My Journeys With Job Analysis

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Ernest J. McCormick Memorial Lecture
Purdue University
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Big Picture Questions

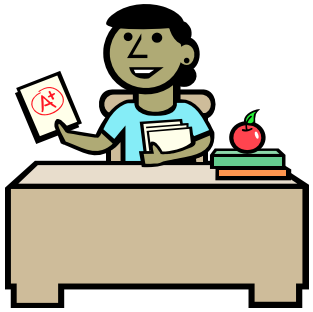
Job analysis lens

In Different Lands

- Sociology
- Intelligence
- Epidemiology
- Human evolution

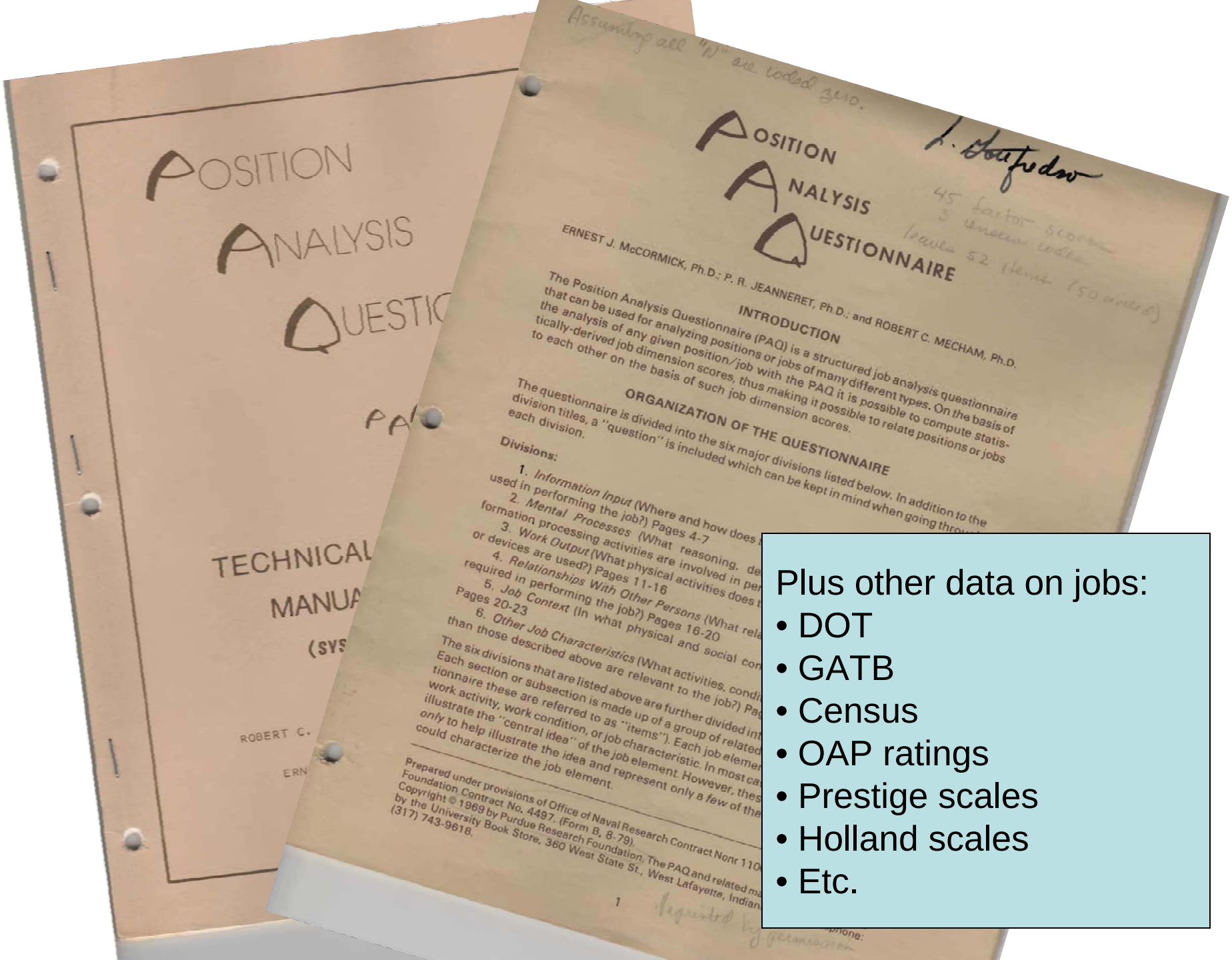
My Starting Point—Part 1

1. Occupational choice


"What abilities do jobs require?"

Occupations mostly black boxes

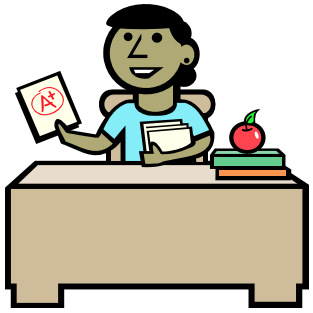


Plus other data on jobs:

- DOT
- GATB
- Census
- OAP ratings
- Prestige scales
- Holland scales
- Etc.

My Starting Point—Part 2

1. Occupational choice

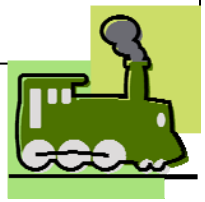




"What abilities do different occupations require?"

2. Occupational attainment

"Who gets ahead, and why?"

