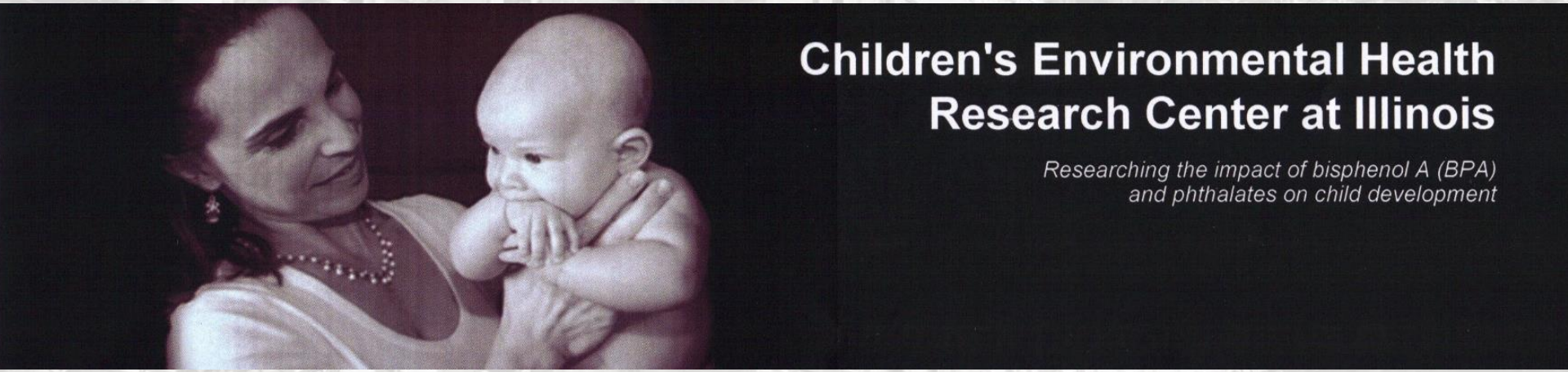
UNIVERSITY OF ILLINOIS
AT URBANA-CHAMPAIGN

Assessing Neurodevelopment in Parallel Animal and Human Studies



Focus of the Children's Health Center at Illinois

parabens

phthalates

BPA

triclosan

Study the impact of chemicals in consumer products on neurodevelopment.

- Assess exposures during the prenatal and adolescent periods.
- Investigate whether maternal obesity increases risks from prenatal chemical exposure.

Center Investigators—A Diverse Team

Susan Schantz (director)—Neuroscience/Toxicology

Jodi Flaws (associate director)—Reproductive Biology/Toxicology

Jay Ko—Reproductive Biology

Sidonie Lavergne—Immunology

Sharon Donovan—Nutritional Science

Yuan Xiang Pan—Nutritional Science

Andrea Aguiar—Developmental Psychology

Renee Baillargeon—Developmental Psychology

Daniel Hyde—Developmental Psychology/Neuroscience

Janice Juraska —Biological Psychology/Neuroscience

Susan Korrick (Harvard Medical School)—Epidemiology

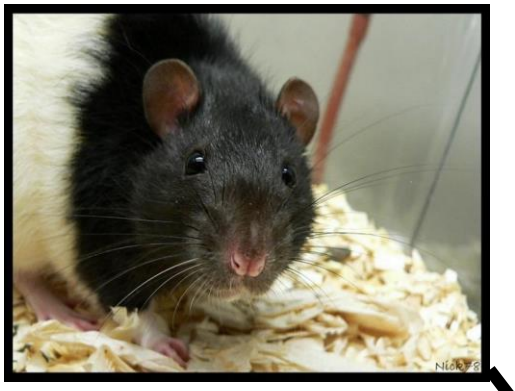
Joseph Gardiner (Michigan State University)—Biostatistics

