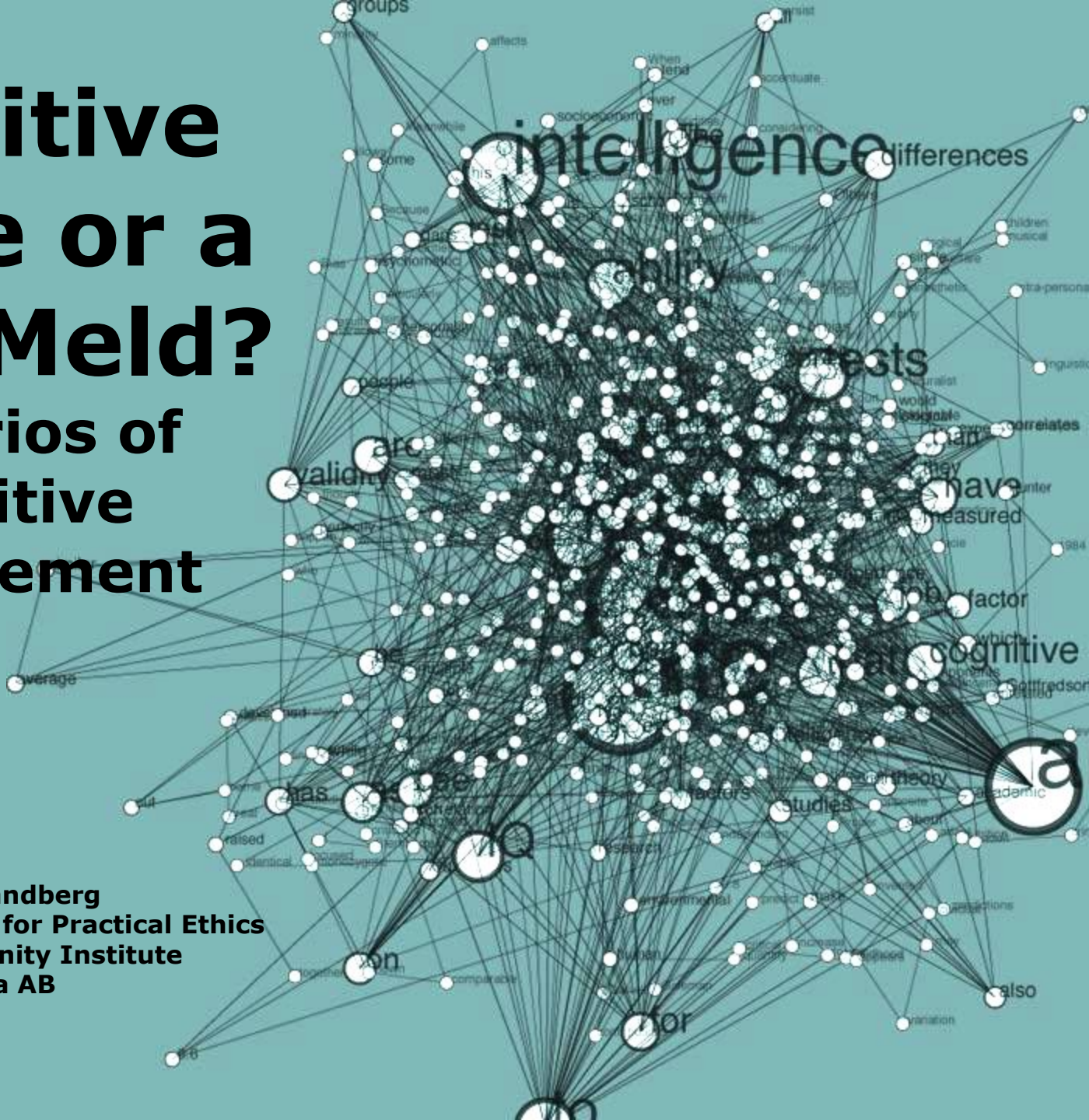
Cognitive Divide or a Mind-Meld?

Scenarios of Cognitive Enhancement



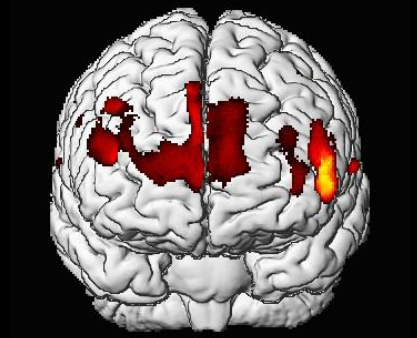
Anders Sandberg
Oxford Uehiro Centre for Practical Ethics
Future of Humanity Institute
Eudoxa AB

Proactionary Principle

"People's freedom to innovate technologically is highly valuable, even critical, to humanity. This implies several imperatives when restrictive measures are proposed: Assess risks and opportunities according to available science, not popular perception. Account for both the costs of the restrictions themselves, and those of opportunities foregone. Favor measures that are proportionate to the probability and magnitude of impacts, and that have a high expectation value. Protect people's freedom to experiment, innovate, and progress."

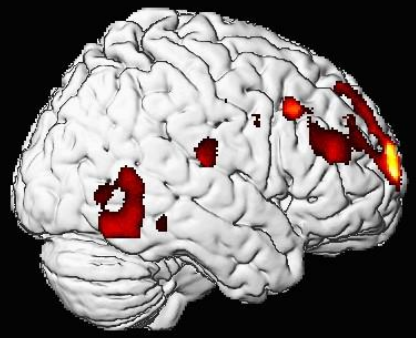
- Max More

IQ/Gray Matter Correlations



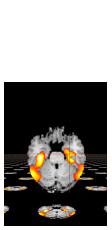
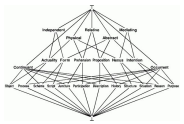
Frontal Lobe

Left Hemisphere



Right Hemisphere

Techniques for Enhancement

	Hardware	Software
Internal		  
External	  	$\int \frac{dx}{x^5(ax+b)^3} = \frac{a^4x^2}{2b^5(ax+b)^2} - \frac{4a^3x}{b^5(ax+b)} - \frac{(ax+b)^2}{2b^5x^2} - \frac{6a^2}{b^5}\ln\left(\frac{ax+b}{x}\right)$  Google 


Recycle Bin
Cygwin
My Computer
TOSHIBA Warranty
My Documents
Emacs
Internet Explorer
Memory Authenticity
TOSHIBA Assist
Evolution heuristic
InterVideo WinDVD
Intelligence Happine...
TOSHIBA User's Manual
Beijing
Mozilla Firefox
Prenatal Enhancemen
MATLAB R12
Social Impact
Intelligence - Wikipedia, the free encyclopedia - Mozilla Firefox
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CSC - Login
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SquirrelMail 1.4.8
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Intelligence
From Wikipedia, the free encyclopedia
For other uses, see Intelligence (disambiguation).
Intelligence is a property of mind that encompasses many related mental abilities, such as the capacities to reason, plan, solve problems, think abstractly, comprehend ideas and language, and learn.
Although many regard the concept of intelligence as having a much broader scope, for example in cognitive science and computer science, in some schools of psychology, the study of intelligence generally regards this trait as distinct from creativity, personality, character, or wisdom.
Contents [hide]
1 Definitions of intelligence
2 Psychometric intelligence
2.1 Intelligence, IQ, and g
2.2 Criticisms of the psychometric approach
3 One or several types of intelligence?
4 Controversies
5 References
6 See also
7 External links
Look up intelligence in Wiktionary, the free dictionary.
WIKIPEDIA
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Donations
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cognition
Go
Search
toolbox
What links here
Related changes
Upload file
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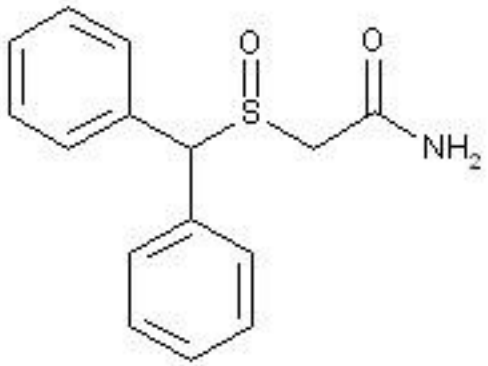
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TECNOLOGIA
FARMACEUTICA
INNOVADORA
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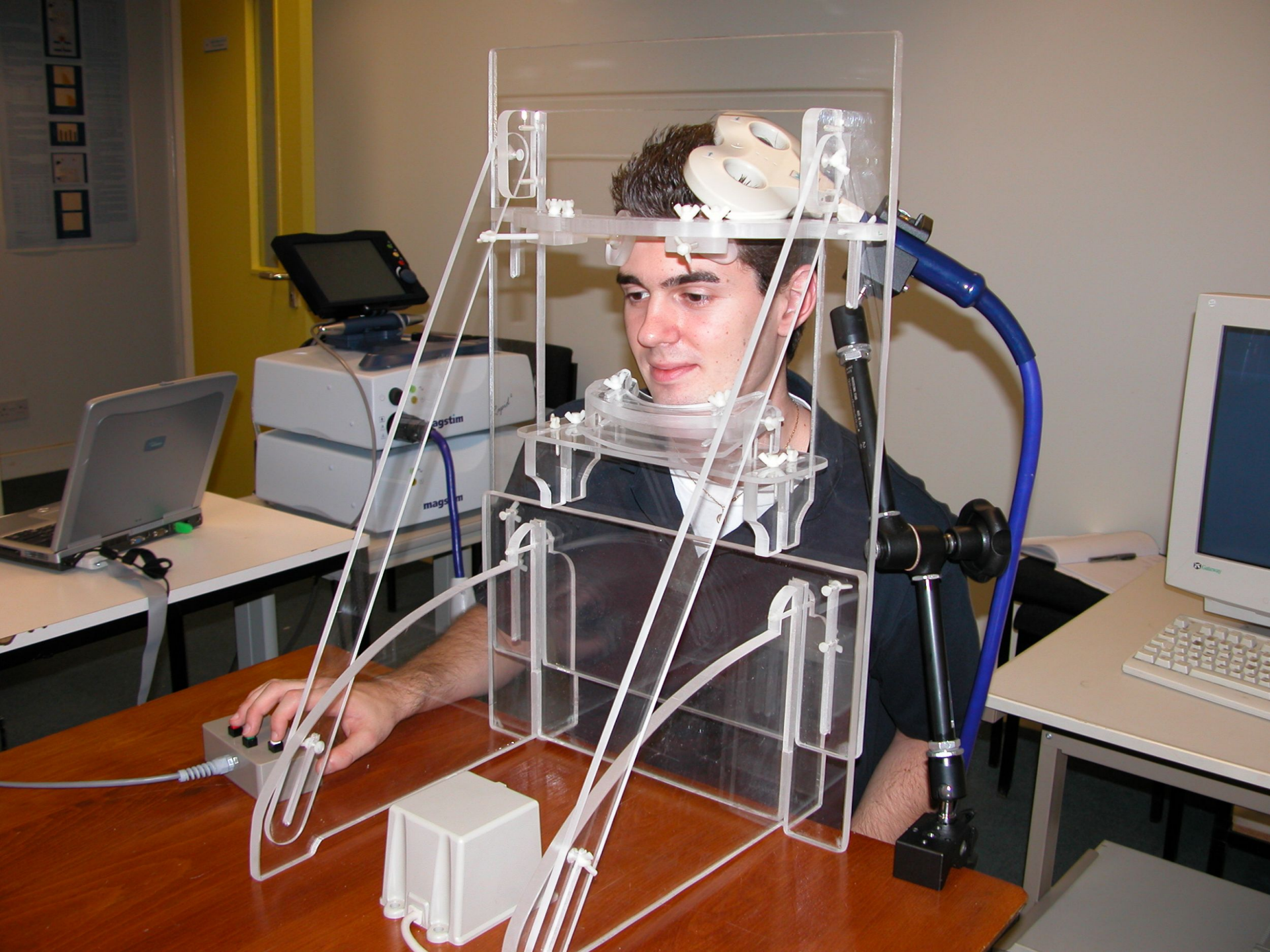
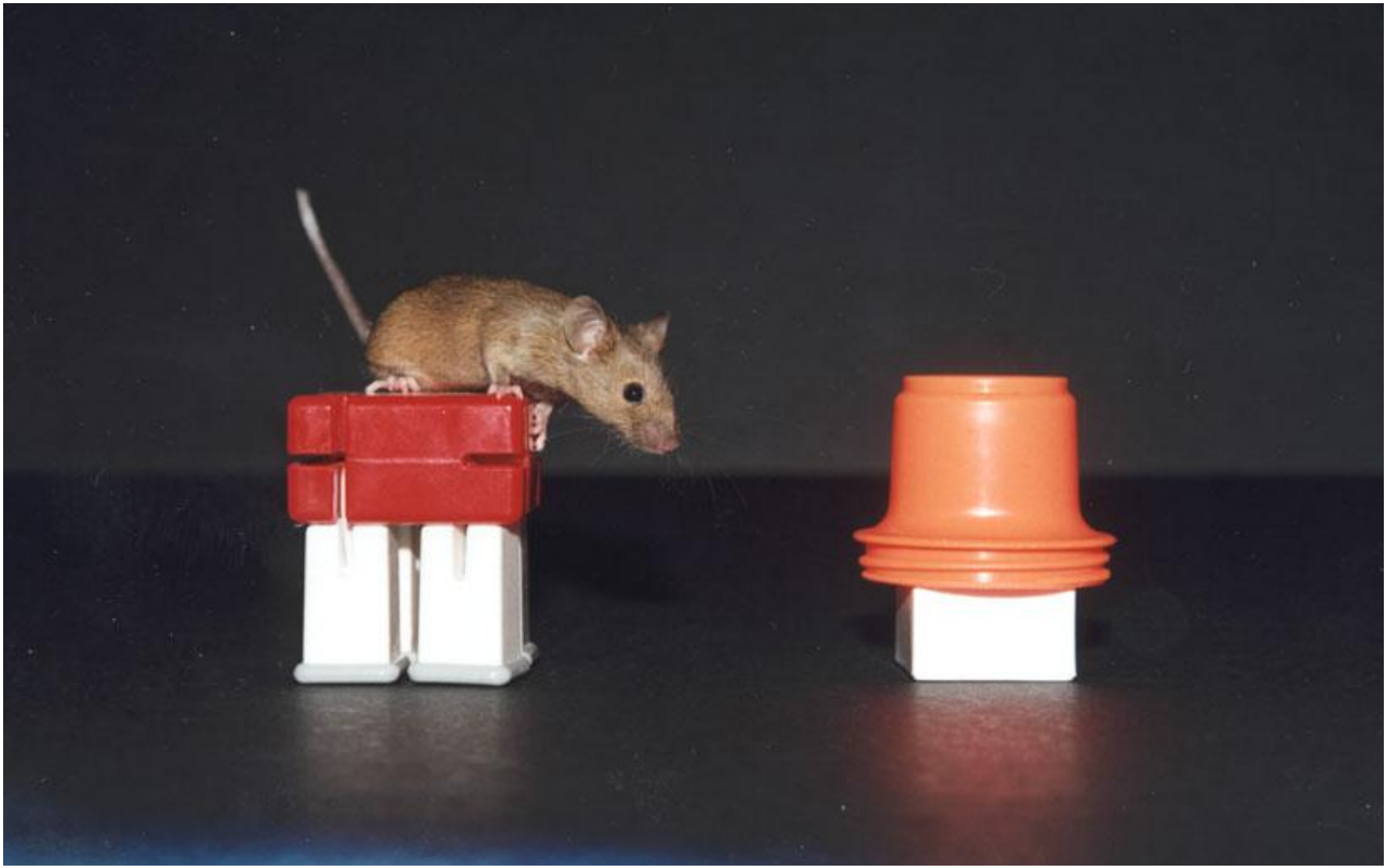
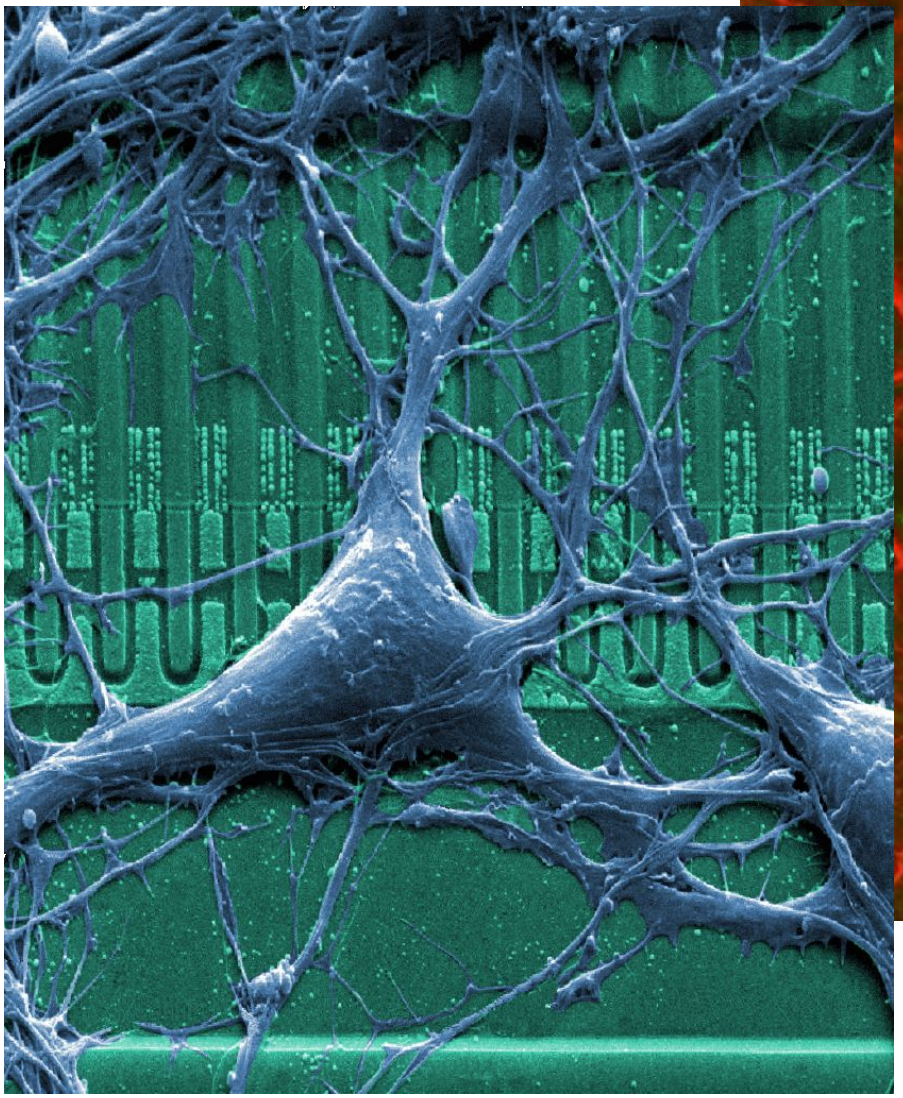
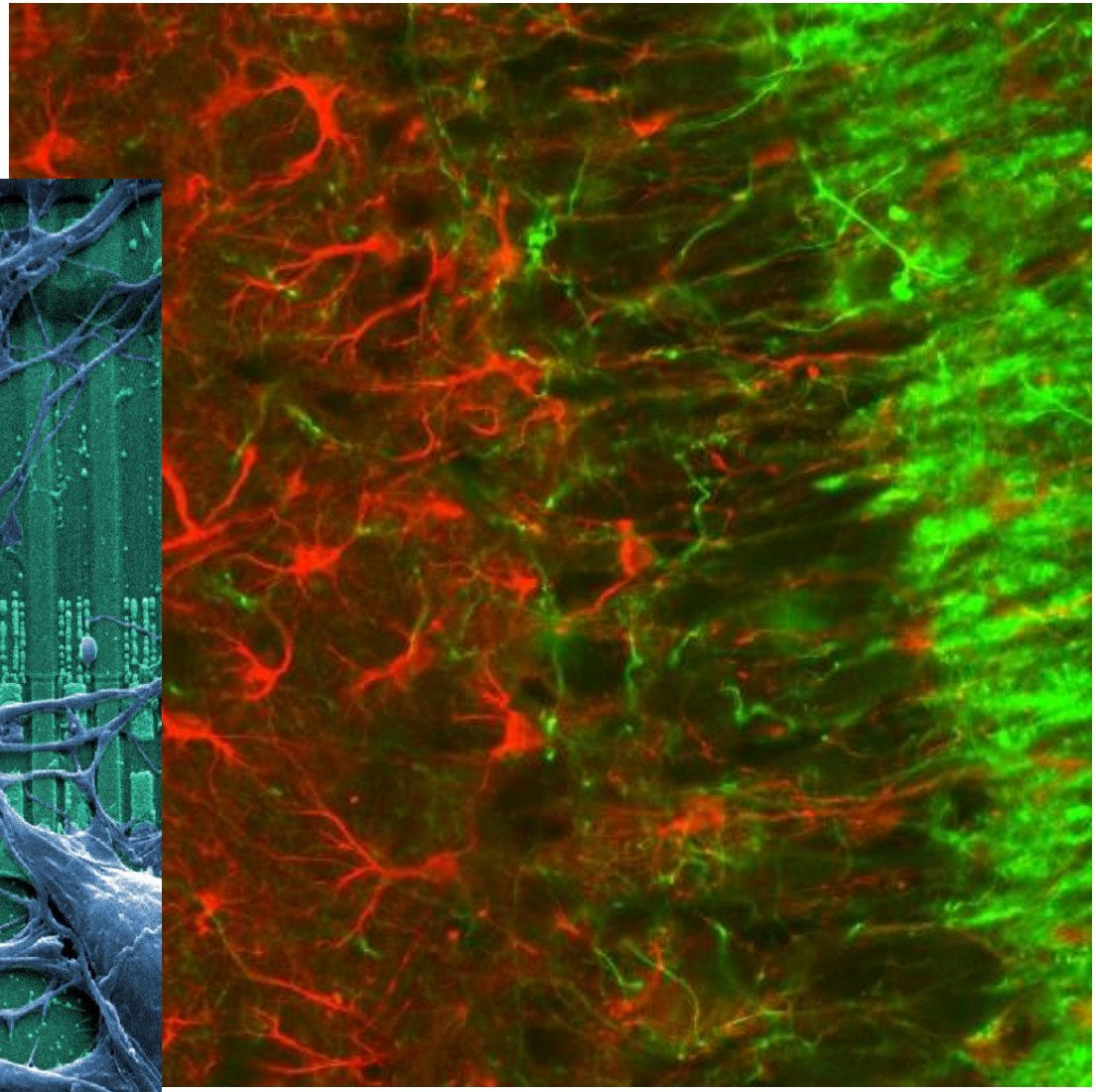
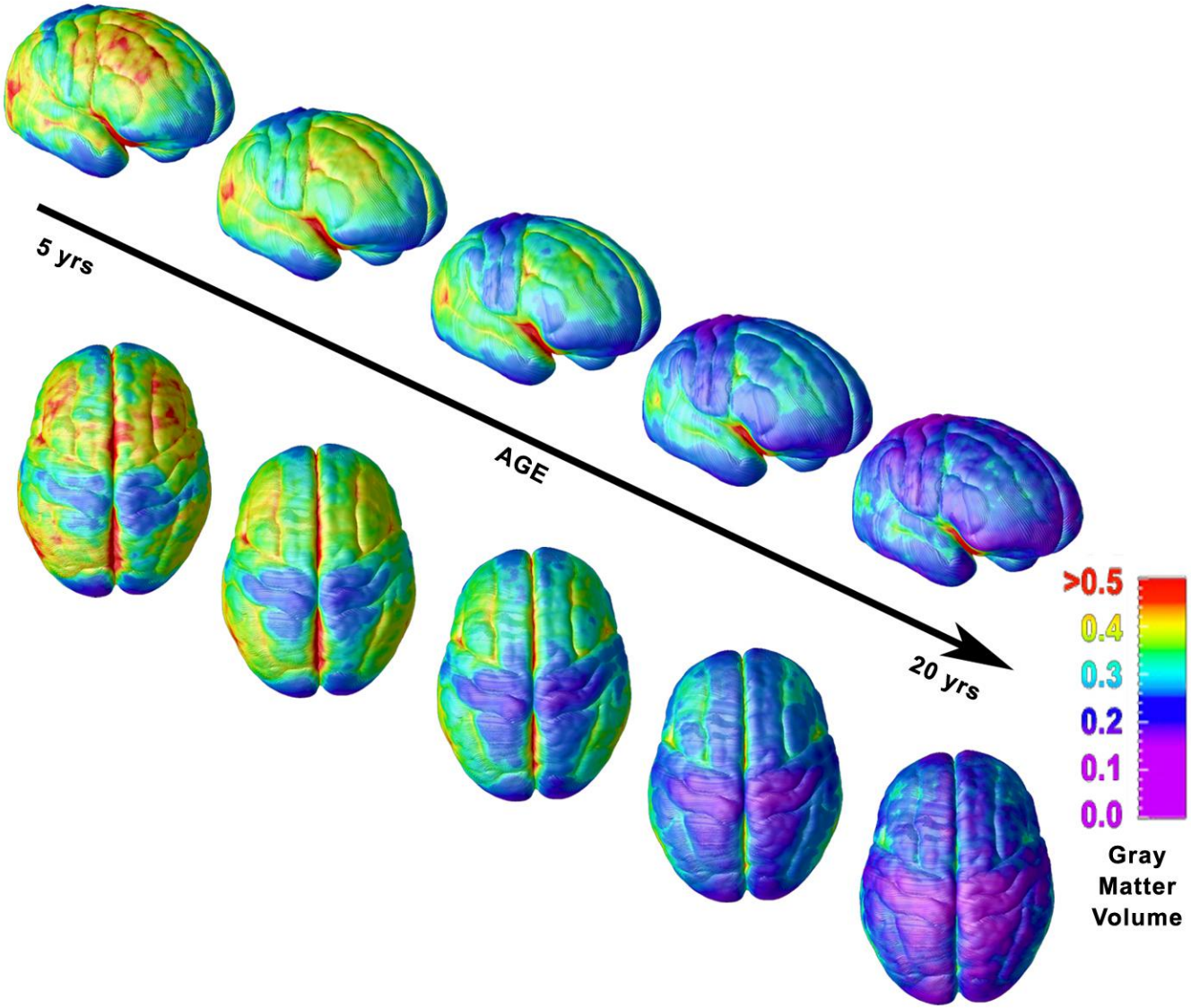


