Intelligence in Everyday Life—Where and Why It Matters

Linda S. Gottfredson, PhD

School of Education

University of Delaware

Newark, DE 19716

How could it possibly matter?

- Isn't IQ just a narrow academic ability?
  - *No: IQ captures a very general, very practical ability*
- Aren't there multiple intelligences?
  - *No: many abilities but only one broad intelligence*
- Don't other things matter in life—motivation, social advantages?
  - *Yes, of course: but higher IQ boosts odds throughout*

Small but consistent tilt in odds has huge cumulative effect over a lifetime
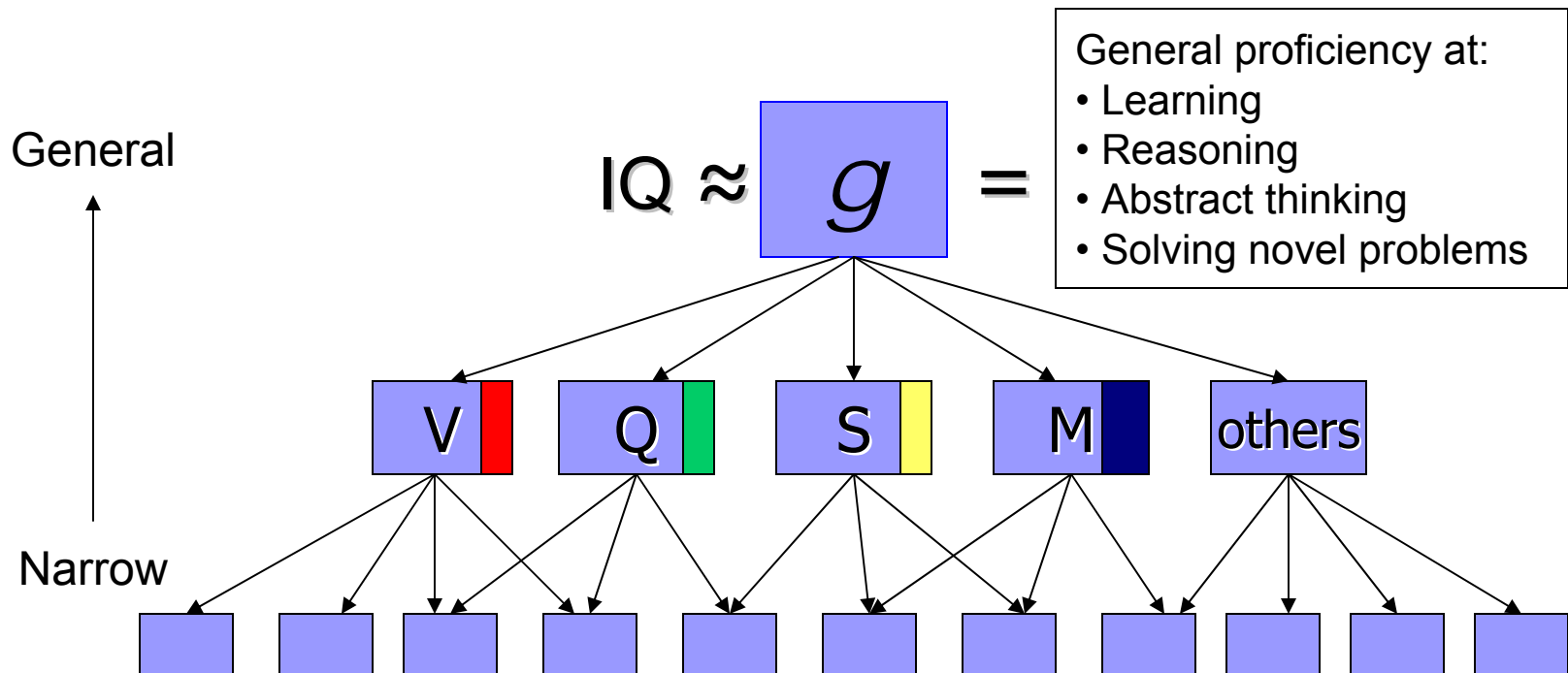
"Intelligence"

General mental ability factor (*g*)

(century of research)

Many abilities, but only one general intelligence

- All mental tests measure mostly the same ability: g
- g is ~content independent
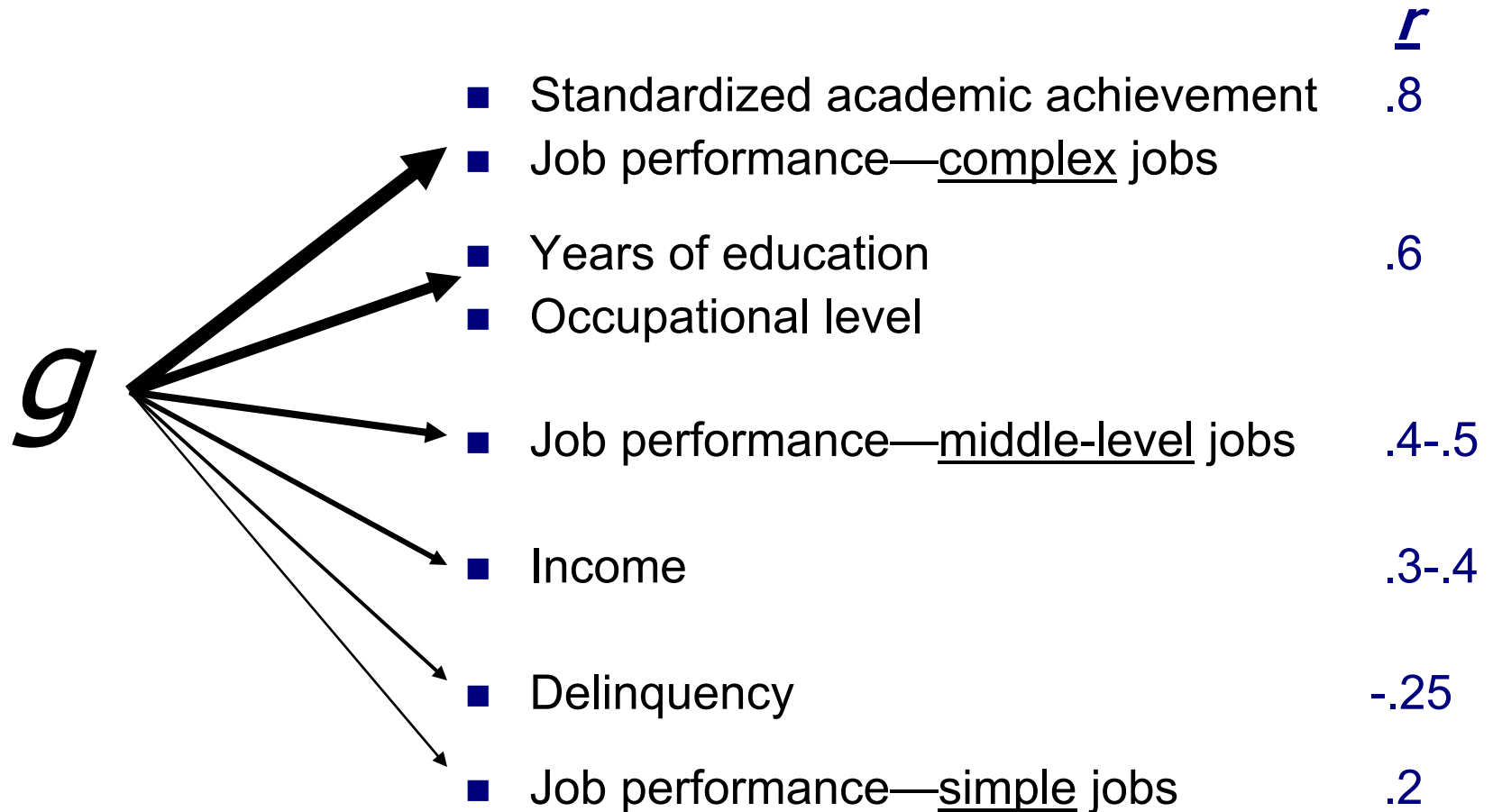- g carries the freight of prediction