Barbara Fiese—Community Outreach

Lizanne Destefano—Community Outreach/Evaluation

Parallel Studies in Animal Models and Exposed Human Populations

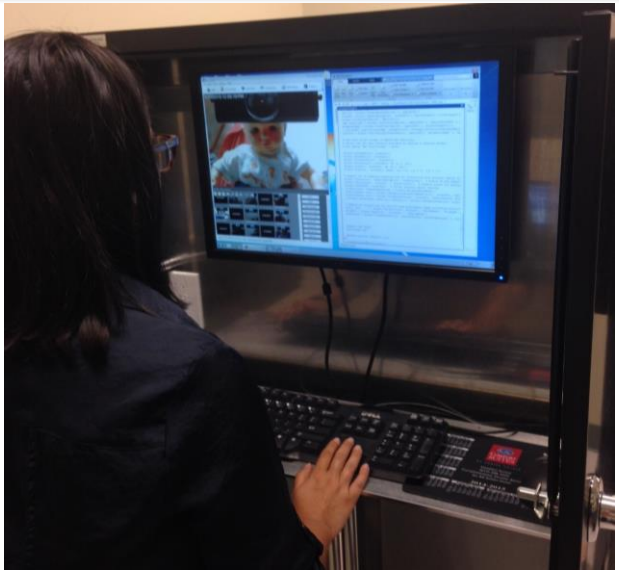
- In animal models we aim to:
  - Closely model human exposure.
  - Conduct studies that probe the underlying biological mechanisms.
  - Use results to guide selection of health outcomes for studies of children.

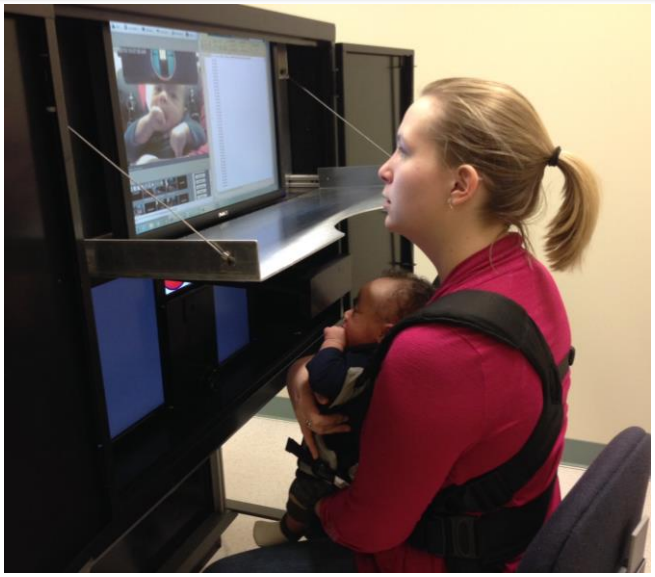


Prospective Birth Cohort Study

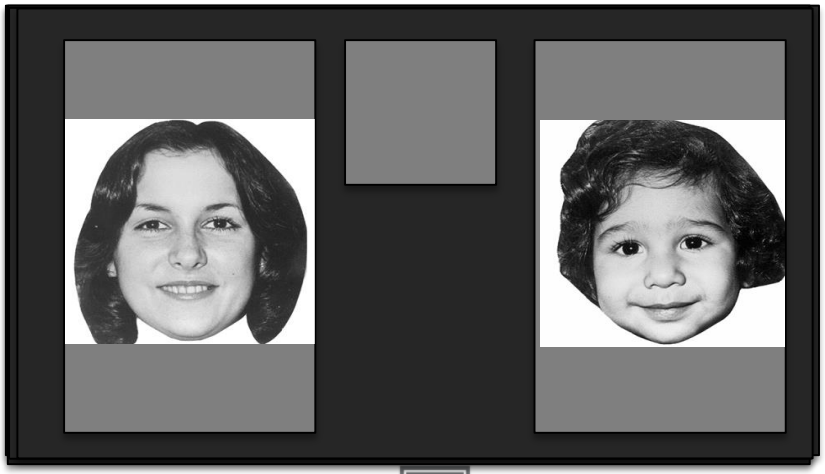
- Goal is to develop better tools that will allow us to reliably identify neurodevelopmental risks from prenatal exposures much earlier.
- Use tests that assess core cognitive abilities.
  - information processing ability, working memory, attention.
  - predictive of cognitive function later in childhood.

