Challenges of Aging Populations: Could partnerships with Industry Accelerate Research Progress?

Richard Suzman Ph.D.
Director, Division of Behavioral and Social Research
National Institute on Aging, NIH
Washington DC. February 28, 2012
NAS Government-University-Industry Roundtable

NATIONAL INSTITUTE ON AGING
NATIONAL INSTITUTES OF HEALTH
U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES

U.S. DEPARTMENT OF STATE

Why Population Aging Matters

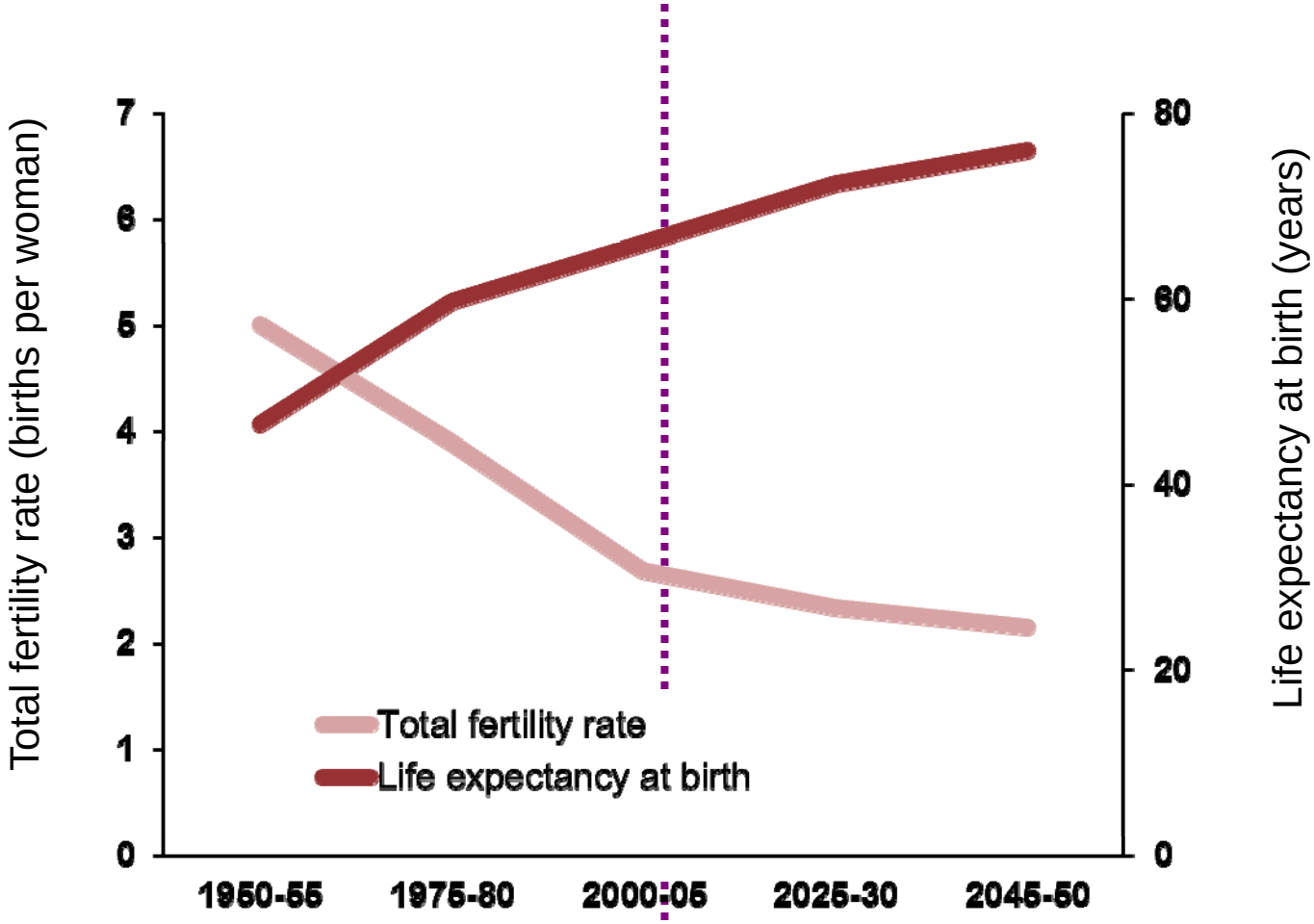
A Global Perspective

It Matters – Because it is Reshaping the World

- Speed of population aging is faster in third world countries
- Simultaneous population aging and population decline in hi $
- Increased longevity has lead to "Exceptional Returns," for GNP (Murphy & Topel) but the extra years have to be financed
- Increasing burden of chronic disease at older ages – especially in dementia – implications for health systems
- Probably will lead to Global capital flows -- what If China sets up a national pension system – Walmart?

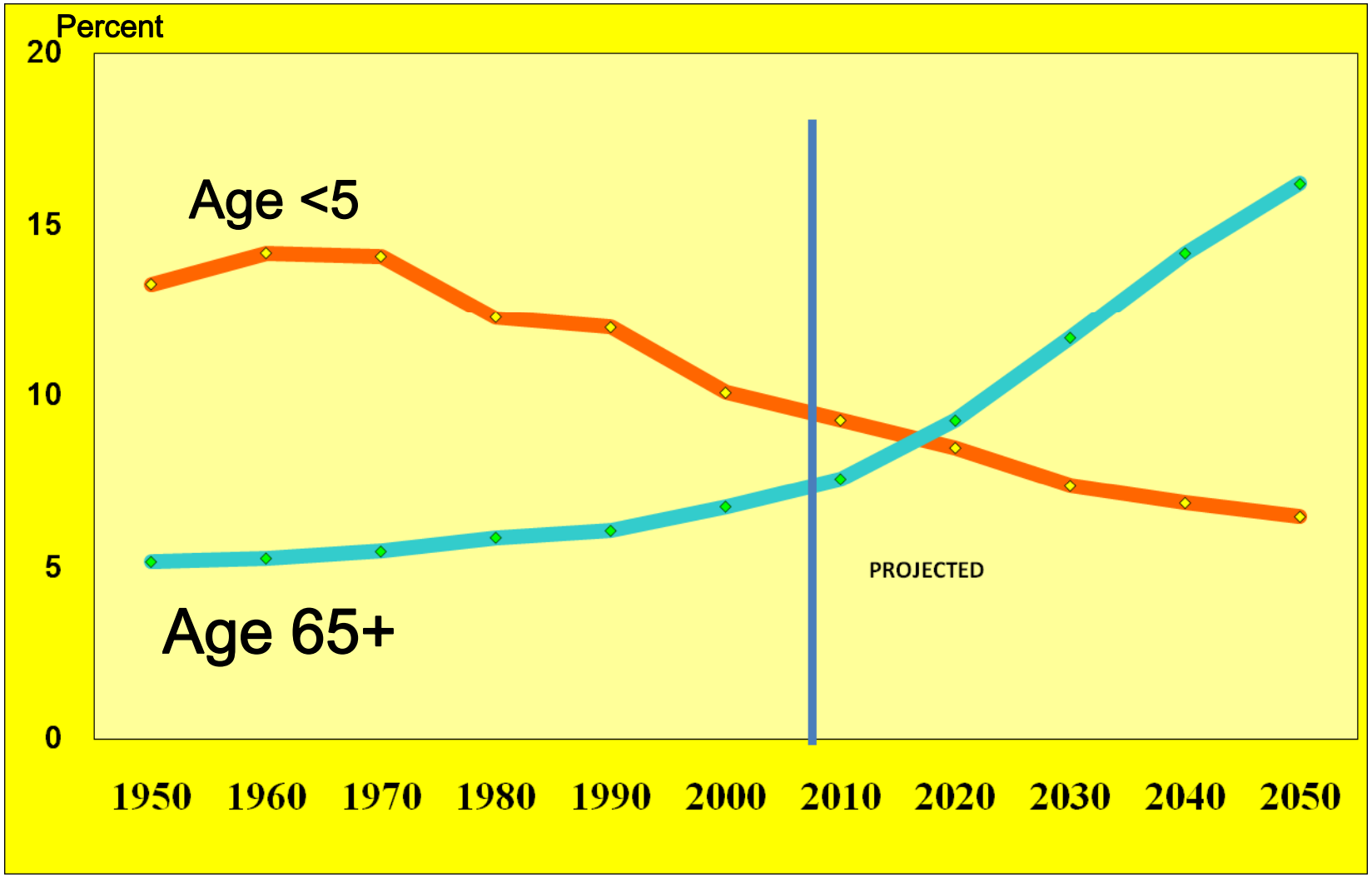
The demographic causes of global population ageing