General

IQ ≈ **g** =

General proficiency at:
- Learning
- Reasoning
- Abstract thinking
- Solving novel problems

V   Q   S   M   others

Narrow

Sample IQ Items
(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, ___, ___
		Infer the rule	
Name one similarity	orange—banana (93%)	table-chair (55%)	Praise-punishment (25%)
		More abstract	
Define the word			

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
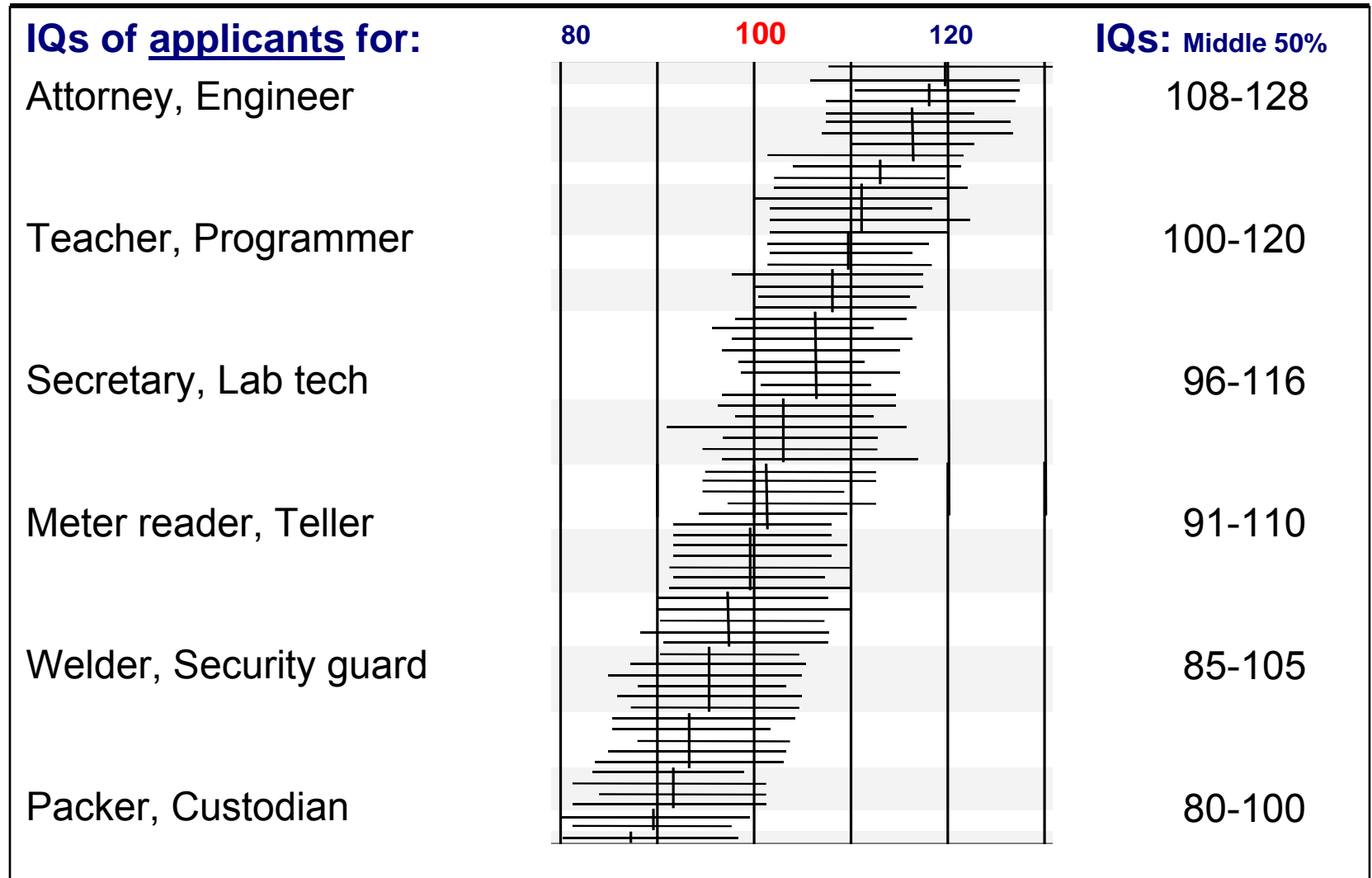
Life's arenas differ in *g* loading

g

_r_

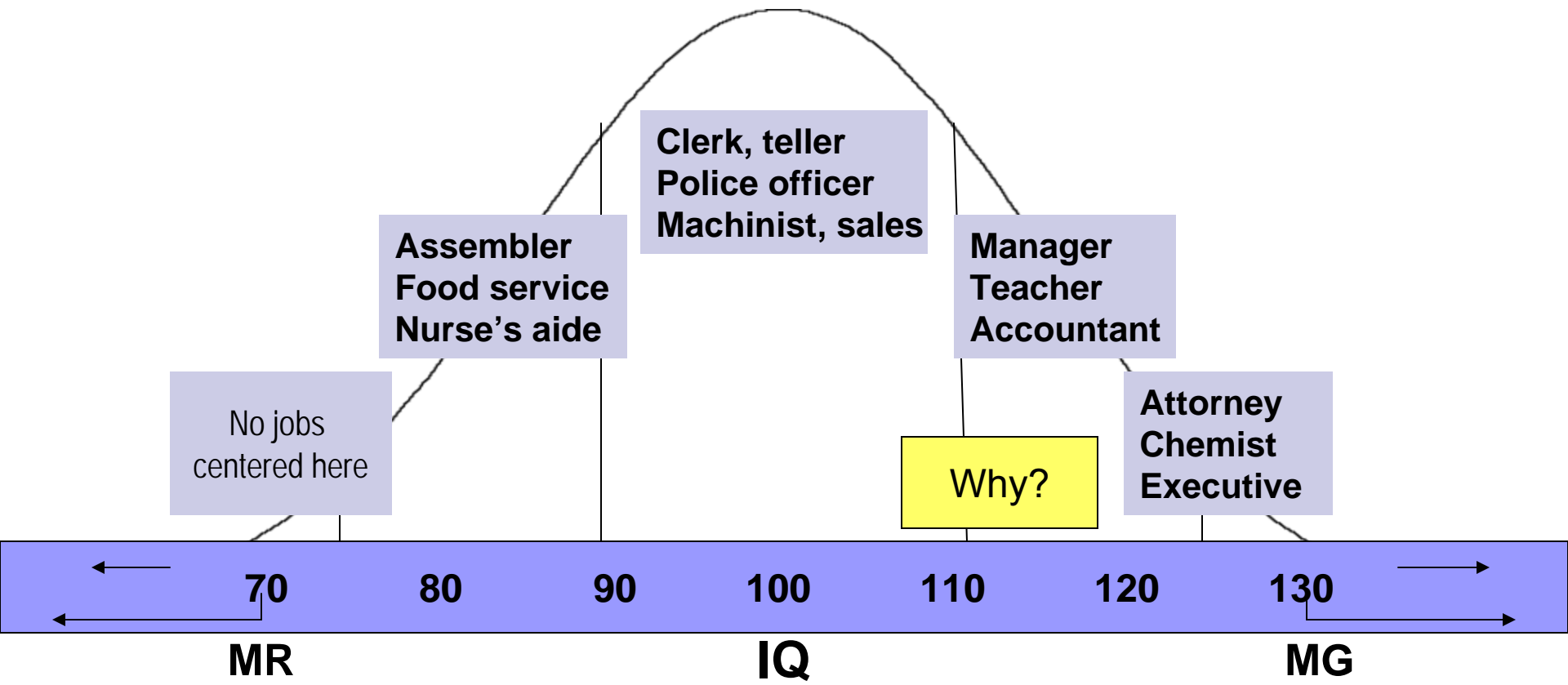- Standardized academic achievement .8
- Job performance—<u>complex</u> jobs

- Years of education .6
- Occupational level

- Job performance—<u>middle-level</u> jobs .4-.5

- Income .3-.4

- Delinquency -.25

- Job performance—<u>simple</u> jobs .2

"Jobs"

Status level & on-the-job performance

(century of research)

Higher-status jobs ⟹ higher-IQ workers

IQs of <u>applicants</u> for:	80	100	120	IQs: Middle 50%
Attorney, Engineer				108-128
Teacher, Programmer				100-120
Secretary, Lab tech				96-116
Meter reader, Teller				91-110
Welder, Security guard				85-105
Packer, Custodian				80-100

Typical IQs in Occupations

Typical IQ range of workers

Clerk, teller
Police officer
Machinist, sales

Assembler
Food service
Nurse's aide

Manager
Teacher
Accountant

No jobs
centered here

Why?

