Evolutionary Perspective on Raising Intelligence

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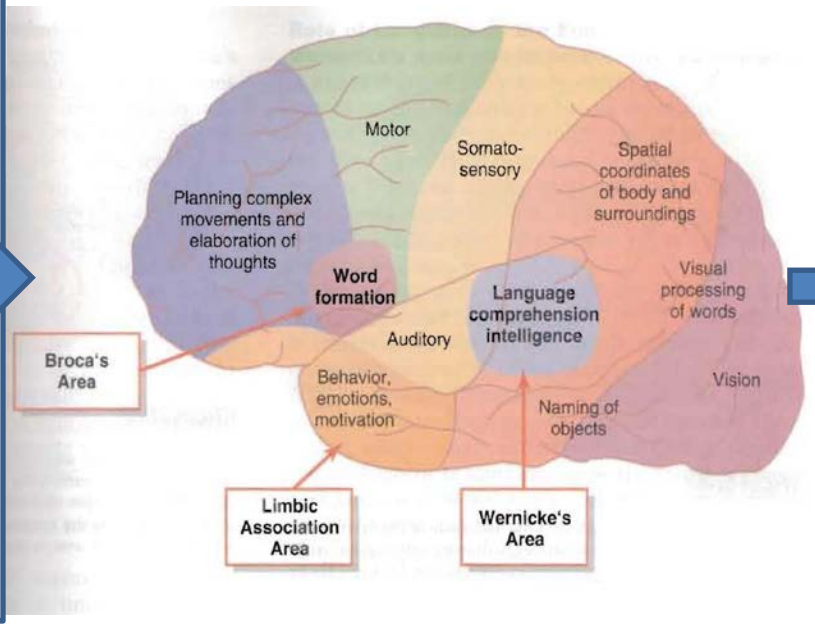
July 22, 2013
International Society for the Study of Individual Differences (ISSID)
Barcelona, Spain

Preview

1. Brain booster enthusiasms
   - Brain enhancement!
   - Better environments!
2. Evolution says “Posh! How’d you humans get so smart without them, eh?”
3. And, “What about all the novel ways you *damage* your intelligence?”
4. Get smart! Stop the drop.

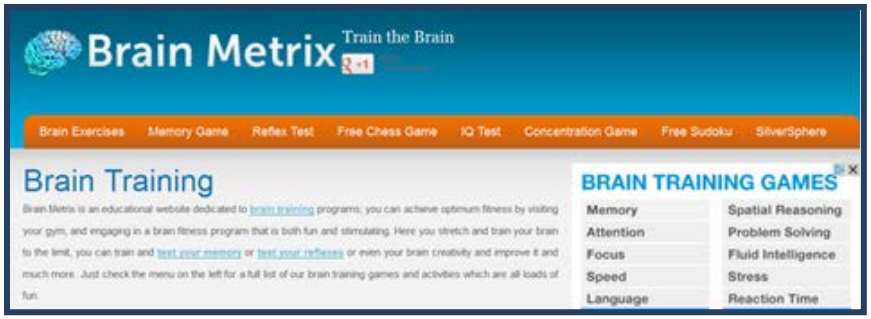
Enthusiasms in raising intelligence

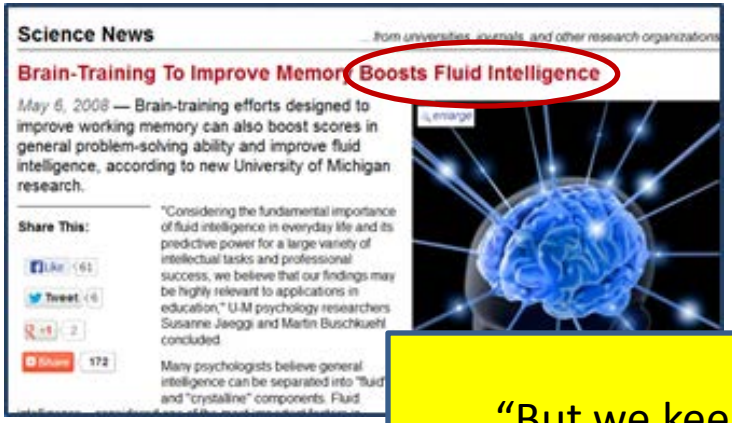
- Social
  - Education
  - Practice
  - Brain training
- Biological
  - Smart pills
  - Brain food
  - Genomics



Intelligence

Brain training (adults)





Early intervention

JUL 10, 2011

The Abecedarian Project - early stimulation gives lasting effects in children's lives

A group of psychologists in North Carolina had an idea to solve the vicious cycle of poverty - with a science experiment called the Abecedarian Project.

Up Close Episode 104: Evidence-based early childhood education: the Abecedarian approach

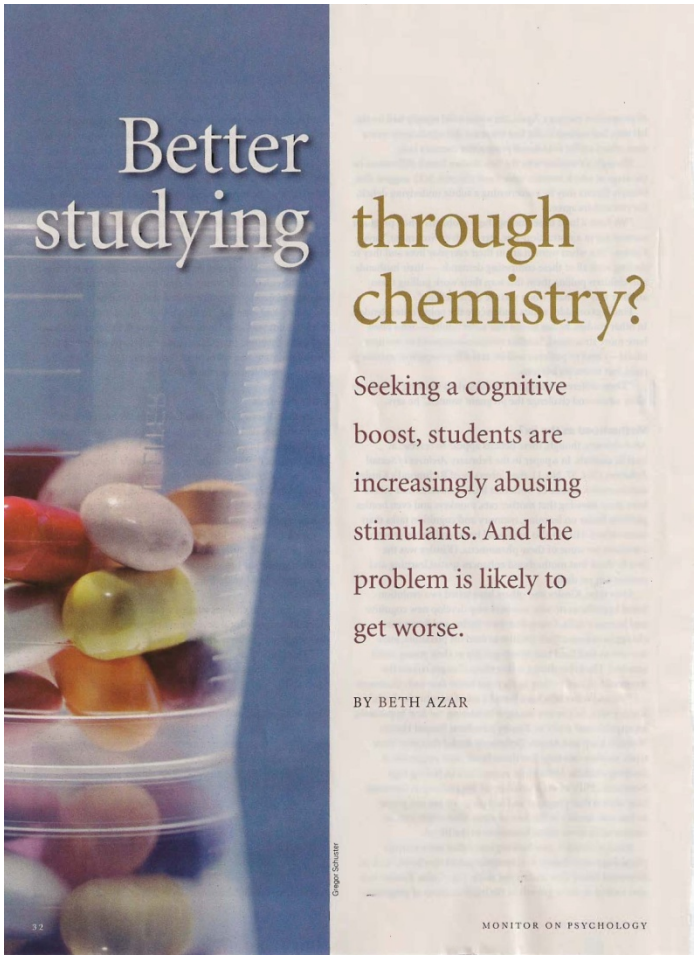
The video describes the Abecedarian Project - how underprivileged children can have increased intelligence and cognitive learning ability when their education starts very early in their lives.

http://www.thearchitectureofearlychildhood.com/2011/07/abecedarian-experiment-early.html

"But we keep getting our heart broken."

Doug Detterman, ISIR 2012

Cognitive enhancers



Better studying through chemistry?

Seeking a cognitive boost, students are increasingly abusing stimulants. And the problem is likely to get worse.

BY BETH AZAR

Gregor Schuster

32

MONITOR ON PSYCHOLOGY

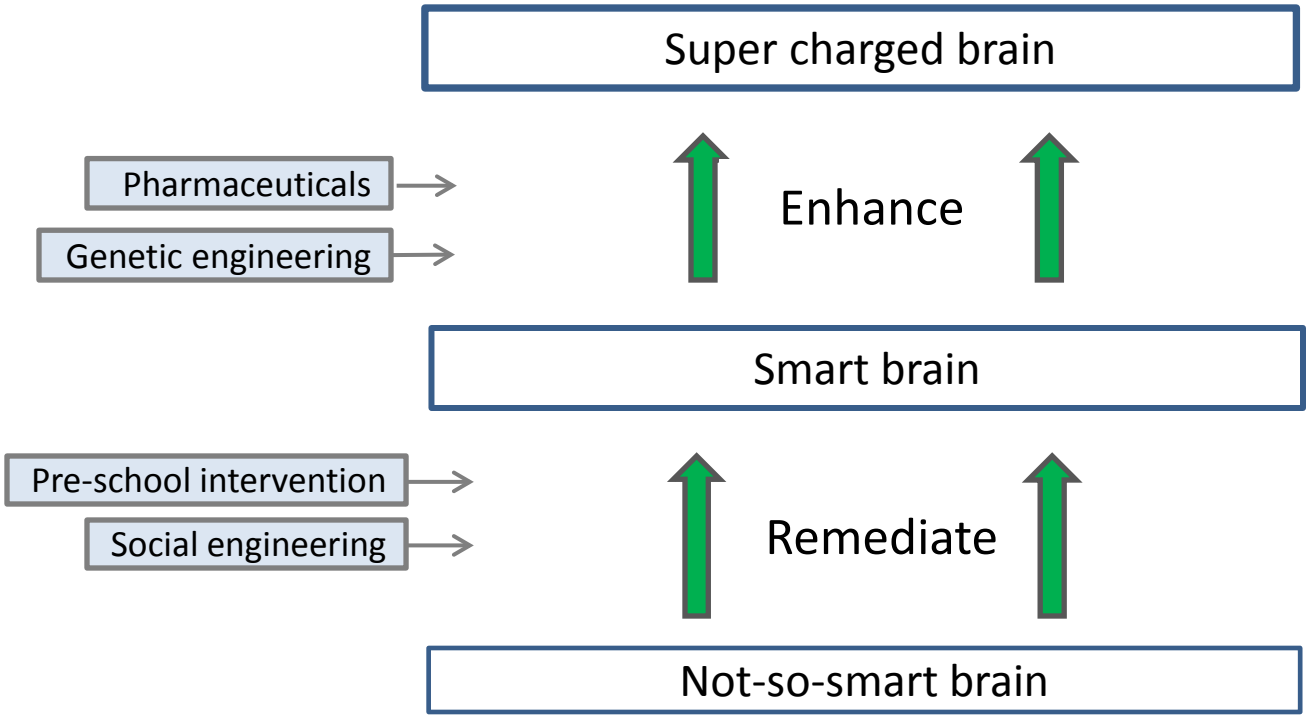
"It's a brave new world"

Before—
- caffeine
- ephedrine-based drugs

Now—
- Ritalin
- Adderall
- Modafinil

Monitor on Psychology, September, 2008, p. 32

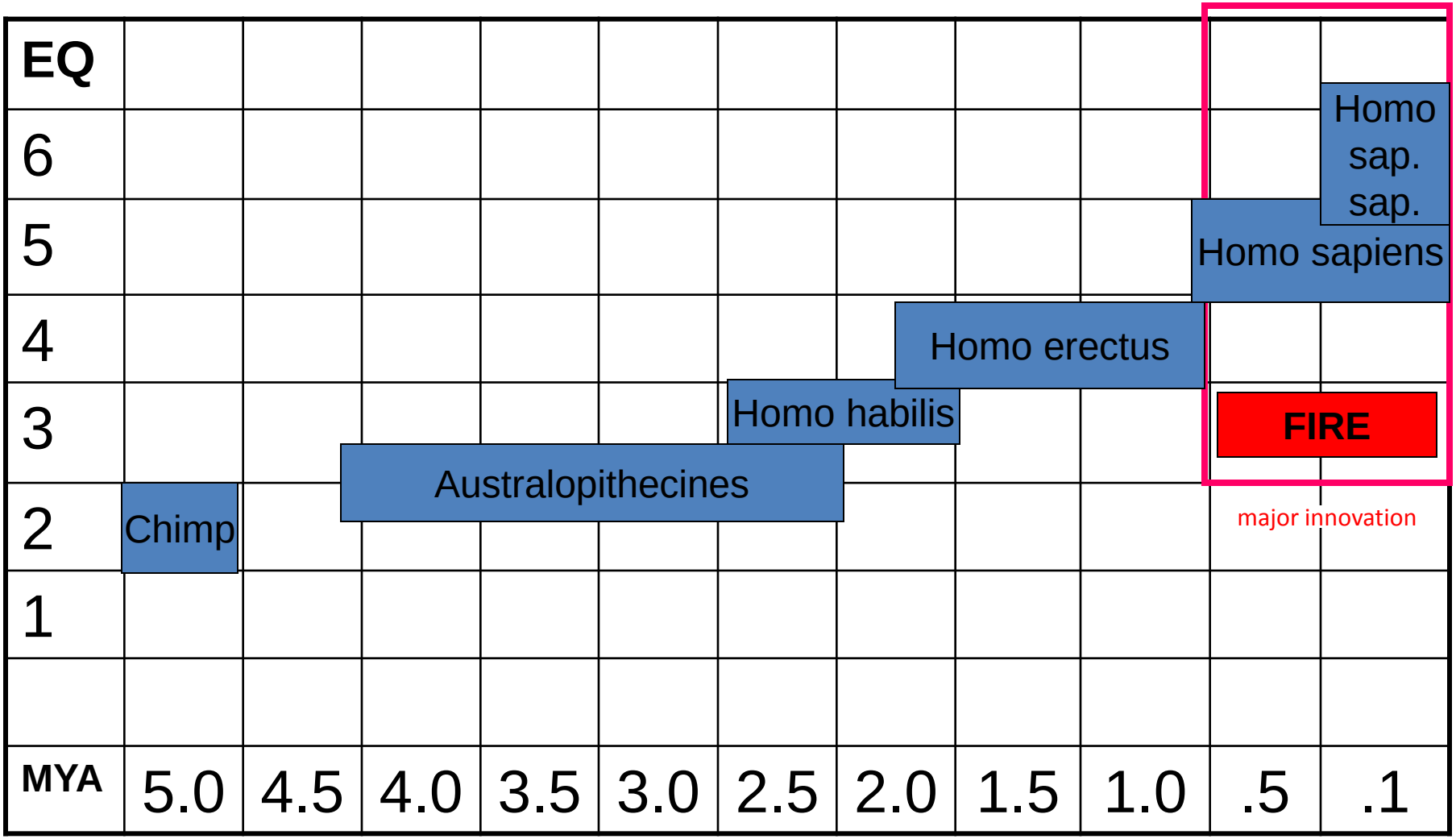
So, is this the hope and challenge of "raising intelligence"?