Neonatal Memory & Attention Task





Andrea Aguiar



Event Related Potentials (ERPs)


Dan Hyde

- Babies see stream of faces with occasional test images that are either the same or novel.
- Compare responses to the same and novel test images (difference scores).
- Five spatial and temporally distinct components that measure:
  - Visual processing
  - Attention
  - Memory

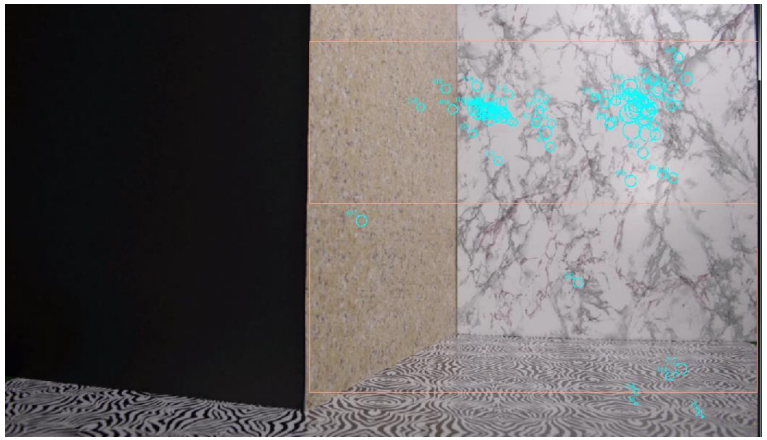
4-5 Month Tasks That Assess Sexual Dimorphisms in Cognition

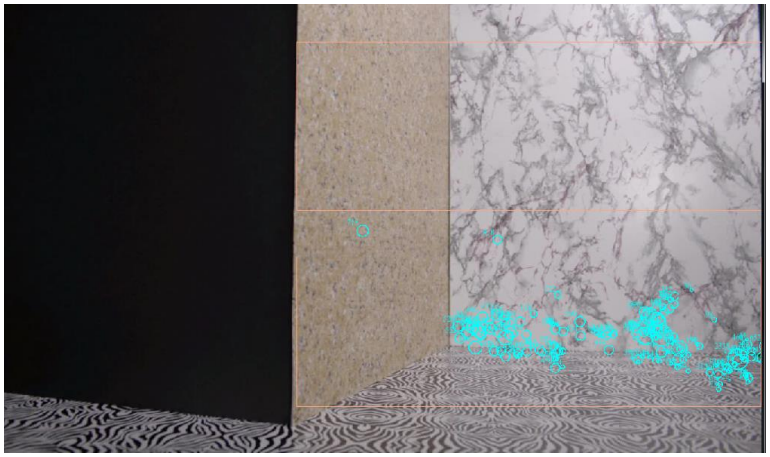
- **Spatial reasoning**—mental rotation task (Moore and Johnson).
  - Boys out perform girls.
- **Physical reasoning**—magic—real task (Baillargeon).
  - Girls out perform boys.