Attorney
Chemist
Executive

| 70 | 80 | 90 | 100 | 110 | 120 | 130 |

MR   **IQ**   **MG**

IQ predicts performance in all jobs—but especially higher up

IQs of <u>applicants</u> for:

Attorney, Engineer

Teacher, Programmer

Secretary, Lab tech

Meter reader, Teller

Welder, Security guard

Packer, Custodian

80   100   120

Criterion validity
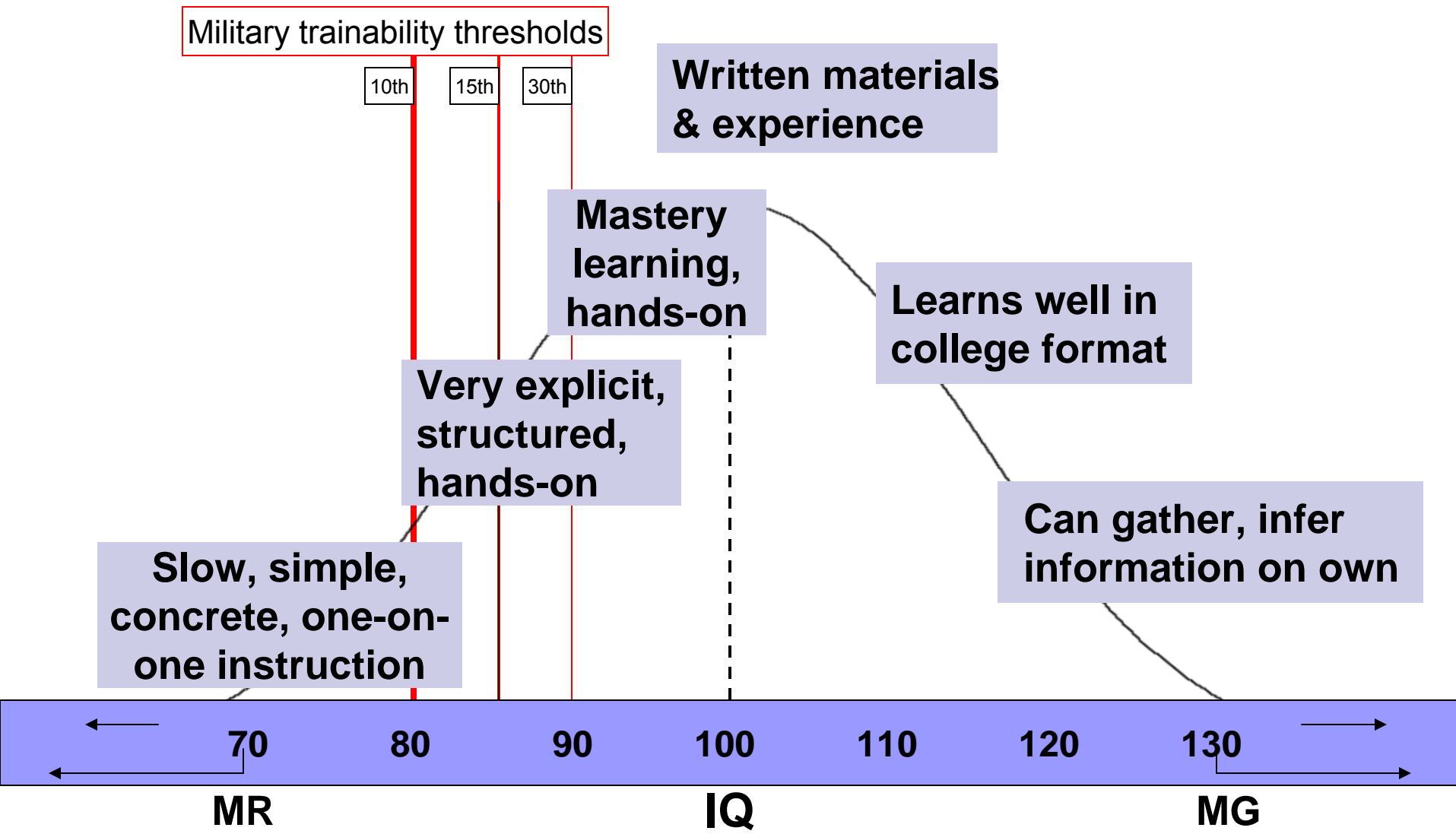(corrected)

.80

Why?

.20
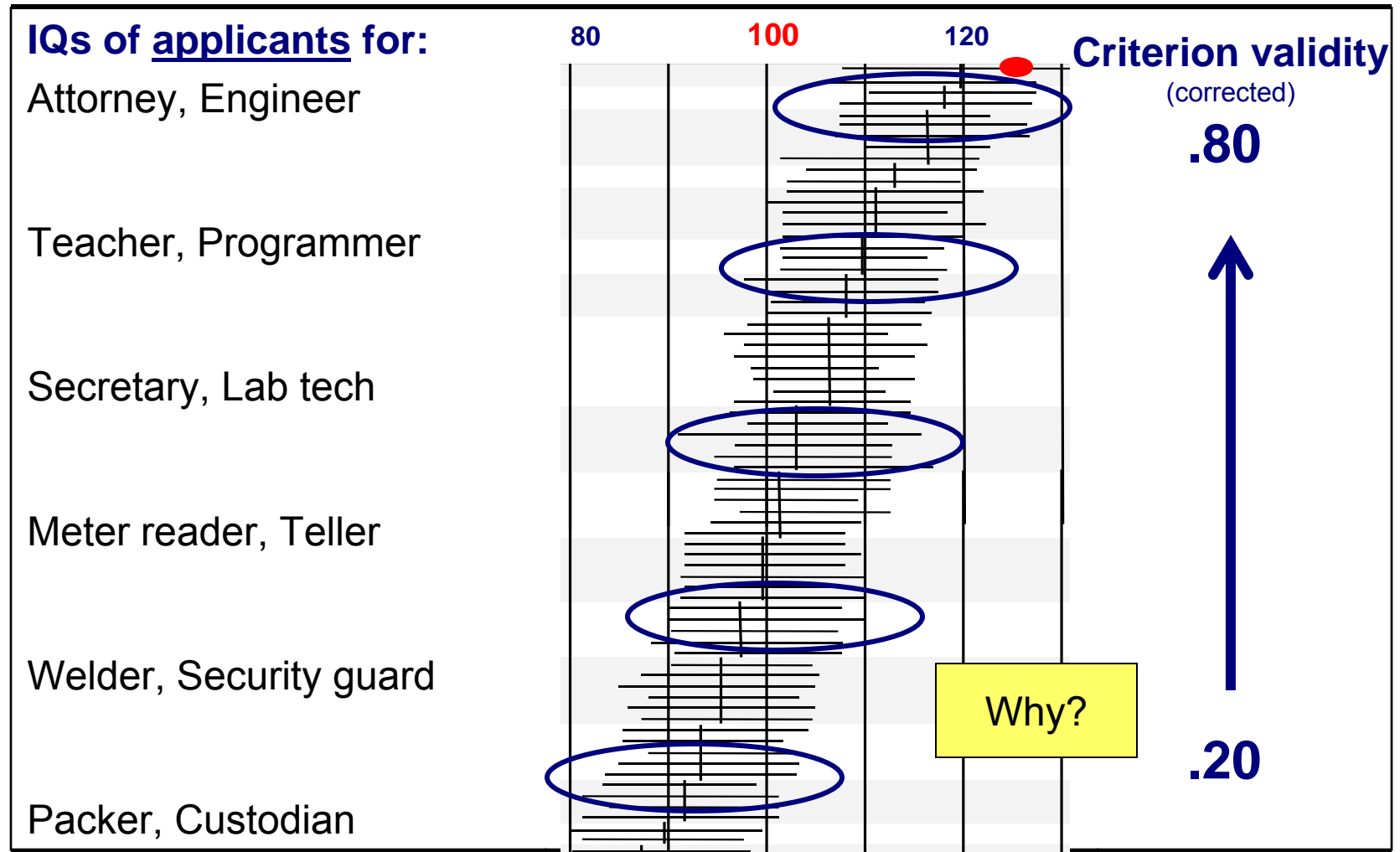
Judgment & Reasoning Factor
Job analysis 1 (Arvey, 1986)