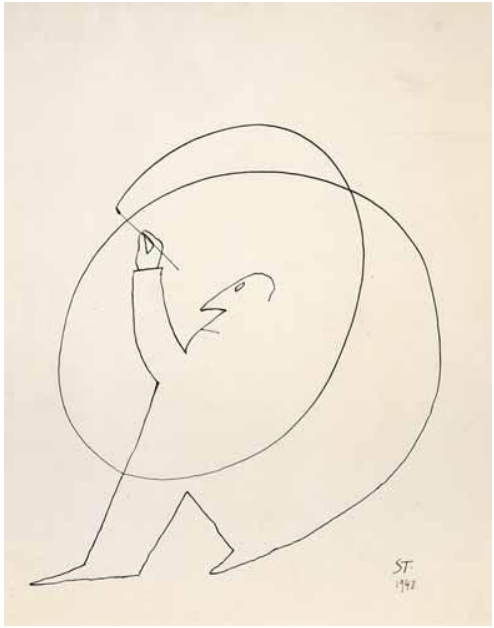







5 yrs
AGE
20 yrs
>0.5
0.4
0.3
0.2
0.1
0.0
Gray
Matter
Volume

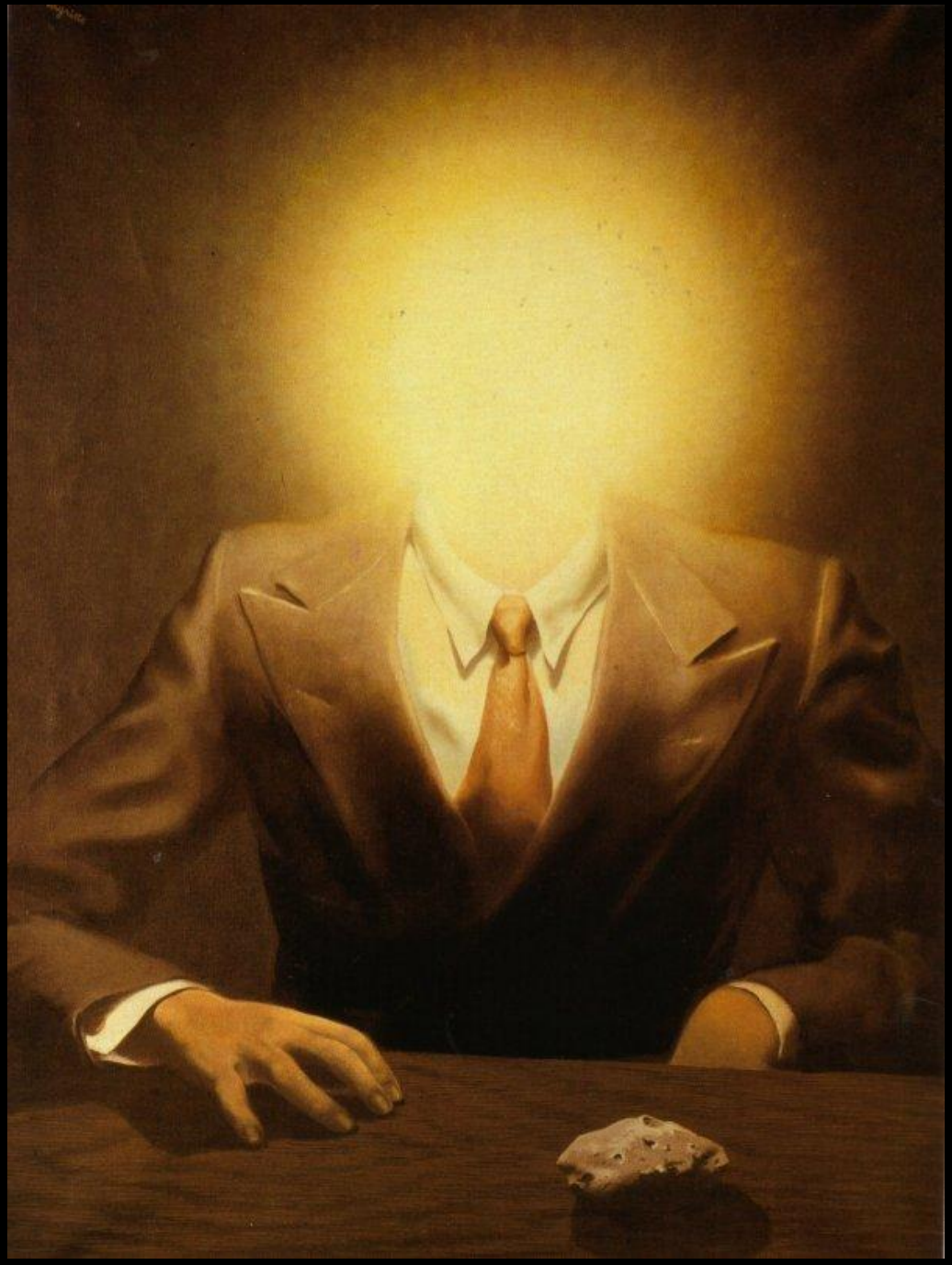
	Internal software	**Mental training**	General thinking	Visualisation	Memory arts	Specific techniques	Meditation	Education	Enriched environments	**Internal hardware**	General health	Drugs	TMS	Genetic modification/selection	Prenatal supplements	Brain computer interfaces	**External hardware/software**	Objects	Software	Wearables	Ubiquitous computing	Social software
Memory/learning			◆		◆				◆		◆	◆	◆	◆				◆	◆	◆		◆
Working memory					◆						◆	◆	◆					◆	◆	◆	◆	
Long term memory					◆				◆		◆	◆	◆	◆	◆			◆	◆	◆	◆	◆
Procedural memory				◆							◆	◆	◆			◆		◆	◆		◆	◆
Cortical reorganisation				◆					◆		◆	◆	◆			◆						
Epistemology								◆										◆	◆			◆
Executive function			◆			◆					◆	◆							◆			
Attention						◆	◆				◆	◆						◆	◆			
Self-control							◆				◆	◆						◆	◆			◆
Metacognition											◆											
Intelligence			◆			◆					◆				◆			◆	◆			◆
Problem solving						◆					◆							◆	◆			◆
Planning						◆					◆							◆	◆			◆
Overview						◆					◆							◆	◆			◆
Creativity				◆		◆					◆	◆	◆					◆	◆			◆
Avoiding biases																		◆	◆			◆
Perception			◆			◆					◆							◆	◆			
Language ability											◆							◆	◆			◆
Mental function			◆								◆											
Energy							◆				◆	◆							◆			
Speed											◆	◆							◆			
Timing											◆							◆	◆			
Wake/sleep							◆				◆	◆				◆		◆	◆			
New capacities																						
New senses																		◆	◆	◆		
New reflexes																		◆	◆	◆		
Human-computer link																◆				◆		

