Intelligence

Chapter 10

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Outline for today

I. Definitions and types of intelligence
II. Measuring intelligence
III. Where intelligence originates
IV. Brain training games
V. Cognitive enhancers
VI. Collective intelligence

I. Definitions and Types of Intelligence

I. Definitions and Types of Intelligence

- Intelligence = the ability to direct one's thinking, adapt to one's circumstances, and learn from one's experiences (Gottfredson, 1997).
  - But is there just one ability that underlies all assessments of intelligence?

I. Definitions and Types of Intelligence

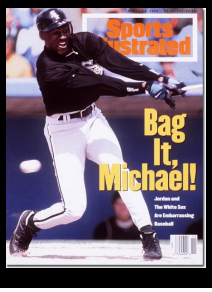
- Factor Analysis = a statistical technique that explains a large number of correlations in terms of a small number of underlying factors
- If there is a single general ability (i.e. intelligence) that enables people to perform a variety of tasks, then people who have this ability should do well on all tasks.
  - More specifically, people without the general ability should do poorly on all tasks
- So, is there is single general ability called "intelligence"?

I. Definitions and Types of Intelligence

- General Intelligence (g) = a variable that summarizes positive correlations among different cognitive tasks, reflecting the fact that an individual's performance on one type of cognitive task tends to be comparable to that person's performance on other kinds of cognitive tasks
- *g* accounts for 40 to 50 percent of the between-individual performance differences on a given cognitive test as well as IQ scores

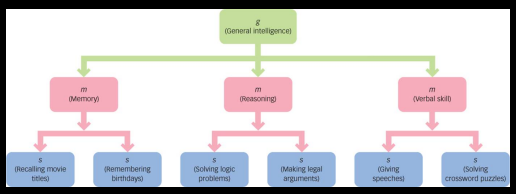
I. Definitions and Types of Intelligence

- Two-factor theory of intelligence – Every task requires a combination of a general ability and skills that are specific to the task



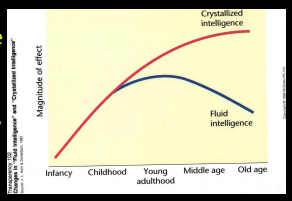
I. Definitions and Types of Intelligence

- Three-Level Hierarchy: people have a general ability called intelligence (*g*), which is made up of subset of middle-level abilities (*m*), which are made up of a task-specific abilities (*s*)



I. Definitions and Types of Intelligence

- Additional middle-level abilities:
  - Fluid intelligence = ability to see similarities, reason, and solve novel problems (i.e. reasoning problems)
  - Crystallized intelligence = ability to retain and use knowledge and skills that were acquired through experience (i.e. vocabulary, reading comp)



II. Measuring Intelligence

II. Measuring Intelligence

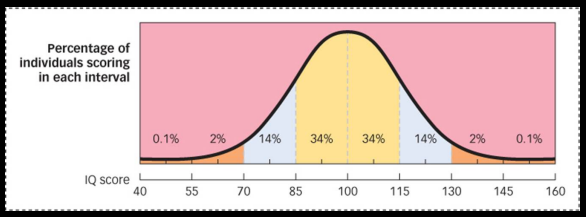
- Intelligence Quotient (IQ) was initially conceived as way to measure a child's "mental level"… Compute average test scores for different age groups and find the group to which a child scored
- To determine cognitive development of a child, compare mental age with "physical age" (actual age of child)
- Two ways to do this…

II. Measuring Intelligence

1. Ratio IQ: *(Mental Age ÷ Physical Age) × 100*
2. Deviation IQ: *(Test Score ÷ Test Score of Age Group) × 100*

- In both instances, average IQ is 100
- Ratio typically used for children, deviation for adults
- *Example: a 16 year old gets a score of 80 on an IQ-test. The average score for a 16 year old is a 65. 80 is the average score for a 20 year old.*

II. Measuring Intelligence

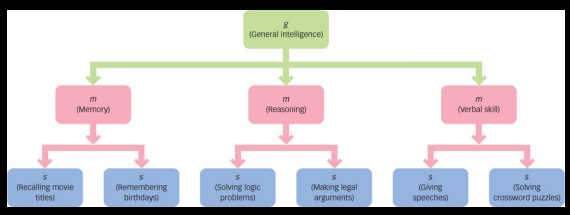


II. Measuring Intelligence

- Wechsler Adult Intelligence Scale (WAIS) is probably the most widely used intelligence test
- Battery of tasks including… identifying similarities/differences between ideas and objects, drawing inferences, applying rules, remembering/articulating meanings, recalling general knowledge…
  - Notice the similarities between these tasks and the specific and mid-level abilities of the Three-Level Hierarchy Model
  - Fluid and crystallized intelligence