Total fertility rate and life expectancy at birth:
World, 1950-2050



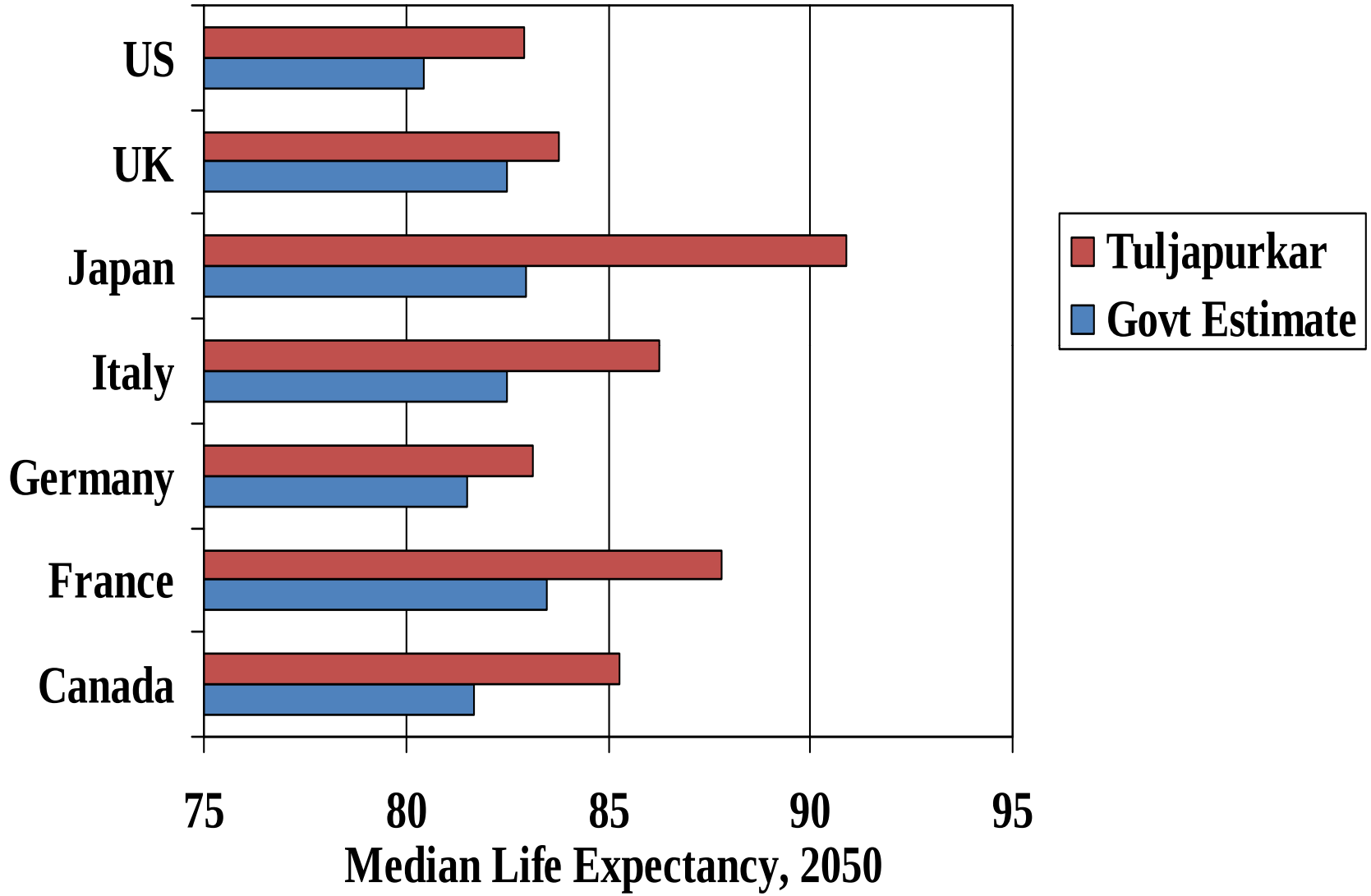
Adapted from An Aging Word: 2008

Young Children and 65+ as a Percent of Global Population- Sept 2010



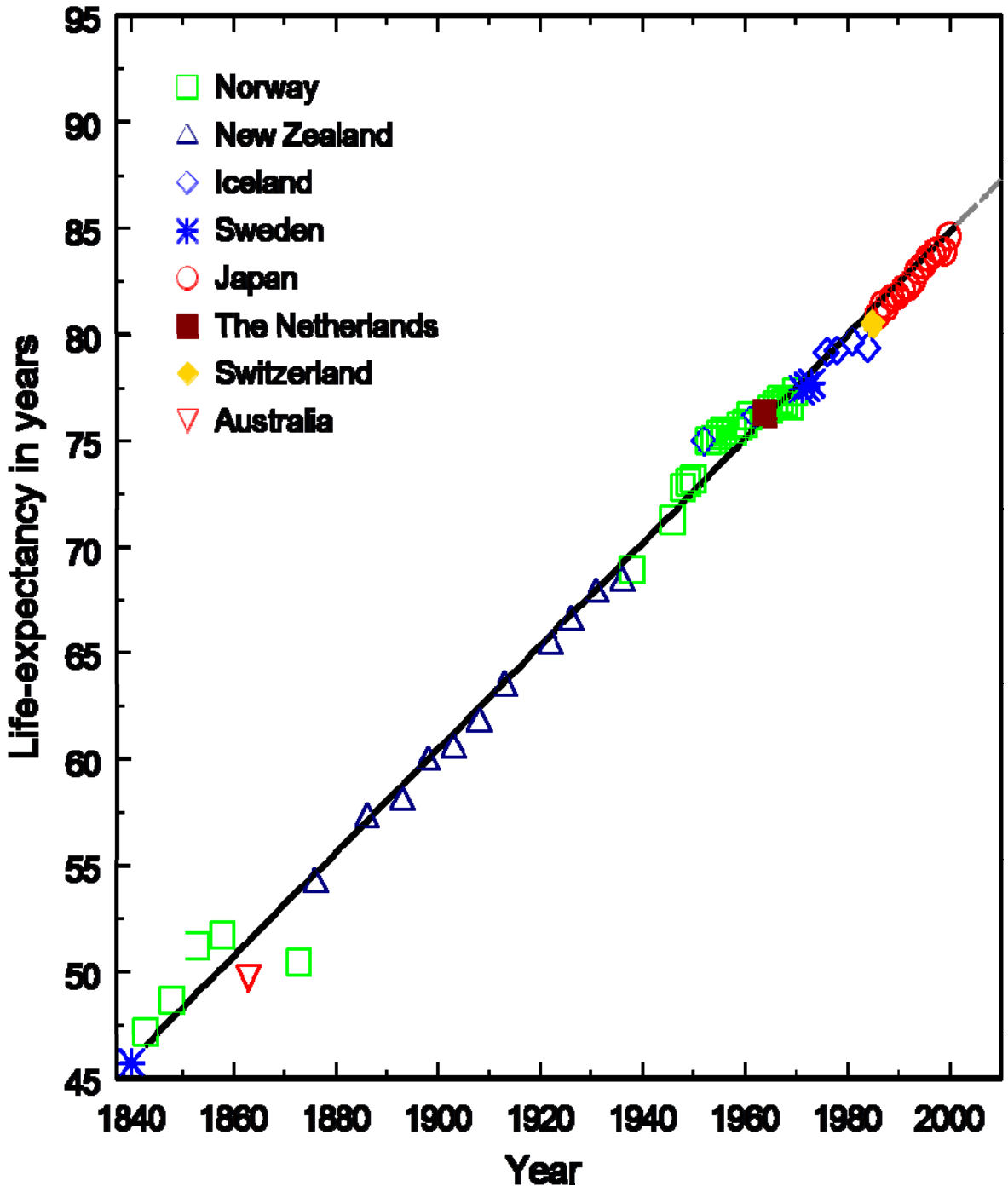
Source: United Nations, *World Population Prospects: The 2008 Revision*.

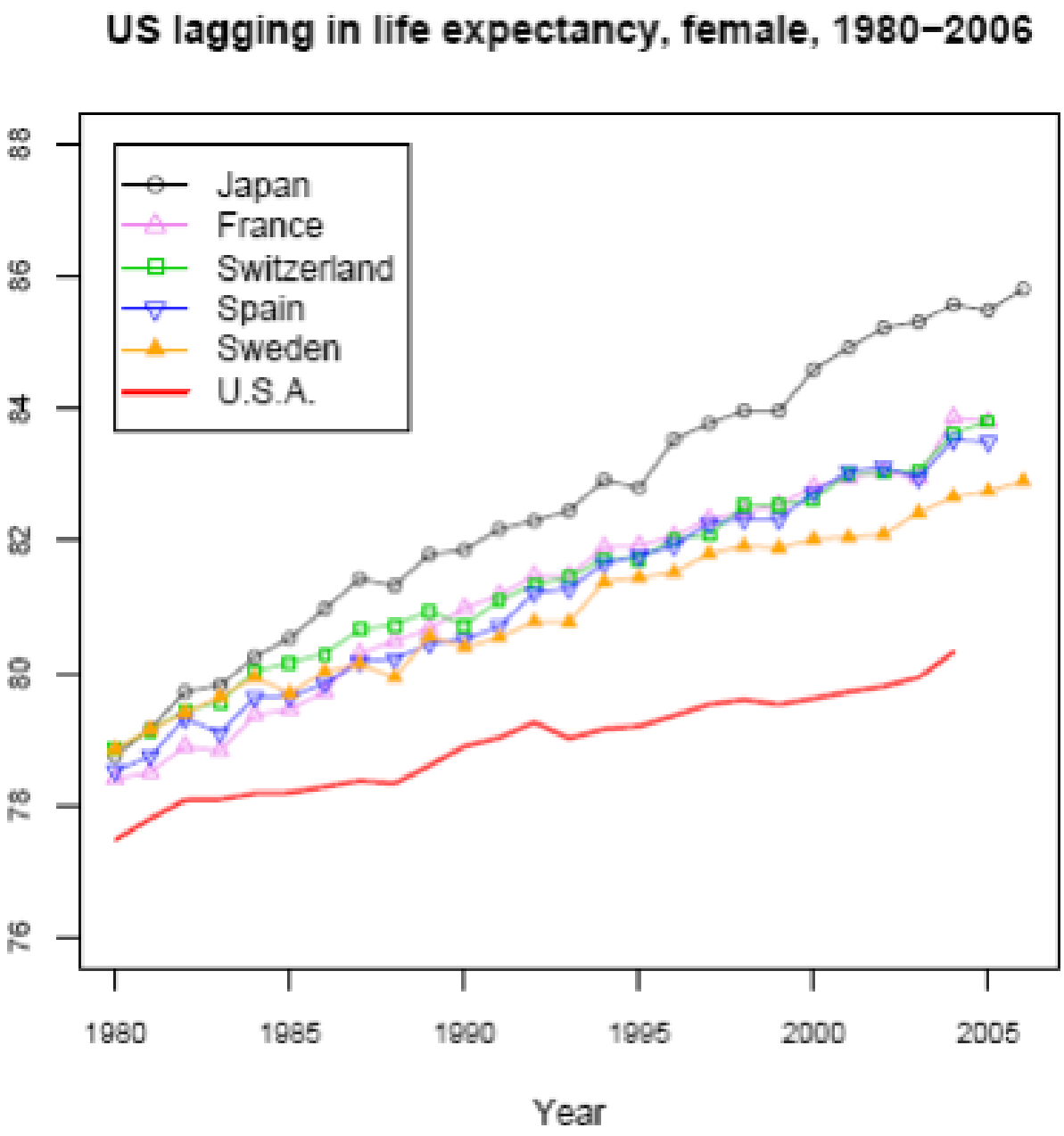
Life Expectancy in G-7 Industrialized Nations, 2050



Source: Shripad Tuljapurkar, Nan Li and Carl Boe. A UNIVERSAL PATTERN OF MORTALITY DECLINE IN THE G-7 COUNTRIES. **Nature** 405: 789-792 (15 June 2000).

