Types of Intelligence: What Does It Mean to Be Smart?
Intelligence

- What is intelligence?
- Are there different types of intelligence?
- If so, how many?
- Can intelligence be measured?
- Not all psychologists agree on the answers to these important questions

The ability to solve problems well and understand and learn complex material; the ability to adapt to the environment (p.380)
What Is IQ?

- IQ: Intelligence Quotient (p.381)
  - Score on an intelligence test
  - Meaning has changed over time
Intelligence Testing: History

- Alfred Binet and Theodore Simon (p.381)
  - Developed first intelligence test (1904-1911)
  - Identify students who need extra help
  - Test many normal children at each age
  - Compare individual’s score to “normal” scores
  - Mental age (MA)
  - Chronological age (CA)

- MA心理年齢. The concept of mental age was critical. Using this method, one could compare the MA of a child with his or her chronological age (CA 實足年齡) as determined by date of birth.
Intelligence Testing: History

- Lewis Terman (Stanford University)
  - Developed American version of the Binet-Simon test, called the Stanford-Binet test, for ages 2 to adult

- David Wechsler
  - Wechsler Adult Intelligence Scale (WAIS)
  - Wechsler Intelligence Scale for Children (WISC)
  - Performance and verbal subtests (p.382)
Calculating IQ智力之計算

- William Stern德國心理學家(p.383)
  - Problem: people don’t get stupider with age
    
    \[ IQ = \frac{\text{mental age}}{\text{chronological age}} \times 100 \]

- Modern approach
  - Compare individual to standardized sample
The Normal Curve

Population
Norming 常模
Mean
Standard deviation 標準差
A good test must be valid and reliable (p. 384)

Reliability
- Test produces consistent results

Validity
- Test measures what it is supposed to

The WAIS-III is highly reliable, but is it a valid measure of intelligence?
IQ and Achievement

IQ tends to be related to achievement
- High school and college grades
- Job prestige and salary
- Marital stability

However, IQ accounts for only a small amount of the variation in job success

Correlation is not causation

Motivation, education, culture are important

動機、教育、文化對智力之重要性
One Intelligence or Many?

- Charles Spearman (1904 智力二因論 p.386)
  - $g$: general factor
  - $s$: specific factors
  - Intelligence depends mostly on $g$
  - Factor analysis 因素分析
- Louis Thurstone (1938 基本心能論 p.387)
  - Separate primary mental abilities
  - Examples: verbal comprehension and spatial visualization 語言理解與空間視覺最為重要
Primary Mental Abilities

- Thurston (1938)
  - Associative Memory
  - Number
  - Perceptual speed
  - General Reasoning
  - Space
  - Verbal Comprehension
  - Word fluency
One Intelligence or Many?

- Raymond Cattell and John Horn (p.387)
  - Crystallized intelligence 固定智力
  - Fluid intelligence 流動智力

- Aging
  - Crystallized intelligence doesn’t suffer
  - Fluid intelligence tends to decrease
  - Different aging effects support the distinction
One Intelligence or Many?

- Carroll’s three-stratum model (1993) 智力三階層模式 (p.389)
  - Top strata is $g$, general intelligence
  - Second strata includes fluid and crystallized intelligence with 6 other broad cognitive abilities
  - Third strata includes 69 specific abilities
  - This hierarchical structure of intelligence is a grand synthesis of the earlier theories, fitting them all, into a single framework. (p.388)
Emotional Intelligence (EI)
Knowing feelings (p.391)

- Knowing your emotions
- Managing your feelings
- Self-motivation
- Recognizing others’ emotions
- Handling relationships
- Women tend to have higher EI than men
Multiple Intelligences (p.392)

Howard Gardner (8 or 9 forms of intelligence)(P.393)

- Linguistic intelligence
- Spatial intelligence
- Musical intelligence
- Logical-mathematical intelligence
- Bodily-kinesthetic intelligence
- Intrapersonal intelligence
- Interpersonal intelligence
- Naturalist intelligence
- Existential intelligence (tentative)
Gardner’s Theory of Multiple Intelligences
八大智能（如小組提供）

