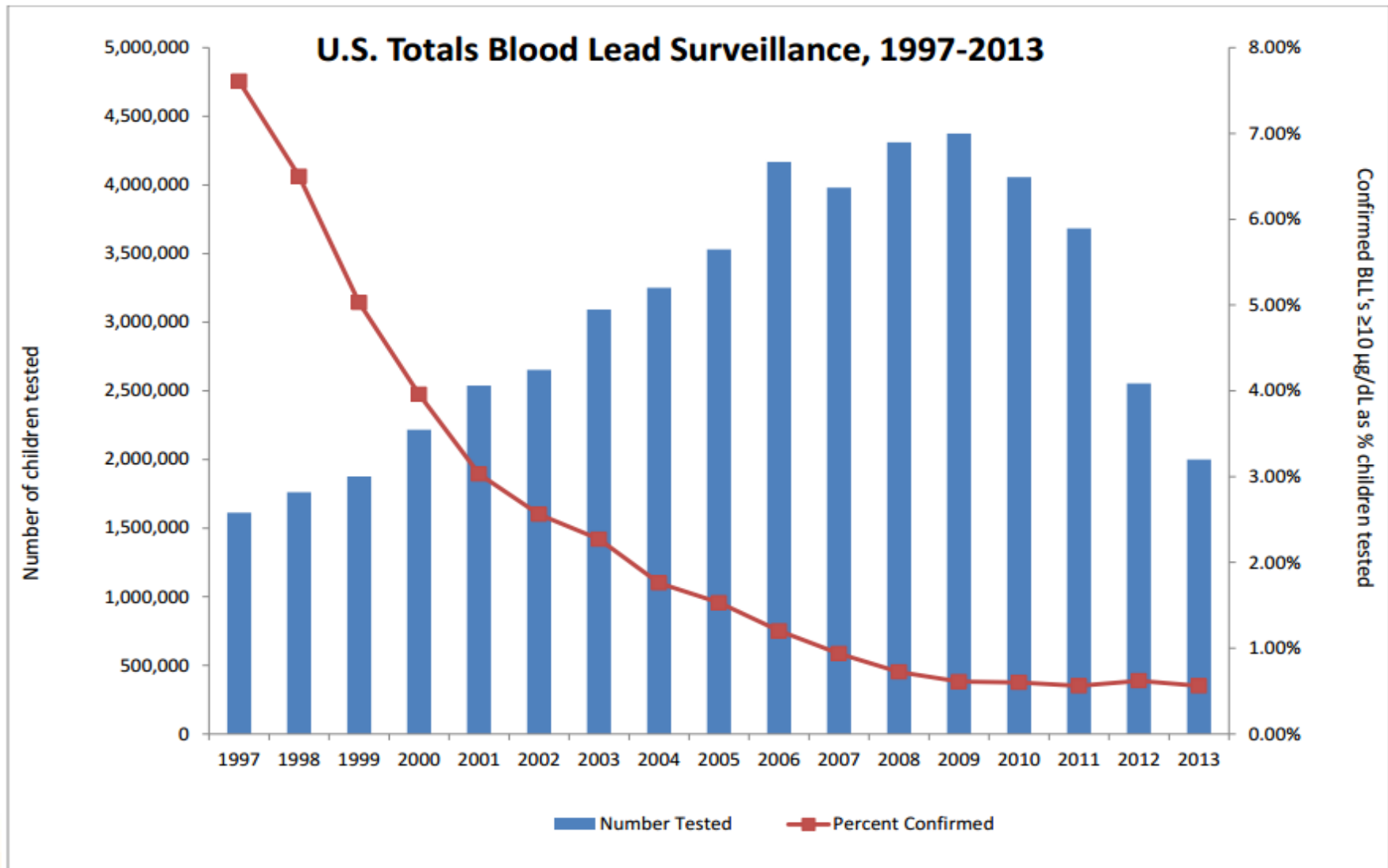
Effects of Lead on the Brain and Its Consequences

Effects at lower levels of exposure in childhood include:

- Irreversible loss of IQ
- Auditory & central processing difficulty
- Attention problems & distractibility (ADHD)
- Difficulty with executive functioning
- Emotional dysregulation
- Higher school drop out rate
- Delinquency
- Incarceration



Trends in Blood Lead Testing & Prevalence of Elevated Blood Lead Levels



Source: Centers for Disease Control and Prevention

The Message That We Want to Send



**Runs better
unleaded**

U.S. Environmental Protection Agency
EPA 747-11-98-002

For more information on preventing lead poisoning
call 1-800-424-LEAD or visit www.epa.gov/lead.

LEAD Awareness Program