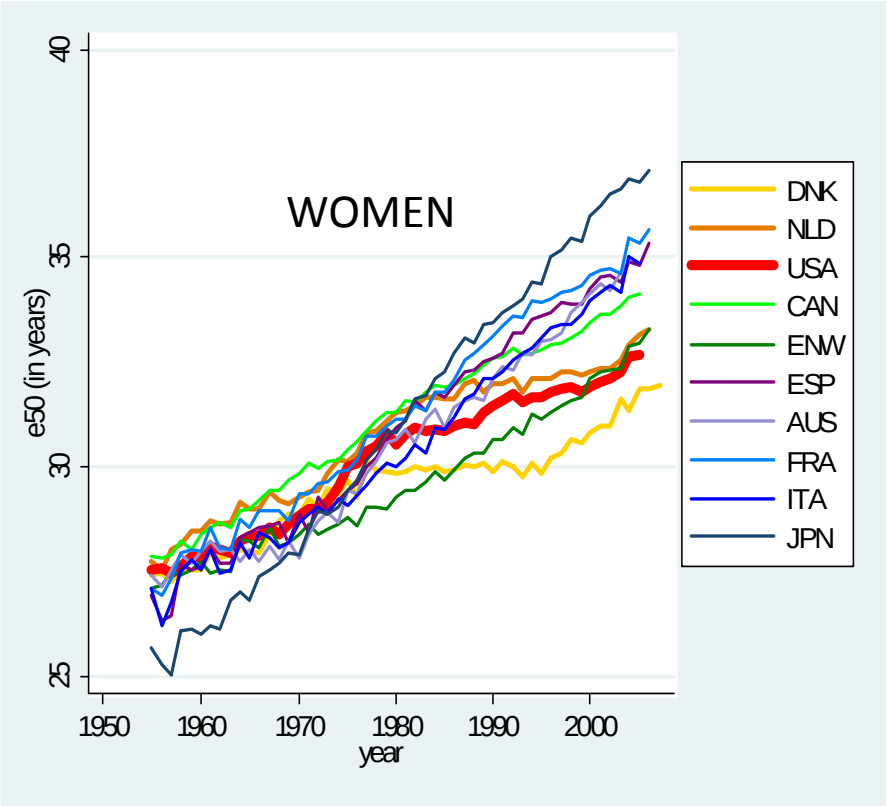
Female life expectancy in the record-holding country
from 1840 to the present
Science 2002
3 years per decade
about 3 months a year
--an hour during my talk?

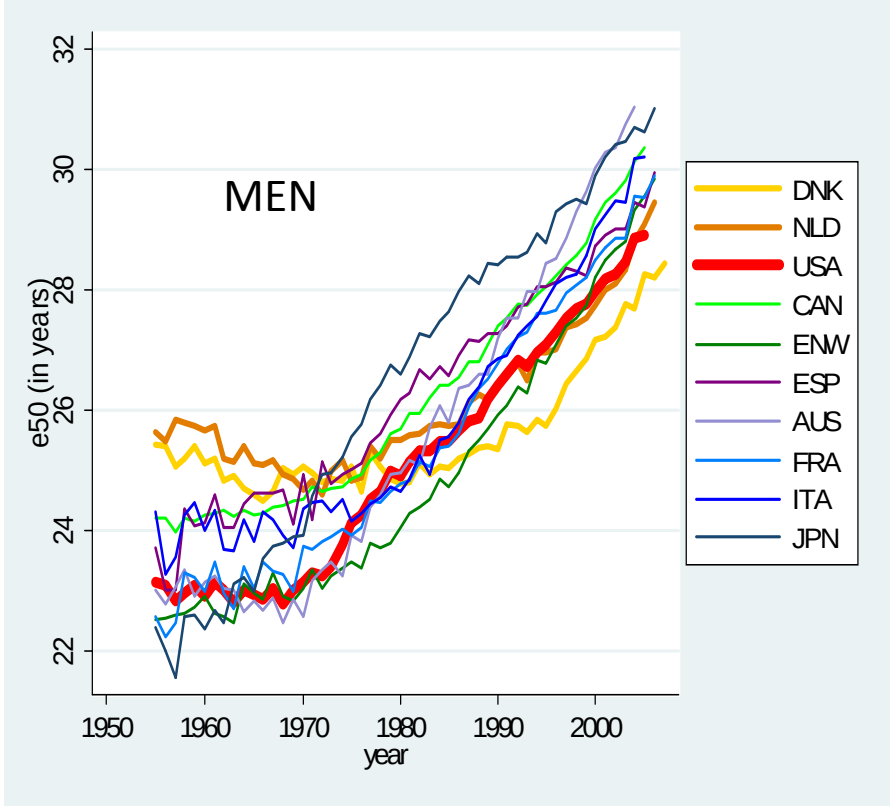




Source: personal correspondence with James Vaupel

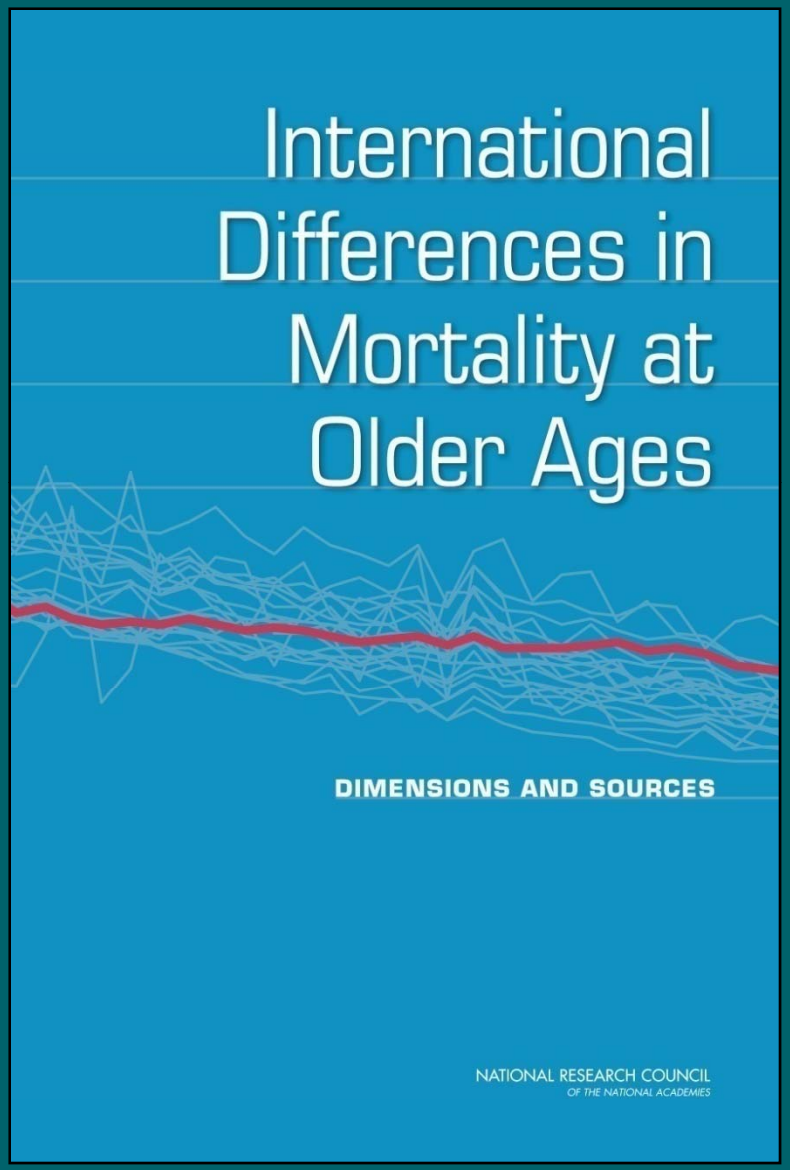
Divergent Trends in Adult Life Expectancy



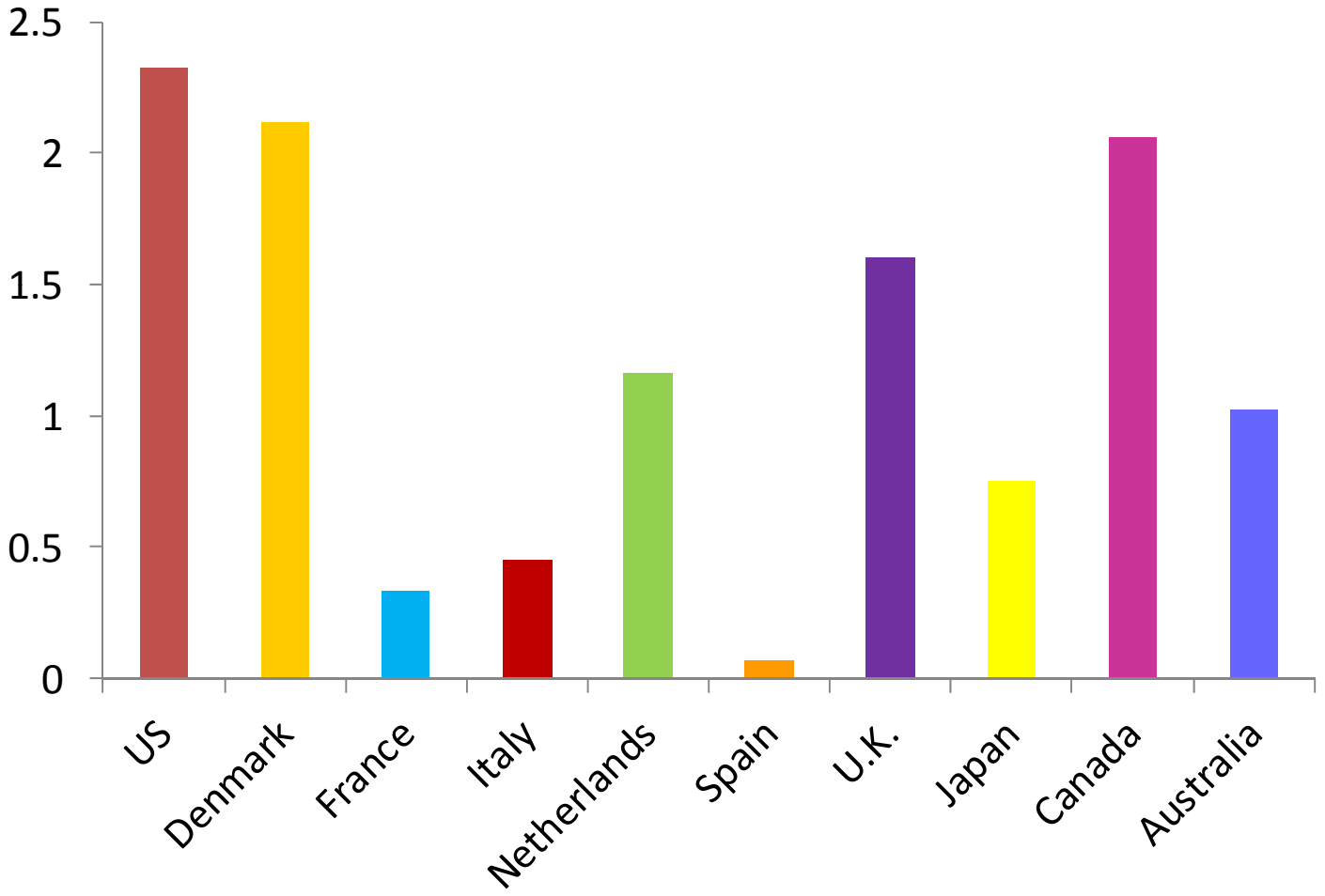


Life expectancy at age 50 for men and women in 10 industrialized nations since 1950.