Peering through an evolutionary lens

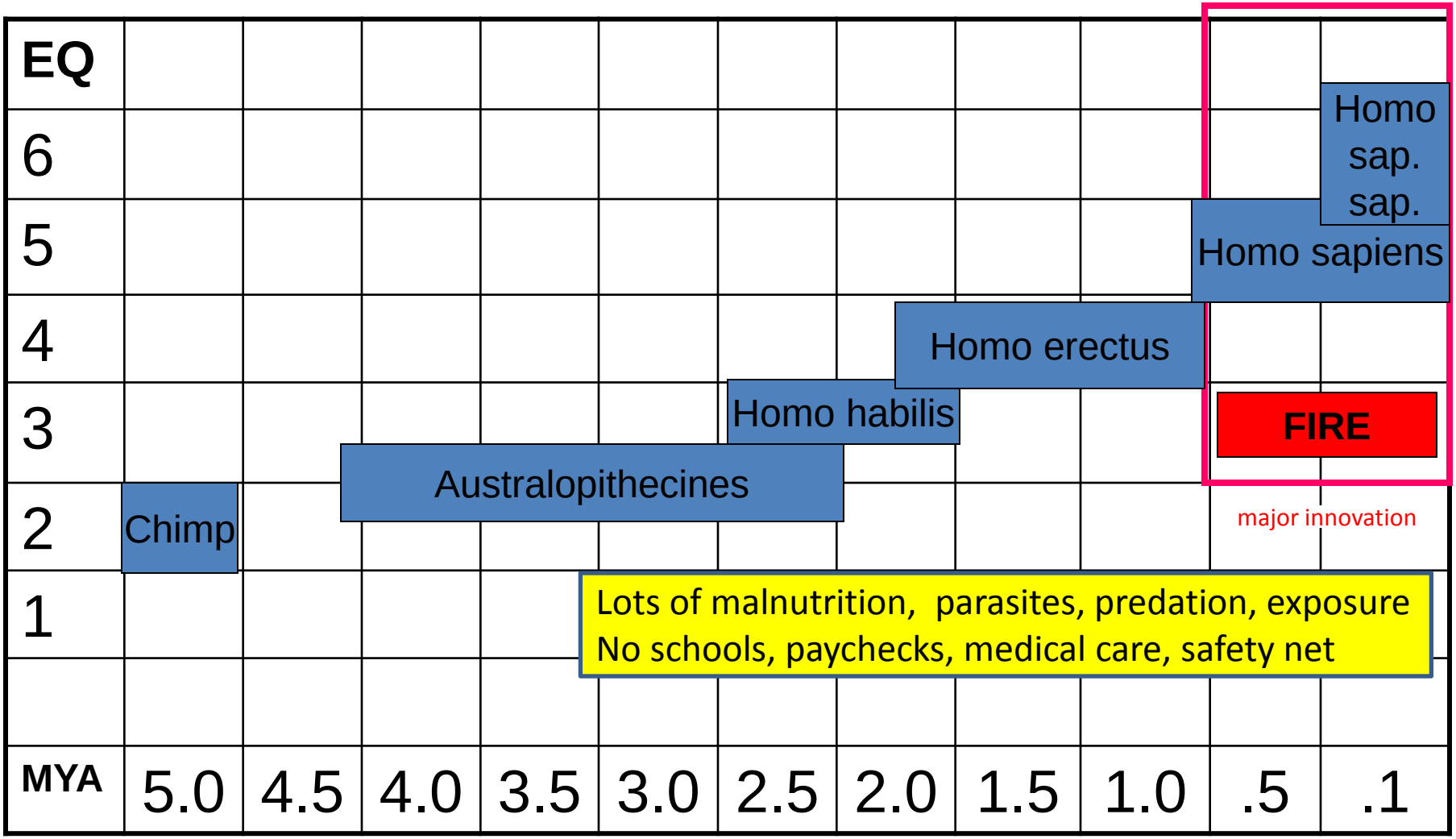
Humans evolved a “remarkable” intellect

Encephalization quotient (EQ) = brain-to-body size compared to the average mammal

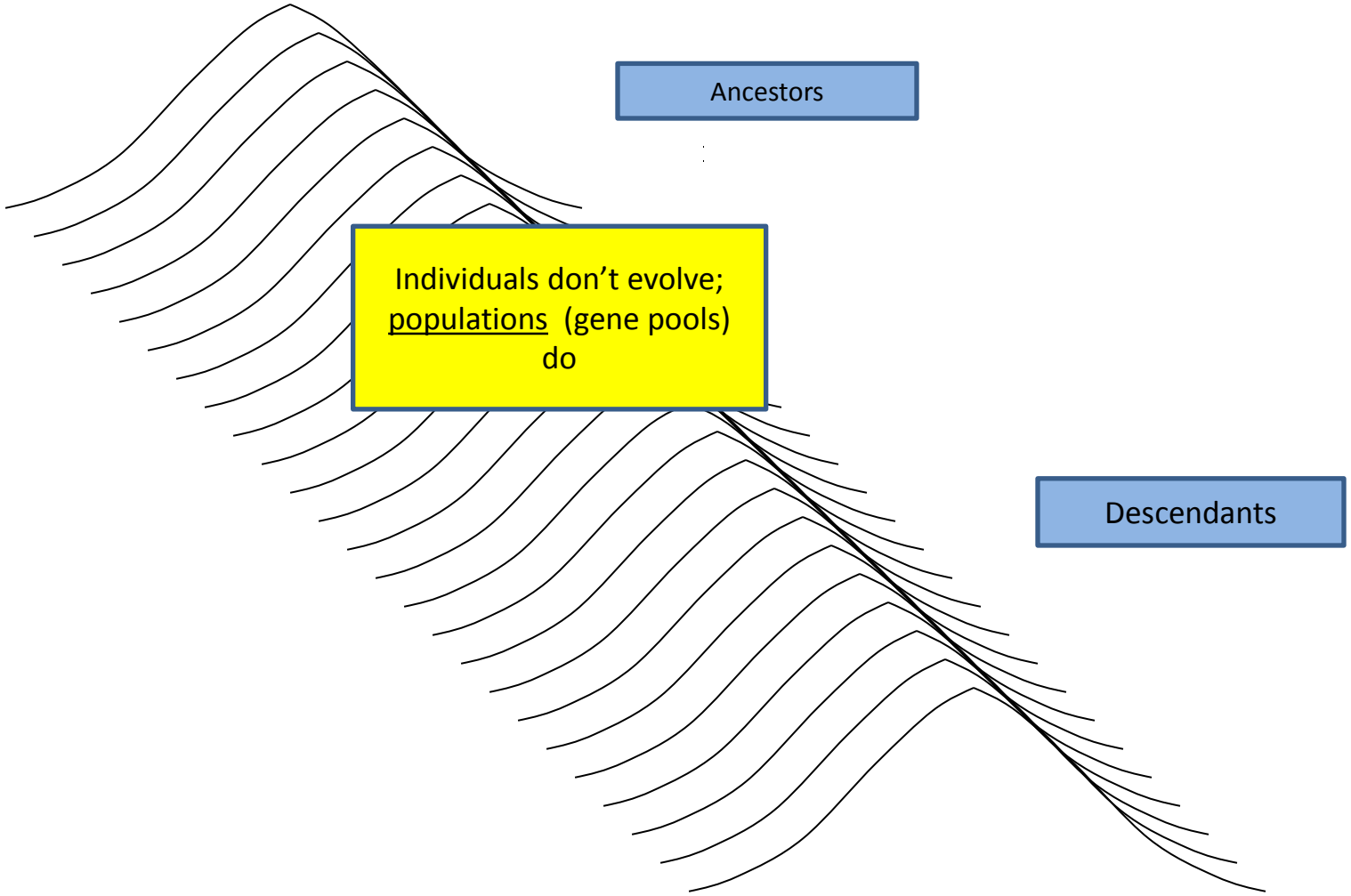


Intelligence evolved in “deprived” environments

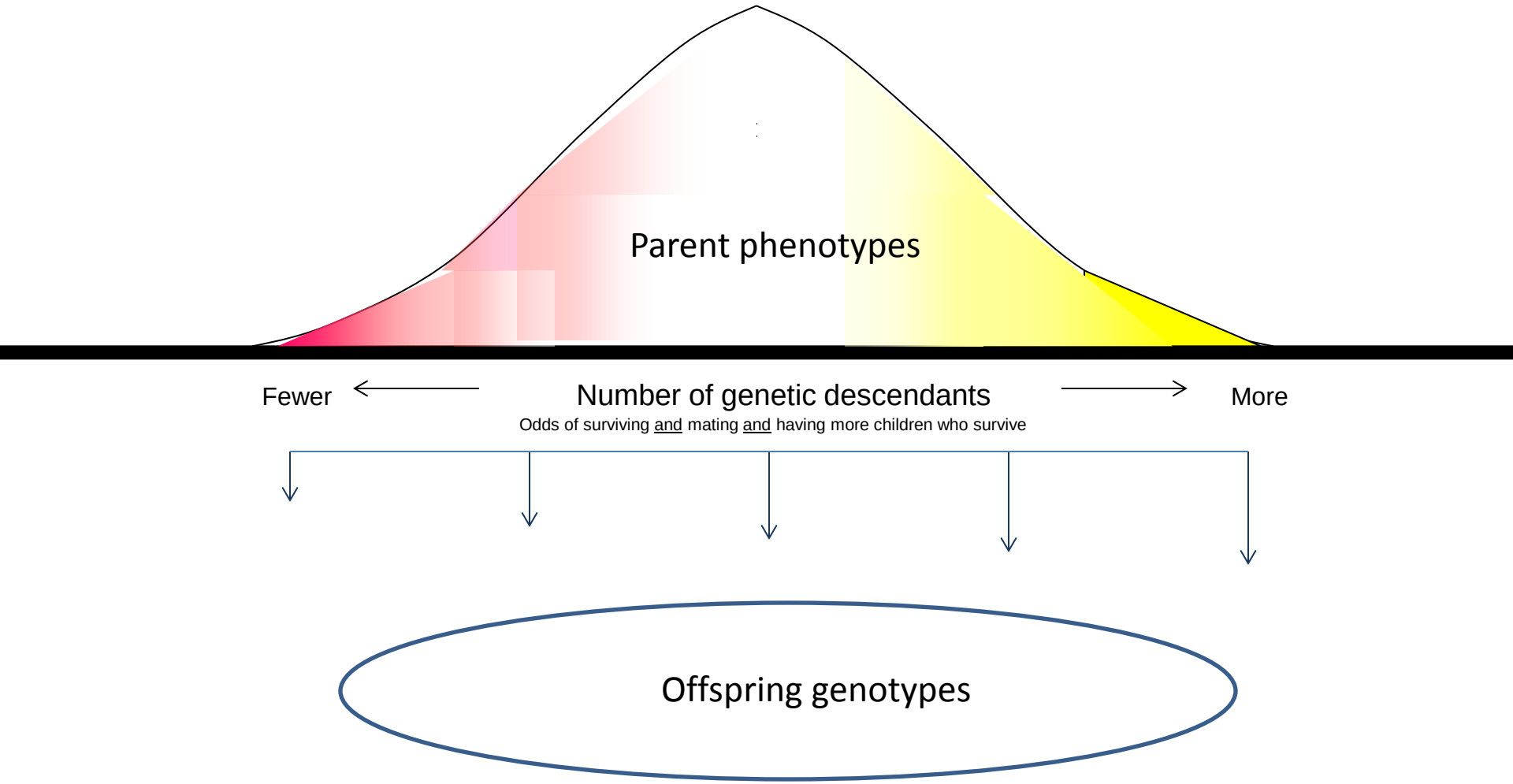
Encephalization quotient (EQ) = brain-to-body size compared to the average mammal



