

Evolutionary Perspective on Raising Intelligence

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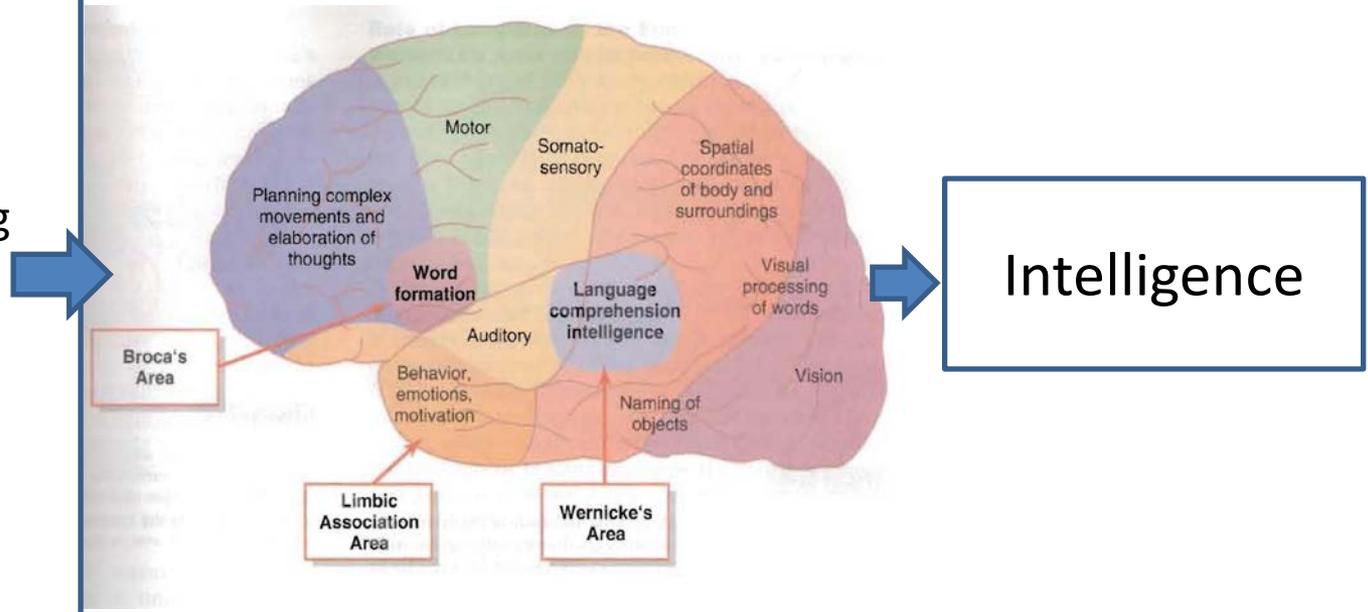
July 22, 2013
International Society for the Study of Individual Differences (ISSID)
Barcelona, Spain

Preview

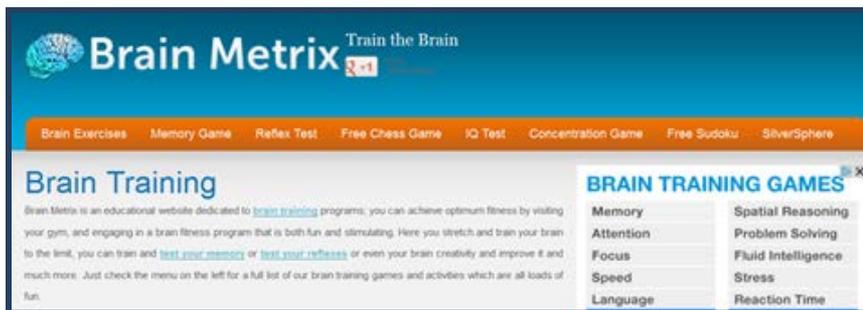
1. Brain booster enthusiasms
 - Brain enhancement!
 - Better environments!
2. Evolution says “Posh! How’d you humans get so smart without them, eh?”
3. And, “What about all the novel ways you *damage* your intelligence?”
4. Get smart! Stop the drop.

Enthusiasms in raising intelligence

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



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

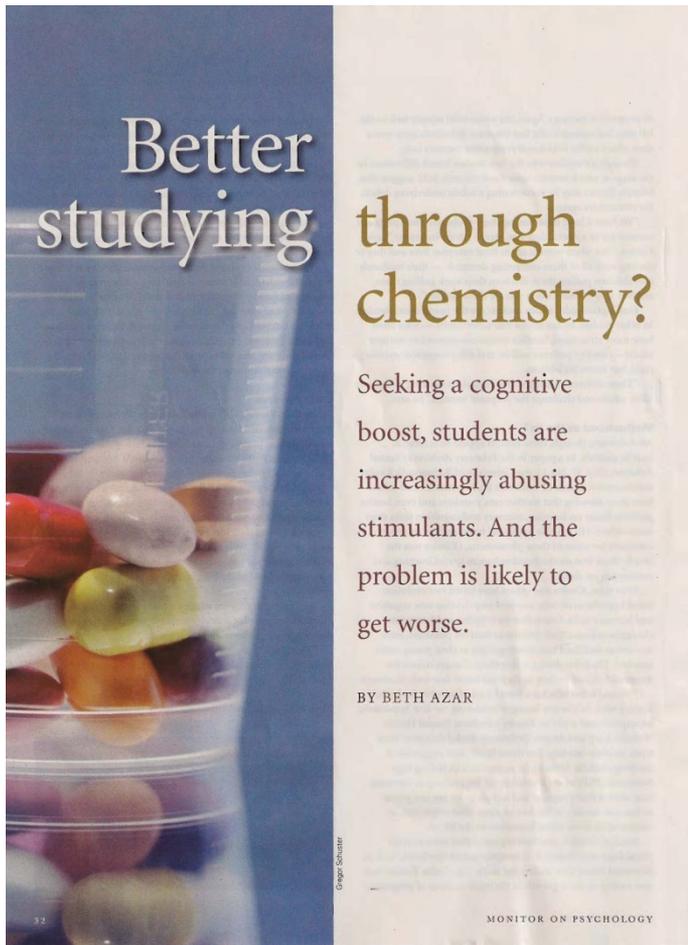
The video describes the Abecedarian Project - how underprivileged children can have increased intelligence and cognitive learning ability when their education starts very early in their lives.

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

“But we keep getting our heart broken.”

Doug Detterman, ISIR 2012

Cognitive enhancers



“It’s a brave new world”

