Intelligence and Academic Achievement

How Children Develop

Chapter 8

Definitions of Intelligence

Dictionary definition: “faculty of thought and reason”

What behaviors are typical of intelligent people?
Definitions of Intelligence

Dictionary definition: “faculty of thought and reason”

What behaviors are typical of intelligent people?

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What behaviors are typical of intelligence at:
  - 6 months
  - 2 years
  - 10 years?

The Study of Intelligence

Research in this area raises many of the most controversial issues about human nature:
  - The roles of heredity and environment
  - The influence of ethnic and racial differences
  - The effects of wealth and poverty
  - The possibility of improvement
Alfred Binet: The holistic view

Asked people to apply functions of intelligent behavior:

**memory, judgment, abstraction.**

Devised test of “general mental ability” or “g”

- First developmental test: Intelligence based on age at which child could do tasks.

Tasks on intelligence tests are positively correlated:

- Overall scores correlate with school grades, test performance, information-processing speed, knowledge of non-studied subjects, and speed of neural transmission.
2 types of intelligence

- **Crystallized intelligence**—factual knowledge of the world (e.g., word meaning)
  - Tends to increase across the life span

- **Fluid intelligence**—ability to think on the spot (e.g., solve novel puzzles)
  - Tends to peak early in adulthood

- Tests for each intelligence correlate more with each other

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**Carroll’s three-stratum model of intelligence**

In Carroll’s three-stratum model of intelligence, general intelligence \( g \) influences several intermediate-level abilities, and each intermediate-level ability influences a variety of specific processes. As this model suggests, intelligence can be usefully viewed as a single entity, as a small set of abilities, or as a very large number of particular processes.
### Gardner's Theory of Multiple Intelligences

<table>
<thead>
<tr>
<th>Type of Intelligence</th>
<th>Description</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Linguistic intelligence</td>
<td>Sensitivity to the meanings and sounds of words; mastery of syntax; appreciation of the ways language can be used</td>
<td>Poet, Political speaker, Teacher, Mathematician, Scientist</td>
</tr>
<tr>
<td>Logical-mathematical intelligence</td>
<td>Understanding of objects and symbols, of the actions that can be performed on them and of the relations between these actions; ability for abstraction; ability to identify problems and seek explanations</td>
<td>Artist, Engineer, Chess master</td>
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<tr>
<td>Spatial intelligence</td>
<td>Capacity to perceive the visual world accurately, to perform transformations upon perceptions and to re-create aspects of visual experience in the absence of physical stimuli; sensitivity to tension, balance, and composition; ability to detect similar patterns</td>
<td>Musician, Composer</td>
</tr>
<tr>
<td>Musical intelligence</td>
<td>Sensitivity to individual tones and phrases of music; an understanding of ways to combine tones and phrases into larger musical rhythms and structures; awareness of emotional aspects of music</td>
<td>Musician, Composer</td>
</tr>
<tr>
<td>Naturalistic intelligence</td>
<td>Sensitivity and understanding of plants, animals, and other aspects of nature</td>
<td>Biologist</td>
</tr>
<tr>
<td>Bodily-kinesthetic intelligence</td>
<td>Use of one's body in highly skilled ways for expressive or goal-directed purposes; capacity to handle objects skillfully</td>
<td>Dancer, Athlete, Actor</td>
</tr>
<tr>
<td>Intrapersonal intelligence</td>
<td>Access to one's own feeling life; ability to draw on one's emotions to guide and understand one's behavior</td>
<td>Novelist, Therapist, Patient</td>
</tr>
<tr>
<td>Interpersonal intelligence</td>
<td>Ability to notice and make distinctions among the moods, temperaments, motivations, and intentions of other people and potentially to act on this knowledge</td>
<td>Political leader, Religious leader, Parent, Teacher, Therapist</td>
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</table>

Source: Gardner (1993)
Infant Intelligence Tests

Most measure perceptual and motor responses

Bayley Scale of Infant Development

1. Mental Scale: e.g., turning to sound, naming pictures.
2. Motor Scale: e.g., grasping, sitting, jumping.

But, poor predictors of later intelligence. WHY?

