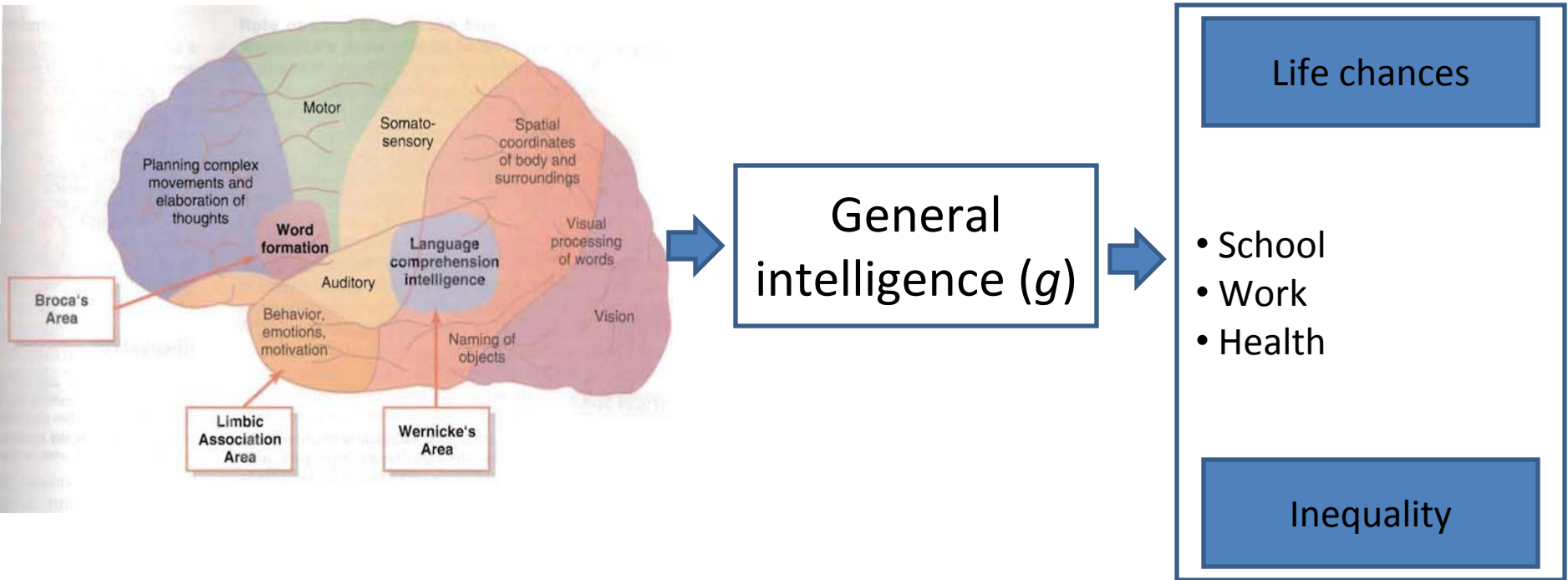


# 4 Decisions in Promoting Cognitive Enhancements

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

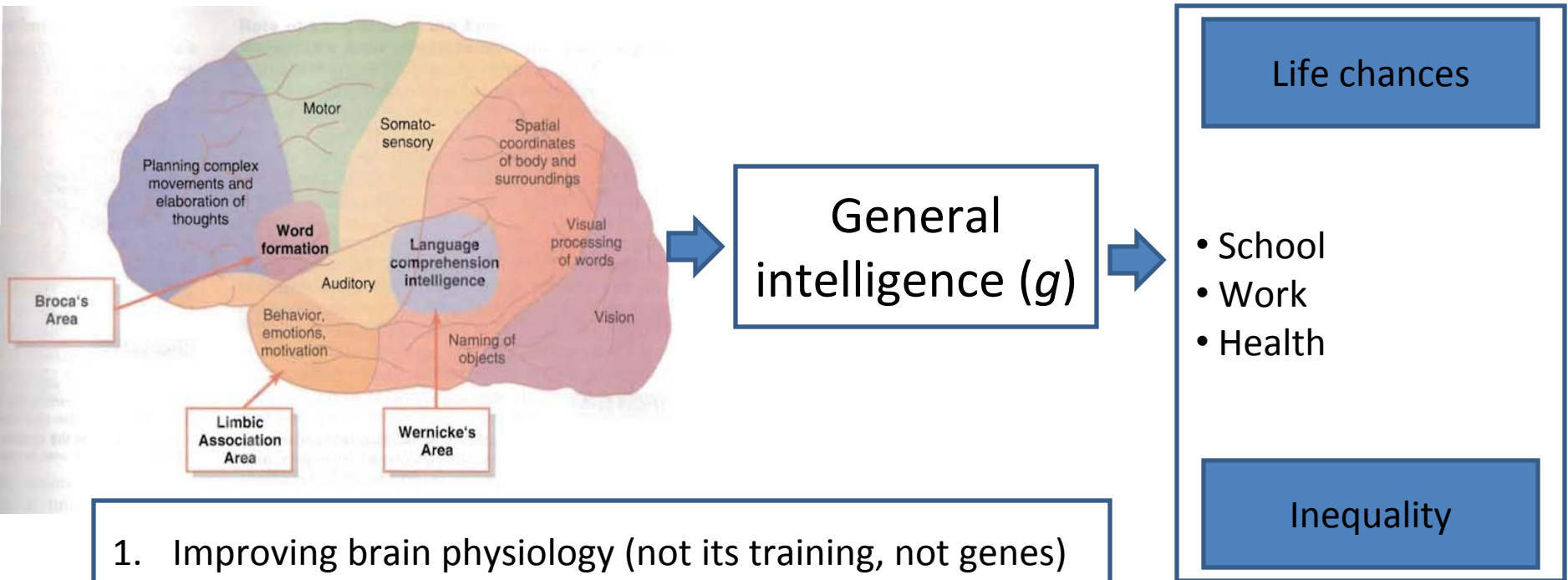
June 27, 2009  
Cognitive Enhancement Workshop  
Future of Humanity Institute  
Oxford University