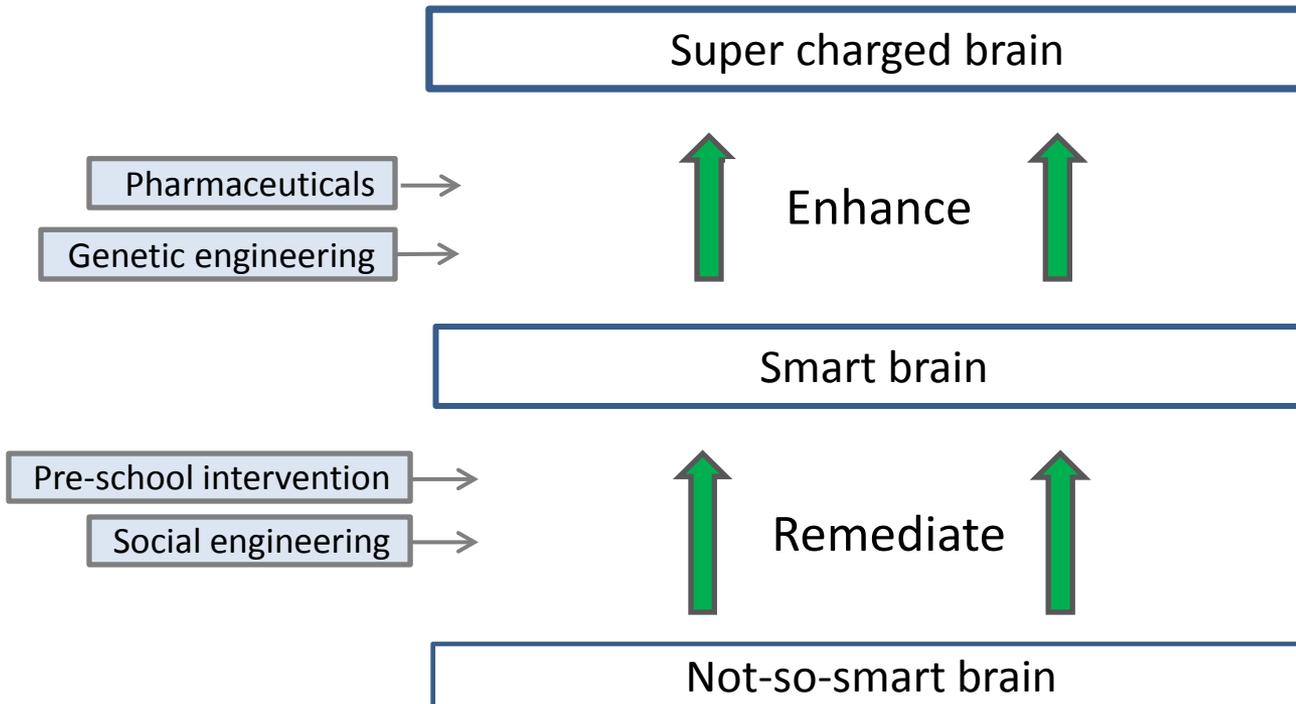
Before—

- caffeine
- ephedrine-based drugs

Now—

- Ritalin
- Adderall
- Modafinil

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

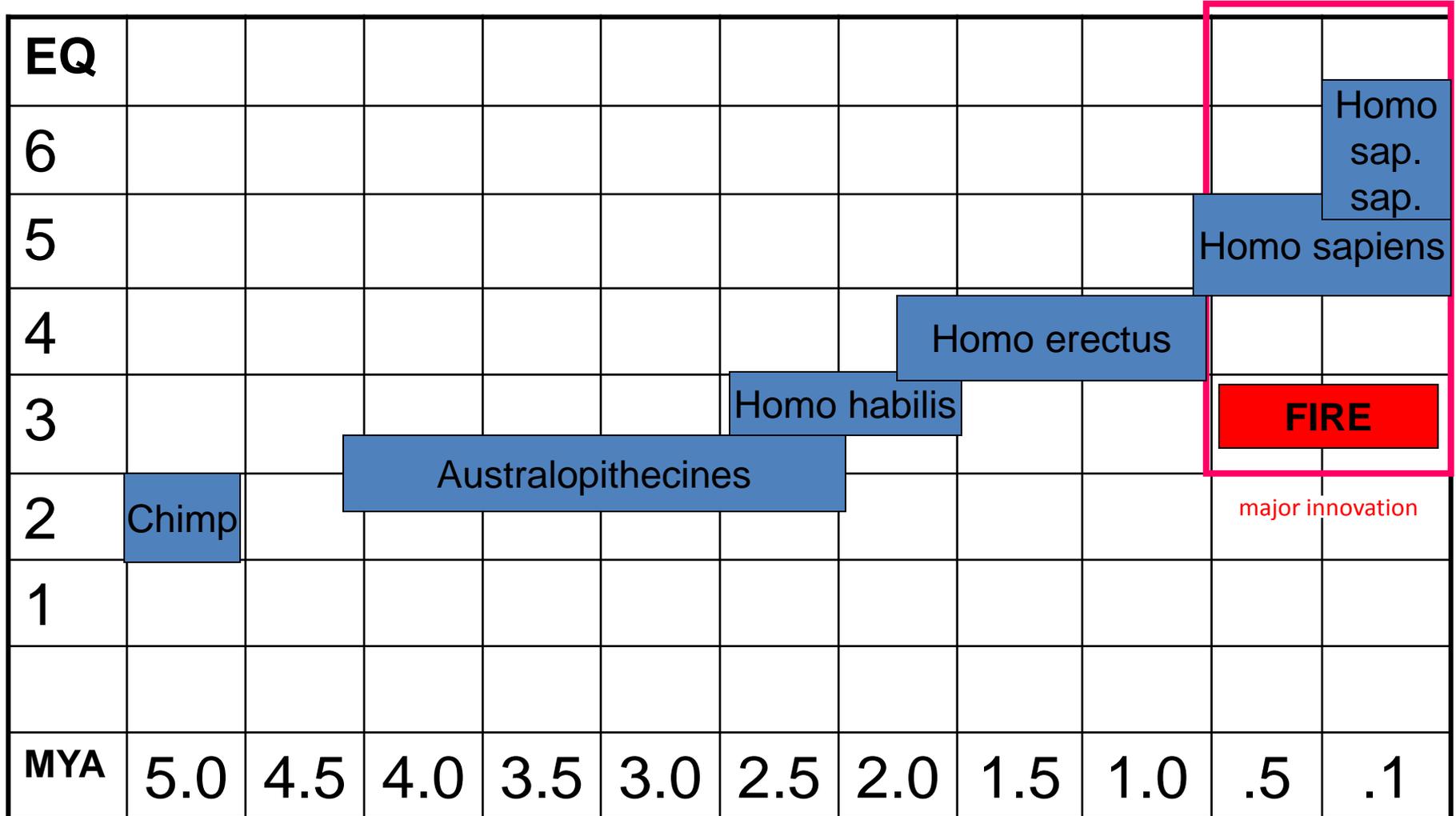


Peering through an evolutionary lens



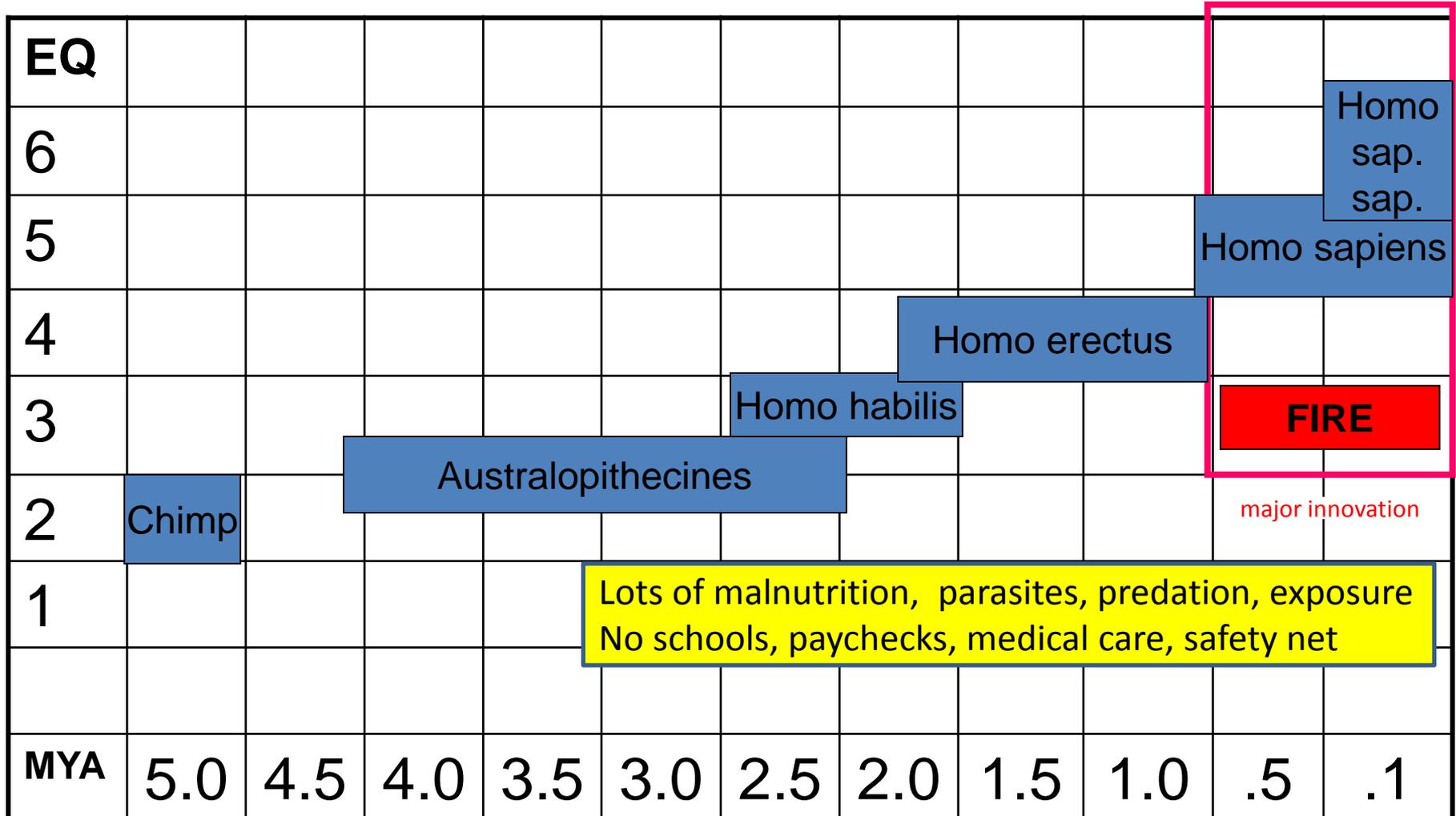
Humans evolved a “remarkable” intellect

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

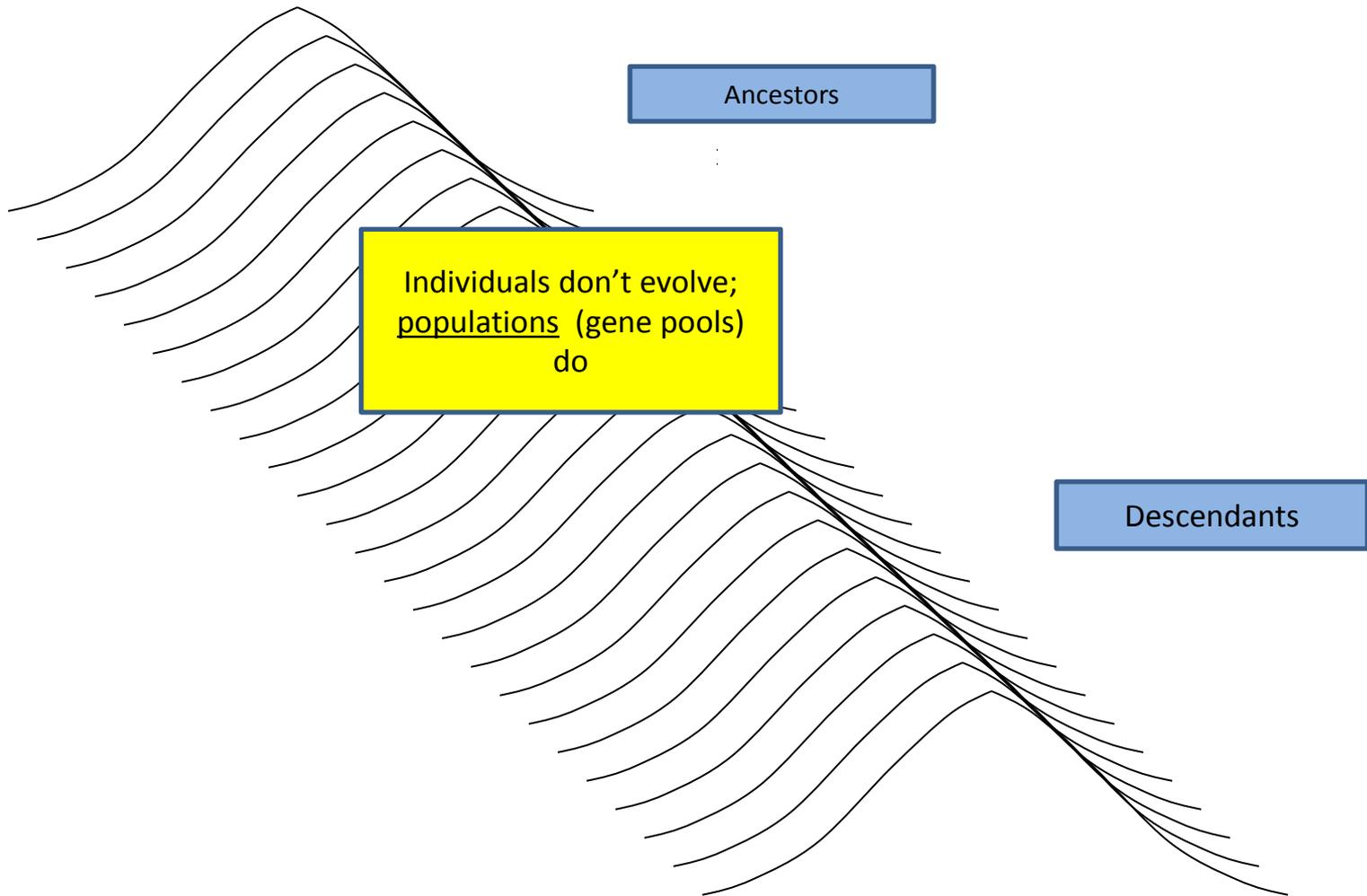


Intelligence evolved in “deprived” environments

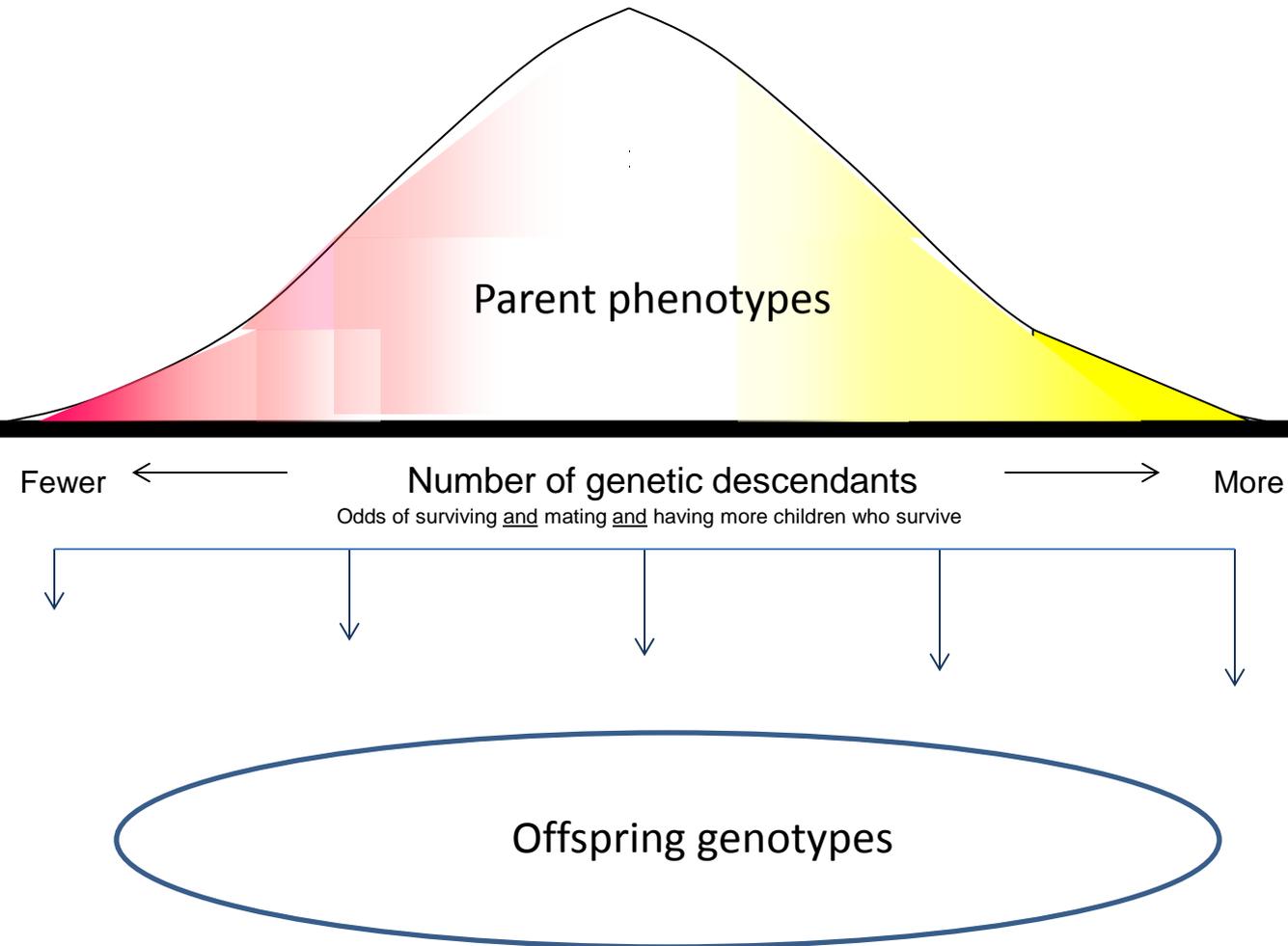
Encephalization quotient (EQ) = brain-to-body size compared to the average mammal