Sociology's Claims in the 1970s

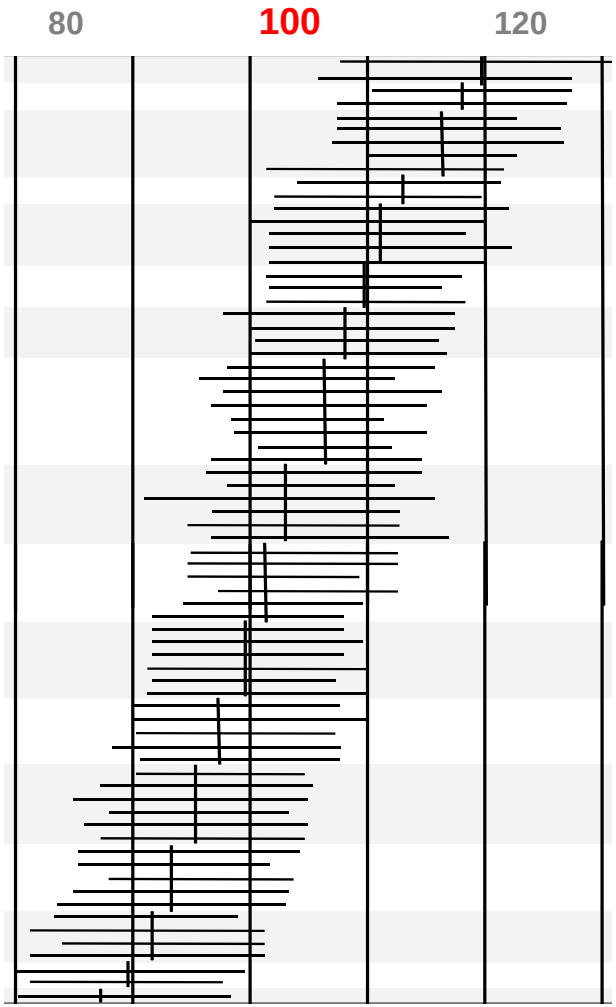


- Education predicts job level better than IQ
- Education doesn't predict job performance
- Ergo, IQ can't predict job performance
- Ergo, virtually everyone could do all jobs
- Conclusion: Education and IQ do not reflect "merit," but social class in disguise. It's a way the ruling classes maintain dominance.
- Generalization: Human inequality is socially constructed, the result of oppression and privilege

IQ Predicts Job Level--Is This Merit at Work, or Oppression?

Status
Education
Income

IQs of applicants for:	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



I/O Had Similar Concerns

- The “criterion problem”
  - Military: ASVAB predicts training, but in jobs too?
  - Civilian: IQ predicts supervisor ratings, but what about objective performance?
- The “adverse impact” standard
  - Education & IQ presumed discriminatory until proved job-related

Does IQ Predict Within-Job Performance?

Correlations

.8

.5

.2

IQs of applicants for:	IQs: Middle 50%
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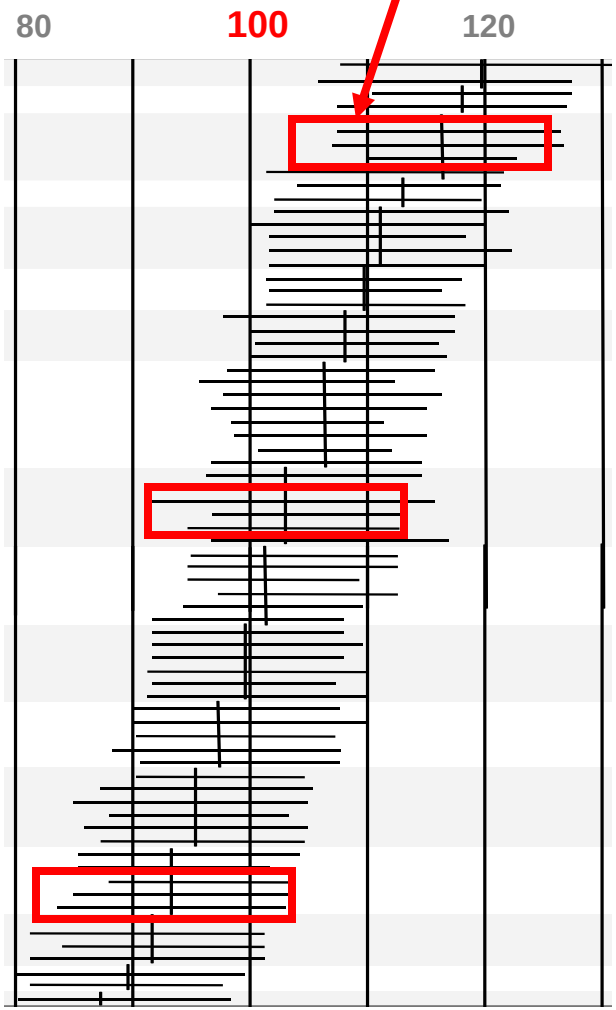

So What?

- Why does IQ predict performance?
- Why better prediction at higher levels?
- Just employer tastes—self-fulfilling prophecy?

Occupations Just Black Boxes

- What is a job?
- What tasks make them up?
- Are tasks in higher-level jobs more cognitively demanding?

How would we know?

Assuming all "N" are coded zero.

45 factor scores
3 dimension scores
Leaves 52 items (50 units)

POSITION ANALYSIS QUESTIONNAIRE

ERNEST J. McCORMICK, Ph.D.; P. R. JEANNERET, Ph.D.; and ROBERT C. MECHAM, Ph.D.

INTRODUCTION

The Position Analysis Questionnaire (PAQ) is a structured job analysis questionnaire that can be used for analyzing positions or jobs of many different types. On the basis of the analysis of any given position/job with the PAQ it is possible to compute statistically-derived job dimension scores, thus making it possible to relate positions or jobs to each other on the basis of such job dimension scores.

ORGANIZATION OF THE QUESTIONNAIRE

The questionnaire is divided into the six major divisions listed below. In addition to the division titles, a "question" is included which can be kept in mind when going through each division.