# Assumptions to Focus Discussion



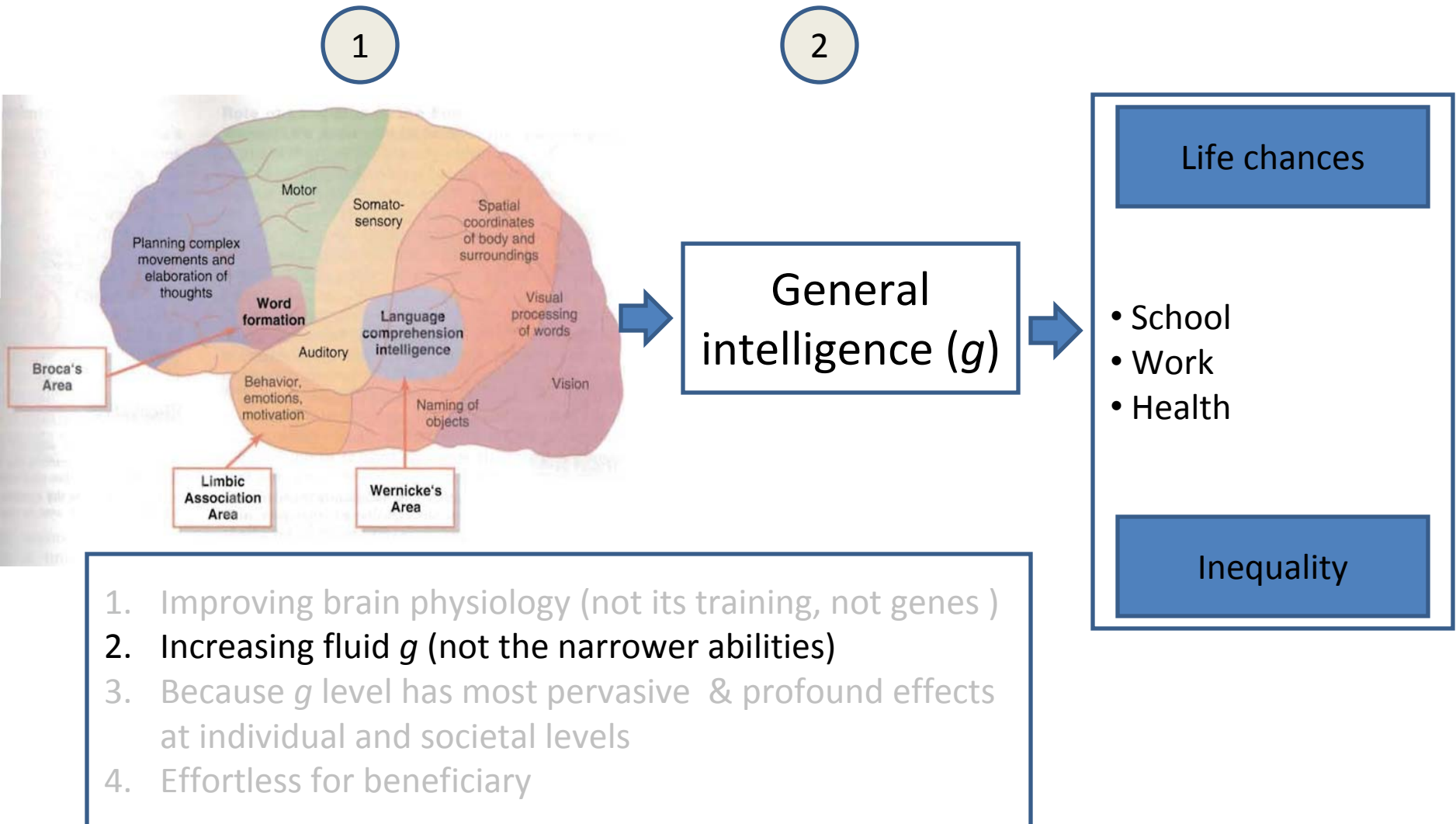
# Assumptions to Focus Discussion

1



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



# But, what is $g$ ?

Core of all mental abilities

Extracted with factor analysis

Carries freight of prediction

MOST GENERAL

Domain general

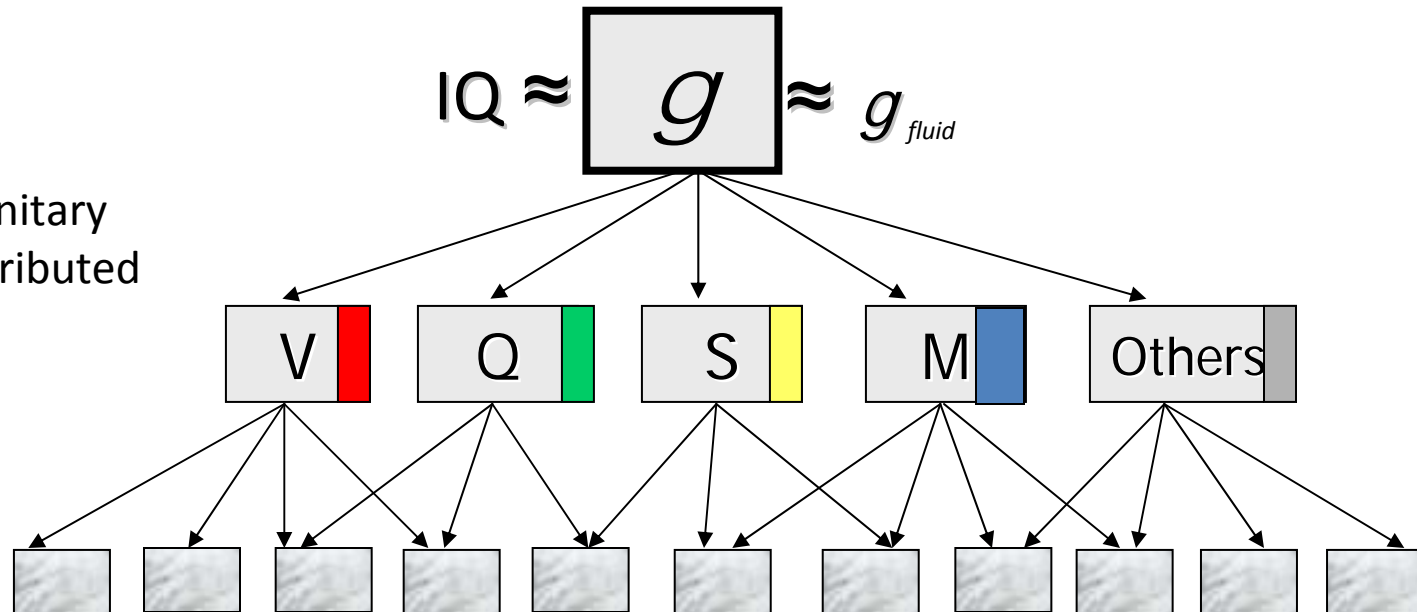
More heritable

*Psychometrically* unitary

*Physiologically* distributed

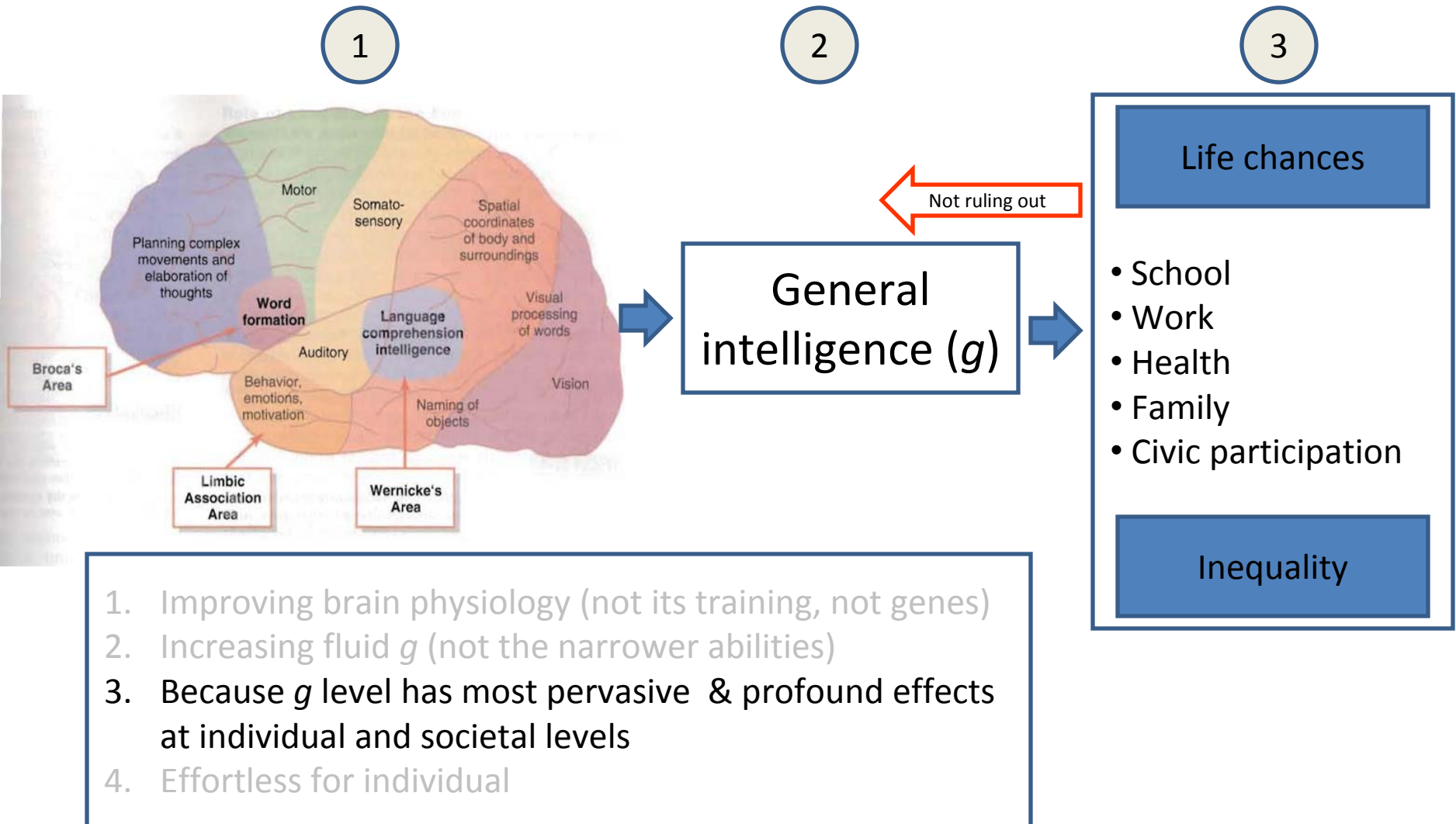


NARROW

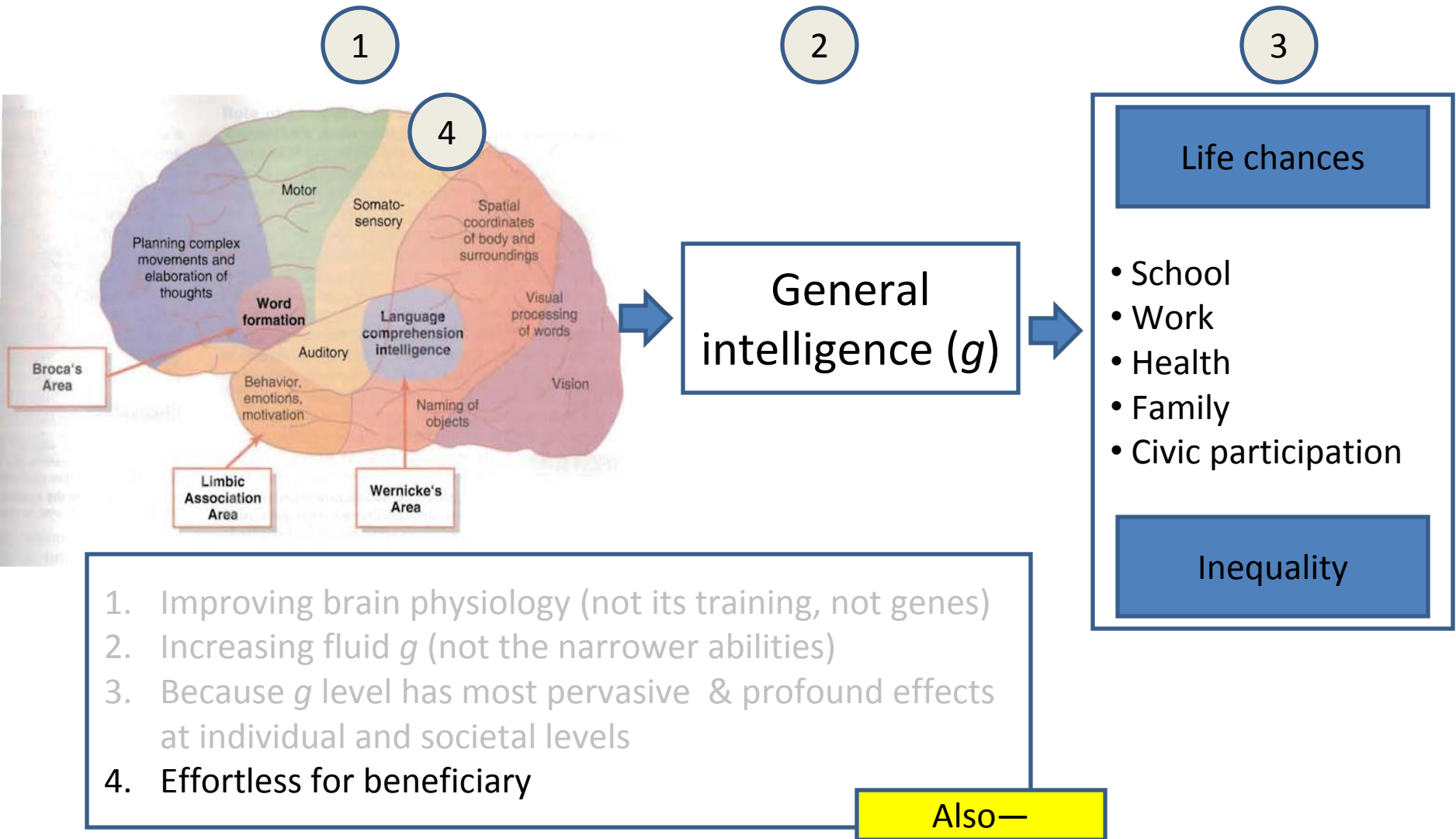


- Proficiency in learning, reasoning, think abstractly
- Ability to spot problems, solve problems
- Not knowledge, but ability to accumulate and apply it

# Assumptions to Focus Discussion

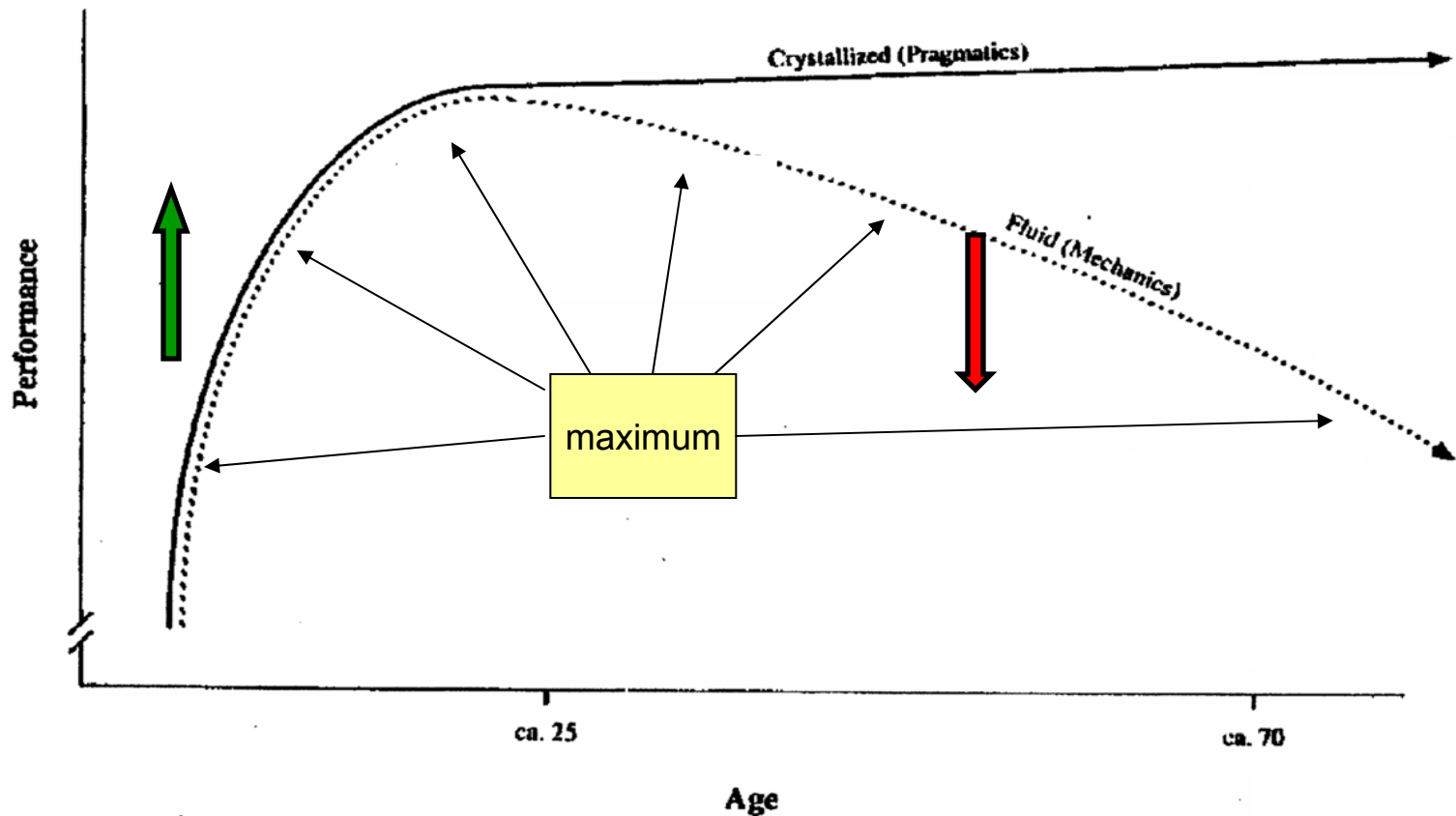


# Assumptions to Focus Discussion



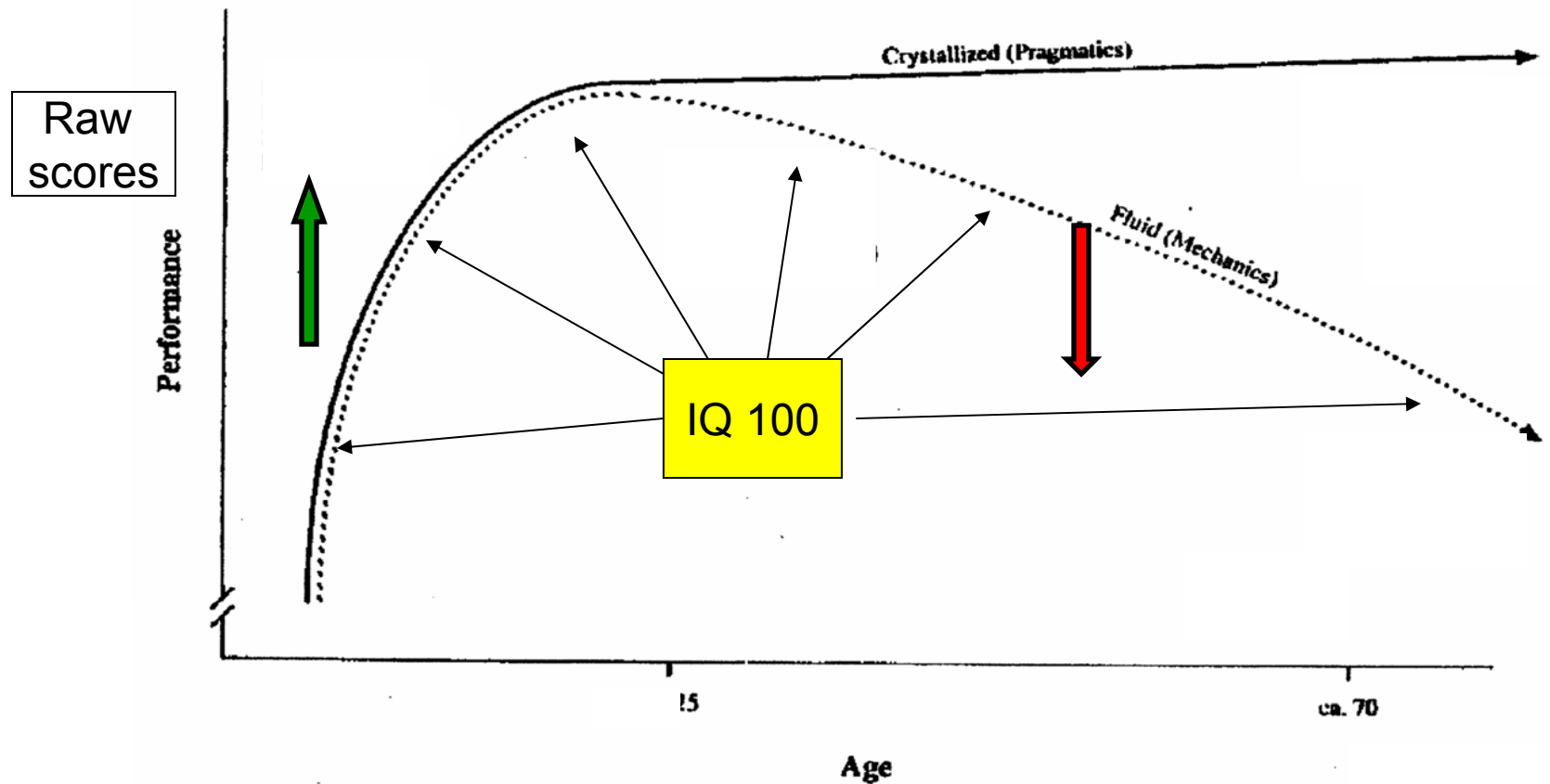
## 5. Not seeking to prevent wasted capacity

*First need to explain that—*  
Maximum capacity in fluid  $g$  rises, then falls with age

