Individuals differ widely in general intelligence: The cause—or consequence—of socioeconomic inequality?

Linda S. Gottfredson, PhD
School of Education, University of Delaware
Newark, DE 19716 USA

Human Capital in Latin-American Societies:
The Importance of Psychological Assessment
The Meeting of Psychological Assessment of Minas Gerais (EMAP)
Universidade Federal de Minas Gerais
Belo Horizonte, Brazil, September 22-25, 2010

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Relevance to human capital??

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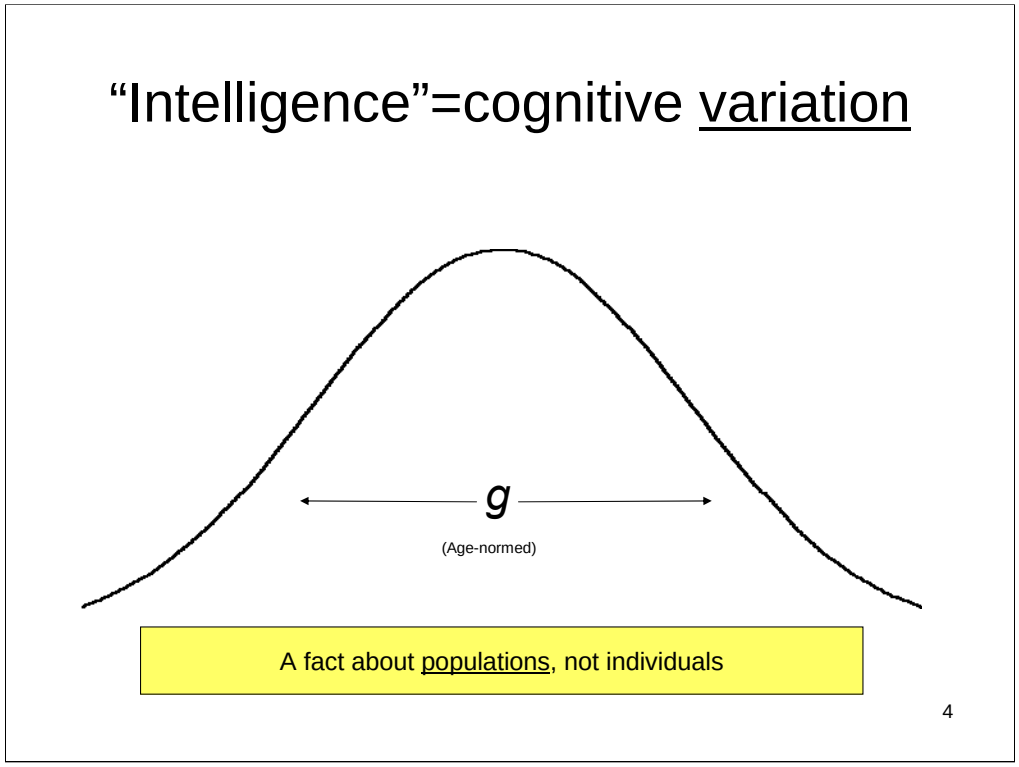
- People in democratic societies are more concerned about social inequality than national productivity
- Policies for changing inequality can affect productivity—hurt or help

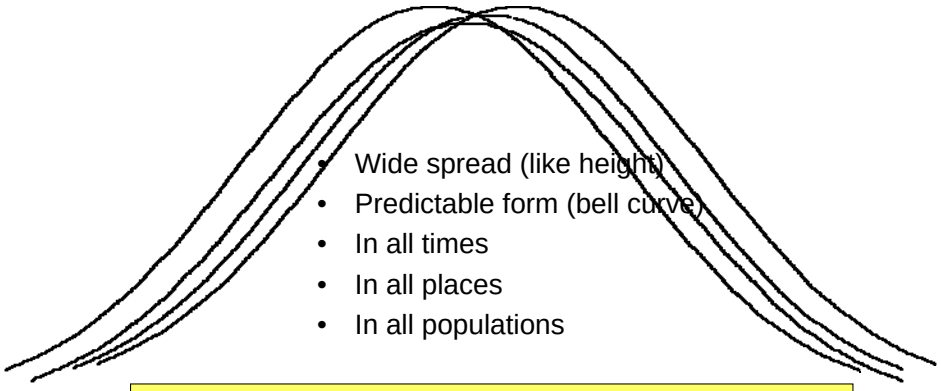
Question 1

How much do people differ in general intelligence (*g*)?



We are not talking here about common human themes—such as how children develop. Instead, we are looking at variations on the common theme—how we differ in growth and competence.

Cognitive variation = biological fact



- Wide spread (like height)
- Predictable form (bell curve)
- In all times
- In all places
- In all populations

Is constraint in nurturing & exploiting human capital

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How does cognitive variation show in behavior?

General ability to:

- Learn
- Reason
- Think abstractly
- Spot & solve novel problems
- Accumulate & apply knowledge

Useful tool—very practical

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Sample IQ items (sample stimuli)

(individually administered)

	Easy	Moderate	Hard
Fill in the next two numbers	3, 5, 7, 9,__, __	3, 5, 6, 8, 9, __, __	10, 9, 8, 9, 8, 7, __, __
Name one similarity	orange—banana (93%)	table-chair (55%)	Praise-punishment (25%)
Def... wo...			

Infer the rule

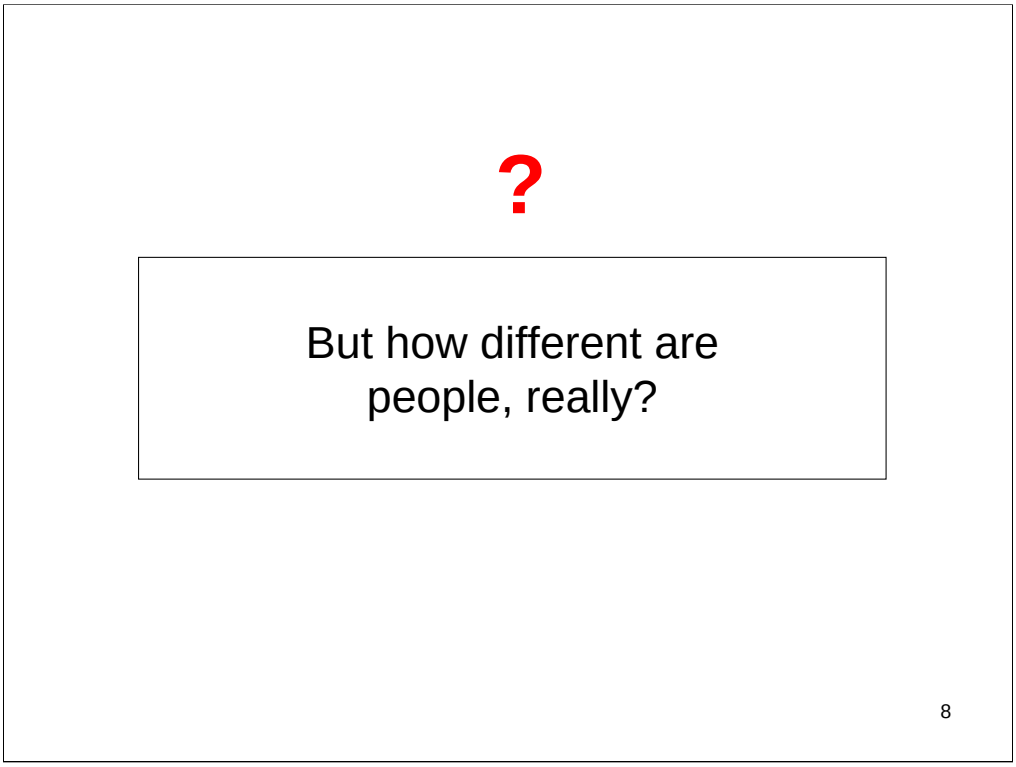
More abstract

Complexity is the active ingredient:
More complex tasks are more "*g* loaded"

% = % of 16-65 year-olds getting at least partial credit for answer, WAIS, 1955

Can see here why very different kinds of test items can measure the same thing – something that highly general and not tied to any particular content.

This brings up a point that will become critical later. We can classify tasks, not just people, according to g. That's not just an aid in creating tests (item response theory), but to understanding where g matters most in everyday life. How much g level matters in daily life depends on how much is required, where, and when.



IQ tests tell us only who is brighter than someone else. They only rank people. They do not tell us what they actually can or cannot do in school, work, or daily life. By themselves, they do not give us an intuitive sense of how big or small—how meaningful—our intelligence differences are. However, tests of functional literacy function like an everyday “test of intelligence” and the picture they paint surprises many people.

Estimated levels of usual cognitive functioning

U.S. Dept of Education 1993 National Adult Literacy Survey (NALS)
(nationally representative sample, ages 16+, N=26,091)

NALS Level	% pop.	Simulated Everyday Tasks Routinely able to perform tasks only up to this level of difficulty
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 l

Could teach these individual items, but not all such tasks in daily life

This is a test given by the US Department of Education to a large sample of adults. It asks them to do things that we are expected to do in everyday life. Its items simulate those tasks.

Items are ranked by difficulty level into 5 levels. NALS=national adult literacy survey

Samples items are listed. The percentages are for the number of adults who fall into those categories. It is difficulty level at which they function at 80% accuracy. So, it shows that 22% are routinely able to do things no more difficult than locate the expiration date on a driver's licence.

Only 3% are routinely able to carry out tasks as difficult as using a calculator to determine the cost of carpet for a room.

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1	22%	•Total b • Locat river's l

Additional error to not anticipate others' errors!

So, higher error rates at lower ability levels

Could teach these individual items, but not all such tasks in daily life

We could probably teach most people to do most of these things, but there are many such tasks and they keep changing as society changes. People usually have to figure them out on their own.

How do tasks generate errors?

NALS Level	% pop.	Simulate
5	3%	• Use calculator to • Use table of inforr
4	17%	• Use eligibility pam • Explain difference
3	31%	• Calculate miles pe • Write brief letter e
2	27%	• Determine differe • Locate intersectio
1	22%	•Total bank deposit • Locate expiration

Difficulty based on "process complexity"

- level of inference
- abstractness of info
- distracting information

Not reading per se, but **"reasoning & problem solving"**

A lot of work was done to figure out what made some items more difficult than others. It turned out to be the complexity of the mental processes required to perform the task successfully. I will show you examples of how these processes differ by NALS level.

How do tasks generate errors?

