Children and the Environment: A Developmental Pediatric Perspective

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Developmental Theory

- Nature
  - Genetics
  - Temperament
- Nurture
  - Environment
- Transactional theory

Environmental Factors

- Chemicals and toxins
- Physical surroundings
- Home
- Education
- Social cohesion e.g., violence
- TV, video games, mass media
- Political environment

Framework for Understanding

Traits/Abilities

Asperger's syndrome

NUTRITION

GENETICS

SOCIAL ENVIRONMENT

Developmental Syndromes

ADHD

Learning disability
Reported Trends: Real? Better reporting? Changing criteria?

Learning disabilities
- 191%  
  *Children in special education: 1977-1994*

ADHD
- 1  
  *20% Reported prevalence*
- >800%  
  *Ritalin use since 1971*

ADHD
- Between 4 - 12% of all school-age children
- The most common childhood neurobehavioral disorder

Learning Disabilities
- Impairment in abilities underlying academic function
- Neuromotor incoordination
- Difficulties in orientation
- Impaired social adaptive functioning
- Behavioral manifestations

Autism Spectrum Disorders
- ‘Classic’ Autism
- PDD NOS
- Asperger’s Syndrome
- Rett’s Syndrome
- “Others”
Trends, Prevalence, and Clusters

- 100% Autism over 30 years
- 400% Above nation: Prevalence in Brick Township, NJ

Etiology of Autism

- Several genes interacting with many environmental factors
- Autism as a birth defect

Patricia Rodier, PhD
University of Rochester
Joseph Warkany Award
May 23, 2003

Recognition of Developmental Neurotoxins

- Exposure measures
- Outcome measures
- Confounding
- Statistical analysis
- Alpha error (type I)
- Beta error (type II)
- FALSE POSITIVES
- False Alarm
- FALSE NEGATIVES
- False Assurance

Recognition of Toxic Threats:

- WHAT WE KNOW
- WHAT WE DON’T KNOW

- The “UNKNOWN UNKNOWN”
- Thousands of chemicals
- Billions of mixtures
- Gene-environment interactions
- Windows of vulnerability
- Long latency effects
- False Negatives
- False Positives
- False Alarm
- False Assurance
LEARNING, BEHAVIOR, AND DEVELOPMENT: A SPECTRUM OF ACADEMIC DISCIPLINES

CLINICAL
- developmental pediatrics
- behavioral educational psychology
- psychiatry
- family medicine
- adolescent medicine
- developmental psychology
- behavioral genetics
- cognitive psychology
- developmental neurobiology

RESEARCH
- educational psychology
- psychiatry
- neurology
- developmental pediatrics
- family practice
- adolescent medicine
- psychology

LEARNING, BEHAVIOR, AND DEVELOPMENT: A SPECTRUM OF ACADEMIC DISCIPLINES

HUMAN BRAIN GROWTH RATE

DECLINING THRESHOLD OF HARM - LEAD

A SMALL SHIFT IN IQ DISTRIBUTION IN A POPULATION OF 260 MILLION

Note: Exposures expressed in micrograms/deciliter (blood lead).
5 Point Decrease in Mean IQ

- 57% INCREASE
- "Mentally Retarded" Population
- 9.4 million mentally retarded
- 2.4 million gifted

Blood lead levels in the U.S.

An Overview of Mercury

Mercury: Effects of higher dose prenatal exposure

- Mental retardation
- Seizures
- Cerebral palsy
- Disturbances of vision, hearing, sensation
- Abnormal gait
- Abnormal speech
- Disturbances of swallowing and sucking
- Abnormal reflexes
### Mercury: Declining Threshold of Harm

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<th>YEAR</th>
<th>Level associated with harmful effect</th>
<th>Regulatory standard</th>
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<td>FDA, WHO, EPA, ATSDR</td>
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#### Advised Exposure Limit
- EPA Reference Dose ("safe" upper limit) – 0.1 microgram/kilogram/day
- Equivalent consumption limit
  - Women: 1.5 oz. swordfish or 7 oz. tuna/week
  - Children: 1 oz. tuna per 20 lb. body weight/week

### From Factory to the Fetus

#### Dioxins and PCBs: Pathways of Exposure
- **Dioxins:**
  - PVC Manufacturing
  - Medical/Municipal Incinerators
- **PCBs:**
  - Transformers
  - Landfills
  - Hazardous Waste Sites

#### Pesticides
- Physical, chemical or biological agent intended to kill an undesirable plant/animal pest
- Major classes: insecticides, fungicides, herbicides
- Most pesticides are synthetic agents new to humans and the environment
- Inherent toxicity

*1999 estimates*
Pesticides

- **Reported use:** 98% of families, 80% during pregnancy
- **In Humans** - detectable chlorpyrifos metabolites in 92% of children’s, 82% of adults’ urine samples
- **In Food** - detectable residues of at least one pesticide on 72% fruits/vegetables
- **In Homes** – 3 to 9 pesticide residues in typical home with 70% infant exposure from dust
- **In Air** - indoor air levels 10-100X higher than outdoor air
- **In Water** - >90% stream samples, 50% of wells

What about the children?

- **Deficiencies in animal studies:**
  - Underestimate human DNT by 100-10,000x
  - Single genetic strains
  - Test single chemical exposures (cf. mixtures)
- **Prospective epidemiological studies rare**
- **Adult norms**

Emerging Themes

- With understanding of neurodevelopmental effects, estimates of toxic thresholds fall
- Animal testing underpredicts human vulnerability
- Subtle effects in individuals carry profound impacts when expressed over a population
- Adverse effects of some DNT are synergistic or additive

Summary: Policy Principles

- Disabilities are widespread
- Chemical exposures are preventable
- Toxicity at high doses should be a red flag for harm from low-dose “background” exposures
- Slow rate at which “proof” of harm materializes, results in at risk generations being harmed before adequate regulatory response occurs
- Protecting children will require a more flexible regulatory system capable of preventing as well as responding to widespread exposures and harm
THE TOXIC ICEBERG

Acknowledgement
In Harm’s Way
&
Leslie Rubin, MD