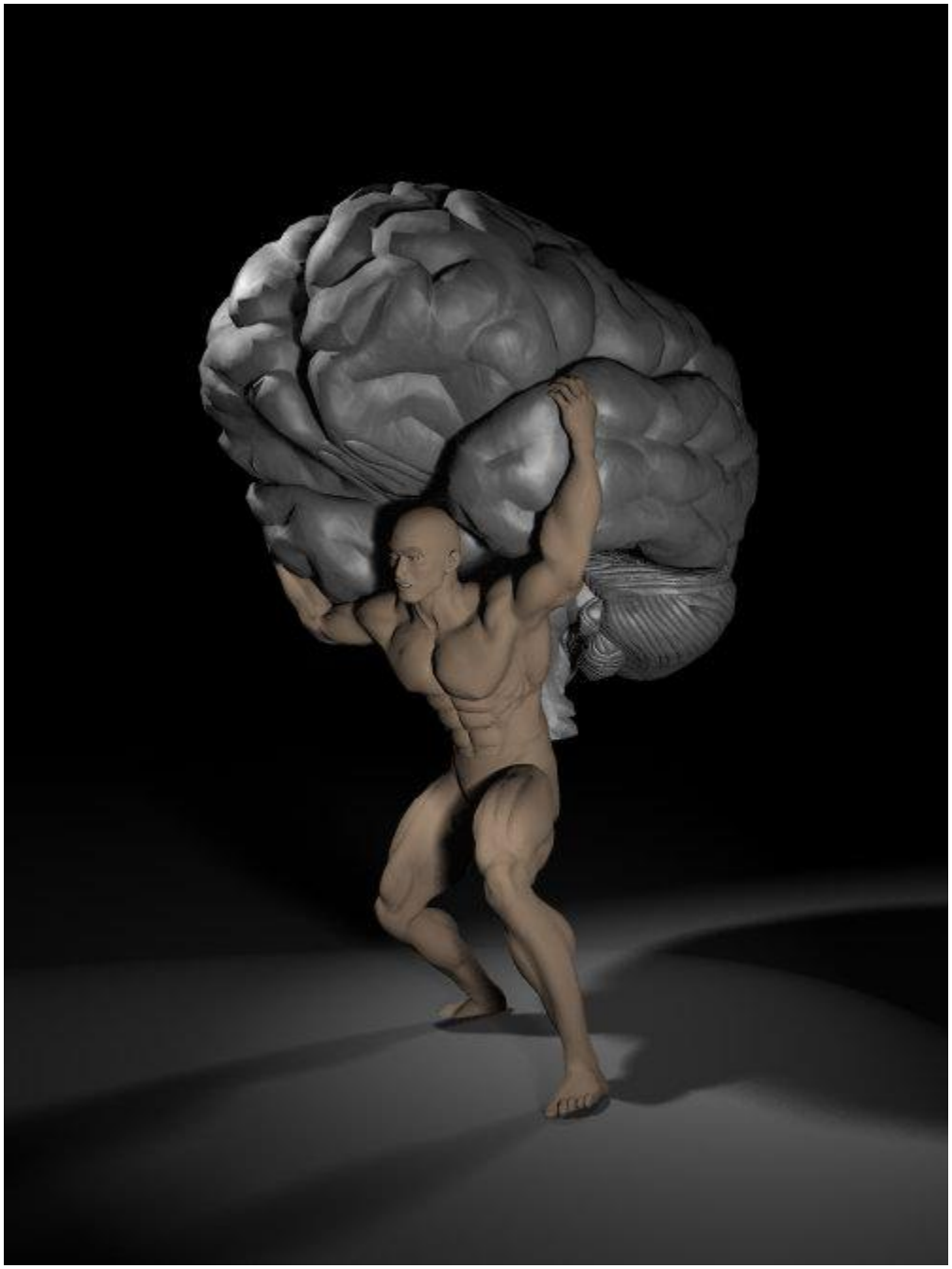


◆: Some evidence

◆ : Successful use

◆ : In use





Regression Coefficients					Test That Each Coefficient = 0	
	B	SE(B)	Beta	SE(Beta)	T-statistic	Probability
AGE	-.001	.001	-.027	.023	-1.172	.242
SEX	-.033	.024	-.027	.020	-1.363	.174
RACE	.033	.022	.030	.020	1.484	.138
EDUC	-.008	.005	-.037	.023	-1.619	.106
INCOME	-.015	.006	-.056	.021	-2.676	.008
MARITAL	.072	.008	.191	.022	8.873	.000
ATTEND	-.016	.005	-.070	.020	-3.443	.001
HEALTH	.203	.016	.266	.021	12.693	.000
VOTE96	-.005	.022	-.005	.022	-.232	.817
WORDSUM	.014	.007	.046	.022	2.055	.040
Constant	1.524	.131			11.616	.000

Color coding:	<-2.0	<-1.0	<0.0	>0.0	>1.0	>2.0	T
Effect of each variable:	Negative			Positive			

Multiple R =	.380	R-Squared =	.145	Std Error of Estimate =	.568

Frequency Distribution

Cells contain:
-Column percent
-N of cases

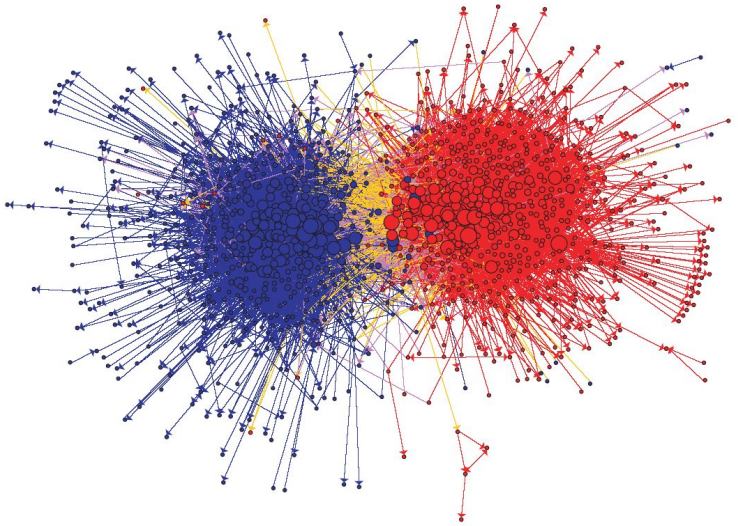
		HAPPY			
		1 VERY HAPPY	2 PRETTY HAPPY	3 NOT TOO HAPPY	*ROW TOTAL*
WORDSUM	0	.8 50	.7 80	1.5 35	*.8* *165*
	1	2.0 131	1.5 166	3.5 79	*1.9* *376*
	2	3.5 227	3.2 362	4.8 109	*3.5* *698*
	3	5.9 379	6.0 684	10.4 237	*6.5* *1,300*
	4	9.7 627	10.5 1,188	13.4 305	*10.6* *2,120*
	5	15.8 1,017	16.1 1,833	18.5 420	*16.3* *3,270*
	6	20.7 1,335	22.2 2,521	18.7 424	*21.3* *4,280*
	7	16.1 1,040	15.6 1,778	10.8 245	*15.2* *3,063*
	8	11.1 714	10.0 1,142	7.8 178	*10.1* *2,034*
	9	8.1 524	8.1 918	6.1 138	*7.9* *1,580*
	10	6.3 405	6.1 695	4.5 103	*6.0* *1,203*
	COL TOTAL	*100.0* *6,449*	*100.0* *11,367*	*100.0* *2,273*	*100.0* *20,089*

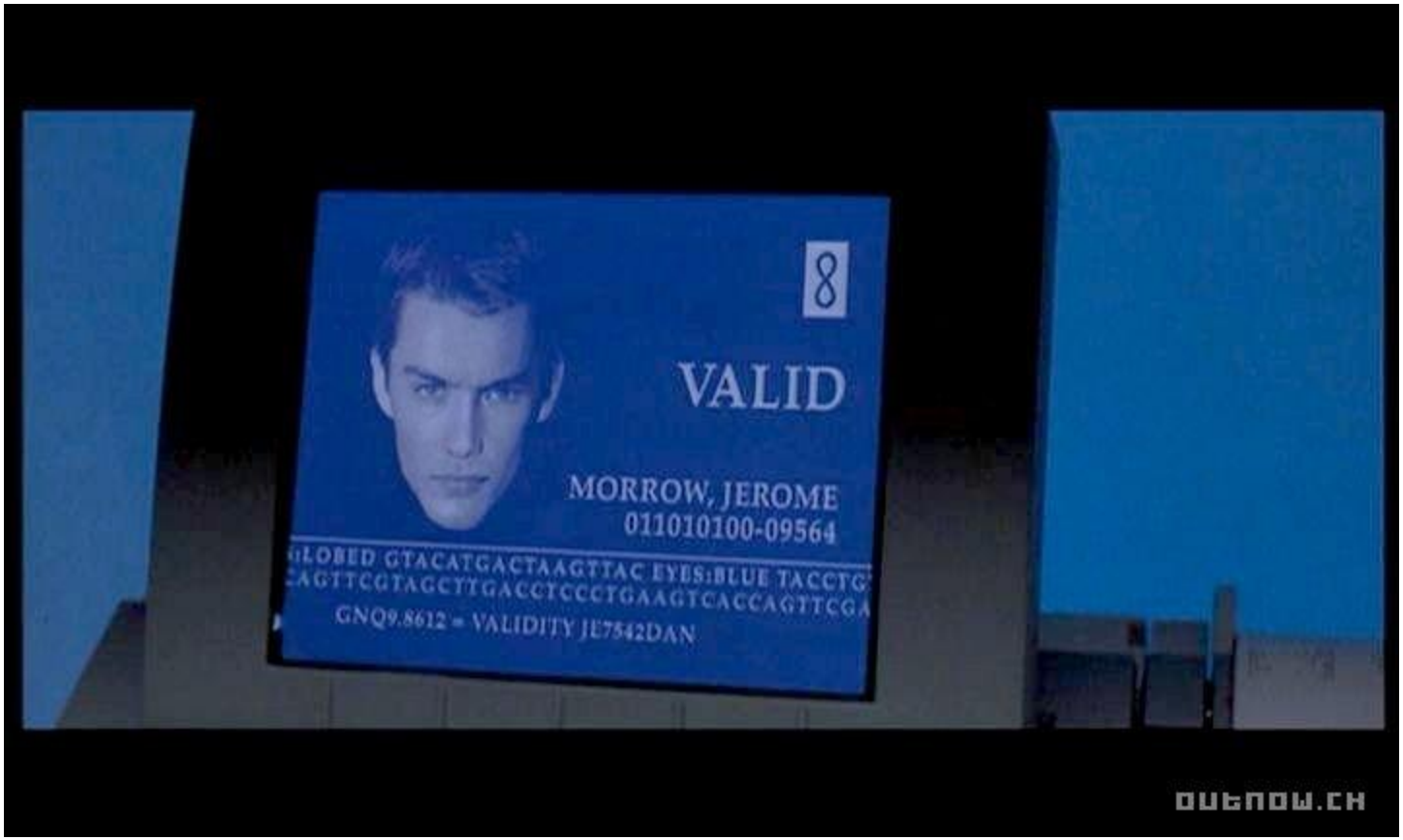
Color coding:	<-2.0	<-1.0	<0.0	>0.0	>1.0	>2.0	Z
N in each cell:	Smaller than expected			Larger than expected			

Analysis from General Social Surveys, 1972-2004. WORDSUM is a vocabulary test with about 0.83 correlation with IQ (Sigelman 1981). Table A is regression of stated happiness (HAPPY) against several different factors. Table B shows the distribution of HAPPY and WORDSUM scores. Note the strong unhappiness among the lower than average vocabulary scorers.

"[I]t's not the poor families in Africa that are going to be doing this, it's going to be the very affluent who are going to at first have healthier children…and then it becomes the slippery slope, they will have stronger, faster, smarter children… Then you've got these two very disparate classes."

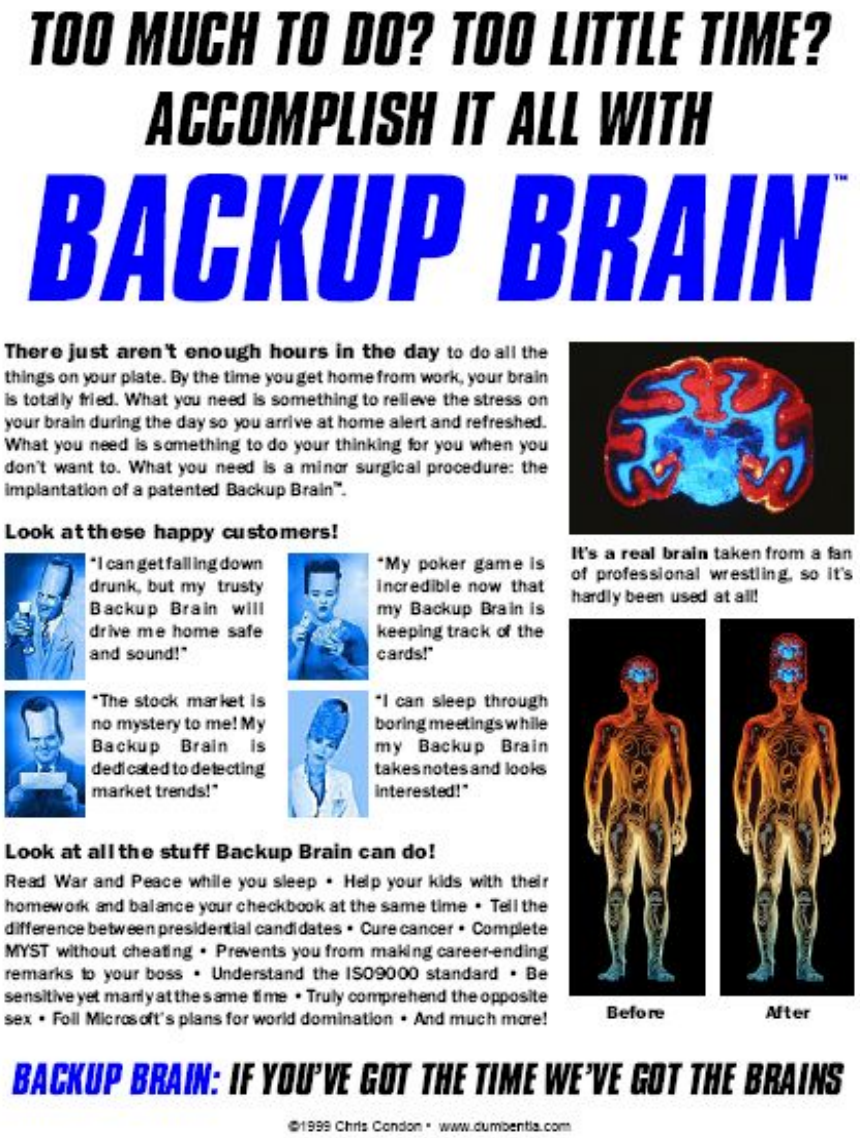
Kalfoglou A, Suthers, K, Scott J, & K Hudson, *Reproductive Genetic Testing: What America Thinks*, Washington, DC: Genetics and Public Policy Center, 2002




VALID
MORROW, JEROME
011010100-09564
GLOBED GTACATGACTAAGTTAC EYES:BLUE TACCTG
CAGTTCGTAGCTTGACCTCCCTGAAGTCACCAGTTCGA
GNQ9.8612 = VALIDITY JE7542DAN
OUTNOW.CH

Economy of Enhancement

- Benefits
  - Reduction of losses
  - Individual benefits
  - Societal benefits
- Costs
  - Individual
  - Competition