NALS Level	% pop.	Simulate
5	3%	• Use calculator to • Use table of inforr
4	17%	• Use eligibility pam • Explain difference
3	31%	• Calculate miles pe • Write brief letter e
2		
1		

Point of cognitive overload, breakdown ← $g \approx$

Difficulty based on "process complexity"

- level of inference
- abstractness of info
- distracting information

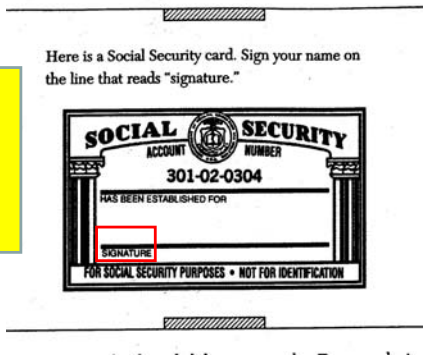
Not reading per se, but **"reasoning & problem solving"**

Item at NALS Level 1*

15%
(25-39 year-olds)

85% do better

- Literal match
- One item
- Little distracting info



* 80% probability of correctly answering items of this difficulty level

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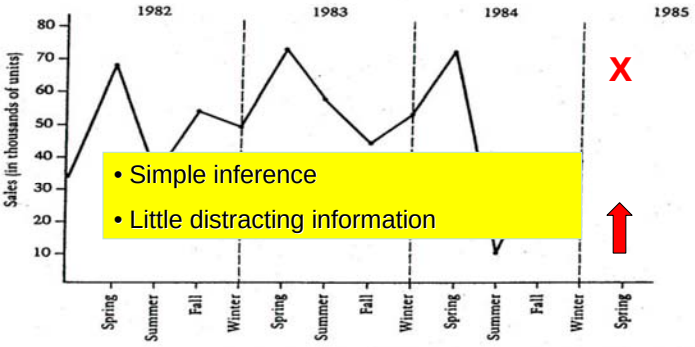
Item at NALS Level 2

15% | 24% (25-39 year-olds) | 61%

You are a marketing manager for a small manufacturing firm. This graph shows your company's sales over the last three years. Given the seasonal pattern shown on the graph, predict the sales for Spring 1985 (in thousands) by putting an "x" on the graph.

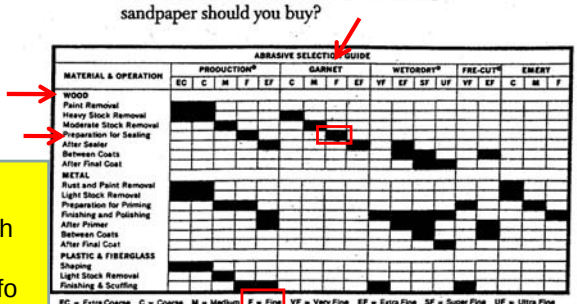


- Simple inference
- Little distracting information

Item at NALS Level 3

39% | 34% (25-39 year-olds) | 27%

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



Reduced from original copy

- Cycle through complex table
- Irrelevant info

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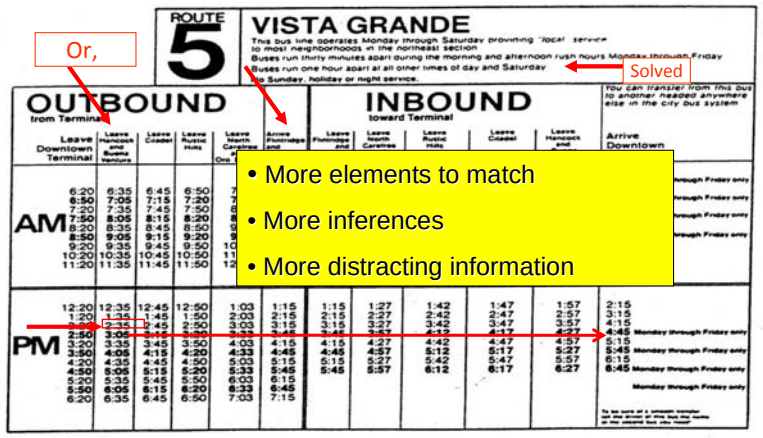
Item at NALS Level 4

73% | 22% (25-39 year-olds) | 5%

On Saturday afternoon, if you miss the 2:35 bus leaving Hancock and Buena Ventura going to Flintridge and Academy, how long will you have to wait for the next bus?



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Item at NALS Level 5

95%

5%
(25-39 year-olds)

Using the information in the table, write a brief paragraph summarizing the extent to which parents and teachers agreed or disagreed on the statements about issues pertaining to parental involvement at their school.

- Search through complex displays
- Multiple distractors
- Make high-level text-based inferences
- Use specialized knowledge

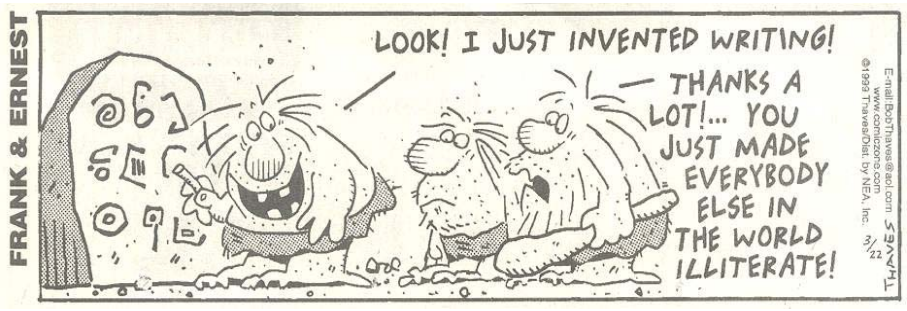
Parents and Teachers Evaluate Parental Involvement at Their School

Do you agree or disagree that . . . ?

	Total	Level of School: Elementary	Junior High	High School
		percent agreeing		
Our school does a good job of encouraging parental involvement in sports, arts, and other nonsubject areas				
Parents	77	76	74	79
Teachers	77	73	77	85
Our school does a good job of encouraging parental involvement in educational areas				
Parents	73	82	71	64
Teachers	80	84	78	70
Our school only contacts parents when there is a problem with their child				
Parents	55	46	62	63
Teachers	23	18	22	33
Our school does not give parents the opportunity for any meaningful roles				
Parents	22	18	22	28
Teachers	8	8	12	7

Source: The Metropolitan Life Survey of the American Teacher, 1987

Smart people make life more complex for the rest of us



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Question 2

How tight is the link between cognitive variation and social inequality?

- pervasive
- persisting
- worldwide

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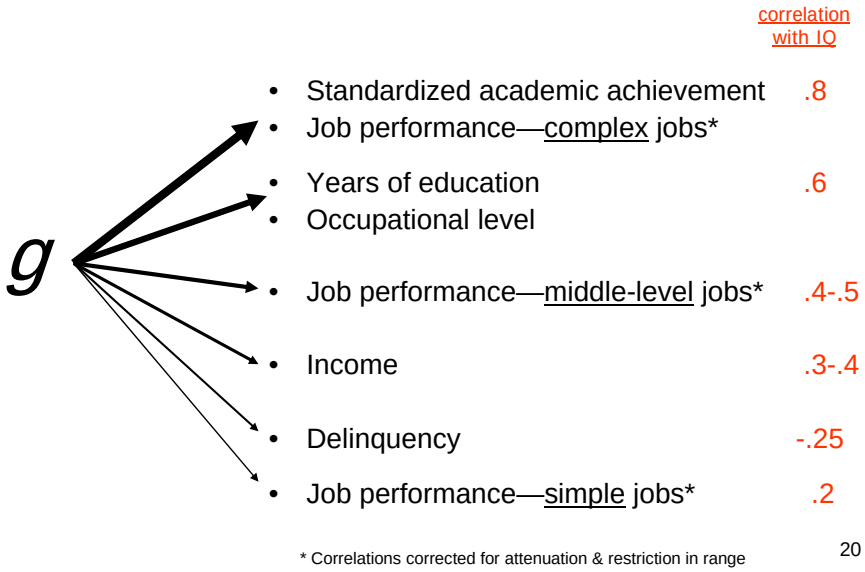
Our focus here will be on data from the US and Europe

Correlations differ systematically by outcome



* Correlations corrected for attenuation & restriction in range

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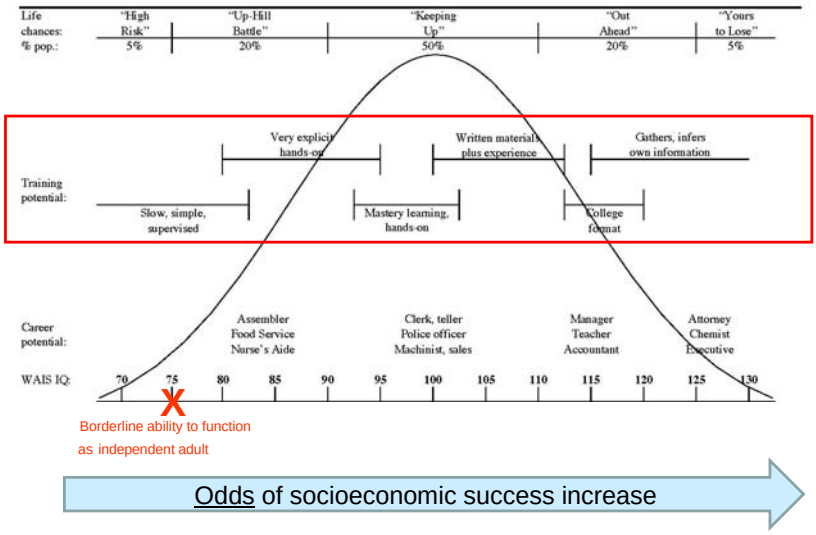
IQ is correlated with just about every measure of socioeconomic success and failure. That is quite remarkable, but what is more interesting is that these relations differ a lot across different kinds of outcome. Higher g is a huge advantage in some life arenas but only a small one in others.

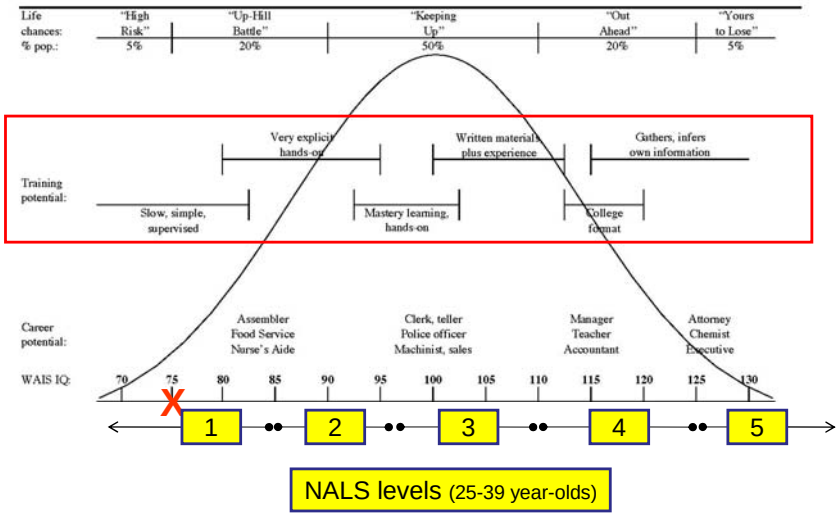
We can learn a lot from trying to figure out why the links are tight for some, looser for others, and hardly there for others.

