Empirical Treasure, Lost and Found

Linda S. Gottfredson
University of Delaware, USA
International Society for Intelligence Research
Melbourne, Australia
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Imagine
...that someone told you this.

“If all 13-year-olds took the same 15-minute test (WASI), I could give you each child’s odds for all these adult outcomes *without* knowing anything else about them.”

- Drops out of high school,
- Holds mostly unskilled jobs, skilled jobs vs. professional jobs
- Performs those jobs well
- Lives in poverty

**AND**
- Can find a particular intersection on a map, or grams of carbohydrate per serving on a food label
- Adheres to a medical treatment regimen for diabetes or other chronic illness
- Dies prematurely

Miraculous? Would you bet against this odds-maker? Don’t!
Actual landscape of odds, by outcome and IQ*

* Source of data: Gottfredson, 1997, p.118 (young adults) and p.116 (all adults)
Now imagine
...that this person also claims that:

“With just one more piece of information, I can tell you how to improve the worst odds—without changing IQ and without leveling social resources.

AND

It would save thousands if not millions of lives, and millions if not billions of health care dollars.”

Miraculous? Credible?? Yes, and g is the key!
Lost treasure of $g$—a personal account

Chronology
- Today—$g$ 30 years after rediscovery
- Yesterday—Dark Ages before rediscovery
- Tomorrow—Vast opportunities ahead

Unexpected lessons
- Complexity of everyday life
- Power of “inconsequential” effects

A story to remember
g: 30 Years of Discovery
Performance

Life outcomes

Social structure

Traits

Evolution

Genes

Brain

g rediscovered
(See notes for slide)
Performance

Brain

Genes

Traits

Evolution

Social structure

Life outcomes

$rediscovered$

(See notes for slide)
g rediscovered
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Life outcomes

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g rediscovered
(See notes for slide)
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(See notes for slide)
g rediscovered
(See notes for slide)
g rediscovered
(See notes for slide)
$g$ rediscovered
$g$ rediscovered
g rediscovered
Nomological network

Traits

Brain

Genes

Evolution

Performance

Life outcomes

Social structure

$g$ rediscovered
Human variation in $g$: Extraordinary phenomenon

- Recurring
- Species-wide
- General-use capacity
- Shapes human institutions
- Drives its own evolution
Dark Ages Before Rediscovery
g lost by 1970s

when I entered grad school

IQ

Traits

Brain

Genes

Evolution

Performance

Life outcomes

Social structure
My 30 years, pre-PhD

Themes
Explore, collect & classify
Chase puzzles
Feet on the ground
Man from Mars
1970s Sociology

• Difference = inequality
• Inequality is neither natural nor moral
1970s
Social privilege is...

...socially reproduced

Social class hierarchy

Social inequality
1970s
Social privilege is...

...socially inherited

...socially reproduced

Performance

Social inequality

Social class hierarchy
1970s
Social privilege is...

“everyone can do any job”
“doctors should work up from orderly”

Manufactured differences

aspirations IQ

...disguised as “merit”

...socially inherited

...socially reproduced

Performance

Social inequality

Social class hierarchy
Sound eerily familiar?

In USA:

- Law—“No Child Left Behind”
- Too-good-to-be-true science—“several weeks of N-back training raised intelligence”
Needed: Shift in Focus

Knowing $g$ by what brings it forth—task complexity
My alternative explanation:*
Higher intelligence has *functional* value

Required me to study attributes of *jobs and tasks*, not just people.

Specifically--
What in a job requires the exercise of *g*?
What makes some more “*g* loaded” than others?