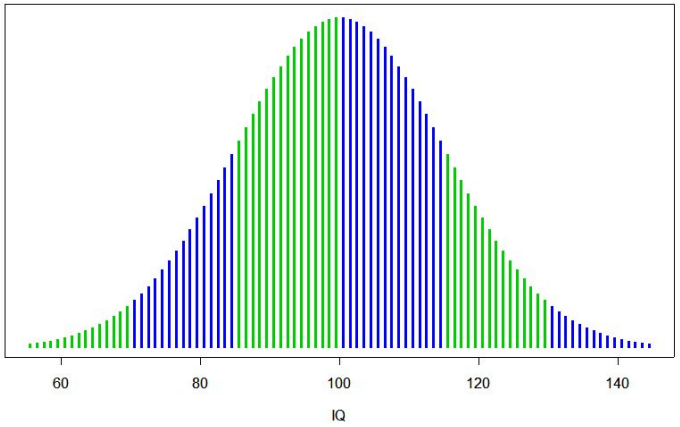


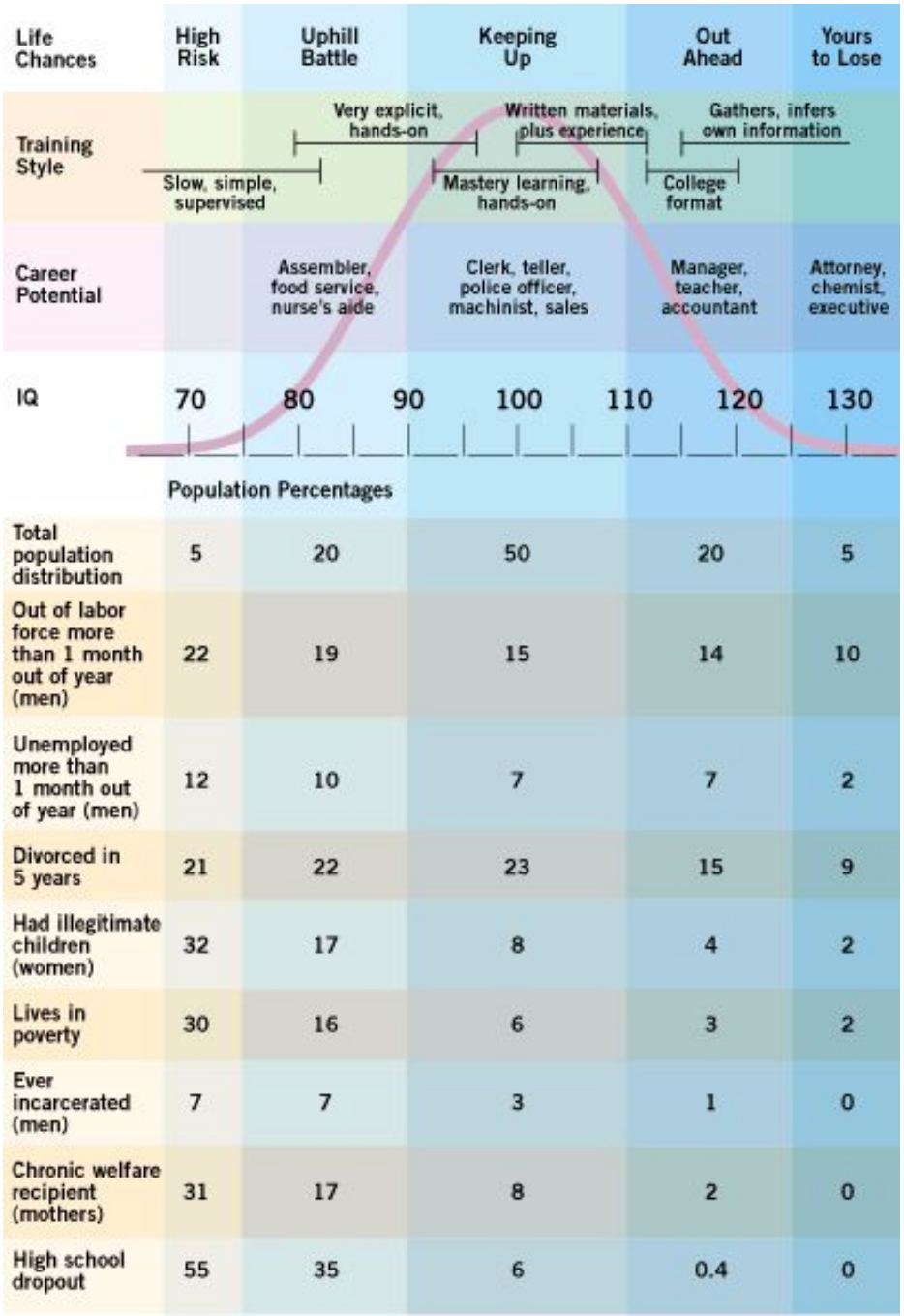
Reduction of Losses

- Lost keys UK £250 million/year
- Forgotten standing payment orders: £400 million/month ($53/month person)
- Sleepiness cause 15-20% road accidents (as well as work-related accidents, iatrogenic illness etc)
- Higher IQ likely reduces accident risks

- Can cognitive enhancement reduce this?

- Linda Gottfredson:
  - IQ 75: not likely to master the elementary school curriculum or function independently in adulthood in modern societies.
  - IQ 85: close to the upper boundary for Level 1 functional literacy, the lowest of five levels in the U.S. government's 1992 National Adult Literacy Survey. (locating the expiration date on a driver's license or totalling a bank deposit slip, but not writing a brief letter explaining an error in a credit card bill or find a piece of information in an article)
  - IQ 105: minimum threshold for achieving moderately high levels of success. Competitive for middle-level jobs (clerical, crafts and repair, sales, police and fire fighting)
  - IQ 115+: ability threshold for being competitive as a candidate for graduate or professional school in the U.S. and thus for high levels of socioeconomic success. Self-instructing and are expected to instruct, advise, and supervise others in their community and work environments. Range from which cultural leaders tend to emerge and be recruited.





Individual Effects

Cognition important for good life

Environmental toxin models

+1 IQ point = +1.763% income (Schwartz), +2.094/3.631% (Salkever, m/f)

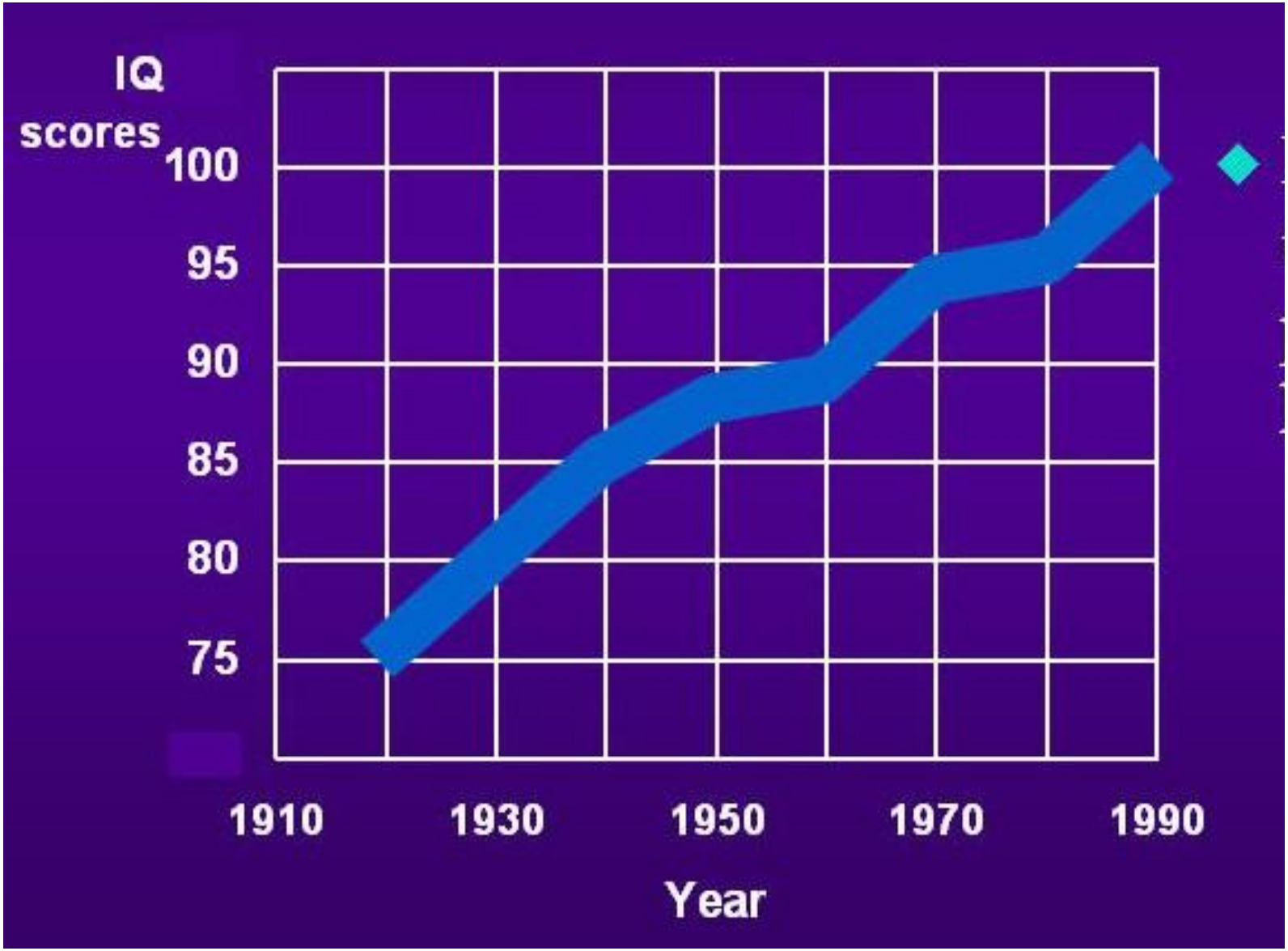
Annual gain / IQ point US $55-65 billion
0.4-0.5% GDP

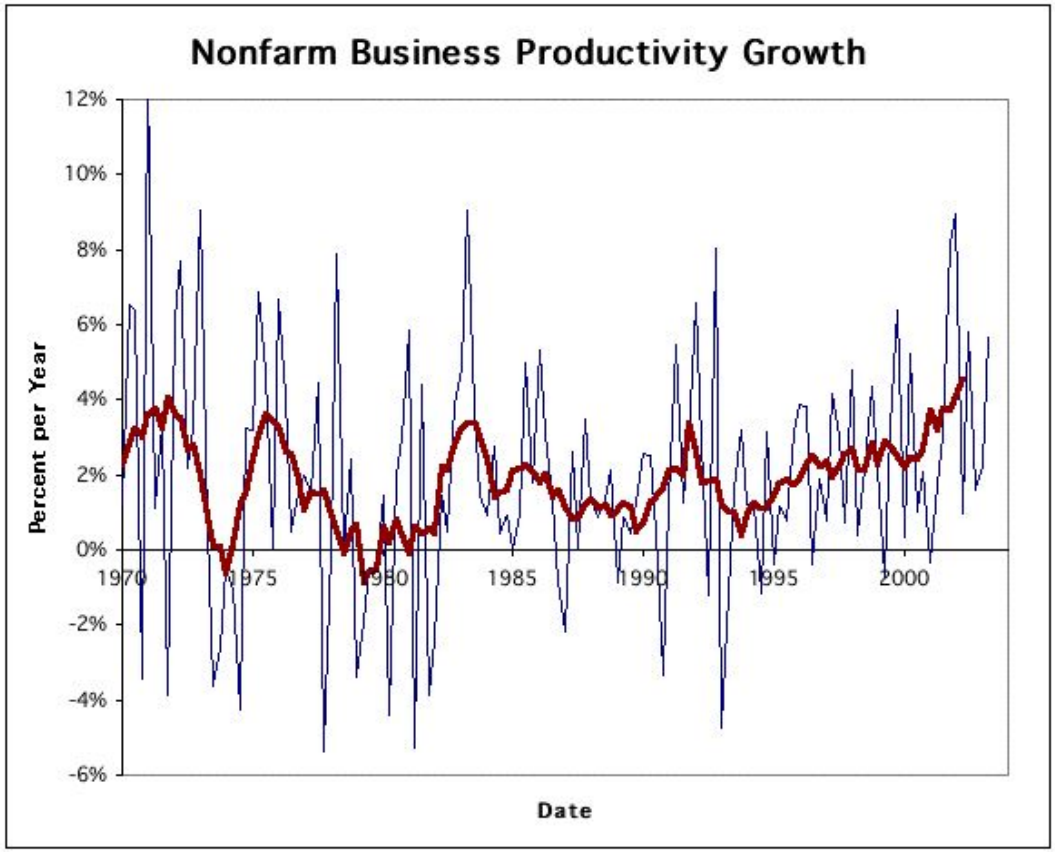
Effects on schooling, participation rate, social costs

Weiss 1998: 3 point IQ increase:

Poverty rate	-25%
Males in jail	-25%
High school dropouts	-28%
Parentless children	-20%
Welfare recipiency	-18%
Out-of-wedlock births	-15%

Gottfredson 2002

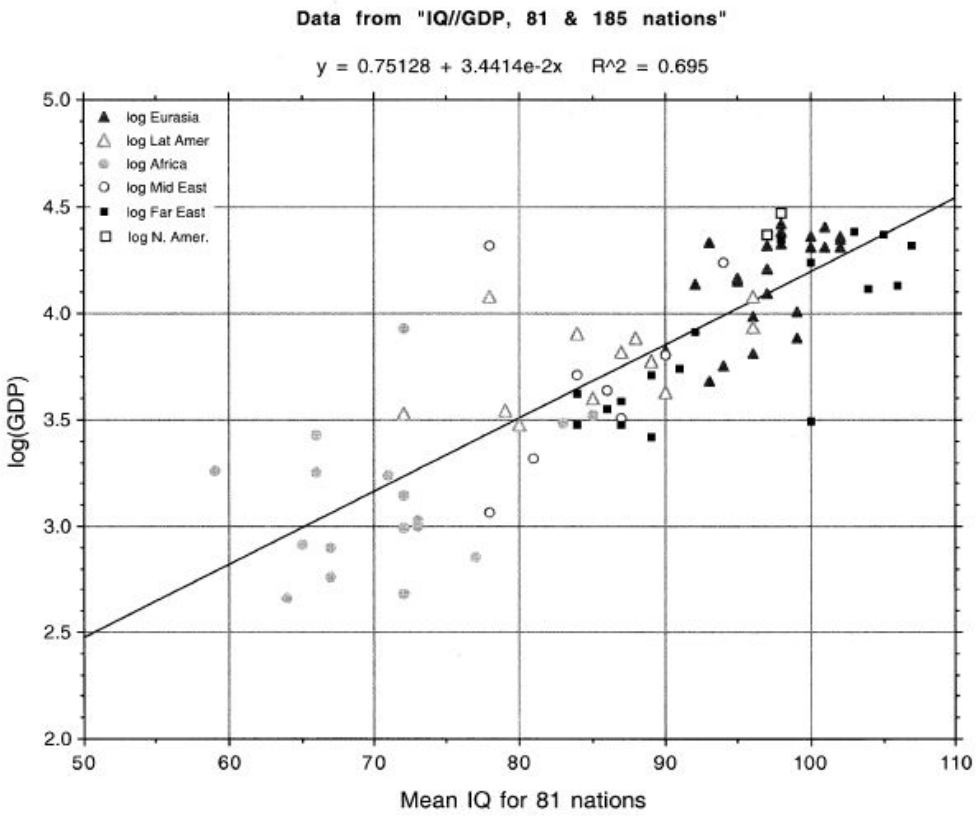

IQ scores
100
95
90
85
80
75
1910
1930
1950
1970
1990
Year



Economy Impact

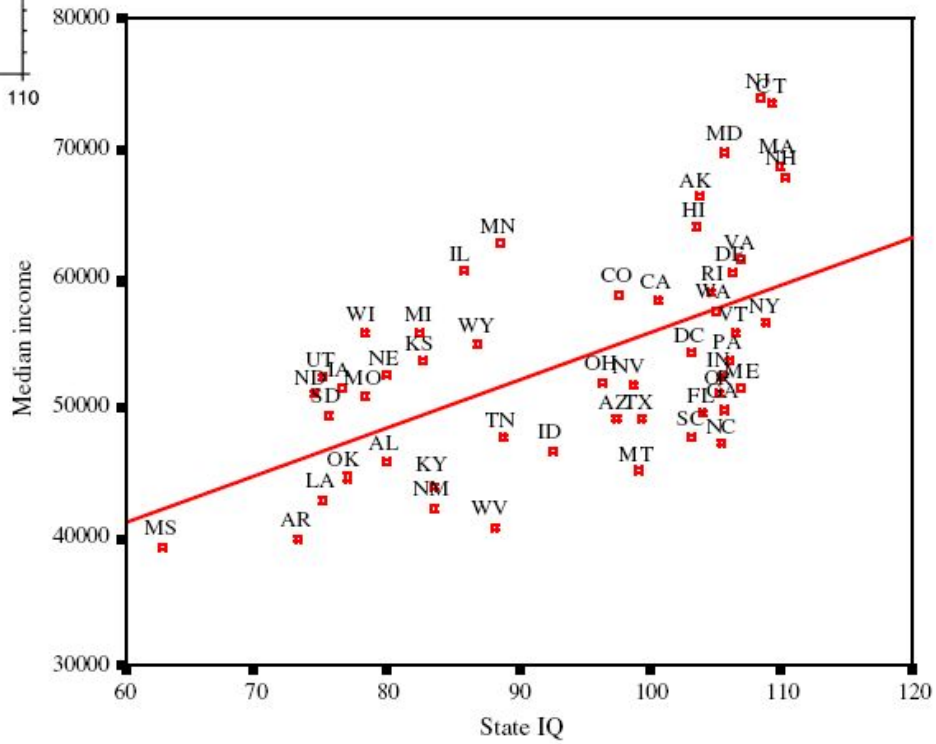
Growth residual due to productivity increase due to technology, human capital and other factors