II. Measuring Intelligence

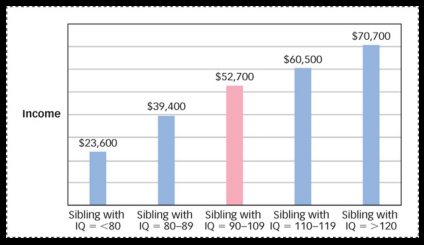
- Remember this??



II. Measuring Intelligence

- Tests measure general intelligence (*g), mid-level abilities (m), and task-specific abilities (s)*
- Produce scores (IQ) → IQ represents mental abilities within age group or with respect to others → IQ predicts life outcomes.
- Thus, intelligence tests (and therefore intelligence) can predict life outcomes

II. Measuring Intelligence



II. Measuring Intelligence

- There are many problems with IQ tests…
- What are they *actually* measuring?
  - Factor analysis has identified general intelligence as underlying performance across IQ tests, not the less-quantifiable concept of "being smart"
- Individual differences
  - IQ score can be skewed due to sub-groups of general intelligence model
  - 95% of gifted children show sharp disparity between math and verbal abilities
- Group differences
  - White routinely outscore Latinos, who outscore Blacks
  - Women outscore men on some tasks (semantic information), men outscore women on others (spatiotemporal reasoning)

II. Measuring Intelligence

- Why the differences between groups?
- Testing environment. Even if tests are unbiased (which can be debated), situations may not be
  - African Americans perform more poorly when asked to report race on answer sheet
  - Asian women perform worse on math tests when must report gender, but better when must report race
- Anxiety about confirming racial or gender stereotypes can harm test performance

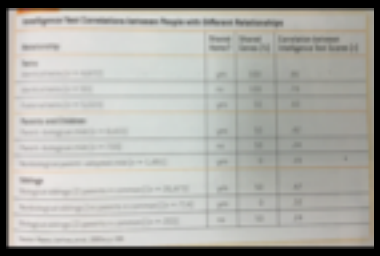
Where does intelligence come from?

III. Where Intelligence Originates

Genetic Influence

- Must be able to separate influence of genes from influence of environment. How?
- Twin studies: IQs of identical twins strongly correlated when they are separated at birth and raised in different households (r=.78)

III. Where Intelligence Originates



III. Where Intelligence Originates

Environmental Influence

- Socioeconomic Status (SES) influences…
  - Brain development. Low SES children have poorer nutrition and medical care, higher levels of daily stress, & more exposure to environmental toxins
  - Learning environment. Intellectual stimulation (i.e. reading to children, asking stimulating questions) more common in high SES families

III. Where Intelligence Originates

Environmental Influence

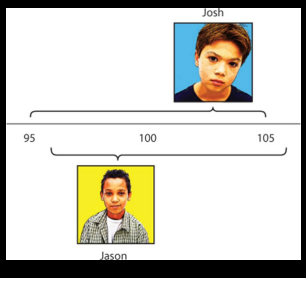
- Educational influences…
  - Correlation between amount of formal education and intelligence test scores is large (r = .55 - .90)
  - Education reliably increases intelligence BUT…
  - It's impact is small
  - And may tend to enhance test-taking ability more than general cognitive ability

III. Where Intelligence Originates

Epigenetic Construct

- Genes and environment interact in complex ways
- Such that even studies that attempt to look at individual aspects are not perfect
  - i.e. Separated twin adoption studies