Life chances at different levels along the IQ continuum



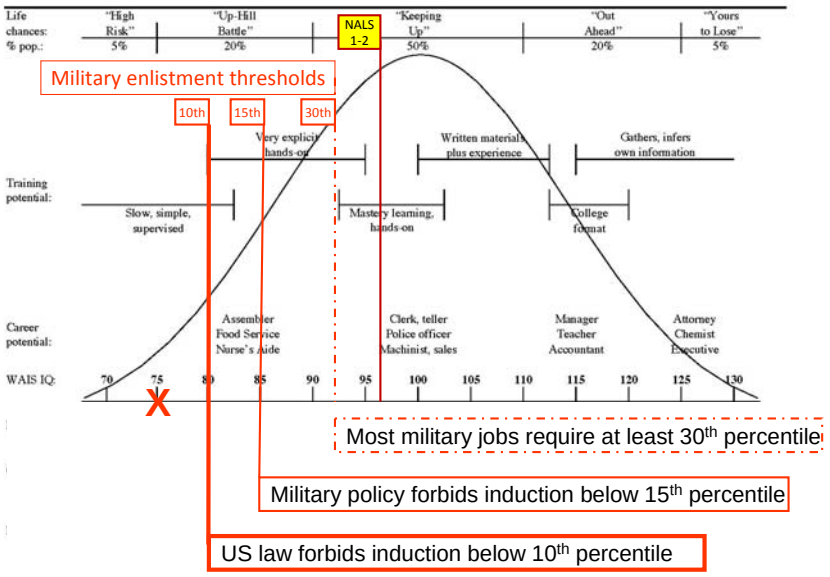
Notice the level of job training potential documented at different levels of the bell curve. It goes from people who need a lot of help and time to learn very simple things to people who can teach themselves what they need to know that no one else may know.

Life chances at different levels along the IQ continuum



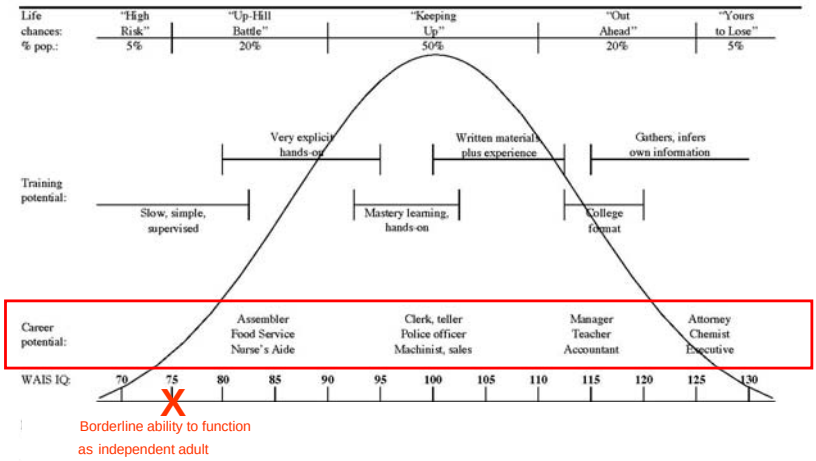
Differences in NALS level along the bell curve parallel the differences in trainability.

3 thresholds: “trainability” for military



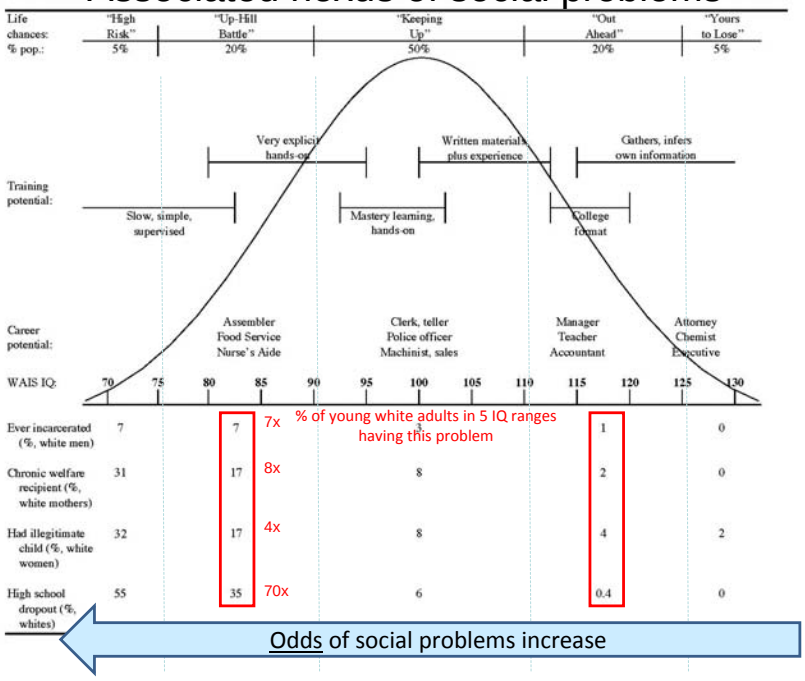
The US military tests all recruits for trainability; the test is really an intelligence test. The law forbids taking anyone in the bottom 10% , and they themselves have decided never to take anyone in the bottom 16% because they are not trainable enough. This corresponds to IQ 85. Right now, they do not take anyone below the 31st percentile, which rules out almost a third of the population. This has become more important as soldiering has become more complex.

Life chances at different levels along the IQ continuum

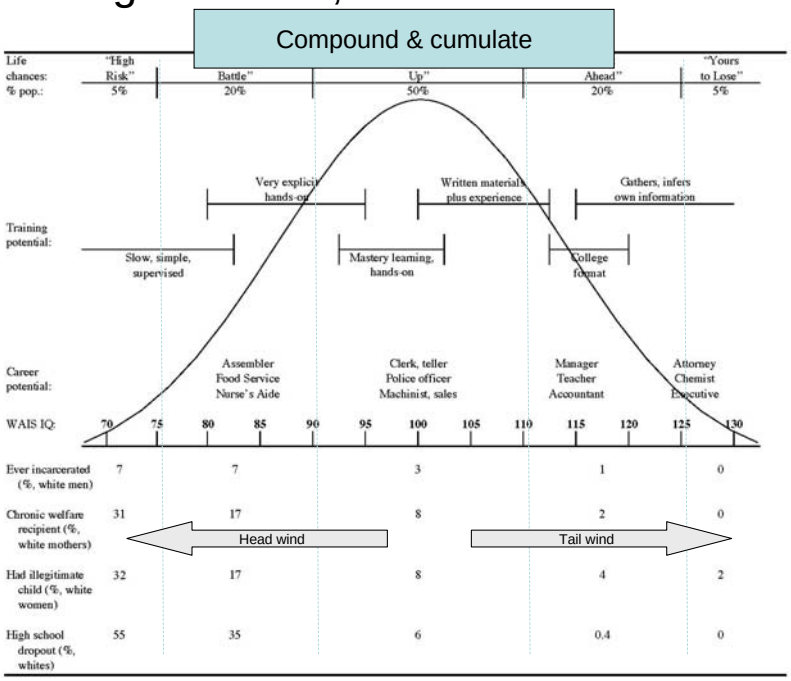


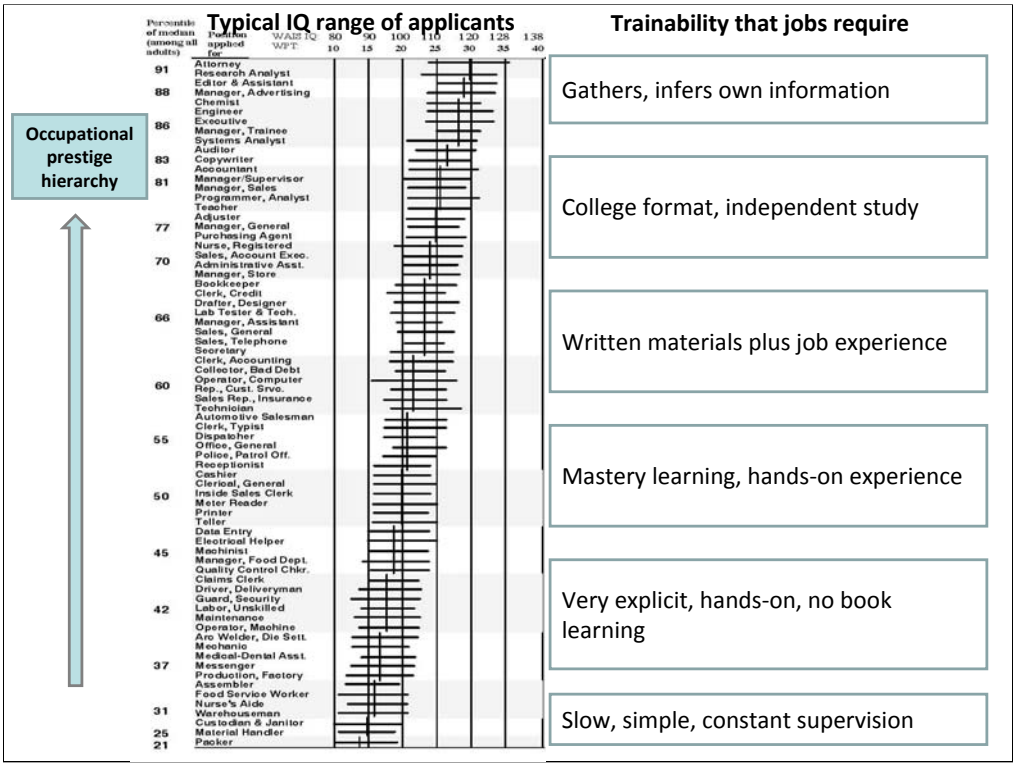
Training potential (and IQ level) affects the kind of job you are likely to get and keep.

Associated nexus of social problems



Large or small, effects are relentless





3 major findings here

Jobs are perceived as being on a status ladder or hierarchy.

The middle part of the figure shows the typical IQs of people who apply for jobs at different levels of the occupational hierarchy. Higher level jobs employ higher IQ workers (though each job includes a wide range of IQs). As we saw earlier, IQ predicts job level. This figure just gives you a more concrete idea of what that means.

The right hand side of the figure shows that greater trainability is required up the occupational ladder.