Divisions:

1. *Information Input* (Where and how does the worker get the information that is used in performing the job?) Pages 4-7
2. *Mental Processes* (What reasoning, decision-making, planning, and information processing activities are involved in performing the job?) Pages 7-11
3. *Work Output* (What physical activities does the worker perform and what tools or devices are used?) Pages 11-16
4. *Relationships With Other Persons* (What relationships with other people are required in performing the job?) Pages 16-20
5. *Job Context* (In what physical and social contexts is the work performed?) Pages 20-23
6. *Other Job Characteristics* (What activities, conditions, or characteristics other than those described above are relevant to the job?) Pages 23-28

The six divisions that are listed above are further divided into sections and subsections. Each section or subsection is made up of a group of related job elements (in the questionnaire these are referred to as "items"). Each job element describes some *general* work activity, work condition, or job characteristic. In most cases examples are given to illustrate the "central idea" of the job element. However, these examples are intended *only* to help illustrate the idea and represent only a *few* of the possible examples that could characterize the job element.

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JOB DIMENSIONS BASED ON PRINCIPAL COMPONENTS ANALYSES OF PAQ DATA FOR 2200 JOBS:

SYSTEM II

General categories

	OPERATIONAL TITLE
DIVISION DIMENSIONS	
Division 1: Information Input	
1. Perceptual interpretation	Interpreting what is sensed
2. Input from representational sources	Using various sources of information
3. Visual input from devices/ materials	Watching devices/materials for information
4. Evaluating/judging sensory input	Evaluating/judging what is sensed
5. Environmental awareness	Being aware of environmental conditions
6. Use of various senses	Using various senses
Division 2: Mental Processes	
7. Decision making	Making decisions
8. Information processing	Processing information
Division 3: Work Output	
9. Using machines/tools/ equipment	Using machines/tools/equipment
10. General body vs. sedentary activities	Performing activities requiring general body movements
11. Control and related physical coordination	Controlling machines/processes
12. Skilled/technical activities	Performing skilled/technical activities
13. Controlled manual/related activities	Performing controlled manual/ related activities
14. Use of miscellaneous equipment/devices	Using miscellaneous equipment/ devices
15. Handling/manipulating/related	Performing handling/related

NO.	TECHNICAL TITLE	OPERATIONAL TITLE
	Division 4: Relationships With Other Persons	
17.	Interchange of judgmental/ related information	Communicating judgments/ related information
18.	General personal contact	Engaging in general personal contacts
19.	Supervisory/coordination/ related activities	Performing supervisory/ coordination/related activities
20.	Job-related communications	Exchanging job-related information
21.	Public/related personal contacts	Public/related personal contacts
	Division 5: Job Context	
22.	Potentially stressful/ unpleasant environment	Being in a stressful/ unpleasant environment
23.	Personally demanding situations	Engaging in personally demanding situations
24.	Potentially hazardous job situations	Being in hazardous job situations
	Division 6: Other Job Characteristics	
25.	Non-typical vs. typical day work schedule	Working non-typical vs. day schedule
26.	Businesslike situations	Working in businesslike situations
27.	Optional vs. specified apparel	Wearing optional vs. specified apparel
28.	Variable vs. salary compensation	Being paid on a variable vs. salary basis
29.	Regular vs. irregular work schedule	Working on a regular vs. irregular schedule
30.	Job demanding responsibilities	Working under job-demanding circumstances
31.	Structured vs. unstructured job activities	Performing structured vs. unstructured work
32.	Vigilant/discriminating work activities	Being alert to changing conditions

Specific items

at which a lathe turns, etc.)

ng objects (estimating the speed of moving *objects* or *materials* r to other moving objects, for example, the speed of vehicles, lt, flow of liquids in transparent pipes, etc.)

30 I Estimating speed of processes (estimating the speed of ongoing *processes* or a series of events while they are taking place, for example, chemical reactions, assembly operations, timing of food preparation in a cafeteria, etc.)

31 I Judging condition/quality (estimating the condition, quality, and/or value of objects, for example, antique dealer, appraiser, jeweler, used-car dealer, coin dealer, etc.)

32 I Inspecting (inspecting products, objects, materials, etc., either one's own workmanship or that of others, in terms of established standards, for example, identifying defects, classifying by grade, etc.; do *not* include here activities described in item 31 above)

166(4)

33 I Estimating quantity (estimating the *quantity* of objects *without direct measurement*, including weight, number, volume, etc., for example, estimating the board feet of lumber in a log, the weight of a beam, the number of bacteria in an area by looking through a microscope, etc.)

34 I Estimating size (estimating the *dimensions* of objects *without direct measurement*, including length, thickness, etc., for example, estimating the height of a tree, judging sizes of boxes or furniture in loading a truck, etc.)

35 I Estimating time (estimating the time required for past or future events or work activities, for example, judging the amount of time to make a delivery, estimating the time required to service a worn machine part or piece of equipment, judging the length of time required to change a production line procedure, etc.)

2 MENTAL PROCESSES

2.1 Decision Making, Reasoning, and Planning/Scheduling

79(7)

36 S Decision making (indicate, using the code below, the level of decision making typically involved in the job, considering: the number and complexity of the factors that are taken into account; the variety of alternatives available; the consequences and importance of the decisions; the background experience, education, and training required; the precedents available for guidance; and other relevant considerations. The examples given for the following codes are *only* suggestive.)

Code *Level of Decision*

1 Very limited ("decisions" such as those in selecting parts in routine

Major Distinction in Task Demands? Complexity

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	
	.36	Recognize	
	-.49	Repetitive	
Custodian	-.56	Physical exertion	
Simple	-.73	Supervision	

Another Job Analysis, Same Complexity Factor

Reasoning & Judgment Factor (Arvey)	*r* with factor
▪ Learn and recall relevant information	**.75**
▪ Reason and make judgments	**.71**
▪ Deal with unexpected situations	**.69**
▪ Identify problem situations quickly	**.69**
▪ React swiftly when unexpected problems occur	**.67**
▪ App	**66**
▪ Lea	**66**
▪ Be a	**55**

g (IQ): A general ability to learn, reason, and solve problems.