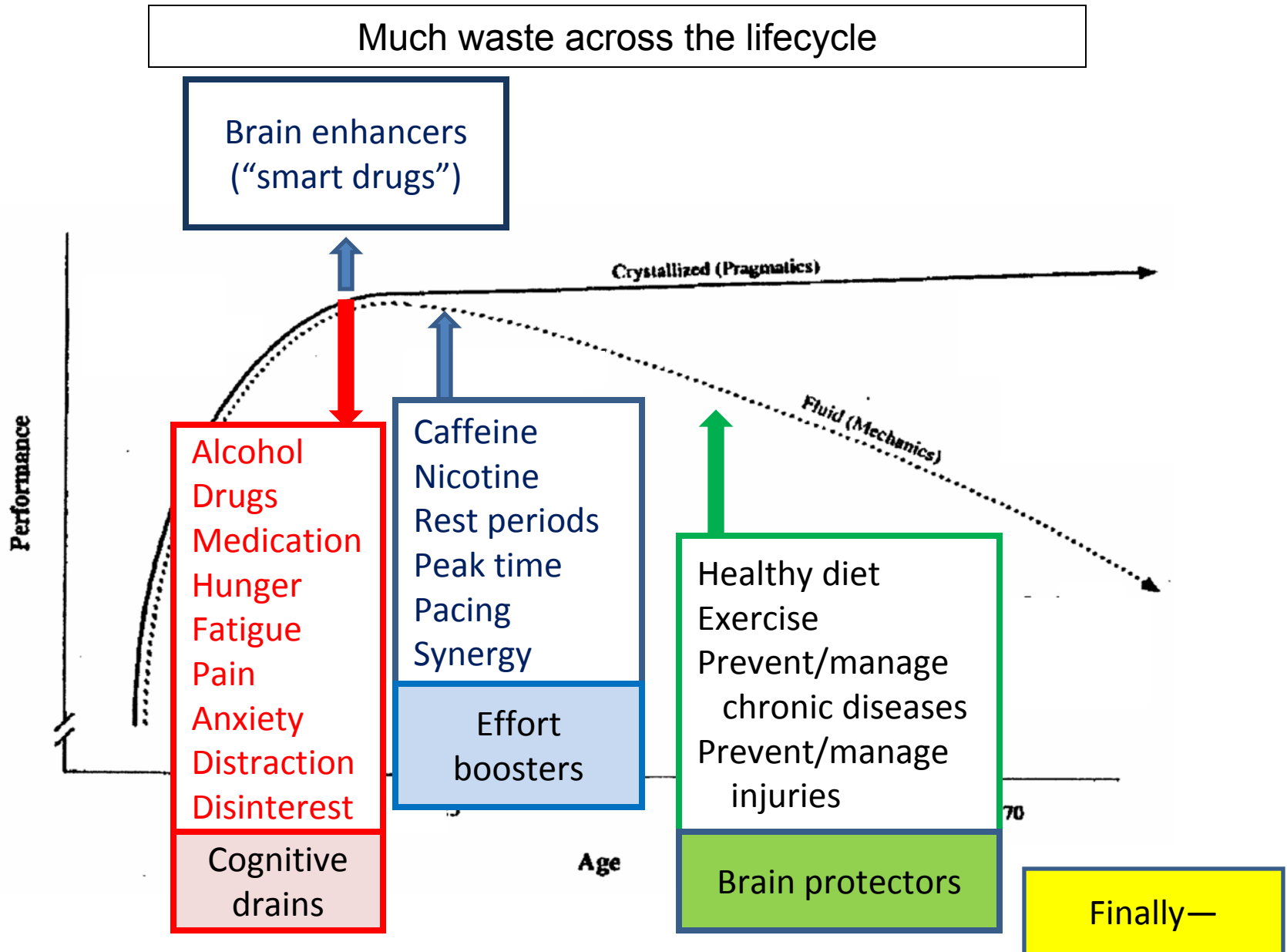




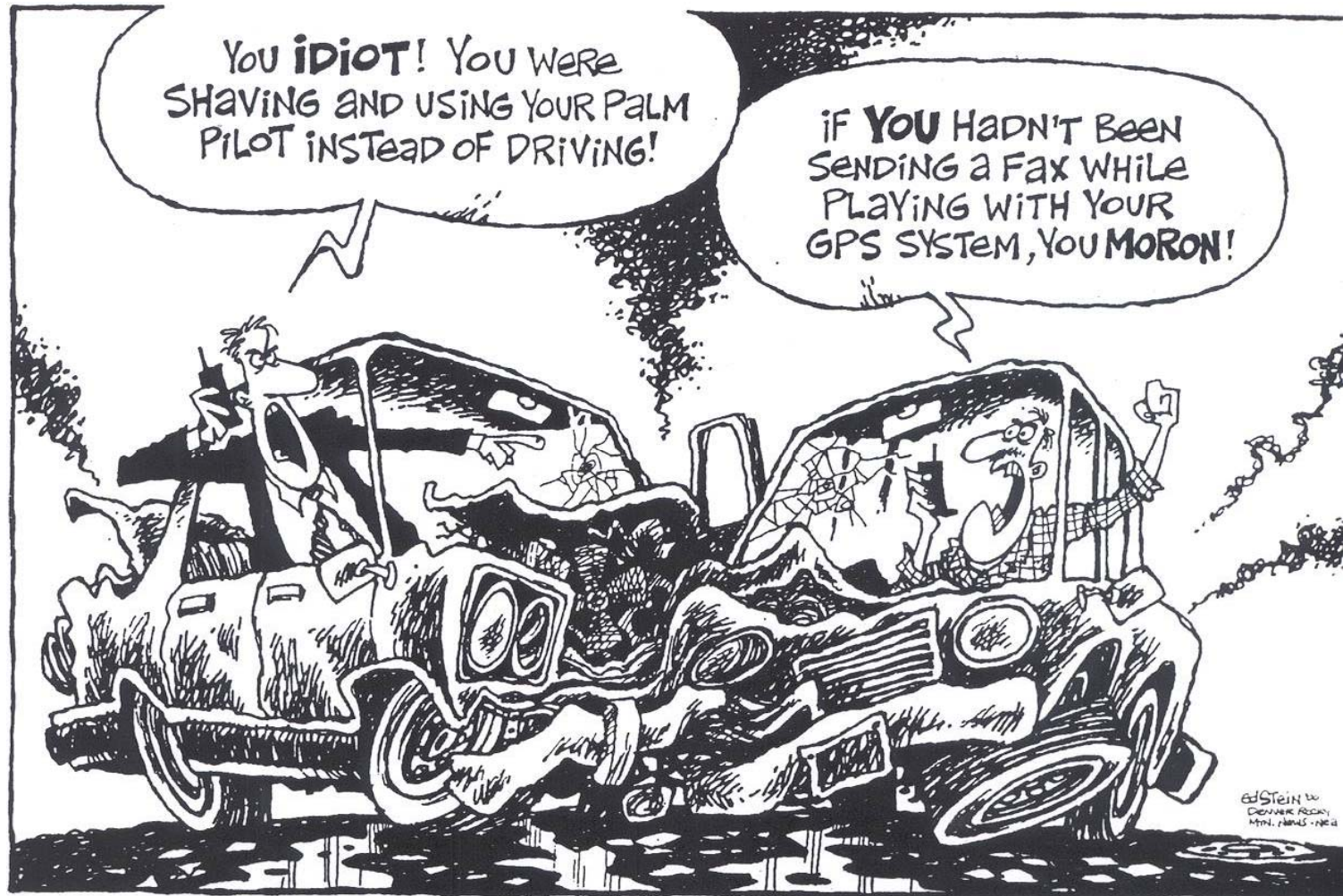
But IQ tests are age-normed  
to center all ages at IQ 100



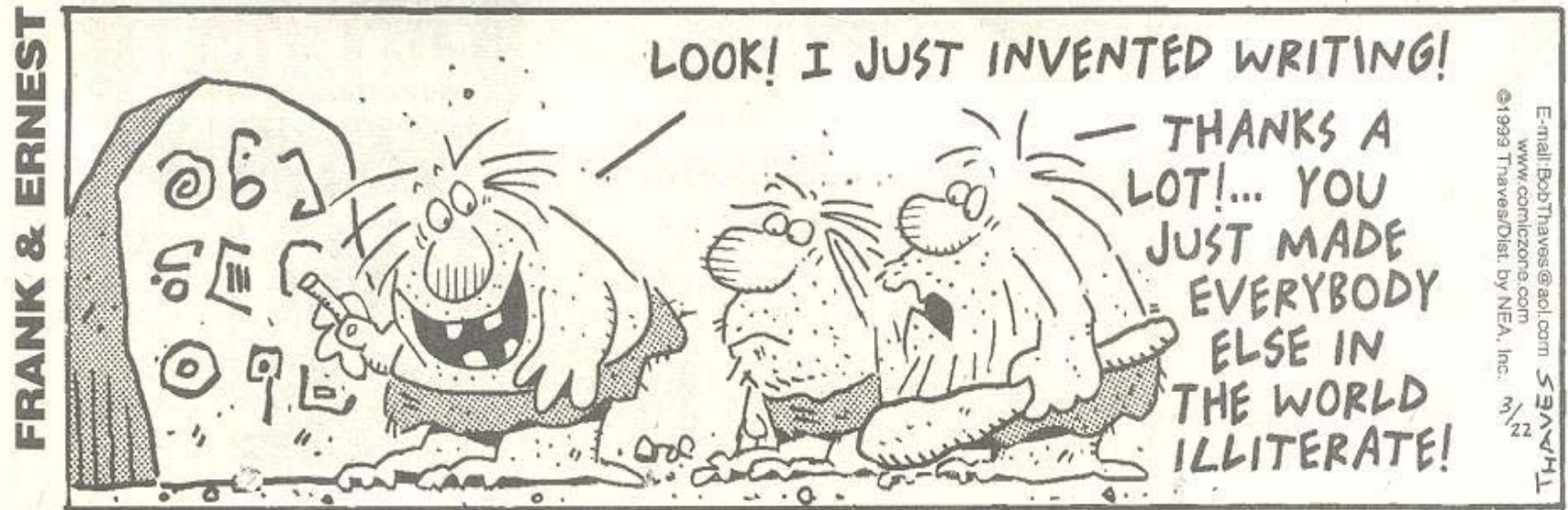
## 5. Not seeking to prevent wasted capacity