All this shows a strong link between IQ and job status, but not why it exists. For example, employers might have an irrational preference for people who are bright or from more advantaged social backgrounds.

Question 3

How do different theories explain the link between cognitive & social inequality?

1. Social privilege theory
2. Useful tool theory

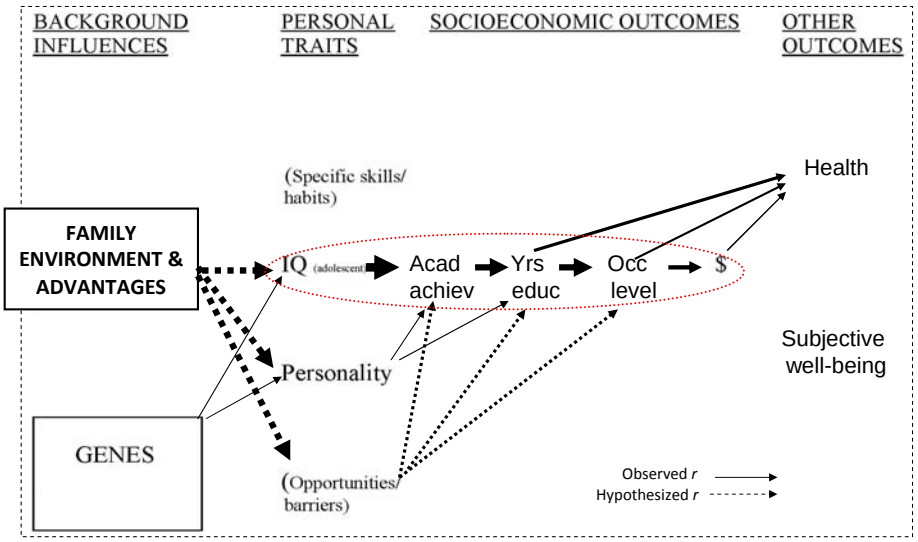
Competing explanations for pervasive, persisting IQ-SES links

1. Social privilege theory
   a. IQ differences result mostly from differences in family privilege
   b. Higher IQ and education does not reflect “merit,” but social class in disguise.
   c. Higher level jobs do not require more intelligence to perform well
   d. If everyone had equal opportunities in life, all could perform well and social inequality would disappear. Unequal outcomes signals unequal opportunity to develop & use cognitive talent.

Privilege perpetuates itself by pretending to be “merit”

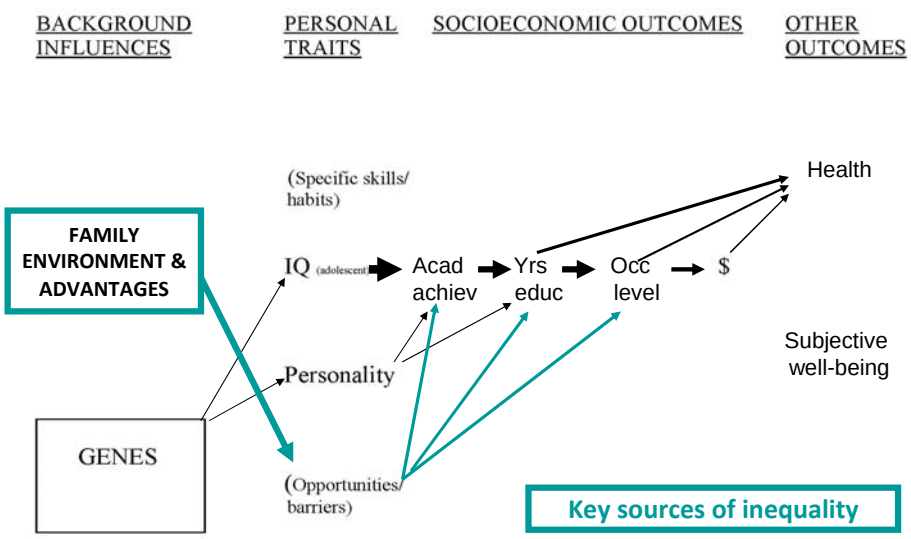
"Social privilege" theory

(Using sociologists' life-cycle model)



This is the sort of conceptual scheme that sociologists use to statistically model "who gets ahead." Everyone agrees that all these different forms of inequality correlate moderately to highly with each other and IQ (the dark arrows), but not why they do. Social privilege theory represents the sort of explanation that sociologists favor.

"Social privilege" theory
(Using sociologists' life-cycle model)



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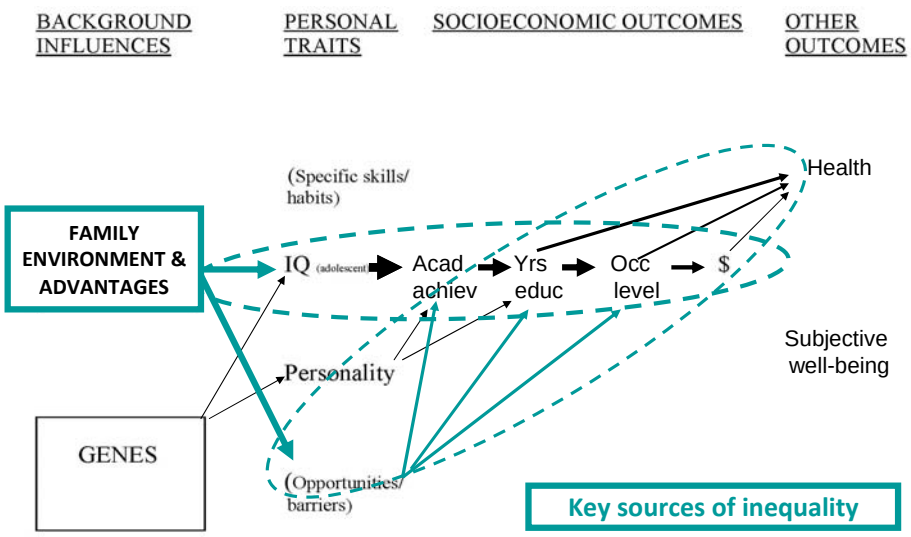

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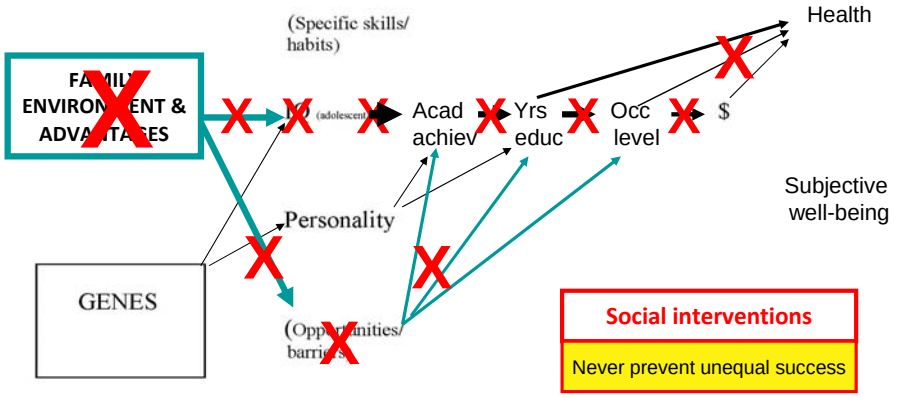
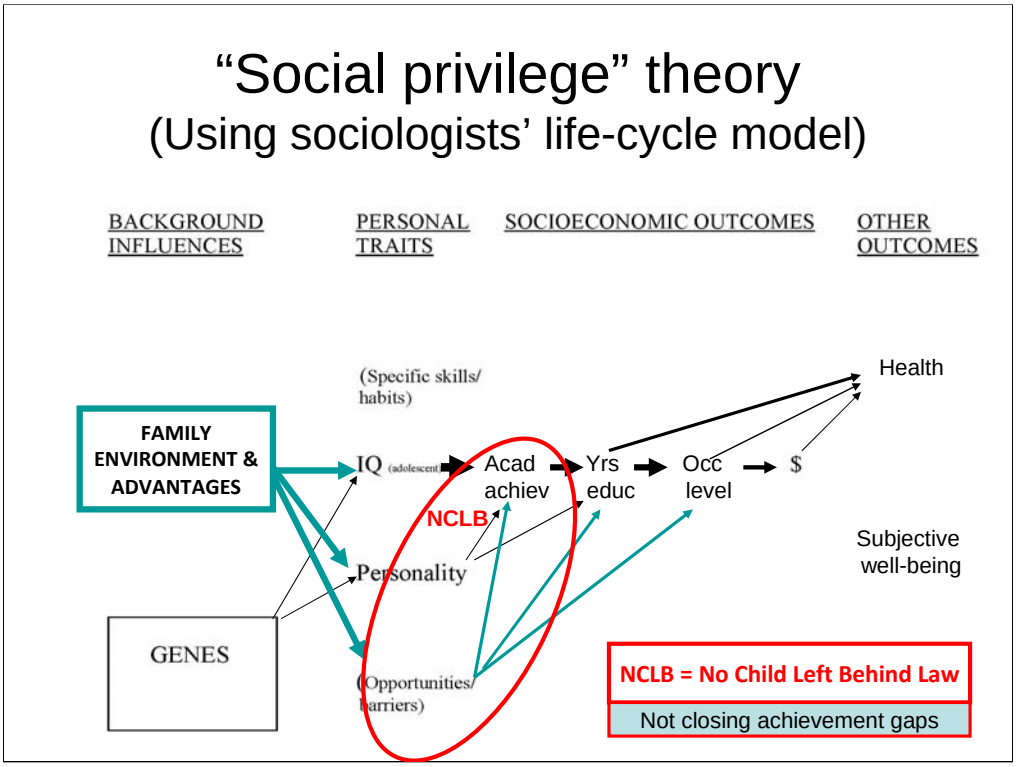


Many social interventions try to make children's families, opportunities, and intelligence more equal

Others try to negate the value of these advantages. For example, to lower the correlation between IQ and years of education by changing college admission & graduation requirements. Or to lower correlation between parent and child outcomes by providing more educational resources to less privileged children.



The US law provides a good example. It mandated that public schools would eliminate all achievement gaps within 14 years by bringing all children up to the same high level of proficiency. The gaps have hardly changed, despite schools being punished for that.