Source: Glei, Mesle, and Vallin, 2009.

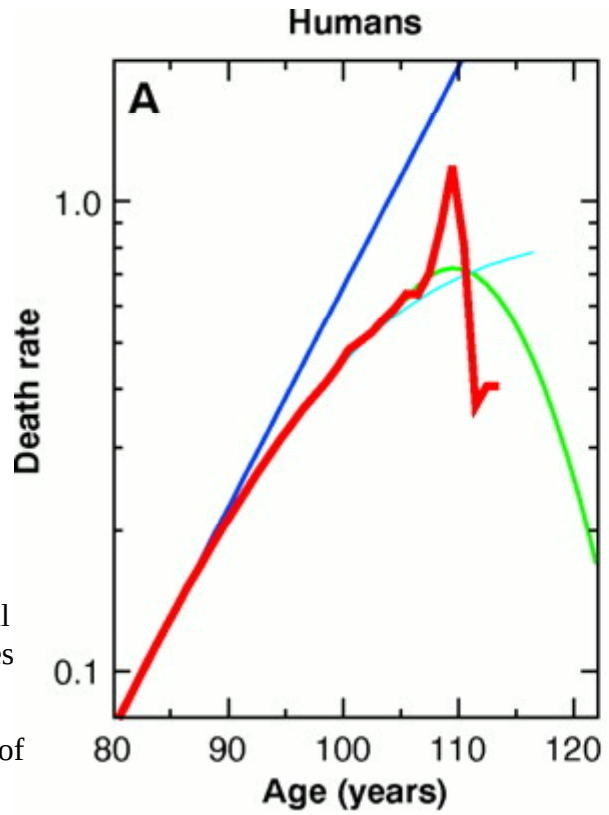

International Differences in Mortality at Older Ages
DIMENSIONS AND SOURCES
NATIONAL RESEARCH COUNCIL
OF THE NATIONAL ACADEMIES

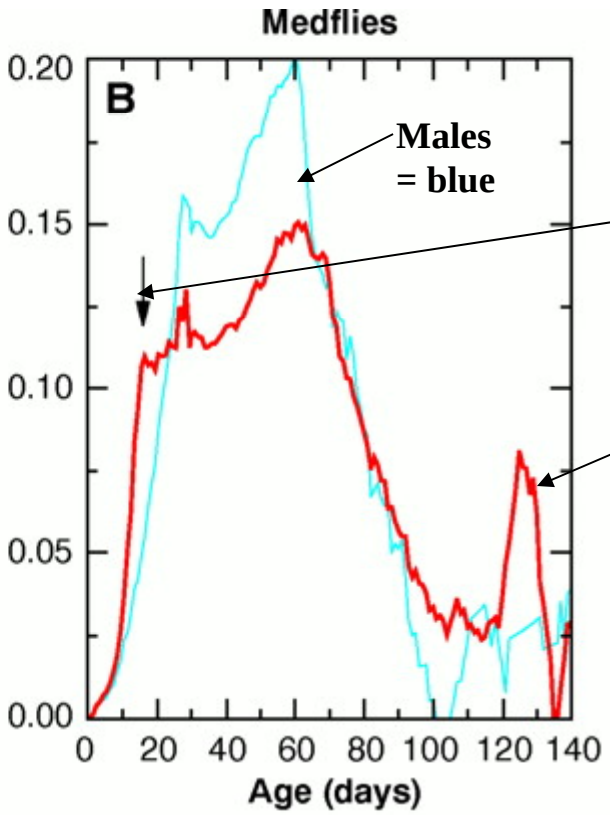
Gains to female life expectancy at age 50 from eliminating smoking



Source: Chapter 4, Contribution of Smoking to International Differences in Life Expectancy, *Samuel H. Preston, Dana A. Glei, and John R. Wilmoth*

“Mortality decelerates and human mortality at older ages has declined substantially”





Males = blue

“Shoulder of mortality”

Females = red

Humans

Blue = exponential curve fits data ages 80-84

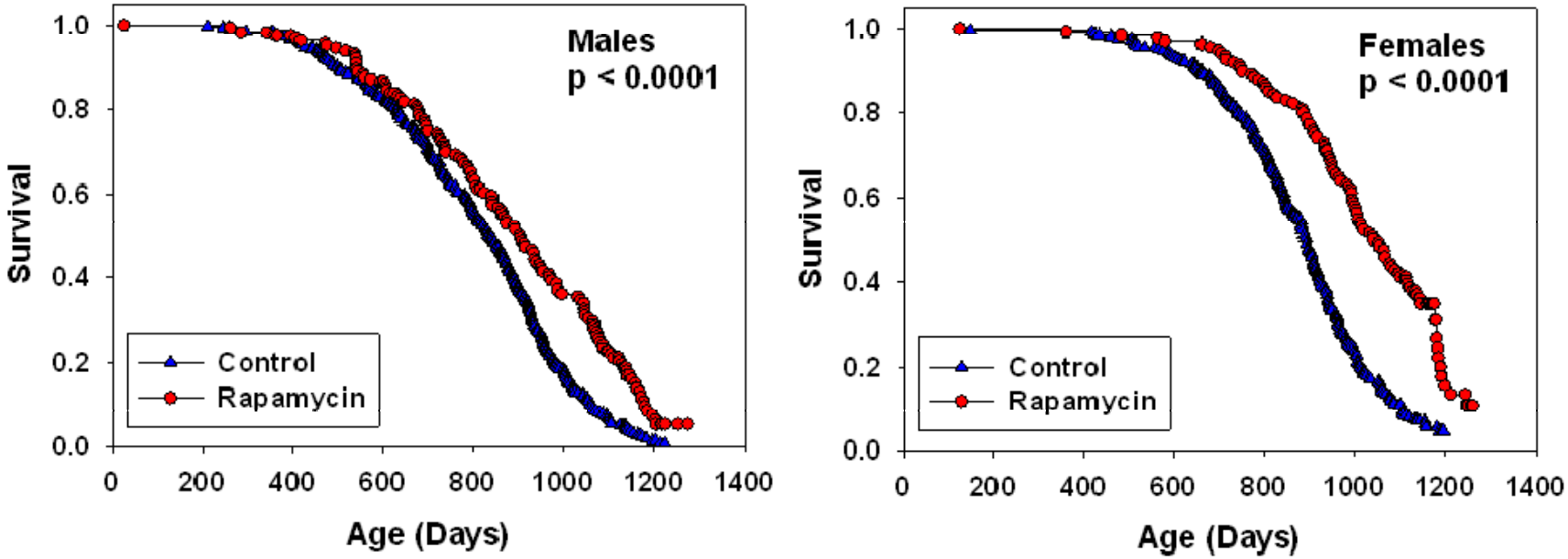
Red = aggregation of 14 countries

Light blue = fits all data best

Green = quadratic curve, fits data at 105+

Vaupel et al., *Science* (1998)

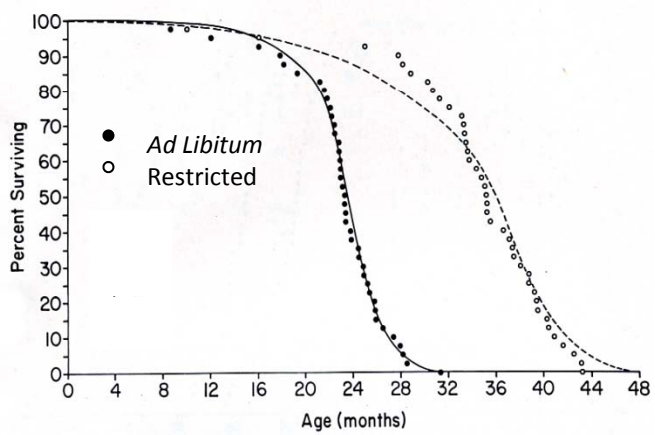
Treatment of Mice with Rapamycin Started at 9 Months



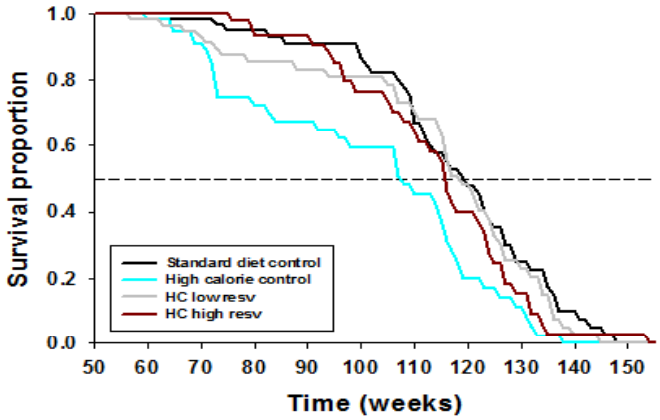
Source: Nature. 2009 July 16; 460(7253): 392–395

EXTENDING THE LIFESPAN OF MICE

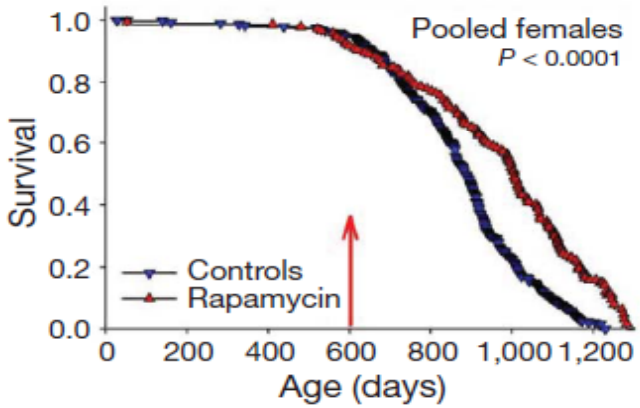
Source:
Nature. 2009
July 16;
460(7253):
392–395



