4 Decisions in Promoting Cognitive Enhancements

Linda S. Gottfredson
School of Education
University of Delaware, USA

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Cognitive Enhancement Workshop
Future of Humanity Institute
Oxford University
Assumptions to Focus Discussion

- General intelligence ($g$)
  - School
  - Work
  - Health
- Inequality
Assumptions to Focus Discussion

1. Improving brain physiology (not its training, not genes)
2. Increasing fluid $g$ (not the narrower abilities)
3. Because $g$ level has most pervasive & profound effects at individual and societal levels
4. Effortless for beneficiary
Assumptions to Focus Discussion

1. Improving brain physiology (not its training, not genes)
2. Increasing fluid $g$ (not the narrower abilities)
3. Because $g$ level has most pervasive & profound effects at individual and societal levels
4. Effortless for beneficiary
But, what is $g$?

Core of all mental abilities
Extracted with factor analysis
Carries freight of prediction

MOST GENERAL
- Domain general
- More heritable
  - *Psychometrically* unitary
  - *Physiologically* distributed

IQ $\approx g \approx g_{\text{fluid}}$

NARROW

- Proficiency in learning, reasoning, think abstractly
- Ability to spot problems, solve problems
- Not knowledge, but ability to accumulate and apply it
Assumptions to Focus Discussion

1. Improving brain physiology (not its training, not genes)
2. Increasing fluid $g$ (not the narrower abilities)
3. Because $g$ level has most pervasive & profound effects at individual and societal levels
4. Effortless for individual
Assumptions to Focus Discussion

1. Improving brain physiology (not its training, not genes)
2. Increasing fluid $g$ (not the narrower abilities)
3. Because $g$ level has most pervasive & profound effects at individual and societal levels
4. Effortless for beneficiary

Also—

Life chances
- School
- Work
- Health
- Family
- Civic participation

Inequality
5. Not seeking to prevent wasted capacity

First need to explain that—
Maximum capacity in fluid $g$ rises, then falls with age
But IQ tests are age-normed to center all ages at IQ 100
5. Not seeking to prevent wasted capacity

Much waste across the lifecycle

Brain enhancers ("smart drugs")

Caffeine
Nicotine
Rest periods
Peak time
Pacing
Synergy

Effort boosters

Healthy diet
Exercise
Prevent/manage chronic diseases
Prevent/manage injuries

Brain protectors

Finally—

Alcohol
Drugs
Medication
Hunger
Fatigue
Pain
Anxiety
Distraction
Disinterest

Cognitive drains
6. **Not** seeking to reduce ever-rising cognitive demands
Technology makes life ever more complex, putting increasing premium on g

Look! I just invented writing!

Thanks a lot!...you just made everybody else in the world illiterate!
So, let’s assume what most people want—”smart drugs” with no side-effects.
4 Decisions

• How delivered?
• To whom?
• For what purposes?
• At what age, and for how long?

All choices create cascading sociopolitical effects
Mode of delivery —

IQ bell curve
Mode of delivery — public health model?

Examples:
- Micronutrients in food
- Vaccinations

Examples:
- Prescription drugs
- Brain stimulation clinics

Subsidized?
Eligibility criteria?
Adherence/utilization rates?
Mode of delivery — public health model?

Examples:
- Micronutrients in food
- Vaccinations

Examples:
- Prescription drugs
- Brain stimulation clinics

Subsidized?
Eligibility criteria?
Adherence/utilization rates?
Social gradients in utilization?
Degree of coverage—

Why will there be pressure to target, or ration?
Typical life outcomes along the IQ continuum

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<th>Life chances:</th>
<th>&quot;High Risk&quot;</th>
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<tbody>
<tr>
<td>% pop.</td>
<td>5%</td>
<td>20%</td>
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<td>5%</td>
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</tbody>
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Training potential:
- Very explicit hands-on
- Written materials plus experience
- Gathers, infers own information
- Slow, simple, supervised
- Mastery learning, hands-on
- College format

Career potential:
- 70: Assembler, Food Service, Nurse’s Aide
- 75: Clerk, teller, Police officer, Machinist, sales
- 80: Manager, Teacher, Accountant
- 85: Attorney, Chemist, Executive
- 90: Borderline ability to function as independent adult

Odds of socioeconomic success & productivity increase
Military requires minimum “trainability” (g)

Most military jobs require at least 30th percentile

Military policy forbids induction below 15th percentile

US law forbids induction below 10th percentile
### Estimated levels of usual cognitive functioning