Evolution—
Works by selecting next generation

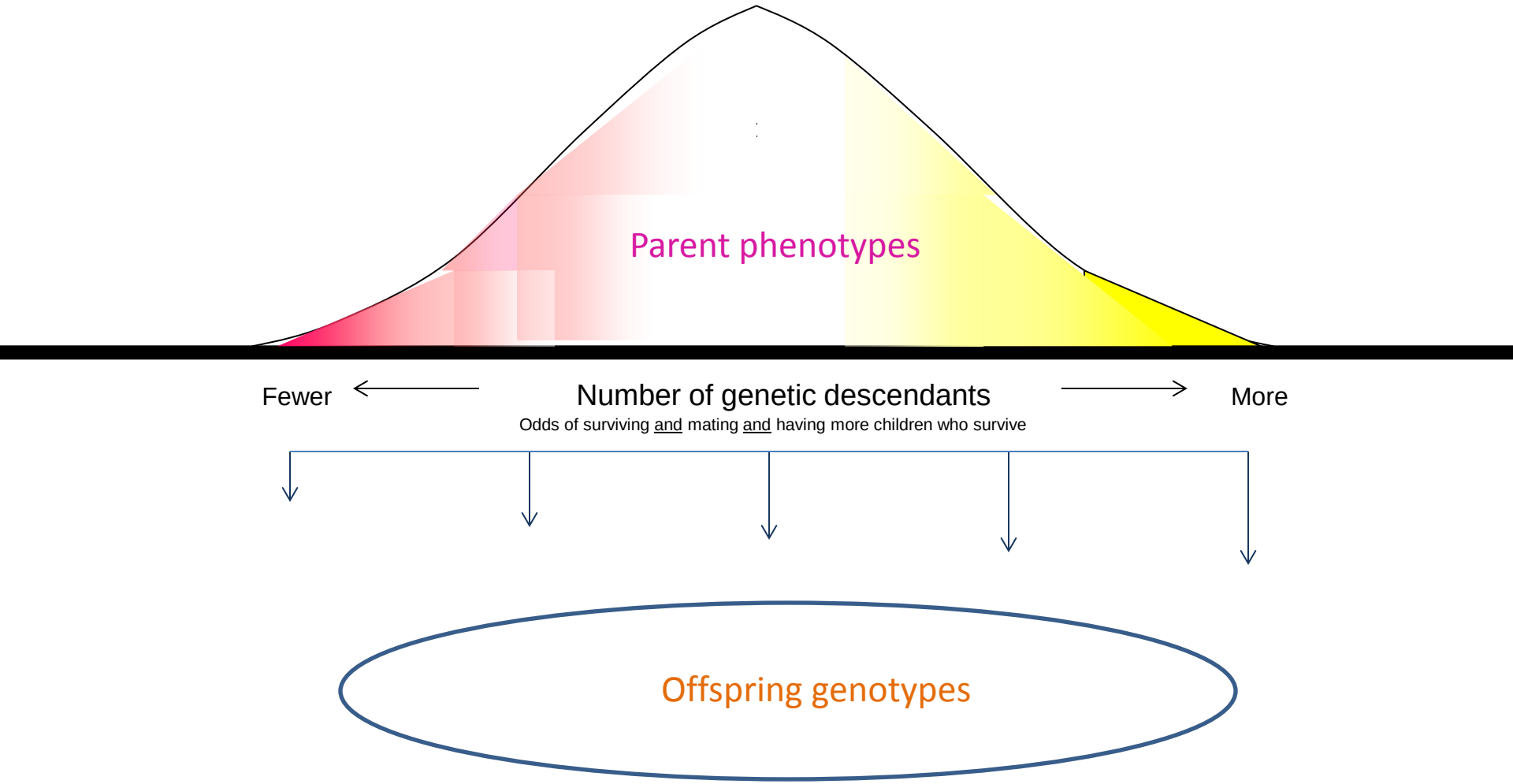


Evolution—Selects by culling parents for the next generation



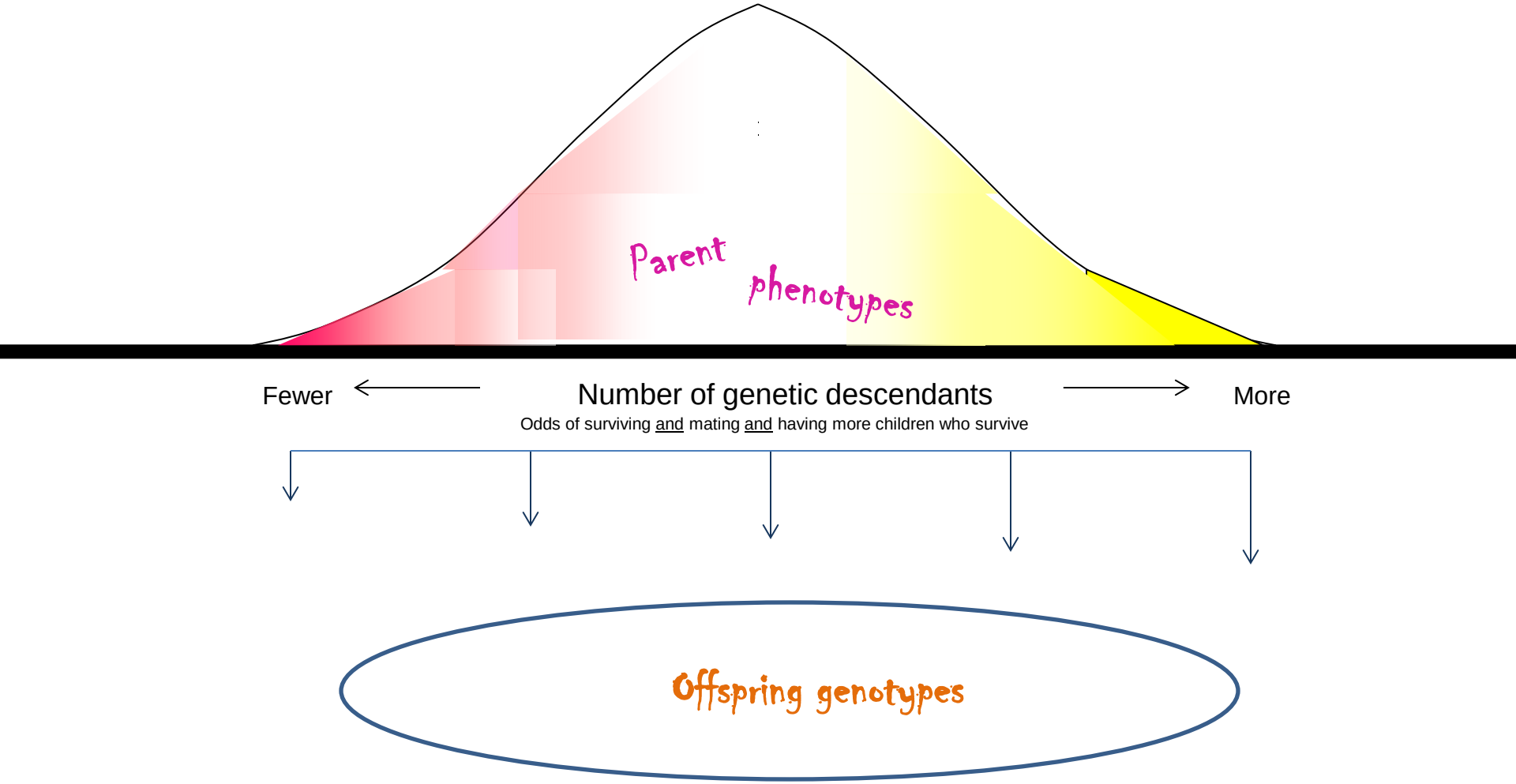
Evolutionary insight #1

- Selection for genetic *g* couldn't have occurred if *g* phenotypes sensitive to deprivation.
- Individual differences in phenotypic *g* not "malleable."



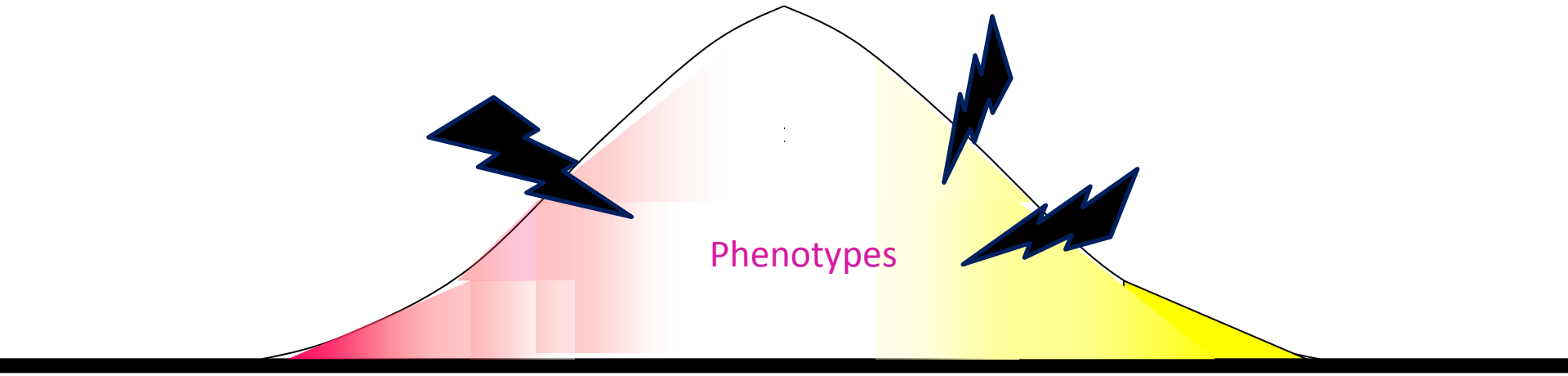
Evolutionary insight #2

- Traits are inherited in correlated sets that reflect evolutionary tradeoffs in a species.
- Can't tinker genetically with one trait (esp. if polygenic) without side-effects.

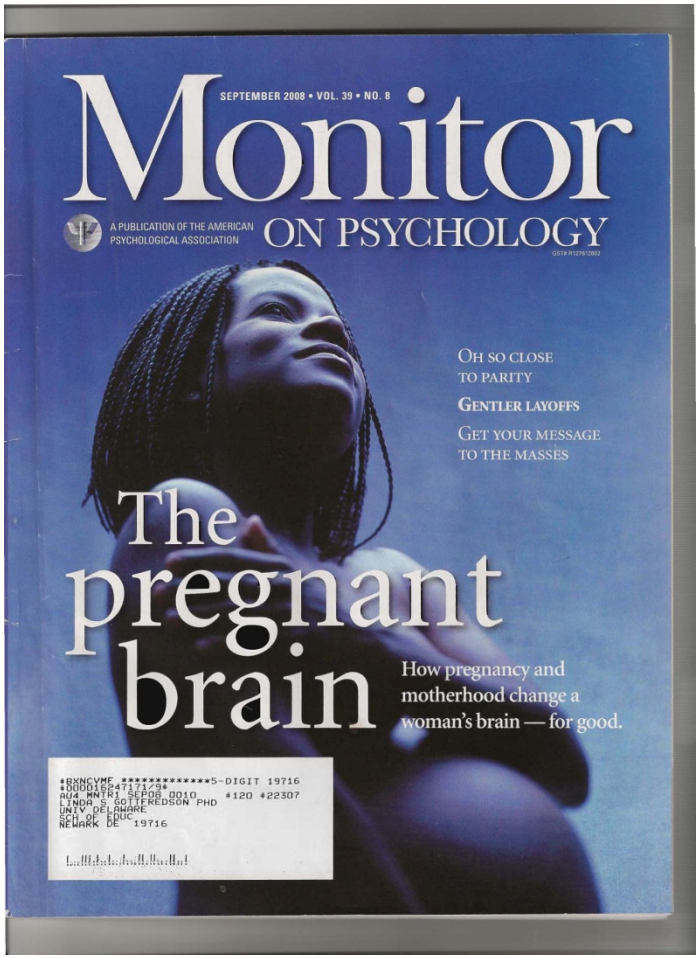


Evolutionary insight #3

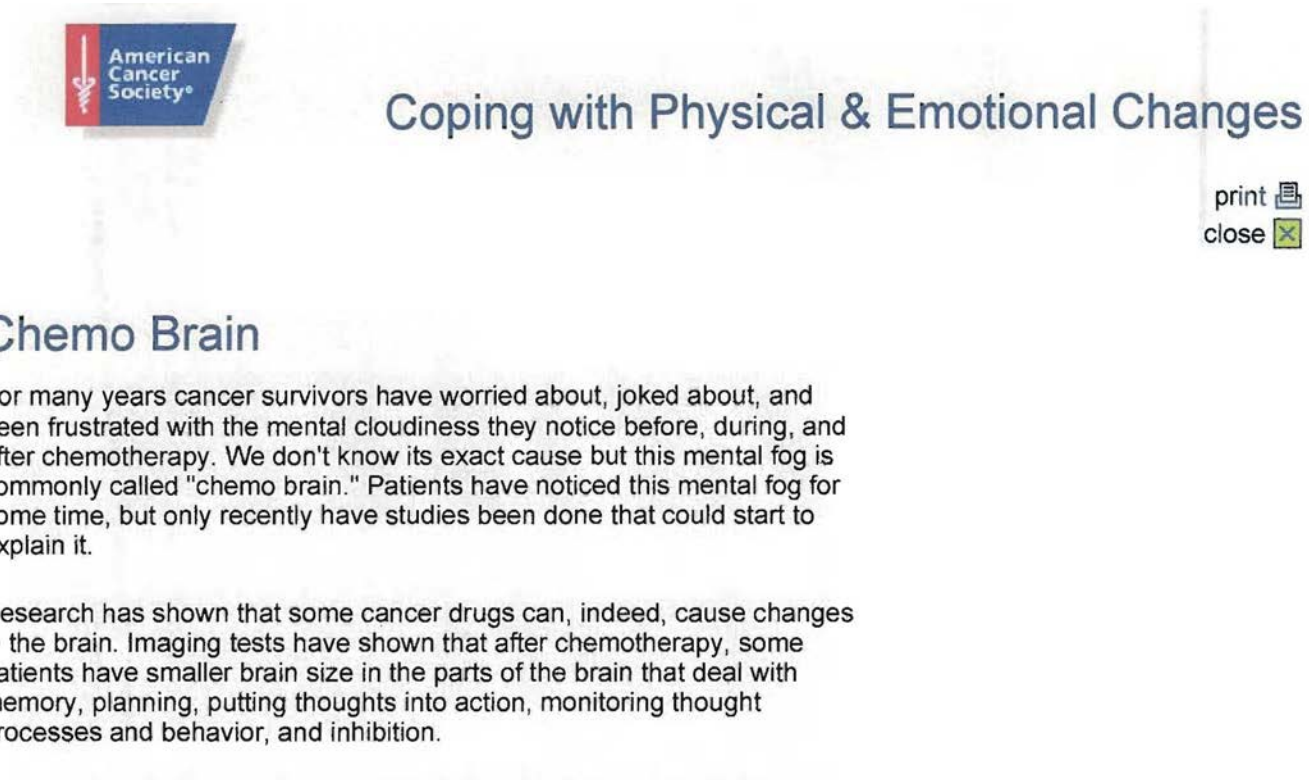
- Humans are resilient to species-typical hardships (robust, resilient, catch-up growth).
- Humans have no evolved protections against novel man-made hazards (PCBs, rich diet).



Species-typical influences on brain



Evolutionarily novel influences on brain



American Cancer Society

Coping with Physical & Emotional Changes

print
close

Chemo Brain

For many years cancer survivors have worried about, joked about, and been frustrated with the mental cloudiness they notice before, during, and after chemotherapy. We don't know its exact cause but this mental fog is commonly called "chemo brain." Patients have noticed this mental fog for some time, but only recently have studies been done that could start to explain it.

Research has shown that some cancer drugs can, indeed, cause changes in the brain. Imaging tests have shown that after chemotherapy, some patients have smaller brain size in the parts of the brain that deal with memory, planning, putting thoughts into action, monitoring thought processes and behavior, and inhibition.

Breastfeeding boosts intelligence?

Health

Breastfeeding boosts intelligence

Publish Date: Mar 08, 2013

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Children who are breastfed are healthier than those who are formula-fed

newvision

LIVE WELL WITH DR. CORY

Researchers have found a connection between breastfeeding and the development of a child's brain. Researchers concluded, in a study of more than 17,000 infants from newborn to 6 ½ years, that prolonged and exclusive breastfeeding improved brain development.