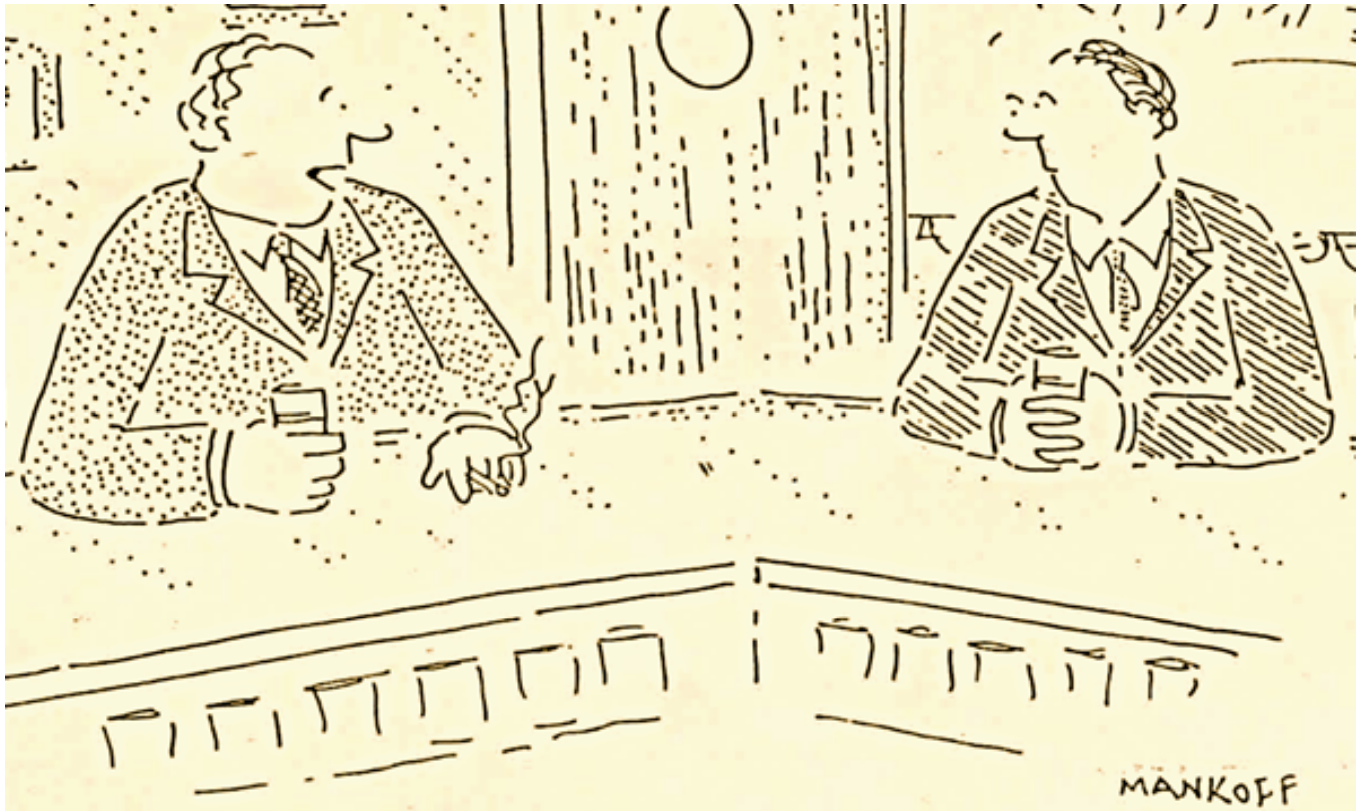
Calorie Restriction



Resveratrol

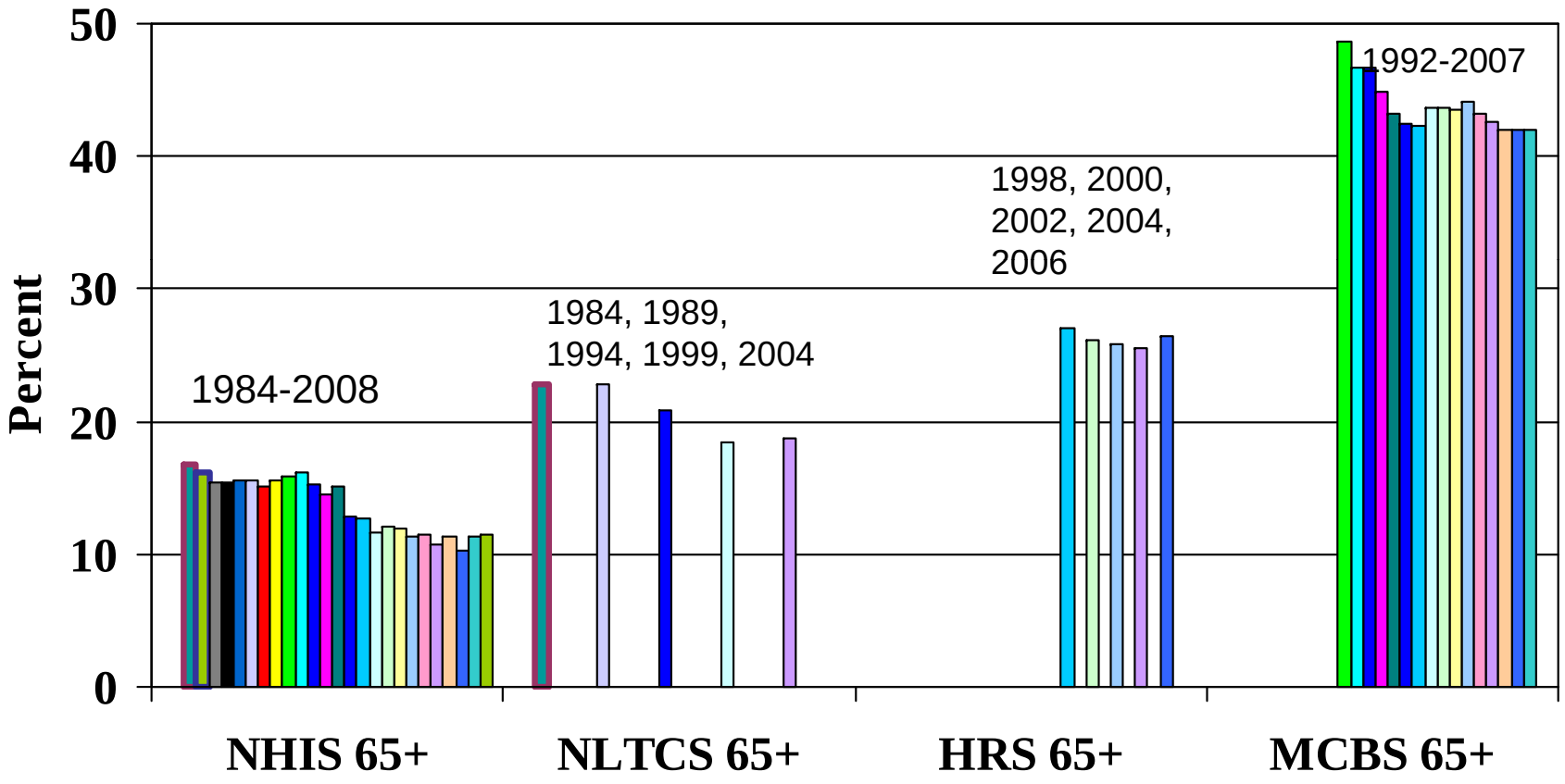


Rapamycin



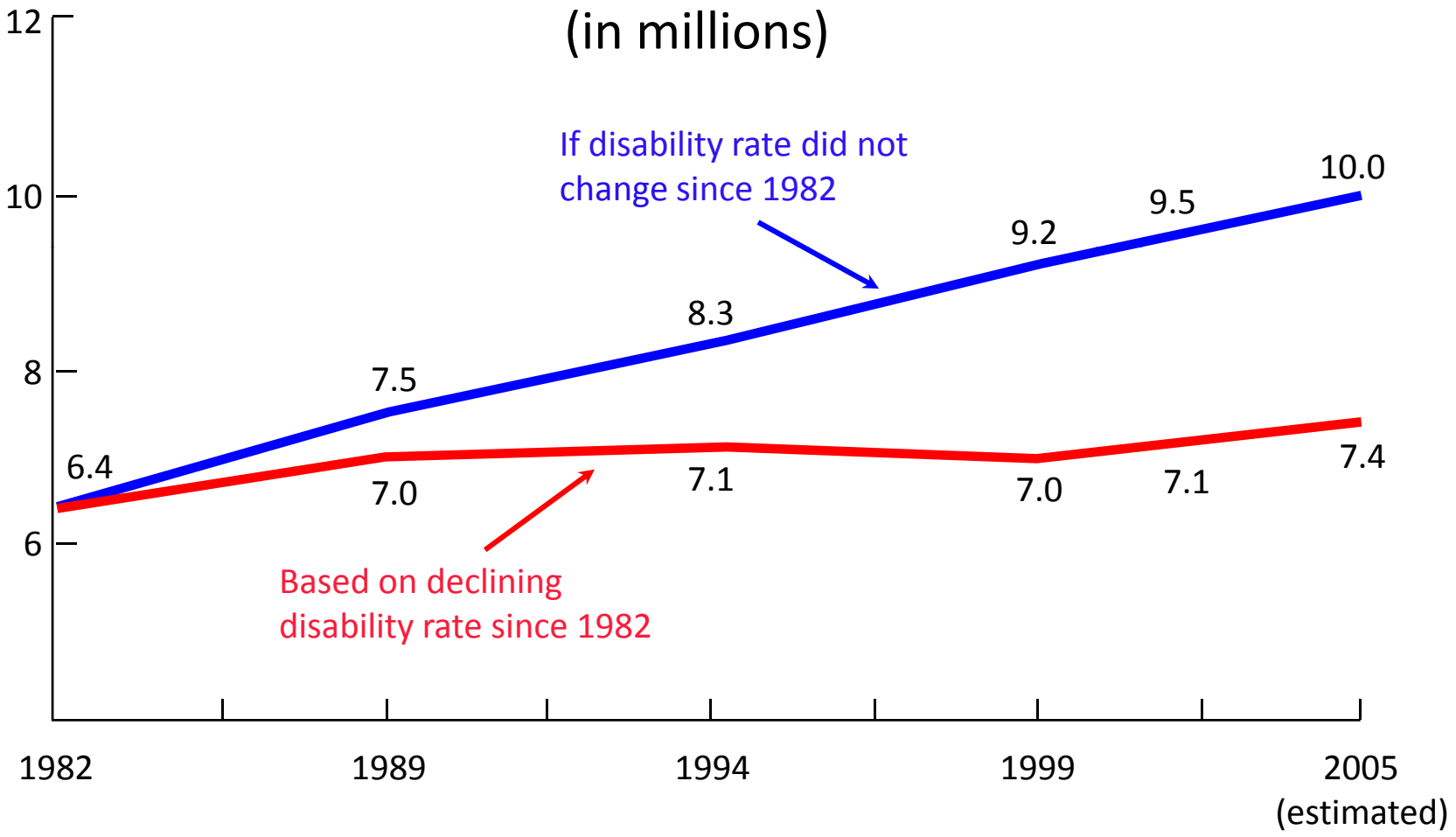
"See, the problem with doing things to prolong your life is that all the extra years come at the end, when you're old."