Set Up for 4-5 Month Tests

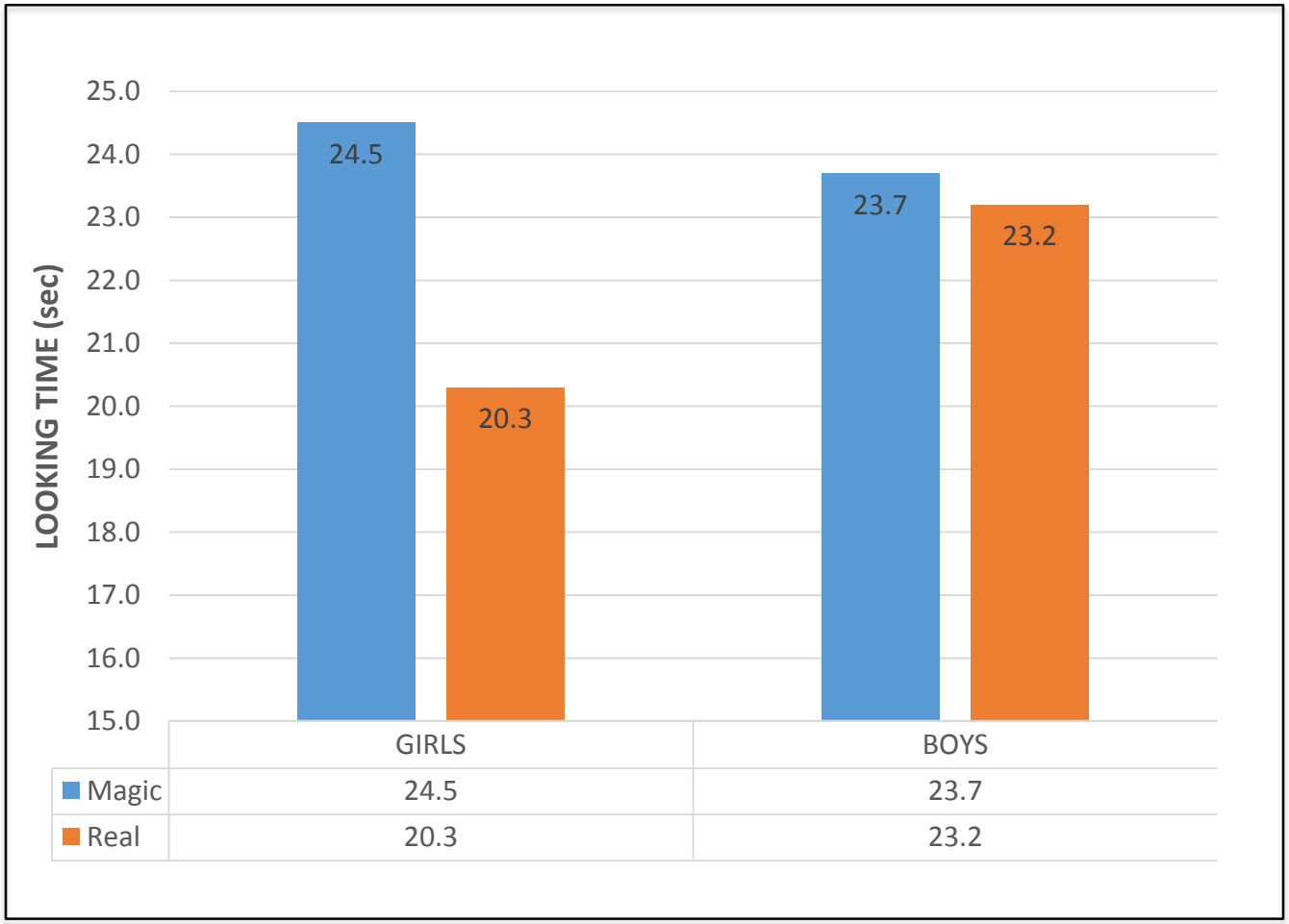
Physical Reasoning Task

Renee Baillargeon





Looking Time to the “Magic” and “Real” Events



Why Does This Difference Exist?

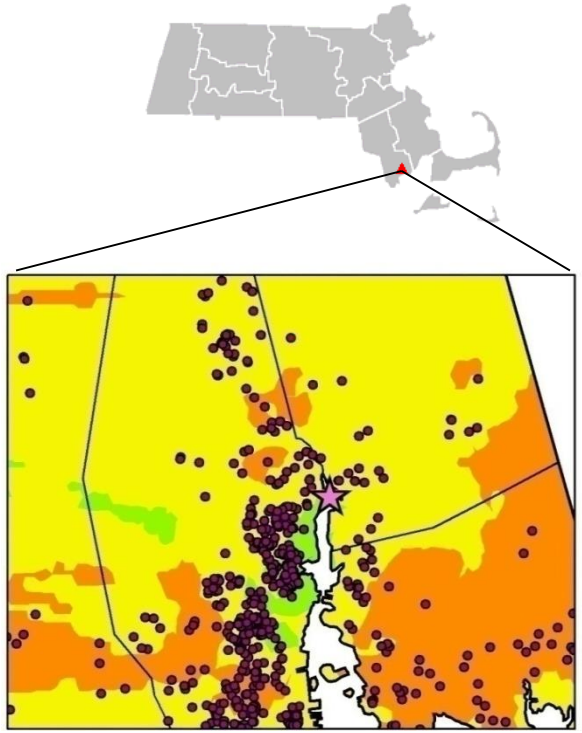
- Binocular vision develops earlier in girls.
  - Learn about physical relationships between objects at earlier age.
  - Slower development in boys mediated by prenatal exposure to androgens.
- Endocrine disruptors (especially anti-androgenic chemicals like phthalates) could affect this process.