Like Detective Building Case

Complexity is Active Ingredient in IQ Items, Too

	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%)	fly-tree (18%)
Define the word	breakfast (99%)	reluctant (50%)	encumber (19%)

Infer the rule

More abstract

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

Conclusion

- Complexity is key distinction among jobs
- *g* is ability to deal with complexity
- Other things matter, but *g* is chief organizing principle in division of labor
- There is a ecological reality, beyond social intent

What About “Jobs” in Daily Life?

- Driving
- Accounting
- Teaching
- Caregiving
- Carpentry

Daily Self-Maintenance

Functional Literacy (NALS)

Why the fed's concern?

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)

Like items in life's "test"?

NALS Level	% pop. (white)	Simulat
5	4%	▪ Use calculator to ▪ Use table of infor
4	25%	▪ Use eligibility pam ▪ Explain difference
3	36%	▪ Calculate miles pe ▪ Write brief letter
2	25%	▪ Determine differe ▪ Locate intersectio
1	14%	▪Total bank deposit ▪ Locate expiration

Difficulty based on "process complexity"

- level of inference
- abstractness of info
- distracting information

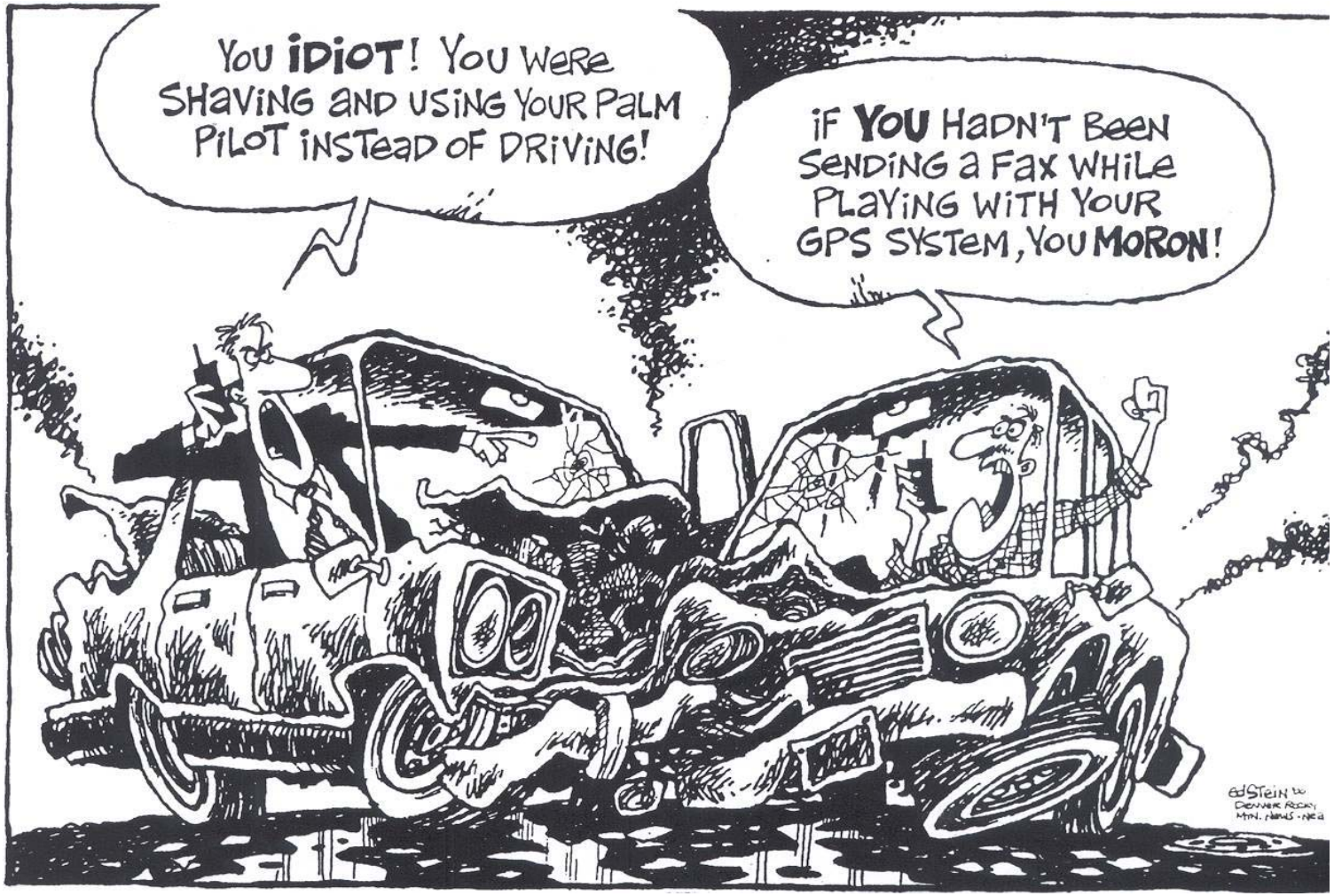
Motor Vehicle Fatalities. Are They Just "Accidental"?

- 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

- Think: What makes driving complex?

Daily Life is Full of Hazards



Common Building Blocks of Task Complexity—All Around You!

- 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

Intelligence a useful tool in everyday life

Health Inequality: Claims Today

- Education & income correlated with illness & injuries
- Assumption: They provide access to more & better care
- Assumption: People alike, only external conditions differ
- Conclusion: Health would be same if resources equal
- Generalization: Human inequality is socially constructed, the result of oppression and privilege
- Recommendation: Diversity training, equalize access and resources

Sound familiar?

But Doesn’t Fit the Evidence

- SES-health relation too general
- Relation is too linear
- Gaps grow when they should shrink

- So, search is on for a “fundamental cause”—perhaps inequality itself sickens & kills

Contributing Behaviors

Even when care is free:

- Lower social classes seek:
  - Less information
  - Less preventive care
  - More—but less appropriate—curative care
- And perform worse:
  - Know, understand less
  - Less healthy behavior (e.g., smoking)
  - Adhere less to treatment regimens

So what? Could still be lack of opportunity and resources.