Job requirements:	Correlation with factor
▪ <u>Learn</u> and recall relevant information	**.75**
▪ <u>Reason</u> and make judgments	**.71**
▪ Deal with unexpected situations	**.69**
▪ <u>Identify problem</u> situations quickly	**.69**
▪ React swiftly when unexpected problems occur	**.67**
▪ Apply common sense to <u>solve problems</u>	**.66**
▪ <u>Learn</u> new procedures quickly	**.66**
▪ Be alert & <u>quick to understand th</u>ings	**.55**

Typical Learning Needs by IQ Level

Military trainability thresholds

10th   15th   30th

Written materials & experience

Mastery learning, hands-on

Learns well in college format

Very explicit, structured, hands-on

Can gather, infer information on own

Slow, simple, concrete, one-on-one instruction

70   80   90   100   110   120   130

MR   IQ   MG

Overall Complexity Factor
Job analysis 2 (Gottfredson, 1997)

Complex	*r*		
Attorney	.88	Self-direction	Combine information
	.86	Reason	Advise
	.85	Update knowledge	Write
	.83	Analyze	Plan
	.79	Lack of structure	Negotiate, Persuade
	.71	Criticality of position	Coordinate
			Instruct
Teller	.51	Transcribe	Patient?
	.36	Recognize	Parent?
	-.49	Repetitive	
Custodian	-.56	Physical exertion	
Simple	-.73	Supervision	

Common Building Blocks of Job Complexity

- **Individual tasks**
  - ☐ Abstract, unseen processes; cause-effect relations
  - ☐ Incomplete or conflicting information; much information to integrate; relevance unclear
  - ☐ Inferences required; operations not specified
  - ☐ Ambiguous, uncertain, unpredictable conditions
  - ☐ Distracting information or events
  - ☐ Problem not obvious, feedback ambiguous, standards change
- **Task constellation** (Often neglected, even in job analyses)
  - ☐ Multi-tasking, prioritizing
  - ☐ Sequencing, timing, coordinating
  - ☐ Evolving mix of tasks
  - ☐ Little supervision; need for independent judgment

Like life itself!

"Functional literacy"

Daily self-maintenance in modern life

(2 decades of research)

Functional Literacy (NALS)
(nationally representative sample, ages 16-65)

NALS Level	% pop. (white)	Simulated Everyday Tasks
5	4%	▪ Use calculator to determine cost of carpet for a room ▪ Use table of information to compare 2 credit cards
4	21%	▪ Use eligibility pamphlet to calculate SSI benefits ▪ Explain difference between 2 types of employee benefits
3	36%	▪ Calculate miles per gallon from mileage record chart ▪ Write brief letter explaining error on credit card bill
2	25%	▪ Determine difference in price between 2 show tickets ▪ Locate intersection on street map
1	14%	▪ Total bank deposit entry ▪ Locate expiration date on driver's license

Functional Literacy (NALS)
(nationally representative sample, ages 16-65)

| NALS Level	% pop. (white)	Simulati...	Difficulty based on "process complexity"
5	4%	• Use calculator to • Use table of infor	
4	25%	• Use eligibility pan • Explain difference	• level of inference
3	36%	• Calculate miles pe • Write brief letter	• abstractness of info
2	25%	• Determine differe • Locate intersectio	• distracting information
1	14%	• Total bank deposi • Locate expiration	Not reading per se, but "problem solving"

"Health literacy"
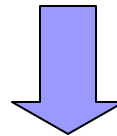
Adherence to treatment

(decade of research)

Example (TOFHLA)

(Controlling for personal resources, access, insurance, education, etc.)

Health literacy

⬇
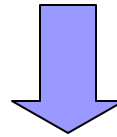
More health knowledge
Better adherence

⬇

Better health
Less hospitalization
Lower health costs/year

Sample TOHFLA Items & Error Rates

Patients examine the actual vials or documents

% of urban hospital outpatients ***not*** knowing:	Health literacy level		
	V-low	Low	OK
How to take meds 4 times per day	24	9	5
When next appointment is scheduled	40	13	5
How many pills of a prescription to take	70	34	13
What an informed consent form is saying	95	72	22

Many professionals have no idea how difficult these "simple" things are for others

Sample TOHFLA Items & Error Rates

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When next appointment is scheduled	40	13	5
How many pills of a prescription to take	70	34	13
What an informed consent form is saying	95	72	22

But how representative?

error

Health Adult Literacy Survey (HALS)

(nationally representative sample)

- Items simulate everyday health tasks
- Analyzed what increases item difficulty (error rates)
- 3 increasingly difficult questions for this item

Sample item

ALCOHOL-FREE
ASPIRIN-FREE
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Ronald McDonald House is a program of
Ronald McDonald Children's Charities*

Pediatric Dosage Chart   Drops, Syrup, & Chewables

Age	Approximate Weight Range*	Dosage			
		Drops	Syrup	Chewables 80 mg	Chewables 160 mg
† Under 3 mo	Under 13 lb	½ dropper	¼ tsp	—	—
† 3 to 9 mo	13-20 lb	1 dropper	½ tsp	—	—
† 10 to 24 mo	21-26 lb	1 ½ droppers	¾ tsp	—	—
2 to 3 yr	27-35 lb	2 droppers	1 tsp	2 tablets	—
4 to 5 yr	36-43 lb	3 droppers	1½ tsp	3 tablets	1½ tablets
6 to 8 yr	44-62 lb	—	2 tsp	4 tablets	2 tablets
9 to 10 yr	63-79 lb	—	2½ tsp	5 tablets	2½ tablets
11 yr	80-89 lb	—	3 tsp	6 tablets	3 tablets
12 yr and older	90 lb & over	—	3-4 tsp	6-8 tablets	3-4 tablets

† Consult with physician before administering to children under the age of 2 years.
Dosage may be given every 4 hours as needed but not more than 5 times daily.
How Supplied:
Drops: Each 0.8 ml dropper contains 80 mg (1.23 grains) acetaminophen.
Syrup: Each 5 ml teaspoon contains 160 mg (2.46 grains) acetaminophen.
Chewables: Regular tablets contain 80 mg (1.23 grains) acetaminophen each. Double
                   strength tablets contain 160 mg (2.46 grains) acetaminophen each.
* If child is significantly under- or overweight, dosage may need to be adjusted accordingly.
The weight categories in this chart are designed to approximate effective dose ranges of 10-15 milligrams per kilogram.
(Current Pediatric Diagnosis and Treatment. 8th ed. CH Kempe and HK Silver, ed. Lange Medical Publications: 1984, p. 1079)
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#1—Underline sentence saying how often to administer medication

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† 3 to 9 mo	13-20 lb	1 dropper	½ tsp	—	—
† 10 to 24 mo	21-26 lb	1½ droppers	¾ tsp	—	—
2 to 3 yr	27-35 lb	2 droppers	1 tsp	2 tablets	—
4 to 5 yr	36-43 lb	3 droppers	1½ tsp	3 tablets	1½ tablets
6 to 8 yr	44-62 lb	—	2 tsp	4 tablets	2 tablets
9 to 10 yr	63-79 lb	—	2½ tsp	5 tablets	2½ tablets
11 yr	80-89 lb	—	3 tsp	6 tablets	3 tablets
12 yr and older	90 lb & over	—	3-4 tsp	6-8 tablets	3-4 tablets

† Consult with physician before administering to children under the age of 2 years.