## 6. Not seeking to reduce ever-rising cognitive demands

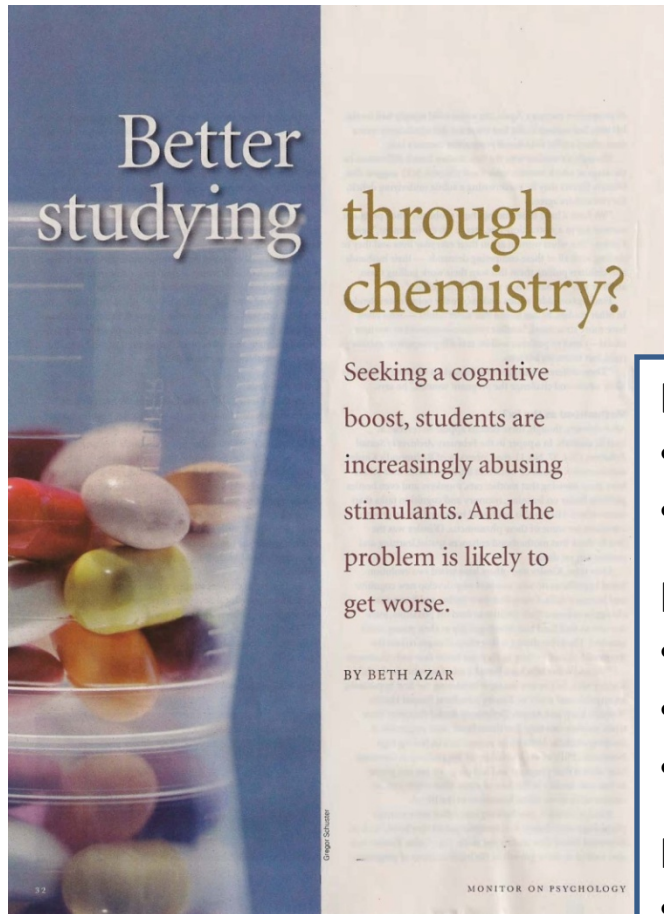


Technology makes life ever more complex,  
putting increasing premium on *g*

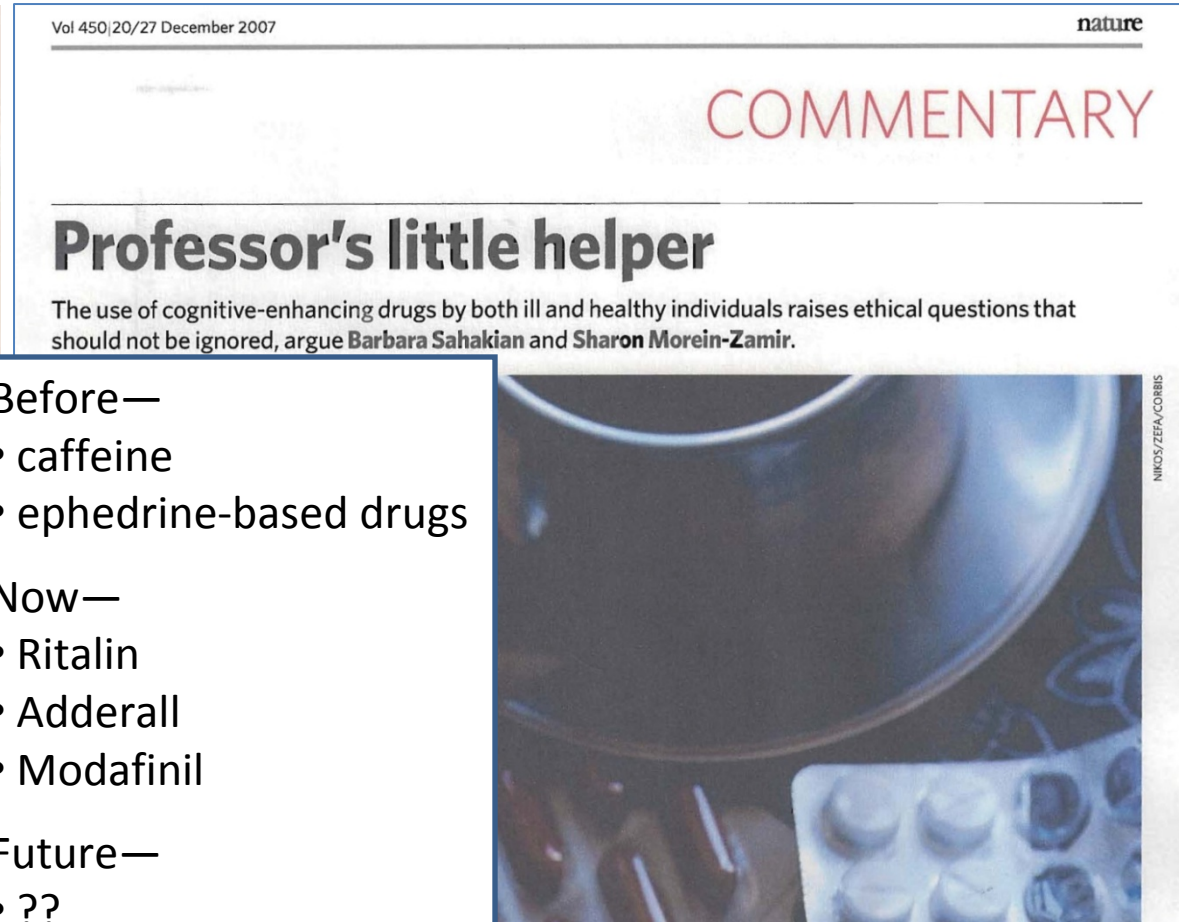




# So, let's assume what most people want— "smart drugs" with no side-effects



*Monitor on Psychology,*  
September, 2008



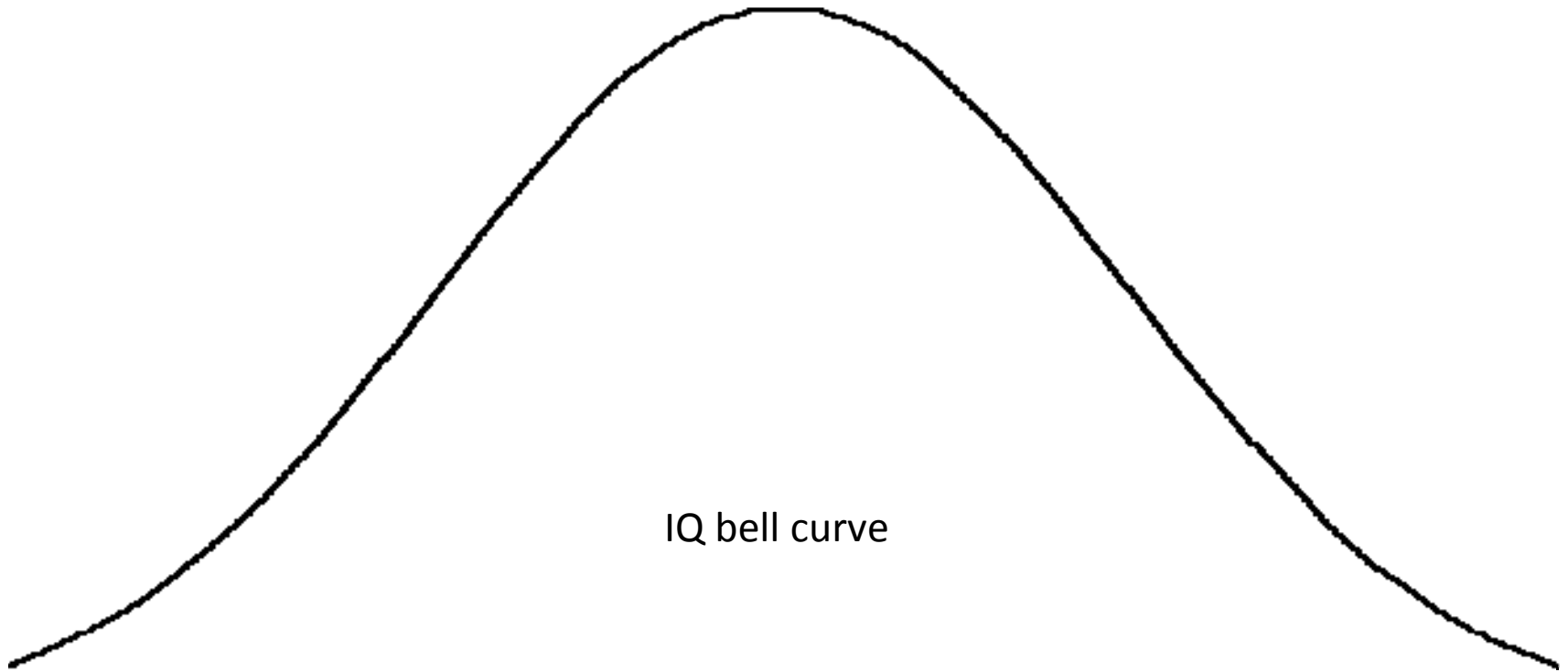
*Nature,* December, 2007

# 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 —

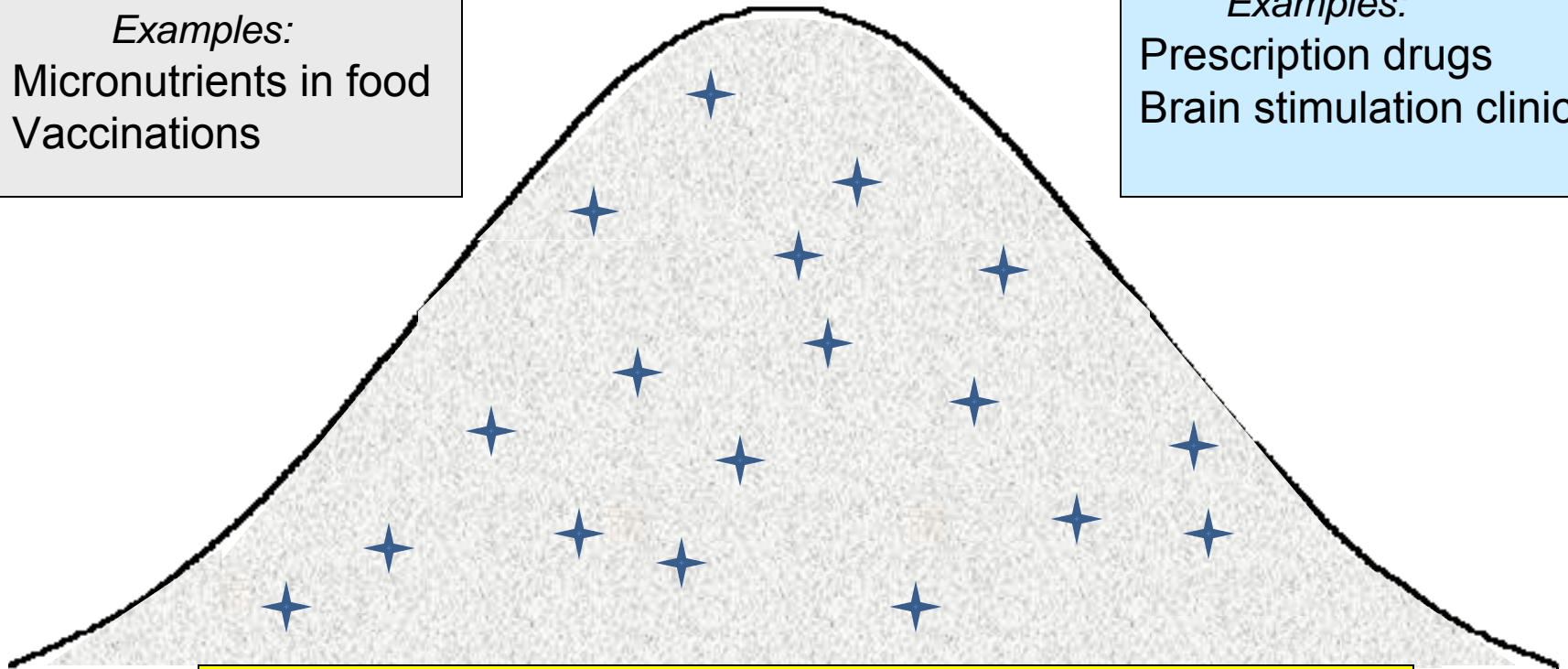


IQ bell curve

# Mode of delivery — public health model?

*Examples:*  
Micronutrients in food  
Vaccinations

*Examples:*  
Prescription drugs  
Brain stimulation clinics



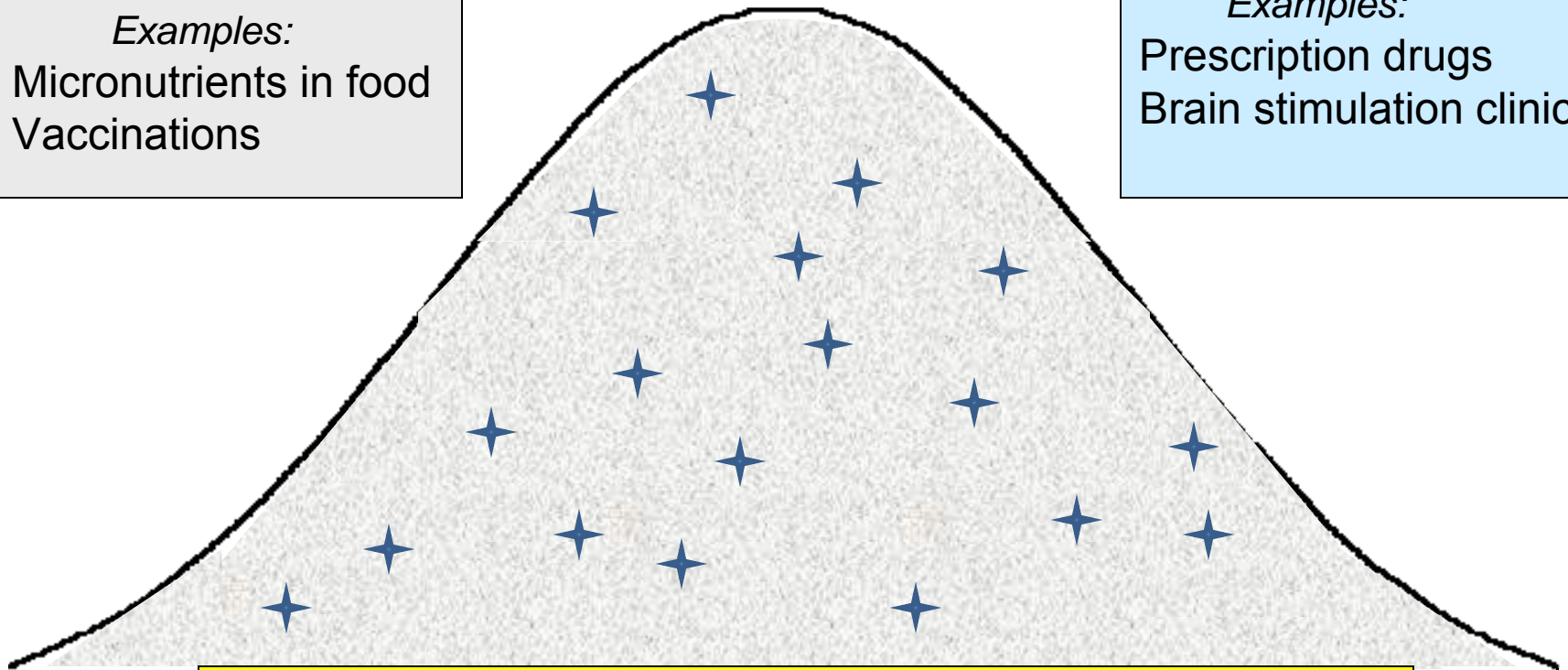
Subsidized?  
Eligibility criteria?  
Adherence/utilization rates?



# Mode of delivery — public health model?

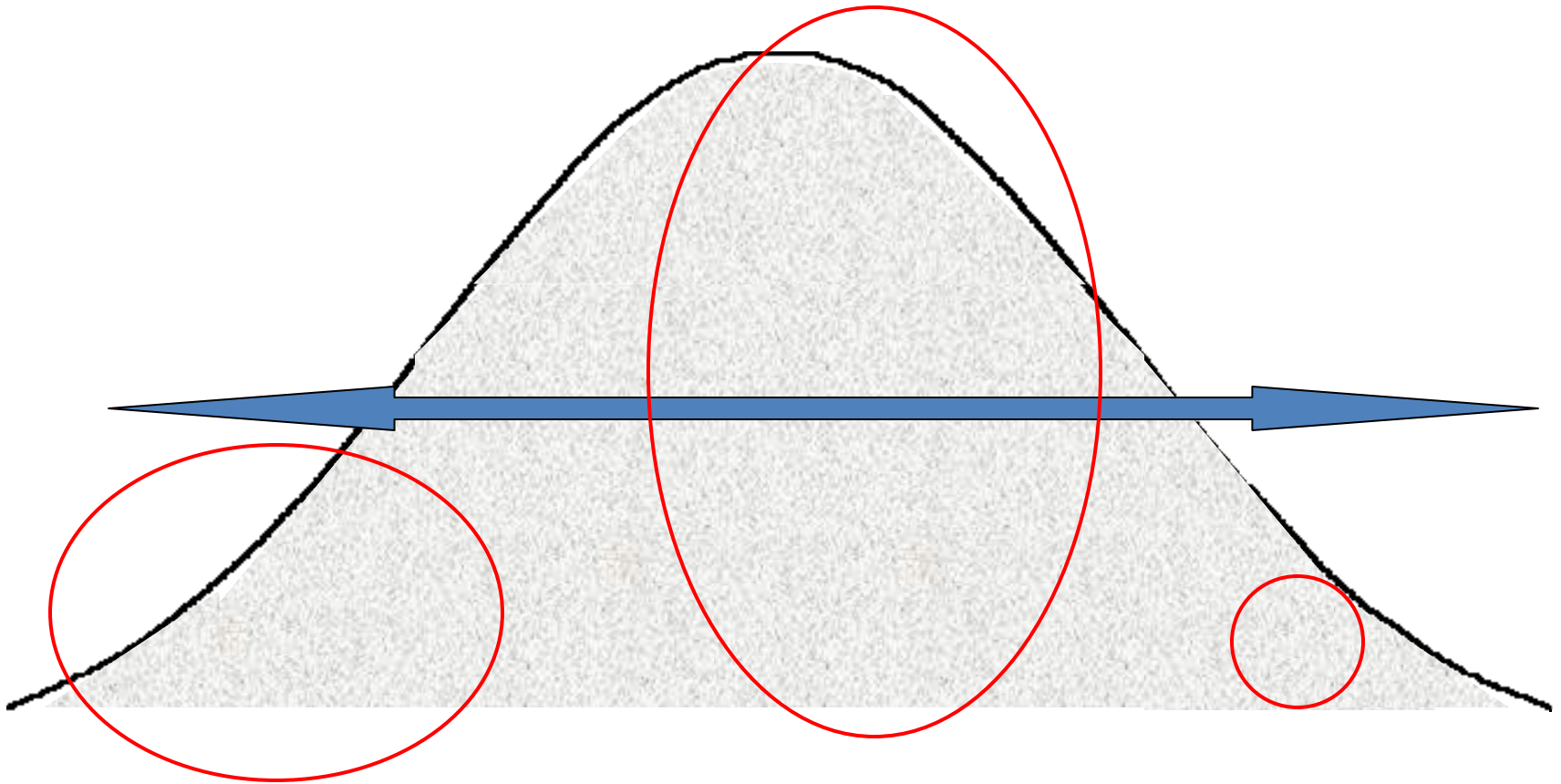
*Examples:*  
Micronutrients in food  
Vaccinations

*Examples:*  
Prescription drugs  
Brain stimulation clinics



Subsidized?  
Eligibility criteria?  
Adherence/utilization rates?  
Social gradients in utilization?

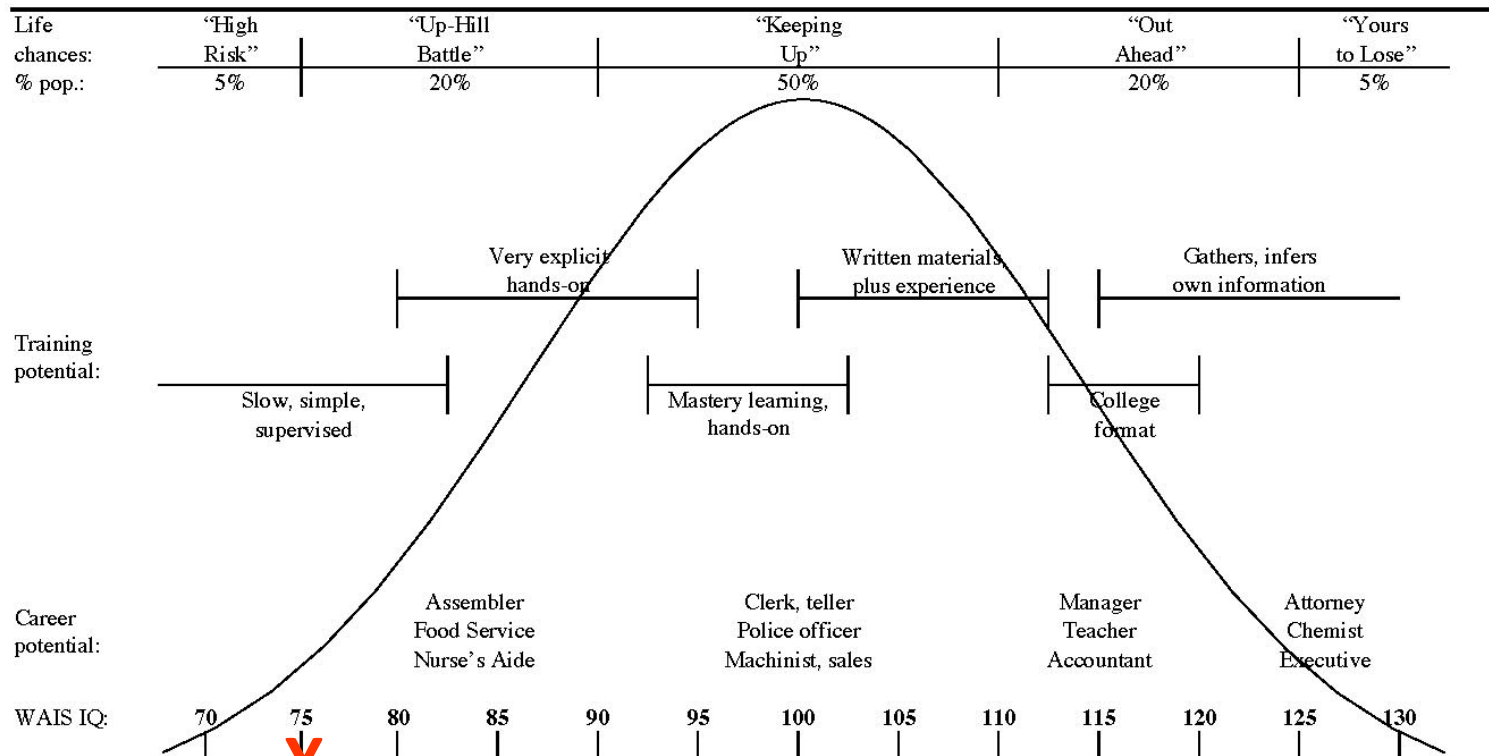
# Degree of coverage—



Why will there be pressure to target, or ration?