Non-Work **Accidental** Death Rates Higher in Lower Classes

	Relative risk for poor vs. middle $
• Suffocation (infants)	1.3
• Choking on food (infants & elderly)	1.5
• Drowning (young males)	2.0
• Motor vehicle (young males)	2.4
• Fires/burns (children & elderly)	2.5
• Lightning (young males)	3.4
• Firearms (young males)	4.4
• Natural disasters (all ages, sexes)	5.0
• Exposure/neglect (infants & elderly)	7.4

So what?

IQ Predicts Health Better Than SES

Large, prospective IQ-SES-health studies

- Scotland (IQ at age 11)
  - Longevity
  - Heart disease, lung cancer mortality
  - Smoking cessation
- Australia (IQ at Army induction)
  - All-cause mortality
  - Motor vehicle deaths
  - Suicide

So what?

Think—Who is your primary health care provider?

You.

"Mortality could be reduced substantially if people at risk would change just five behaviors."

- adherence to medical recommendations
- diet
- smoking
- lack of exercise
- alcohol and drug use

(American Psychological Society, 1996)

"Our own decisions throughout life have a greater effect than all the efforts of medical care combined."

(Surgeon General Report, 1979)

Health Self-Care Is a Lifelong Job

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

Major Forms of Death & Disease

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

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

All are "preventable."

Chronic Illnesses

- Chronic illnesses are “slow-acting, long-term killers that can be treated but not cured”
  - Develop slowly, hard to detect
  - Damage process slow, invisible
  - Lengthy treatment requiring continued need “to learn,” “reason,” and “solve problems”
  - No immediate consequences of back-sliding

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

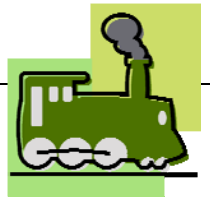
- Follow treatment regimen
  - Use medications as prescribed
  - Diet, exercise, no smoking, etc.
  - Including for diseases without outward signs (e.g., hypertension)
- Monitor daily signs and symptoms
- Adjust medication and behavior in response to signs
- Have regular check-ups

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
• Damage usually small, but it cumulates

Patients Are Not Just Passive "Recipients" of Care



- Chronic diseases are demanding jobs
- Patient performance matters
- Non-adherence might be better understood if the jobs better understood, from patient's perspective

A 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

Very Complex

Error Rates Among Diabetics

Urban hospital outpatients: % diabetics ***not*** knowing that:	Health literacy level		
	V-low	Low	OK
Signal: Thirsty/tired/weak usually means blood sugar too high	40	31	25
Action: Exercise lowers blood sugar	60	54	35
Signal: Suddenly sweaty/shaky/hungry usually means blood sugar too low	50	15	6
Action: Eat some form of sugar	62	46	27

Recall the Job Complexity Factor

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

Even Simplest Tasks Pose Barriers for Some People

Label on a prescription vial:

Acme Pharmacy Dept. **7806** Rt. 4 & Elkton Road
Newark, DE

Date: 07/05/03 Phone: (302) 453-2335

Rx# 19253

LINDA GOTTFREDSON

TAKE 4 CAPSULES BY MOUTH
1 HOUR PRIOR TO DENTAL
APPT.

AMOXYCILLIN 500MG CAPSULE By GENEV

Orig.

Date 7/31/02 Refill Y Qty. 4 RPh SSM

How Difficult a Job?