US Trends in Late-Life Disability



Sources: NHIS, updated tabulations by Schoeni, Freedman, Martin, & Andreski (2010);
NLTCS, unpublished tabulations by Spillman (2010);
HRS, unpublished tabulations by Freedman, Schoeni & Martin (2009); and
MCBS, Health Data Interactive (2010). All estimates age-adjusted.

Number of Chronically Disabled Americans Age 65+



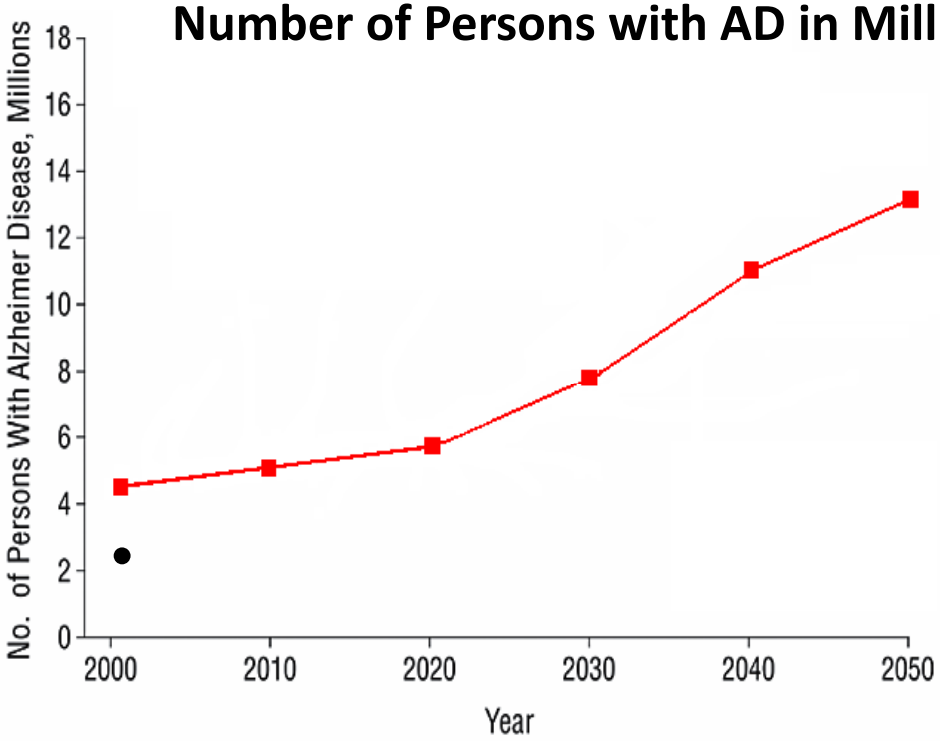
Source: National Long Term Care Survey (Kenneth Manton, Ph.D.)

Age-related Disability in USA is plastic

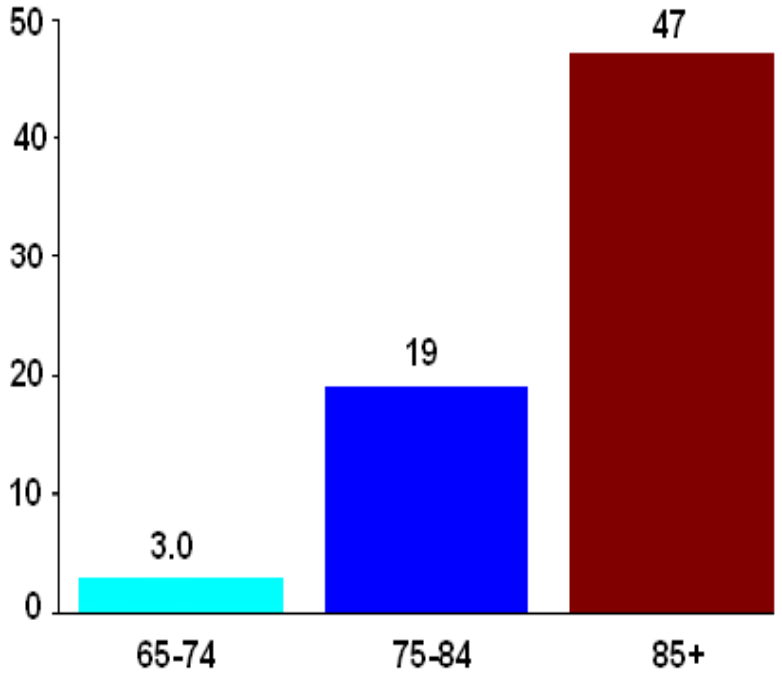
- So, responds to interventions!
- But we know little about disability trends in rich countries and virtually nothing in 3rd world
- MAJOR motivation for funding ELSA, SHARE, SAGE and INDEPTH
- Now the trend is threatened by obesity

Prevalence of Probable Alzheimer's Disease

Number of Persons with AD in Millions



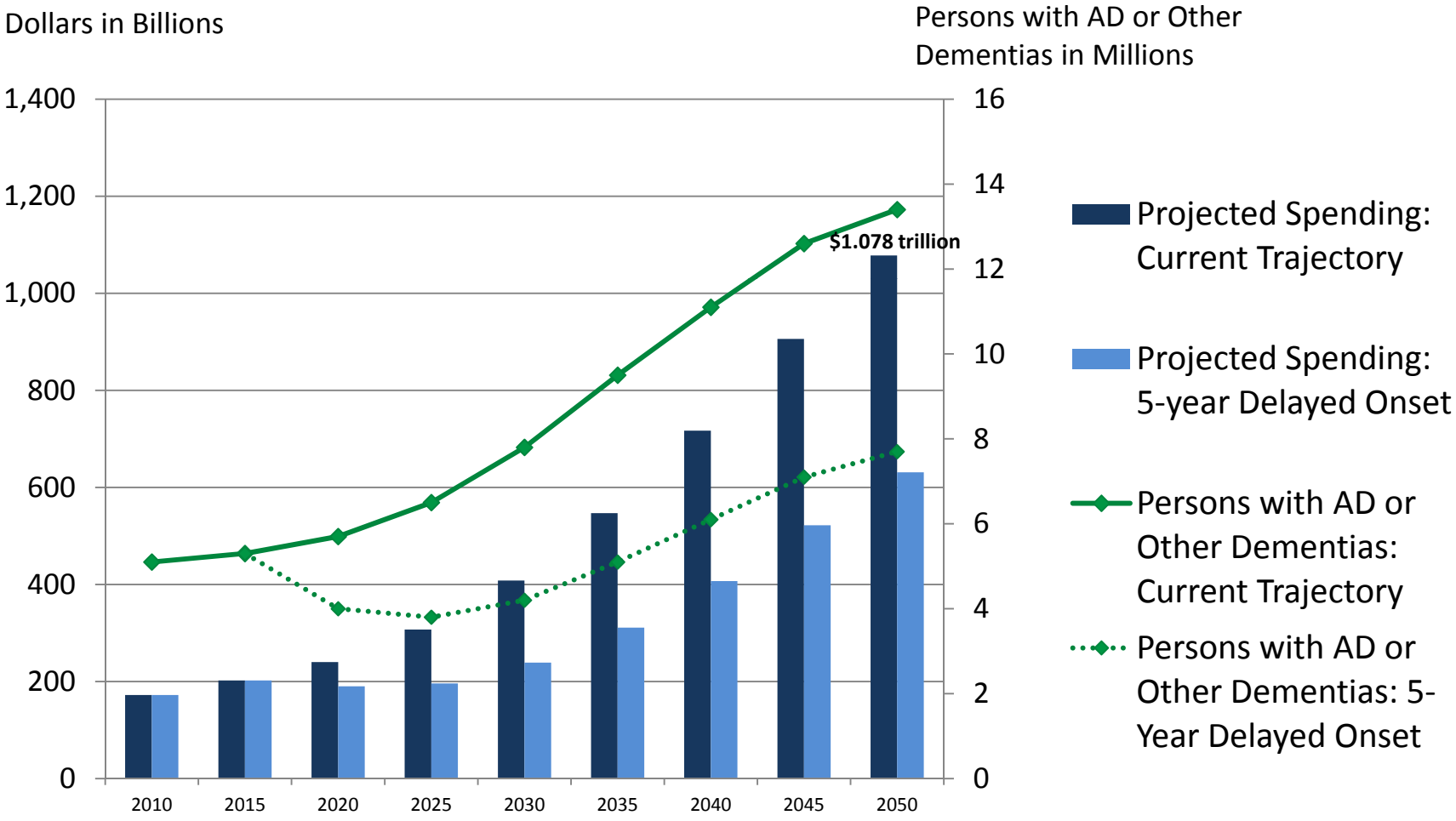
Percent of Persons with AD by Age



- **Evans, et al. Arch Neurol, Vol. 60, 2003.**
- **Plasman et al. Neuroepidemiology, Vol 29, 2007**