# Typical life outcomes along the IQ continuum

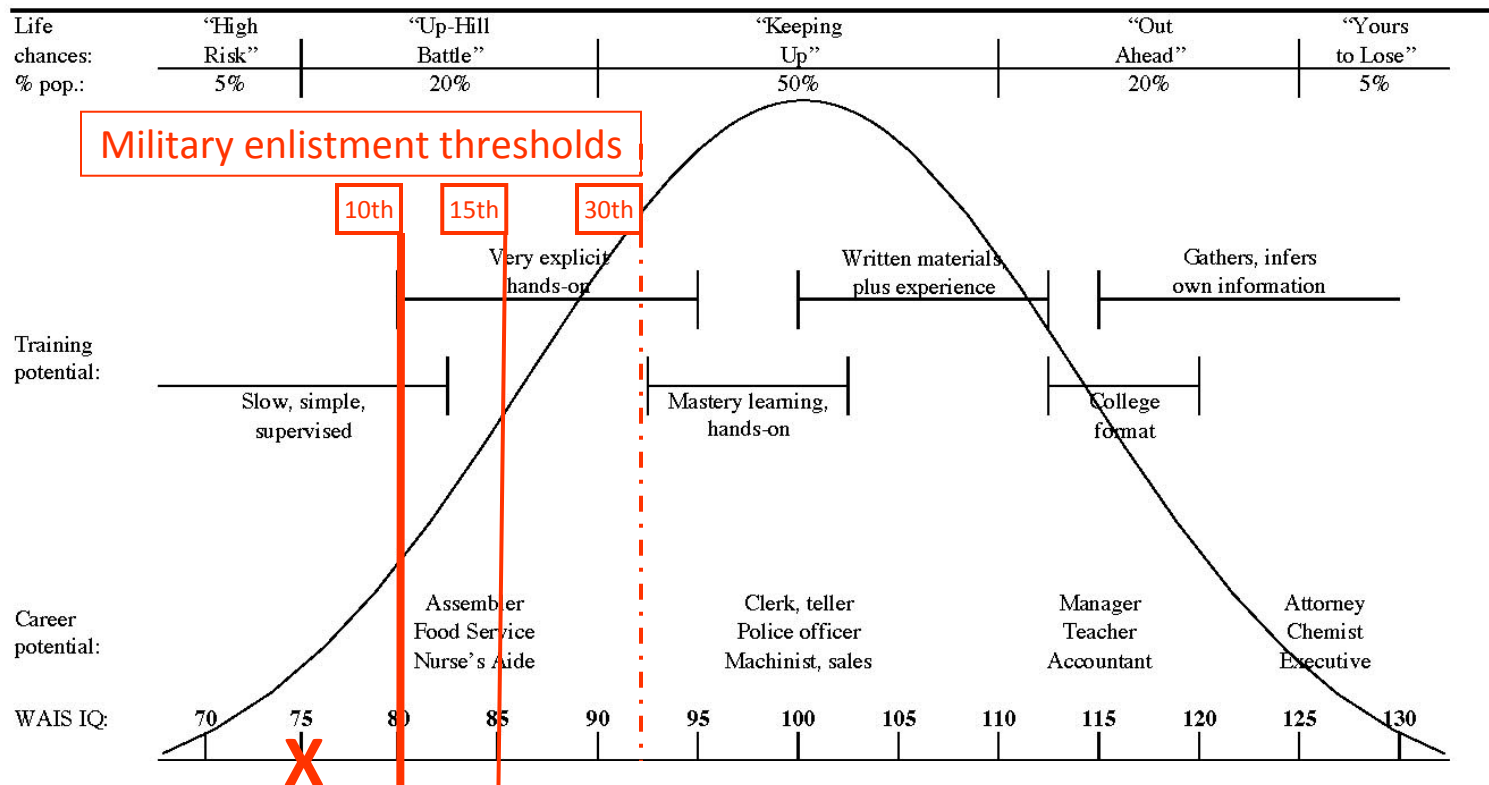
Creates pushes & pulls on public policy



Borderline ability to function  
as independent adult

Odds of socioeconomic success & productivity increase

# Military requires minimum “trainability” ( $g$ )



Most military jobs require at least 30<sup>th</sup> percentile

Military policy forbids induction below 15<sup>th</sup> percentile

US law forbids induction below 10<sup>th</sup> 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)

NALS Level	% pop.	Simulated Everyday Tasks
		Routinely able to perform tasks only up to this level of difficulty
5	3%	<ul style="list-style-type: none"><li>• Use calculator to determine cost of carpet for a room</li><li>• Use table of information to compare 2 credit cards</li></ul>
4	17%	<ul style="list-style-type: none"><li>• Use eligibility pamphlet to calculate SSI benefits</li><li>• Explain difference between 2 types of employee benefits</li></ul>
3	31%	<ul style="list-style-type: none"><li>• Calculate miles per gallon from mileage record chart</li><li>• Write brief letter explaining error on credit card bill</li></ul>
2	27%	<ul style="list-style-type: none"><li>• Determine difference in price between 2 show tickets</li><li>• Locate intersection on street map</li></ul>
1	22%	<ul style="list-style-type: none"><li>• Total bank deposit entry</li><li>• Locate expiration date on driver's license</li></ul>


# Estimated levels of usual cognitive functioning

Example of practical meaning of ability differences

NALS Level	% pop. 	<b>Simulated Everyday Tasks</b> Routinely able to perform tasks only up to this level of difficulty
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# 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

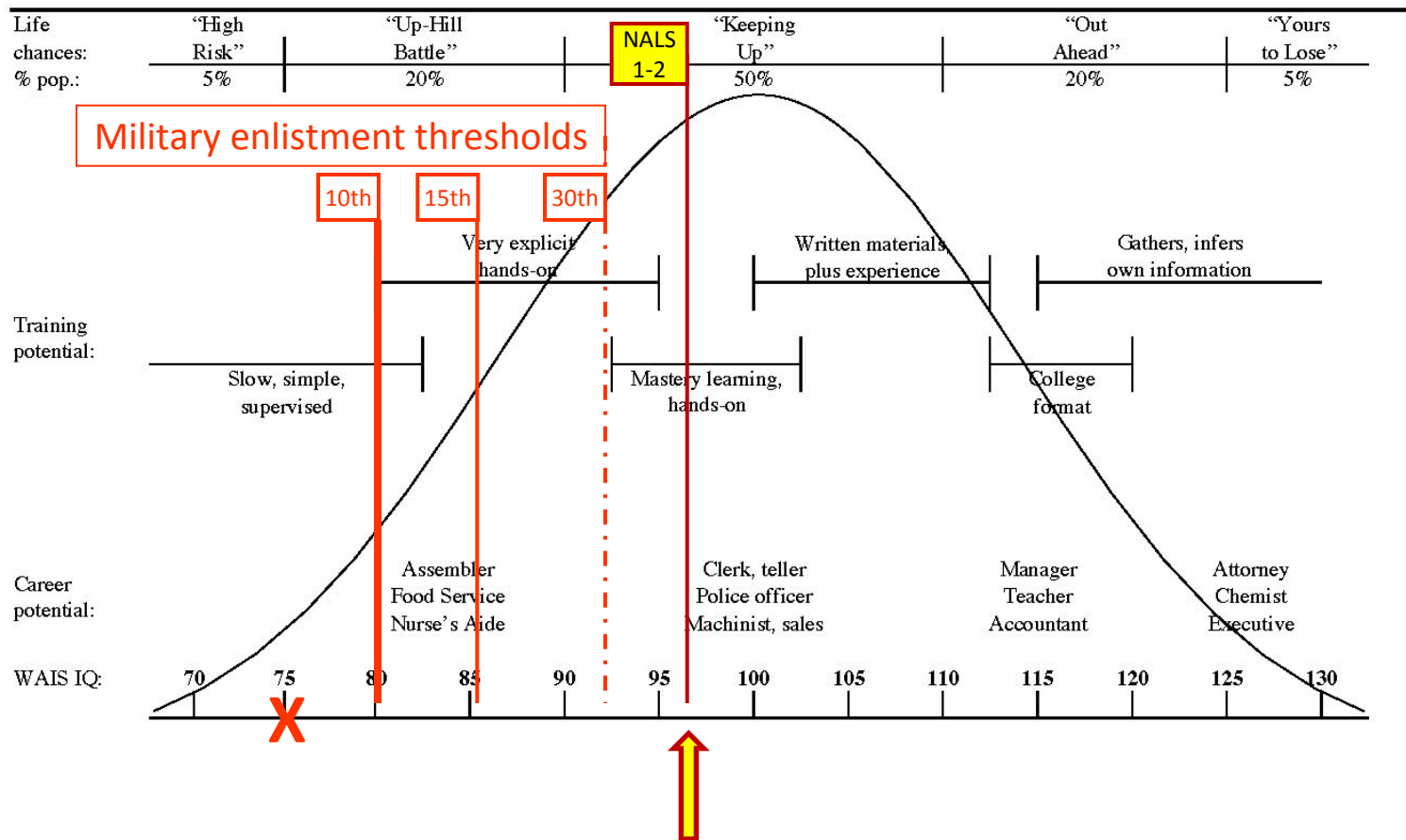
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US Dept of Education: People at levels 1-2 are below literacy level required to enjoy rights & fulfill responsibilities of citizenship		
		
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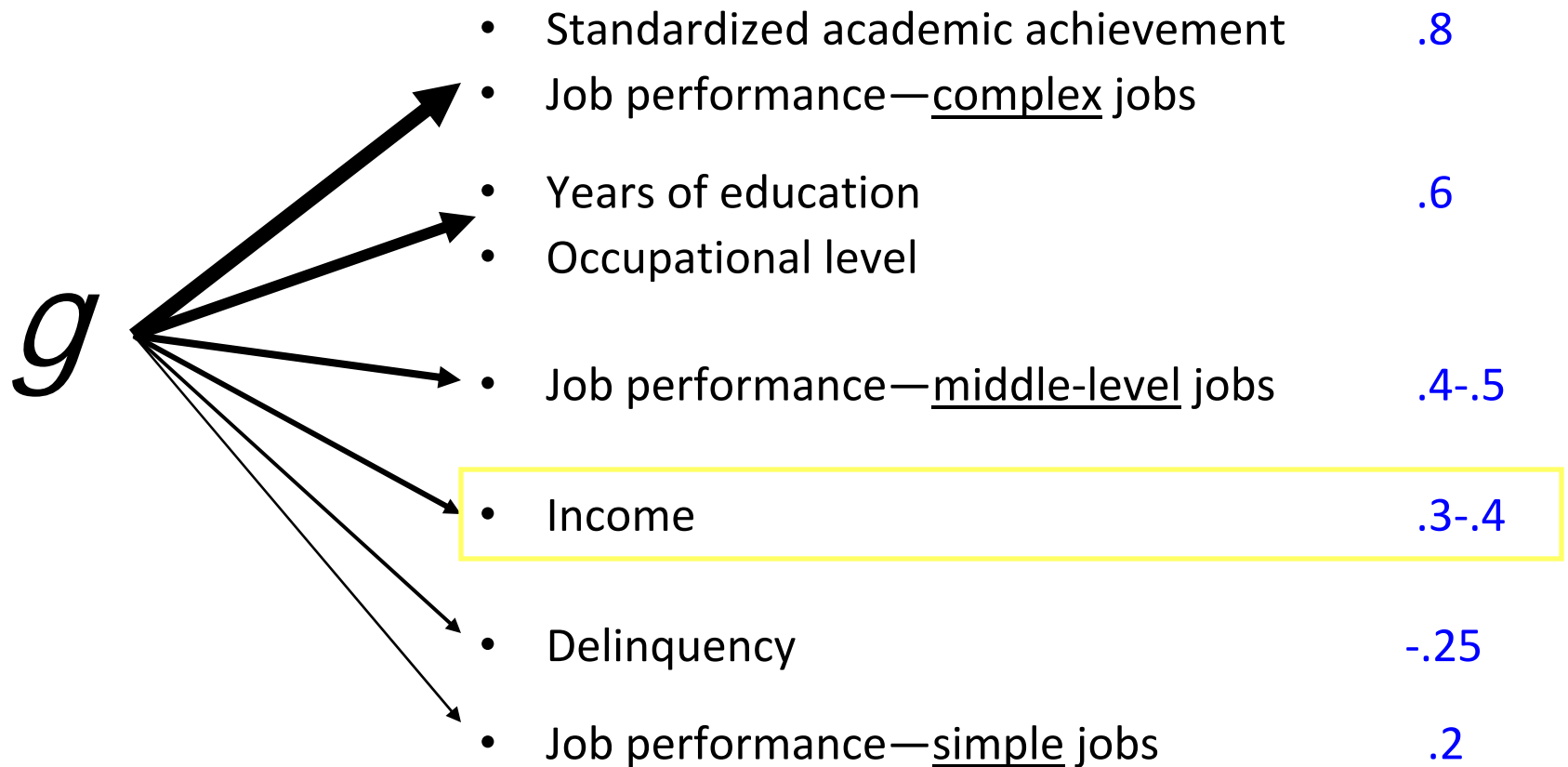
# Typical life outcomes along the IQ continuum



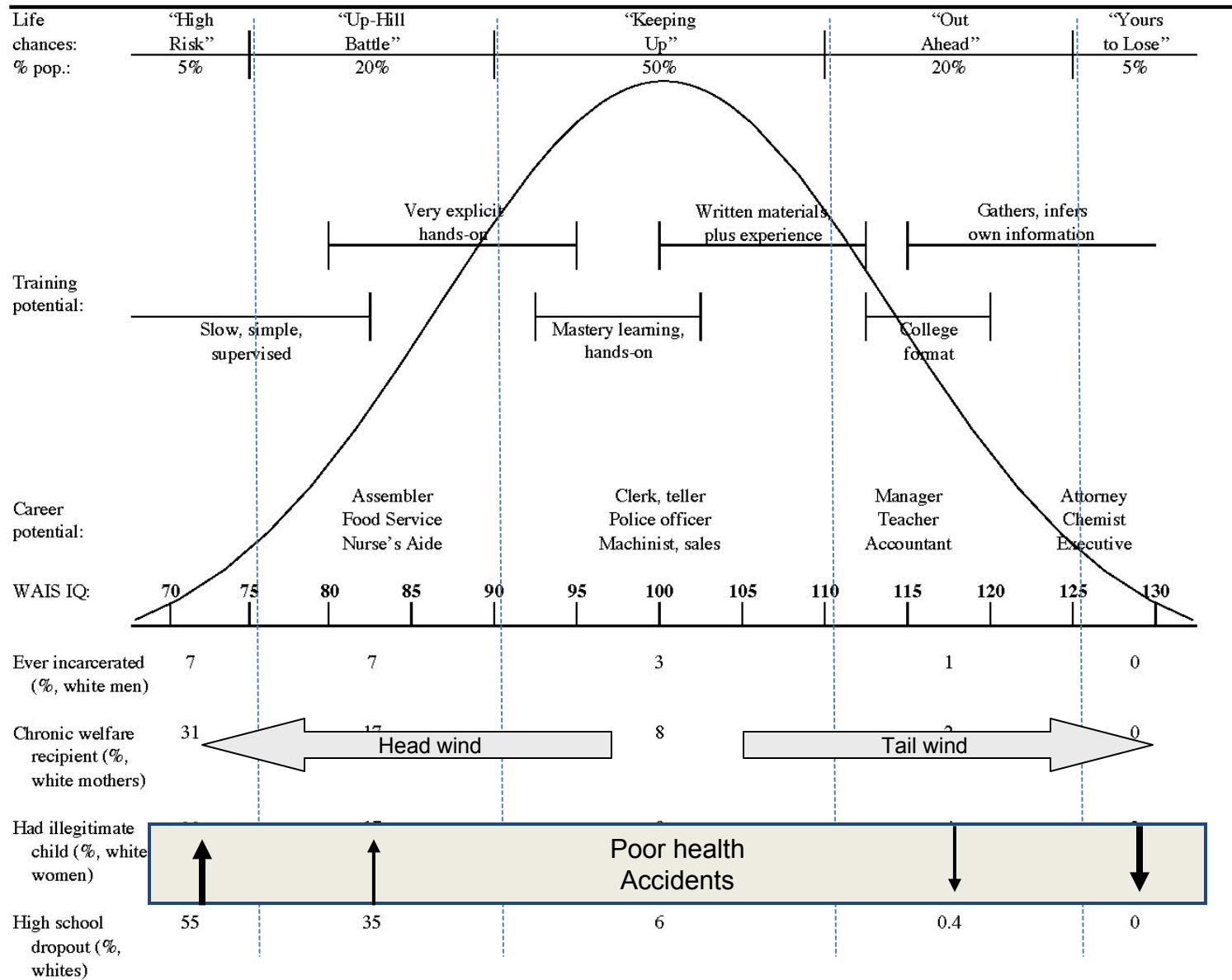
Low functional literacy is a critical threshold in modern world