*Alternative to social privilege theory*
Key finding #1: Occupational hierarchy is cognitive

- Same worldwide
- Mean worker IQs track jobs’ cognitive complexity
- Job complexity hierarchy evolved as work tasks clustered (into occupations) by g loading to fit human variation in g
Key finding #2: “Judgment & Reasoning Factor” among jobs*
Complexity factor among jobs is mirror image of g factor among people

<table>
<thead>
<tr>
<th>Workers must:</th>
<th>Correlation with factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Learn and recall relevant information</td>
<td>.75</td>
</tr>
<tr>
<td>Reason and make judgments</td>
<td>.71</td>
</tr>
<tr>
<td>Deal with unexpected situations</td>
<td>.69</td>
</tr>
<tr>
<td>Identify problem situations quickly</td>
<td>.69</td>
</tr>
<tr>
<td>React swiftly when unexpected problems occur</td>
<td>.67</td>
</tr>
<tr>
<td>Apply common sense to solve problems</td>
<td>.66</td>
</tr>
<tr>
<td>Learn new procedures quickly</td>
<td>.66</td>
</tr>
<tr>
<td>Be alert &amp; quick to understand things</td>
<td>.55</td>
</tr>
</tbody>
</table>

*Job analysis by Arvey (1986)
So, $g$ loading is the flip side of $g$. 

Traits

$g$ loadings

Tasks

Performance

Life outcomes

Social structure
Key finding #3: The Complexity Dynamic

- Tasks that are more complex
  - put a bigger premium on learning-reasoning ability
  - lead to bigger differences in task performance
But how could a *general* intelligence ever evolve?

What adaptive challenges could possibly have been so *general*, so non-specific, to evolve such a content-free, domain-general ability??
Key finding #4: Power of cumulating “inconsequential” effects
Key finding #5: Life’s complexity turns the wheel of $g$
Complexity of everyday life, today
Typical life outcomes along IQ continuum

Source: Gottfredson (1997)
Landscape of cognitive error on everyday tasks*

* Source of data: Gottfredson, 1997, p.118 (young adults) and p.116 (all adults)
Examples of everyday tasks*

**Level 1**

Here is a Social Security card. Sign your name on the line that reads “signature.”

**Level 2**

What is the gross pay for this year to date?

**Level 3**

You need to smooth wood in preparation for sealing and plan to buy garnet sandpaper. What type of sandpaper should you buy?

**Level 4**

Estimate the cost per ounce of the creamy peanut butter. Write your estimate on the line provided.

<table>
<thead>
<tr>
<th>Unit price</th>
<th>You pay</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.89</td>
<td>1.99</td>
</tr>
</tbody>
</table>

**Level 5**

Your child is 11 years old and weighs 85 pounds. How many 80 mg tablets can you give in 24-hr period?

---

*Items on 1993 National Adult Literacy Survey (NALS)*
Landscape of cognitive error on everyday tasks*

Error rate (%)

Difficulty level (sample literacy tasks)
1. Interpret brief phrase in long article
2. Total the costs on order form
3. Write letter explaining error in bill
4. Calculate discount on bill paid early
5. Find meeting time on form

*Source of data: National Adult Literacy Survey (NALS), ages 16-65, Kirsch et al. (1993)
Landscape of cognitive error on everyday tasks*

Error rate (%)

Task complexity
(highest)

Cognitive burden

Cognitive risk

Cognitive resources

<table>
<thead>
<tr>
<th>Ability level</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Error rate (%)</td>
<td>23%</td>
<td>28%</td>
<td>31%</td>
<td>15%</td>
<td>3%</td>
</tr>
<tr>
<td>% of adults:</td>
<td>23%</td>
<td>28%</td>
<td>31%</td>
<td>15%</td>
<td>3%</td>
</tr>
<tr>
<td>% of adults ages 60+:</td>
<td>47%</td>
<td>33%</td>
<td>16%</td>
<td>4%</td>
<td>~0%</td>
</tr>
</tbody>
</table>

*Source of data: National Adult Literacy Survey (NALS), ages 16-65, Kirsch et al. (1993)
Opportunities—An Example
Current (g-blind) “solutions” to challenges in health care

• Political: race-class disparities in health
  – Equalize access to care [it actually *increases* disparities]
  – Teach health providers to be more culturally sensitive
  – Redistribute wealth to keep social disadvantage from “getting under the skin”

• Practical: patient non-adherence to treatment
  – Give patients more information
    “Déjà vu all over again”
Current project
Increase cognitive accessibility of DSM*