New version: categorization, problem solving, and memory.
Best intelligence predictor from infancy?

Habituation procedure

Bornstein & Sigman (1986): median predictive correlation = 0.47.

Infants tested at 4 to 7 months and retested later (IQ, vocab, reading): Correlation: 0.42.

Infant habituation predicts vocabulary size at 1 and IQ at 4.

Note: measure is speed of habituation not test behavior.

What is measured?
Measuring Intelligence

• Measuring intelligence is different at different ages

• What’s on a test? *Here is an example:*

  *Wechsler Intelligence Test for Children (WISC)* (6 and older)

<table>
<thead>
<tr>
<th>Verbal Section</th>
<th>Performance Section</th>
</tr>
</thead>
</table>
| • Crystallized intelligence  
  • Tests general knowledge  
  • Subtests:  
    ▪ Information  
    ▪ Vocabulary  
    ▪ Similarities  
    ▪ Arithmetic  
    ▪ Comprehension  
    ▪ Digit Span | • Fluid intelligence  
  • Tests spatial and perceptual abilities  
  • Subtests:  
    ▪ Picture Completion  
    ▪ Picture Arrangement  
    ▪ Block Design  
    ▪ Object Assembly  
    ▪ Coding  
    ▪ Mazes |

Intelligence
Intelligence Tests for Children

Stanford-Binet Intelligence Scale (2-adult)

Measures general intelligence and four factors:

- Verbal, Quantitative, Abstract/visual reasoning + ST memory

1. Verbal & Quantitative = crystallized (cultural) intelligence

2. Abstract/visual reasoning = fluid intelligence

Supposed to be sensitive to culture and sex

Intelligence Quotient (IQ)

- Stanford-Binet gives overall quantitative measures of a child’s intelligence relative to that of other children of same age

- producing the Intelligence Quotient, or IQ.
Intelligence Quotient (IQ)

- IQ computation is based on a normal distribution of scores,
  - A pattern of data in which scores fall symmetrically around a mean value, with most scores falling close to the mean and fewer scores at the high and low ends.

A Normal Distribution in IQ Scores

![IQ Distribution Chart]

- 0.13% for scores below -3 SD
- 2.14% for scores between -3 SD and -2 SD
- 13.59% for scores between -2 SD and -1 SD
- 34.13% for scores between -1 SD and the mean
- 34.13% for scores between the mean and +1 SD
- 13.59% for scores between +1 SD and +2 SD
- 2.14% for scores between +2 SD and +3 SD
- 0.13% for scores above +3 SD
What and How Well Do Intelligence Tests Predict?

Stability of IQ scores

There are two generalizations about stability:

The older the child at first testing, the better the prediction of IQ

\[
\begin{align*}
2-5 &= .32 \\
5-8 &= .70 \\
9-12 &= .85
\end{align*}
\]

The closer in time the two tests, the stronger the relationship

\[
\begin{align*}
4-5 &= .72 \\
4-6 &= .62 \\
4-18 &= .42
\end{align*}
\]

Intelligence

• Before 5-6, IQ measures present ability, not a stable measure.

Why?

1. Differences in nature of items (concrete vs. abstract)?
2. Different stage (spurts) experienced earlier or later?

Stability of Absolute Scores

• Longitudinal research: from childhood to adolescence IQ fluctuates 10-20 points

Gainers:
Decliners:
• Before 5-6, IQ measures present ability, not a stable measure.

Why?
1. Differences in nature of items (concrete vs. abstract)?
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Stability of Absolute Scores

• Longitudinal research: from childhood to adolescence IQ fluctuates 10-20 points

Gainers: more
Decliners: parents show

IQ as predictor of scholastic performance

Intelligence tests DO predict academic achievement:
Correlations from .40 to .70. Most around .50.

Why?
1. IQ and achievement depend on abstract reasoning or “g”
2. IQ and achievement tap same culturally specific info.
IQ as predictor of scholastic performance

Is it genes or experience?

- About 50% of the variation in IQs among Euro-Americans is attributable to genetic variation.
- IQ-achievement correlation higher in identical than fraternal twins.
- But, IQ is increased by years of schooling.

Note: motivation and personality also important.

