Assessment of Neurodevelopmental Outcomes in the National Children's Study

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Introduction

- Fewer than 25% of neurodevelopmental disabilities that affect 3–8% of the 4 million babies born each year have a known etiology (Weiss and Landrigan, 2000).
- Some neurotoxic effects can occur after long latent periods; e.g., effects of prenatal exposure to chemical substances may not be apparent until later in childhood, adolescence, or in adulthood.
- Because alterations in neurobehavioral development can be expressed through a number of different structural and functional endpoints, assessments of multiple endpoints are necessary to characterize the effects of environmental agents on neurobehavioral development.
- In addition, the role of developmental insults in the etiology of psychiatric disorders that are manifested in adolescence and young adulthood is of concern (Adams et al., 2000).

Projects Developed to Support the National Children's Study Neurodevelopmental Assessment

White Papers

- Identifying and selecting developmental measures
  - Longitudinal Assessment of Motor Development in Epidemiologic Research (Rosenbaum et al., 2005)
  - Psychiatric Assessments in Children from a Longitudinal Epidemiologic Perspective (McClellan et al., 2005)
  - Neuropsychological Assessments in Children from a Longitudinal Perspective (White et al., 2005)
  - Assessing Social-Emotional Development in Children from a Longitudinal Perspective (Denham et al., 2005)
- Lessons learned papers from the Children's Environmental Health Centers - Mini-monograph in EHP

Workshops

- Gene-Environment Interactions and the Regulation of Behavior Workshop — June 2–3, 2004
- Neurobehavioral Development and Environmental Exposures Workshop: Measures for the National Children's Study — September 27–28, 2004

Pilot Studies

- Measures of Spontaneous Motor Activity for Behavioral Assessment – Animal and Human Infants
- Assessment of Neurobehavioral Toxicity in Human Infants and Laboratory Animals

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Results from these and other projects sponsored by the National Children's Study are being used in developing the Study Protocol, which will specify measurements and data collection methods.

White papers and workshop reports are available on the Study Web site at www.nationalchildrensstudy.gov

Domains Considered Important for Neurobehavioral Assessment

The Neurobehavioral Development and Environmental Exposures Workshop (September, 2004) recommended including a series of integrated measures in four broadly-defined domains: Cognitive/Executive Function, Motor Function, Sensory Function, and Social/Emotional Development and Psychiatric Disorders.

In each domain, the functions considered important for assessment during the first 4 years are shown in the tables. Specific tools available for measurement at these ages are discussed in the workshop report.

In addition to many other recommendations, the social/emotional and psychiatric breakout group recommended (1) evaluating aberrant or pathological behaviors as well as variations in the range of social and emotional behaviors in order to determine environmental contributions and the extent to which early variations are predictive of later social/emotional and mental health outcomes; (2) "banking" videotapes for future analyses; and (3) using new and emerging technologies for data collection and processing.

Age at Assessment	Newborn	6 Mos	12 Mos	18 Mos	2 Yrs	3 Yrs	4–5 Yrs
Cognitive/Executive Function							
General mental ability, language processing, visual-perceptual processing			✓		✓		✓
Learning and memory			✓		✓		✓
Attention and executive functioning			✓		✓		✓
School readiness and academic achievement							✓
Motor Function							
Motor tone, reflexes	✓						
Motor development		✓	✓	✓	✓		
Motor proficiency							✓
Vestibular-proprioceptive function							✓ (beginning at 8 yrs)
Sensory Function							
Auditory function	✓	✓	✓		✓		✓
Visual function		✓	✓		✓		✓
Gustatory response	✓						
Olfaction	✓						
Somatosensory integrity	✓				✓		✓
Social/Emotional Development and Psychiatric Disorders							
Temperament		✓	✓	✓	✓	✓	✓
Parent-child interaction		✓		✓	✓	✓	✓
Social-emotional status			✓	✓	✓	✓	✓
Psychiatric assessment			✓	✓	✓	✓	✓
Parent's mood, mental health, reading ability, stress		✓	✓	✓	✓		
Home environment					✓		
Neighborhood characteristics					✓		

Lessons Learned from the NIEHS/EPA Centers for Children's Environmental Health and Disease Prevention Research:

Principles and Practices of Neurodevelopmental Assessment in Children

The "Lessons Learned" papers were commissioned by the National Children's Study from the NIEHS/EPA Centers for Children's Environmental Health and Disease Prevention. One of the papers focused on neurodevelopmental assessment.

NIEHS/EPA Children's Centers Locations

Selected Conclusions and Recommendations — Neurodevelopmental Assessment

- Population factors including ethnicity and language must be considered in selection of neurodevelopmental measures. Ideally, examiners should be familiar with the language and culture of the population under study.
- Any compound that retards intrauterine somatic growth should be examined as a potential neurobehavioral teratogen.
- Animal studies have potential for identifying key functional domains and some of the Children's Centers are using animal models to understand effects of exposures and mechanisms.

Reference

Dietrich KN, Eskenazi B, Schantz S, Yolton K, Rauh VA, Johnson CB, Alkon A, Canfield RL, Pessah IN, and Berman RF. 2005. **Principles and Practices of Neurodevelopmental Assessment in Children: Lessons Learned from the Centers for Children's Environmental Health and Disease Prevention Research** *Environmental Health Perspectives* 113:1437–1446 (2005). doi:10.1289/ehp.7672. [Online 24 June 2005] http://ehp.niehs.nih.gov/docs/2005/7672/abstract.html

Summary and Future Direction

- A number of pilot studies, workshops, and reports examining different aspects of neurodevelopment and behavior have been conducted as part of the planning process for the National Children's Study.
- These pilot activities relied on the input of experts from a broad range of disciplines.
- Results of these efforts are now being used to inform development of the Study Protocol for the National Children's Study.

Implementing the National Children's Study: Scientific Progress, Challenges, and Opportunities

Study Assembly Meeting

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THE NATIONAL CHILDREN'S STUDY

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