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

How Supplied:

- One piece of info
- Simple match
- But lots of irrelevant info

% US adults routinely functioning <u>below</u> this level?

20%

Caution! Could train them do this item, but not all like it

239

HALS LEVELS:	Below Level 1	Level 1	Level 2	Level 3	Level 4	Level 5
HALS SCORES:	175	225	275	325	375	500

#2—How much syrup for 10-year-old who weighs 50 pounds?

- Spot & reconcile conflicting info
- Inference from ambiguous info
- Multiple features to match

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Pediatric Dosage Chart   Drops, Syrup, & Chewables

Age	Approximate Weight Range*	Drops	Dosage Syrup	Chewables 80 mg	Chewables 160 mg
† Under 3 mo	Under 13 lb	½ dropper	⅓ tsp	—	—
† 3 to 9 mo	13-20 lb	1 dropper	½ tsp	—	—
† 10 to 24 mo	21-26 lb	1½ droppers	¾ tsp	—	—
2 to 3 yr	27-35 lb	2 droppers	1 tsp	2 tablets	—
4 to 5 yr	36-43 lb	3 droppers	1½ tsp	3 tablets	1½ tablets
6 to 8 yr	44-62 lb	—	2 tsp	4 tablets	2 tablets
9 to 10 yr	63-79 lb	—	2½ tsp	5 tablets	2½ tablets
11 yr	80-89 lb	—	3 tsp	6 tablets	3 tablets
12 yr and older	90 lb & over	—	3-4 tsp	6-8 tablets	3-4 tablets

† Consult with physician before administering to children under the age of 2 years.
Dosage may be given every 4 hours as needed but not more than 5 times daily.

??

??

% US adults routinely functioning <u>below</u> this level?

54%

		239		329	
HALS LEVELS:	Below Level 1	Level 1	Level 2	Level 3	Level 4	Level 5
HALS SCORES:		175	225	275	325	375	500

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

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Pediatric Dosage Chart   Drops, Syrup, & Chewables

- Multiple features to match
- Two-step task
- Infer proper math operation
- Select proper numbers to use
- Ignore the most obvious but incorrect number
- Calculate the result

			Dosage		
Age	Approximate Weight Range*	Drops	Syrup	Chewables 80 mg	Chewables 160 mg
† Under 3 mo	Under 13 lb	½ dropper	¼ tsp	—	—
† 3 to 9 mo	13-20 lb	1 dropper	½ tsp	—	—
† 10 to 24 mo	21-26 lb	1½ droppers	¾ tsp	—	—
2 to 3 yr	27-35 lb	2 droppers	1 tsp	2 tablets	—
4 to 5 yr	36-43 lb	3 droppers	1½ tsp	3 tablets	1½ tablets
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† Consult with physician before administering to children under the age of 2 years.
Dosage may be given every 4 hours as needed but not more than 5 times daily.
How Supplied:

% US adults routinely functioning <u>below</u> this level?

95%

| 239 | | 329 | 378 | |

HALS LEVELS:	Below Level 1	Level 1	Level 2	Level 3	Level 4	Level 5
HALS SCORES:		175	225	275	325	375	500

Literacy Researchers' Conclusion

Non-compliance with treatment

- Often due to a failure to "learn, reason, & problem-solve"

- Leads to higher morbidity

- Leads to higher mortality

- Can create <u>new</u> health problems (e.g., by taking medication incorrectly)

Material resources not enough

- Equalizing resources _increases_ health disparities
  - When Britain introduced **national health care**
  - When media made **health information** _more_ widely available (signs and symptoms of cancer, diabetes, etc.)

- Old story—average rises, but variance too
  - Like in schools—some students more effectively exploit the same instruction

- Mental resources matter too—insufficiency means:
  - Inefficient use of available care
  - Inappropriate criticism of care

"Health"

Health self-care

(new research)

Health Self-Care Is a Lifelong Job: Yours!

- Constellation of tasks to perform, actions to avoid
- Training required
- Coordinate & communicate with others
- Exercise independent judgment
- Only occasional supervision or consultation
- Job changes as technology & conditions evolve
- Sometimes tiring, frustrating, affects family life
- Central to personal well-being
- But no vacations, no retirement

Major Causes of Premature Death

- **Chronic illnesses (heart disease, cancer, etc.)**
  - ☐ Middle-age & older

- **Unintentional ("accidental") injury**
  - ☐ Childhood & early adulthood

All are "preventable."

Avoiding Chronic Illness Requires Foresight & Prevention

- Keep informed
- Live healthy lifestyle
- Get preventive checkups
- Detect signs and symptoms
- Seek timely, appropriate medical attention

Chronic Illnesses Require Self-Regulation

- Follow treatment regimen
  - Use medications as prescribed
  - Diet, exercise, no smoking, etc.
  - Including for diseases without outward signs (e.g., hypertension)
- Monitor daily signs and symptoms
- Adjust medication and behavior in response to signs
- Have regular check-ups

Accidents: Prevention Is Key

- Recognize hazards

- Prevent incidents starting

- Halt progress of incidents

- Limit damage during incidents

- Recover and redesign

• Same process as with chronic illnesses
• Myriad low-probability, often-hidden hazards

Plan, Anticipate Problems
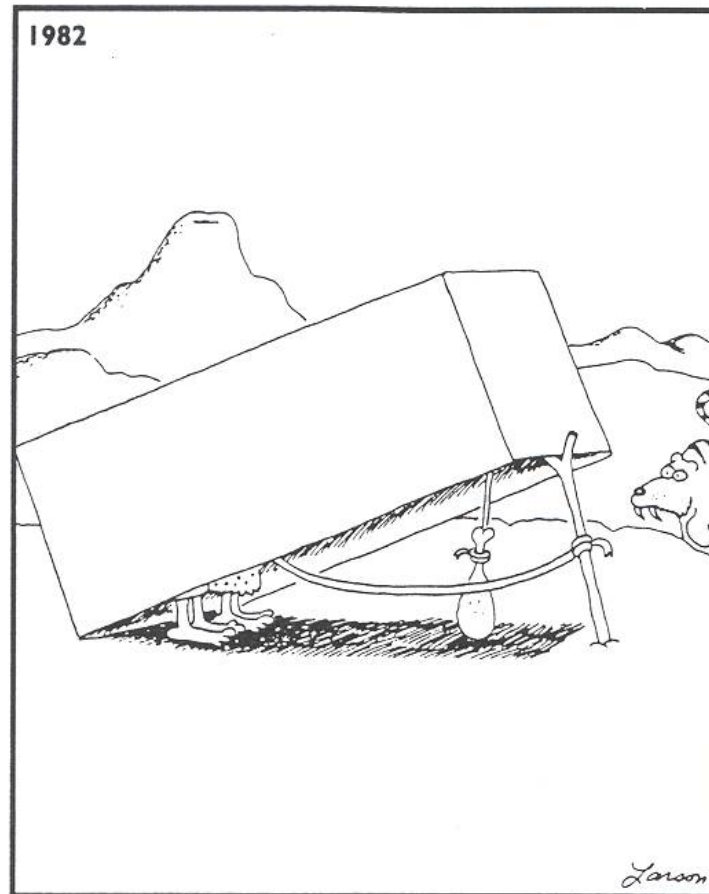
"Shhhh, Zog! ... Here come one now!"