Cognition plays a sizeable role



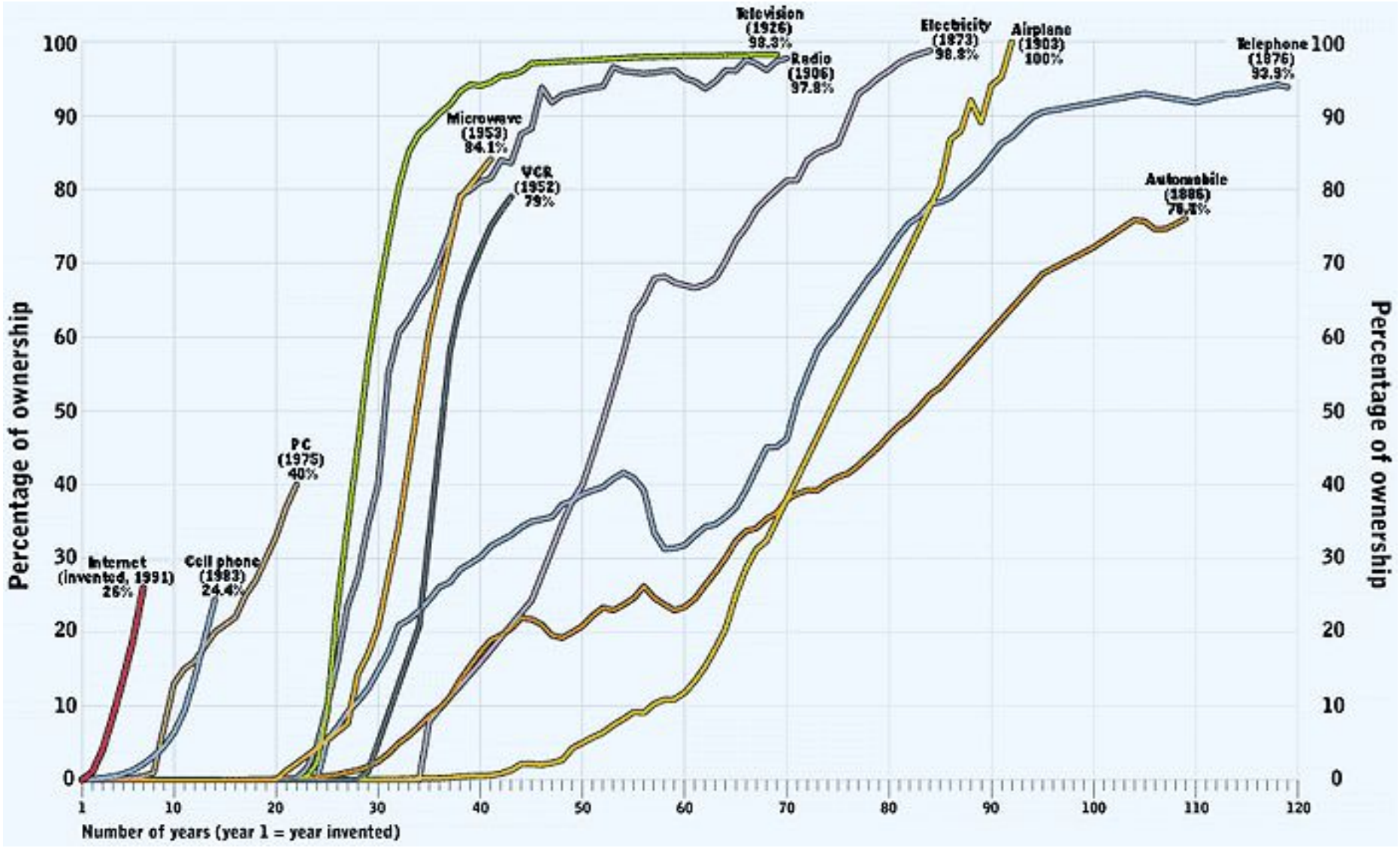
Dickerson 2005
(+1 IQ = +8.2% GDP)

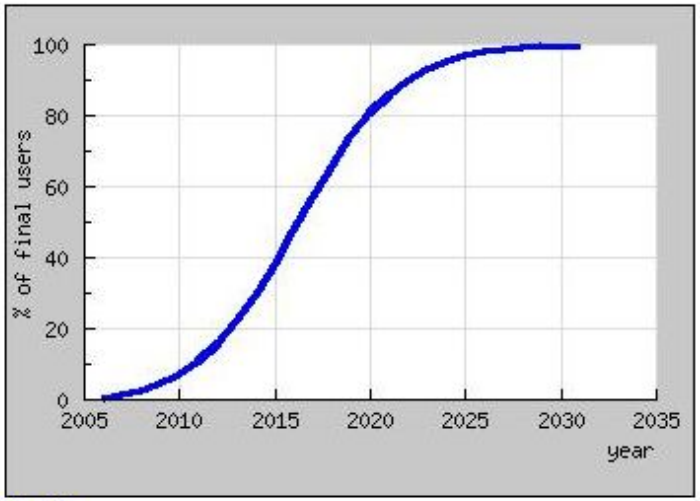
Kanazawa 2006



Costs

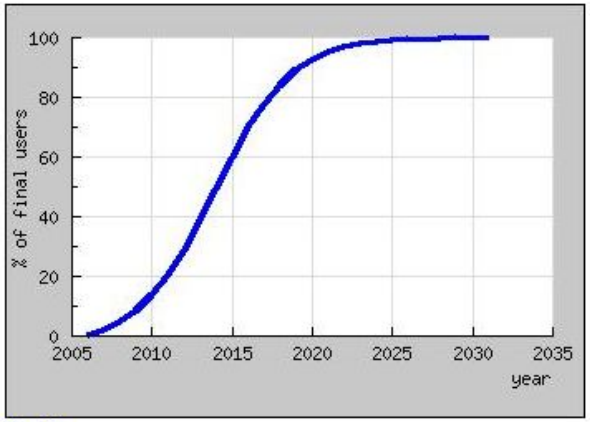
- Technology diffusion
  - Devices spread fast and thoroughly
  - Country gap
- Drugs
  - Monthly Modafinil cost ~3% of UK median income
- (Medical) services
  - Cost set by expert salaries


Television (1926) 98.3%
Radio (1906) 97.8%
Electricity (1873) 98.8%
Airplane (1903) 100%
Telephone (1876) 93.9%
Microwave (1953) 84.1%
VCR (1952) 79%
Automobile (1885) 79.8%
PC (1975) 40%
Internet (invented, 1991) 26%
Cell phone (1983) 24.4%
Percentage of ownership
Percentage of ownership
Number of years (year 1 = year invented)
0
10
20
30
40
50
60
70
80
90
100
1
10
20
30
40
50
60
70
80
90
100
110
120



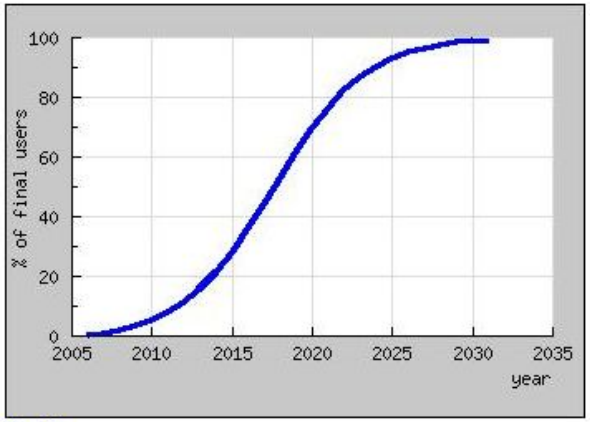
Prediction for:
Industry: general
Introduction in: 2006
Degree of Innovation: standard
Degree of Imitation: standard

View data



Prediction for:
Industry: medical
Introduction in: 2006
Degree of Innovation: standard
Degree of Imitation: standard

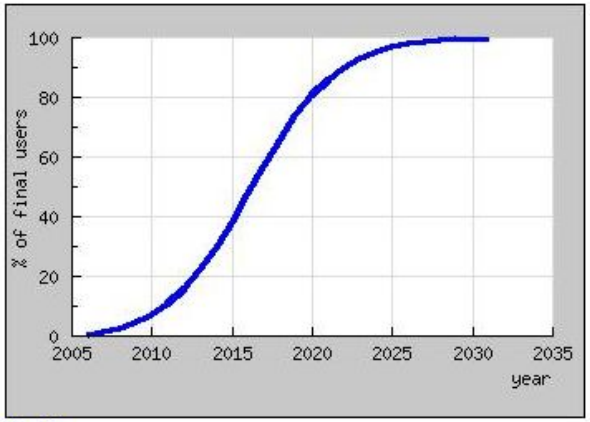
View data



Prediction for:
Industry: non durable
Introduction in: 2006
Degree of Innovation: standard
Degree of Imitation: standard

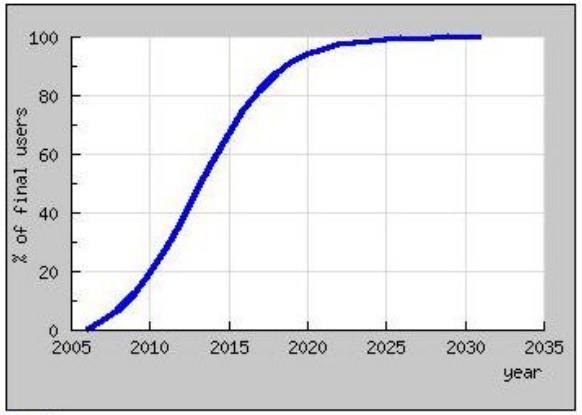
View data

http://www.andorraweb.com/bass/index.php?show[prediction]=1



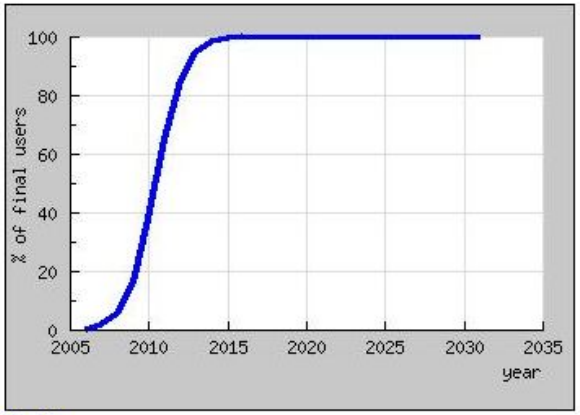
View data

Prediction for:
Industry: general
Introduction in: 2006
Degree of Innovation: standard
Degree of Imitation: standard



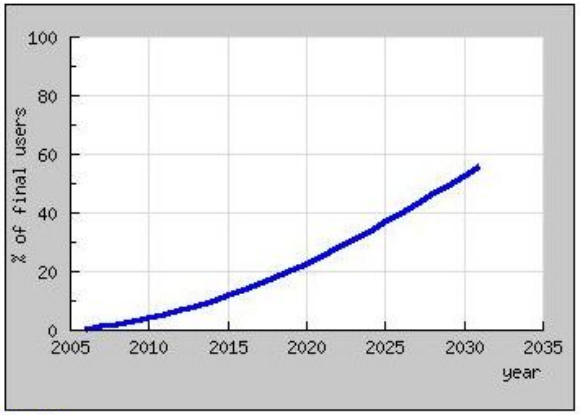
View data

Prediction for:
Industry: general
Introduction in: 2006
Degree of Innovation: +3
Degree of Imitation: standard



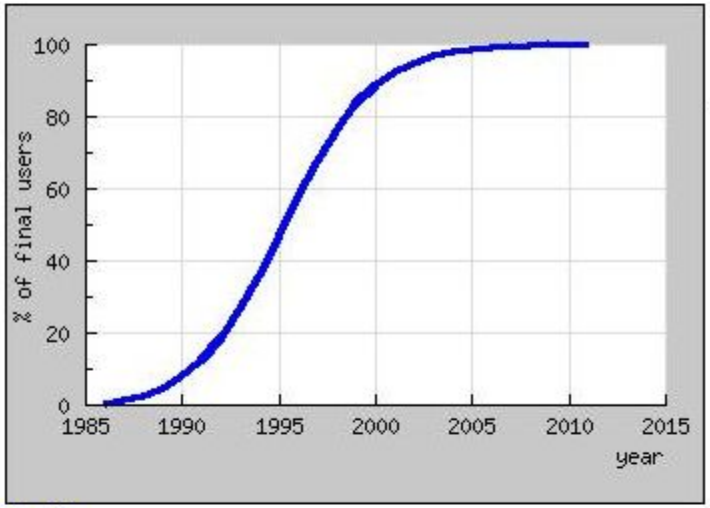
View data

Prediction for:
Industry: general
Introduction in: 2006
Degree of Innovation: standard
Degree of Imitation: +3



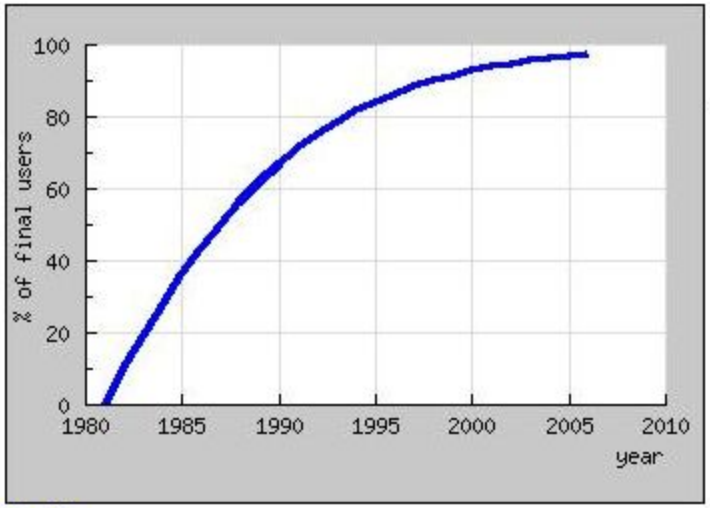
View data

Prediction for:
Industry: general
Introduction in: 2006
Degree of Innovation: standard
Degree of Imitation: -3



Cellular telephone
[Source: Lilien (1999),
http://www.ebusines

View data



Cable television
[Source: Lilien (1999),
http://www.ebusiness.

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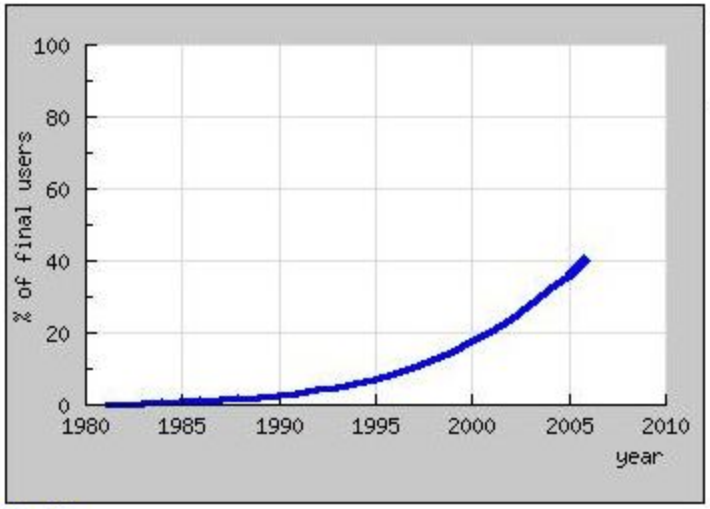

PC
[Source: Frank Bass (
http://www.utdallas.e

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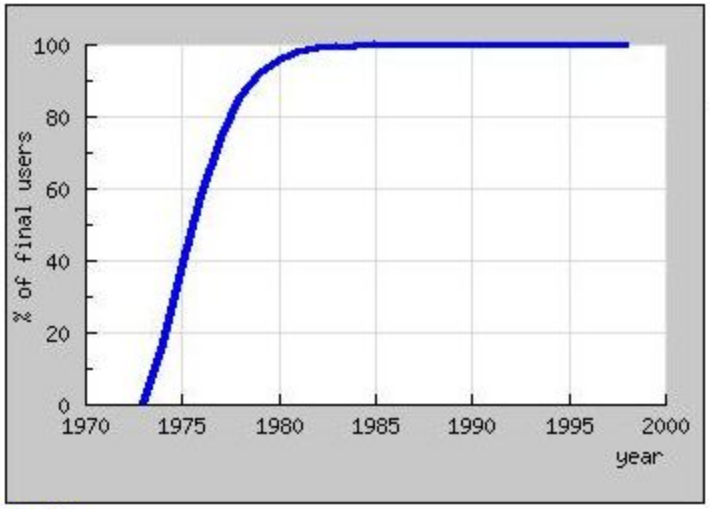


Calculators
[Source: Lilien (1999),
http://www.ebusiness.xe

View data

Drug Development Pipeline

gap 1

Basic research is published but preclinical research is not considered worthwhile.