# Practical value of $g$ level differs by life arena

correlation  
with IQ

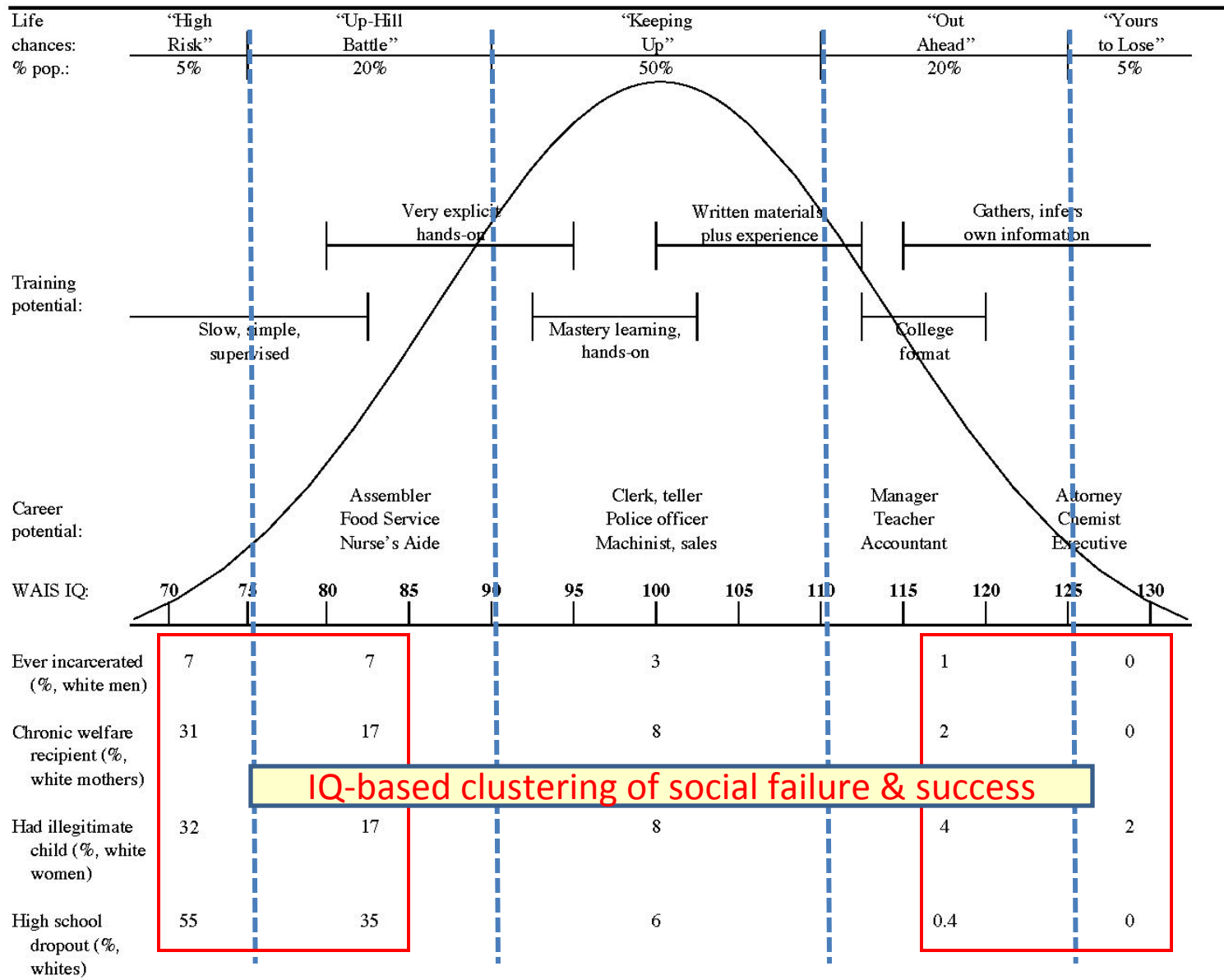


# Large or small, effects are relentless

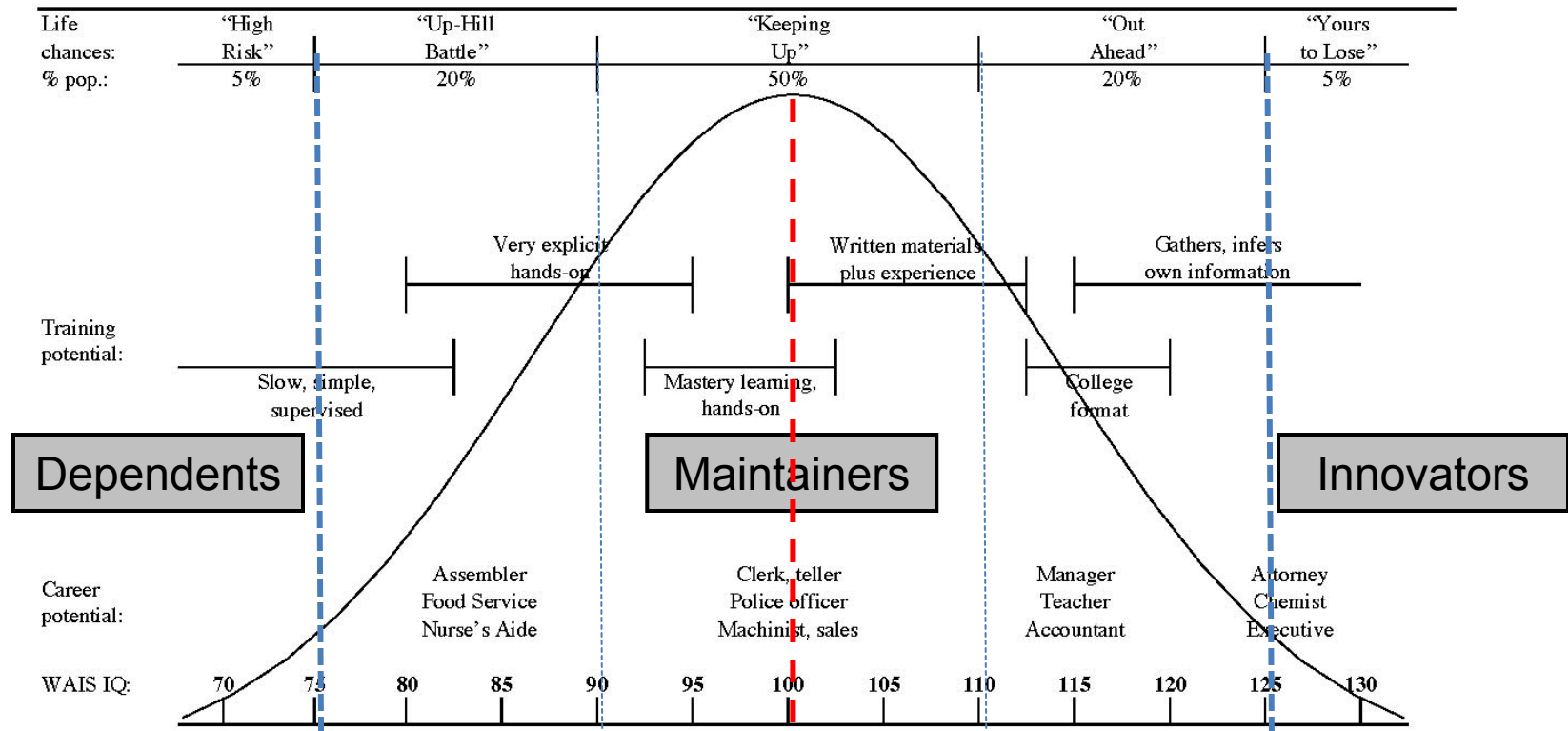


# Some societal-level implications of $g$ variation

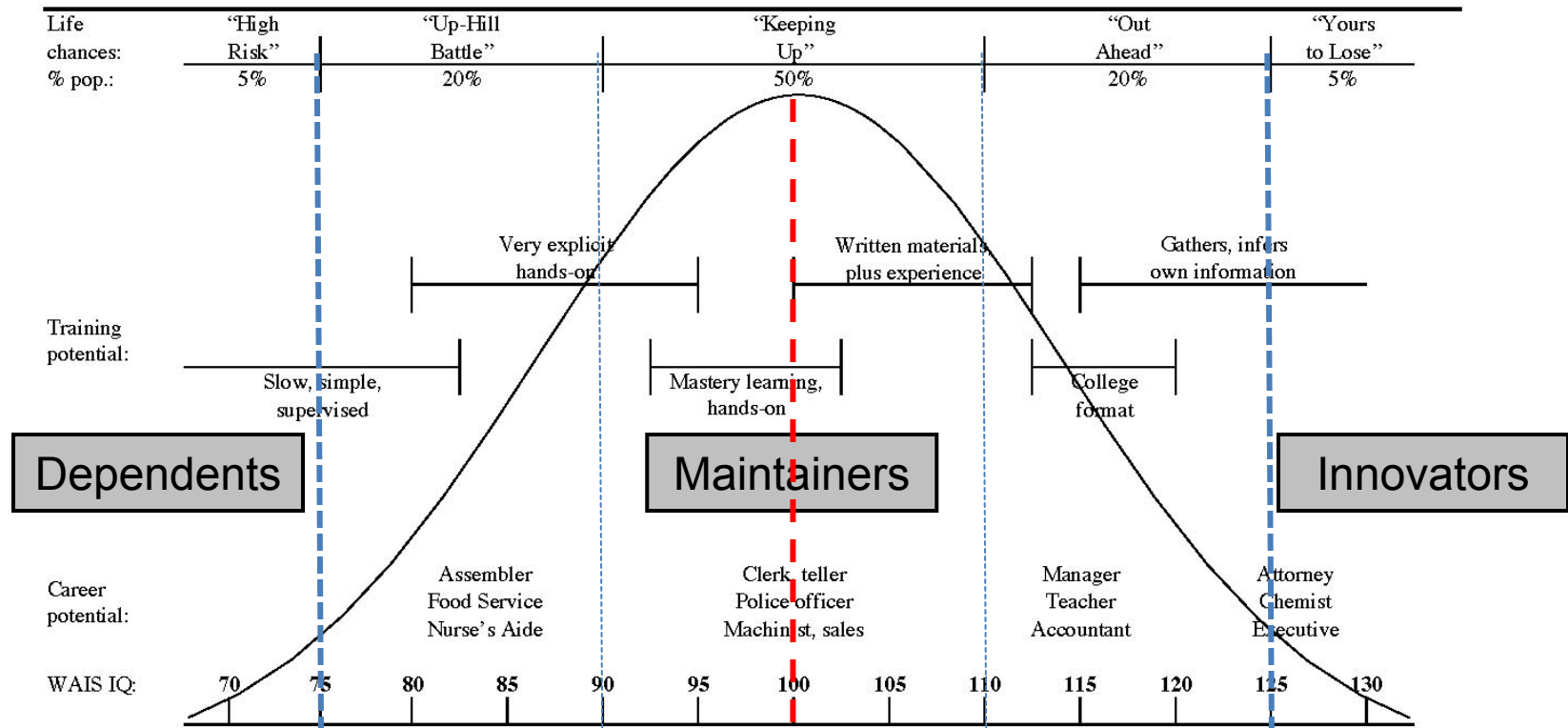
## IQ-based clustering across neighborhoods



# Nation-level implications: Carrying capacity



# Nation-level implications: Carrying capacity

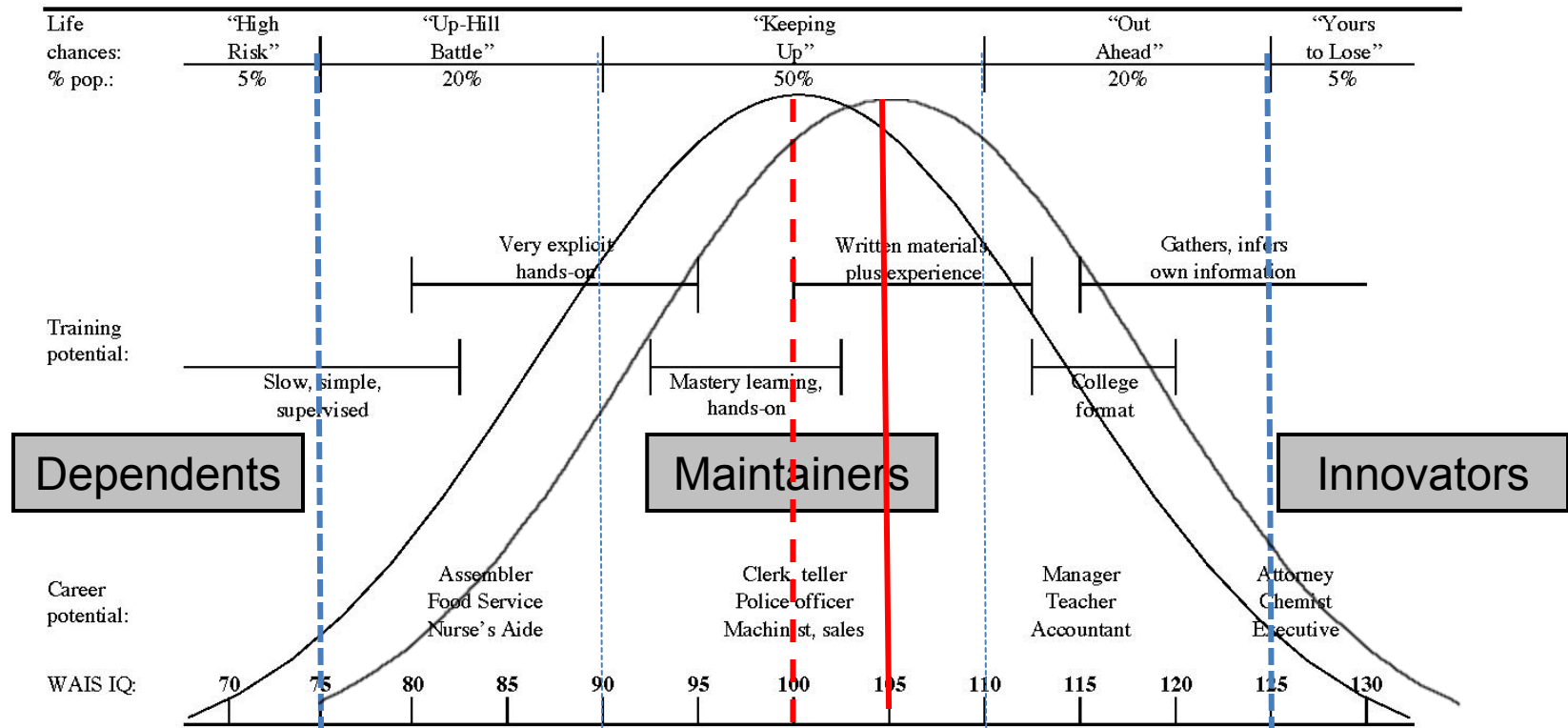


**Current standard**  
(Mean 100/SD 15)

$$\frac{\text{Innovators}}{\text{Dependents}} = \frac{5\%}{5\%} = 1.0$$

$$\frac{> \text{IQ } 100}{< \text{IQ } 100} = \frac{50\%}{50\%} = 1.0$$

# Nation-level implications: 5-point rise



**Current standard**  
(Mean 100/SD 15)

$$\frac{\text{Innovators}}{\text{Dependents}} = \frac{5\%}{5\%} = 1.0$$

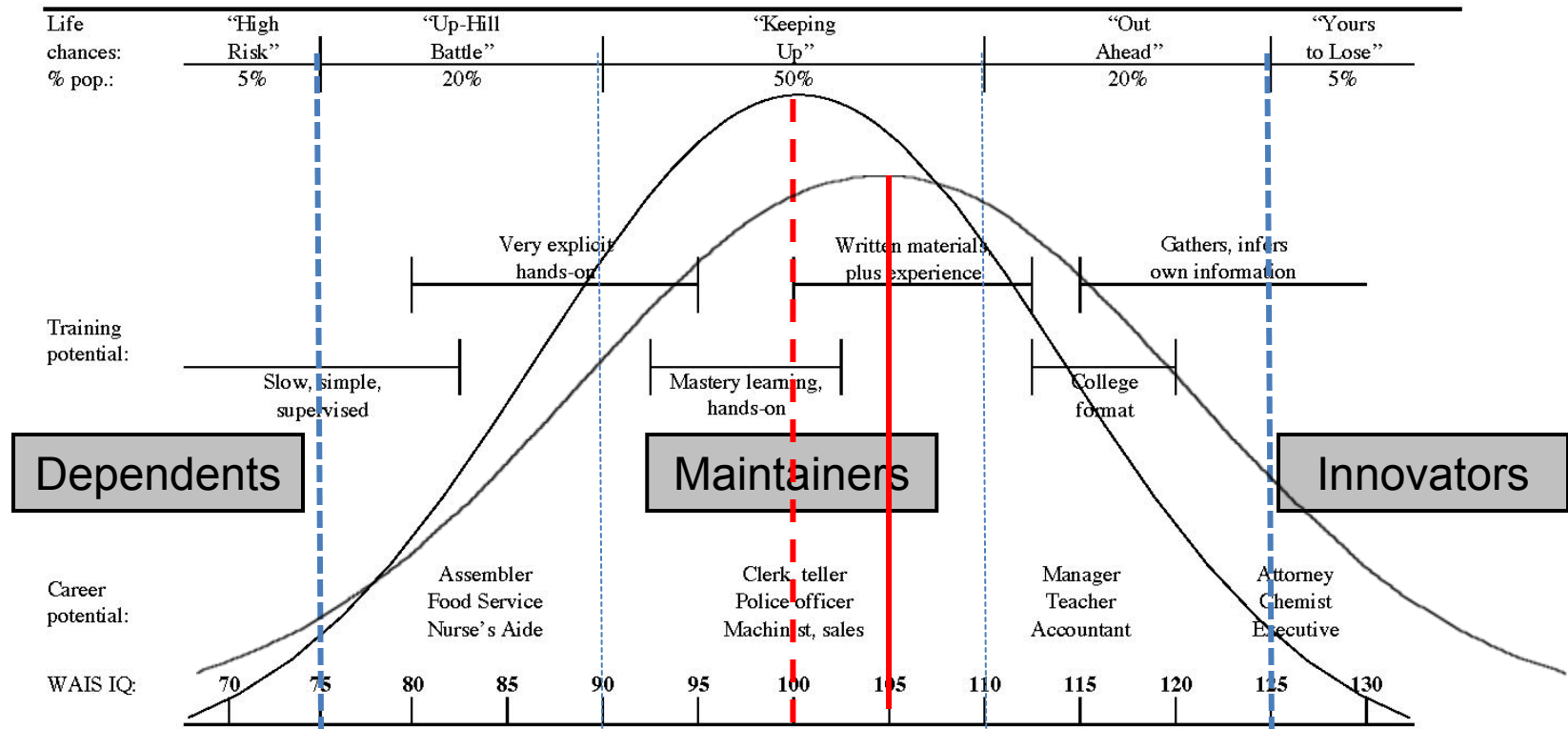
$$\frac{> \text{IQ } 100}{< \text{IQ } 100} = \frac{50\%}{50\%} = 1.0$$