Motor Vehicle Fatalities.
Are They Just "Accidental"?

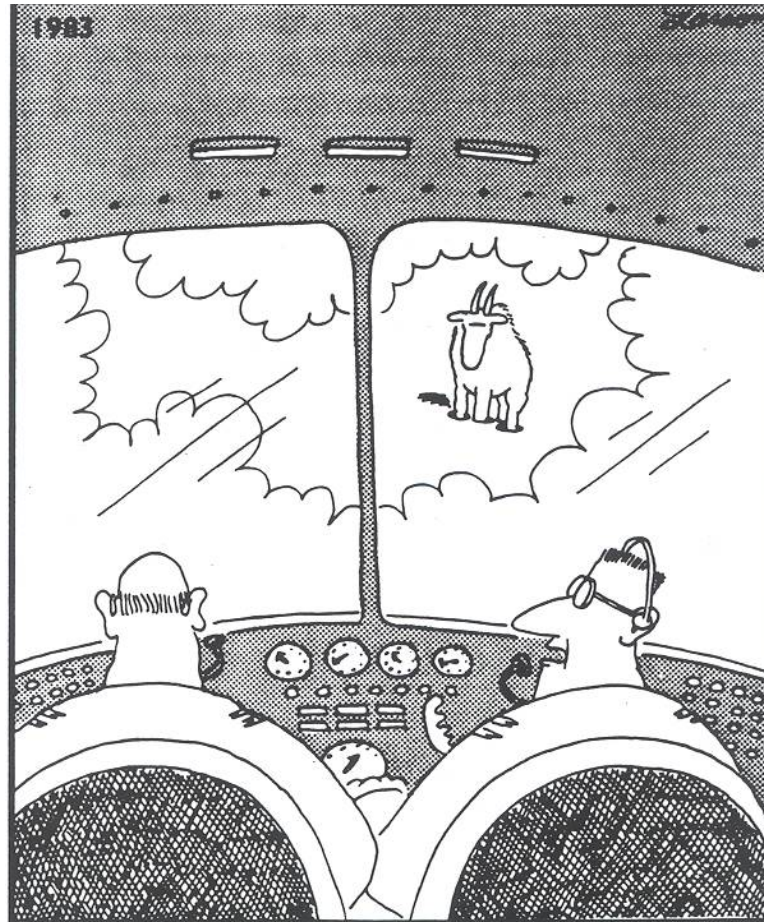- IQ is best predictor
- Predicts net of 56 other variables

Australian veterans followed to age 40	Death rate per 10,000	
IQ: above 115	51.3	
100-115	51.5	
85-100	92.2	**2x**
80- 85	146.7	**3x**

Life requires "defensive driving"

Dealing with the unexpected

"Say ... what's a mountain goat doing
way up here in a cloud bank?"

Complexity of Accident Prevention

Complex jobs require workers to: (Arvey, 1986) (Applied to health)	Correlation with overall job complexity
• Learn and recall <u>relevant</u> information (symptoms)	.75
• Reason and make judgments (timely preventive care)	.71
• Deal with <u>unexpected</u> situations (meal delayed)	.69
• <u>Identify problem situations quickly</u> (hazards)	.69
• React <u>swiftly</u> when <u>unexpected</u> problems occur (injuries, asthma attack)	.67
• Apply common sense to solve problems	.66
• Learn new procedures <u>quickly</u> (treatment regimens)	.66
• Be alert & <u>quick</u> to understand things (feverish child)	.55

Chronic Illnesses as Demanding "Careers"

Example: Diabetic's Job

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

Good Performance

- **IT IS NOT** mechanically following a recipe
- **IT IS** keeping a complex system under control in often unpredictable circumstances
  - 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

Extremely Complex

Error Rates Among Diabetics
(insulin dependent)

Urban hospital outpatients: % diabetics **_not_** knowing that:	Health literacy level		
	V-low	Low	OK
Signal: Thirsty/tired/weak usually means <u>blood sugar too high</u>	40	31	25
Action: Exercise lowers blood sugar	60	54	35
Signal: Suddenly sweaty/shaky/hungry usually means <u>blood sugar too low</u>	50	15	6
Action: Eat some form of sugar	62	46	27

Treatment regimens becoming more complex

- **Heart attacks**
  - 1960's—just "good luck"
  - Now often includes:
    - regimen of aspirin, β-blocker, angiotensin-converting enzyme inhibitor
    - low-salt and low-cholesterol diet
    - Medicine to control hypertension, diabetes, & hypercholesterolemia

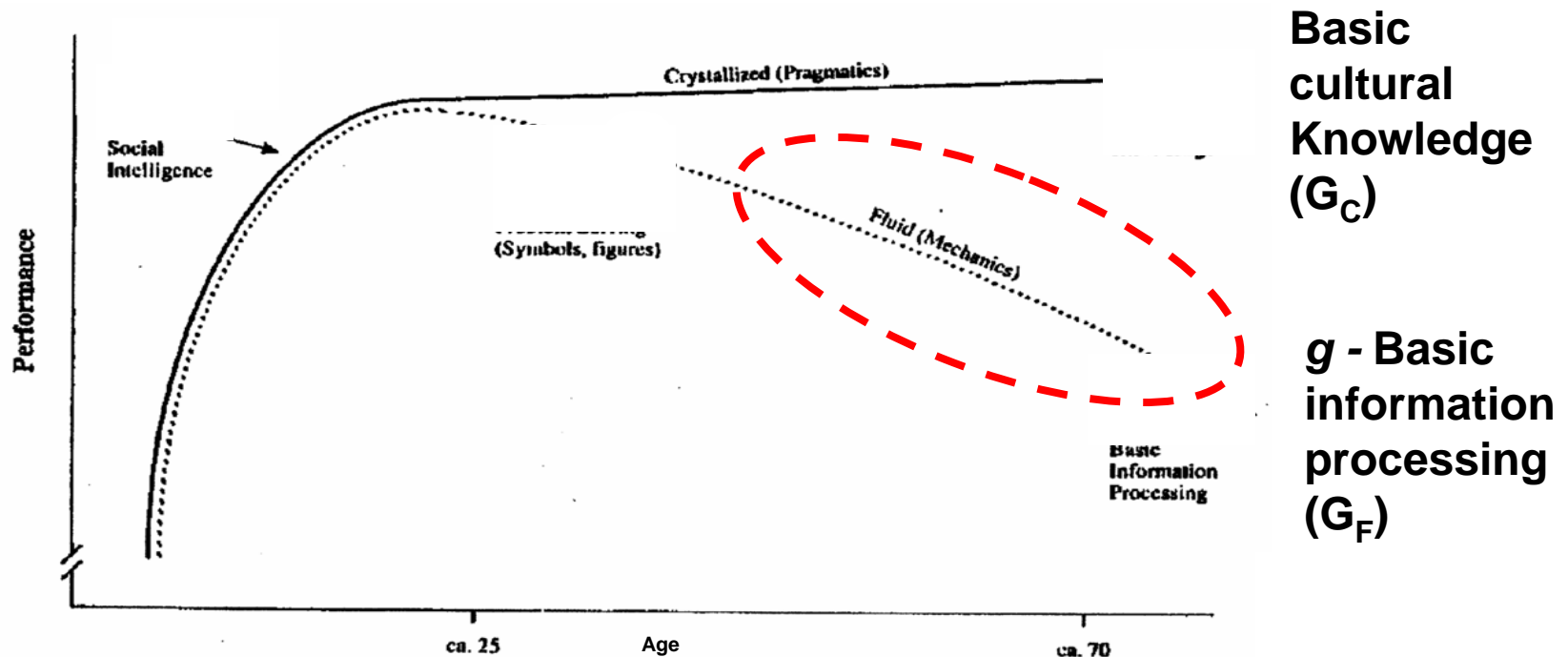Brighter individuals can better capitalize on medical advances