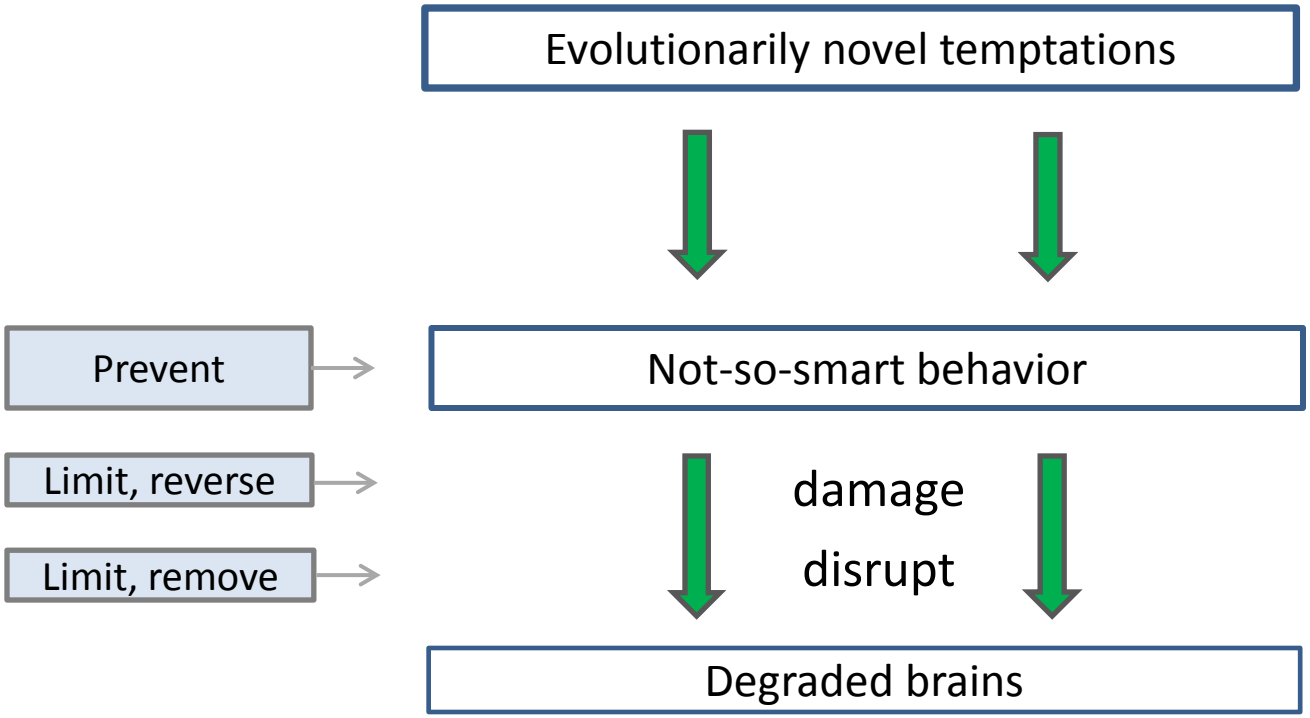
A similar study of nearly 4,000 children showed that babies who were breastfed had significantly higher scores on vocabulary testing at five years of age in comparison with children who were not breastfed. Higher levels were directly correlated with a longer duration of breastfeeding.

Pre-term infants with low-birth weight that received breast milk improved their brain development

No! It's the evolutionary norm.

Not breastfeeding lowers it.

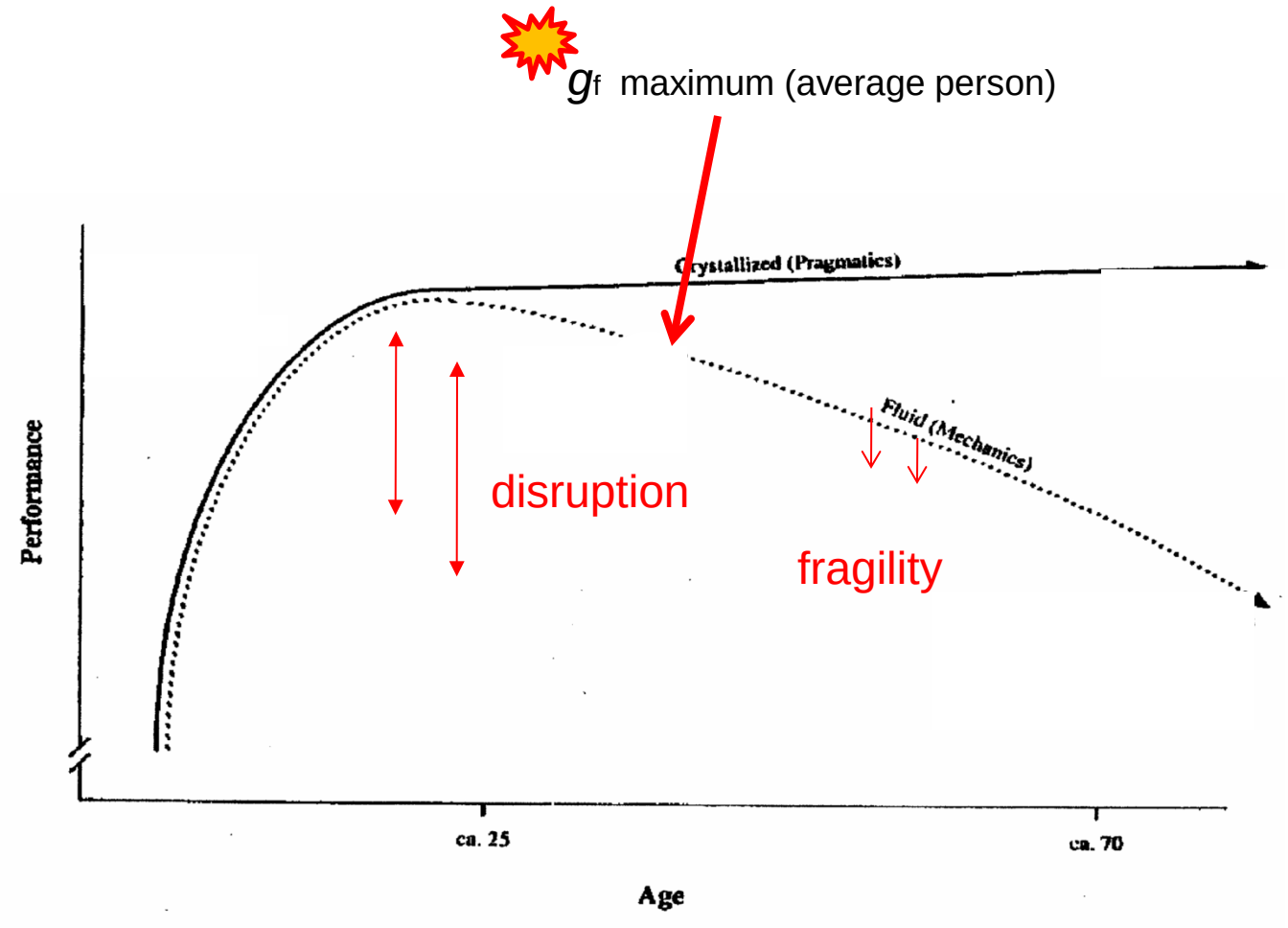
So, might the real challenge be to protect & preserve intelligence?



Evolutionary perspective

1. Suppose individuals have physiological maximum for g
2. And they experience:
   - cognitive disturbances when deploying it
   - threats to integrity of brain
3. Most are evolutionarily novel
4. Most are preventable

Vulnerabilities of *g* across the lifespan

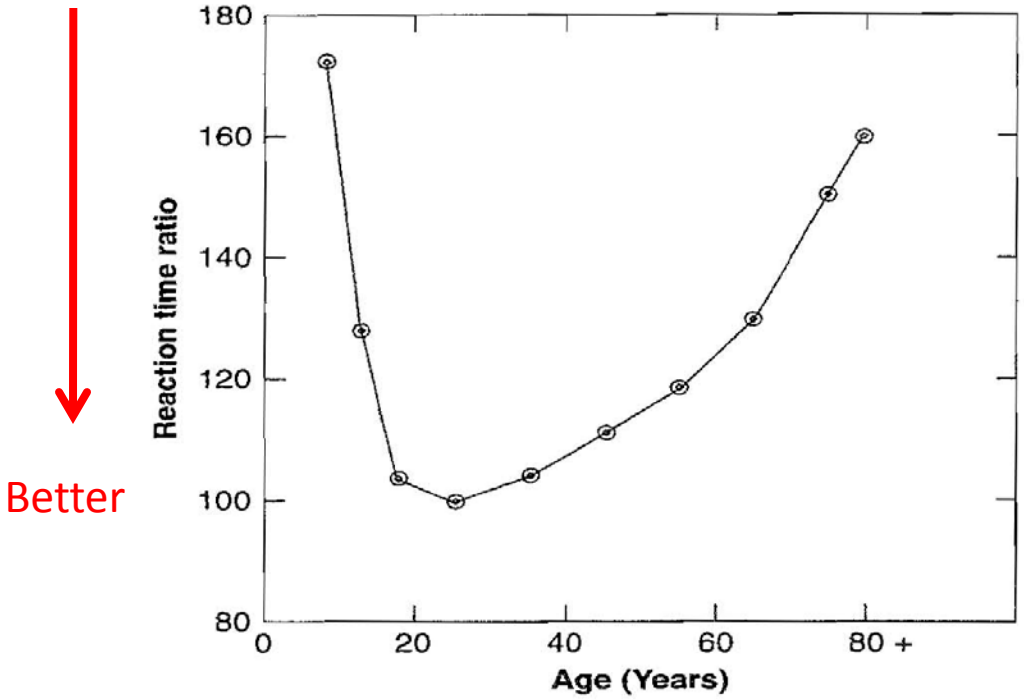


Basic cultural Knowledge (G_C)

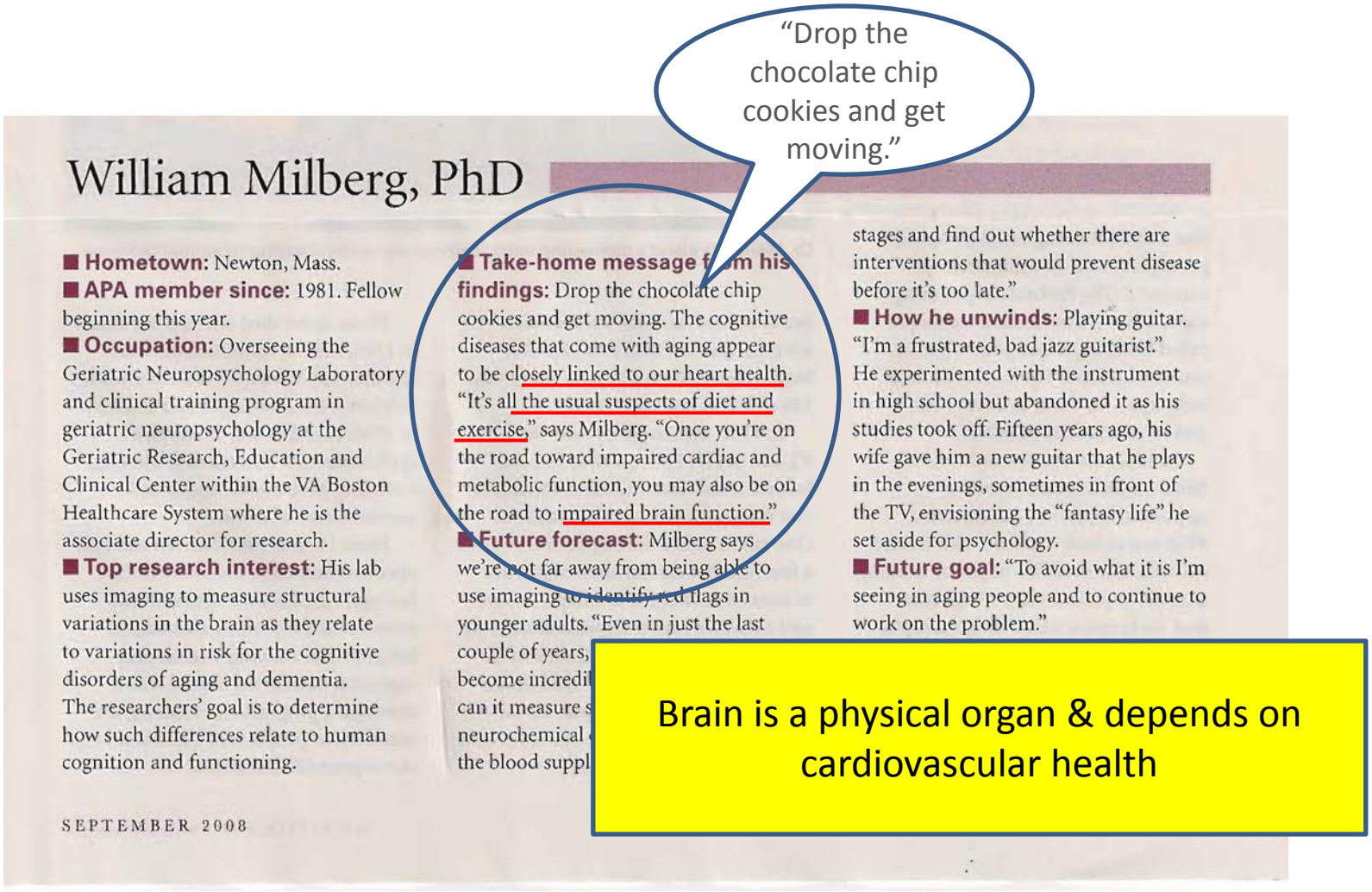
***g* - Basic information processing (G_F)**

Normal effects of aging on brain (reaction time)

78 *Clocking the Mind*



Much excess cognitive decline with age



"Drop the chocolate chip cookies and get moving."

William Milberg, PhD

■ **Hometown:** Newton, Mass.
■ **APA member since:** 1981. Fellow beginning this year.
■ **Occupation:** Overseeing the Geriatric Neuropsychology Laboratory and clinical training program in geriatric neuropsychology at the Geriatric Research, Education and Clinical Center within the VA Boston Healthcare System where he is the associate director for research.
■ **Top research interest:** His lab uses imaging to measure structural variations in the brain as they relate to variations in risk for the cognitive disorders of aging and dementia. The researchers' goal is to determine how such differences relate to human cognition and functioning.

■ **Take-home message from his findings:** Drop the chocolate chip cookies and get moving. The cognitive diseases that come with aging appear to be closely linked to our heart health. "It's all the usual suspects of diet and exercise," says Milberg. "Once you're on the road toward impaired cardiac and metabolic function, you may also be on the road to impaired brain function."
■ **Future forecast:** Milberg says we're not far away from being able to use imaging to identify red flags in younger adults. "Even in just the last couple of years, become incredi can it measure s neurochemical the blood suppl

stages and find out whether there are interventions that would prevent disease before it's too late."
■ **How he unwinds:** Playing guitar. "I'm a frustrated, bad jazz guitarist." He experimented with the instrument in high school but abandoned it as his studies took off. Fifteen years ago, his wife gave him a new guitar that he plays in the evenings, sometimes in front of the TV, envisioning the "fantasy life" he set aside for psychology.
■ **Future goal:** "To avoid what it is I'm seeing in aging people and to continue to work on the problem."