Evolution— Works by selecting next generation

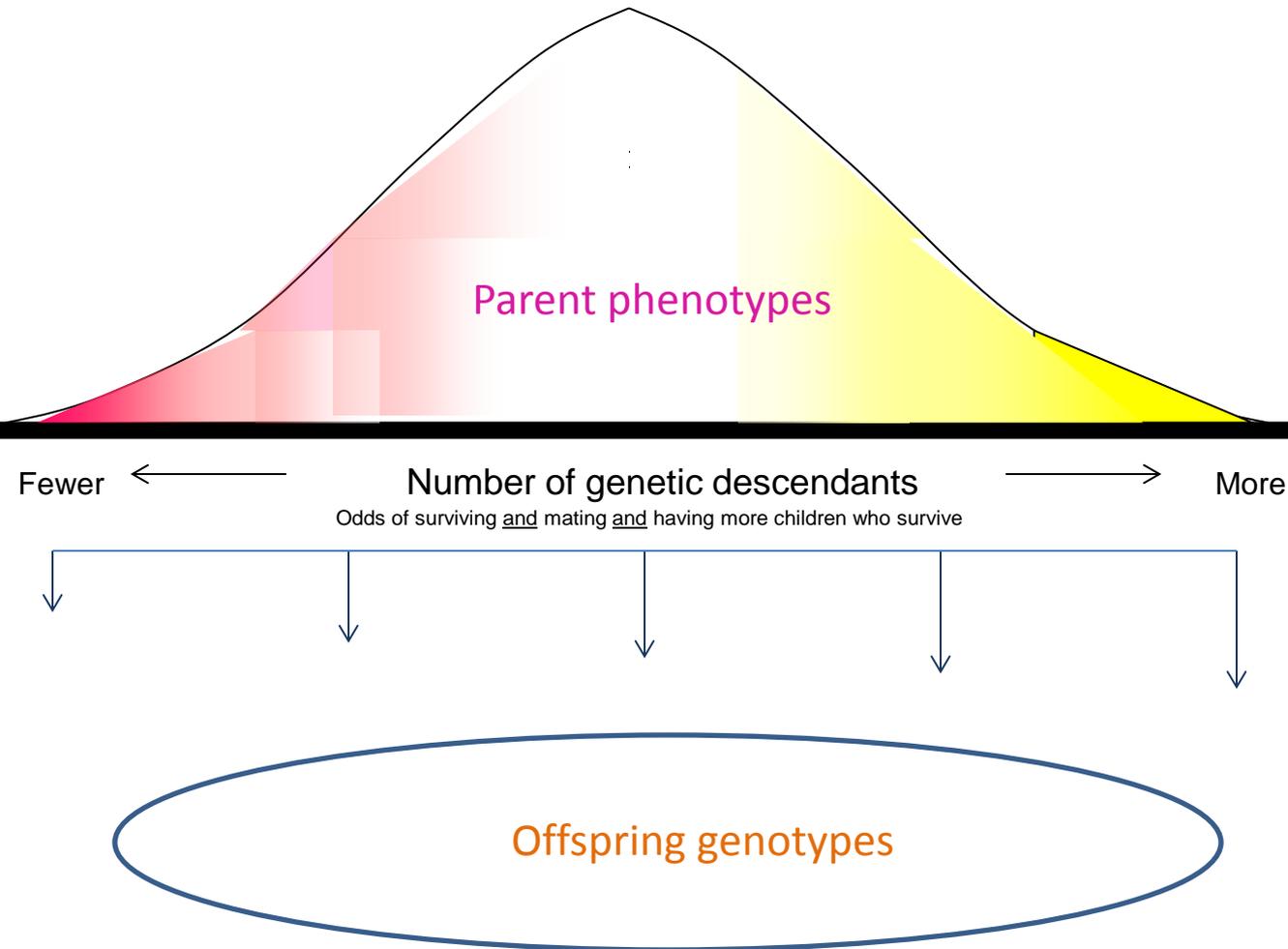


Evolution—Selects by parents for the next generation



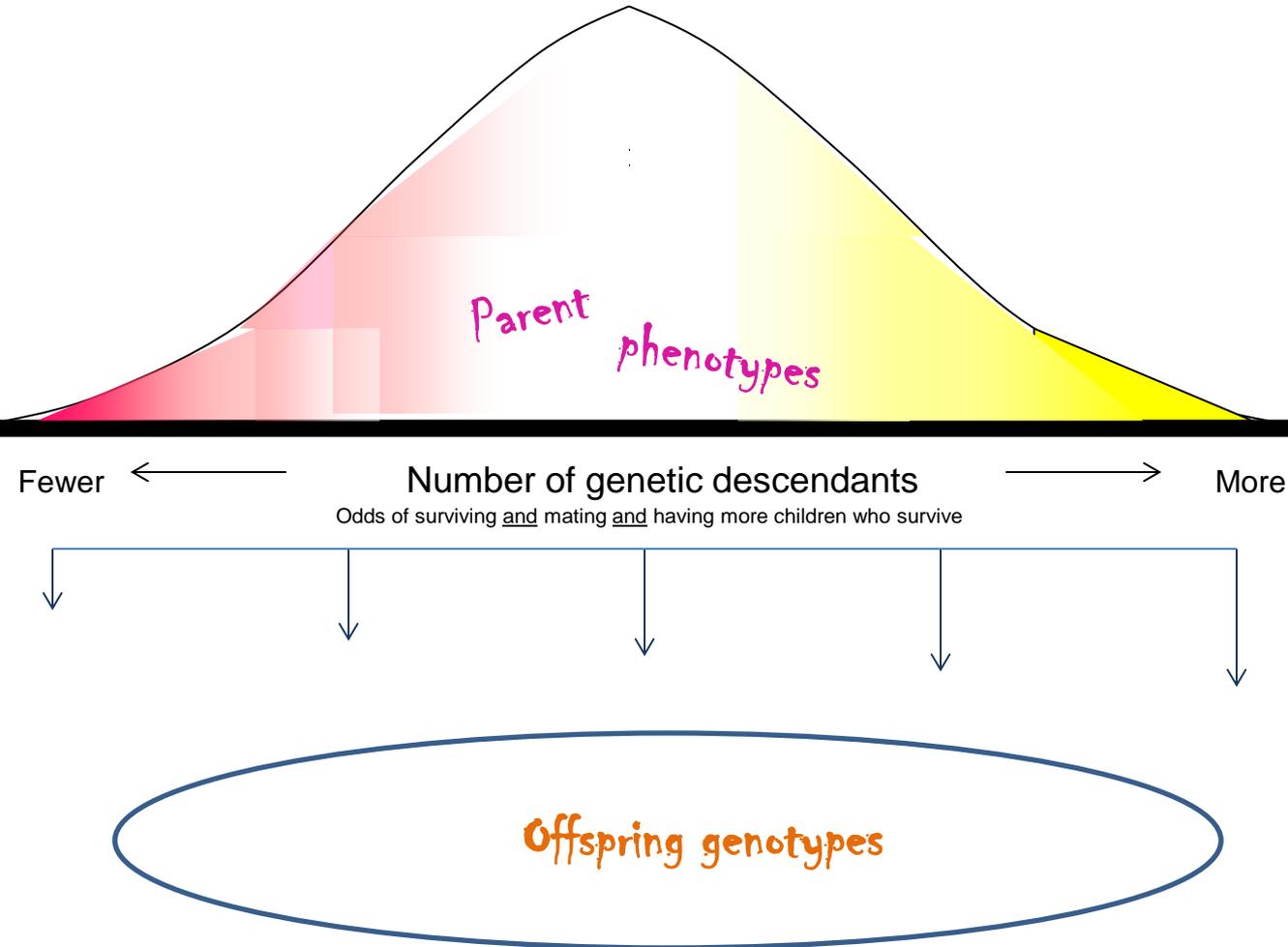
Evolutionary insight #1

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



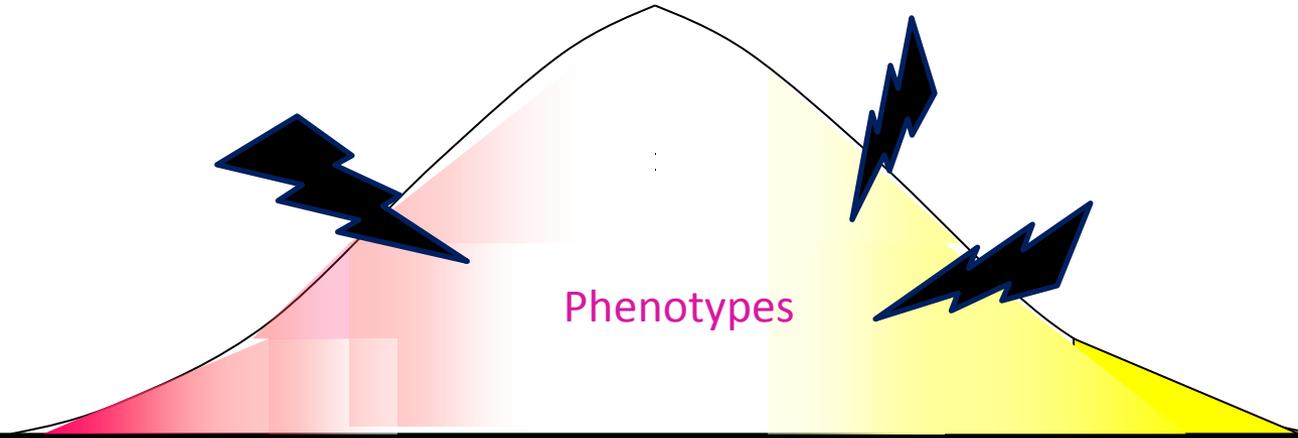
Evolutionary insight #2

- 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).