Complex

Simple

Attorney

Teller

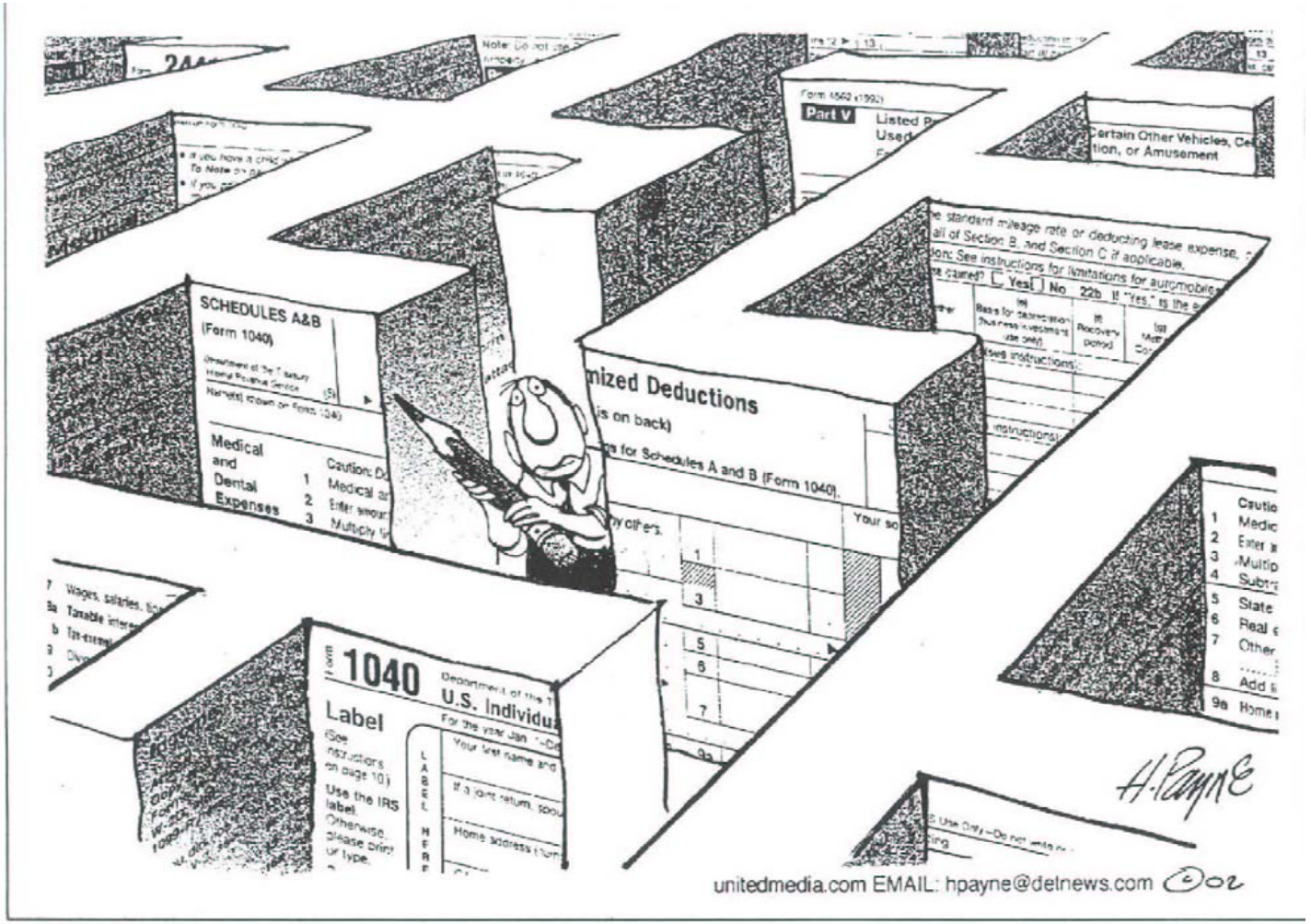
Custodian

Diabetic?

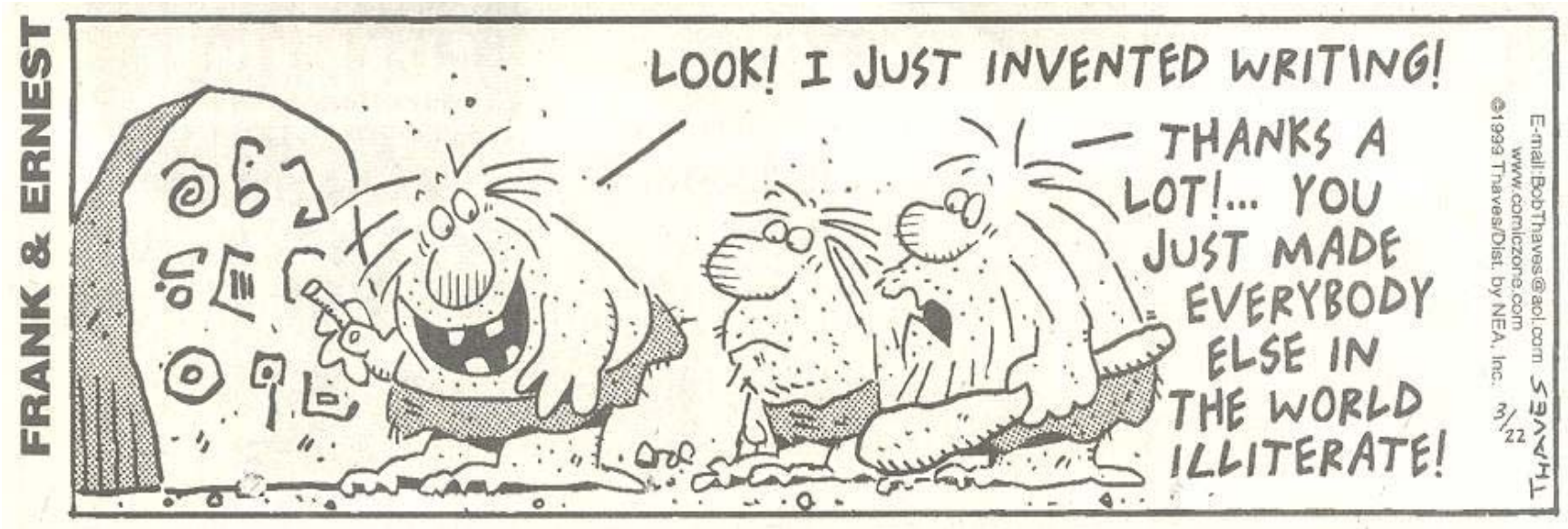
r		
.88	Self-direction	Combine information
.86	Reason	Advise
.85	Update knowledge	Write
.83	Analyze	Plan
.79	Lack of structure	Negotiate, Persuade
.71	Criticality of position	Coordinate
		Instruct
.51	Transcribe	
.36	Recognize	
-.49	Repetitive	
-.56	Physical exertion	
-.73	Supervision	

Do health care providers realize this?

Much Needless Complexity



But Advances in Treatment Increase Complexity



Aging Reduces Ability While Greatly Increasing Complexity

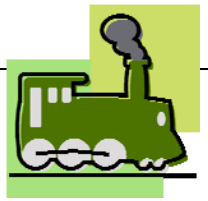
"Okay your father
managed to get a mouse.
Now how do we use it?"