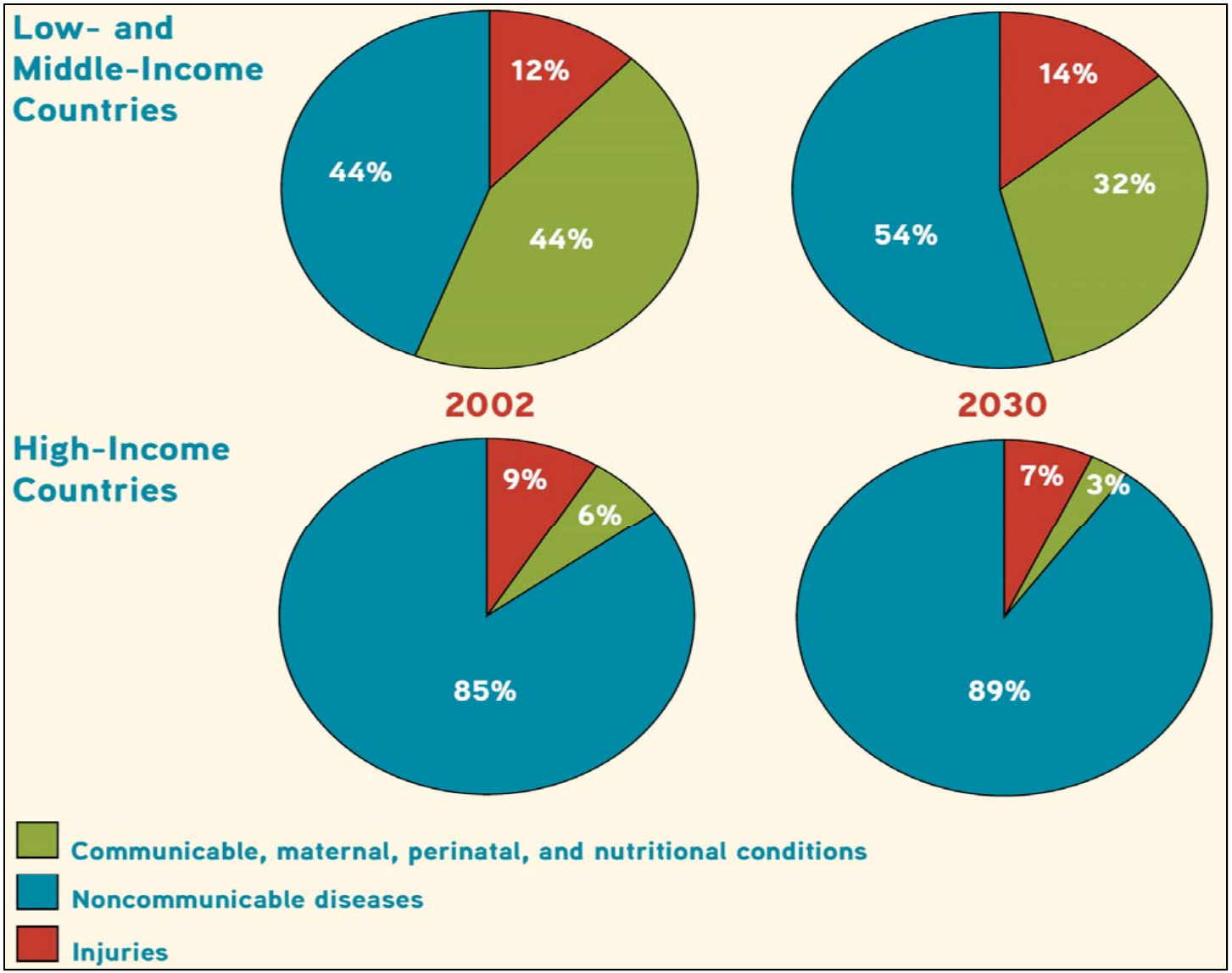
Evans D , et al. *JAMA* , Vol. 262, 1989

Projected Health Care Spending on Persons with Alzheimer's Disease or Other Dementias



Source: Alzheimer's Association, *Changing the Trajectory of Alzheimer's Disease: A National Imperative* (2010).

FIG. C-1. THE INCREASING BURDEN OF CHRONIC NONCOMMUNICABLE DISEASES: 2002-2030 --Murray et al.



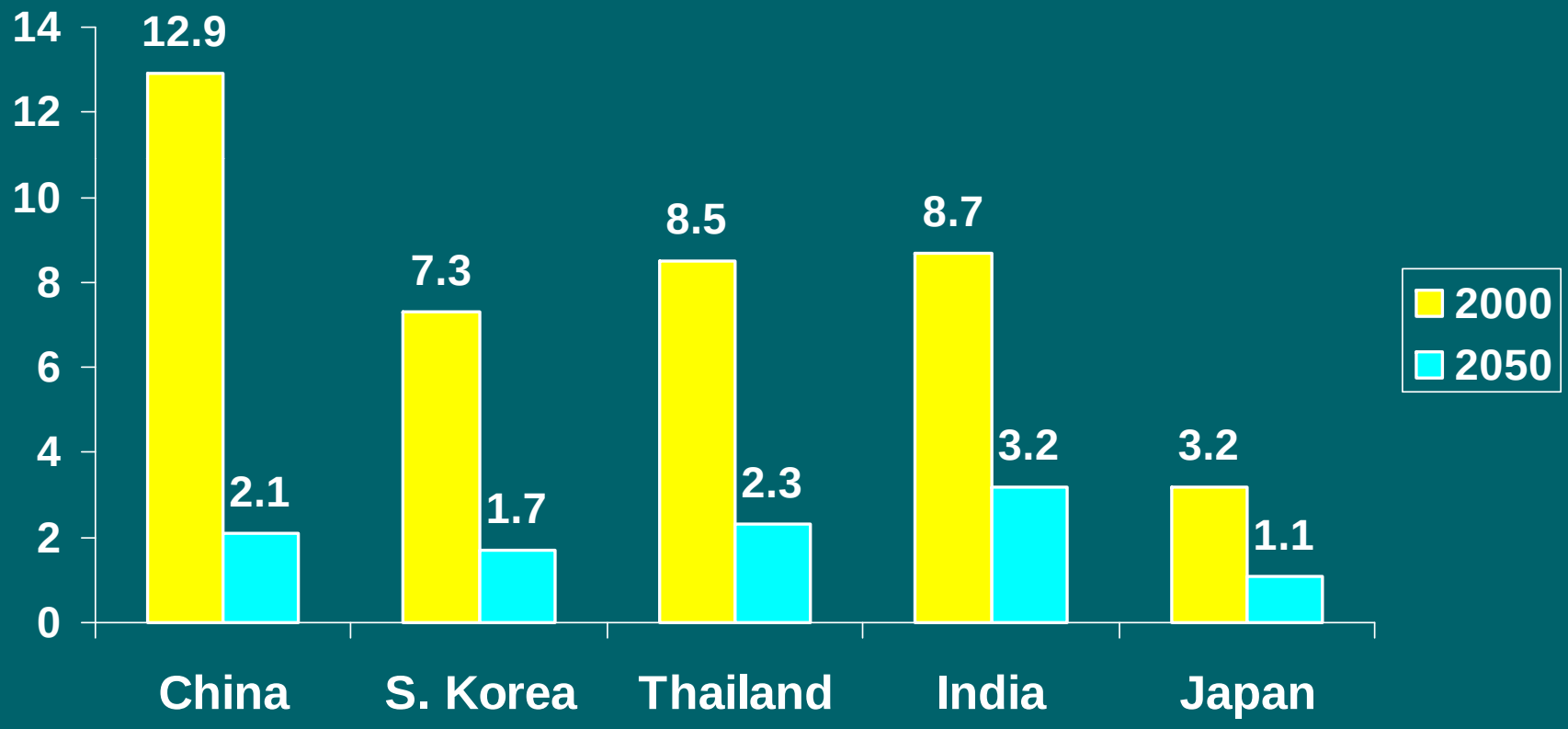
Source: Lopez et al. 2006.

LIVING LONGER AND LONGER

- **Wonderful, even if the extra years come at the end of life**
- **But, the extra years need to be financed somehow –the nub of aging**
- **Difficult with workers to pensioners ratio shrinking**
- **Work longer, save more, improve productivity/health, reduce disability, etc.**