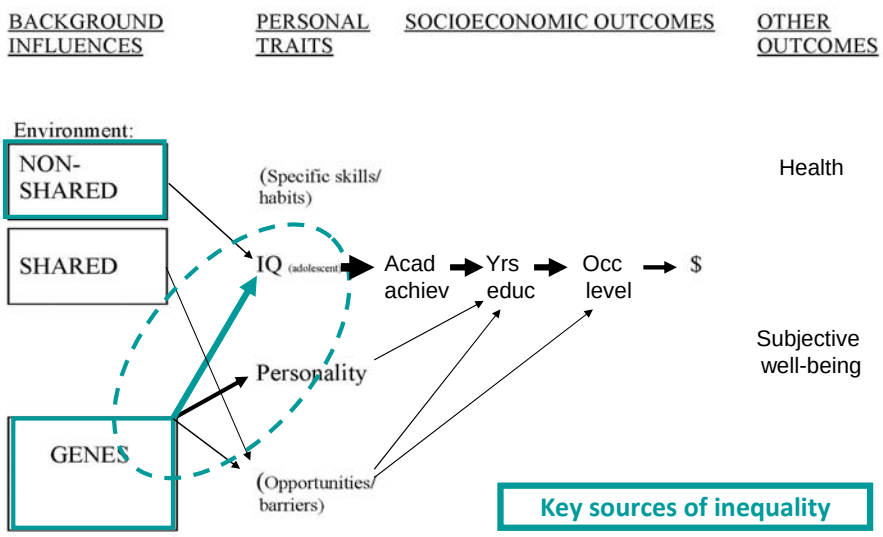
Competing explanations for pervasive, persisting IQ-SES links

1. Social privilege theory
   a. IQ differences result mostly from differences in family privilege
   b. Higher IQ and education does not reflect "merit," but social class in disguise.
   c. Higher level jobs do not require more intelligence to perform well
   d. If everyone had equal opportunities in life, all could perform well and social inequality would disappear. Unequal outcomes signals unequal opportunity to develop & use cognitive talent.

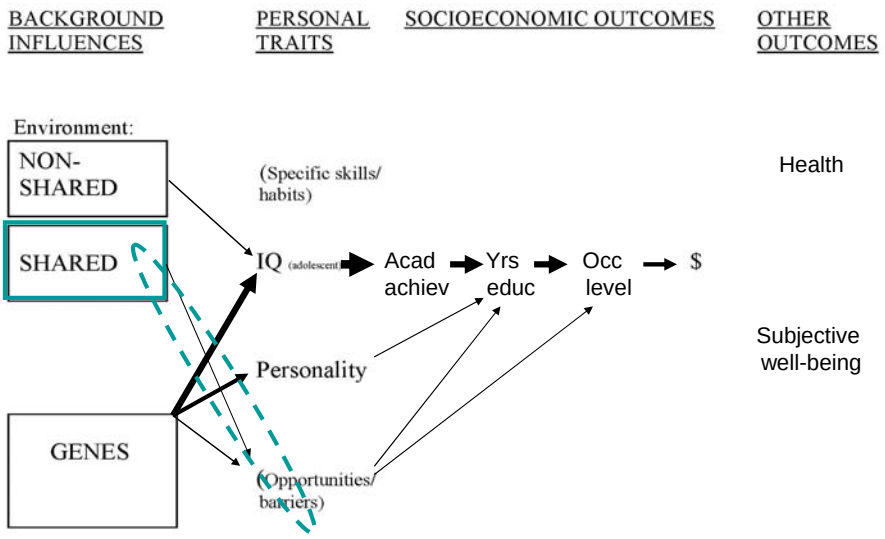
2. Useful tool theory
   a. IQ differences result mostly from differences in genetic heritage.
   b. Higher *g* level reflects stronger learning & reasoning ability.
   c. Higher *g* enhances performance in all jobs, but especially more complex ones.
   d. If everyone had equal opportunities in life, people would perform to very different levels and create social inequality. Equal outcomes would require unequal opportunity to develop & use cognitive talent.

Human cognitive variation guarantees moderate social inequality in any complex, free society

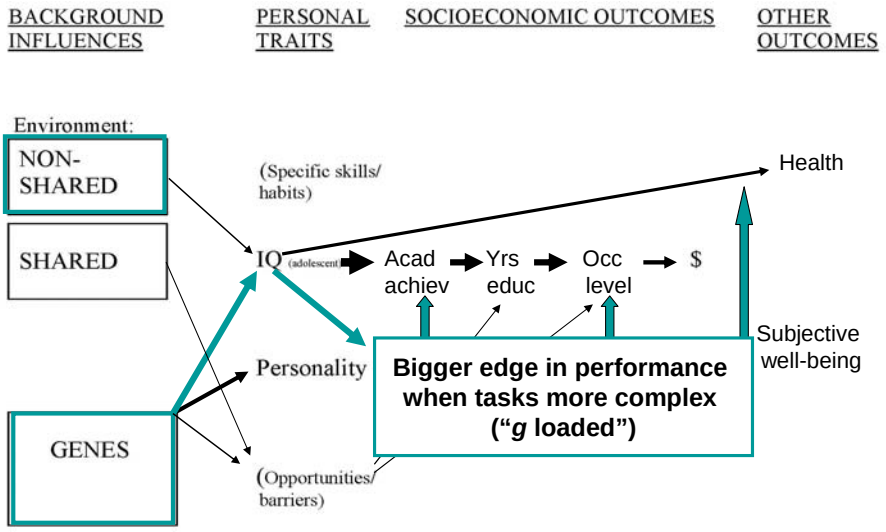
“Useful tool” theory



Recall opposite emphasis of social privilege theory



"Useful tool" theory: Where's the practical advantage?



Recall that privilege theory ignores task performance and how IQ level affects it

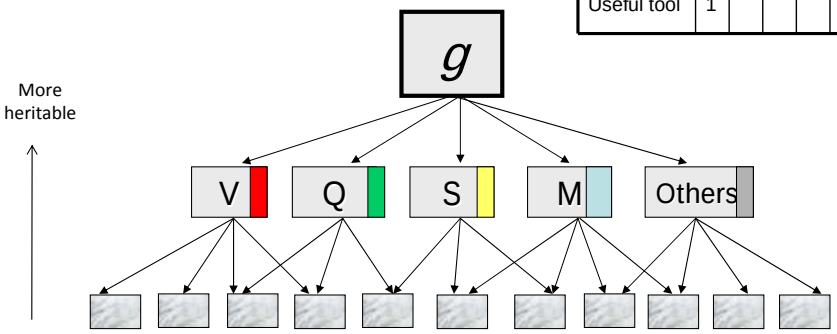
Question 4

Which explanation is most consistent with the full body of evidence—"social privilege" or "useful tool" theory?

Cognitive variation is highly structured, but not socially constructed

Its phenotypic structure appears to be replicated at genetic level

Privilege	0							
Useful tool	1							



More heritable

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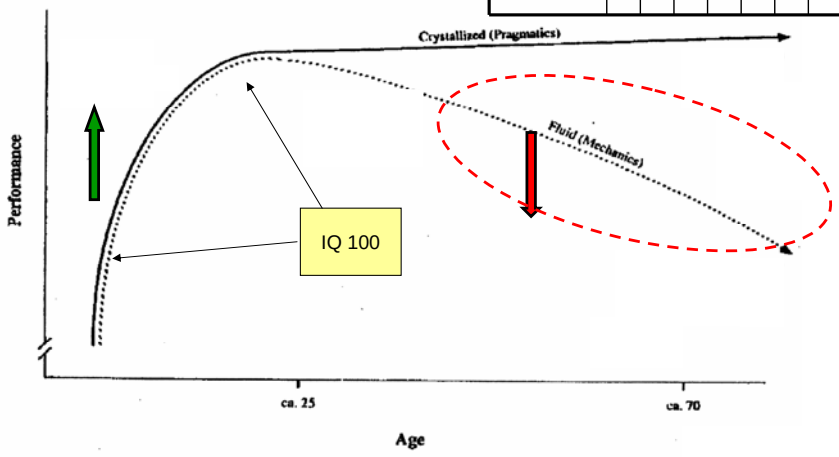
Fluid *g* rises, then falls with biological age

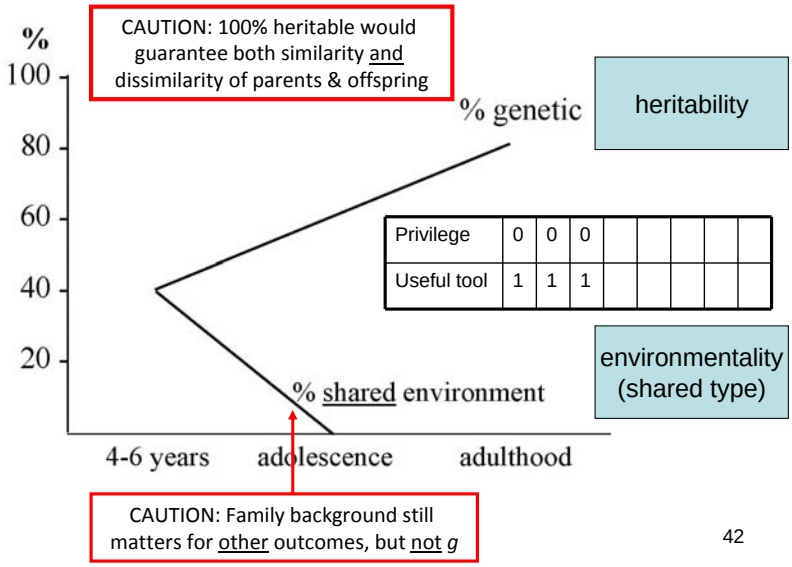
All fluid abilities move in tandem

Privilege	0	0						
Useful tool	1	1						



This is very consistent with a biological intelligence, but not one that is sensitive to social privilege.