U.S. Dept of Education 1993 survey of adult functional literacy  
(nationally representative sample, ages 16+, N=26,091)

<table>
<thead>
<tr>
<th>NALS Level</th>
<th>% pop.</th>
<th>Simulated Everyday Tasks</th>
</tr>
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</table>
| 5          | 3%     | • Use calculator to determine cost of carpet for a room  
|            |        | • Use table of information to compare 2 credit cards                                     |
| 4          | 17%    | • Use eligibility pamphlet to calculate SSI benefits  
|            |        | • Explain difference between 2 types of employee benefits                               |
| 3          | 31%    | • Calculate miles per gallon from mileage record chart  
|            |        | • Write brief letter explaining error on credit card bill                                |
| 2          | 27%    | • Determine difference in price between 2 show tickets  
|            |        | • Locate intersection on street map                                                      |
| 1          | 22%    | • Total bank deposit entry  
|            |        | • Locate expiration date on driver’s license                                            |
### Estimated levels of usual cognitive functioning

**Example of practical meaning of ability differences**

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Routinely able to perform tasks only up to this level of difficulty
## Estimated levels of usual cognitive functioning

Example of practical meaning of ability differences

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*Lower IQ persons *  
*Impaired elderly *  
*Non-native English speakers*
# Estimated levels of usual cognitive functioning

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| 1          | 22%    | • Total bank deposit entry  
|            |        | • Locate expiration date on driver’s license                                           |

US Dept of Education: People at levels 1-2 are below literacy level required to enjoy rights & fulfill responsibilities of citizenship
Typical life outcomes along the IQ continuum

Low functional literacy is a critical threshold in modern world
Practical value of g level differs by life arena

- Standardized academic achievement: .8
- Job performance—complex jobs
- Years of education: .6
- Occupational level
- Job performance—middle-level jobs: .4-.5
- Income: .3-.4
- Delinquency: -.25
- Job performance—simple jobs: .2
Large or small, effects are relentless.
Some societal-level implications of g variation

IQ-based clustering across neighborhoods

<table>
<thead>
<tr>
<th>Life chances:</th>
<th>&quot;High Risk&quot;</th>
<th>&quot;Up-Hill Battle&quot;</th>
<th>&quot;Keeping Up&quot;</th>
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Training potential:
- Slow, simple, supervised
- Mastery learning, hands-on
- Written materials plus experience
- College format
- Gathers, infers own information

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

<table>
<thead>
<tr>
<th>Ever incarcerated (% white men)</th>
<th>7</th>
<th>7</th>
<th>3</th>
<th>1</th>
<th>0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chronic welfare recipient (% white mothers)</td>
<td>31</td>
<td>17</td>
<td>8</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Had illegitimate child (% white women)</td>
<td>32</td>
<td>17</td>
<td>8</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>High school dropout (% whites)</td>
<td>55</td>
<td>35</td>
<td>6</td>
<td>0.4</td>
<td>0</td>
</tr>
</tbody>
</table>
Nation-level implications: Carrying capacity

<table>
<thead>
<tr>
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<tbody>
<tr>
<td></td>
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<td>20%</td>
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<td>Training potential:</td>
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<tr>
<td>Dependents</td>
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<td></td>
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<td></td>
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</tr>
<tr>
<td>Maintainers</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Innovators</td>
<td></td>
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</tr>
</tbody>
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Career potential:

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

WAIS IQ:

- Dependents: 70-75
- Maintainers: 80-85
- Innovators: 90-100
Nation-level implications: Carrying capacity

Current standard
(Mean 100/SD 15)

Innovators = 5% = 1.0
Dependents = 5%

> IQ 100 = 50% = 1.0
< IQ 100 = 50%
Nation-level implications: 5-point rise

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<th>Life chances: % pop.</th>
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<tbody>
<tr>
<td>Dependents</td>
<td>5%</td>
<td>20%</td>
<td>50%</td>
<td>20%</td>
<td>5%</td>
</tr>
<tr>
<td>Maintainers</td>
<td>20%</td>
<td>50%</td>
<td>30%</td>
<td>10%</td>
<td>5%</td>
</tr>
<tr>
<td>Innovators</td>
<td>5%</td>
<td>20%</td>
<td>50%</td>
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Training potential:
- Slow, simple, supervised
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- Written materials, plus experience
- Gathers, infers, own information