Evolutionarily novel influences on brain



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

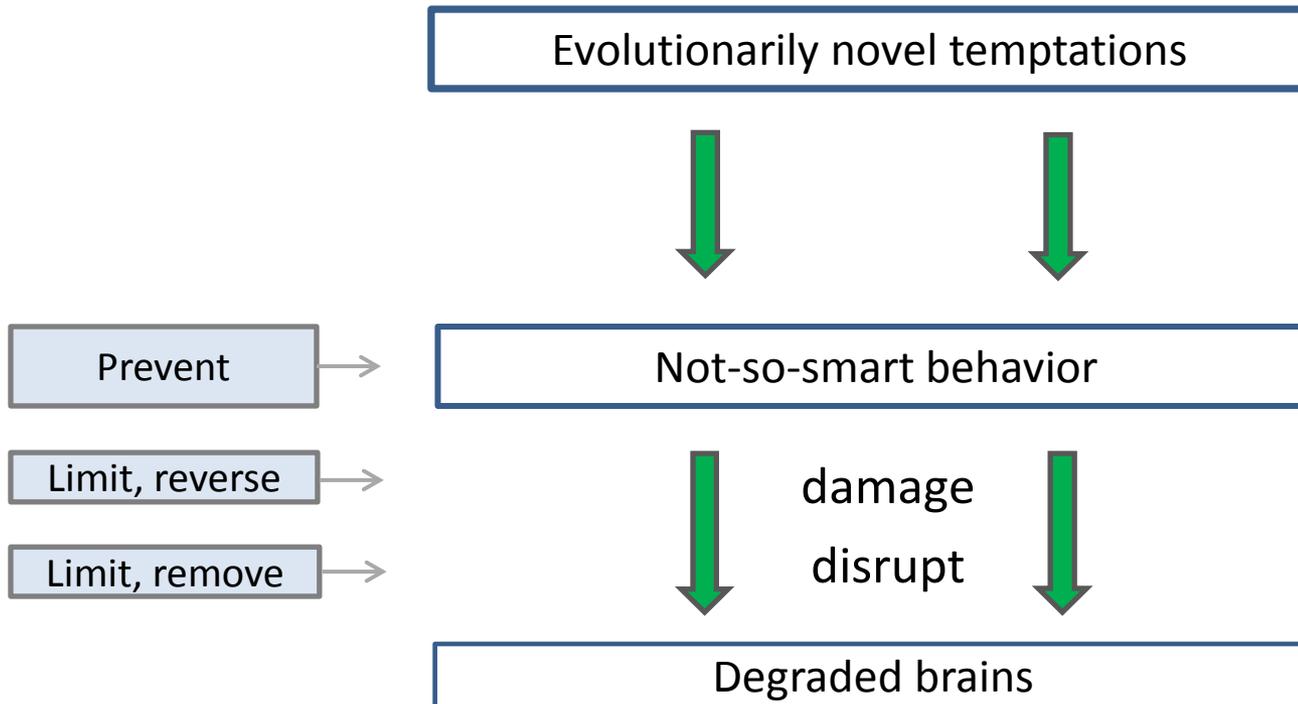
 **LIVE WELL WITH DR. CORY** Researchers have found a connection between breastfeeding and the development of a child's brain. Researchers concluded, in a study of more than 17,000 infants from newborn to 6 ½ years, that prolonged and exclusive breastfeeding improved brain development.

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.

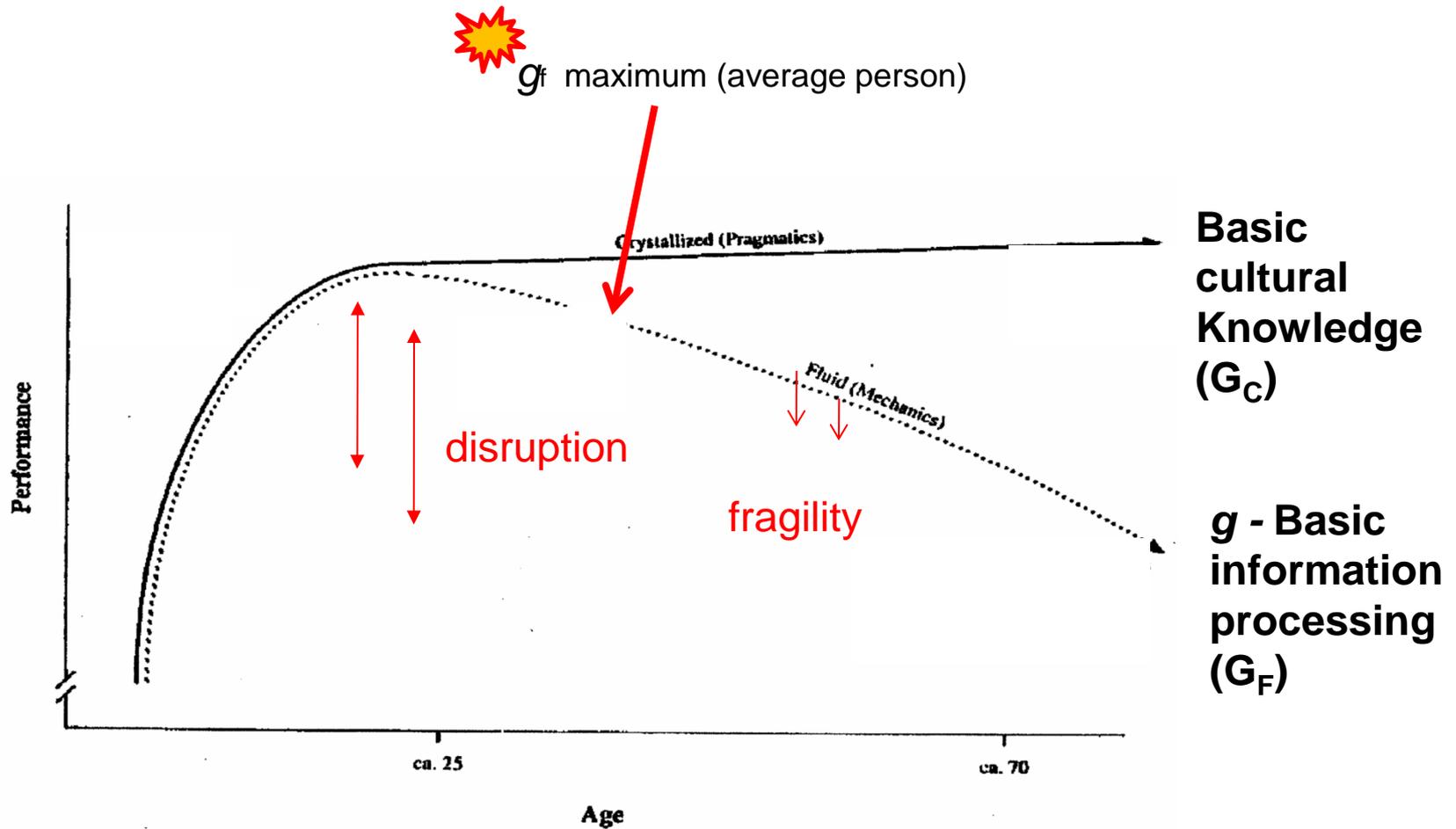
So, might the real challenge be to protect & preserve intelligence?



Evolutionary perspective

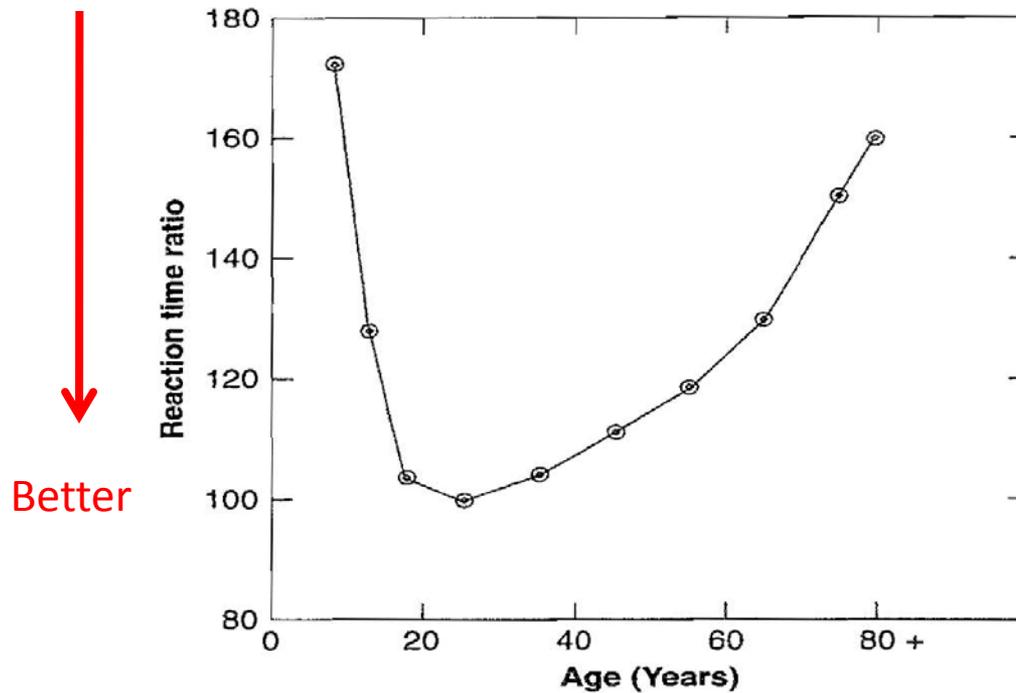
1. Suppose individuals have physiological maximum for g
2. And they experience:
 - cognitive disturbances when deploying it
 - threats to integrity of brain
3. Most are evolutionarily novel
4. Most are preventable

Vulnerabilities of g across the lifespan



Normal effects of aging on brain (reaction time)

78 *Clocking the Mind*



Much excess cognitive decline with age

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 incredible can it measure neurochemical the blood suppl

"Drop the chocolate chip cookies and get moving."

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.

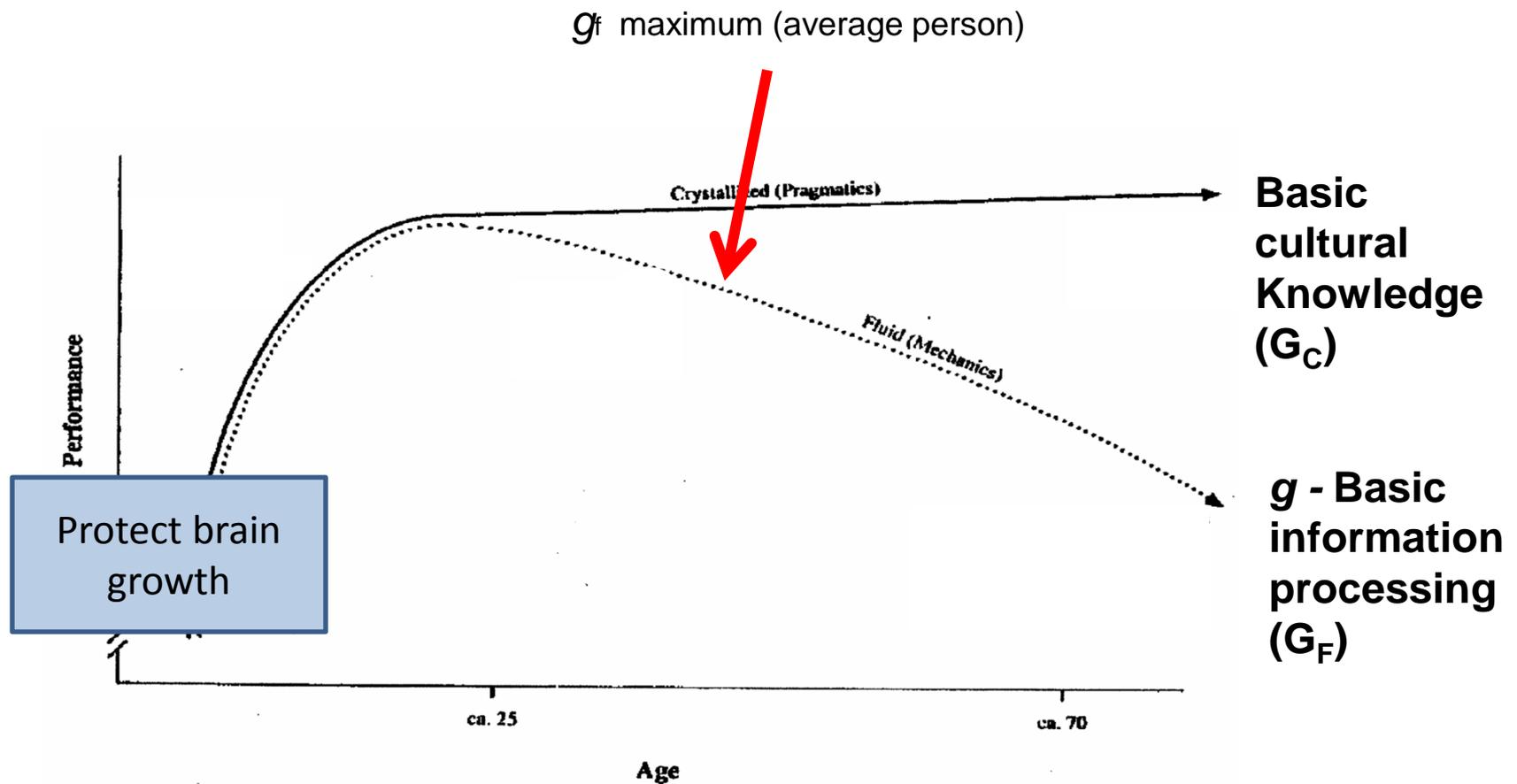
■ **Future goal:** "To avoid what it is I'm seeing in aging people and to continue to work on the problem."