IQ as predictor of occupational attainment/performance

2nd grade: high IQ predicts becoming lawyer, scientist, etc.

IQ also correlates with on-the-job performance

But: other variables important: “need to achieve”, family background
Effects of IQ and Education on Income

Racial & Socioeconomic Differences in IQ

The outcomes predicted by IQ vary by race/ethnicity/SES.

- Asian-American scores are higher than those of any other group in the United States.
- Low SES children score 9 points lower than middle SES children.

Are early differences genetic? Or fewer opportunities for some racial/ethnic groups?
Racial & Socioeconomic Differences in IQ

Does SES account for racial discrepancy? **Yes and no.**

- If matched for SES, still a 10 point difference.

But: individual differences: **curves overlap**

**Level I** = rote learning

**Level II** = complex cognitive processing.

- Claimed differences due to Level II not Level I.

**But, what about culturally loaded questions?**

Jenson: black children do worst on least culturally loaded questions – problem solving

But: when black children grow up in a white middle-class home?

They attain IQ scores 20 points above mean of black children in low SES communities

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**Risk Factors and Intellectual Development**

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<th>TABLE 8.2</th>
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<tbody>
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<td><strong>Risk Factors Related to IQ Scores</strong></td>
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<tr>
<td>1. Head of household unemployed or working in low-status occupation.</td>
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<tr>
<td>2. Mother did not complete high school.</td>
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<tr>
<td>3. At least four children in family.</td>
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<td>4. No father or stepfather in home.</td>
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<td>5. African-American family.</td>
</tr>
<tr>
<td>6. Large number of stressful life events in past few years.</td>
</tr>
<tr>
<td>7. Rigidity of parents’ beliefs about child development.</td>
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</table>

Source: Sameroff et al. (1993)
Interventions

- Many home- and center-based intervention programs were initiated in the 1960s to enhance the intellectual development of poor children
  - Of eleven early-intervention programs, Lazar found that initial IQ gains were lost over time
  - However, participation linked to reduced rates of school failure, higher rates of high school graduation, and higher earnings as adults
Project Head Start

- Has provided a range of services to more than 13 million children for 35 years
- At present, serves about 1 million 3- to 5-year-olds each year in approximately 2,000 centers around the United States
  - Children receive medical, dental, and nutrition services as well as intellectual stimulation and day care
  - Emphasizes involving family and community; building on children’s strengths; and fostering social, emotional and physical as well as intellectual growth
  - Long-term results are consistent with those of other early intervention programs

Does Schooling Influence IQ?

Intelligence affects achievement: does schooling affect intelligence?\n

Suggests that events in classroom have profound effects:

Summer:
- A small drop in IQ over summer, especially low income children.
- Advantaged children in summer activity show no decline
What other features of schooling?

Irregular attendance: has larger impact on IQ.

Regular schooling gives 10-30 point advantage.

Delayed entry: 5-7 point loss per year delayed schooling.

Drop out: each year not completed loses 1.8 points.

Ceci (1991) claims schooling influences IQ in three ways:

1. Teaches children factual knowledge relevant to questions
2. Promotes IP skills (memory strategies) tapped by test
3. Encourages attitudes and values for successful test taking

Gifted Children

- Some gifted children display astonishing early facility in a particular area such as numbers or music, whereas a smaller number of others are exceptional in a wide range of intellectual areas.

- These globally gifted children often display signs of giftedness from very early in development.

- Exceptional early ability often, but not always, foreshadows outstanding later achievement.

- Exceptional ability in one area does not imply exceptional ability across the board.
Beyond IQ: The Development of Creativity

Creativity is often ignored in IQ tests. Why?

• People who are a “genius” are often highly creative.

Creativity in children: **convergent** and **divergent** thinking.

**Convergent thinking**: a single correct answer – typical IQ

**Divergent thinking**: generation of multiple possibilities.

IQ and divergent thinking poorly correlated: in intelligent adults is virtually zero.

Nature and nurture?

Creative children’s parents:

1. Encourage nonconformity & intellectual curiosity
2. Accept individual characteristics

School doesn’t help: answer-centered approach stops unusual ideas.