- Analyze the “job” of diabetes
- Focus on most critical tasks
- Target instruction to ability level
- Feedback & follow-up

12/12/2013

*DSM = diabetes self-management
Human face of diabetes self-management
Job analyst’s view: The patient’s job description

- **Learn about diabetes in general** *(At “entry’)*
  - Physiological process
  - Interdependence of diet, exercise, meds
  - Symptoms & corrective action
  - Consequences of poor control

- **Apply knowledge to own case** *(Daily, Hourly)*
  - Implement appropriate regimen
  - Continuously monitor physical signs
  - Diagnose problems in timely manner
  - Adjust food, exercise, meds in timely and appropriate manner

- **Coordinate with relevant parties** *(Frequently)*
  - Negotiate changes in activities with family, friends, job
  - Enlist/capitalize on social support
  - Communicate status and needs to practitioners

- **Update knowledge & adjust regimen** *(Occasionally)*
  - When other chronic conditions or disabilities develop
  - When new treatments are ordered
  - When life circumstances change

- **Conditions of work** — *24/7, no days off, no retirement*
Good performance requires good judgment

- **IT IS NOT** mechanically following a recipe
- **IT IS** keeping a complex system under control in often unpredictable circumstances (like accident prevention process)
  - Coordinate a regimen having multiple interacting elements
  - Adjust parts as needed to maintain good control of system buffeted by many other factors
  - Anticipate lag time between (in)action and system response
  - Monitor advance “hidden” indicators (blood glucose) to prevent system veering badly out of control
  - Decide appropriate type and timing of corrective action if system veering off-track
  - Monitor/control other shocks to system (infection, emotional stress)
  - Coordinate regimen with other daily activities
  - Plan ahead (meals, meds, etc.)
    - For the expected
    - For the unexpected and unpredictable
  - Prioritize conflicting demands on time and behavior
Occupational hierarchy

- Cognitive complexity
Sample guidance today

“Adjust insulin dose for number of carbohydrates in meal”

Knowledge & mental calculations required??
Sample health literacy item—how simple?

Task #1—Underline sentence saying how often to give medicine

Caution!
Can train people to do this task, but not all possible tasks like it
Not so simple for many people...

Task #1—Underline sentence saying how often to give medicine

---

**Pediatric Dosage Chart**

<table>
<thead>
<tr>
<th>Age</th>
<th>Approximate Weight Range</th>
<th>Drops</th>
<th>Syrup</th>
<th>Chewables 80 mg</th>
<th>Chewables 160 mg</th>
</tr>
</thead>
<tbody>
<tr>
<td>† Under 3 mo</td>
<td>Under 13 lb</td>
<td>½ dropper</td>
<td>⅛ tsp</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>† 3 to 9 mo</td>
<td>13-20 lb</td>
<td>1 dropper</td>
<td>⅛ tsp</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>† 10 to 24 mo</td>
<td>21-26 lb</td>
<td>1½ droppers</td>
<td>⅛ tsp</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>2 to 3 yr</td>
<td>27-35 lb</td>
<td>2 droppers</td>
<td>1 tsp</td>
<td>2 tablets</td>
<td>—</td>
</tr>
<tr>
<td>4 to 5 yr</td>
<td>36-43 lb</td>
<td>3 droppers</td>
<td>1½ tsp</td>
<td>3 tablets</td>
<td>1½ tablets</td>
</tr>
<tr>
<td>6 to 8 yr</td>
<td>44-62 lb</td>
<td>—</td>
<td>2 tsp</td>
<td>4 tablets</td>
<td>2 tablets</td>
</tr>
<tr>
<td>9 to 10 yr</td>
<td>63-79 lb</td>
<td>—</td>
<td>2½ tsp</td>
<td>5 tablets</td>
<td>2½ tablets</td>
</tr>
<tr>
<td>11 yr</td>
<td>80-89 lb</td>
<td>—</td>
<td>3 tsp</td>
<td>6 tablets</td>
<td>3 tablets</td>
</tr>
<tr>
<td>12 yr and older</td>
<td>90 lb &amp; over</td>
<td>—</td>
<td>3-4 tsp</td>
<td>6-8 tablets</td>
<td>3-4 tablets</td>
</tr>
</tbody>
</table>

Dosage may be given every 4 hours as needed but not more than 5 times daily.