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

WAIS IQ:
- 70
- 80
- 90
- 100
- 110
- 120
- 130

Current standard (Mean 100/SD 15)

<table>
<thead>
<tr>
<th>Dependent Group</th>
<th>Current Standard</th>
<th>Higher Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>Innovators</td>
<td>5% = 1.0</td>
<td>9.2% = 4.0</td>
</tr>
<tr>
<td>Dependents</td>
<td>5% = 1.0</td>
<td>2.3% = 1.7</td>
</tr>
<tr>
<td>&gt; IQ 100</td>
<td>50% = 1.0</td>
<td>62.9% = 1.7</td>
</tr>
<tr>
<td>&lt; IQ 100</td>
<td>50%</td>
<td>37.1%</td>
</tr>
</tbody>
</table>

Higher (Mean 105)
Nation-level implications: with rise & bigger SD

<table>
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<tr>
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Training potential:
- Slow, simple, supervised
- Mastery learning, hands-on
- Written material, plus experience
- Gathers, infers own information

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

Current standard
(Mean 100/SD 15)

<table>
<thead>
<tr>
<th>Innovators</th>
<th>Dependents</th>
</tr>
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<tbody>
<tr>
<td>Innovators</td>
<td>= 5% 1.0</td>
</tr>
<tr>
<td>Dependents</td>
<td>= 5% 1.0</td>
</tr>
</tbody>
</table>

Higher
(Mean 105)

<table>
<thead>
<tr>
<th>Innovators</th>
<th>Dependents</th>
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<tbody>
<tr>
<td>Innovators</td>
<td>= 9.2% 4.0</td>
</tr>
<tr>
<td>Dependents</td>
<td>= 2.3% 1.7</td>
</tr>
</tbody>
</table>

Higher & less equal
(Mean 105, SD 17)

<table>
<thead>
<tr>
<th>Innovators</th>
<th>Dependents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Innovators</td>
<td>= 11.5% 2.9</td>
</tr>
<tr>
<td>Dependents</td>
<td>= 3.9% 1.6</td>
</tr>
</tbody>
</table>
Current racial differences in carrying capacity

<table>
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<tr>
<th>Life chances: % pop.</th>
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Training potential:
- Black
  - Very explicit hands-on
  - Written materials plus experience

Career potential:
- Slow, simple, supervised
- Mastery learning, hands-on
- College format
- Gathers, infers own information

<table>
<thead>
<tr>
<th>WAIS IQ:</th>
<th>70</th>
<th>75</th>
<th>80</th>
<th>85</th>
<th>90</th>
<th>95</th>
<th>100</th>
<th>105</th>
<th>110</th>
<th>115</th>
<th>120</th>
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<th>130</th>
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Current Standard
(Mean 100/SD 15)

| Current Black (in West)
(Mean 87, SD 13) |
| Current White
(Mean 101, SD 15) |

| Innovators |
| Dependents |
| > IQ 100 |
| < IQ 100 |
| Innovators |
| Dependents |
| > IQ 100 |
| < IQ 100 |
## Current racial differences in carrying capacity

<table>
<thead>
<tr>
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<td>20%</td>
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**Training potential:**
- Slow, simple, supervised
- Very explicit hands-on
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**Career potential:**
- Assembler
- Food Service
- Nurse’s Aide
- Clerk, teller
- Police Officer
- Machinist, sales
- Manager
- Teacher
- Accountant
- Attorney
- Chief of Executive

### WAIS IQ:
- Black
- E Asian
- Current
- Standard (Mean 100/SD 15)
- Current Black (in West) (Mean 87, SD 13)
- Current White (Mean 101, SD 15)
- Current East Asian (Mean 106, SD 15)

<table>
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<th>Current East Asian (Mean 106, SD 15)</th>
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<td>Dependents</td>
<td></td>
<td></td>
</tr>
<tr>
<td>%</td>
<td>5%</td>
<td>0.3%</td>
<td>5%</td>
</tr>
<tr>
<td>%</td>
<td>5%</td>
<td>0.3%</td>
<td>5%</td>
</tr>
<tr>
<td>IQ &gt;100</td>
<td>50%</td>
<td>16%</td>
<td>54%</td>
</tr>
<tr>
<td>IQ &lt;100</td>
<td>50%</td>
<td>84%</td>
<td>46%</td>
</tr>
<tr>
<td>Equal</td>
<td>1.0</td>
<td>0.20</td>
<td>1.2</td>
</tr>
<tr>
<td>Equal</td>
<td>1.0</td>
<td>0.20</td>
<td>1.2</td>
</tr>
<tr>
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<td>0.20</td>
<td>1.2</td>
</tr>
</tbody>
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## Current racial differences in carrying capacity

**Should—could—enhancements be made without considering race?**

### Graphical Representation

- **Dependents**: Slow, simple, supervised.
- **Maintainers**: Mastery learning, hands-on.
- **Innovators**: Gathers, infers own information.