Brain is a physical organ & depends on cardiovascular health

SEPTEMBER 2008

The good news—impairment
preventable

Opportunities



Accumulation of preventable injuries

control and Prevent-
more troubling, as
of all high school
in concussions an-
Because teenage
developing, injuries
pecially damaging:
is and colleges fail
the kind of neuro-
g that's needed to

ches have become
it concussions. The
hlete who's had this
ckside and sending
ne are diminishing,
at someone who's
eds rest. He or she
a break from the
school. This allows
all its resources to

victim risks devel-
n syndrome, which
headaches, dizziness

scans cannot reveal when the athlete
has had enough rest, because they are
not sensitive enough to detect the kind
of microscopic damage to brain cells
and brain chemistry that concussions
can cause.

The only way to know for sure wheth-
er a concussion victim's brain has re-
turned to normal is to compare the re-
sults of neuropsychological tests con-
ducted before and after the injury. That
requires preparing athletes for the sea-
son by putting them through baseline

control one's emotions and impulses.

The baseline evaluation also includes
a medical history, which helps deter-
mine the athlete's future risk of head in-
jury and his long-term prognosis in the
event of a concussion. At greatest risk
for post-concussion syndrome are peo-
ple who have had concussions before,
have a family member with a psychiat-
ric disorder or have a condition like at-
tention deficit hyperactivity disorder,
seizures or bipolar disorder. Also, the
risk is greater for females than for
males.

A brain injury can do lasting damage
to neurons and arteries and alter brain
chemistry, too. That can reduce a pa-
tient's ability to concentrate or cope
with frustration, and lead to moodiness,
irritability and depression. Such impair-
ments make it more difficult to deal
with daily stresses, and thus often lead
to significant social problems.

To fully recover from a concussion,
the brain must quickly reorganize itself

Clueless, she
Charlie?"
"Well, what d
said Mr. Gibson
"His worldvie
Later, in the
commentators
point that there
voters — some
"hockey moms'
the Bush doctri
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campaigns. You
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The Bush doc
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Schools must do more to protect athletes from concussions.

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

Negligent infliction of devastating damage



Fetal Alcohol Syndrome

KidsHealth > Parents > Diseases & Conditions > Brain & Nervous System > Fetal Alcohol Syndrome

Text Size Print

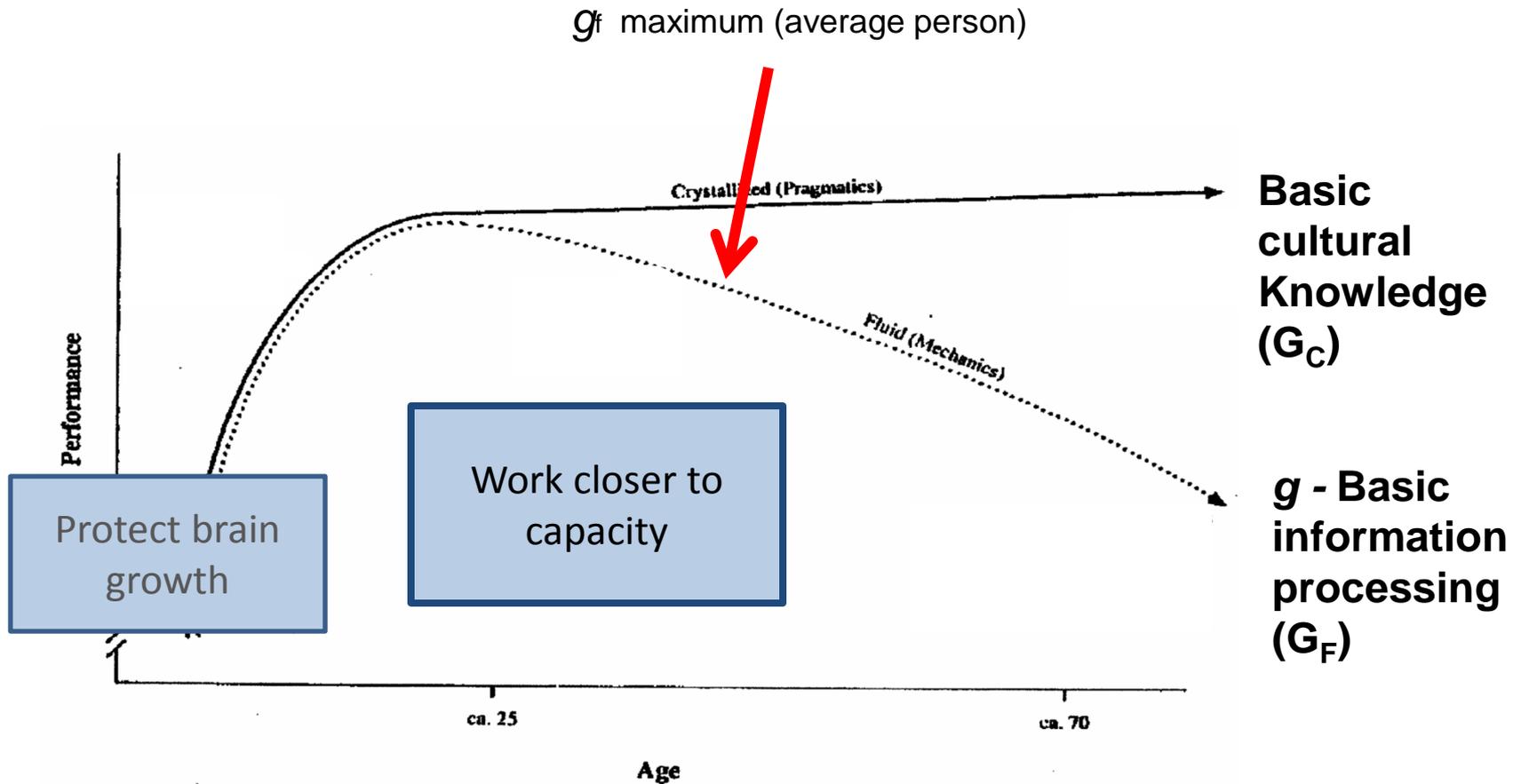
▶ [What's in this article? \(click to view\)](#)

Listen

Alcohol (wine, beer, or liquor) is the leading known preventable cause of developmental and physical birth defects in the United States.

Lea este artículo en Español

Opportunities



Respect circadian rhythms, sleep needs

Sleep Medicine Reviews (2008) 12, 257–273



SLEEP
MEDICINE
reviews

www.elsevier.com/locate/smr

CLINICAL REVIEW

Alertness management strategies for operational contexts

John A. Caldwell^{a,*}, J. Lynn Caldwell^{b,1}, Regina M. Schmidt^{b,2}

^aArchinoetics, LLC, Topa Financial Center, 700 Bishop Street, Suite 2000, Honolulu, HI 96813, USA

^bAir Force Research Laboratory, Biosciences and Protection Division, 2215 First Wright-Patterson AFB, OH 45433, USA

