Intelligence: One or Many?

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### 4 Theories

<table>
<thead>
<tr>
<th><strong>Number</strong></th>
<th><strong>Name</strong></th>
<th><strong>Content domains</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>7+</strong></td>
<td>Multiple intelligences</td>
<td>“Psychobiological potential to solve problems or fashion products that are valued in at least one cultural context”</td>
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<tr>
<td></td>
<td>Gardner, 1983</td>
<td>Linguistic Logical-mathematical</td>
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<td></td>
<td></td>
<td>Spatial Musical</td>
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<td></td>
<td></td>
<td>Bodily-kinesthetic Interpersonal Intrapersonal</td>
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<tr>
<td><strong>3</strong></td>
<td>Triarchic</td>
<td>“Process domains”</td>
</tr>
<tr>
<td></td>
<td>Sternberg, 1985</td>
<td>Analytical Creative Practical</td>
</tr>
<tr>
<td><strong>1</strong></td>
<td>g (~IQ)</td>
<td>General facility for learning and reasoning in all domains</td>
</tr>
<tr>
<td></td>
<td>Spearman, 1904</td>
<td>g factor</td>
</tr>
<tr>
<td></td>
<td>Jensen, 1998</td>
<td></td>
</tr>
<tr>
<td><strong>0</strong></td>
<td>Specificity</td>
<td>Many specialized abilities with narrow domain coverage</td>
</tr>
<tr>
<td></td>
<td>Guilford, 1967</td>
<td>150+</td>
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</tbody>
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Agree: An “intelligence” is a very broad, important, and enduring ability

Maybe agree: Intelligences are potentials for later achievement

Disagree: How broad and content-specific “intelligences” are
Which One Should Psychology Teach?

1. Which is most accurate, and how do we know?
   • 4 hypotheses/counter-hypotheses (of many)
2. What, then, should we teach?
3. How can we best teach it?
Common Impressions

• For “one intelligence”
  – People who do well on one test tend to do well on all others
  – Some people are “faster” learners than others

• For “multiple intelligences”
  – People tend to be stronger in some areas than others (verbal vs. quantitative, etc.)
  – There are different kinds of prodigies and geniuses
Large Network of Evidence

Personal traits ← Biological origins → Social outcomes
Large Network of Evidence

**Personal traits**
- Abilities
  - Personality
  - Social class
  - Race, sex, age
  - Health
  - Education
  - Etc.

**Social outcomes**
- Occupation level
  - Income
  - Job performance
  - School performance
  - Health/longevity
  - Law-abiding
  - Etc.

**Biological origins**
- Brain physiology
- Genes
  - Health
  - Nutrition
  - Prenatal conditions
  - Etc.

**Guiding question:** Which theory is most consistent with, best explains, and is least often contradicted by the totality of evidence?
My Unintended Journey Begins: Helping Career Counselors Help Clients (1980s)

- Personal traits
  - Social class
  - Interests

- Social outcomes

- Biological origins

OK, but what *abilities* do jobs require??

Field (Holland type)

Job level
First Step in My Journey (Pre-MI)

Personal traits
- Social class
- Interests

Social outcomes

Biological origins

Different abilities needed?

Field (Holland type)
My Analyses of Labor Dept. Job Aptitude Profiles

Personal traits
- Social class
- Interests

Social outcomes

Biological origins

Aptitude Demands
- Spatial
- Verbal
- Psychomotor
- IQ

Results: IQ more important in higher jobs (in all domains).
Narrower abilities useful in certain content domains.
Converging Evidence on IQ’s Import (Employment Test Studies)

IQ predicts better in higher jobs

Higher-level jobs draw higher-IQ workers

IQs: Middle 50%

<table>
<thead>
<tr>
<th>IQs of applicants for:</th>
<th>80</th>
<th>100</th>
<th>120</th>
<th>IQs:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attorney, Engineer</td>
<td></td>
<td></td>
<td></td>
<td>108-128</td>
</tr>
<tr>
<td>Teacher, Programmer</td>
<td></td>
<td></td>
<td></td>
<td>100-120</td>
</tr>
<tr>
<td>Secretary, Lab tech</td>
<td></td>
<td></td>
<td></td>
<td>96-116</td>
</tr>
<tr>
<td>Meter reader, Teller</td>
<td></td>
<td></td>
<td></td>
<td>91-110</td>
</tr>
<tr>
<td>Welder, Security guard</td>
<td></td>
<td></td>
<td></td>
<td>85-105</td>
</tr>
<tr>
<td>Packer, Custodian</td>
<td></td>
<td></td>
<td></td>
<td>80-100</td>
</tr>
</tbody>
</table>
Converging Evidence for Limited Import of “Broad” Abilities
(More Test Studies)

• Broad cognitive abilities (spatial, verbal, math, etc.)
  – Don’t predict much better in own domain than others
  – Don’t add much to IQ’s prediction, either singly or all together

• Same for performance in:
  – Jobs
  – Job training
  – School subjects

**Inference:** One general ability dominates all the narrower ones.
Counter-Hypothesis #1
(Sociology, 1970s)

• Higher IQ does *not* have functional value, because
  – Employers favor high IQ because they are irrational or favor “their own kind.”
  – Most job performance research relies on subjective ratings by supervisors.
  – IQ measures social class, not “merit.” “Intelligence” is a smokescreen for justifying privilege.