### Current Standard

- **(Mean 100/SD 15)**
- **Innovators/Dependents**: $5\% / 5\% = 1.0$
- **> IQ 100**: $50\% / 50\% = 1.0$
- **< IQ 100**: $50\% / 84\% = 0.62$

### Current Black (in West)

- **(Mean 87, SD 13)**
- **Innovators/Dependents**: $0.3\% / 18\% = 0.02$
- **> IQ 100**: $16\% / 84\% = 0.20$

### Current White

- **(Mean 101, SD 15)**
- **Innovators/Dependents**: $5\% / 4\% = 1.2$
- **> IQ 100**: $54\% / 46\% = 1.2$

### Current East Asian

- **(Mean 106, SD 15)**
- **Innovators/Dependents**: $10\% / 2\% = 5.0$
- **> IQ 100**: $66\% / 34\% = 2.0$

---

---
When in the life-cycle should fluid $g$ be enhanced?
When in the life-cycle should fluid $g$ be enhanced?

- Increase innovation
- Reduce dependency

Depends on aims
When in the life-cycle should fluid $g$ be enhanced?

Also depends on permanency & required frequency of boost

- Better peak application
- Better learning
- Longer maintenance
- Cost?
  - Is consent required?
  - Adherence rates?
## Cascading, Multi-Level Effects of Human Dispersion in g

<table>
<thead>
<tr>
<th></th>
<th>12</th>
<th>10</th>
<th>7</th>
<th>7</th>
<th>2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unemployed</td>
<td>32</td>
<td>17</td>
<td>8</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Illegitimate child</td>
<td>30</td>
<td>16</td>
<td>6</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Lives in poverty</td>
<td>31</td>
<td>17</td>
<td>8</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Chronic welfare</td>
<td>55</td>
<td>35</td>
<td>6</td>
<td>0.4</td>
<td>0</td>
</tr>
<tr>
<td>HS dropout</td>
<td></td>
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### g-based social clustering in schools, jobs, neighborhoods

### g-based sub-cultures; diffusion gradients for information, help, & regard

### Different interpersonal climates, help, risks

### Social inequality, job hierarchies, intergroup competition, policy responses
**g-Based Cultural Processes**

**Cascading, Multi-Level Effects of Human Dispersion in g**

- **g-based social clustering in schools, jobs, neighborhoods**
- **g-based sub-cultures; diffusion gradients for information, help, & regard**
- **Social inequality, job hierarchies, intergroup competition, policy responses**

**Dispersion creates much social tension, many political pressures**

**Attempts to change it would too**
Tradeoff with equalization of outcomes

Cascading, Multi-Level Effects of Human Dispersion in g

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g-based social clustering in schools, jobs, neighborhoods

Different interpersonal climates, help, risks

g-based sub-cultures; diffusion gradients for information, help, & regard

Social inequality, job hierarchies, intergroup competition, policy responses

Workforce productivity, GDP, health, innovation rates, functioning democracy

↓ = counterproductive

Tradeoff with equalization of outcomes

g-Based Cultural Processes
Sample predictions, if reliable brain-boosters become available

• Old debates continue
  – Distributive justice by race and class
• Opportunistic reversals in political rhetoric
  – To “racial gaps in IQ are genetic” because “social justice requires eradicating effects of genetic disadvantage”
• New debates
  – Do potential mates or employers have a right to know if the applicant has been temporarily enhanced? Can either require (continued) enhancement?
• Old frustrations
  – Less apt beneficiaries won’t make equally effective use of interventions, so disparities will increase, which will provoke accusations of injustice
• New frustrations
  – National impact will result from accumulation of myriad small effects from marginal increases in IQ, but “marginal” increases with “small” effects won’t impress users, tax-payers, or politicians. They will disappoint compared to overhyped promises
References


Thank you.

- gottfred@udel.edu
- http://www.udel.edu/educ/gottfredson