SEPTEMBER 2008

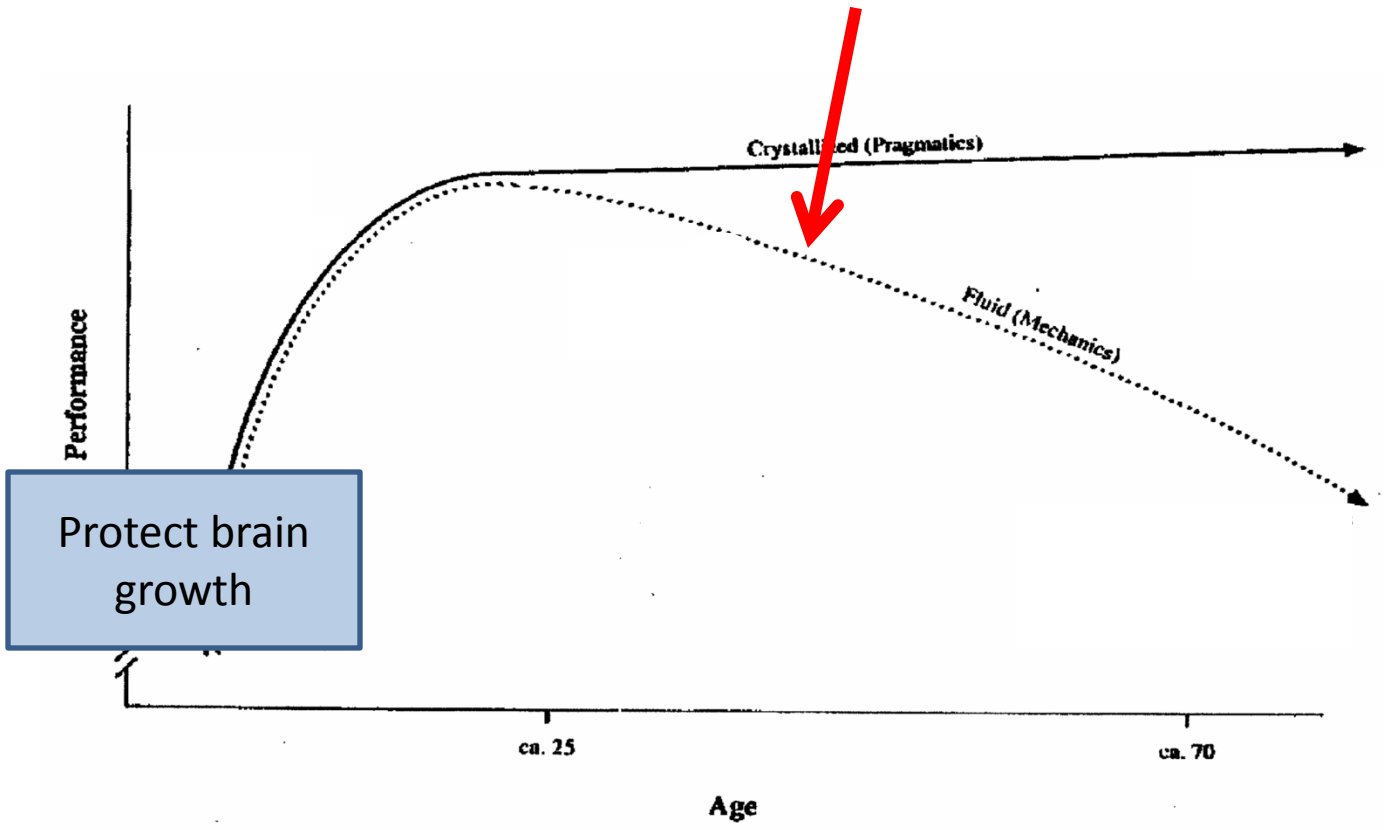
Brain is a physical organ & depends on cardiovascular health

Monitor on Psychology, September, 2008, p. 23

The good news—impairment preventable

Opportunities

g_f maximum (average person)

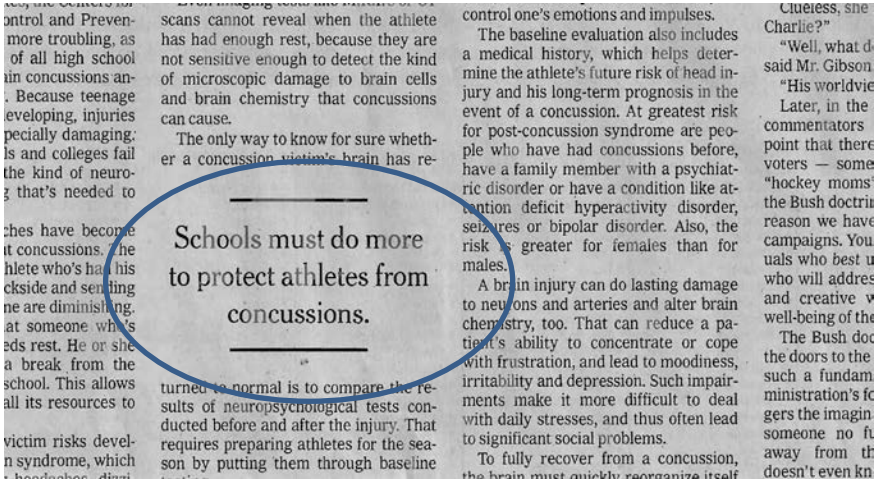


Protect brain growth

Basic cultural Knowledge (G_C)

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

Accumulation of preventable injuries

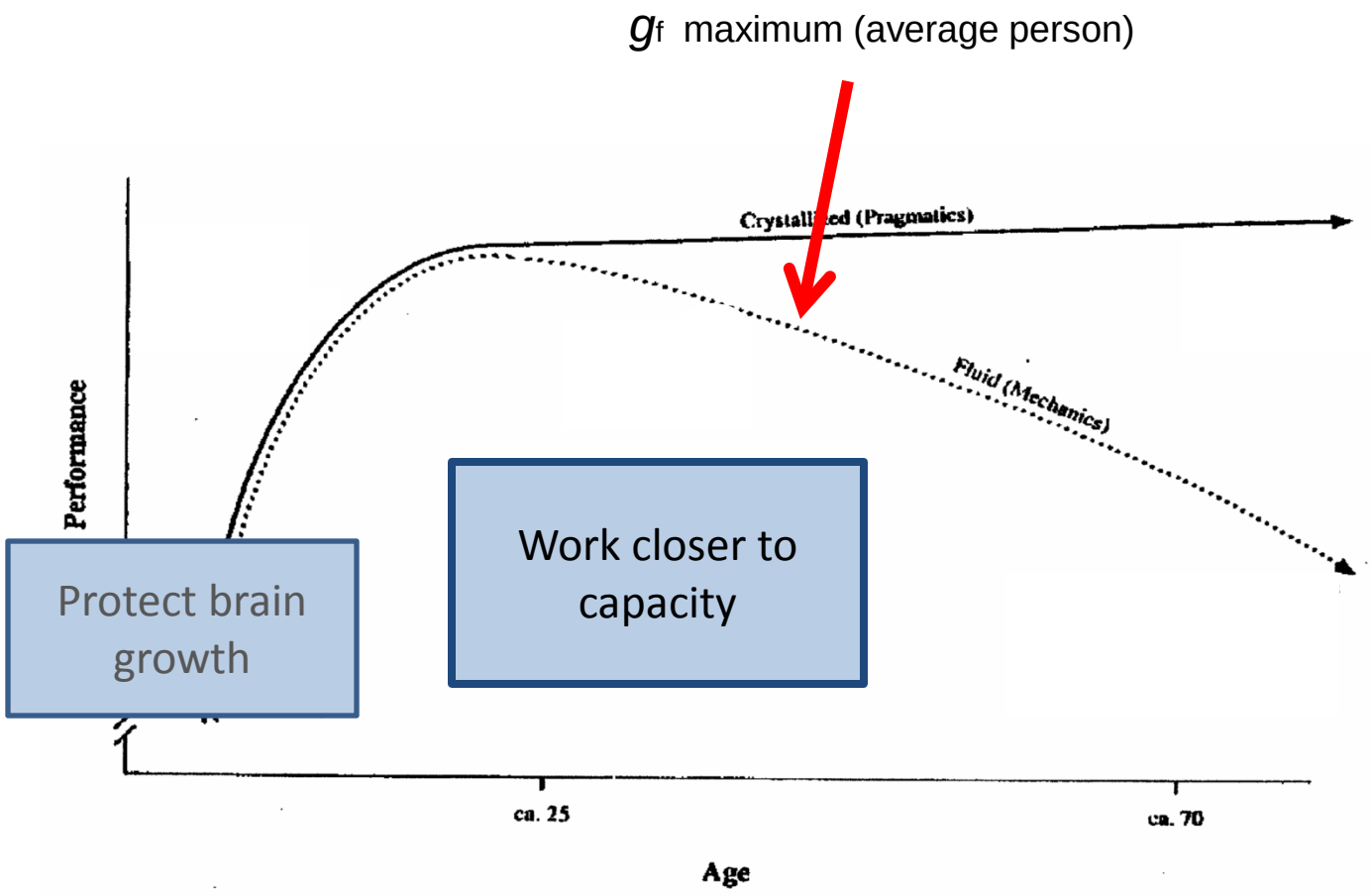


Schools must do more to protect athletes from concussions.

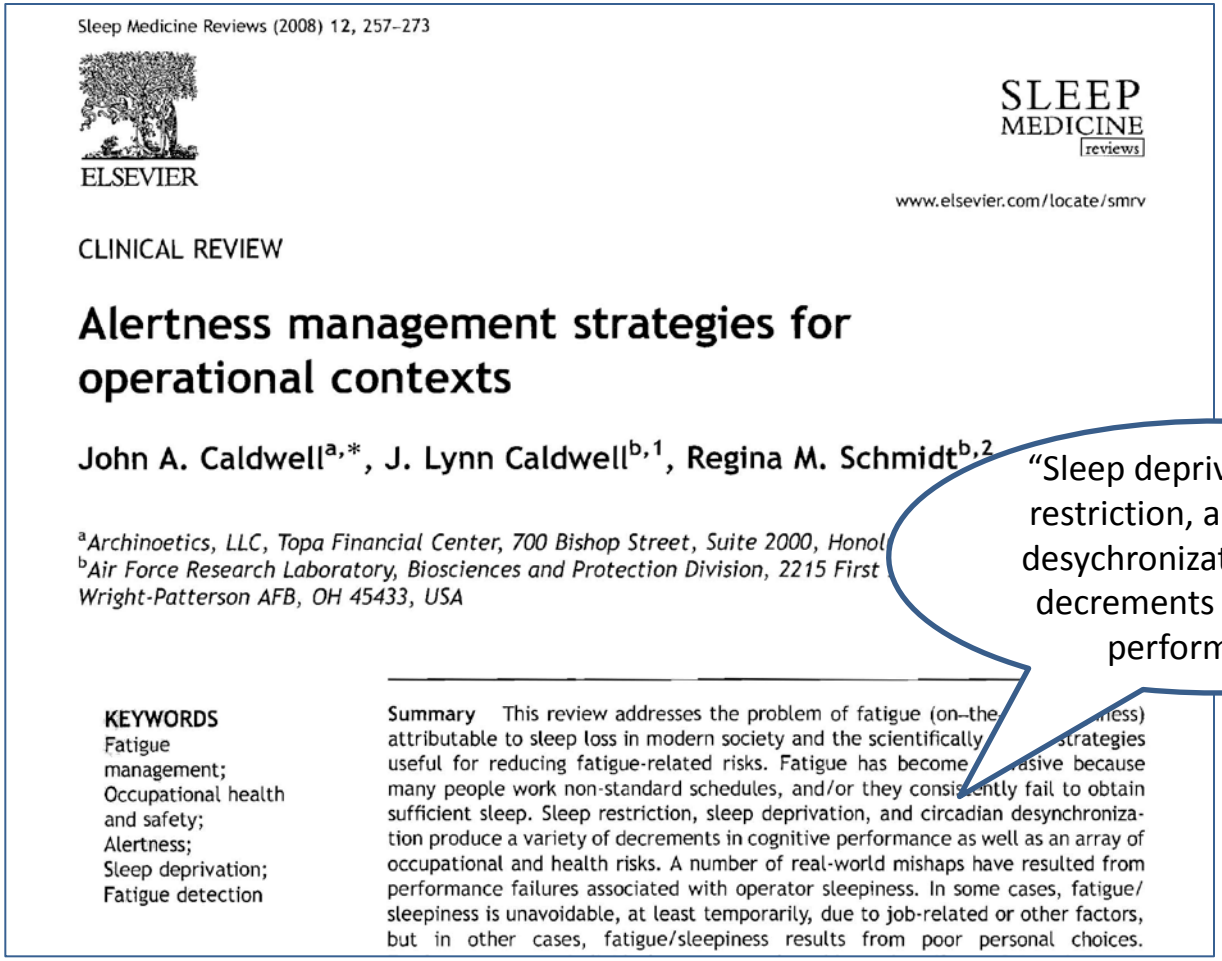
New York Times, 9/13/08, p. A19

Negligent infliction of devastating damage

Opportunities



Respect circadian rhythms, sleep needs



Sleep Medicine Reviews (2008) 12, 257–273

ELSEVIER

SLEEP MEDICINE reviews

www.elsevier.com/locate/smrv

CLINICAL REVIEW

Alertness management strategies for operational contexts

John A. Caldwell[a,*], J. Lynn Caldwell[b,1], Regina M. Schmidt[b,2]