• How would you test this hypothesis?
Counter-Hypothesis #1
(Sociology, 1970s)

• It would predict that:
  – IQ predicts supervisor ratings better than *objectively* measured job performance
    Results?—just the opposite
  – Work in high-level jobs is *not* more cognitively demanding (job analysis data)
    Results?—the higher the job level, the more complex the work
      – analysis, reasoning, decision-making, updating knowledge, self-direction, change and ambiguity
      vs.
      – set procedures, routine tasks, much supervision, physical demands

No evidence here against a “one-intelligence” theory
Counter-Hypothesis #2
(1980s MI Theories)

• Multiple intelligences exist, but Western society rewards only one.
  – IQ tests are paper-and-pencil tests
  – Paper-and-pencil tests privilege linguistic (Gardner) or analytical (Sternberg) intelligence
  – Other cultures value other achievements not measured by those tests
• How would you test this hypothesis?

Wrong reasons, but still a good hypothesis.
Counter-Hypothesis #2

• It would predict:
  – You will find them if you try to assess them
  – They will be mostly independent of each other
  – There will be no superordinate general intelligence
  – IQ will coincide with one of the multiple intelligences

• To verify, we need:
  – Ways to measure the proposed intelligences
  – Have people take those tests
  – Have them take IQ test at the same time
  – Observe that different intelligences don’t correlate much with each other or IQ tests
Constraints & Options in Testing It

Bad
• No tests available for Gardner’s MIs
• STAT test for Sternberg’s Triarchics, but not much data

Good
• But many hundreds of studies with other tests
• Those tests quite varied in nature
• Effort in mid-century to create tests that don’t correlate
• John Carroll (1993) reanalyzed all this evidence!
Results: Many Mental Abilities, but All Systematically Related

- All abilities correlated
- Differ in generality (scope)
- Only one at apex ($g$)
- $g$ is backbone of all others
- Broad abilities (II.) are “flavors” of $g$

Stratum

III.

II.

I.

\[ g \approx \text{IQ} \]
All Theories on Same Map

Best guesses:
Sternberg’s Triarchic (see Brody, 2003)
Gardner’s MI (see Carroll, 1993).
Counter-Hypothesis #3

• IQ/g is just a narrow academic ability
  – IQ tests were created to measure academic ability
  – IQ items can’t measure practical or creative abilities
    • well-defined, with one right answer
    • decontextualized, and of no intrinsic interest
  – “Virtual simulations” needed for non-academic abilities
• How would you test that?
Counter-Hypothesis #3

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• How would you test that?

Yes, but a non-sequitur
Plausible, let’s check

Prior studies of practical tasks say not—all tapped mostly g despite their intent not to
• Adult functional literacy
• Health literacy
• Army simulations of actual work
Recall: IQ Predicts Better in Less Structured Jobs

- IQ
- Social outcomes
  - Standardized academic achievement
  - Job performance-complex job
  - Years of education
  - Occupation level
  - Job performance-middle level job
  - Income
  - Law-abidingness
  - Job performance-simple job
  - Happiness
  - Health self-care is also a complex, unstructured job

Biological origins
Complexity: How IQ Tests (and Life) Tap $g$

**Behavioral signs of $g$**
- Learn
- Reason
- Solve problems

**Mental manipulation**
- See connections
- Make distinctions
- Draw inferences
- Fill in gaps
- Turn things over in your mind

**Practical meaning of $g$**
"Deal with complexity"

**IQ items require**
- Number series: 2, 4, 6, __, __
- Similarities: dog-lion, air-water

**More complexity if**
- unpredictable
- changing
- means-ends unclear
- multifaceted
- many alternatives
- ambiguous

**LIFE!**
Suddenly, a heated exchange took place between the king and the moat contractor.
Impact of $g$ Varies, But Is Pervasive

Training potential:
- Slow, simple, supervised
- Mastery learning, hands-on
- College format

Career potential:
- Assembler
- Food Service
- Nurse’s Aide
- Clerk, teller
- Police officer
- Machinist, sales
- Manager
- Teacher
- Accountant
- Attorney
- Chemist
- Executive