gap 2

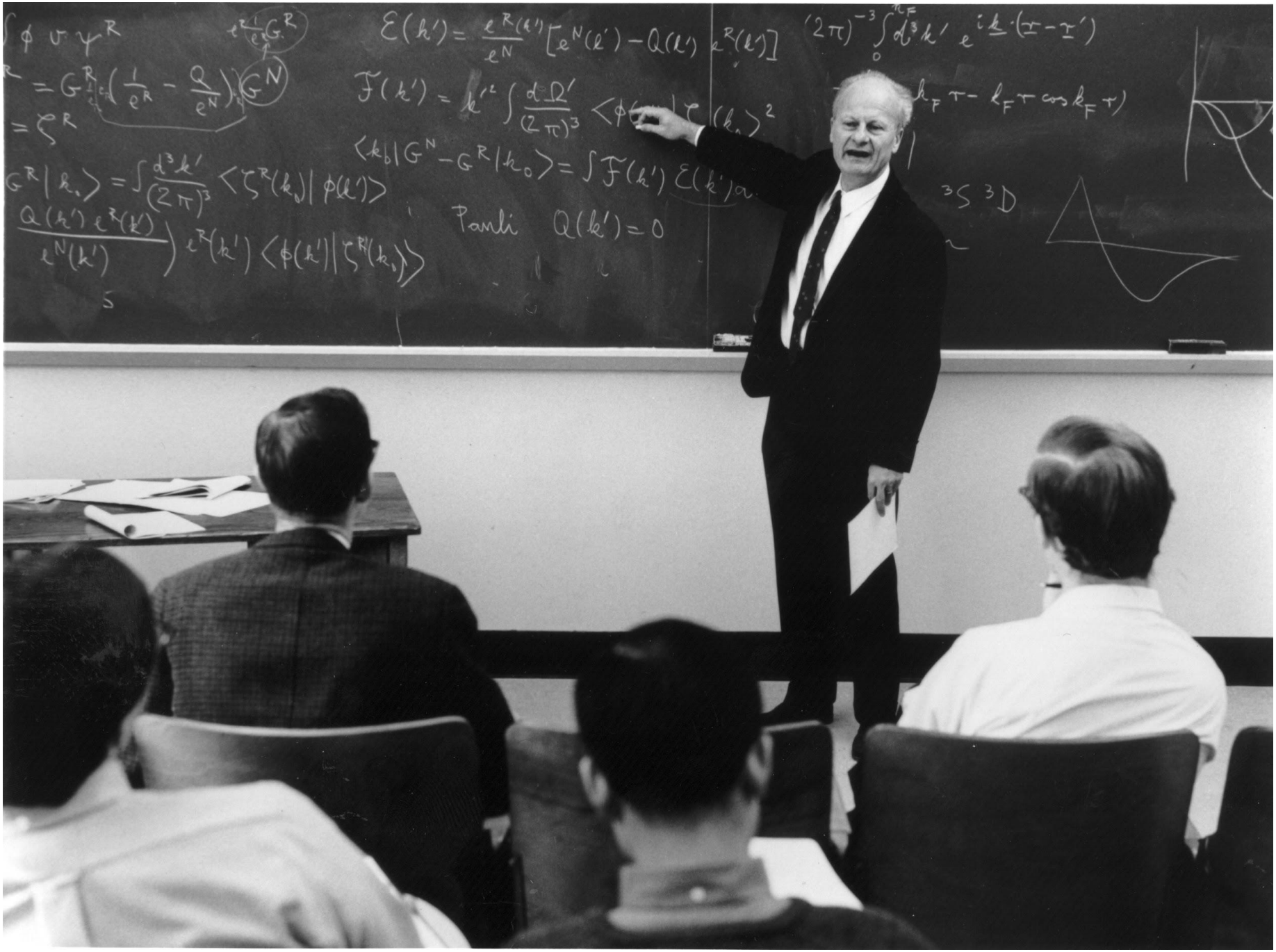
Validated candidate drugs don't enter clinical development because of profit-based company choices.

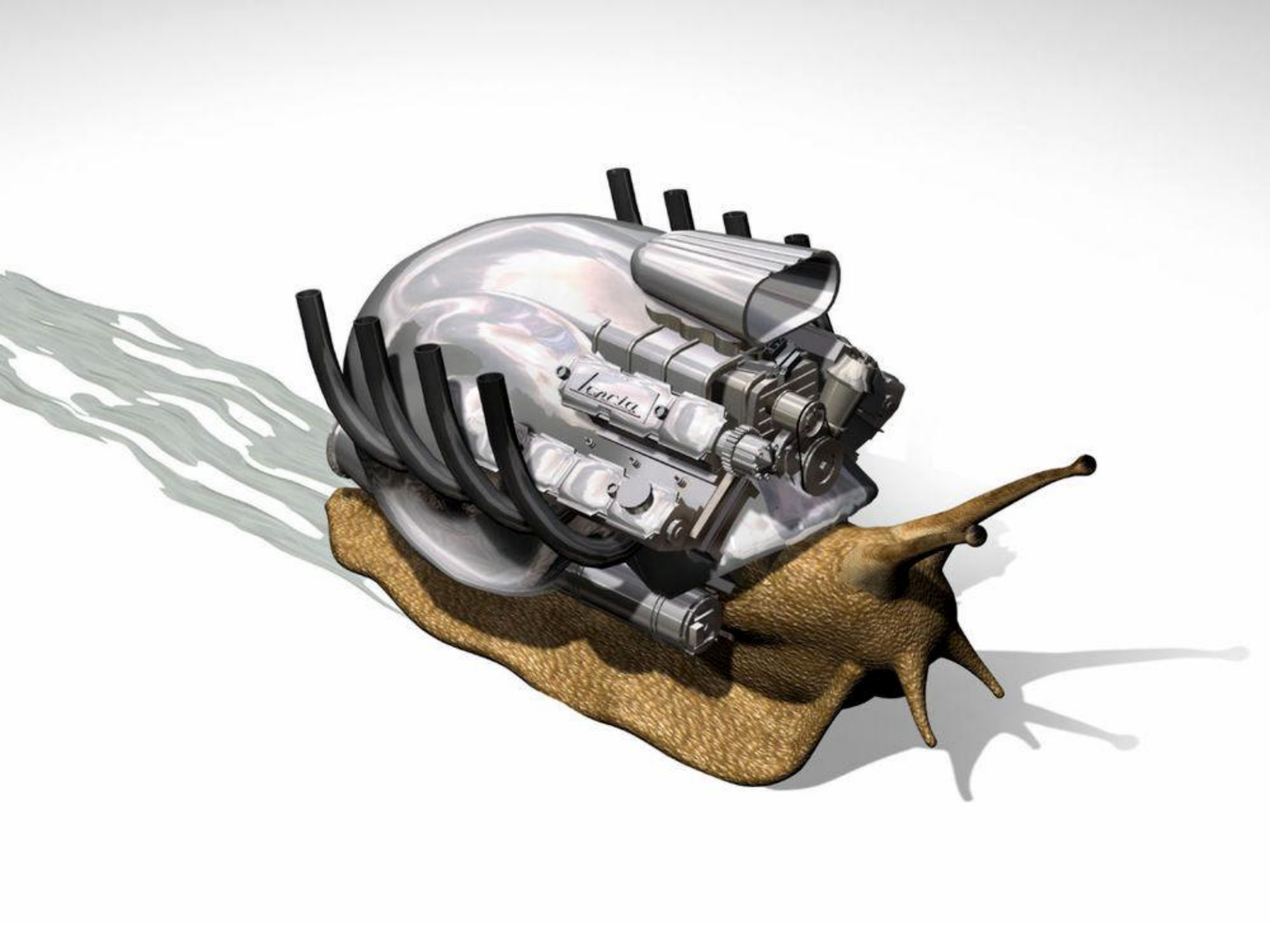
Predevelopment

Development

gap 3

Drugs never reach the patient (registration problems, lack of production, high prices or drugs poorly adapted to local conditions).

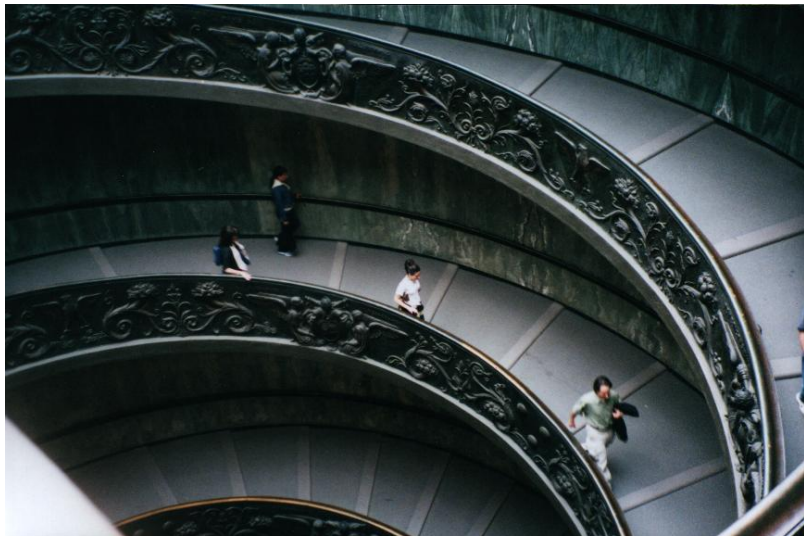

Pauli $Q(k')=0$
^3S ^3D

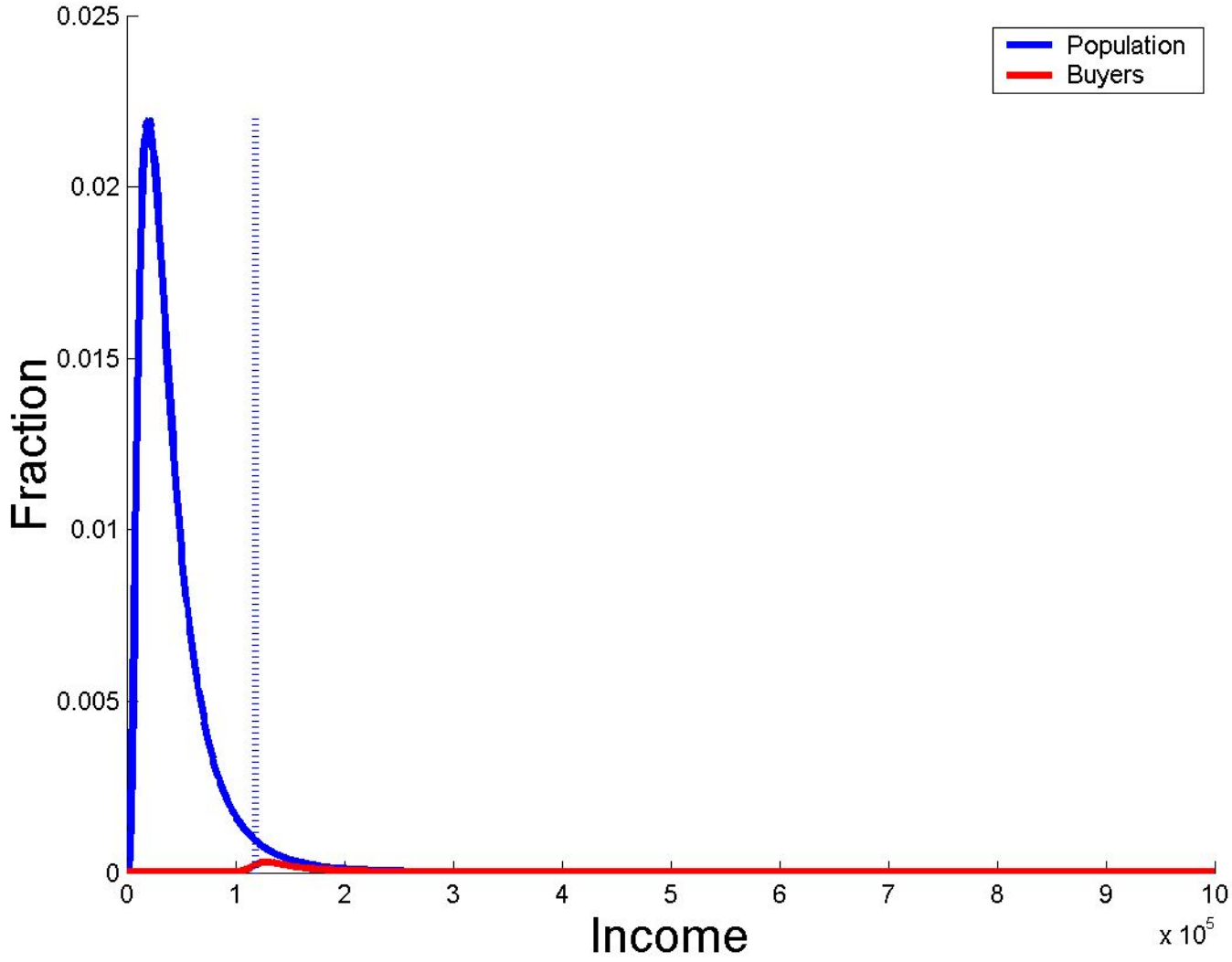


Simulation

- Initial experiments with income-enhancement models

- Enhancements that increase earning ability constant factor, decreasing to a low price
- Assumes no redistribution

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Buyers
Fraction
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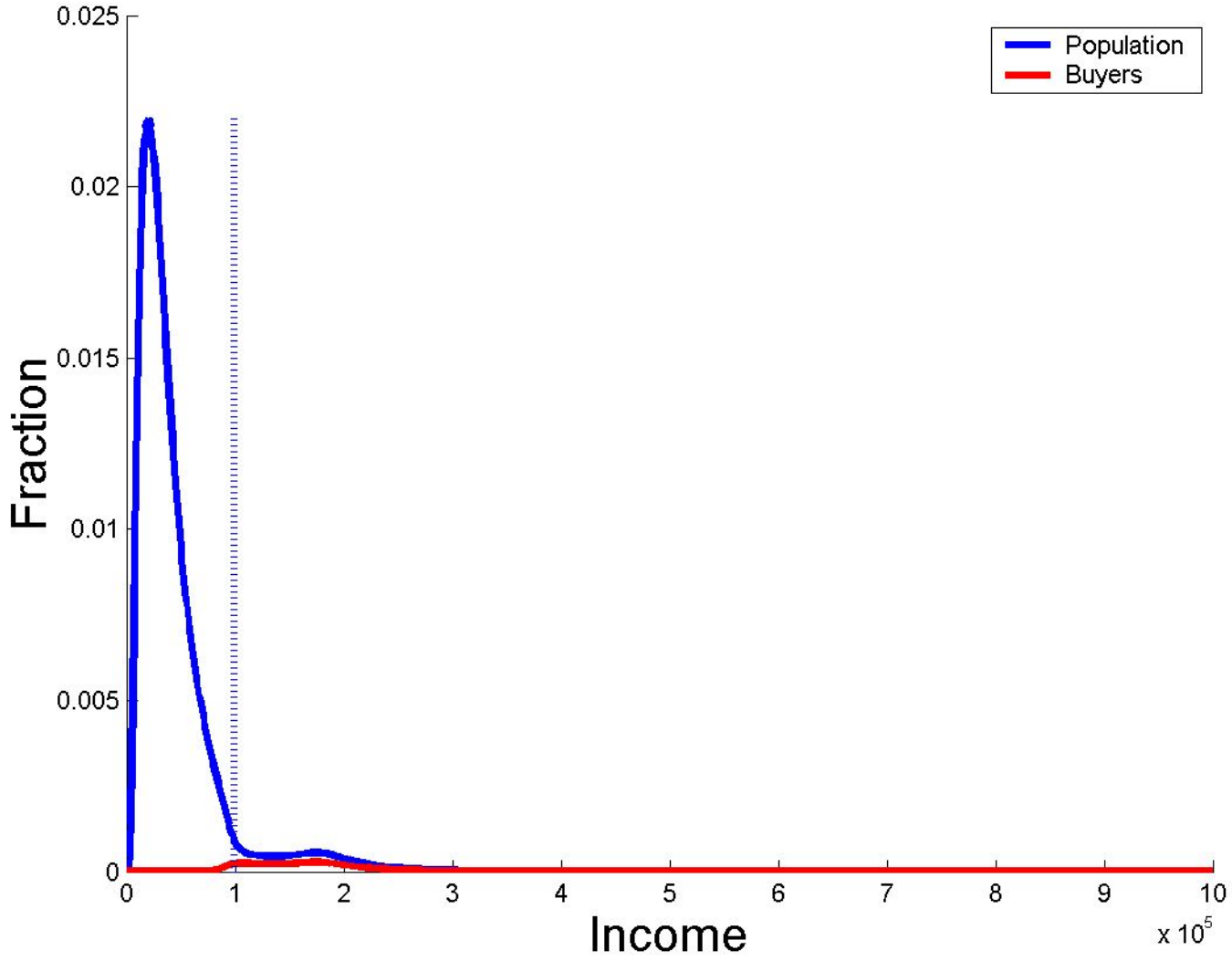
0.02
0.015
0.01
0.005
0
0
1
2
3
4
5
6
7
8
9
10
Income
x 10^5