III. Where Intelligence Originates



Okay… time for some application of all this

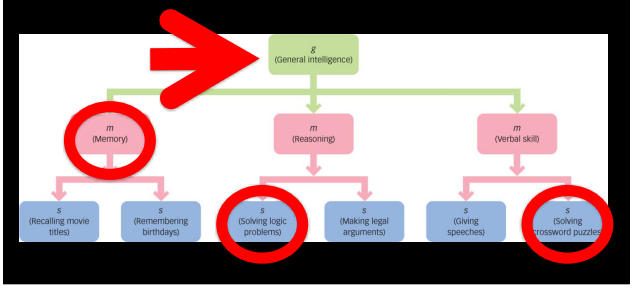
IV. Brain Training Games

lumosity

IV. Brain Training Games
The Lumosity Story

- "Based on extensive research, Lumosity improves memory, attention, processing speed, and problem-solving skills so you can feel more confident in your abilities."
- Brain training will "improve performance on everyday tasks…delay age-related decline in memory" and protect against "mild cognitive impairment, dementia, and Alzheimer's disease, and reduce cognitive impairment associated with the side effects of chemotherapy, post-traumatic stress disorder, traumatic brain injury, attention deficit hyperactivity disorder, Turner syndrome, stroke, and other health conditions."

One more time…



And this too…

- Educational influences…
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IV. Brain Training Games

What would it take?

1. Transfer to untrained tasks:
   - Training results in improvement in untrained tasks, NOT just trained tasks
   - Working memory training produces generalized gains to other skills (i.e. verbal ability, math)
2. Durable improvements:
   - Dose dependant relationship in that the more you practice, the longer the effects remain

V. Cognitive Enhancers


BUILDING A BETTER BRAIN:

WIRED ON NOOTROPICS

A new generation of "smart drugs" that promise to enhance cognitive ability are now available, but are they the key to the human race's next evolutionary leap or merely 21st century snake oil? ROLLING STONE finds out …

BY ANDREW McMILLEN

Illustration by AMANDA UPTON

ROLLING STONE, NOVEMBER 2012 | 79

V. Cognitive Enhancers

- "[on Adderall] I didn't want to stop what I was doing until it was completed up to a certain level of my satisfaction"
- "You're interested in what you're doing even if it's boring"
- "Adderall doesn't necessarily make you smarter [. . .], the main benefit, really, is that on it, I don't mind doing work."

V. Cognitive Enhancers

How/do they work??

- Inconclusive experimental evidence on whether or not Adderall and/or Ritalin provide any actual boost to cognitive abilities (coding, storing, manipulating information)
- Stronger evidence in support of motivational "boost" from amphetamines
  - Stimulant medication shown to increase dopamine activity in mesolimbic system = pathway crucial for motivation
  - Amphetamine increase self-reported level of enjoyment
- Students report increased energy and alertness

V. Cognitive Enhancers

Modafinil

- Another psychostimulant; used for the treatment of excessive daytime sleepiness in narcolepsy
- Directly inhibits central dopamine and noradrenaline uptake transporters
  - Results in elevation of extracellular concentrations of these neurotransmitters which in turn elevate concentration of other neurotransmitters such as serotonin and glutamate
- Modafinil intake appears to
  - Enhance executive function including fluid intelligence
  - Improve learning and memory, enhance attention in more complex tasks
  - With, little side effects and little potential for abuse

VI. Collective Intelligence (c)

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- Hypothesis: Groups, like individuals, have characteristic levels of intelligence (*g* in individuals, c in groups) that can be measured and used to predict the groups' performance on a wide variety of tasks
  - A property of the group itself, not just the people in it
- Alternative Explanation: Group performance has several equally independent factors. Groups that do well on one task do not necessarily do well on another

VI. Collective Intelligence (c)

- Woolley et al. (2010) created teams of participants.
- Found groups that did well on one task tended to do well on others = supports idea of single dominant "c factor" underlying group performance
- So what distinguish highly intelligent groups from lower intelligent ones?

VI. Collective Intelligence (c)

1. Significant correlation between *c* and social sensitivity of group members
2. Equal "turn-taking" in conversation – groups where a few people dominated conversation were less collectively intelligent
3. Positive and significant correlation with proportion of females in the group

Follow up work found same results even when group members completed tasks only through online communication!

Additional Readings

- http://www.latimes.com/business/hiltzik/la-fi-mh-if-you-weren-t-smart-enough-20160106-column.html
- http://www.nytimes.com/2015/01/18/opinion/sunday/why-some-teams-are-smarter-than-others.html
- http://www.nytimes.com/2016/02/28/magazine/what-google-learned-from-its-quest-to-build-the-perfect-team.html
- http://www.sciencedirect.com.proxy.library.georgetown.edu/science/article/pii/S0924977X15002497

Thank you!

- Georgetown Laboratory for Relational Cognition is always looking for new research assistants and volunteers
- Please reach out to me if you are interested in anything that was discussed in today's lecture and want to gain some experience in the lab!