**Higher**  
(Mean 105)

$$\frac{9.2\%}{2.3\%} = 4.0$$

$$\frac{62.9\%}{37.1\%} = 1.7$$

# Nation-level implications: with rise & bigger SD



**Current standard**  
(Mean 100/SD 15)

$$\frac{\text{Innovators}}{\text{Dependents}} = \frac{5\%}{5\%} = 1.0$$

$$\frac{> \text{IQ } 100}{< \text{IQ } 100} = \frac{50\%}{50\%} = 1.0$$

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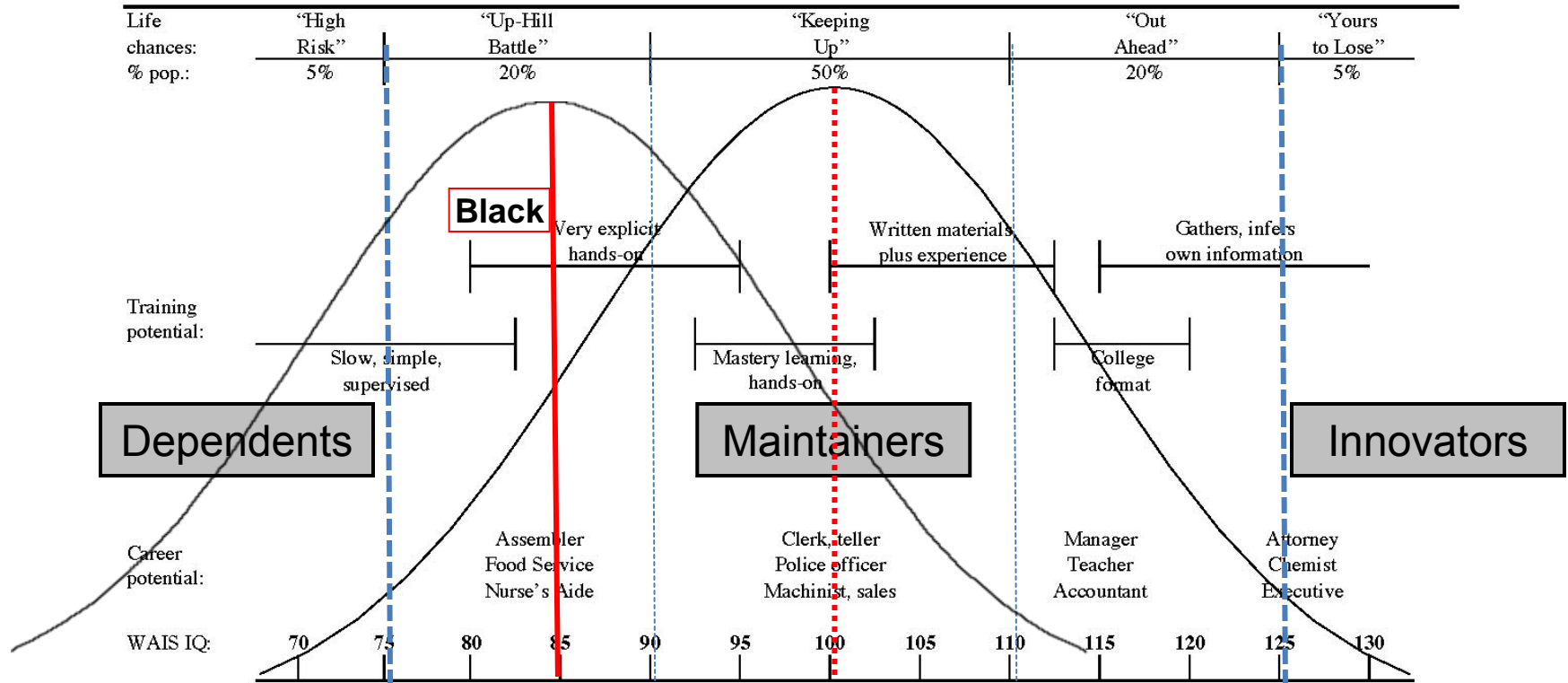
**Higher & less equal**  
(Mean 105, SD 17)

$$\frac{11.5\%}{3.9\%} = 2.9$$

$$\frac{61.6\%}{38.4\%} = 1.6$$



# Current racial differences in carrying capacity



**Current Standard**  
(Mean 100/SD 15)

**Current Black (in West)**  
(Mean 87, SD 13)

**Current White**  
(Mean 101, SD 15)

$$\frac{\text{Innovators}}{\text{Dependents}} = \frac{5\%}{5\%} = 1.0$$

$$\frac{0.3\%}{18\%} = 0.02$$

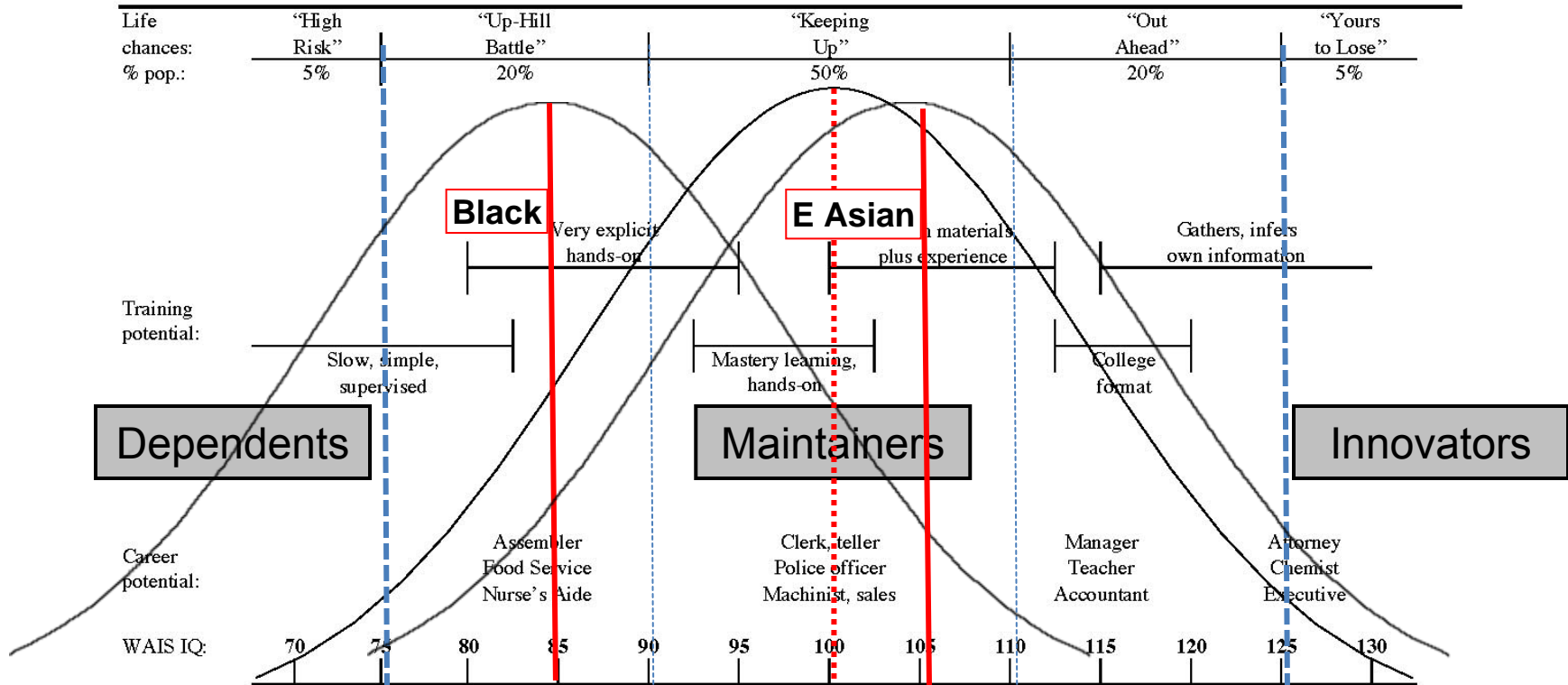
$$\frac{5\%}{4\%} = 1.2$$

$$\frac{> \text{IQ } 100}{< \text{IQ } 100} = \frac{50\%}{50\%} = 1.0$$

$$\frac{16\%}{84\%} = 0.20$$

$$\frac{54\%}{46\%} = 1.2$$

# Current racial differences in carrying capacity



**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)

$\frac{\text{Innovators}}{\text{Dependents}} = \frac{5\%}{5\%} = 1.0$

$\frac{0.3\%}{18\%} = 0.02$

$\frac{5\%}{4\%} = 1.2$

$\frac{10\%}{2\%} = 5.0$

$\frac{> \text{IQ } 100}{< \text{IQ } 100} = \frac{50\%}{50\%} = 1.0$

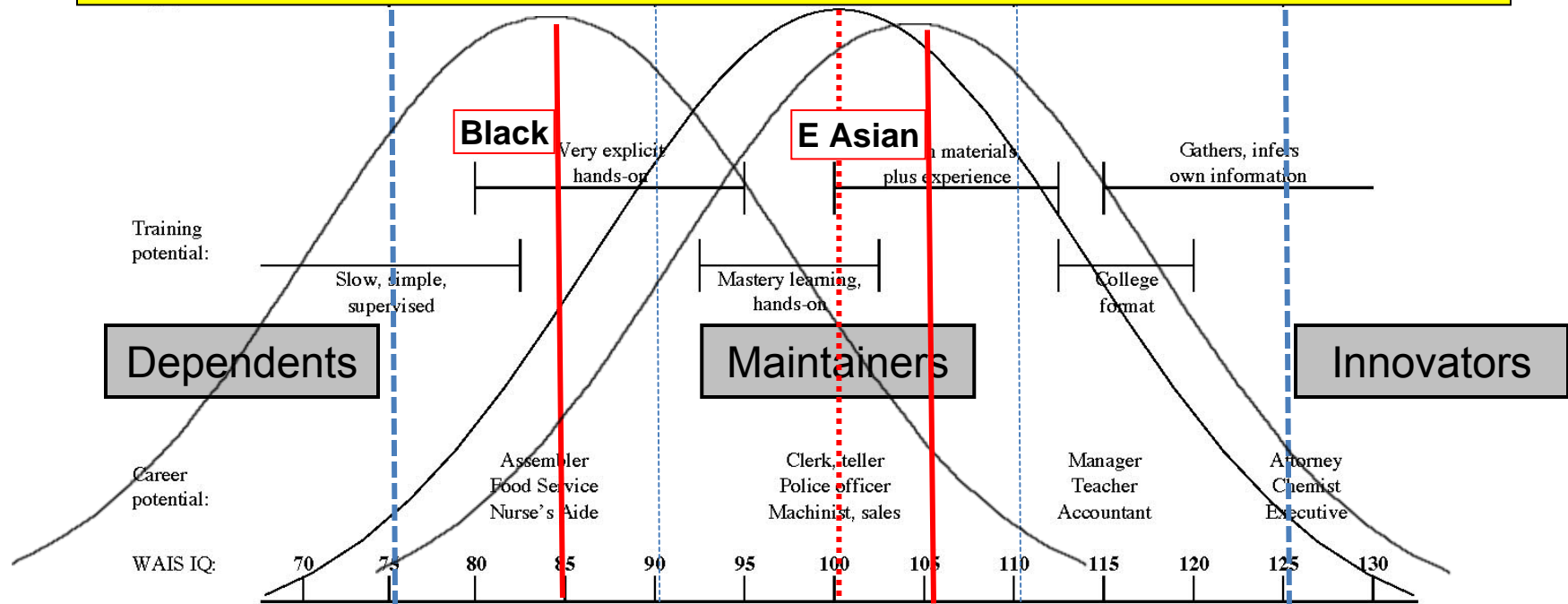
$\frac{16\%}{84\%} = 0.20$

$\frac{54\%}{46\%} = 1.2$

$\frac{66\%}{34\%} = 2.0$

# Current racial differences in carrying capacity

Should—could—enhancements be made without considering race?