Population
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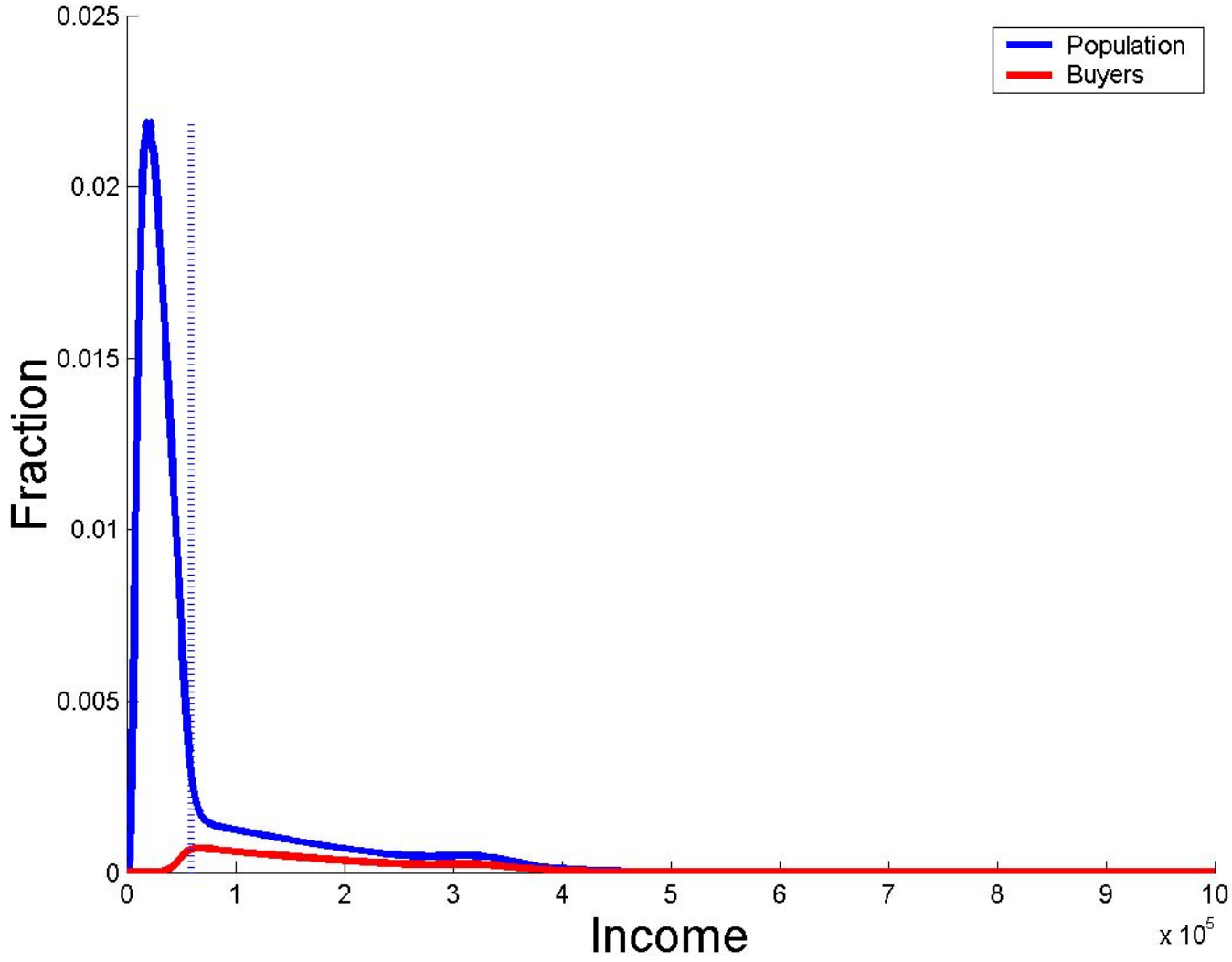
Income
x 10^5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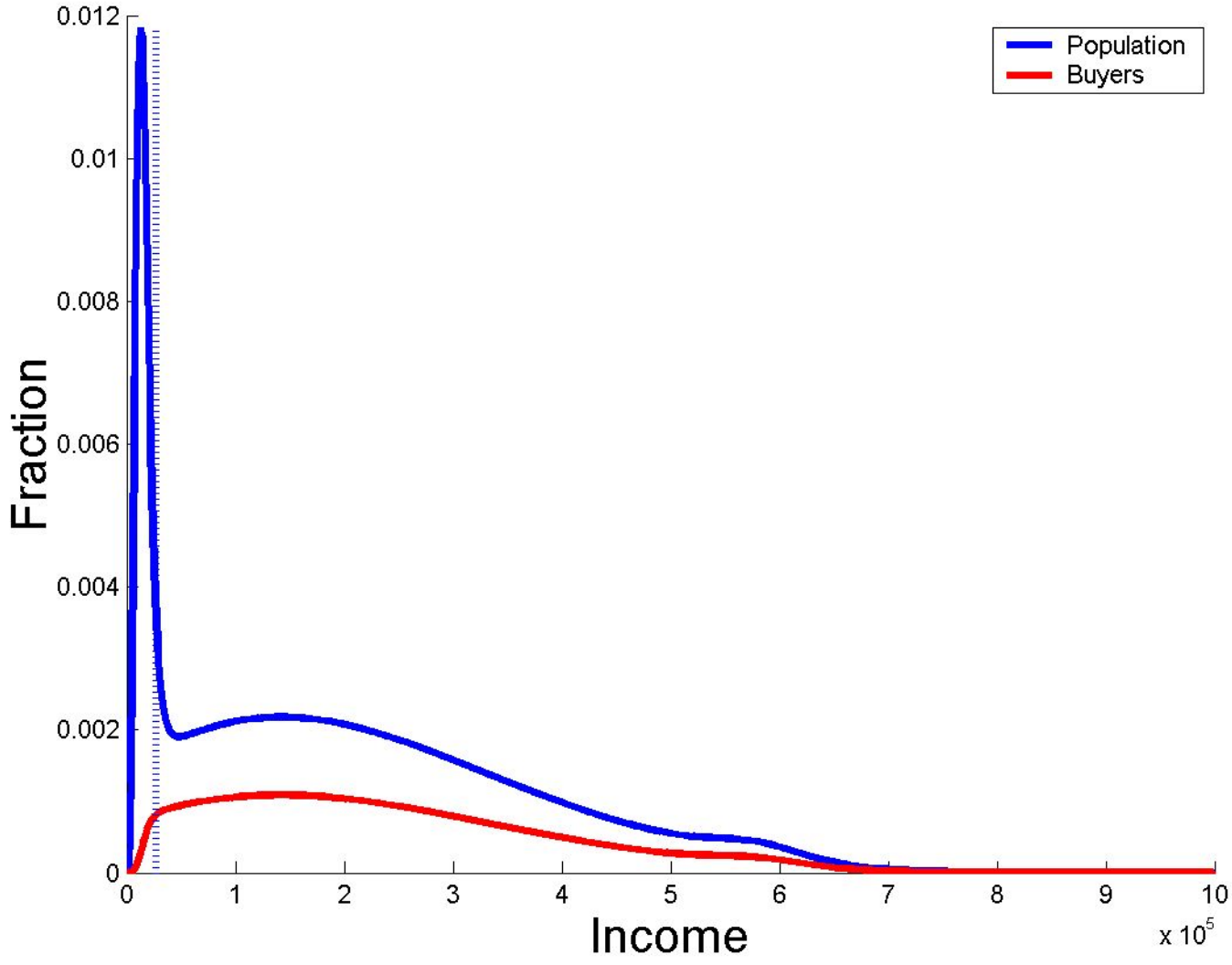
Income
x 10^5


Population
Buyers
Fraction
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0.01
0.008
0.006
0.004
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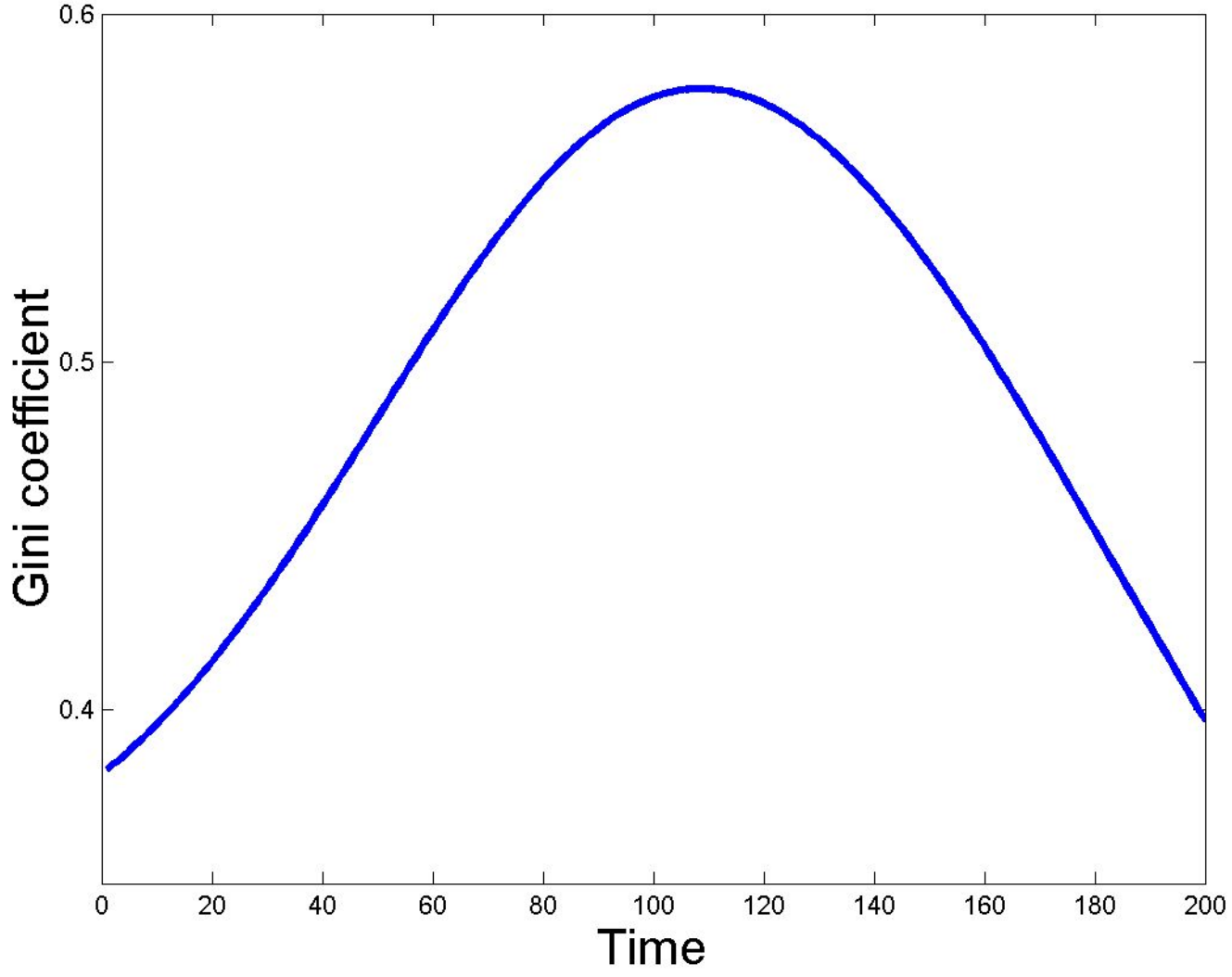
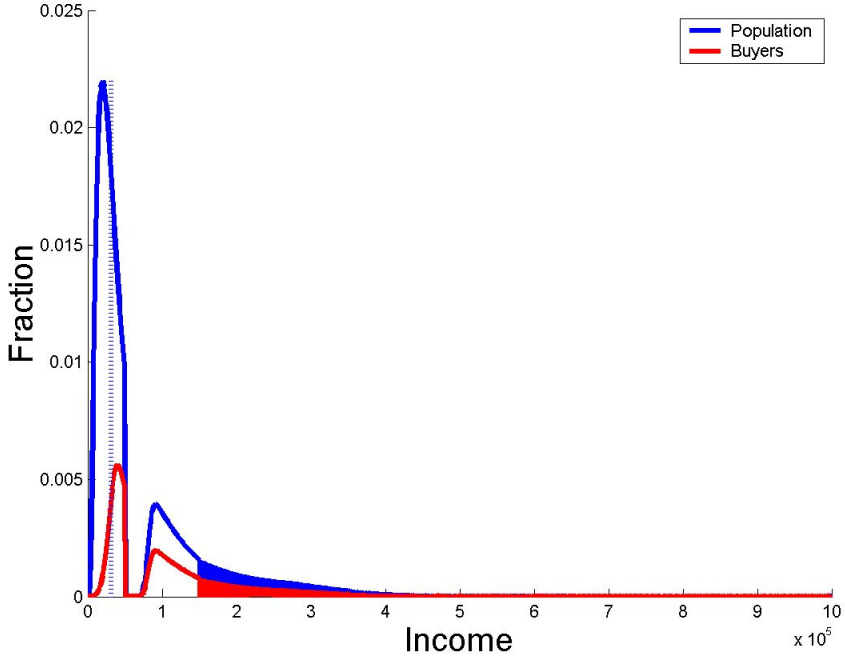
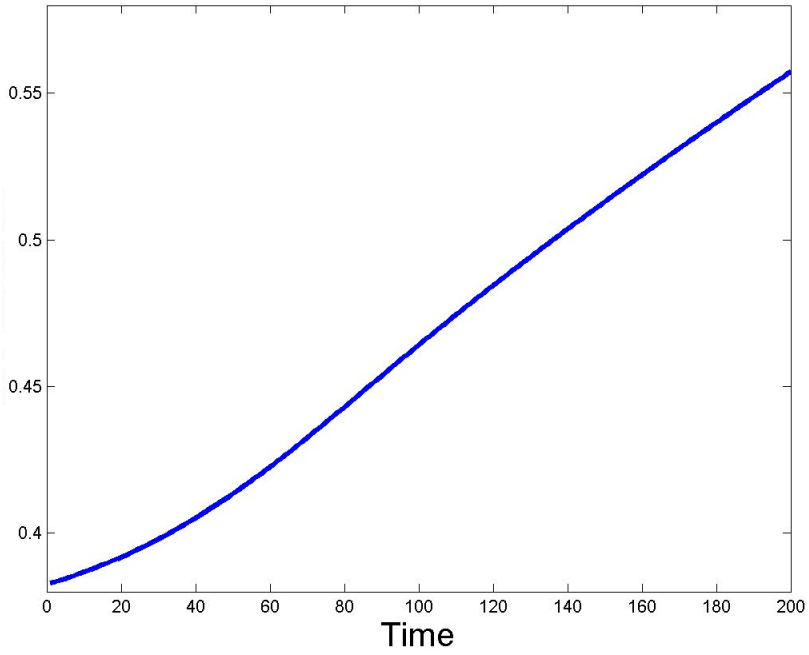
Income
x 10^5

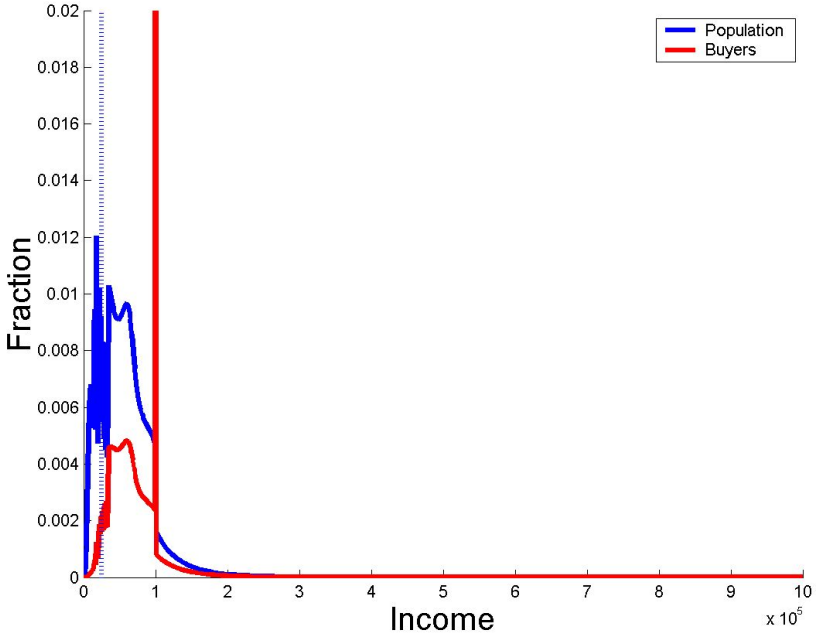

0.6
0.5
0.4
Gini coefficient
0
20
40
60
80
100
120
140
160
180
200
Time

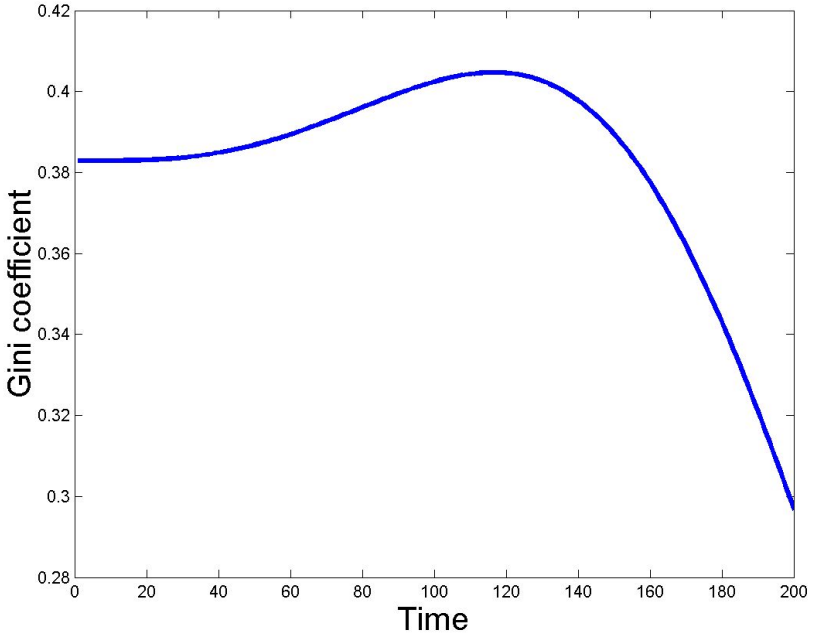
Enhancement proportional to income





Decreasing Margins





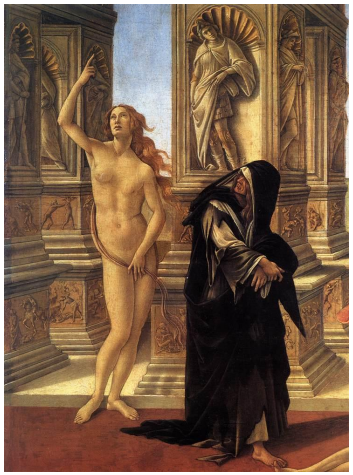
- Gadgets come down in price, problematic if enhances earning capacity proportionally
- Decreasing margins stabilize
- Services likely to be problematic
- Temporary increases in inequality may be worth it if they speed transition
- “We shouldn’t sacrifice the poor of tomorrow for the poor of today”