Smart people make life more complex for the rest of us
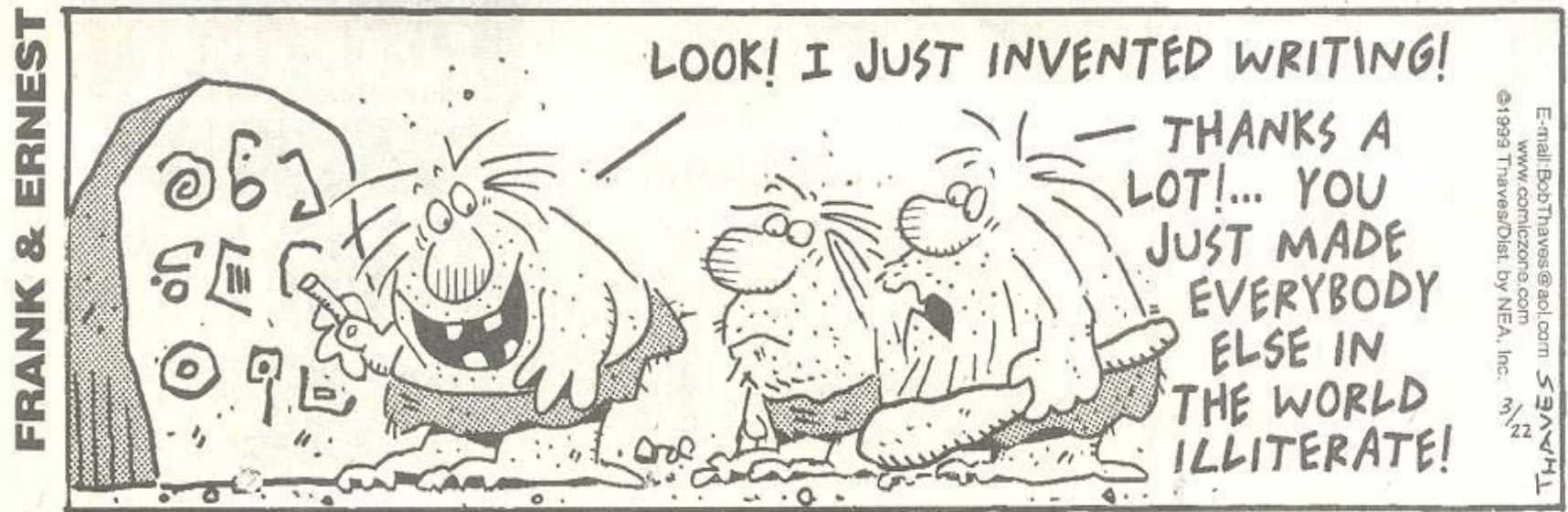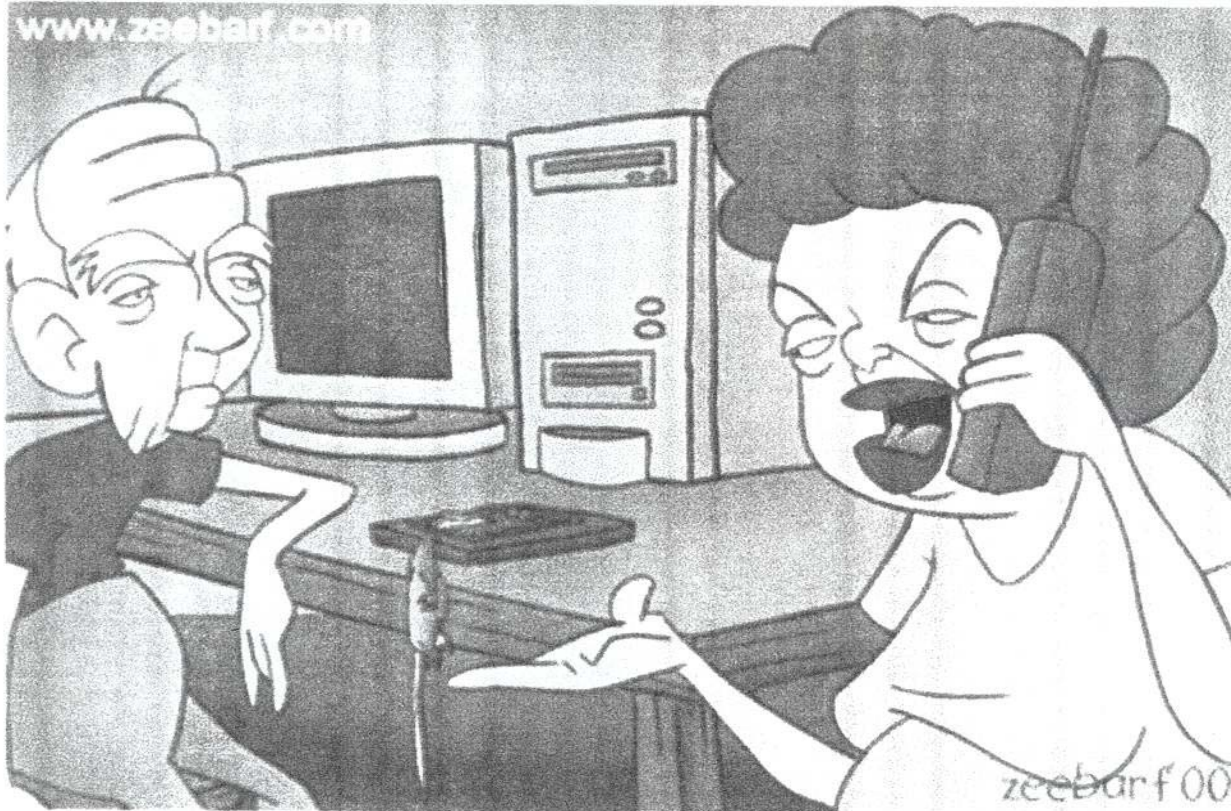
Increasing Complexity Favors the Young

Raw mental horsepower (ability to learn and reason) rises into early adulthood, then falls

Average profile only

Basic cultural Knowledge (G_C)