Adolescent Cohort Study

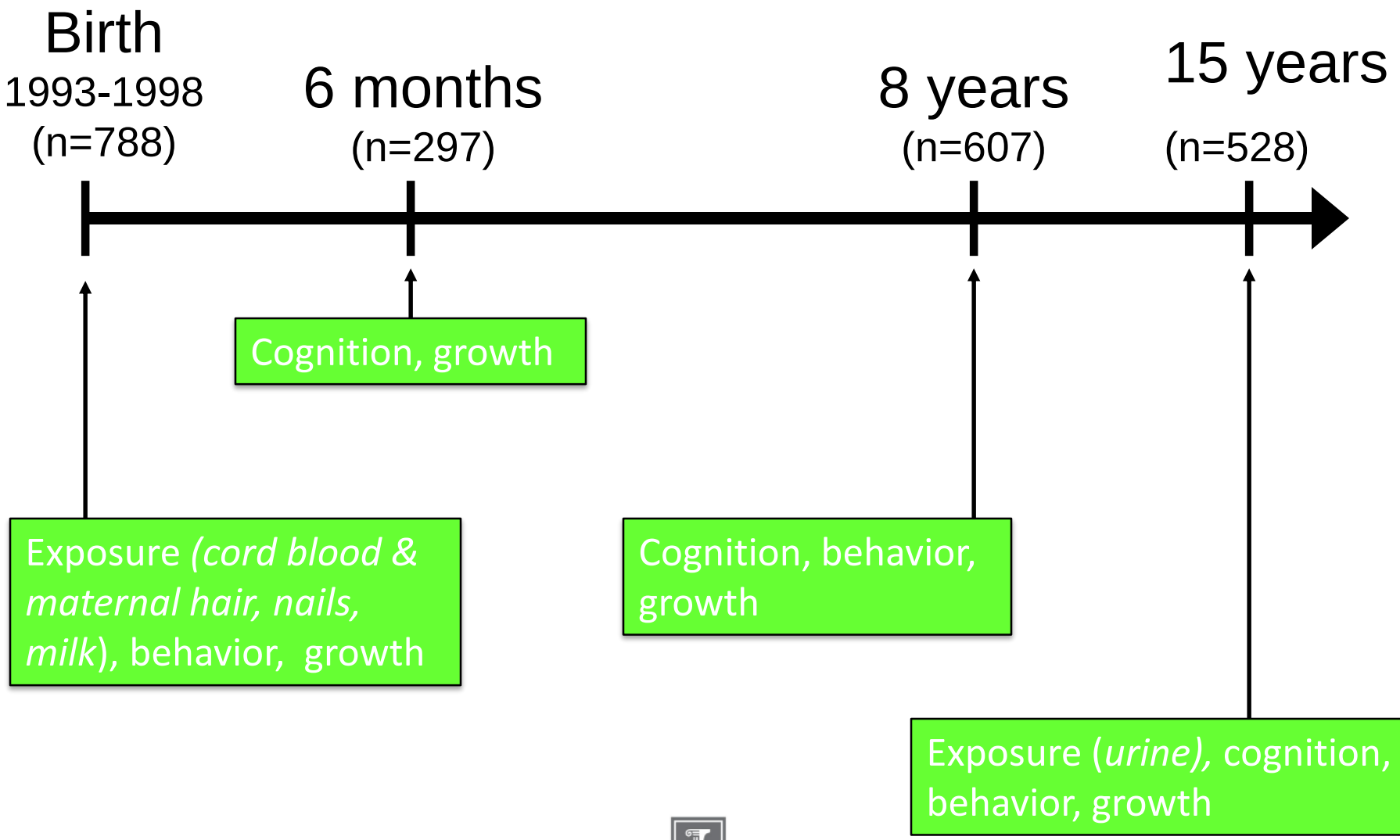
Susan Korrick

New Bedford Birth Cohort Study (NBC)

- 788 newborns enrolled at birth (1993-1998).
- Maternal residence in towns next to PCB-contaminated harbor in New Bedford, MA.
- Parent study goal to assess PCBs, OC pesticides, metals and child development.