Genetic portion of IQ variation rises with age
Family SES contributions to IQ variation wash away



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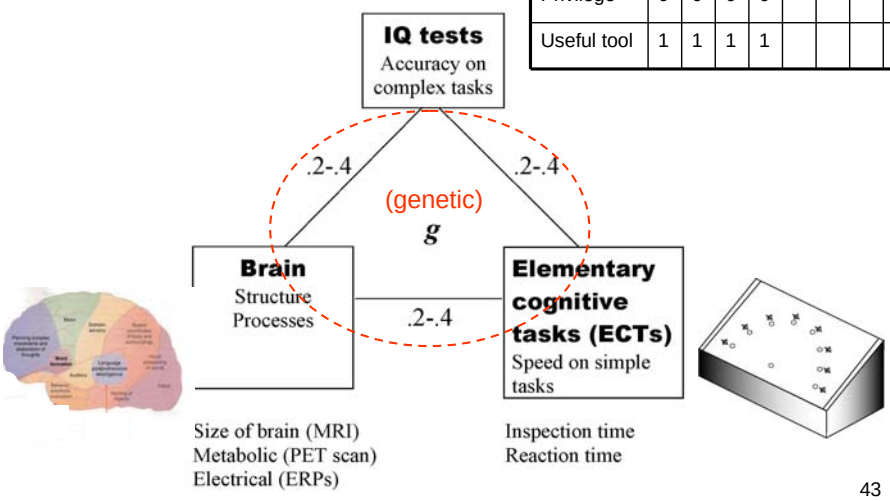
This is opposite what social privilege theory would predict. It would predict that environments would have more and more influence as people age.

g is genetically enmeshed in brain physiology

Privilege	0	0	0	0				
Useful tool	1	1	1	1				



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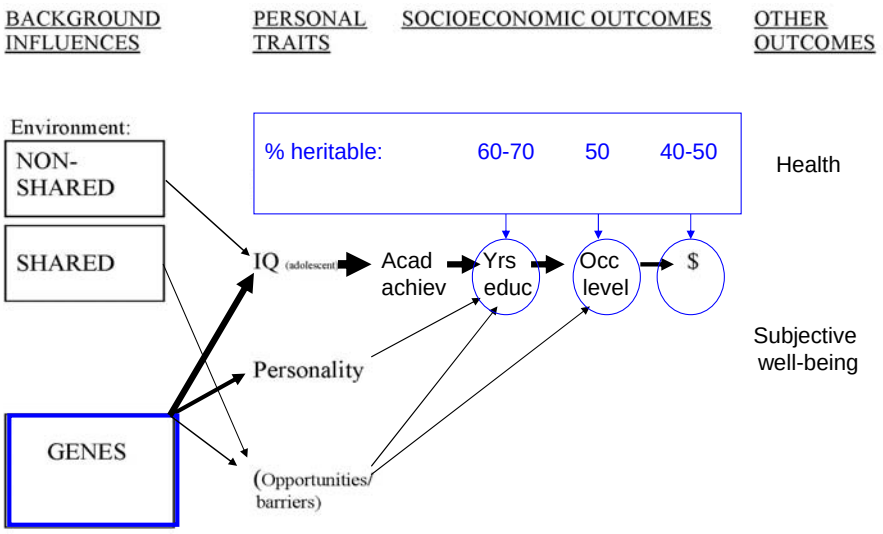
Shows that g not a psychometric artifact and restricted to test items and their content. Found in physical brain and in speed of performing tasks that no one gets wrong.

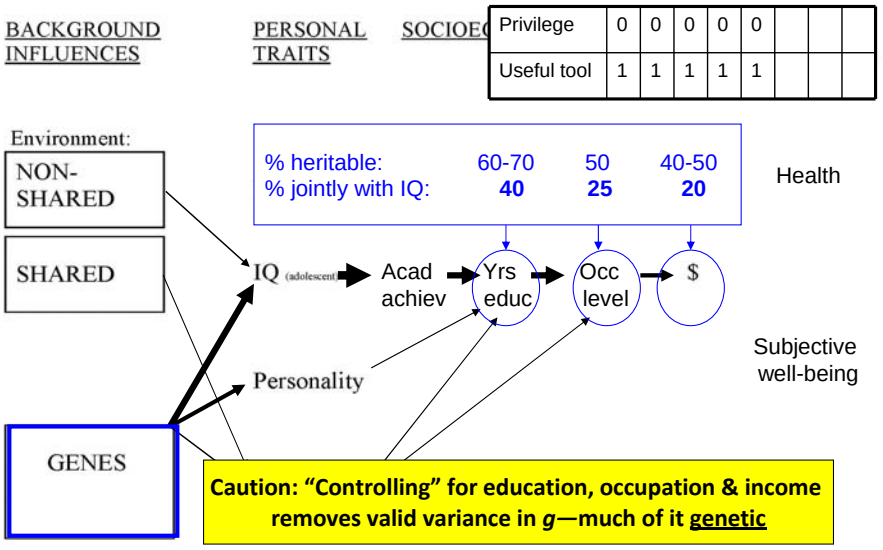
And the phenotypic links are mostly genetic.

Behavior genetic evidence on IQ-SES link

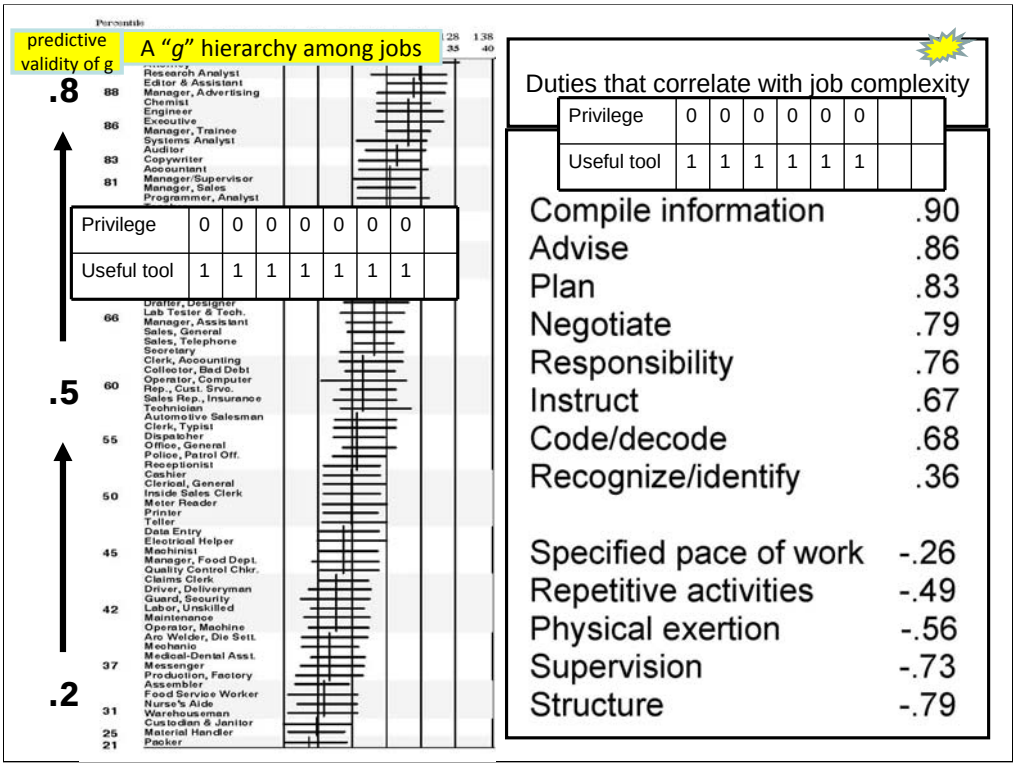


Behavior genetic studies find that differences in education, occupation, and income can be traced in part to genetic differences among us.

Behavior genetic evidence on IQ-SES link

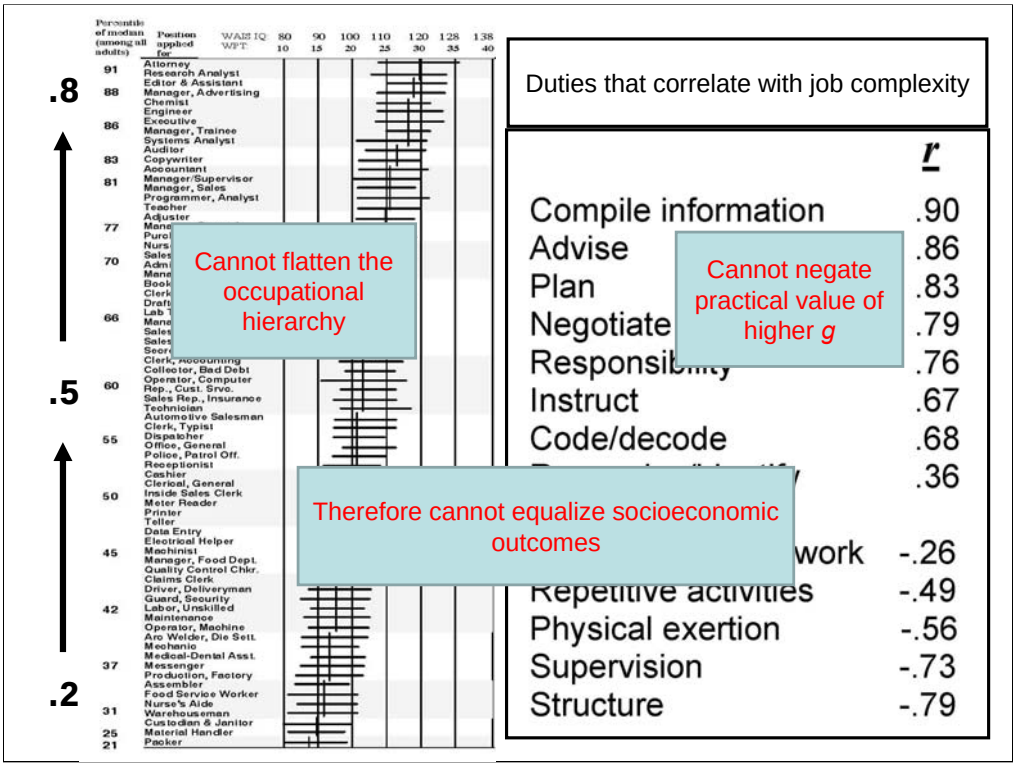


What is more important is that this heritability is shared in large part with intelligence. That means their correlation can be traced to having some genes in common. Social privilege theory would not predict this.

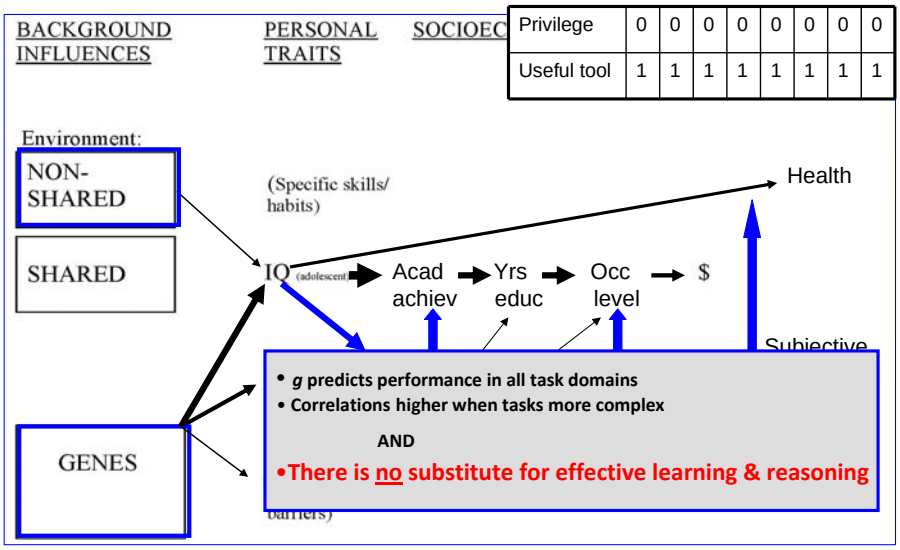


But what makes a job more complex? This is what job analysts have found. These are mental tasks whose good performance is critical to the organization but which are performed without much supervision or guidance.