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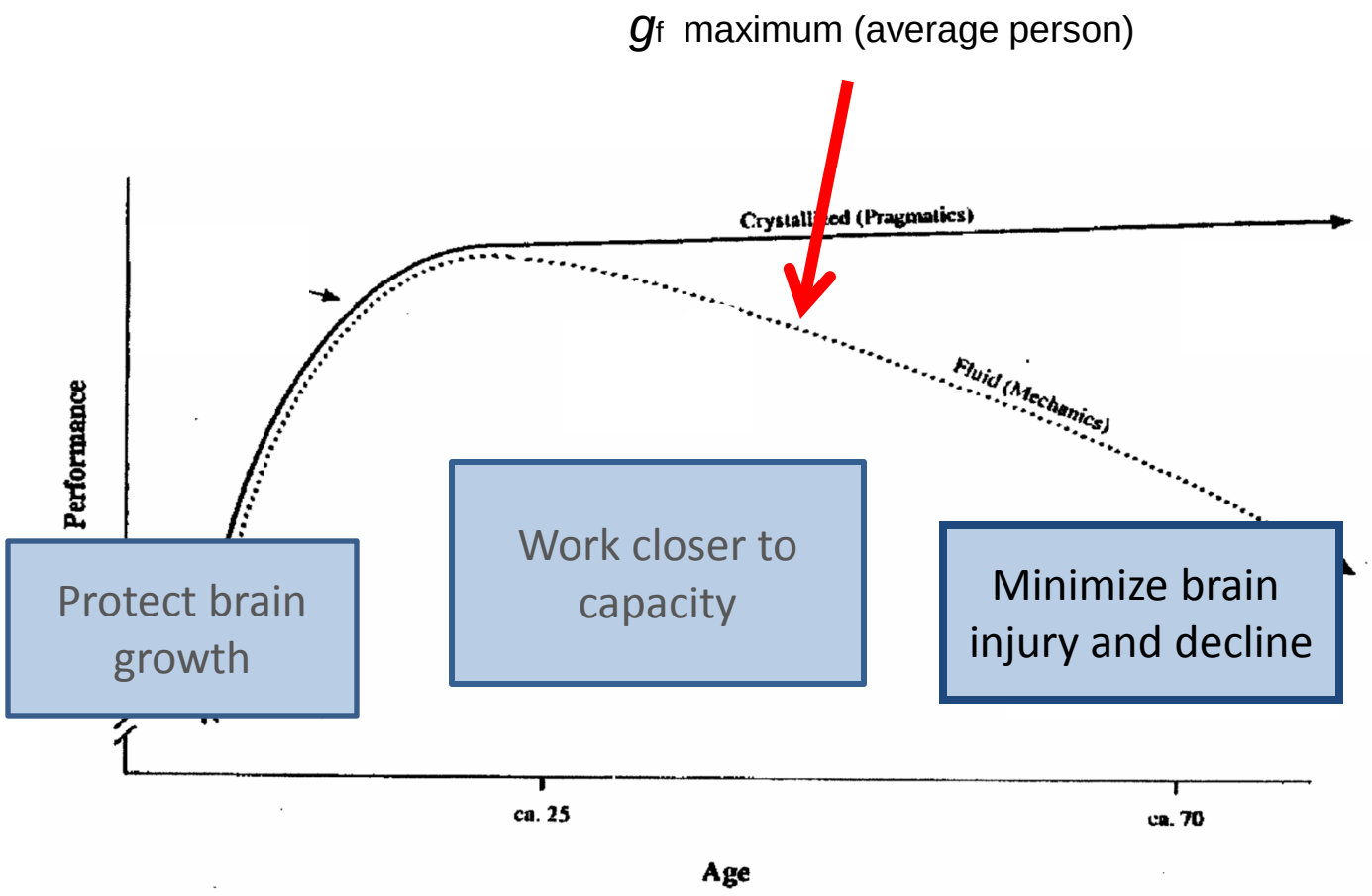
Wright-Patterson AFB, OH 45433, USA

KEYWORDS
Fatigue management;
Occupational health and safety;
Alertness;
Sleep deprivation;
Fatigue detection

Summary This review addresses the problem of fatigue (on–the …ness) attributable to sleep loss in modern society and the scientifically …strategies useful for reducing fatigue-related risks. Fatigue has become …asive because many people work non-standard schedules, and/or they consi…ently fail to obtain sufficient sleep. Sleep restriction, sleep deprivation, and circadian desynchronization produce a variety of decrements in cognitive performance as well as an array of occupational and health risks. A number of real-world mishaps have resulted from performance failures associated with operator sleepiness. In some cases, fatigue/sleepiness is unavoidable, at least temporarily, due to job-related or other factors, but in other cases, fatigue/sleepiness results from poor personal choices.

"Sleep deprivation, sleep restriction, and circadian desychronization produce decrements in cognitive performance."

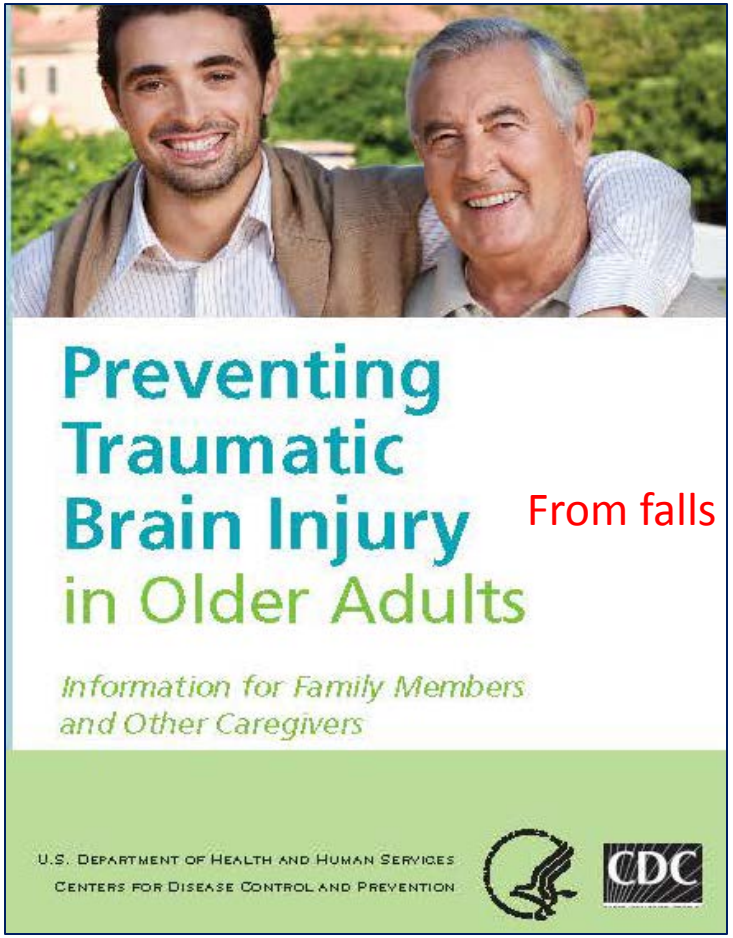
Opportunities



Basic cultural Knowledge (G_C)

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

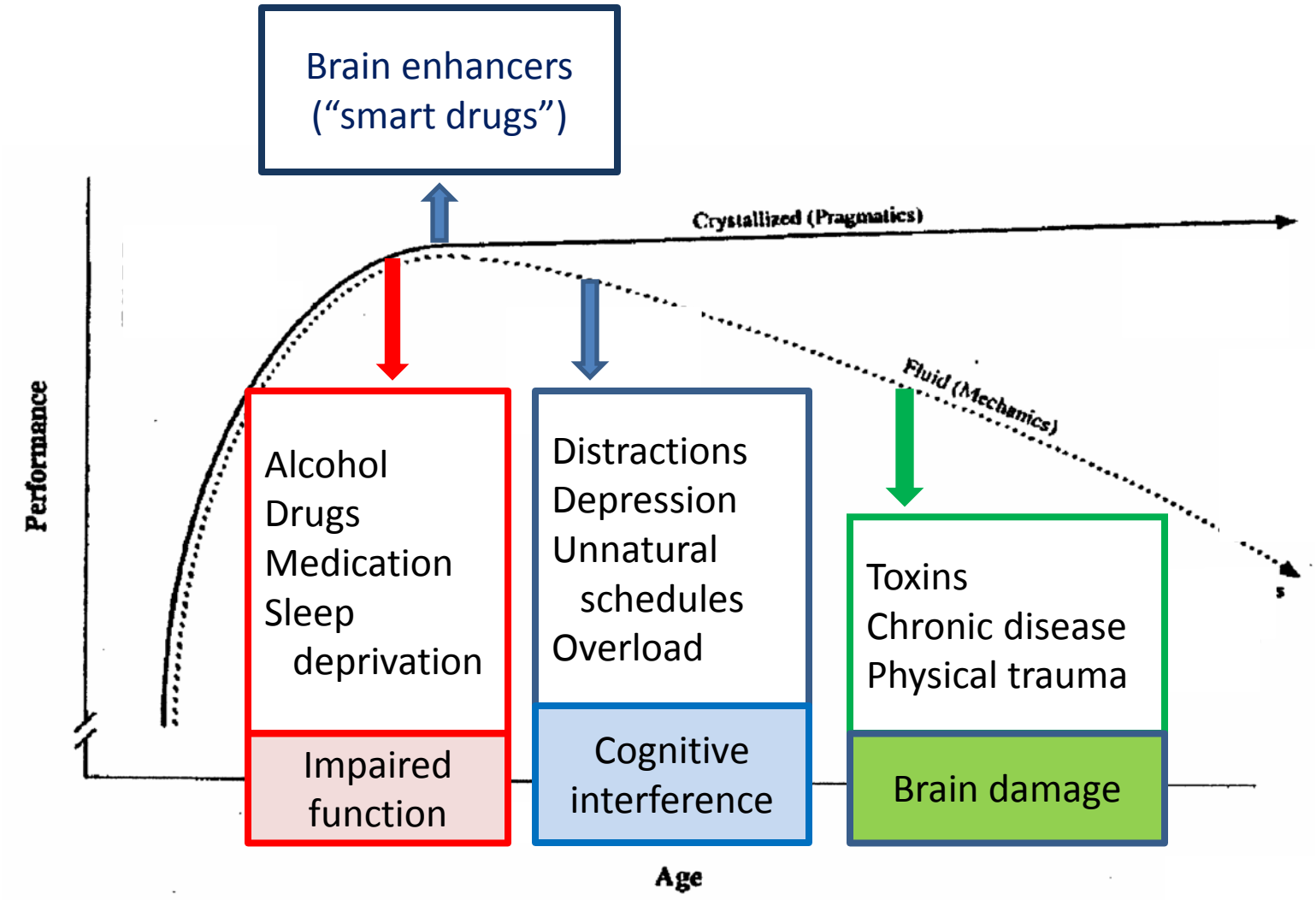
Be alert to (novel) hazards: stairs, rugs, furniture and fixtures with hard surfaces



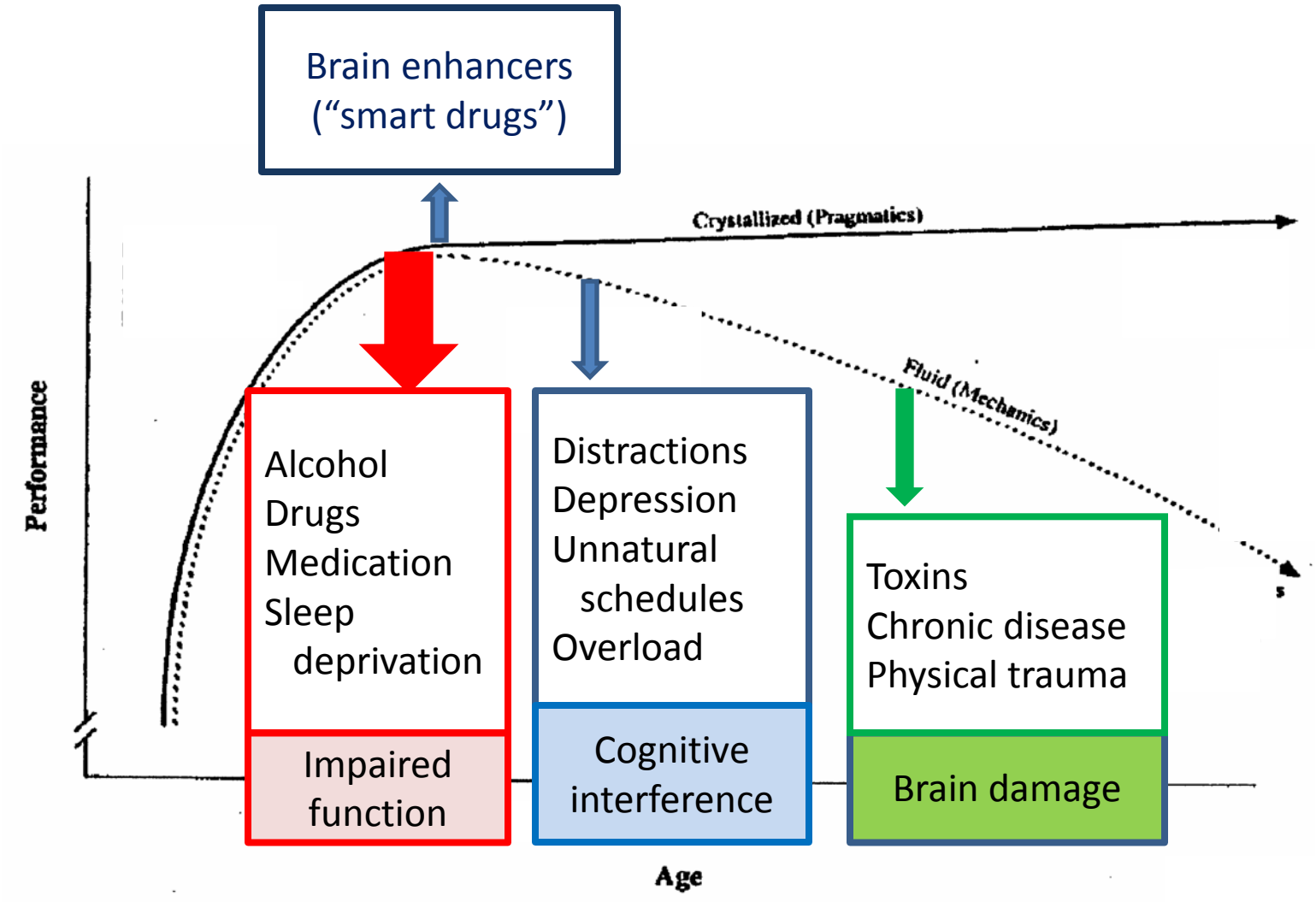
From falls

More good news—usually
in individual's power to control

Behavior matters



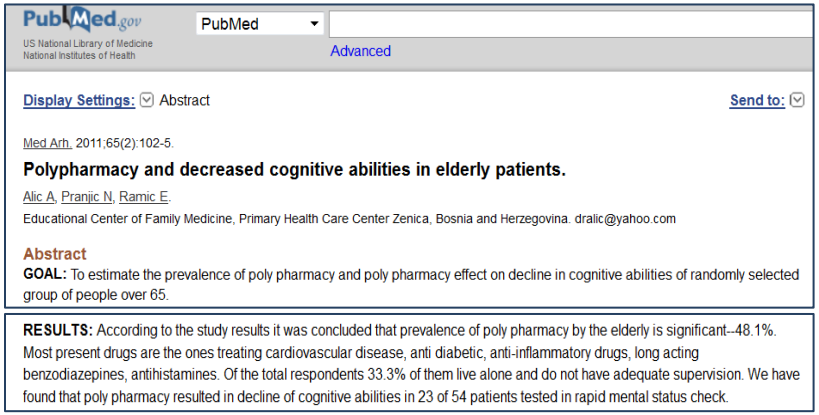
Especially with evolutionarily novel hazards