Conclusion

- Access to care is important, but not enough
- Motivation is important, but not enough
- Job descriptions for a few chronic illnesses would shock health care providers

Need a PAQ for chronic diseases

Also Need for Evolution of Intelligence Itself

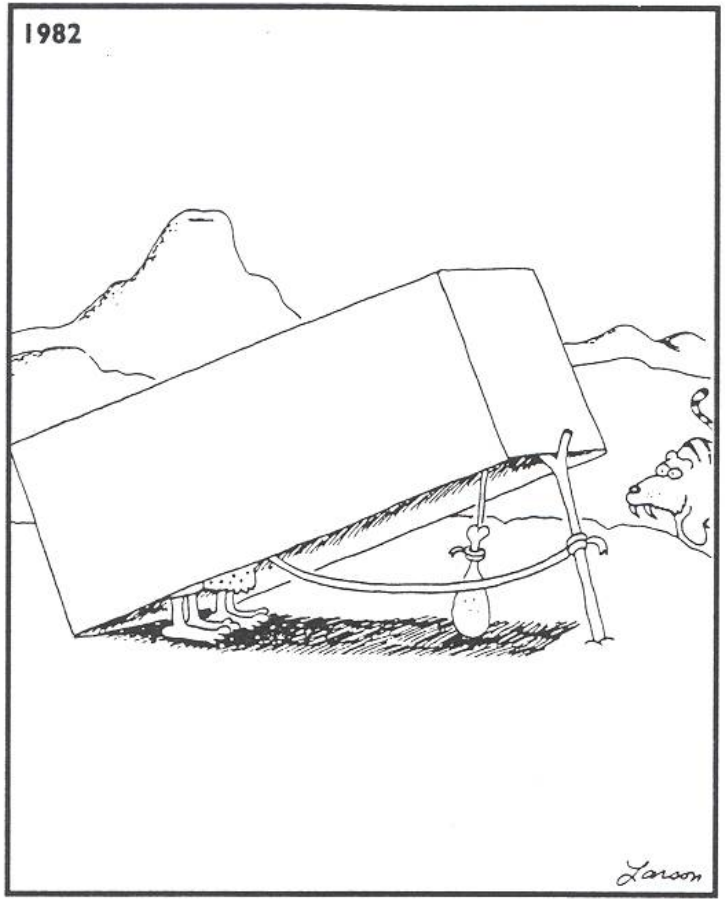


- What ecological demands could have selected for a highly general, content-independent general ability?

But wasn't life simpler in the early human EEA?

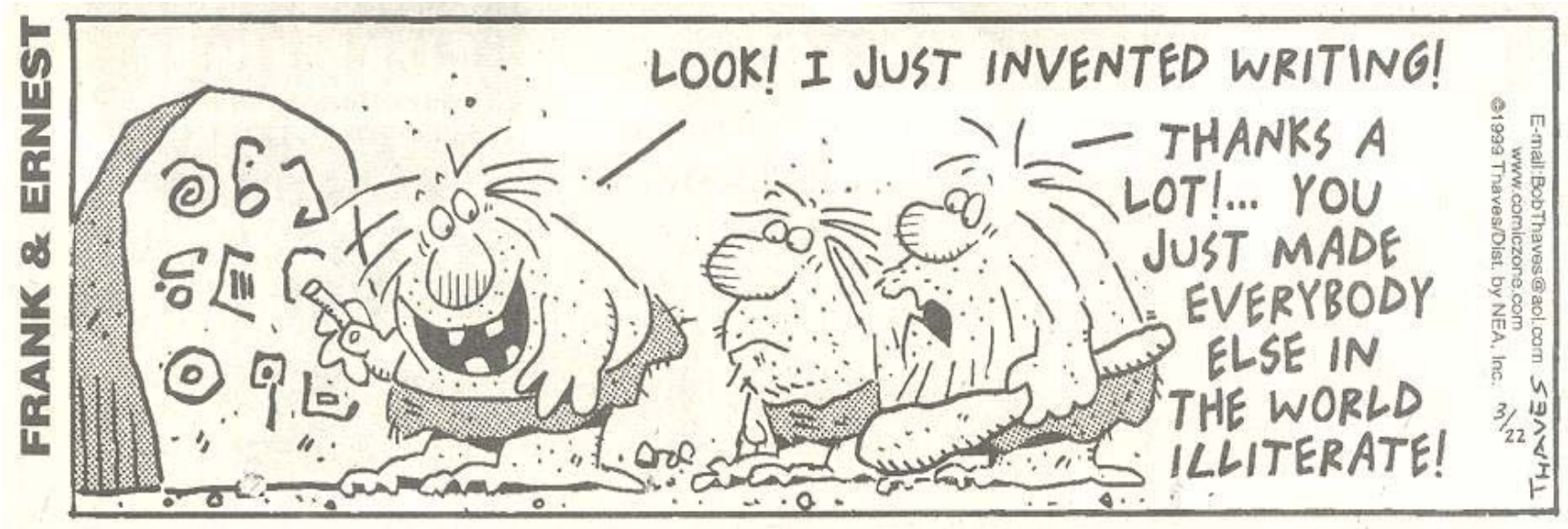
- Yes, but it was never *g*-proof
- Opportunity to learn & reason + within-group *variation* in *g* = opportunity for selection
- Tiny effect size + many generations = big shift in distribution

Plan, Anticipate Problems



"Shhhh, Zog! … Here come one now!"

High-*g* innovators make like difficult for everyone else



What Unique to Human EEA?

Human Innovation

- Changed physical environment or how humans interacted with it (e.g., fire, weapons)
- Improved average well-being but created novel risks (e.g., burns/scalds, inattention to snakes)
- Put a premium on independent learning and foresight,
  - especially for recognizing hazards and preventing "accidental" injury and death during core activities

Innovation & hazards require a mind's eye—imagination, foresight

Cause of Ache Deaths (N, <1971)

Age:	0-3		4-14		15-59		60+	
Sex:	F	M	F	M	F	M	F	M
Illness			**8**	**7**	**9**	**26**	**2**	**3**
Congenital/degenerative					**1**		**2**	**4**
Childbirth					**3**			
Accident			**1**	**10**	**6**	**23**	**4**	**3**
jaguar/snake				3	4	19	1	3
lightning				3	1	2		
lost				3		1	3	
drowned/falls/other			1	1	1	1		
Homicide			**14**	**3**	**4**	**7**	**1**	**4**
sacrificed with adult			10	1				
homicide/neglect			3					
buried alive/left behind			1	2	2		1	2
ritual club fights						6		2
non-sanctioned murder					2	1		