WAIS IQ:
- 70
- 75
- 80
- 85
- 90
- 95
- 100
- 105
- 110
- 115
- 120
- 125
- 130

WPT score:
- 6
- 8
- 10
- 13
- 15
- 17
- 20
- 23
- 25
- 28
- 30
- 33
- 36

Ever incarcerated (men) (%):
- 7
- 7
- 3
- 1
- 0

Chronic welfare recipient (mothers) (%):
- 31
- 17
- 8
- 2
- 0

Lives in poverty (%):
- 30
- 16
- 6
- 3
- 2

High school dropout (%):
- 55
- 35
- 6
- 0.4
- 0
High-IQ People Make Life More Complex for Everyone
Counter-Hypothesis #4

• The hierarchical structure is an artifact of (a) the kinds of tests used, (b) factor analysis, or (c) Western culture.
  – It is “socially constructed.”
  – It is not writ in the genes.
  – The brain has different modules corresponding to the MIs.

• Behavior genetics provides a test:
  – Do broad abilities overlap because they share the same genetic roots? (genetic covariance analysis, say, using twins)
Results: Prime MI Suspects Are Mostly Genetic $g$

- Genes
- Shared environments
- Non-shared environments

(adults)
Genetic Overlap With Outcomes Too

- Standardized academic achievement
- Job performance-complex job
- Years of education
- Occupation level
- Job performance-middle level job
- Income
- Law-abidingness
- Job performance-simple job
- Happiness

IQ
80%

Genetic roots

Social outcomes

$h^2$ (heritability) % $h^2$ shared with g

Genetic roots

80%

60-70% two-thirds

50% half

40-50% half
Same Being Found for Brain

- IQ
  - Size
  - White matter
  - Grey matter
  - Nerve speed
  - Etc.

- Standardized academic achievement
- Job performance—complex job
- Years of education
- Occupation level
- Job performance—middle level job
- Income
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Genetic roots

h² (heritability) % h² shared with g

80% two-thirds half

40-50% half
Other Evidence Dovetails

Personal traits
- Abilities
- Personality
- Social class
- Race, sex, age
- Health
- Education
- Etc.

Biological origins
- Brain physiology
- Genes
- Health
- Nutrition
- Prenatal conditions
- Etc.

Social outcomes
- Occupation level
- Income
- Job performance
- School performance
- Health/longevity
- Law-abiding
- Etc.
Current Place in My Journey?

• Interim judgment
  – $g$ theory: better tested, more consistent with totality of evidence
  – MIs probably known traits, some outside the cognitive realm
  – Triarchics: all mostly $g$

• Current steps
  – Cognitive demands in preventing and managing accidental injury and chronic disease
  – Pedagogical demands in communicating the science
What, Then, Should We Teach?

• Evidence matters
  – Anecdotes don’t count
  – Single studies rarely do
  – Robust, replicated patterns matter most

• *Weight* of evidence matters
  – Explanations must go head-to-head
  – Practice healthy skepticism
  – Listen hard to other side (especially when you don’t want to)

• *Is ≠ ought; ought ≠ is*
  – Facts reveal moral choices, not make them
What, Then, Should We Teach?

• Focus on strata most relevant to your purpose
  – Explaining social inequality? III. (g)
  – Career counseling? II. (but can’t ignore III.)
  – Skills training? I. (but can’t ignore III.)

• What we don’t yet know
  – Specific genes and environments that affect broad abilities
  – Neural basis of \( g \)
  – Why shared family influences on IQ vanish with age
  – Why IQ scores have been rising in recent decades
  – How to raise low IQs permanently
  – Whether results hold in all times, places, extremes

🌟 Surprising puzzles
How Should We Teach It?

• Clear underbrush of confusions & misconceptions
  – IQ is rank within age, not raw horsepower
  – Phenotype vs. genotype
  – Genetic does not mean fixed (it limits elasticity)
  – Intelligence is useful tool, not human worth
  – IQ differences not “against the Declaration of Independence”

• Anticipate emotion, urge to self-censor
  – Be matter-of-fact
  – Set up debates on policy implications (the “might” & “oughts”)
  – Make classroom safe and civil

• Push to dig beneath the surface
  – “What’s behind that label?”
  – “Change one fact and probe the consequences”
  – “Spy the implicit message: God words & devil words”
How Should We Teach It?

• Have bag of tricks for clarifying new concepts
  – Mental manipulation (what is $g$)
  – Task complexity (what calls it forth)
  – Heritability/environmentality

• Explore $g$ in everyday life (Open the black box)
  – Functional literacy items
  – Spotting hazards
  – Managing a chronic disease

• Explore its limits (Other things matter, too)

Give $g$ its due, but put it in its place
Thank You

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