**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)

$\frac{\text{Innovators}}{\text{Dependents}} = \frac{5\%}{5\%} = 1.0$

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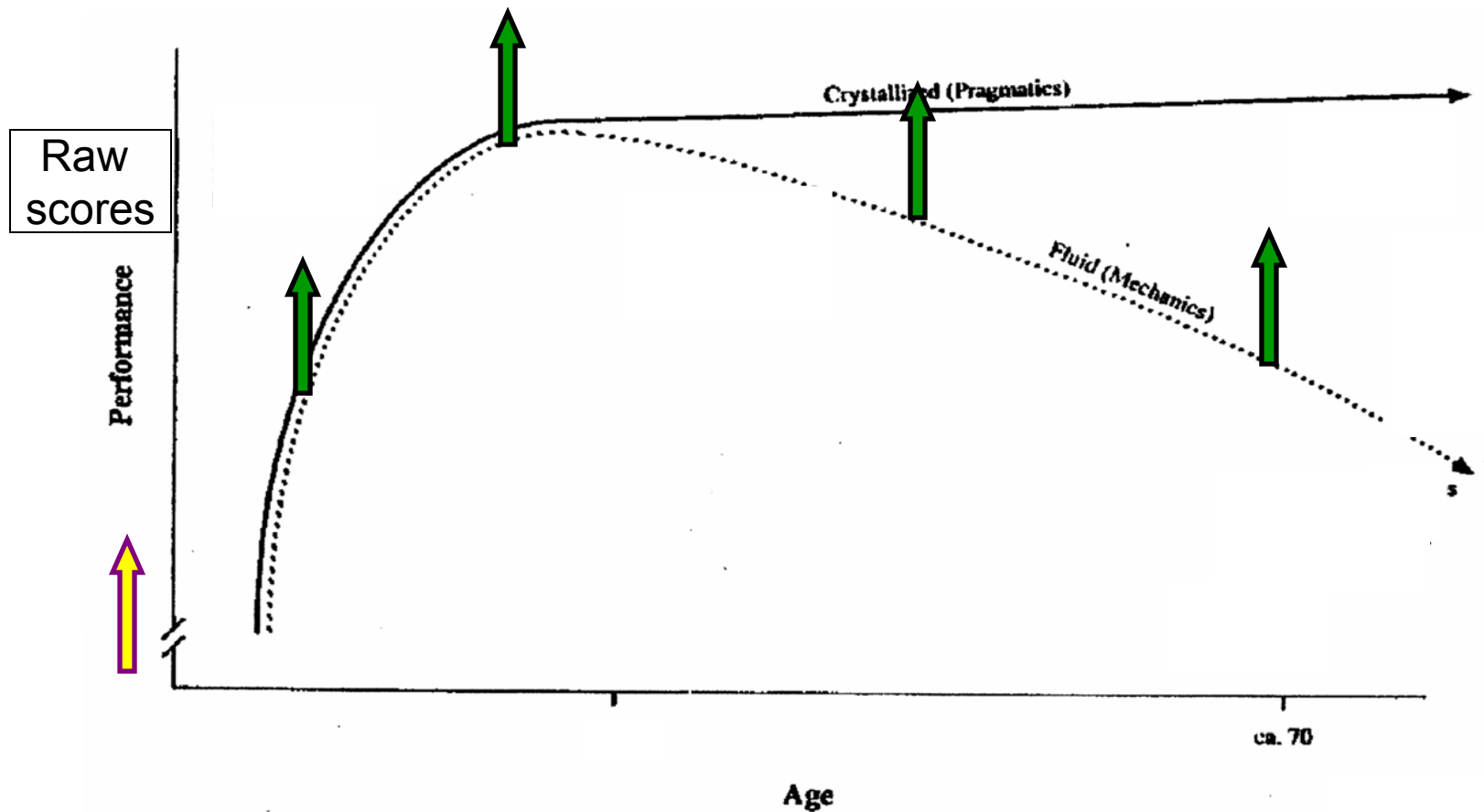
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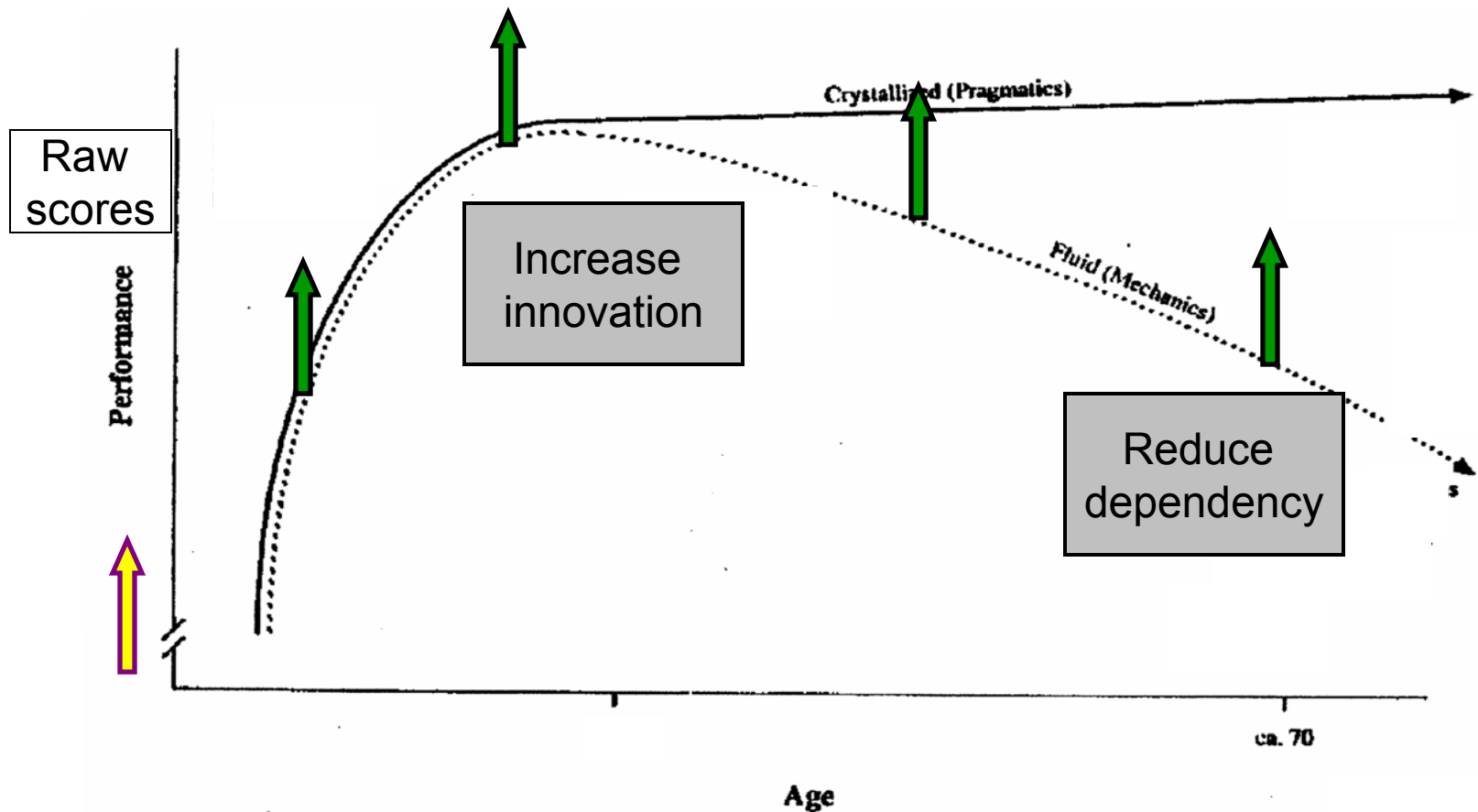
$\frac{66\%}{34\%} = 2.0$

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



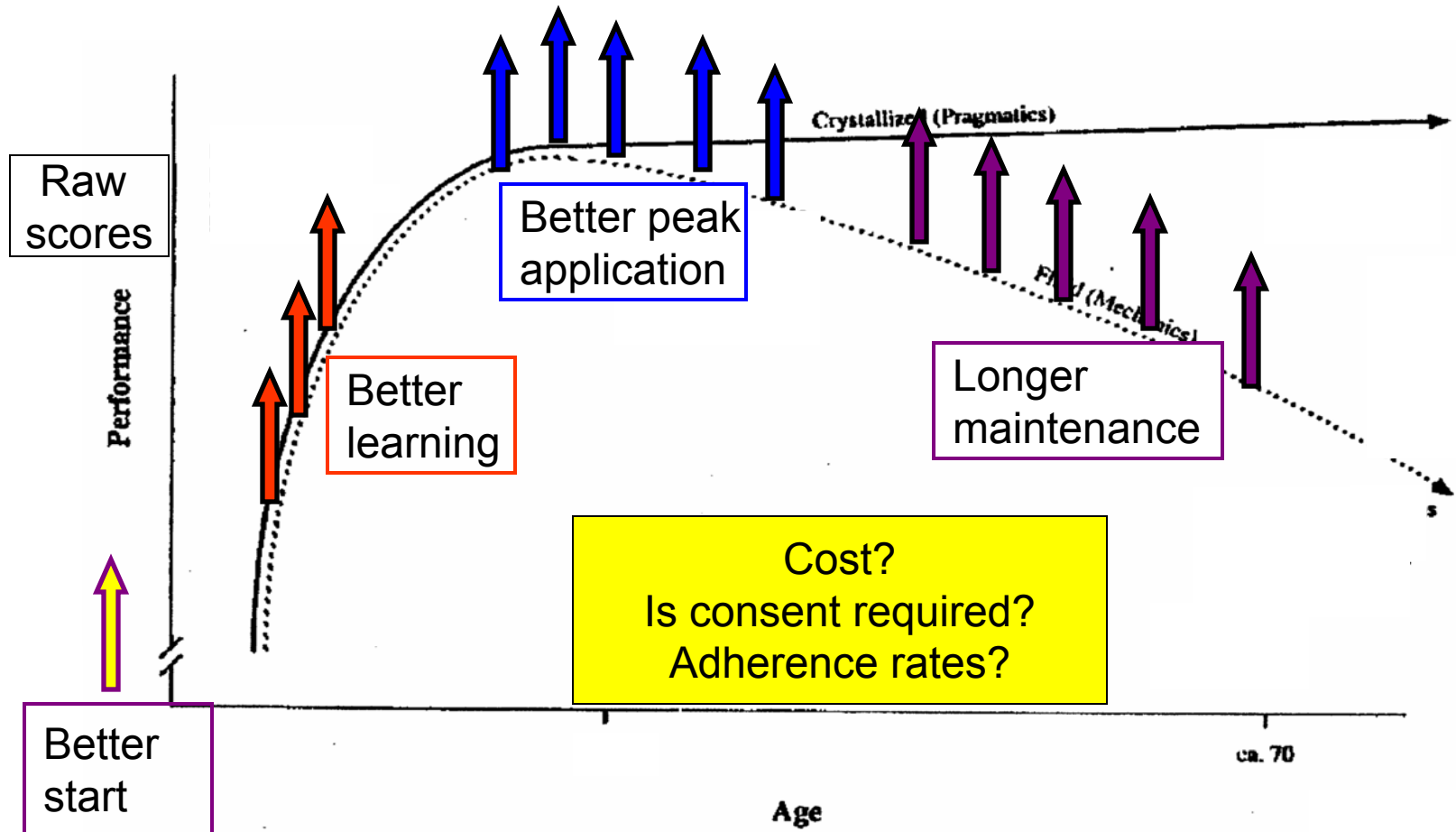
# When in the life-cycle should fluid $g$ be enhanced?

Depends on aims

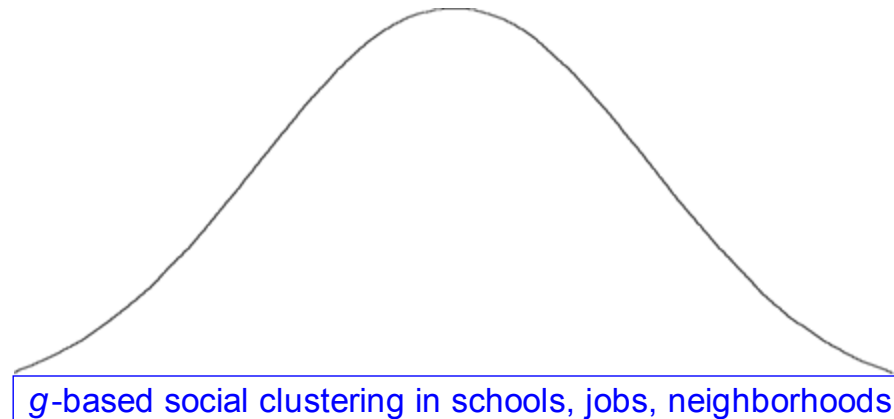


# When in the life-cycle should fluid $g$ be enhanced?

Also depends on permanency & required frequency of boost



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



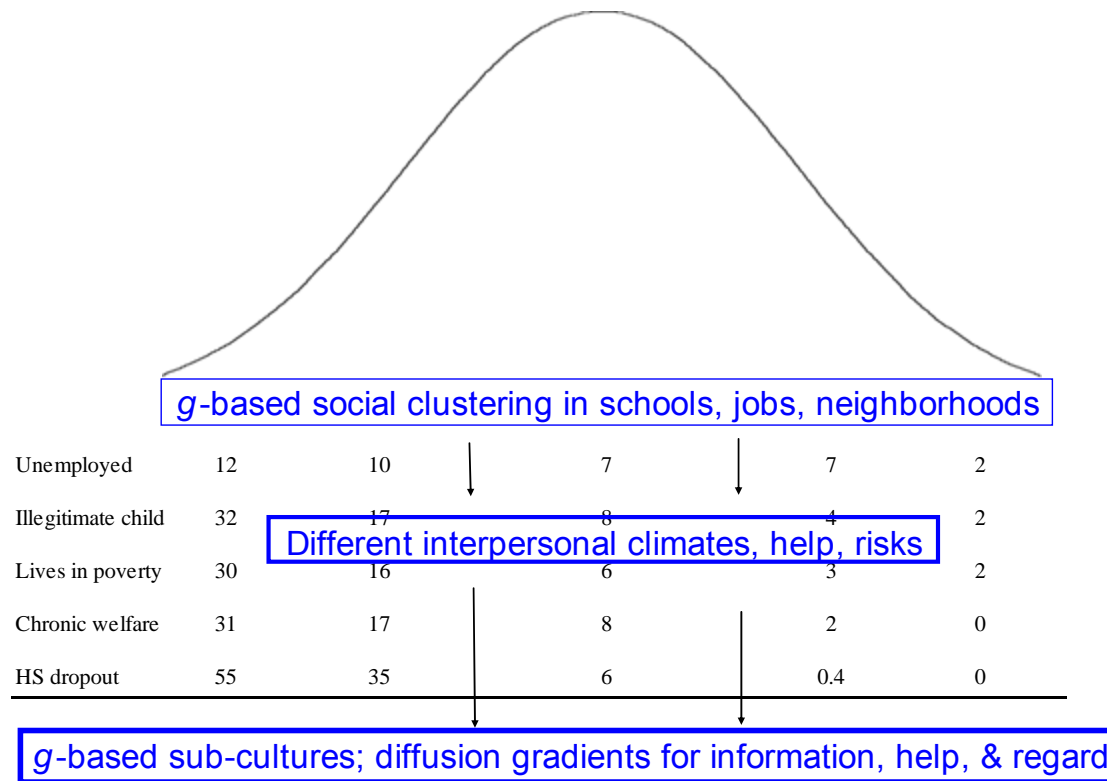
Unemployed	12	10	↓	7	↓	7	2
Illegitimate child	32	17	↓	8	↓	4	2
Lives in poverty	30	16	↓	6	↓	3	2
Chronic welfare	31	17	↓	8	↓	2	0
HS dropout	55	35	↓	6	↓	0.4	0

Different interpersonal climates, help, risks

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

Social inequality, job hierarchies, intergroup competition, policy responses

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



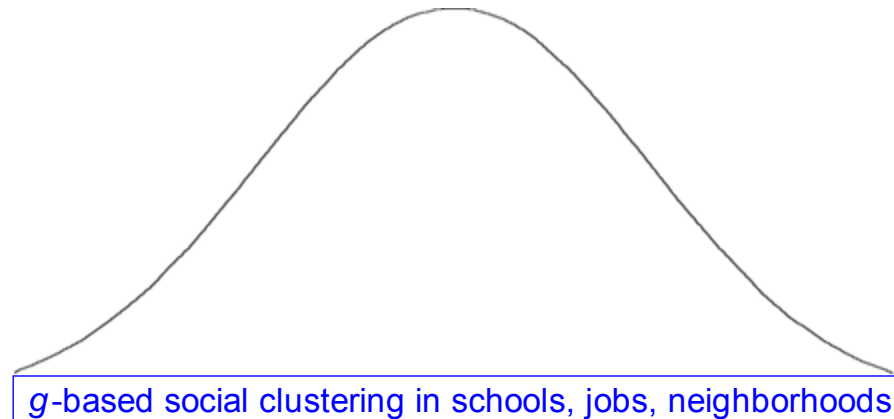
Social inequality, job hierarchies, intergroup competition, policy responses

Dispersion creates much social tension, many political pressures

Attempts to change it would too



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



Unemployed	12	10	↓	7	↓	7	2
Illegitimate child	32	17	↓	8	↓	4	2
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Different interpersonal climates, help, risks

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

Social inequality, job hierarchies, intergroup competition, policy responses

↓ = counterproductive

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

Tradeoff with equalization of outcomes

# 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

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- Gottfredson, L. S. (2008). [The fragility of maximal performance.](#) Presented at the conference, “How can we improve our brains?” The Banbury Center, Cold Spring Harbor, NY, USA, September 16.
- Kirsch, I. S., Jungeblut, A., Jenkins, L., & Kolstad, A. (1993). [Adult literacy in America: A first look at the result of the National Adult Literacy Survey.](#) Washington, DC: US Department of Education, National Center for Education Research.

# Thank you.

- [gottfred@udel.edu](mailto:gottfred@udel.edu)
- <http://www.udel.edu/educ/gottfredson>