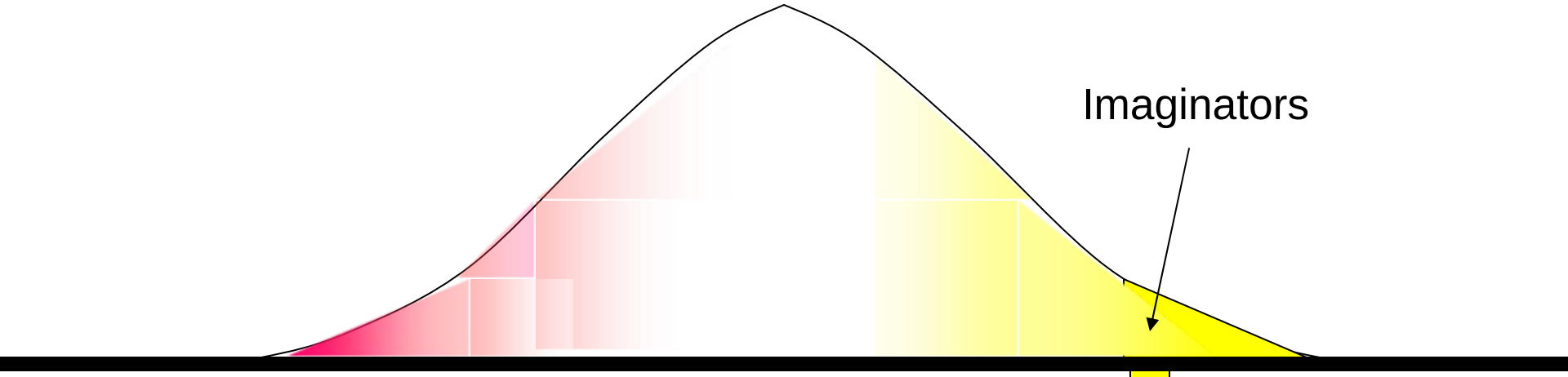
Most are "mistakes" (faulty mind's eye) during provisioning

Mistakes reverberate

Cause of Ache Deaths (N, <1971)

Age:	0-3		4-14		15-59		60+	
Sex:	F	M	F	M	F	M	F	M
Illness	**19**	**17**	**8**	**7**	**9**	**26**	**2**	**3**
Congenital/degenerative	**8**	**11**			**1**		**2**	**4**
Childbirth					**3**			
Accident	**1**	**2**	**1**	**10**	**6**	**23**	**4**	**3**
jaguar/snake				3	4	19	1	3
lightning		1		3	1	2		
lost				3		1	3	
drowned/falls/other	1	1	1	1	1	1		
Homicide	**26**	**26**	**14**	**3**	**4**	**7**	**1**	**4**
sacrificed with adult	7	4	10	1				
homicide/neglect	17	18	3					
buried alive/left behind	2	4	1	2	2		1	2
ritual club fights						6		2
non-sanctioned murder					2	1		

Migration Ratchet



Mean IQ rises

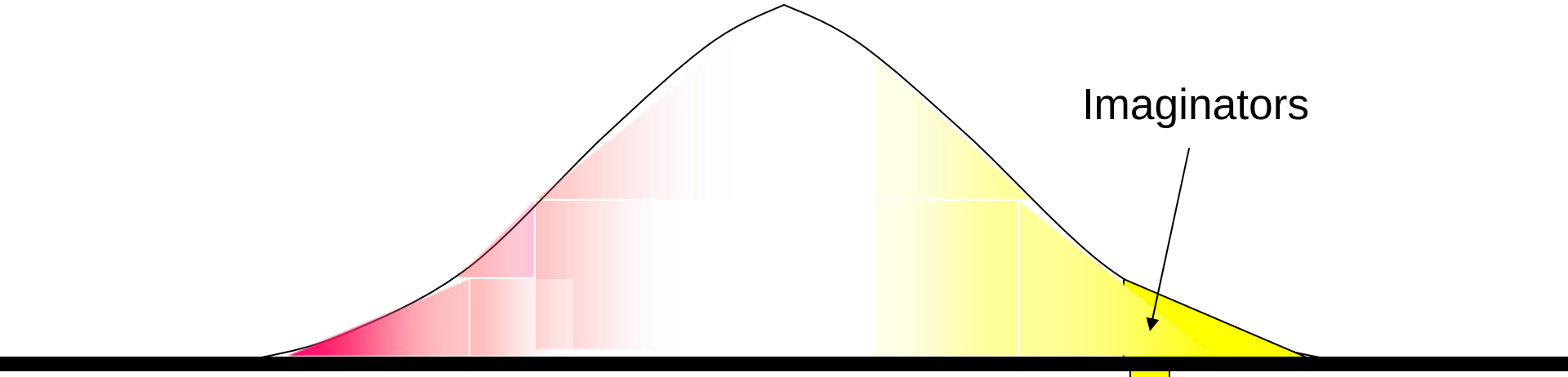
Innovate to adapt to harsher climates:

- clothing, shelter
- storage, preservation

Relative risk steepens

Bigger consequences ← More hazards ← More complexity ← More innovations

“Evolution of idiots”(Scott Adams)



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Bigger consequences ⟵ More hazards ⟵ More complexity ⟵ More innovations

What Killed Differentially by *g* Level?

- **Not the obvious**
  - Not high-interest, high-probability threats to band's survival (e.g., starvation, harsh climate)
  - Because the fruits of competence are shared (e.g., meat from hunting)
- **But the "minor" side-effects of core tasks**
  - Myriad low-probability, chance-laden, oft-ignored risks in daily chores (e.g., "accidental" injury)
  - Costs of injury not shared widely

Recall Spearman-Brown Formula for test reliability:
Low-*g* items can yield high-*g* test when many items cumulated (here: across tasks, individuals, generations)

Big Picture

- Ecology makes functional demands
- Small and cumulative errors cumulate
- People differ, even when have same barriers and privileges
- Social competition is not answer to all performance questions

Thank you.