- 語文智能→有效運用口頭語言或書寫文字的能力。
  Ex：JK羅琳、金恩博士。
- 數學邏輯智能→有效運用數位和推理的能力。
  Ex：比爾蓋茲、居禮夫人。
- 視覺空間智能→可以準確感覺視覺空間，並把所知覺到的表現出來的能力。
  Ex：貝聿銘。
- 肢體運動智能→運用整個身體來表達想法和感覺，
  及運用雙手靈巧地生產或改造事物。
  Ex：Tiger Woods。
八大智能（琼如小组提供）

- **音樂智能**→察覺、辨別、改變和表達音樂的能力。
  Ex：馬友友、史蒂夫汪達。
- **人際智能**→察覺並區分他人的情緒、意向、動機及感覺的能力。
  Ex：邱吉爾、曼德拉。
- **內省智能**→對自己相當的了解，包括長處及短處，可以意識到自己的內在情緒、意向、動機、脾氣和欲求，以及自律、自知和自尊的能力。
  Ex：佛陀（德瑞莎修女）。
- **自然觀察者智能**→對周遭生活環境的認知與喜好的表現。
  Ex：達爾文。
Multiple Intelligences

Robert Sternberg (3 forms of intelligence)

- Analytic intelligence
- Practical intelligence
- Creative intelligence
Sternberg’s Triarchic Theory

**Componental Intelligence (Academic Ability)**
Abilities to solve problems, compare and contrast, judge, evaluate, and criticize.

**Experiential Intelligence (Creativity and Insight)**
Abilities to invent, discover, suppose, or theorize.

**Practical Intelligence ("Street Smarts")**
Abilities to adapt to the demands of one’s environment, apply knowledge in practical situations.
Brain Size and Intelligence

- Is bigger always better? \( (p.396) \)
  - Depends more on size of crucial brain areas
  - Females tend to have smaller brains but equal IQs
  - Correlation between size and intelligence is small
  - Correlation is not causation
IQ and Speed of Processing

- Is IQ correlated with speed of information processing? (p.397)
  - Mixed results
  - Those with higher IQs are better able to judge which of two briefly presented lines are longer
  - Measures of neural conduction are only weakly related to intelligence
Working Memory and IQ (p.397-398)

- IQ is correlated with working memory
  - May reflect the ability to focus attention and use WM efficiently
- WM is correlated with fluid intelligence
Adoption studies

- Correlation of IQs for identical twins raised apart is higher than that for fraternal twins and nontwin siblings raised together.
- An adopted child’s IQ correlates higher with the biological mother’s IQ than with the adoptive mother’s IQ.
- Strong evidence of the link between genes and IQ.
Genetic Relatedness and IQ (p.400)

The diagram illustrates the relationship between genetic relatedness and IQ, with different categories represented as bars.

- **Together**: This category shows the IQ correlation for genetically related individuals who live together.
- **Adopted–apart**: This category represents the IQ correlation for genetically related individuals who are adopted and live apart.
- **Adoptive**: This category indicates the IQ correlation for adoptive relationships.
- **Both**: This category combines all the previous categories.

The table below summarizes the data for each category:

<table>
<thead>
<tr>
<th>Relationship</th>
<th>Number of pairs</th>
<th>Genetic relatedness</th>
<th>Same home?</th>
</tr>
</thead>
<tbody>
<tr>
<td>P-O Sib</td>
<td>8,433 26,473</td>
<td>0.5 0.5</td>
<td>Yes Yes</td>
</tr>
<tr>
<td>P-O Sib MZ</td>
<td>720 203 93</td>
<td>0.5 0.5 1.0</td>
<td>No No Yes</td>
</tr>
<tr>
<td>P-O Sib</td>
<td>1,397 714</td>
<td>0.0 0.0</td>
<td>Yes Yes</td>
</tr>
<tr>
<td>MZ DZ</td>
<td>4,672 5,533</td>
<td>1.0 0.5</td>
<td>Yes Yes</td>
</tr>
</tbody>
</table>