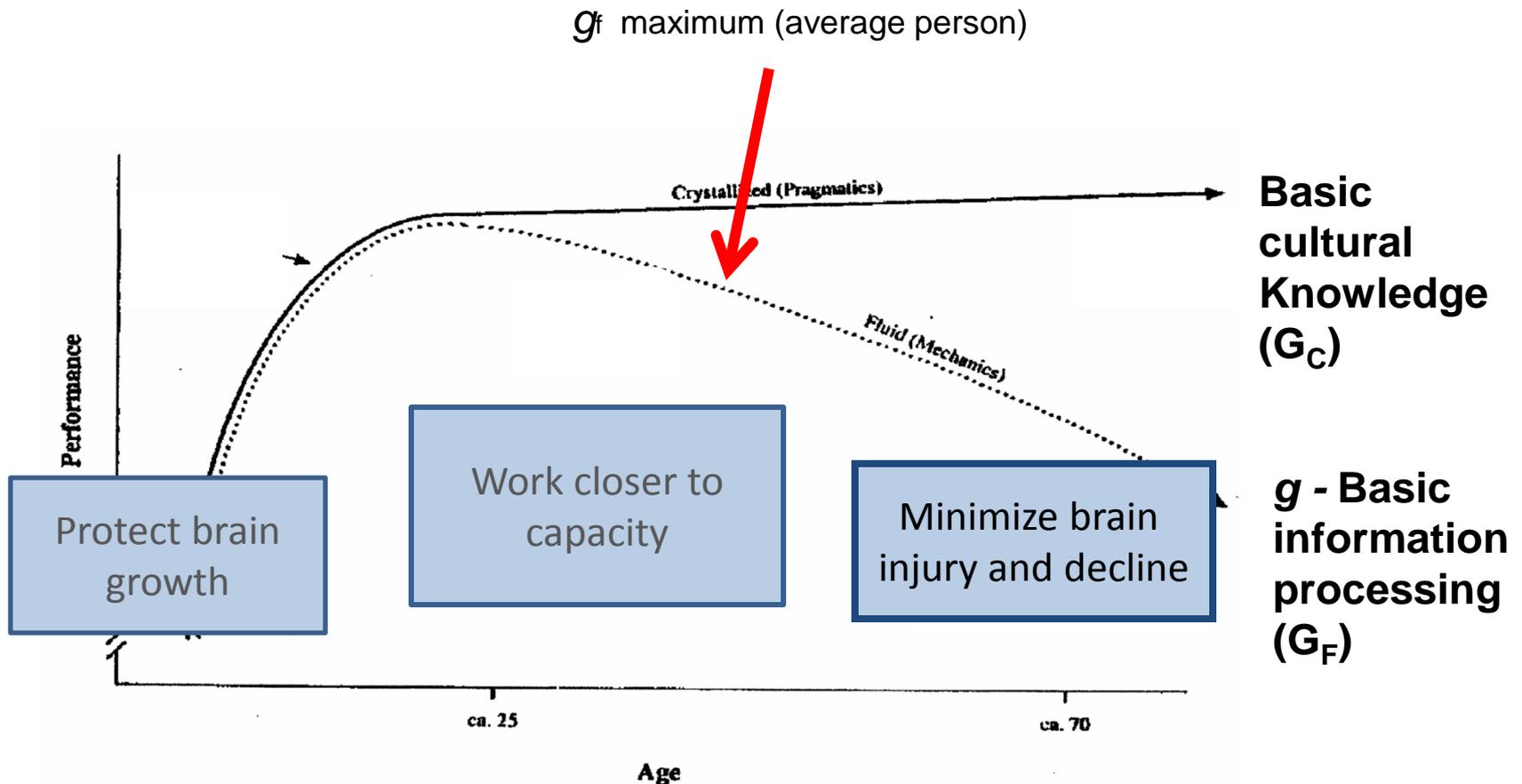
KEYWORDS

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

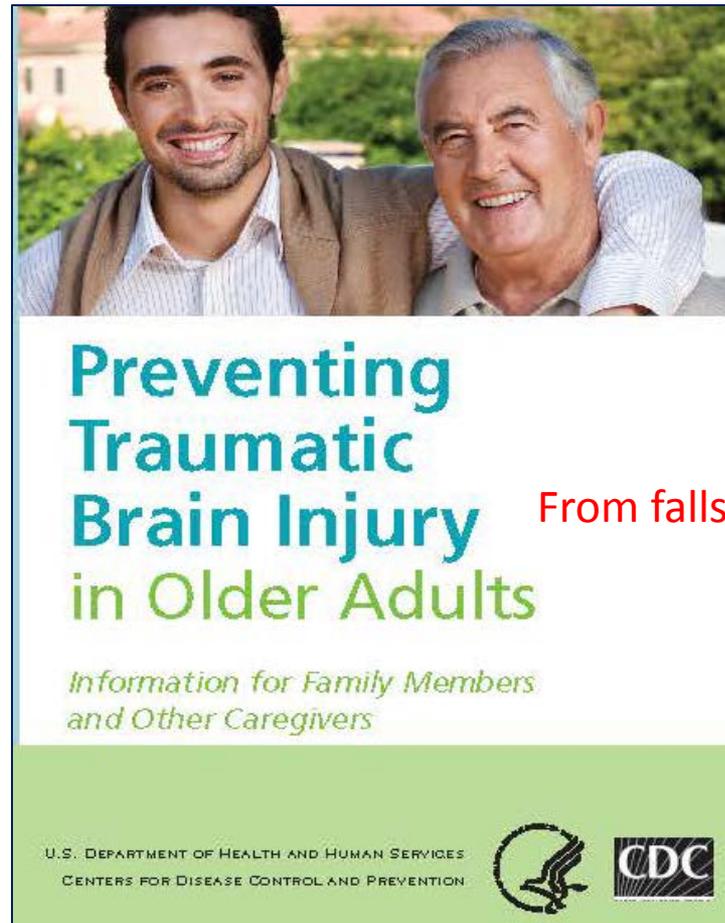
Summary This review addresses the problem of fatigue (on-the-job fatigue) attributable to sleep loss in modern society and the scientifically based strategies useful for reducing fatigue-related risks. Fatigue has become a pervasive problem because many people work non-standard schedules, and/or they consistently 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 desynchronization produce decrements in cognitive performance.”

Opportunities

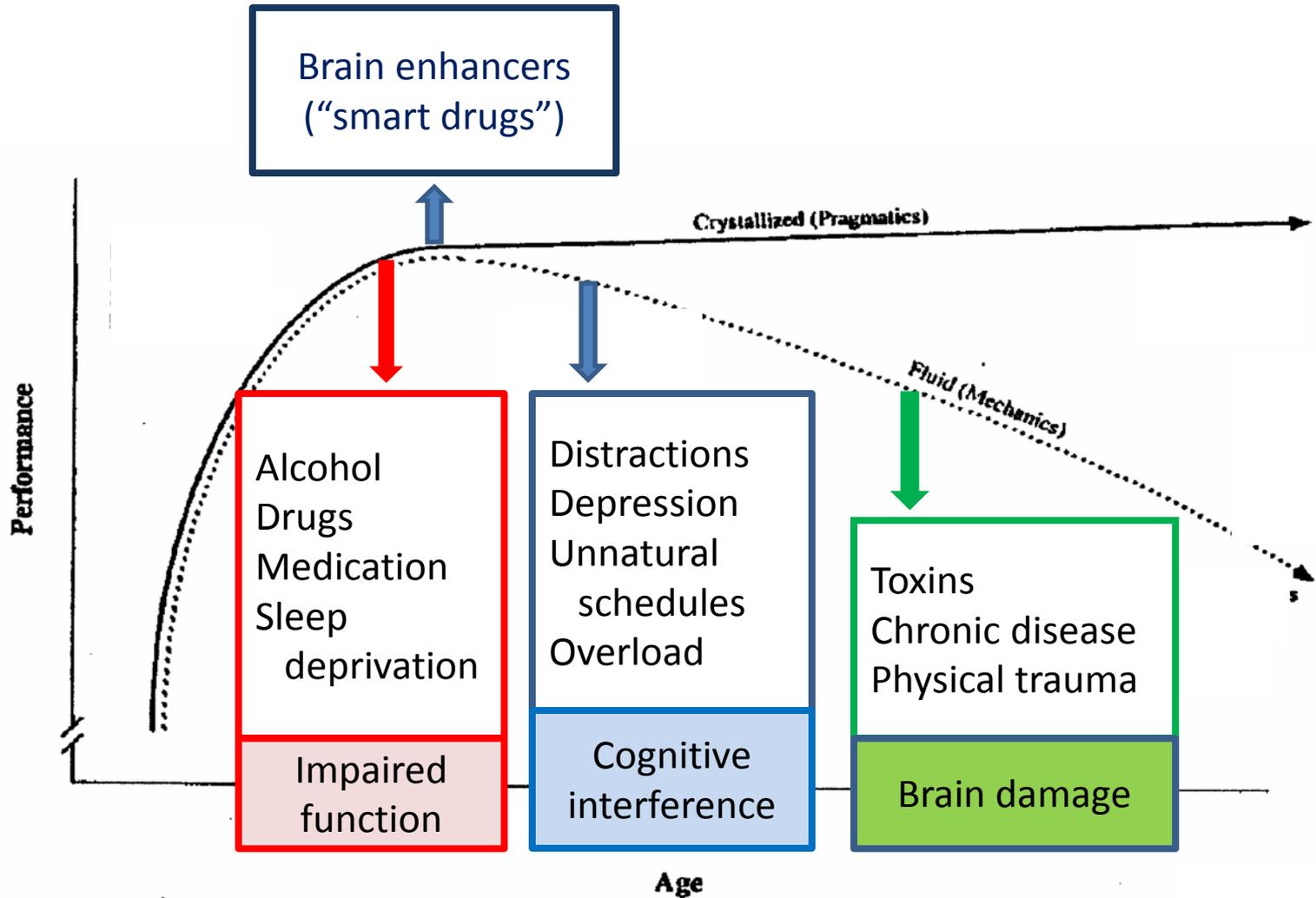


Be alert to (novel) hazards: stairs, rugs, furniture and fixtures with hard surfaces

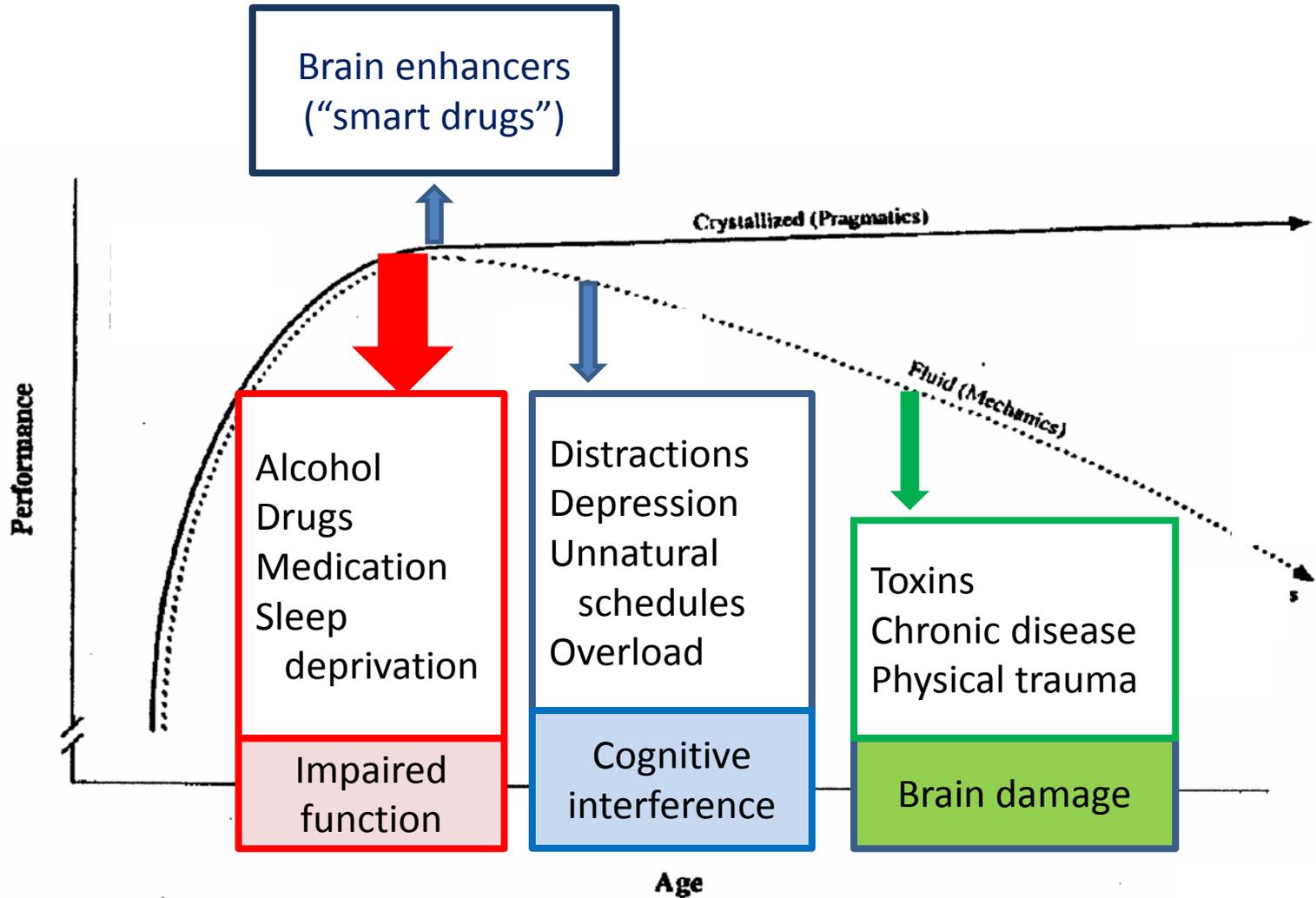


More good news—usually
in individual's power to control

Behavior matters

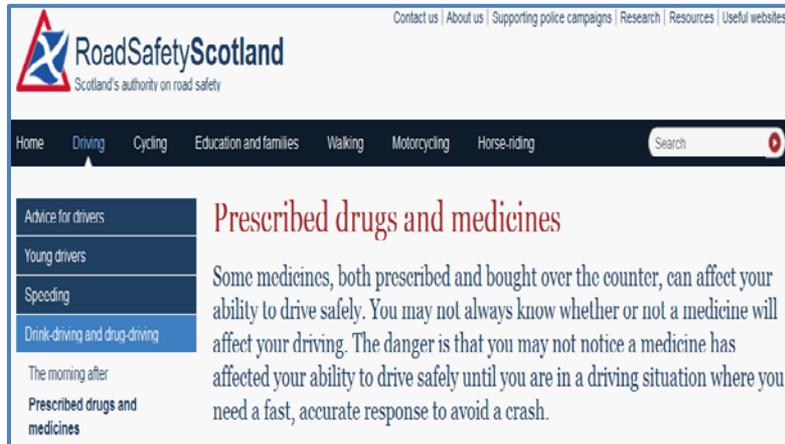


Especially with evolutionarily novel hazards



Medication

Confusion & drowsiness



Contact us | About us | Supporting police campaigns | Research | Resources | Useful websites

Road Safety Scotland
Scotland's authority on road safety

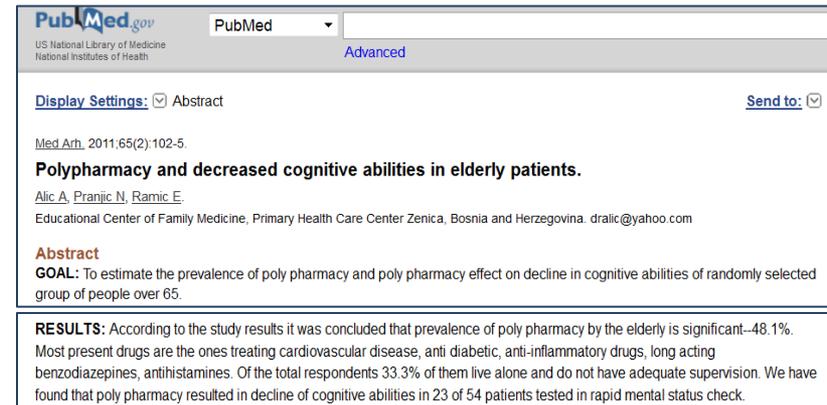
Home | Driving | Cycling | Education and families | Walking | Motorcycling | Horse-riding | Search

Advice for drivers
Young drivers
Speeding
Drink-driving and drug-driving
The morning after
Prescribed drugs and medicines

Prescribed drugs and medicines

Some medicines, both prescribed and bought over the counter, can affect your ability to drive safely. You may not always know whether or not a medicine will affect your driving. The danger is that you may not notice a medicine has affected your ability to drive safely until you are in a driving situation where you need a fast, accurate response to avoid a crash.