Also, as noted before, intelligence predicts job performance better in more complex jobs.


.8
.5
.2
Percentile of median (among all adults)
Position applied for
WAIS IQ
WPT
80 90 100 110 120 128 138
10 15 20 25 30 35 40
91 Attorney
Research Analyst
Editor & Assistant
88 Manager, Advertising
Chemist
Engineer
86 Executive
Manager, Trainee
Systems Analyst
83 Auditor
Copywriter
Accountant
81 Manager/Supervisor
Manager, Sales
Programmer, Analyst
Teacher
Adjuster
77
70
66
60 Collector, Bad Debt
Operator, Computer
Rep., Cust. Srvc.
Sales Rep., Insurance
Technician
Automotive Salesman
Clerk, Typist
55 Dispatcher
Office, General
Police, Patrol Off.
Receptionist
Cashier
50 Clerical, General
Inside Sales Clerk
Meter Reader
Printer
Teller
Data Entry
45 Electrical Helper
Mechinist
Manager, Food Dept.
Quality Control Chkr.
Claims Clerk
Driver, Deliveryman
Guard, Security
42 Labor, Unskilled
Maintenance
Operator, Machine
Arc Welder, Die Sett.
Mechanic
37 Medical-Dental Asst.
Messenger
Production, Factory
Assembler
Food Service Worker
31 Nurse's Aide
Warehouseman
25 Custodian & Janitor
21 Material Handler
Packer
Cannot flatten the occupational hierarchy
Therefore cannot equalize socioeconomic outcomes
Duties that correlate with job complexity
r
Compile information .90
Advise .86
Plan .83
Negotiate .79
Responsibility .76
Instruct .67
Code/decode .68
.36
work -.26
Repetitive activities -.49
Physical exertion -.56
Supervision -.73
Structure -.79
Cannot negate practical value of higher g

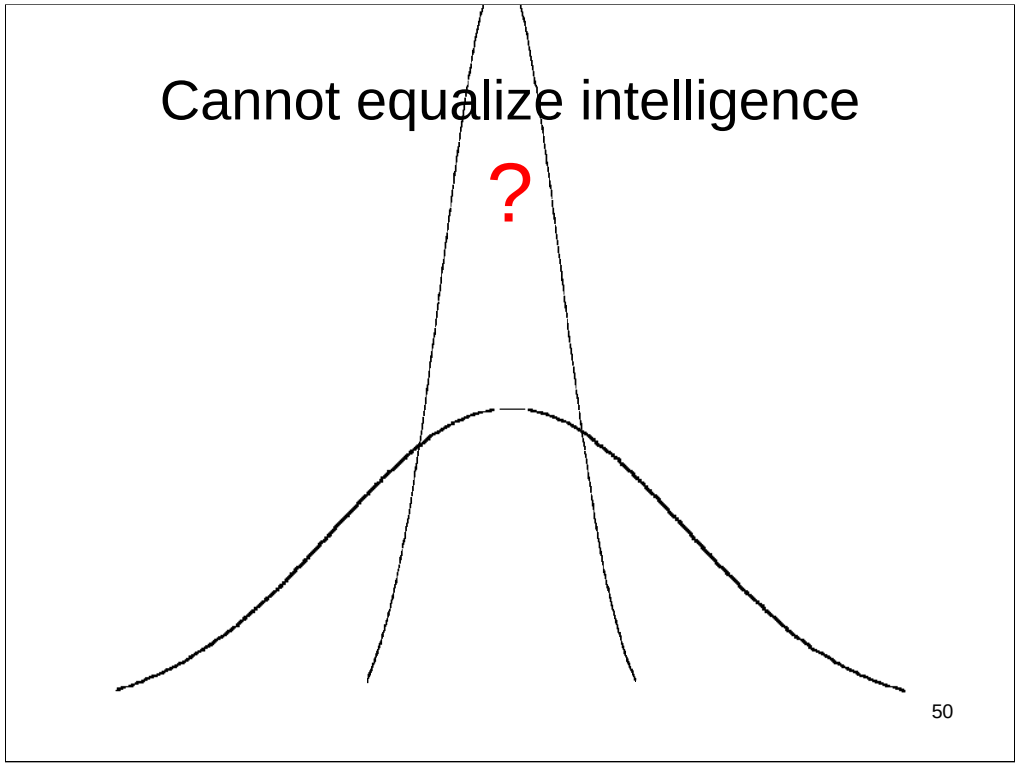
Task performance evidence on the IQ-SES link

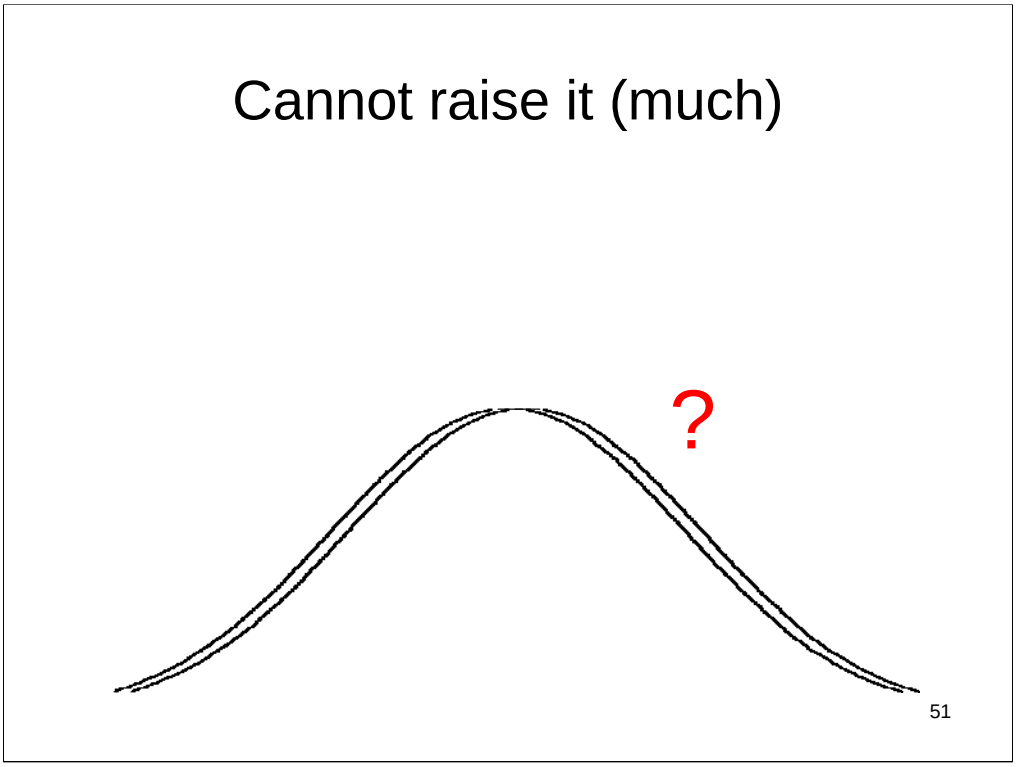


Implications for human cognitive capital?

#1

Work within the constraints imposed by human variation


Cannot equalize intelligence
?
50



We have tried and failed—many interventions.

Implications for cognitive capital?

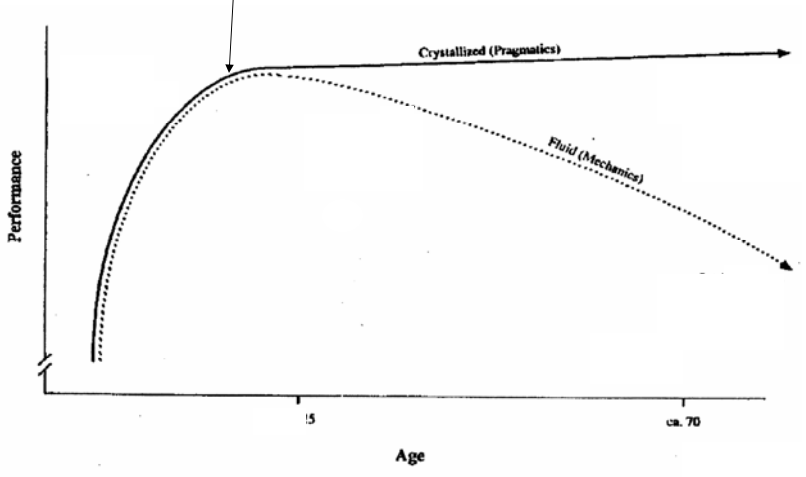
#2

Exploit opportunities

- Protect brain power
- Optimize its use at every ability level
- Control task complexity

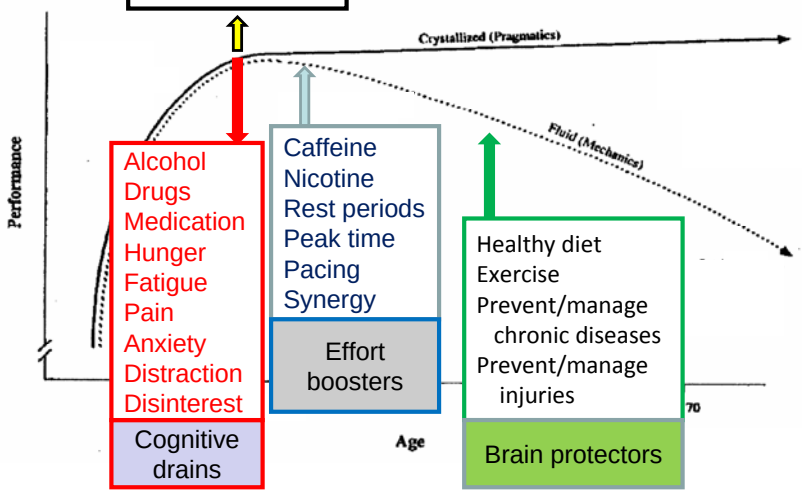
IQ tests measure our maximum power

But we rarely work to our maximum or protect it!!



Brain drains, full utilization, brain savers

PROTECT COGNITIVE CAPITAL!