**Family Designs**

**Adoption Designs**

**Twin Designs**
IQ: Genes and Environment

- Effects of environment (p.401)
  - Stoolmiller (1999) estimated the effects of the environment on IQ to be 57%
  - Microenvironment (微視環境)
  - Selecting the environment as we age
  - Reaction range/ range of reaction: the entire scope of possible reactions to environmental events, which is set by the genes. (p.403)
Group Differences in IQ

- Within-group versus between-group differences
  - Genetics accounts for 72% of IQ variation in affluent environments
  - Genetics accounts for 15% of IQ variation in impoverished environments
- Race differences
- Test bias
- Environmental differences
- Microenvironments
- Sex differences
Boosting IQ 智力上升 (p.409)

- The Flynn effect: Increase in IQ the overall population with the passage of time (p.409)
  - Average IQ increases 3 points every 10 years
  - Explanations?
    - Daily life is more challenging
    - Nutrition is better
    - Reasoning ability stressed by IQ tests has gotten better, not IQ itself
    - Hybrid vigor 混血活力：intermarriage among different populations tends to "weed out" receive genes
The Pygmalion Effect

Rosenthal & Jacobson (1968)

Teacher-student interaction can affect intelligence

- “Harvard Test of Inflected Acquisition”
- Random selection of children
- Self-fulfilling prophecy 自驗預言

what the teachers expected to happen, they made happen
Educational Programs and IQ

- Head Start and similar projects
  - Most show only short-term IQ gains
  - Most gains evaporate over time
- Abecedarian Project
  - Intellectual, medical, and nutritional enrichment
  - 5 years before kindergarten
  - Long-term 5-point IQ boost
Mental Retardation 智力遲緩 (p.414)

- IQ less than 70
- 4-7 million Americans
- Islands of excellence 在某方面表現特別傑出
  - Savants 例如：電影雨人
  - Williams syndrome: 威廉氏症候群
    - 一種罕見的基因缺陷疾病，約佔所有出生嬰兒的兩萬分之一。男女比率相同，大部份是偶發的，屬於自體顯性遺傳。
    - 智力障礙：大部份的病人智力及學習會有障礙，包括注意力不集中，過動、心智及運動發展遲緩等，但語言能力還不錯。
Mental Retardation

- Genetic influences
  - Down syndrome
  - Fragile X syndrome
  - Autism

- Environmental influences
  - Fetal alcohol syndrome (FAS)
  - Childhood diseases
  - Exposure to environmental toxins
  - Inadequate medical care
national down syndrome society

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“Full inclusion and acceptance!”
national down syndrome society

“Acceptance and Understanding.”
The Gifted 資賦優異 (p.416)

- IQ of 150-180
- Prodigies 非凡: Children who demonstrate immense talent in a particular area, such as music or math, but who are normal in other area. (p.417)
- Gifted child → Gifted adult?
Creativity 創造力 (p. 417-421)

The ability to produce something original of high quality or to devise effective new ways of solving a problem

- Two stages of creativity
  - Generate various possible solutions
  - Select among them
Creative People創意者(p.419)

- Characteristics
  - Use of analogies
  - High intelligence
  - Wide interests
  - Don’t like traditional dogma
  - High self-esteem
  - Work hard
  - Highly motivated and persistent
- No strong genetic relationship
- Creativity and mental stability?
Enhancing Creativity (p.421)

提升創意

- Redefine problems
- Analyze your own ideas
- Sell your ideas
- Knowledge is a double-edged sword
- Surmount obstacles
- Take sensible risks
- Be willing to grow
- Believe in yourself
- Tolerate ambiguity
- Find what you love to do and do it

Proposed by Sternberg (2001)