Polypharmacy



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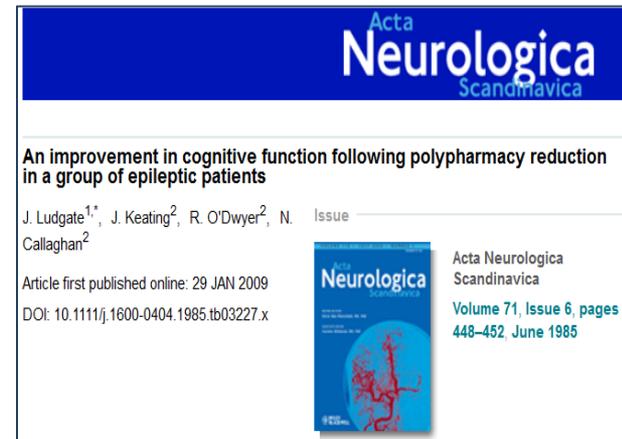
Med. Arh. 2011;65(2):102-5.

Polypharmacy and decreased cognitive abilities in elderly patients.

Alic A. Pranjic N., Ramic E.
Educational Center of Family Medicine, Primary Health Care Center Zenica, Bosnia and Herzegovina. dralic@yahoo.com

Abstract
GOAL: To estimate the prevalence of poly pharmacy and poly pharmacy effect on decline in cognitive abilities of randomly selected group of people over 65.

RESULTS: According to the study results it was concluded that prevalence of poly pharmacy by the elderly is significant—48.1%. Most present drugs are the ones treating cardiovascular disease, anti diabetic, anti-inflammatory drugs, long acting benzodiazepines, antihistamines. Of the total respondents 33.3% of them live alone and do not have adequate supervision. We have found that poly pharmacy resulted in decline of cognitive abilities in 23 of 54 patients tested in rapid mental status check.



Acta
Neurologica
Scandinavica

An improvement in cognitive function following polypharmacy reduction in a group of epileptic patients

J. Ludgate^{1*}, J. Keating², R. O'Dwyer², N. Callaghan² Issue

Article first published online: 29 JAN 2009
DOI: 10.1111/j.1600-0404.1985.tb03227.x



Acta Neurologica Scandinavica
Volume 71, Issue 6, pages 448–452, June 1985

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

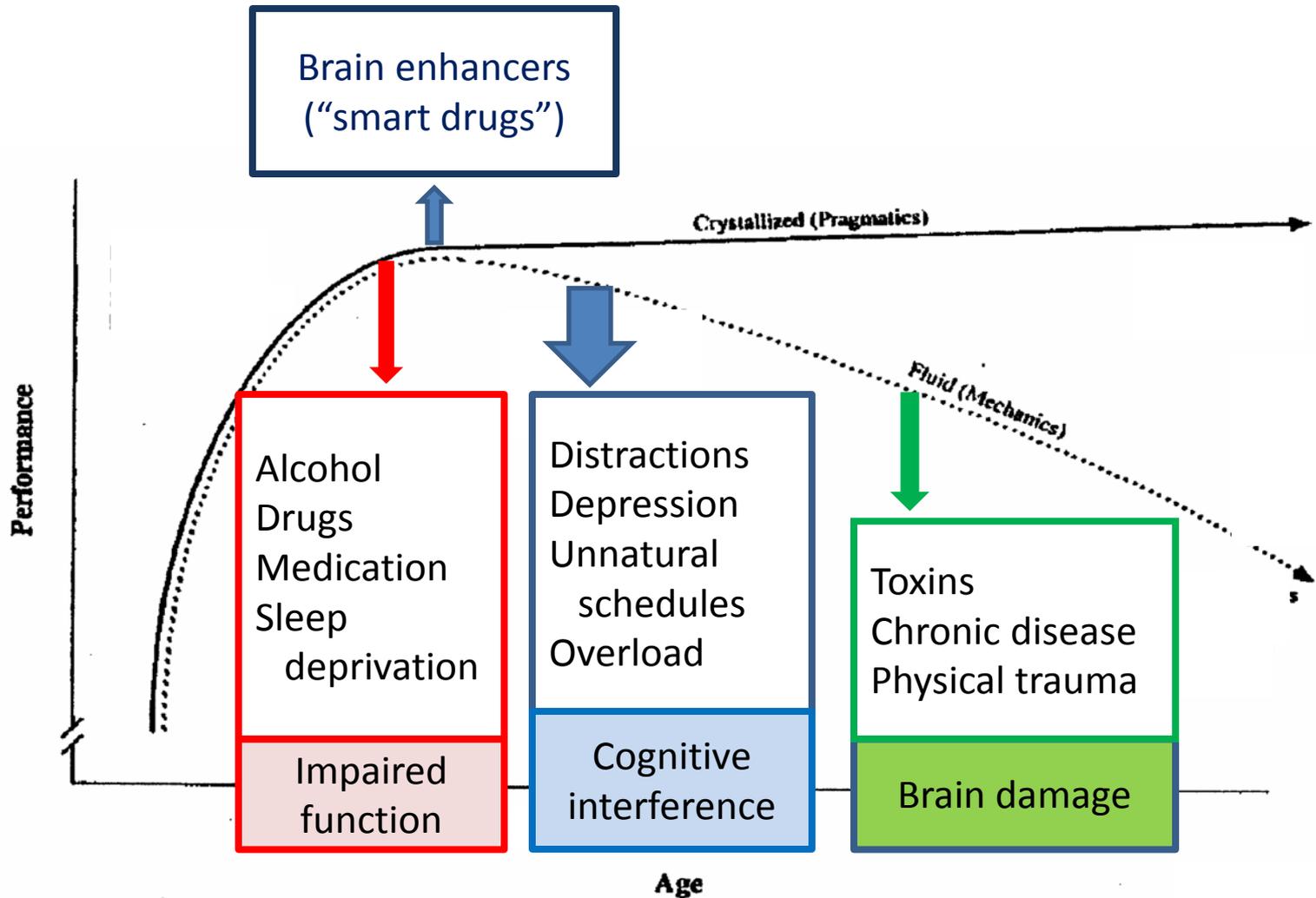
After working more than 12 hours in a row—inside and out of the cockpit—error rates shoot up, complacency increases and communications become impaired, says Peter Demitry, a former test pilot and fatigue expert who consults for pilot groups. One symptom of fatigue that scientists are now studying is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

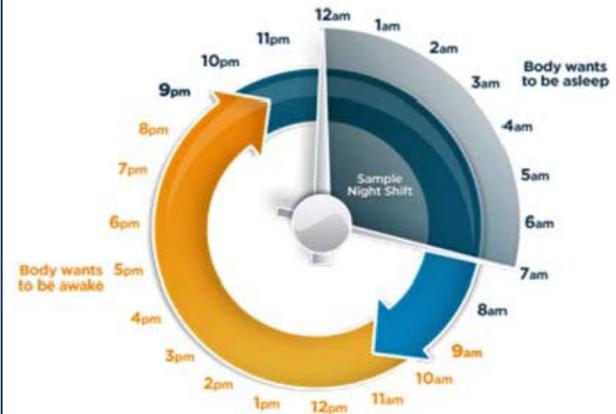
About Shift Work Disorder (SWD)

Shift work disorder is a medical condition that can be diagnosed and treated by a doctor^{1,4}

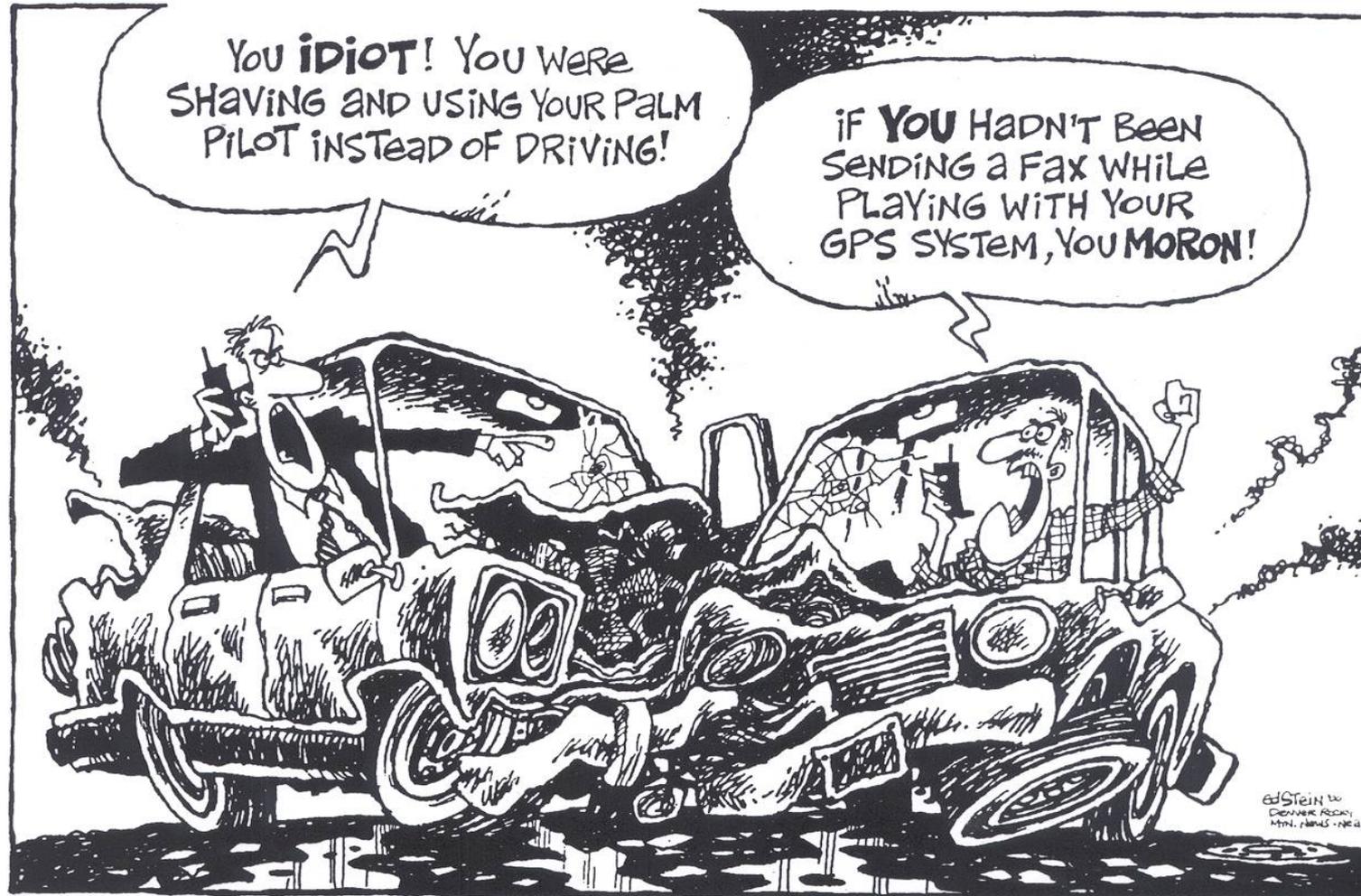
SWD occurs when your work schedule is out of sync with your body's internal sleep-wake clock — your body is telling you to go to sleep when your work schedule needs you to stay awake.