Study Design and Timeline



Outcome Assessment

Visual Motor Abilities

Wide Range Assessment of Visual Motor Abilities (WRAVMA)

Verbal Abilities

Wide Range Achievement Test (WRAT-4: Reading)

Verbal Memory (WRAML2)

Math skills

Wide Range Achievement Test (WRAT-4: Math)

Executive Function:

Working Memory (WRAML2)

ADHD-related Behavior

Conners' Attention Deficit Scale (CADS)

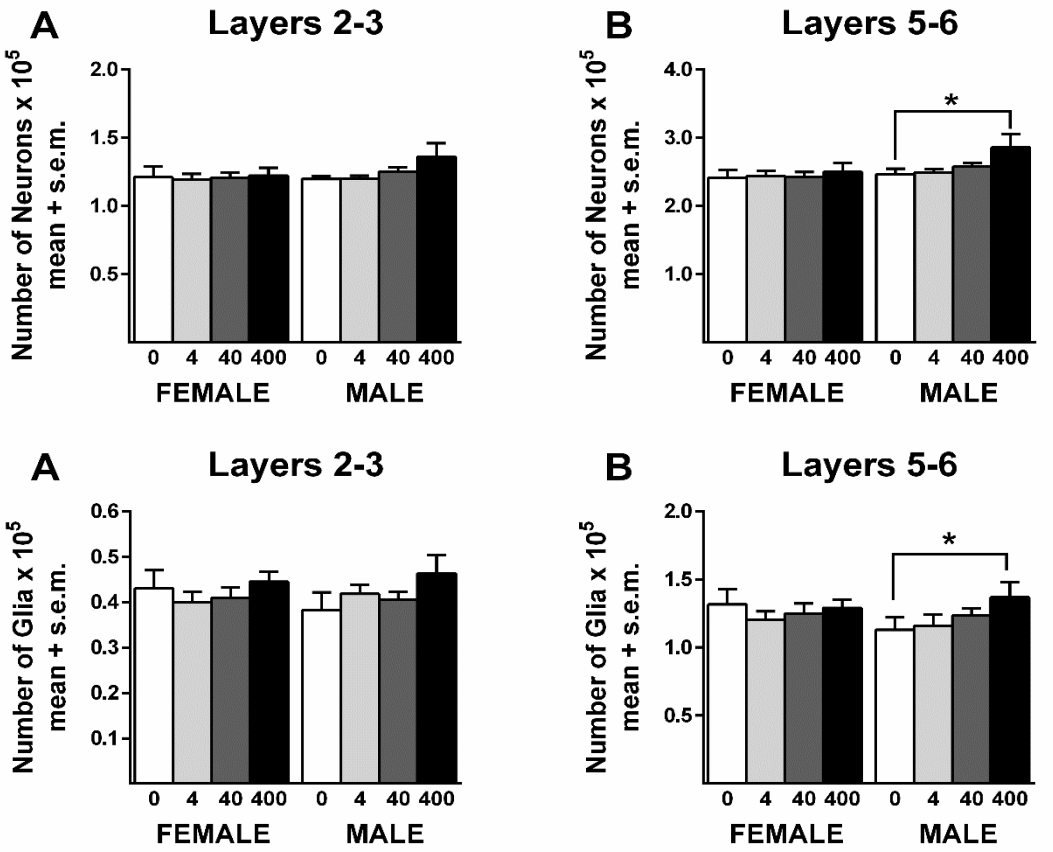
Psychiatric Symptoms

Behavioral Assessment System for Children (BASC-2: teacher, parent, self)

Social Cognition

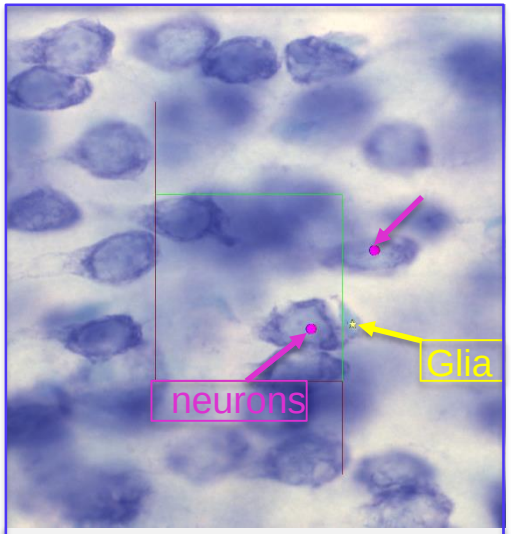
Developmental Social Disorders (BASC-2)