Mean = 272

<table>
<thead>
<tr>
<th>NALS levels</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>LITERACY SCORES:</td>
<td>100</td>
<td>200</td>
<td>250</td>
<td>300</td>
<td>350</td>
</tr>
</tbody>
</table>

#1 239
Need an epidemiology of patient error

Error rate (%)

Cognitive risk

Task complexity (highest)

Cognitive burden

Cognitive resources

% of adults: 23% 28% 31% 15% 3%
% of adults ages 60+: 47% 33% 16% 4% ~0%
Change the job (not person) strategies

Error rate (%)

Cognitive risk

Task complexity (highest)

Cognitive burden

Reduce/limit

Supplement when critical tasks complex

Cognitive resources

*Source of data: National Adult Literacy Survey (NALS), ages 16-65, Kirsch et al. (1993)
Stories of Synergy in Research on $g$

**Synergy** – Interaction of parts has bigger effect than the sum of parts
THE g FACTOR IN EMPLOYMENT

A Special Issue of the Journal of Vocational Behavior

Edited by LINDA S. GOTTFREDSON

Journal of Vocational Behavior
Volume 29, Number 3, December 1986

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Mainstream Science on Intelligence: An Editorial With 52 Signatories, History, and Bibliography

Linda S. Gottfredson
University of Delaware

The following statement was first published in the Wall Street Journal, December 13, 1994.

Mainstream Science on Intelligence

Since the publication of "The Bell Curve," many commentators have offered opinions about human intelligence that resonate current scientific evidence. Some conclusions dismissed in the media as discredited are actually firmly supported.

This statement outlines conclusions reached as mainstream among researchers on intelligence, in particular, on the nature, origins, and practical consequences of individual and group differences in intelligence. Its aim is to promote more reasoned discussion of this vexing phenomenon that the research has revealed in recent decades. The following conclusions are fully described in the major scientific, professional journals and encyclopedias in intelligence.

The Meaning and Measurement of Intelligence

1. Intelligence is a very general mental capability that, among other things, involves the ability to reason, plan, solve problems, abstractly, conceptually comprehend ideas, learn from experience. It is not merely book learning, a narrow academic skill, or test-taking smarts. Rather, it reflects a broader and deeper capability for comprehending our surroundings—what's going on, 'making sense' of things, or "thinking out" what to do.

2. Intelligence, so defined, can be measured, and intelligence tests measure it well. They are among the most accurate (in technical terms, reliable and valid) of all psychological tests and assessments. They do not measure creativity, character, personality, or other important differences among individuals, nor are they intended to.

3. While there are different types of intelligence tests, they all measure the same intelligence. Some use words or numbers and require specific cultural knowledge (like vocabulary). Other do not, and instead use shapes or diagrams require knowledge of only simple, universal concepts (many/few, big/little, up/down).

4. The spread of people along the IQ continuum, from low to high, can be represented well by the bell curve (statistical jargon, the "normal curve"). Most people cluster around the average (IQ 100). Few are either very bright or very dull. About 3% of Americans score above IQ 130 (often considered the threshold for "geniuses"), with about 1/2% below IQ 70 (often considered the threshold for "dyslexics"). The following professors all agree in intelligence and allied fields have signed this statement:


"It is the position of AAIDD that intellectual functioning (as defined [by Mainstream Science on Intelligence, 1997]) is best conceptualized and captured by a general factor of intelligence, g" (p. 34).

*AAIDD = Amer. Assoc. of Intellectual & Developmental Disabilities
Nomological network grows ever denser
Shoulders I’ve stood on

 genes

 Performance

 Life outcomes

 ISIR

 Traits

 Many others

 Evolution

 Social structure

 12/12/2013
To our young members

Go find some good shoulders to stand on!
Thank you.