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

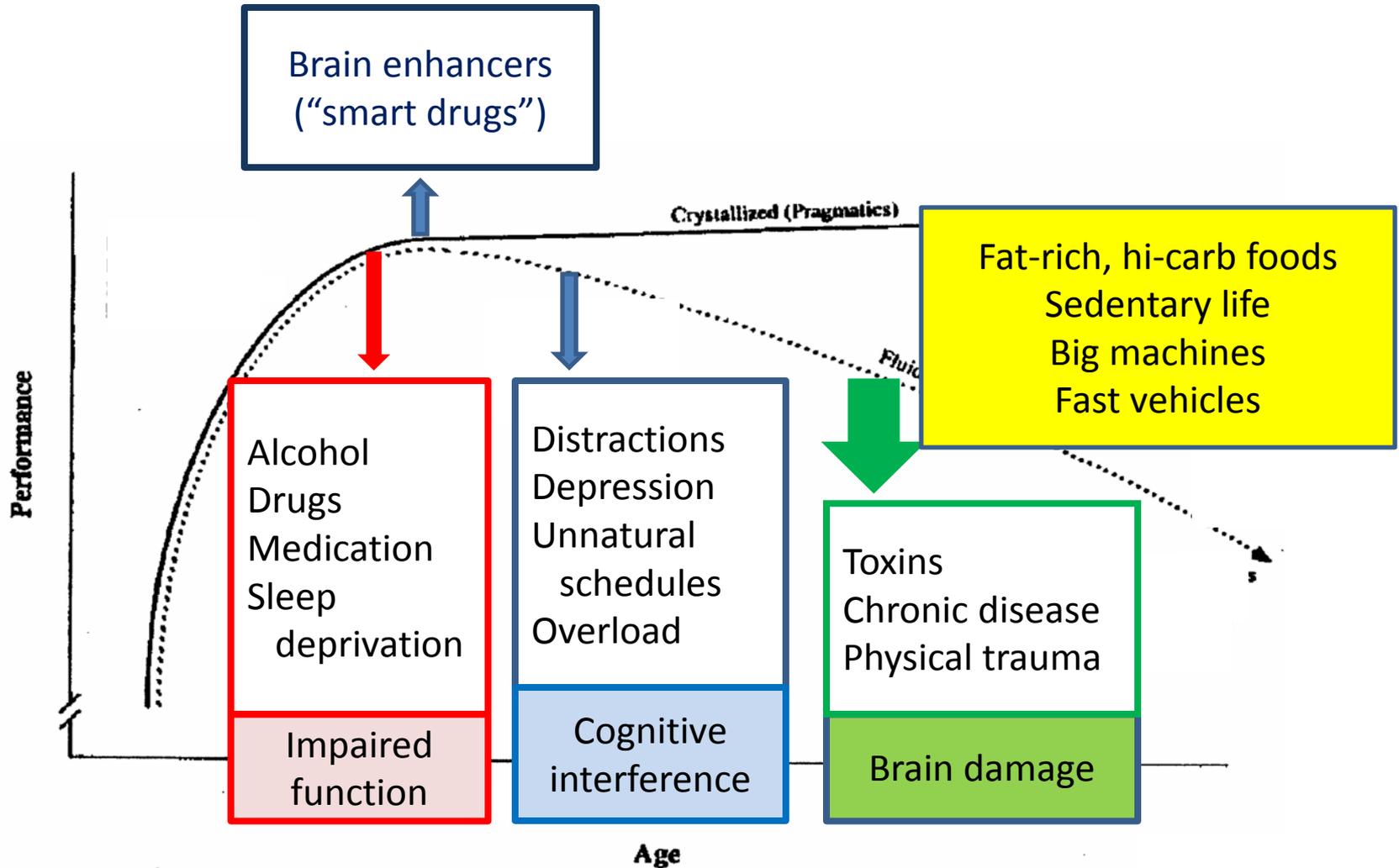
Model of the Sleep-Wake Cycle¹



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

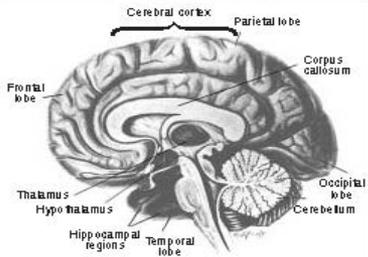
ALCOHOL ALERT

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 conditions 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

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[Cochrane Database Syst Rev. 2000;\(2\):CD001855.](#)

Helmets for preventing head and facial injuries in bicyclists.

Thompson DC, Rivara FP, Thompson R.
Pediatrics; Harborview Injury Prevention & Research Center, University of Washington, Box 359960, 325 Ninth Avenue, Seattle, WA 98104, USA.
dct@u.washington.edu

Abstract

BACKGROUND: Each year, in the United States, approximately 900 persons die from injuries due to bicycle crashes and over 500,000 persons are treated in emergency departments. Head injury is by far the greatest risk posed to bicyclists, comprising one-third of emergency department visits, two-thirds of hospital admissions, and three-fourths of deaths. Facial injuries to cyclists

MAIN RESULTS: No randomized controlled trials were found. This review identified five well conducted case control studies which met our selection criteria. Helmets provide a 63%-88% reduction in the risk of head, brain and severe brain injury for all ages of bicyclists. Helmets provide equal levels of protection for crashes involving motor vehicles (69%) and crashes from all other causes (68%). Injuries to the upper and mid facial areas are reduced by

Helmets provide a 63-88% reduction in risk of head, brain and severe brain injury”

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



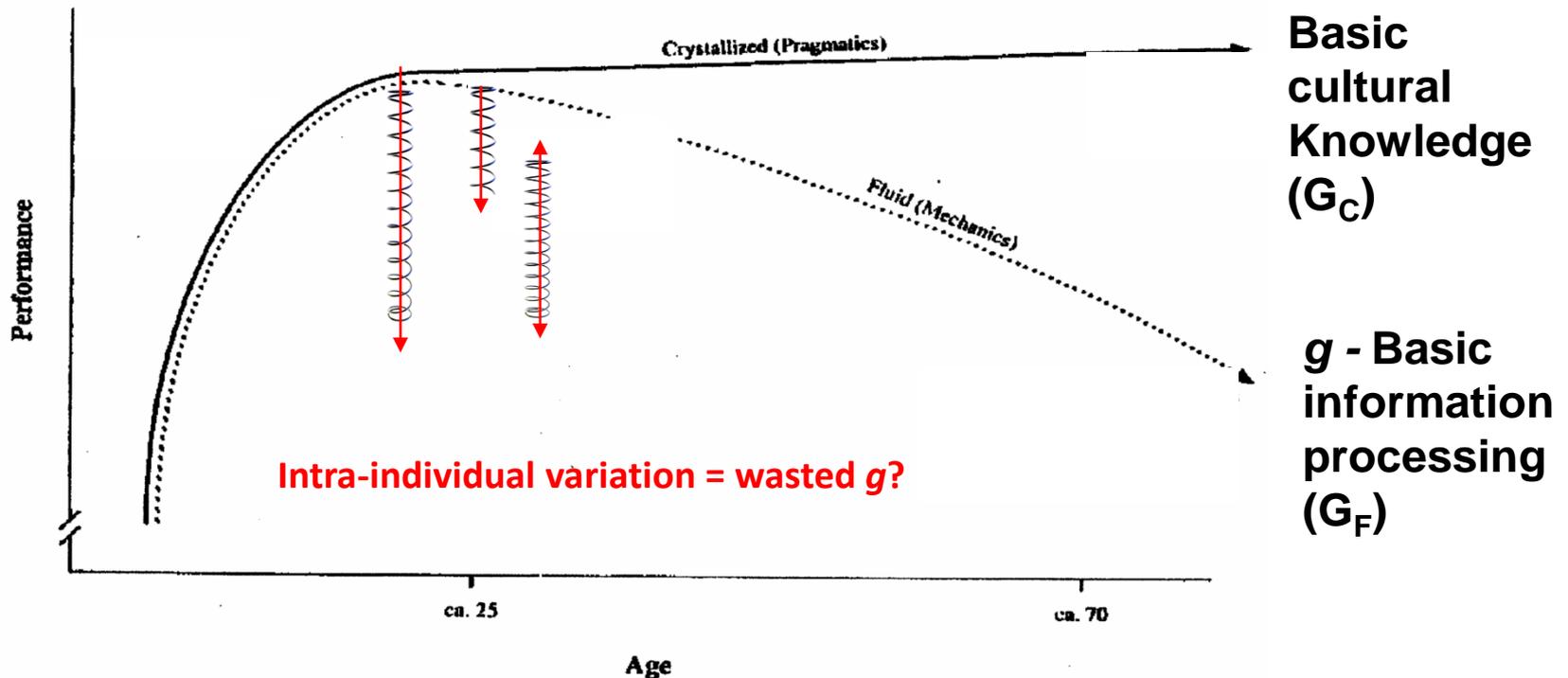
Time Magazine

How could it not affect the brain!

Evolutionary guidance on “raising” intelligence

1. Tighter focus

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



Evolutionary guidance on “raising” intelligence

1. Tighter focus

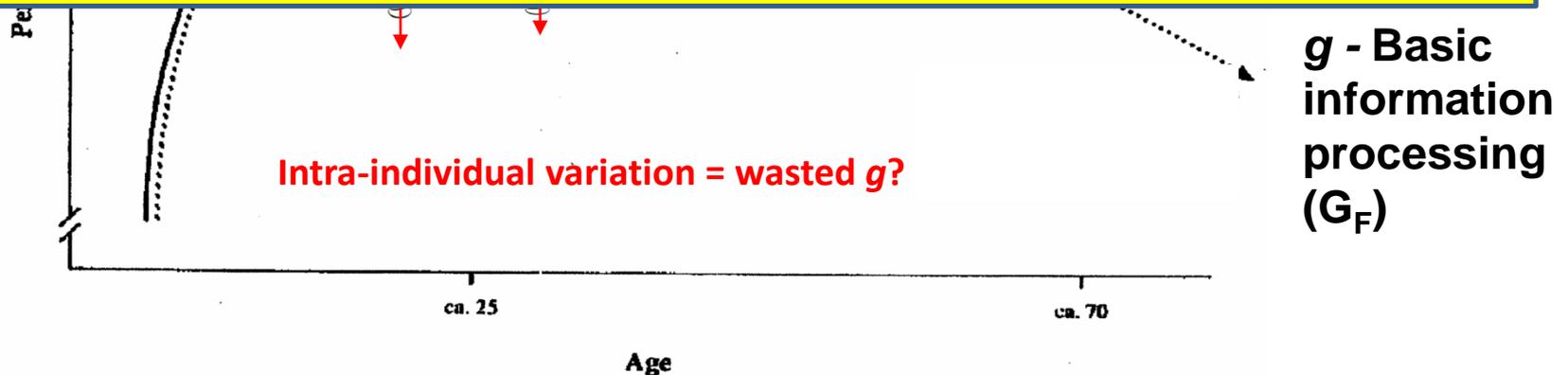
- Protect the max (brain damage) & limit excursions below it (impaired function & interference)
- Focus on evolutionarily novel tasks & temptations (environments are malleable)

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)



Thank you.