

Education 173
Cognition and Learning in
Educational Settings

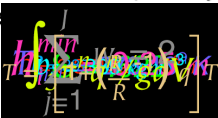
Intelligence
Fall Quarter 2007

More than Ever, Intelligence
Matters

- To Promote Economic Prosperity
 - Shift from physical to mental
production
- Solving Complex Social and
Technological Problems

Defining Intelligence

Intelligence is a repertoire of learnable
cognitive competencies (knowledge, skills,
strategies, habits) that permit
effectiveness in a complex, symbol-rich,
and problem-rich environment



Gardner's Multiple Intelligences

The Eight Intelligences		
Intelligence	End-States	Core Components
Logical-mathematical	Scientist, Mathematician	Sensitivity to, and capacity to discern, logical or numerical patterns; ability to handle long chains of reasoning.
Linguistic	Poet, Journalist	Sensitivity to the sounds, rhythms, and meanings of words; sensitivity to the different functions of language.
Musical	Composer, Violinist	Abilities to produce and appreciate rhythm, pitch, and timbre; appreciation of forms of musical expressiveness.
Spatial	Navigator, Sculptor	Capacities to perceive the visual-spatial world accurately and to perform transformations of one's initial perceptions.
Bodily-kinesthetic	Dancer, Athlete	Abilities to control one's body movements and to handle objects skillfully.
Interpersonal	Therapist, Salesman	Capacities to discern and respond appropriately to the moods, temperaments, motivations and desires of other people.
Intrapersonal	Person with detailed, accurate self-knowledge	Access to one's own feelings and the ability to discriminate among them and draw upon them to guide behavior; knowledge of one's own strengths, weaknesses, desires, and intelligences.
Naturalist	Botanist, Geologist, Archaeologist	The ability to distinguish among, classify, and use features of natural and artificial environments.

Note: The description and end-states for the last listed intelligence, naturalist, are taken from the Project SUMIT website (<http://pcweb.harvard.edu/SUMIT/SUMIT.HTM>) and Gardner, 1997. All others are from Gardner & Hatch, 1989.

MI Theory: Claims and Evidence

- Eight "relatively autonomous" intelligences
- Multiple criteria including
 - Selective brain impairment
 - Adult expert end-states
 - Associations with symbol systems
 - Prodigies and savants

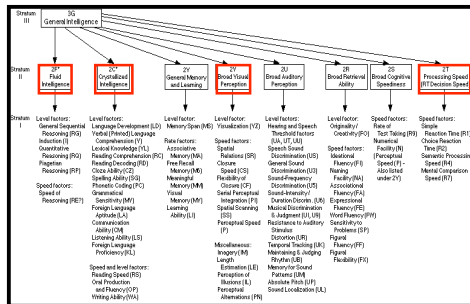
Sternberg's Successful Intelligence

- Three Forms of Intelligence
 - Analytical
 - Academic and abstract; essentially traditional intelligence
 - Creative
 - Divergent production; captions for cartoons
 - Practical
 - Real-life situations; tacit or implicit knowledge
- In the Rainbow Study, tests of creative and practical intelligence added to the SAT's ability to predict first-year college grades.

Emotional Intelligence

- Ability to understand one's own emotions
 - Compare with Gardner's interpersonal and intrapersonal; with social intelligence
 - Popularized by Daniel Goleman
- Is it really an intelligence?
 - Some evidence suggests, yes
 - Factorially coherent
- Does it address a neglected ability?

Carroll's Hierarchical Model

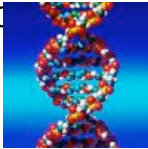


Fluid and Crystallized Intelligence

- **Fluid:** the ability to succeed in novel, complex, and challenging environments
- **Crystallized:** the ability to acquire knowledge, and knowledge itself

What About Genetics?

- The heritability (h^2) of IQ is about 0.5
- 50% of IQ is *non-genetic*



Two Kinds of Twins

- Monozygotic (genetically identical)
- Dizygotic (genetically, no more closely related than any two siblings)



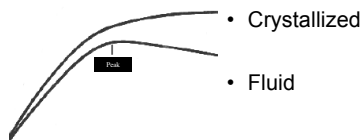
Conceptual Limitations of h^2

- Genes Shape The Environment
 - Reactive Covariance
 - Active Covariance
 - Heritability increases with age
 - Greater freedom to choose experience
 - What is nature? What is nurture?
- Environment Shapes Gene Function

Heritability Does Not Preclude IQ Change

- Within individuals
 - Childhood: Escalating mental age
 - Lifelong: Up/down IQ fluctuation (up to 20 pts.)
- Between generations
 - Height h^2 is close to 1.0
 - And yet, height has increased by 3 cm or more per generation (Europeans, Americans, Asians).

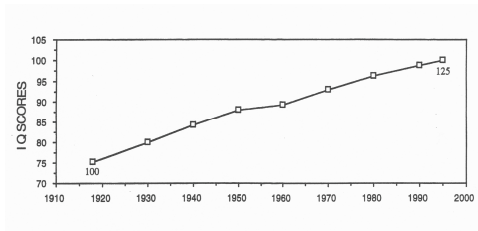
Fluid and Crystallized Intelligence Change Over the Life Span



The Flynn Effect

- IQ rose in 20th century in every country (20) for which data are available
- About 1 standard deviation per generation
- Demonstrates the intergenerational plasticity of IQ

Rising IQ Scores in the U.S.

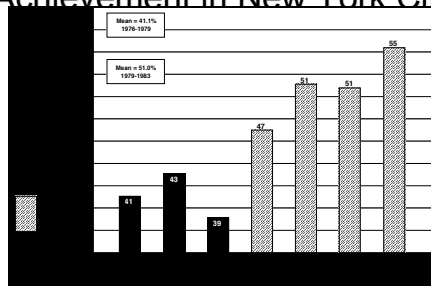


What Caused The Flynn Effect?

- Improved Nutrition
- Mass Media
- Universal Education
- Longer Average Education



Nutrition and School Achievement in New York City



Intelligence and Experience

- Prenatal
- Family
- School
- University
- Job



Prenatal Experience

- Can Inhibit Cognitive Development
 - Toxins: fetal alcohol syndrome, cigarette smoke, pesticides, radiation, barbiturates, methylmercury, polychlorinated biphenyls
 - Infection
- Can Facilitate Cognitive Development
 - Vitamin/protein supplementation
 - Breastfeeding

Family Experience

- Home Environment
 - Cognitive and emotional richness
 - Play materials, interaction, variety of experiences
 - Maternal education
- Socioeconomic Status (SES)
 - Income, parental education, flexible structure
 - Cross-SES adoption studies

Cross-SES Adoption Study

	High SES Adoptive	Low SES Adoptive
High SES Biological	119.6	107.5
Low SES Biological	103.6	94.2

School Experience

- Research shows that IQ is correlated with the number of years of schooling.
- If children begin with comparable IQ scores, then the child with more formal education will have a higher adult IQ, on average.

English Canal Boat Children