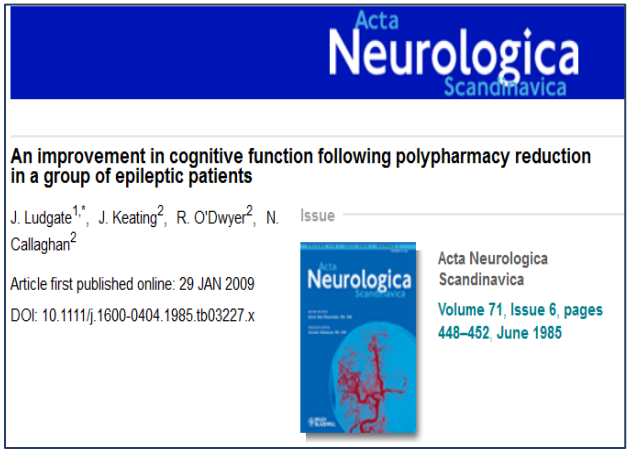


Medication

Confusion & drowsiness

Polypharmacy





Sleep deprivation

Pilot Fatigue Spurs Renewed Calls For Safeguards, Shorter Flying Times

By Andy Pasztor And Susan Carey

Safety experts and regulators have long been concerned about the dangers of exhausted, overworked or downright sleepy pilots. But the problem is intensifying as financially strapped airlines try to squeeze more productivity out of pilots, who by most measures are log-

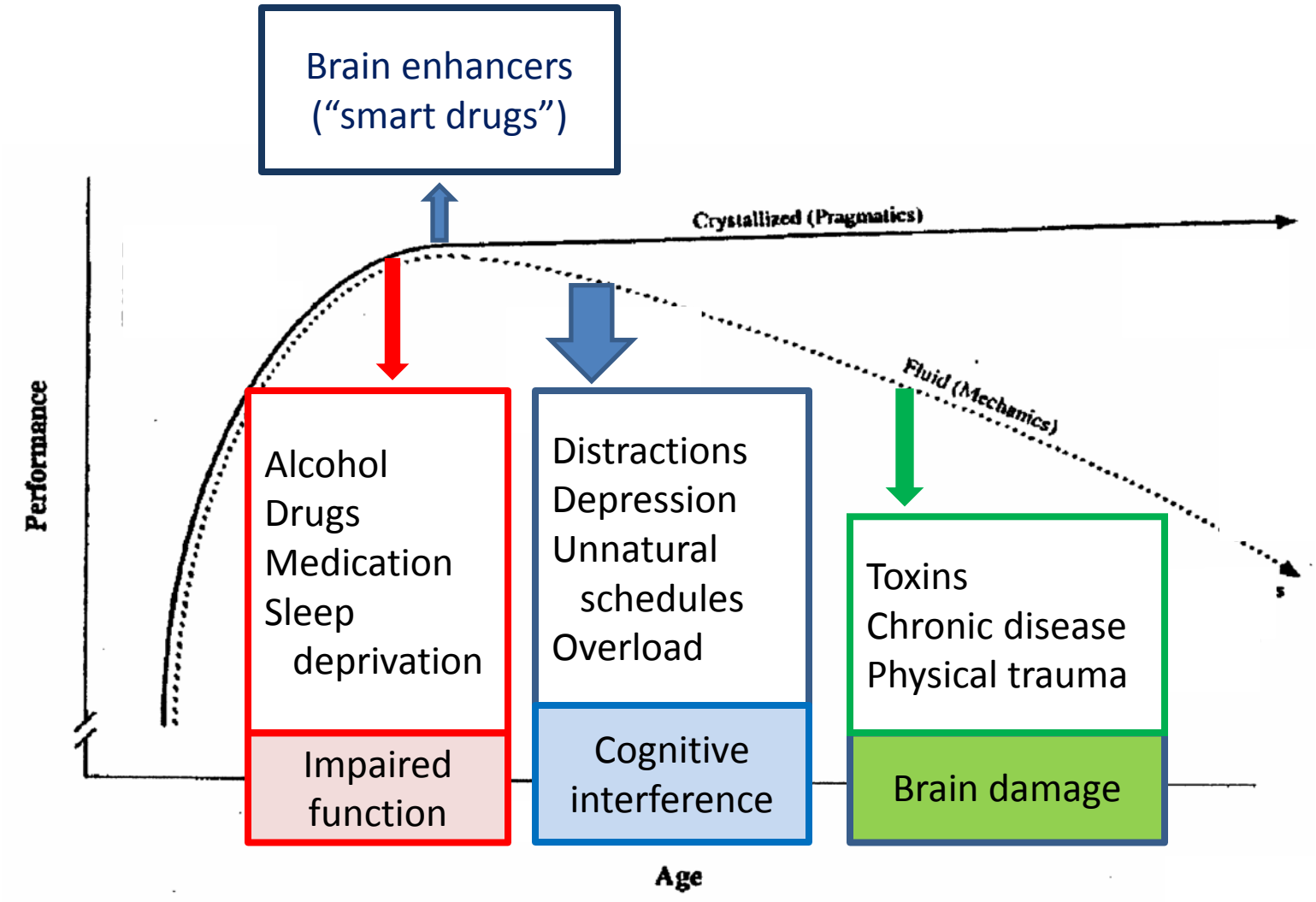
manageable on paper often don't account for storms, air-traffic congestion or other potential delays that can make a long work day longer. In July, according to the latest government statistics, 19 U.S. airlines saw one quarter of all their flights, on average, arrive late by more than 15 minutes. And pilots say certain airlines schedule flight times at or just under eight hours—the FAA-mandated

After working more than 12 hours in a row—inside and out of the cockpit—error rates shoot up, complacency increases and communications become impaired, says Peter Demitry, a former test pilot and fatigue expert who consults for pilot groups. One symptom of fatigue that scientists are now studying is "micro sleep," when pilots become unresponsive for

Wall Street Journal, 9/12/08, p. A1

“This is your brain on drugs” (1980)

New forms of cognitive interference



Novel work schedules

September 10, 2012

Too tired for school? Science on teens' side

Sleep experts say many Maine high schools start classes too early in the day for teenagers.

By SUSAN MCMILLAN Kennebec Journal

AUGUSTA - Cony High School sophomore Shaun Gallagher has had a year to adjust to starting school at 7:10 a.m.

But he's not there yet.

"Sometimes I'll just randomly have lots of energy, but some days I'm really sluggish and not really awake until 10:30," he said.

Although they're twins, Shaun's brother, Noah, said he's a morning person and feels ready to go at the first bell. "But I know that a lot of my friends complain about the schedule still," Noah said.

Shift Work Disorder

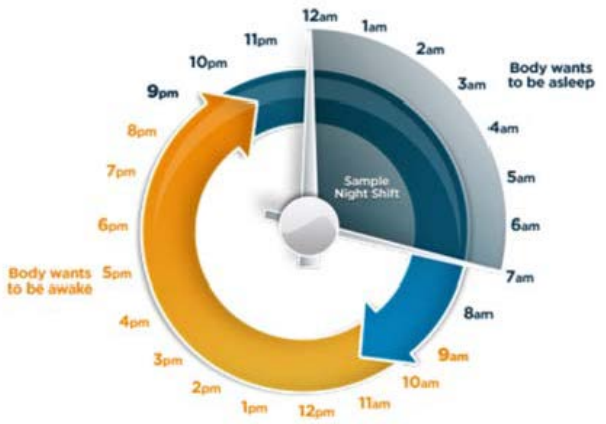
About Shift Work Disorder (SWD)

Shift work disorder is a medical condition that can be diagnosed and treated by a doctor[1-4]

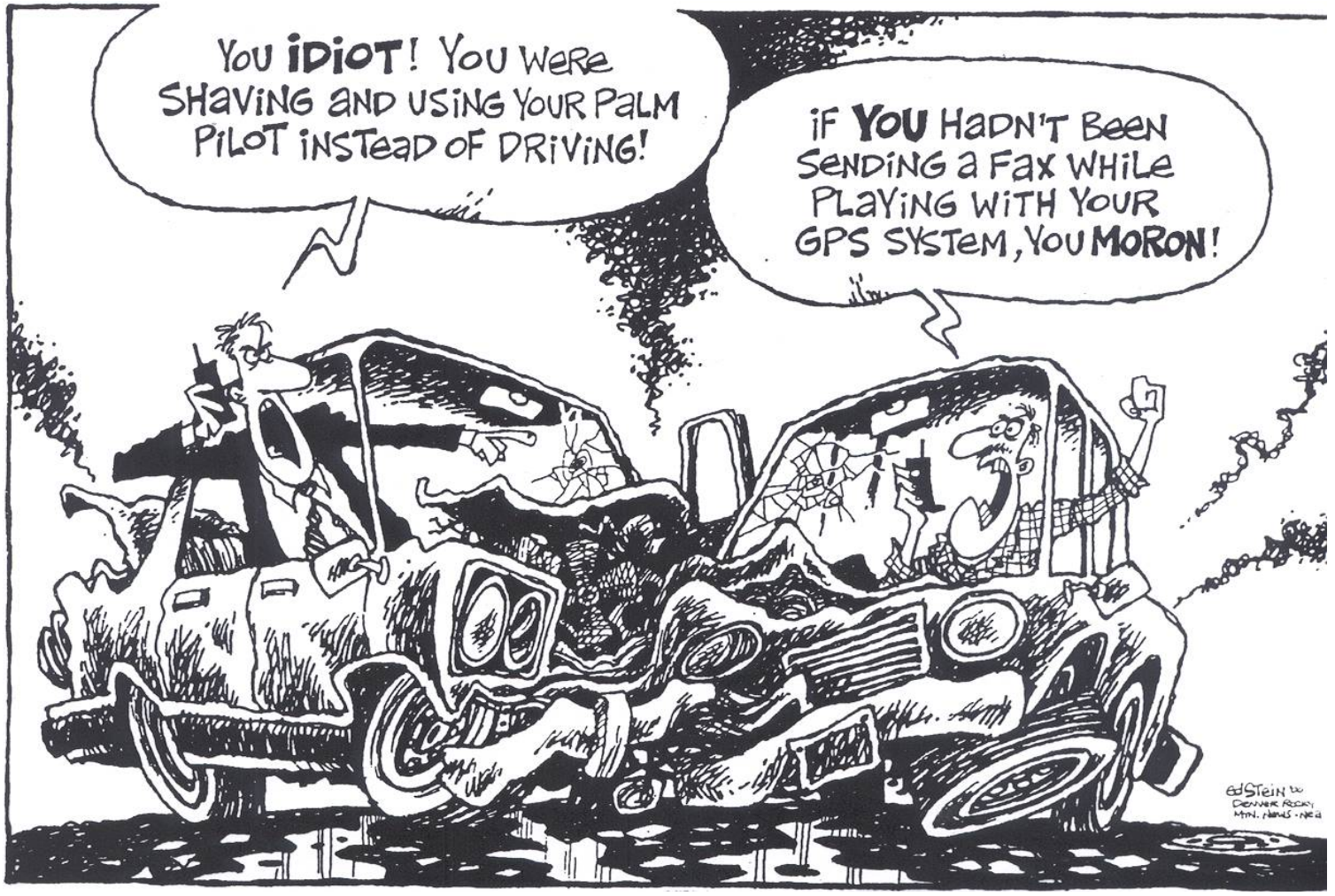
SWD occurs when your work schedule is out of sync with your body's internal sleep-wake clock — your body is telling you to go to sleep when your work schedule needs you to stay awake.

If you work non-traditional hours and struggle to stay awake at work, you may be experiencing **excessive sleepiness (ES)** due to SWD.

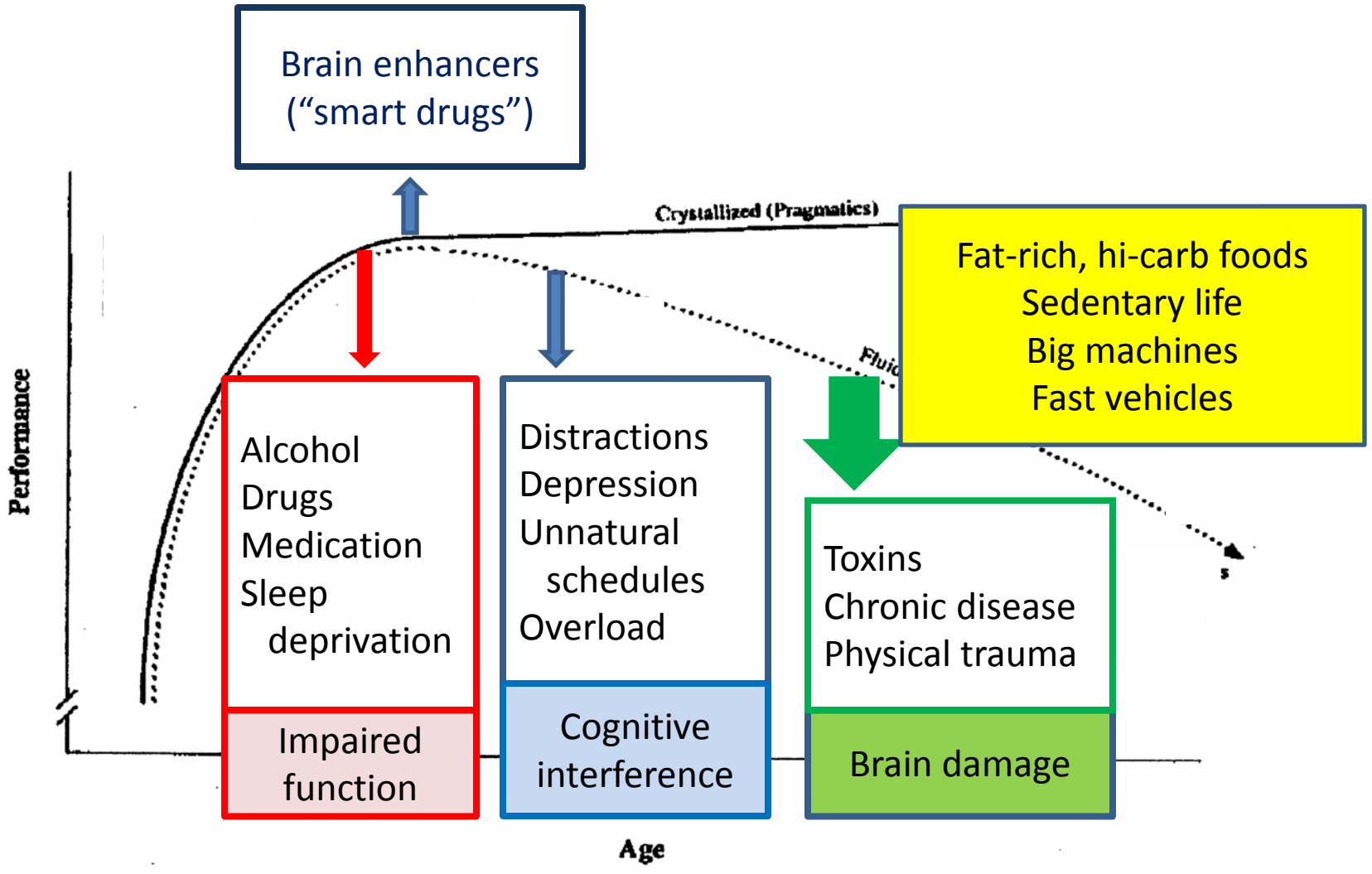
Model of the Sleep-Wake Cycle[1]