Neuron and Glia Numbers after Perinatal BPA Exposure



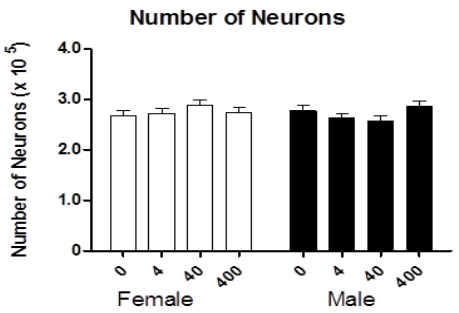
Neuron and glia numbers are increased in the prefrontal cortex of BPA-exposed male rats.

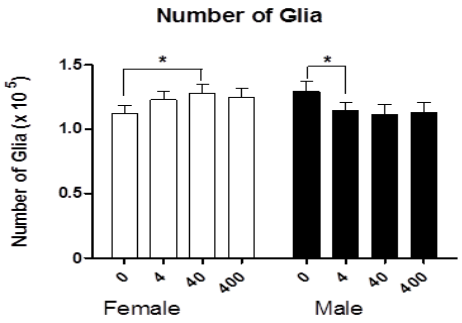
Janice Juraska



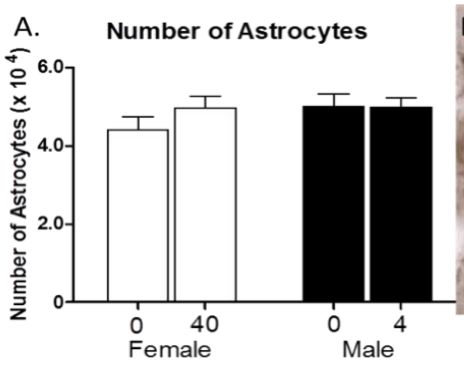
Methylene Blue/Azure II stained section from the prefrontal cortex.

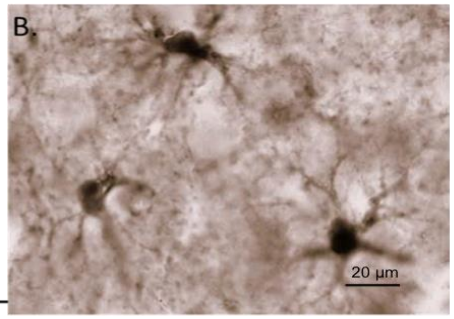
Neuron and Glia Numbers after Adolescent BPA Exposure

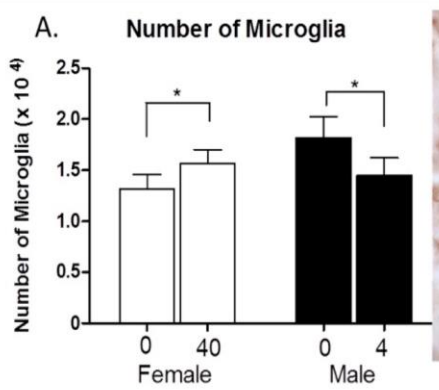


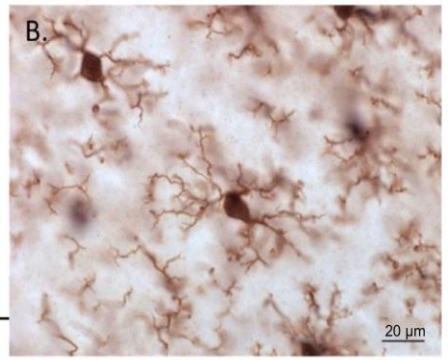


Glia numbers were increased in females and decreased in males.









There was no change in astrocytes but microglia were increased in females and decreased in males.

Summary

- Using complementary studies in animal models and humans to identify risks from chemical exposures.
- Studying exposure during two key developmental periods: prenatal and adolescent.
- Focusing on basic building blocks of cognition (information processing, attention and memory) that are relatively stable across time.
- Addressing whether EDCs disrupt typical male-female differences in cognition.
- Using animal models to determine if there are underlying changes in brain development.