- Most relevant where small increases have big effect
  - Competitive areas
  - Rising above threshold
  - Little effect in areas of diverse talents
- Compounding
  - Problem when new “must have” enhancements arrive faster than the old reduce in price

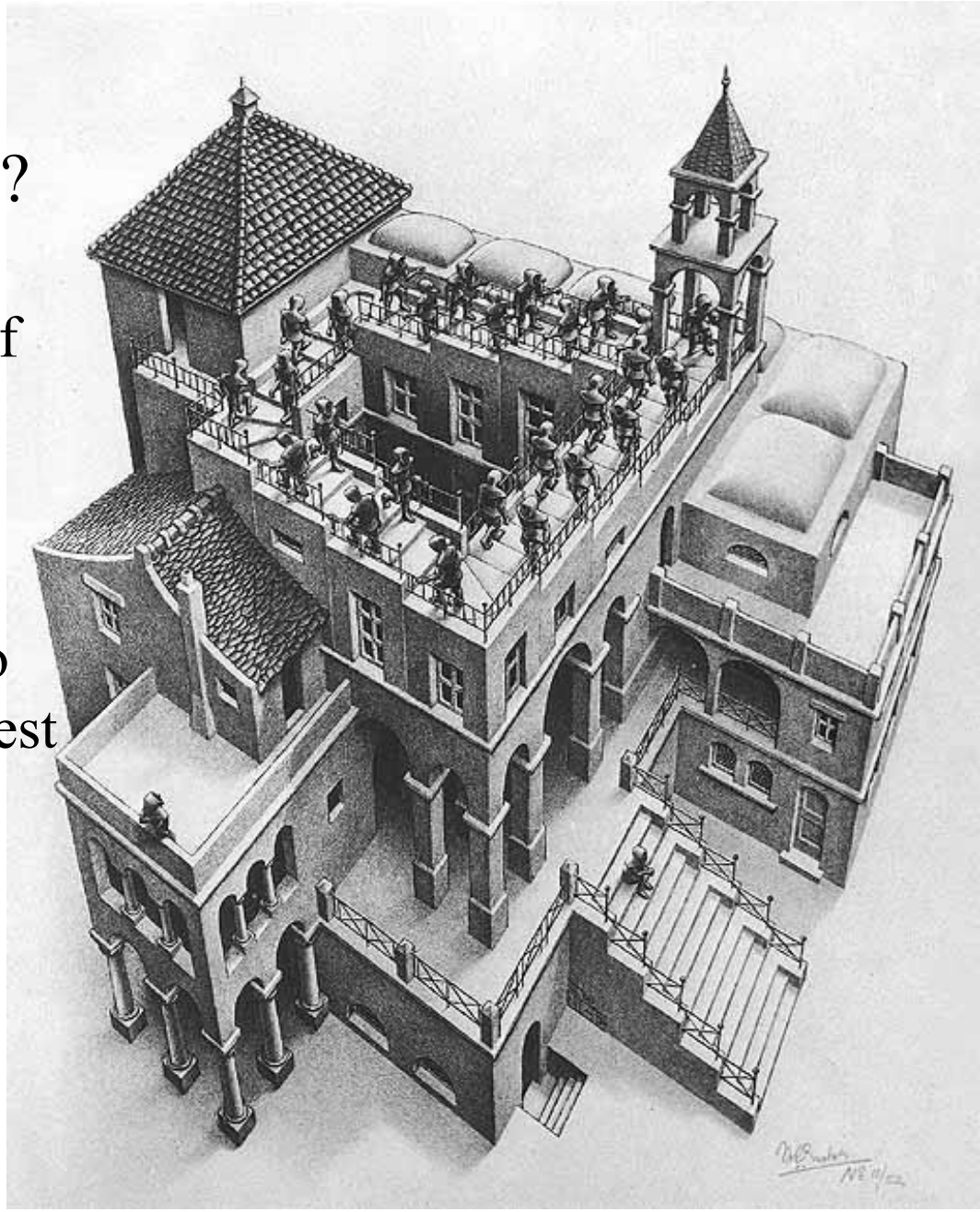
- Near-term enhancements
  - Gadgets and drugs
  - Decreasing margins
  - Narrow task improvements
  - Hence unlikely to be major disruptors
  - Biological enhancements at first less significant than external software, hardware
  - Important tryout for handling more radical enhancement

Approaches

- Laissez-faire
- Rawls: are benefits to worst off worth it?
  - The parties to the social contract "want to insure for their descendants the best genetic endowment (assuming their own to be fixed)."
  - Kaldor Hicks – enhanced pay compensation to the unenhanced through improved economy
- Create a no-envy situation
- Capability approach
- Lottery
- Taxing enhancements
- Taxing enhanceds
- Speed diffusion



- Risks making people fundamentally unequal?
  - Liberal democracy already based on idea of common society of unequal individuals
- Competition
  - Worst off are those who can compete in the fewest domains
  - Many enhancements non-positional (e.g. reducing accidents)

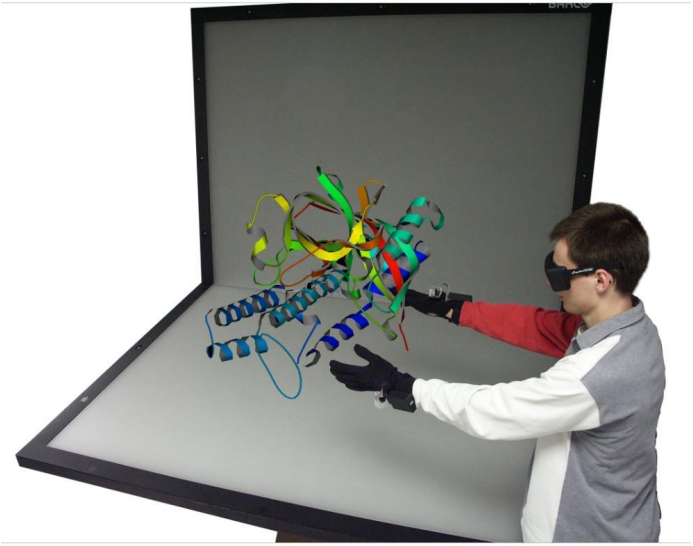


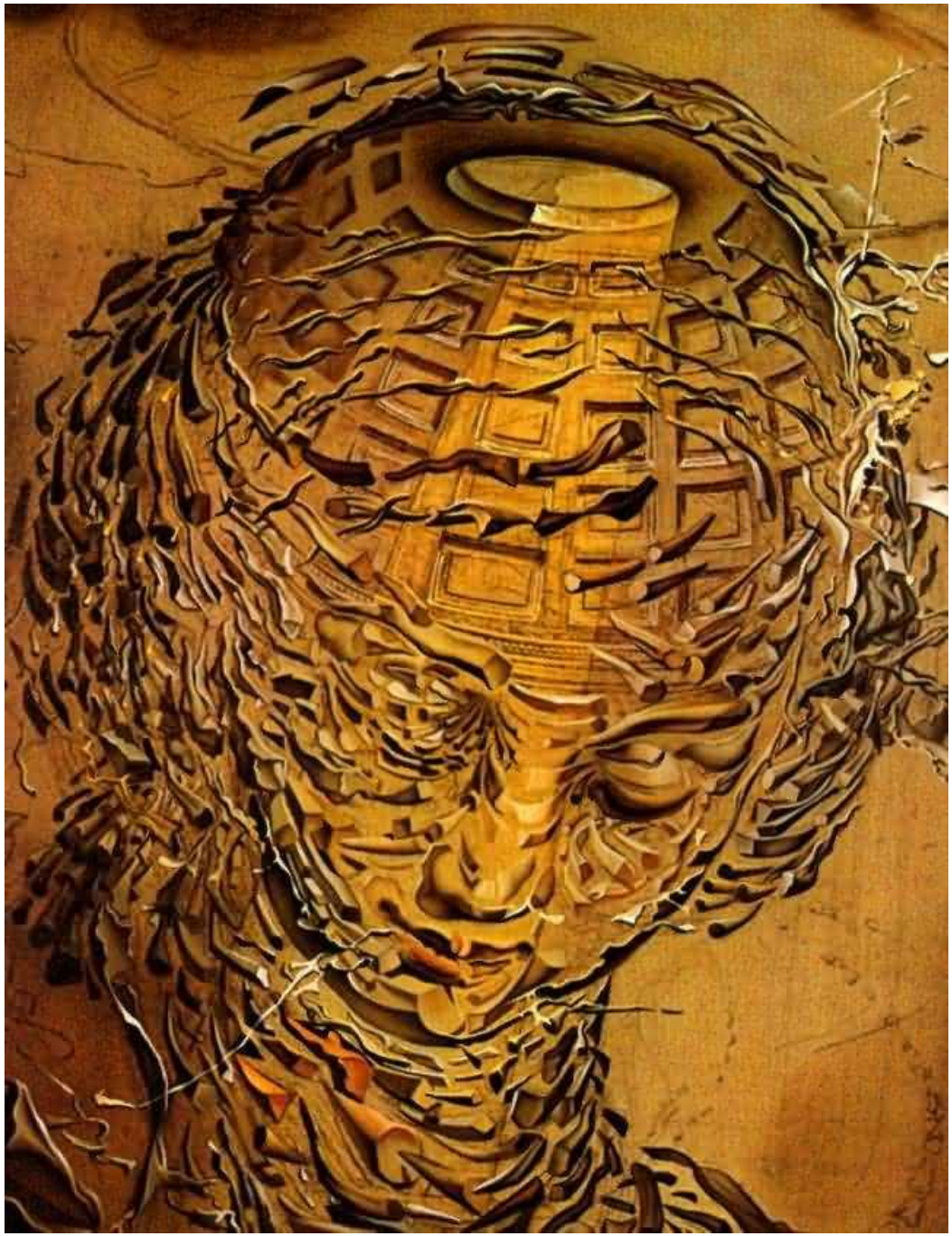
Conclusions

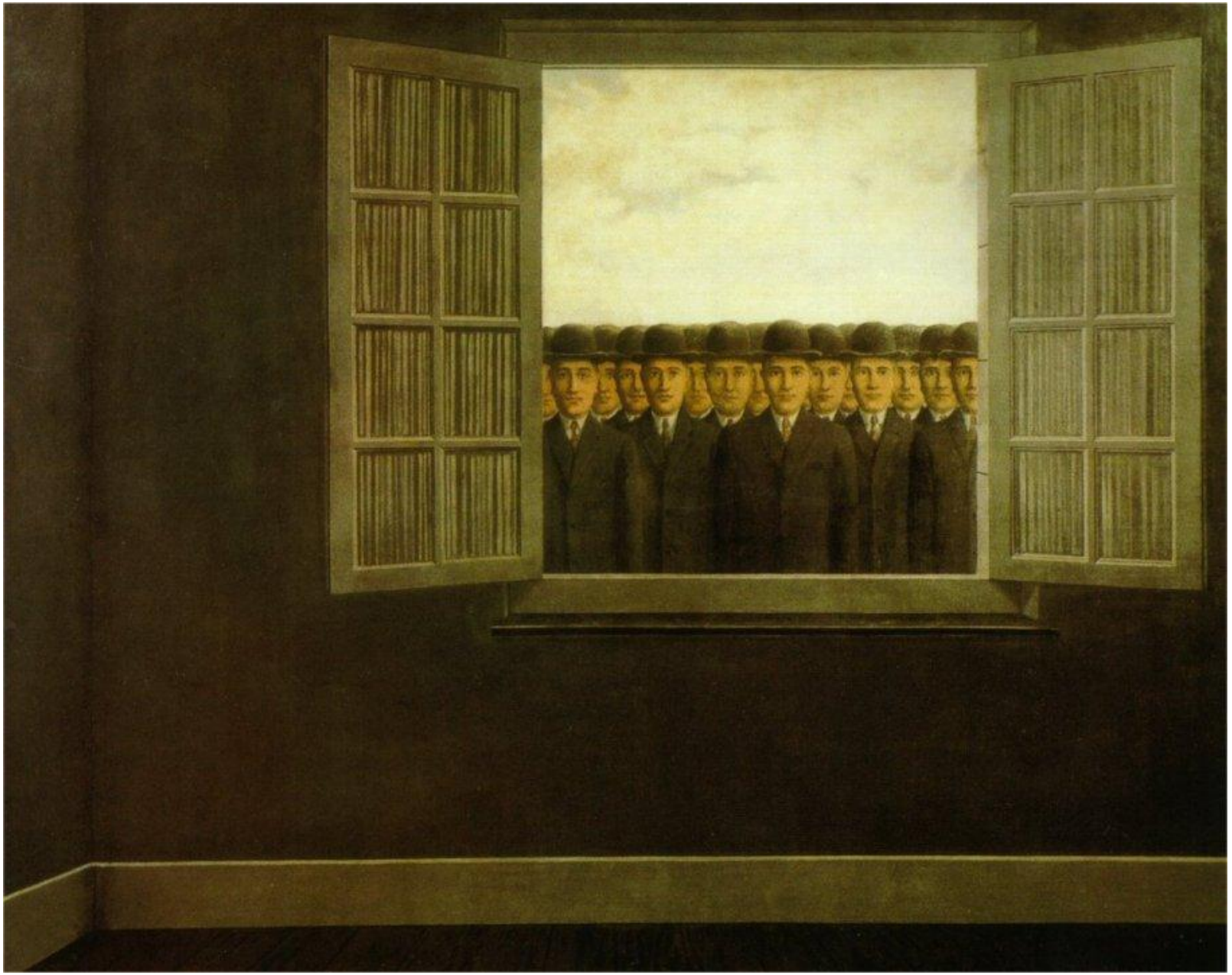
- Potential gains very large
- Spread across society
- Lowest performers likely gain most
- Competition may increase, but also overall wealth and opportunities
- Risks manageable near term
- Need for ecological studies
- Collective enhancement

H+ Things to Do

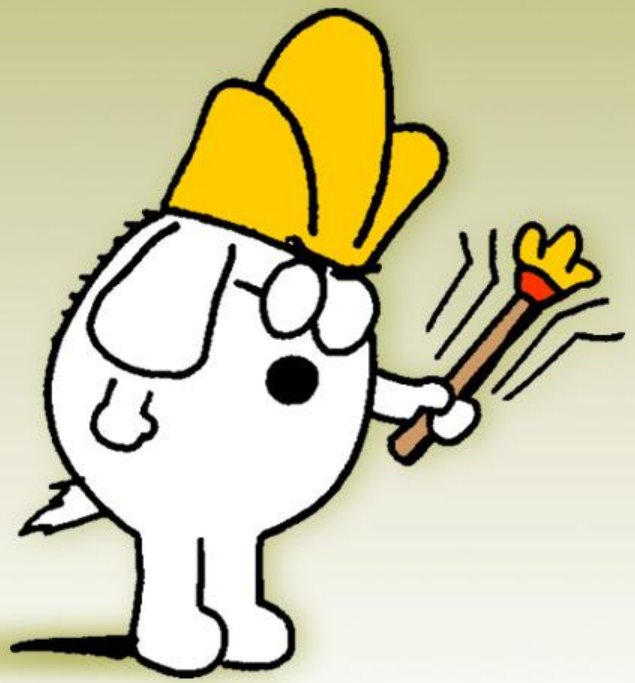
- Support morphological/cognitive freedom
- "I'm not a genetic determinist, but everybody else is"
  - Need to counteract stupid biologism
- Patient choice
- Harm reduction
- Speed development







OUT OUT!!
YOU DEMONS OF
STUPIDITY!!



% Population Online vs. PPP per capita