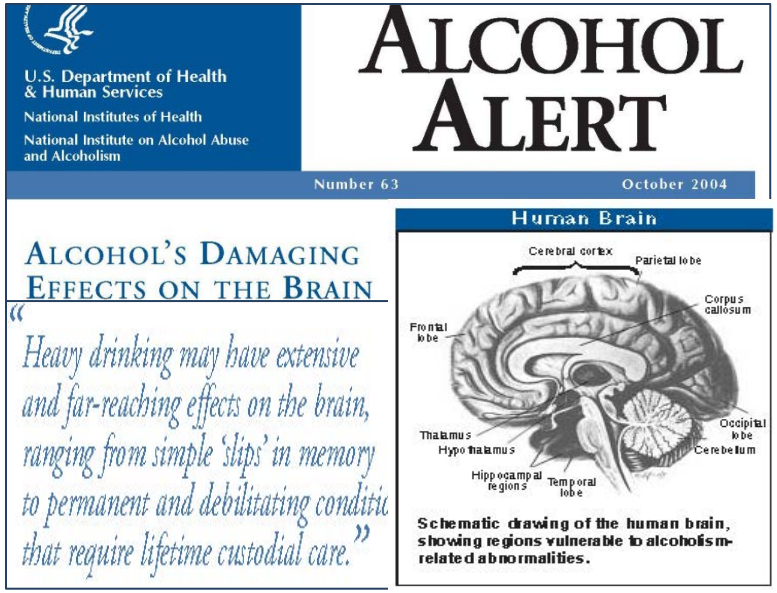
Disrupted attention



Novel indulgences



Evolutionarily novel in quantity & proof



U.S. Department of Health & Human Services
National Institutes of Health
National Institute on Alcohol Abuse and Alcoholism

ALCOHOL ALERT

Number 63 October 2004

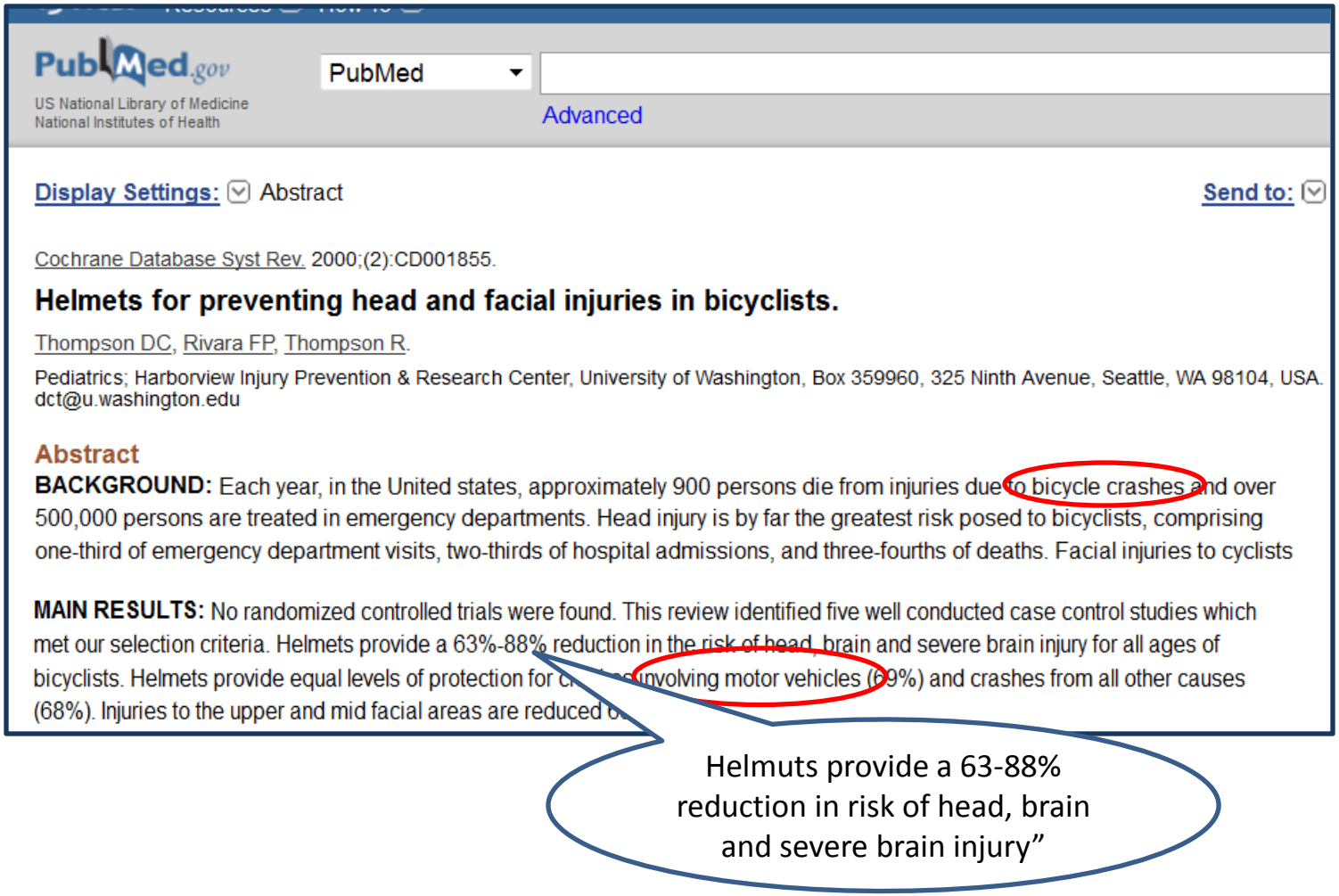
ALCOHOL'S DAMAGING EFFECTS ON THE BRAIN

"*Heavy drinking may have extensive and far-reaching effects on the brain, ranging from simple 'slips' in memory to permanent and debilitating conditio that require lifetime custodial care.*"

Human Brain

Schematic drawing of the human brain, showing regions vulnerable to alcoholism-related abnormalities.

Novel hazards: Fast-moving vehicles and hard obstructions



Chronic diseases of modernity—all preventable

Novel hazard—smoking
Disease—Chronic Obstructive Pulmonary Disease

SCIENCE BLOG

COPD increases risk of developing cerebral microbleeds

July 19, 2013 8:46am

Chronic obstructive pulmonary disease COPD is associated with an increased risk of developing cerebral microbleeds, according to a new study from researchers in the Netherlands.

New York Times

"increased risk of developing cerebral microbleeds"

Novel hazard—chronic carbohydrate overload
Disease—Diabetes Type 2

Study: Diabetes Linked to Cognitive Decline

By Alice Park | Monday, Jan. 05, 2009

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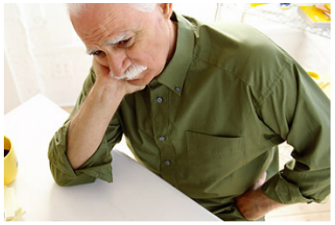
Diabetes can take a toll on the body, taxing the heart, circulation, the kidneys and even the eyes. Now it's becoming clear that the disease may affect the brain as well, contributing to a decline in mental functioning.



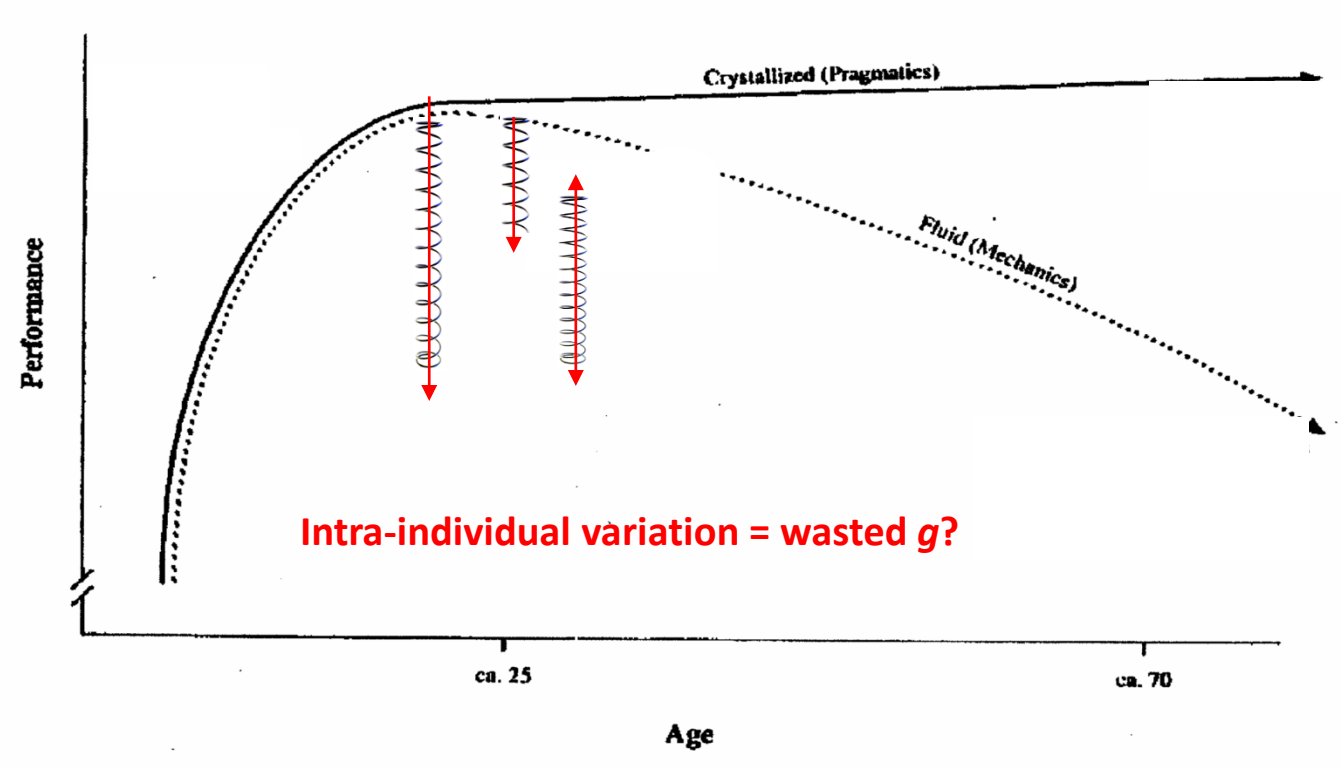
Studies have shown that diabetes may speed up aging-related deficits in mental function and lead to a twofold increase in the risk of dementia. Some researchers

Time Magazine

How could it <u>not</u> affect the brain!

Evolutionary guidance on “raising” intelligence

1. Tighter focus
   - Protect the max (brain damage) & limit excursions below it (impaired function & interference)

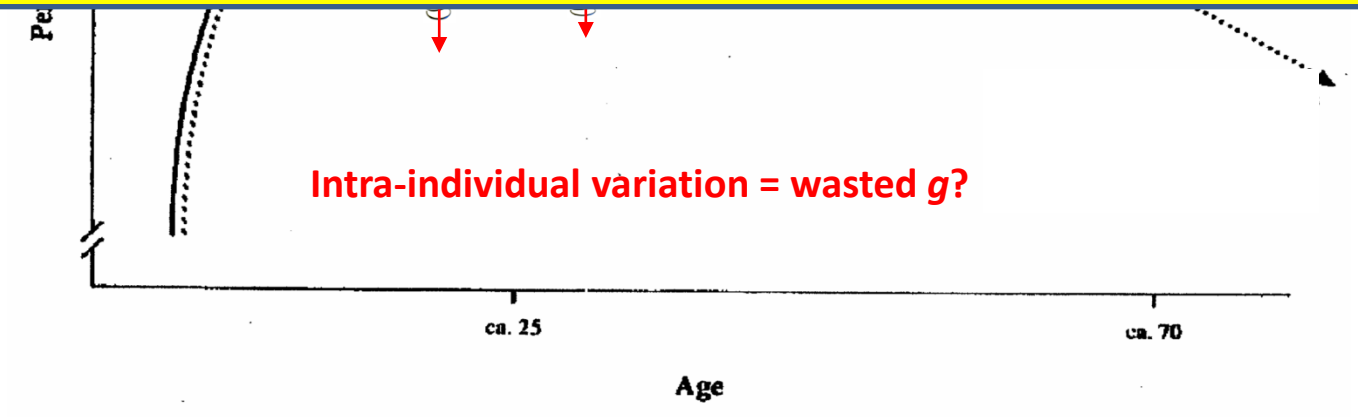


Basic cultural Knowledge (G_C)

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

Evolutionary guidance on “raising” intelligence

1. Tighter focus
   - Protect the max (brain damage) & limit excursions below it (impaired function & interference)
   - Focus on evolutionarily novel tasks & temptations (environments are malleable)
2. Measurement challenges:
   - Measure deviations from person’s own max, not someone else’s
   - Measure evo-novel environs
3. Other opportunities—theoretical predictions, e.g.:
   - What now puts all genotypes at greater risk
   - What puts some genotypes at particular risk (more vulnerable)



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

Thank you.