g - **Basic information processing (G_F)**

Score *relative to age mates* ("IQ") is stable from adolescence on

Complexity & Aging

"Okay your father managed to get a mouse. Now how do we use it?"
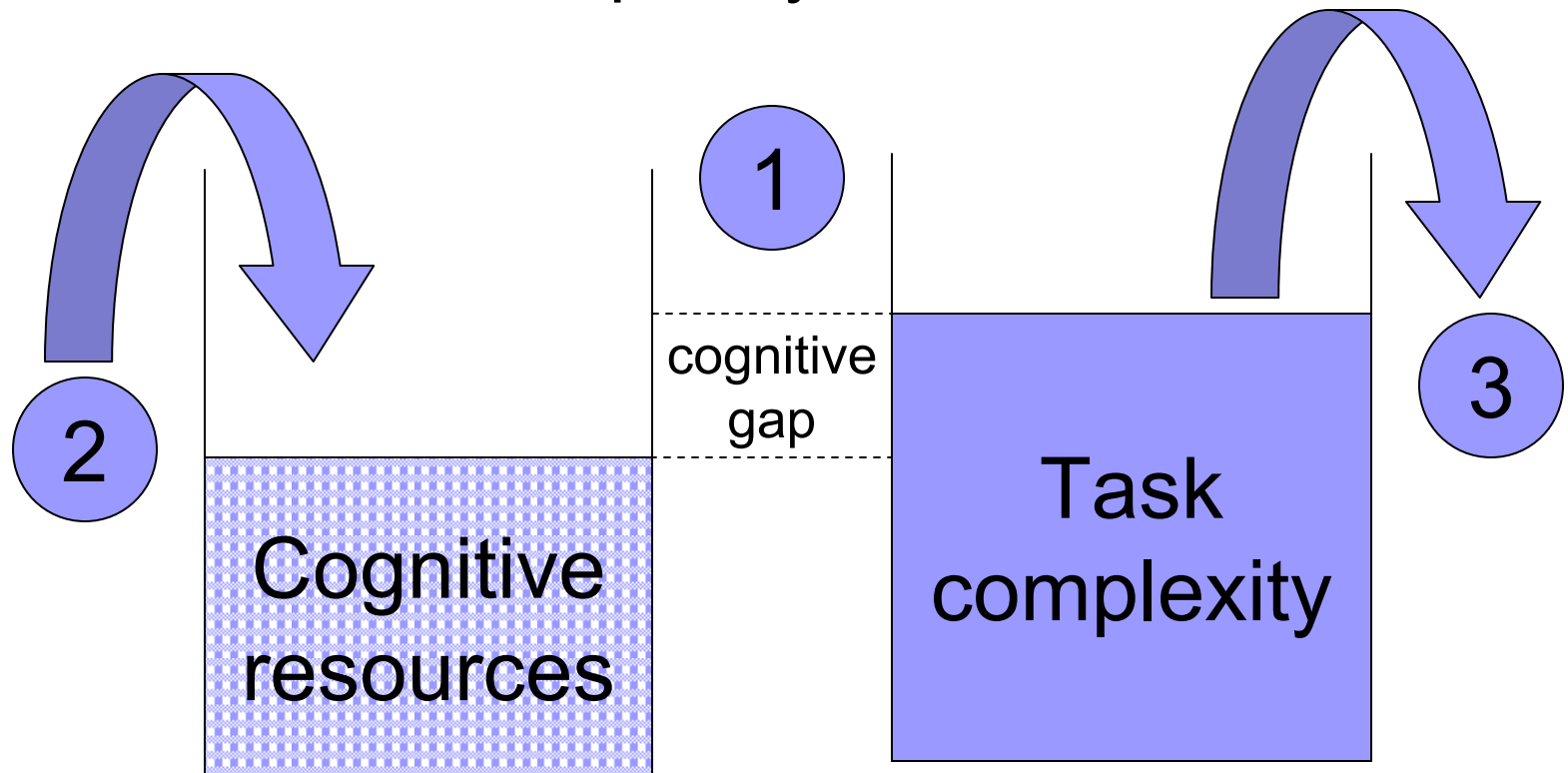
Opportunities for Intervention

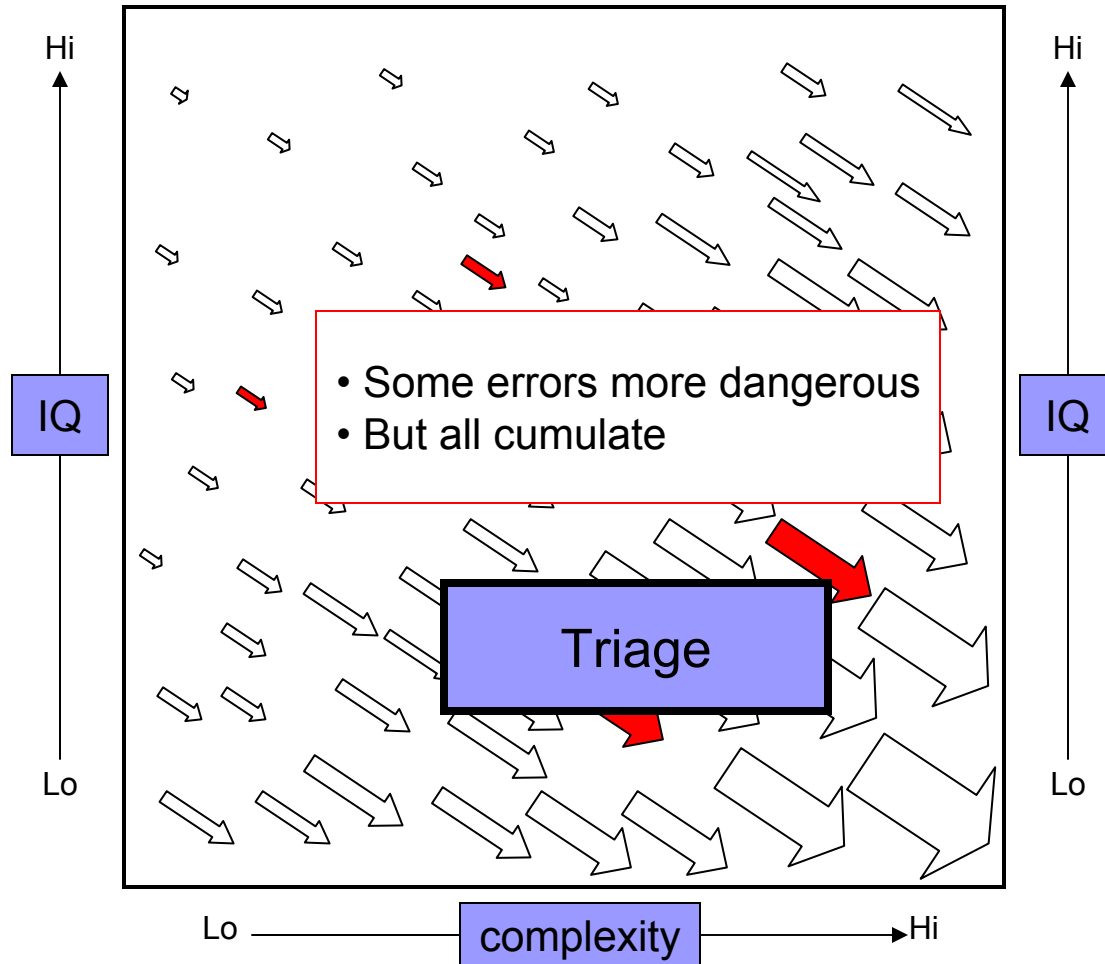True, we cannot change intelligence (*g*)

BUT

Lots of opportunities to help clients and providers

Can Reduce Risk of Error

1. Mind the gap
2. Provide cognitive assistance
3. Reduce task complexity

Matrix of Cognitive Risk
(error rates)

Can predict error if we know:

Distribution of *g* in groups of patients:
• race
• age
• locale

Assess

Distribution of *g* loadings in sets of tasks:
• preventive care
• chronic disease

Audit

Within the matrix:
Hi — IQ — Lo
Lo — complexity — Hi

• Some errors more dangerous
• But all cumulate

Triage

Audit cognitive resources
Patients' own & supplementary

- **Patient differences in *g***
  - ☐ Train providers
    - Size, nature, distribution, practical meaning of differences
    - Recognize/communicate across large IQ gaps
  - ☐ Create short unobtrusive measure of "literacy"
  - ☐ Target pockets of high error
  - ☐ Identify options for cognitive scaffolding
    - Tailored instruction, comprehension checks
    - Feedback, monitoring, retraining, reminders, hotlines
    - Auxiliary staff, family

Schools do it, military and employers do it

Audit complexity of patients' "jobs"

- **Task differences in complexity**
  - ☐ Audit complexity in:
    - Information & instructions
    - Individual treatments, diseases
    - Clinic layout, patient interface
  - ☐ Target tasks with:
    - High expected error rates
    - Needless complexity
  - ☐ Write job descriptions for chronic diseases
    - Biggest cognitive barriers to adherence
    - Touch-points for intervention to surmount barriers
    - Set priorities for triage

Badly neglected, everywhere

Thank you.