The Fragility of Maximal Performance

Linda S. Gottfredson
School of Education
University of Delaware

September 16, 2008
Conference: “How can we improve our brains?”
Banbury Center, Cold Spring Harbor, New York
How can we improve our brains?

Intelligence

Life chances
• School
• Work
• Health

Inequality
The problem with “intelligence”: I
Human norm, or variations on it?
(E.g., developmental change, or inter-individual differences?)
The problem with “intelligence”: II
Which inter-individual differences are we talking about?

GENERAL
• Domain general
• More heritable
• Psychometrically unitary
• Physiologically distributed

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- *Psychometrically* unitary
- *Physiologically* distributed

\[ \text{IQ} \approx g \]

**NARROW**
- Learning
- Reasoning
- Abstract thinking
- Solving novel problems
Global phenotype differences
(e.g., typical learning needs by IQ level)

Military trainability thresholds

Very explicit, structured, hands-on

Mastery learning, hands-on

Written materials & experience

Learns well in college format

Can gather, infer information on own

Equalization

Democratization

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

0th 10th 15th 30th

IQ

70 80 90 100 110 120 130

MR MG
Correlated life consequences

Typical IQ range of workers

Military trainability thresholds

70 80 90 100 110 120 130

MR IQ MG

- No jobs centered here
- Assembler, Food service, Nurse’s aide
- Clerk, teller, Police officer, Machinist, sales
- Manager, Teacher, Accountant
- Attorney, Chemist, Executive

Typical IQ range of workers: 10th, 15th, 30th
Black-white disproportions

Military trainability thresholds

10th 15th 30th

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Black

White

70 80 90 100 110 120 130

MR IQ MG
My focus: How can we better use and protect our brains?

3. Vulnerable to chronic disruption
4. Preventable

1. Measured at maximum
2. Rarely function at maximum

Life chances
- School
- Work
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Inequality
My focus: How can we better use and protect our brains?

Intelligence

Life chances
- School
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Inequality

Intra-individual fluctuation

Inter-individual differences
Species-typical influences on brain
Evolutionarily novel influences on brain

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.
Effects of Aging on Brain (Reaction Time)

Better
Behavior that increases brain’s vulnerability to aging
Accumulation of preventable injuries

Schools must do more to protect athletes from concussions.

Fatigue, sleepiness

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 workday 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...
Alertness management strategies for operational contexts

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

\textsuperscript{a}Archinoetics, LLC, Topa Financial Center, 700 Bishop Street, Suite 2000, Honolulu, HI 96813, USA
\textsuperscript{b}Air Force Research Laboratory, Biosciences and Protection Division, 2215 First Street, Bldg. 33, Wright-Patterson AFB, OH 45433, USA

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\textbf{KEYWORDS} & \textbf{Summary} \\
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Fatigue management; Occupational health and safety; Alertness; Sleep deprivation; Fatigue detection & This review addresses the problem of fatigue (on-the-job-sleepiness) attributable to sleep loss in modern society and the scientifically proven strategies useful for reducing fatigue-related risks. Fatigue has become pervasive 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. \\
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Disrupted attention

You idiot! You were shaving and using your palm pilot instead of driving!

If you hadn't been sending a fax while playing with your GPS system, you moron!
Cognitive enhancers (doping?)

“It’s a brave new world”

Before—
• caffeine
• ephedrine-based drugs

Now—
• Ritalin
• Adderall
• Modafinil

Monitor on Psychology, September, 2008, p. 32
Professor’s little helper

The use of cognitive-enhancing drugs by both ill and healthy individuals raises ethical questions that should not be ignored, argue Barbara Sahakian and Sharon Morein-Zamir.

Today there are several drugs on the market that improve memory, concentration, planning and reduce impulsive behaviour and risky decision-making, and many more are being developed. Doctors already prescribe these drugs to treat cognitive disabilities and improve quality of life for patients with neuropsychiatric disorders and brain injury. The prescription use of such drugs is being extended to other conditions, including shift-workers. Meanwhile, off-label and non-prescription use by the general public is becoming increasingly commonplace.

Although the appeal of pharmaceutical cognitive enhancers — to help one study longer, work more effectively or better manage everyday stresses — is understandable, potential users, both healthy and diseased, must consider the pros and cons of their choices. To enable this, scientists, doctors and policy-makers should provide easy access to information about the advantages and dangers of using cognitive-enhancing drugs and set out clear guidelines for their future use. To trigger broader discussion of these issues we offer the following questions, to
Suppose a physiological maximum and:

— myriad cognitive disturbances
— threats to system integrity

\( g_f \) maximum (average person)

fluctuation
fragility

Basic cultural Knowledge (\( G_C \))

Basic information processing (\( G_F \))
Opportunities

$g_f$ maximum (average person)

- Basic cultural Knowledge ($G_C$)
- Basic information processing ($G_F$)

- Protect brain growth
- Work closer to capacity
- Minimize brain decline and atrophy

Performance vs. Age

ca. 25 - ca. 70
Behavioral influences

Brain enhancers ("smart drugs")

Brain protectors

Caffeine
Nicotine
Rest periods
Peak time
Pacing
Synergy

Effort boosters

Healthy diet
Exercise
Prevent/manage chronic diseases
Prevent/manage injuries

Cognitive drains

Alcohol
Drugs
Medication
Hunger
Fatigue
Pain
Anxiety
Distraction
Disinterest

Peak time
Pacing
Synergy
Environmental drains

- Constant interruptions (visitors, phone, meetings)
- Many distractions (email, noise)
- Disrupted sleep cycles (jet lag, shift work, artificial light, schools start too early)
- Insufficient sleep (noisy dorms, soldiers, parents)
- Poor scheduling/pacing of work (airlines)
- Over-medication of elderly
- Other

- Lower $g$ and age increase vulnerability
- All are manipulable
Thank you.
Closing thought
Need more precise, theoretically appropriate measurement