Alcohol
Drugs
Medication
Hunger
Fatigue
Pain
Anxiety
Distraction
Disinterest

Cognitive drains

Caffeine
Nicotine
Rest periods
Peak time
Pacing
Synergy

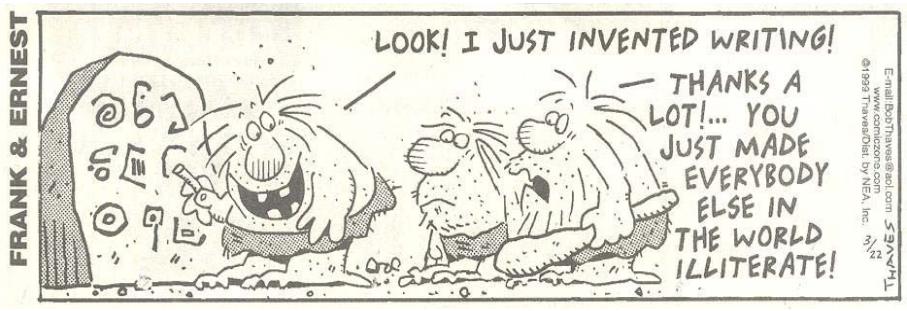
Effort boosters

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

Brain protectors

Recall:

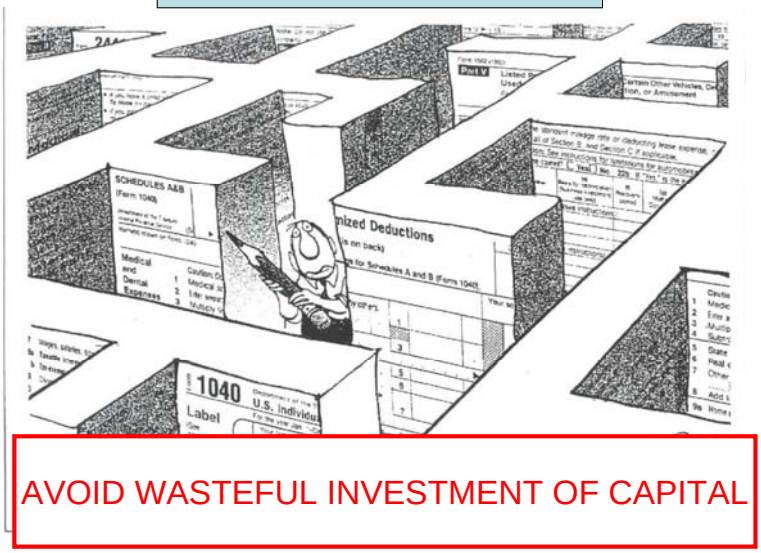
Smart people make life more complex for the rest of us



55

Overly complex tasks generate stupid people (raise error rates)

US income tax forms



AVOID WASTEFUL INVESTMENT OF CAPITAL

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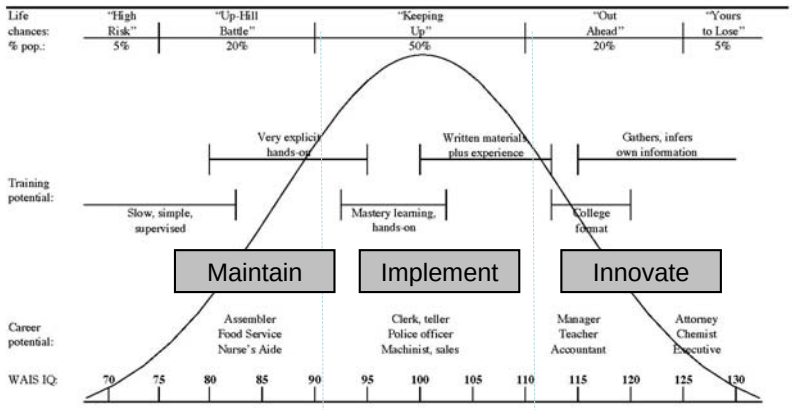
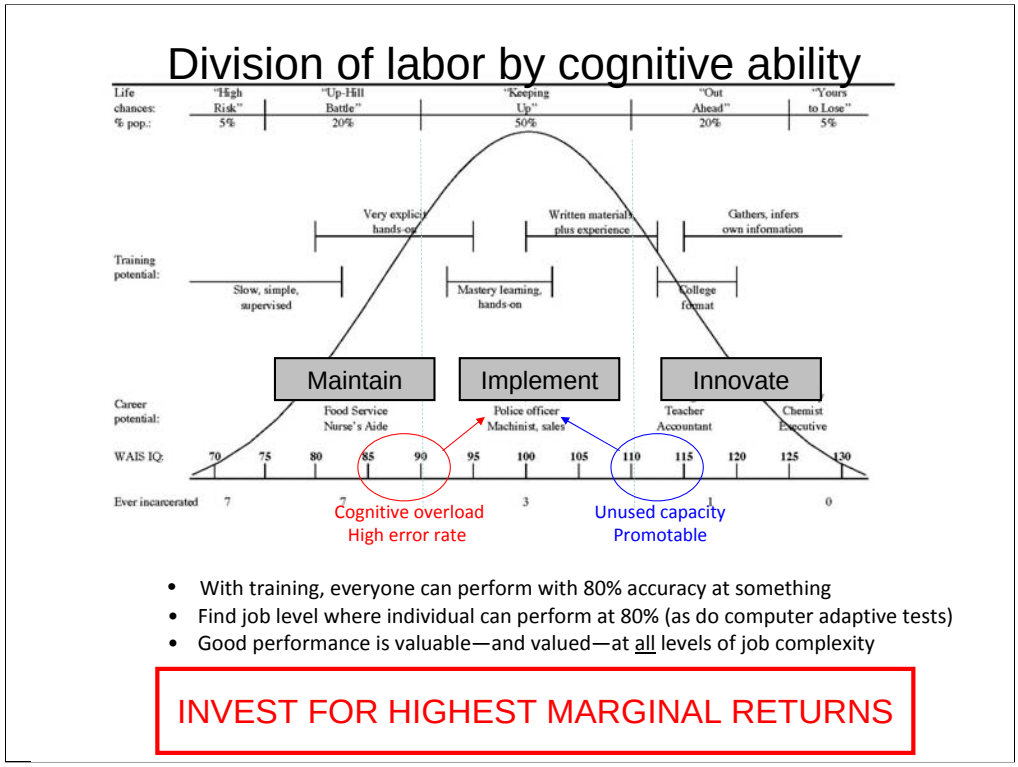
A lot of complexity is inherent. It cannot be eliminated without removing something essential to a job or task. But the modern world and big bureaucracies create a lot of needless complexity—confusing instructions, unnecessary steps, constantly changing technologies. This is not only wastes brain power, but leads to people making lots of mistakes—which only confuses things more.

Division of labor by cognitive ability



HUSBAND CAPITAL AT ALL LEVELS

Cultures and economies prosper only when they can implement their good ideas and maintain what they create. Everyone contribute to innovation, OR implementation, OR maintenance. All are crucial. Good performance is required at all levels; all levels need to be nourished. None is expendable.



- With training, everyone can perform with 80% accuracy at something
- Find job level where individual can perform at 80% (as do computer adaptive tests)
- Good performance is valuable—and valued—at <u>all</u> levels of job complexity

INVEST FOR HIGHEST MARGINAL RETURNS

Also important is to help people find their 80% fit, or what American's might dub the "sweet spot." This is where all levels of cognitive capital optimize returns for their investing cognitive effort.

Estimated levels of usual cognitive functioning

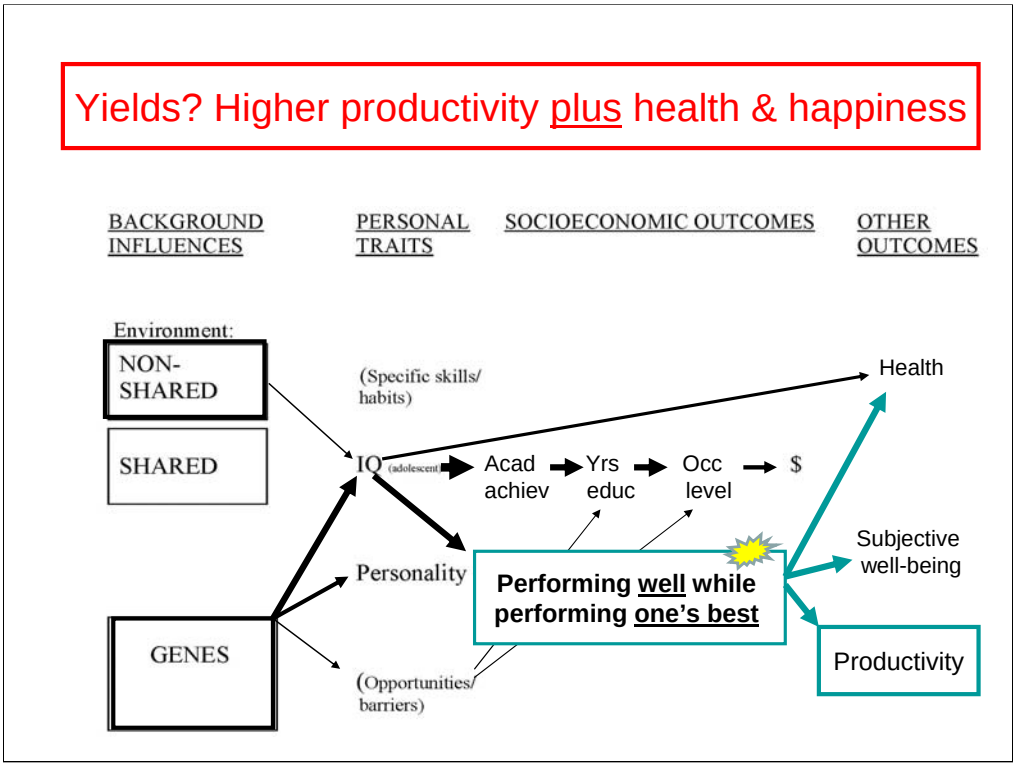
U.S. Dept of Education 1993 survey of adult functional literacy
(nationally representative sample, ages 16+, N=26,091)

NALS Level	% pop.	Simulated Everyday Tasks
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

IDENTIFY LIKELY POINTS OF COGNITIVE OVERLOAD

We all make mistakes; the challenge is to anticipate when and where, then prevent as many as possible.

We can prevent some errors if we better anticipate who will make them, when, and why. Understanding how task complexity is distributed across different life arenas will help us do that. This especially important in health care and helping people manage their own health. Self-management of chronic diseases such as diabetes is a very, very complex job. We have to learn which tasks are most complex, and why. We will sometimes have to triage the sets of tasks we expect patients and workers to perform if many are too difficult for them to perform without high rates of error. We might assign them only the most critical tasks (e.g., in health self-care), only assign them ones within their range of 80% competence, or, if possible, provide them special cognitive assistance or supervision. Our job is to help people perform to their personal maximum.



People who perform to their personal maximum are respected for that and are proud of their contribution. Helping people perform to their best in health self-care will also protect the cognitive capital they can invest for our collective benefit.

Thank you.

Linda S. Gottfredson
gottfred@udel.edu
www.udel.edu/educ/gottfredson