

## Introduction

- No dichotomy between nature (genetic and other biological factors) and nurture (environment and experience), but an interplay between them
- Brain not fully mature until 20 to 25 years after birth
- Adult brain is highly differentiated; infant brain is not. Experience will shape it.

## Plasticity

- **Neuroplasticity**: The changing of the brain's neural connections because of experience
- Three profiles of plasticity:
  - Constrained: not highly modifiable
    - Examples: Circuits that transmit discomfort and central vision
  - Highly modifiable dependent on experience, but only during certain sensitive periods
    - Sensitive periods: windows of opportunity that vary between and within systems
    - Examples: Visual acuity and depth perception, sound and grammar aspects of language
  - Highly modifiable throughout life
    - Examples: Skills, knowledge, vocabulary
- **Pruning**: Loss of unused or redundant neural connections

## Lab-Based Research into Brain Plasticity

**Empirical studies**: Experiments that test specific hypotheses; have stringent controls for other hypotheses, and produce carefully analyzed data.

- Methods used in this lab:
  - Psychometric assessments
    - Example: vocabulary tests
  - Non-invasive brain imaging:
    - Event Related Potentials (ERPs):
      - ♦ Measure voltage fluctuations in response to stimuli
      - ♦ Reveal time course of neural response
    - Magnetic Resonance Imaging (MRIs):
      - ♦ Spatial images of regions of the brain where activity is taking place
- Studies of the vision of congenitally deaf vs. hearing people:
  - Central and color vision is the same (constrained plasticity): ventral pathway
  - Deaf people have better motion perception, peripheral vision, and attention (system is modifiable): dorsal pathway.
  - Dorsal pathway more plastic: enhancements in deaf, vulnerability in developmental disorders
- Language studies:
  - Language systems are within left hemisphere of brain.
  - Phonology: Sounds of language
    - Highly modifiable and dependent on experience, but only during certain sensitive periods
  - Grammar: System of linking words together to make sense
    - Highly modifiable and dependent on experience but only during certain sensitive periods
  - Semantics: Words that refer to particular objects, descriptions, and events; vocabulary
    - Highly modifiable throughout life

- *Focalization*: Specialization; indicates more mature organization of the brain
  - Adults and children with better language skills have more focalized brain responses to grammatical and semantic errors.
- Intervention study with Head Start children
  - Studied the children before intervention:
    - Health and developmental histories
    - Psychometric tests
    - Attention skills
  - Randomly assigned children to six groups for study:
    - Parenting classes
    - Small group sessions:
      - ◆ Music
      - ◆ Language
      - ◆ Attention
      - ◆ Small control group
      - ◆ Large control group
  - Conclusions:
    - Attention can be modified
    - Better attention skills improve performance in many spheres of life.

**Related Films Also Available from Davidson Films**

*This is one of four films in Davidson Films' "Neuroscience" series. The other titles are:*

- *Discovering the Human Brain: New Pathways to Neuroscience* (2006) 29 Minutes
- *Making Sense of Sensory Information* (2008) 30 Minutes
- *The Emotional Brain: An Introduction to Affective Neuroscience* (2009) 33 Minutes

*Another related film is:*

- *Building Literacy Competencies in Early Childhood* (1996) 31 Minutes