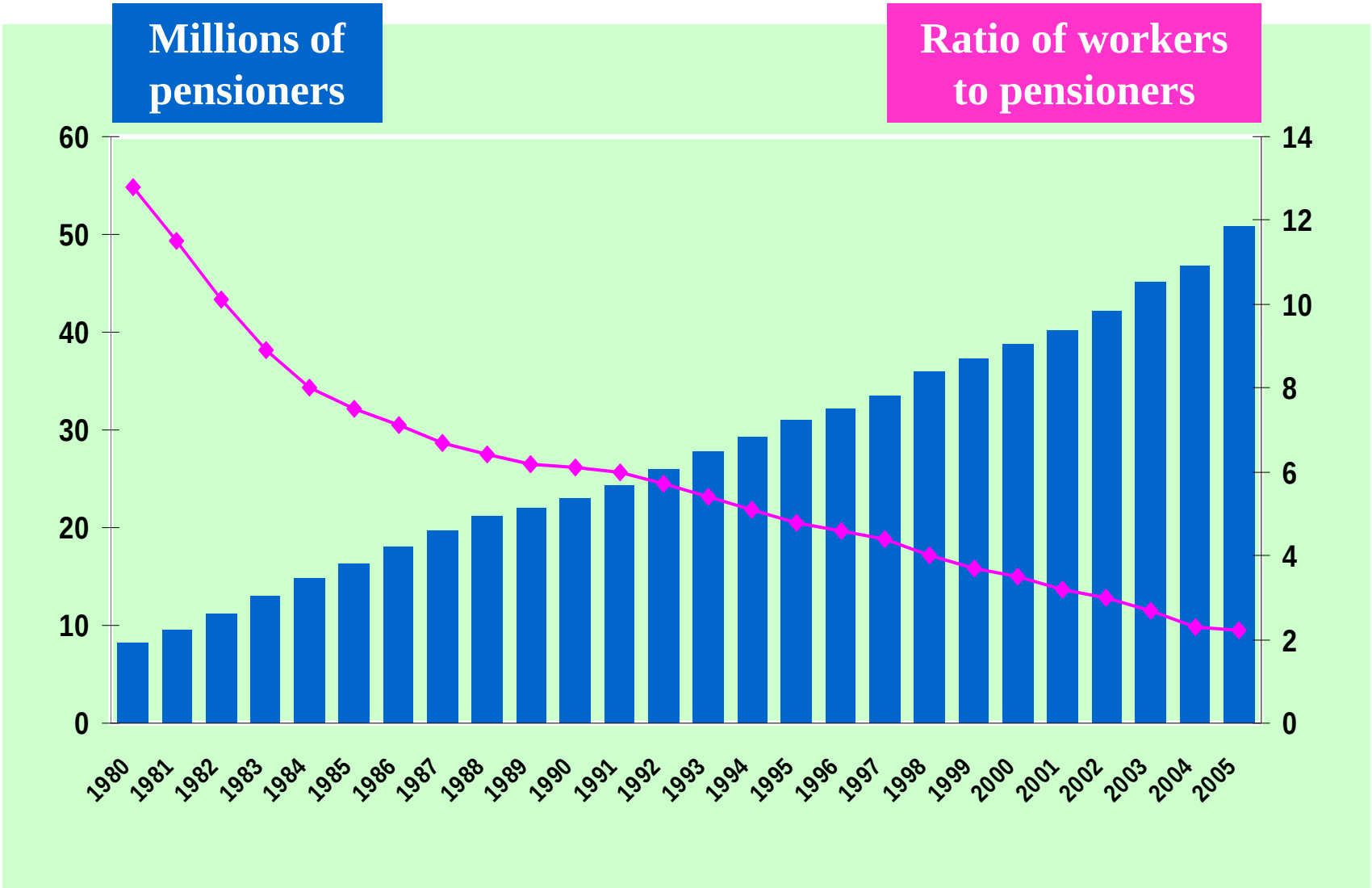
Support Ratios in Asia in 2000 and 2050

People 25–64/People 65+



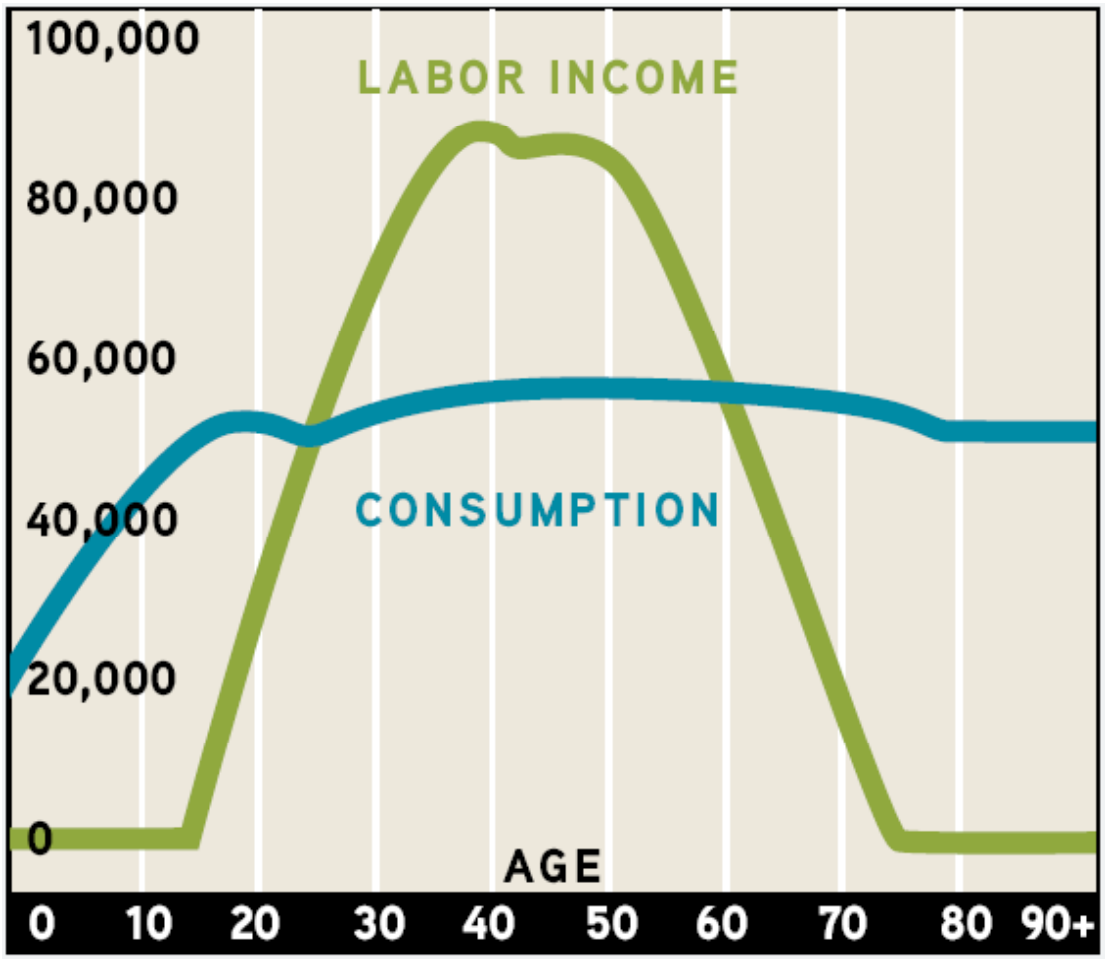
Source: U.S. Census Bureau, International Data Base

China's Declining Ratio of Covered Workers to Pensioners



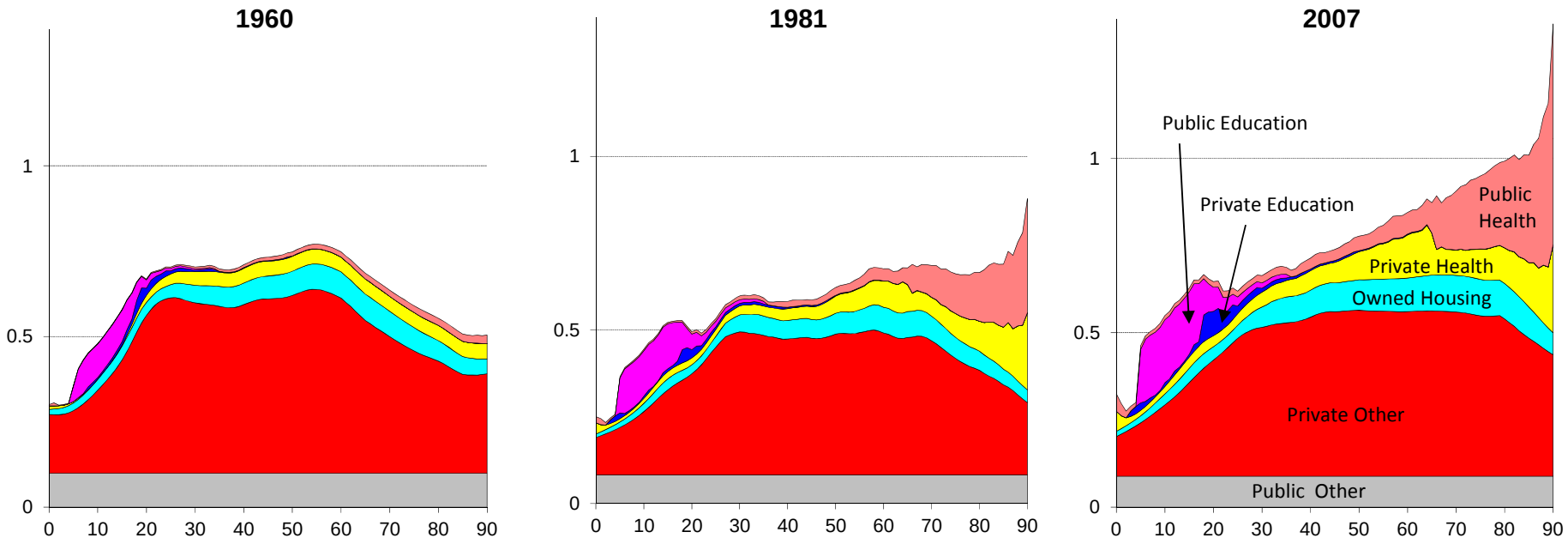
Sources: ***China Labour Statistical Yearbook*, various years; *China Statistical Abstract*, 2006.**

ECONOMIC LIFE CYCLE – EXTRA YEARS



Source: Chawla A. National Transfer Account Estimates for Thailand, as reported in Lee R, Mason A, eds. What Is the Demographic Dividend? *Finance and Development*. 2006:43(3). Available at: http://www.imf.org/external/pubs/ft/fandd/2006/09/basics.html.

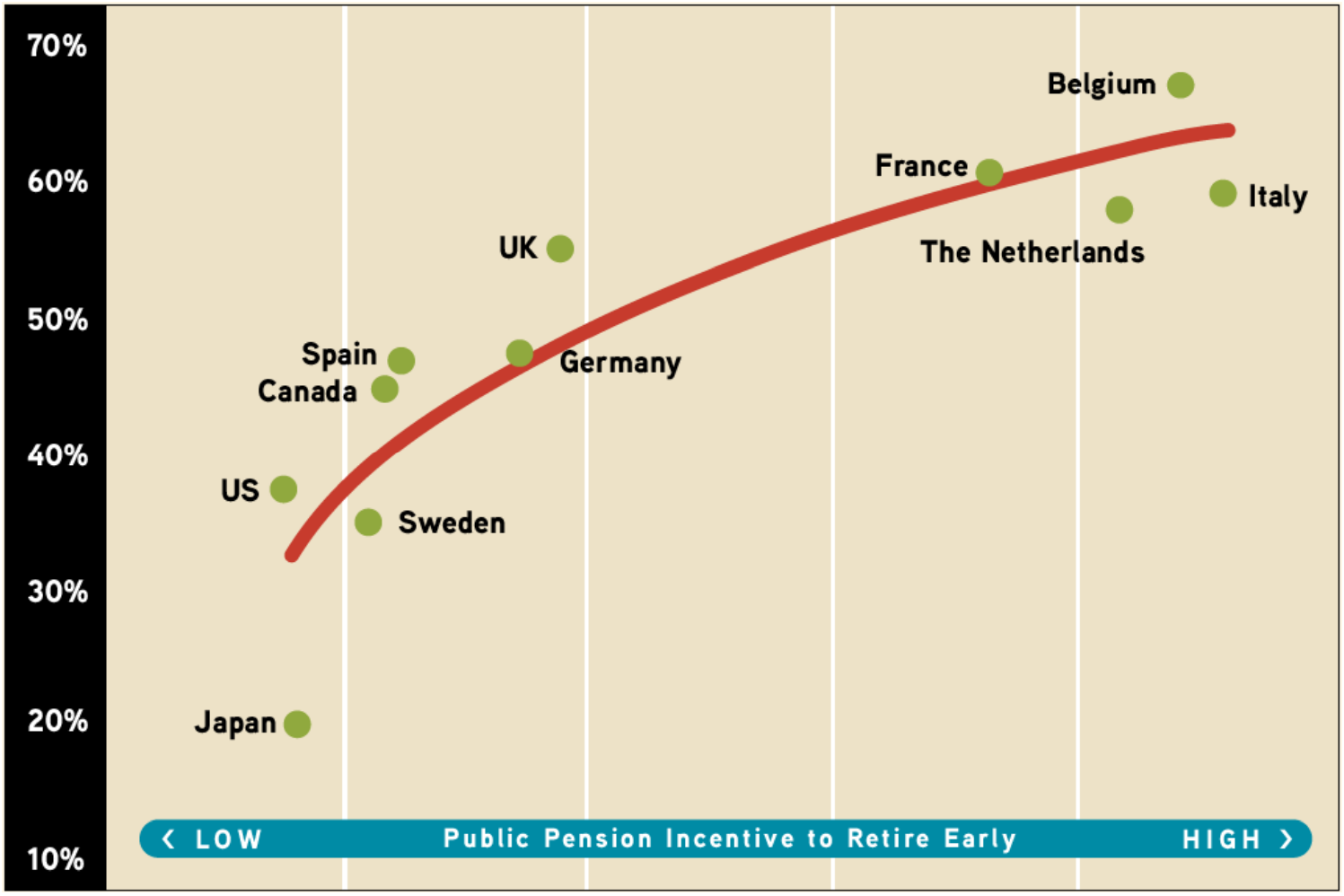
US consumption by age (private plus public in-kind transfers) for 1960, 1981 and 2007 (Ratio to average labor income ages 30-49).



Source: US National Transfer Accounts, Lee and Donehower, 2011

PUBLIC PENSION INCENTIVES DETERMINE RETIREMENT AGE FOR MEN IN 11 COUNTRIES

Percent of men age 55 and 65 not working

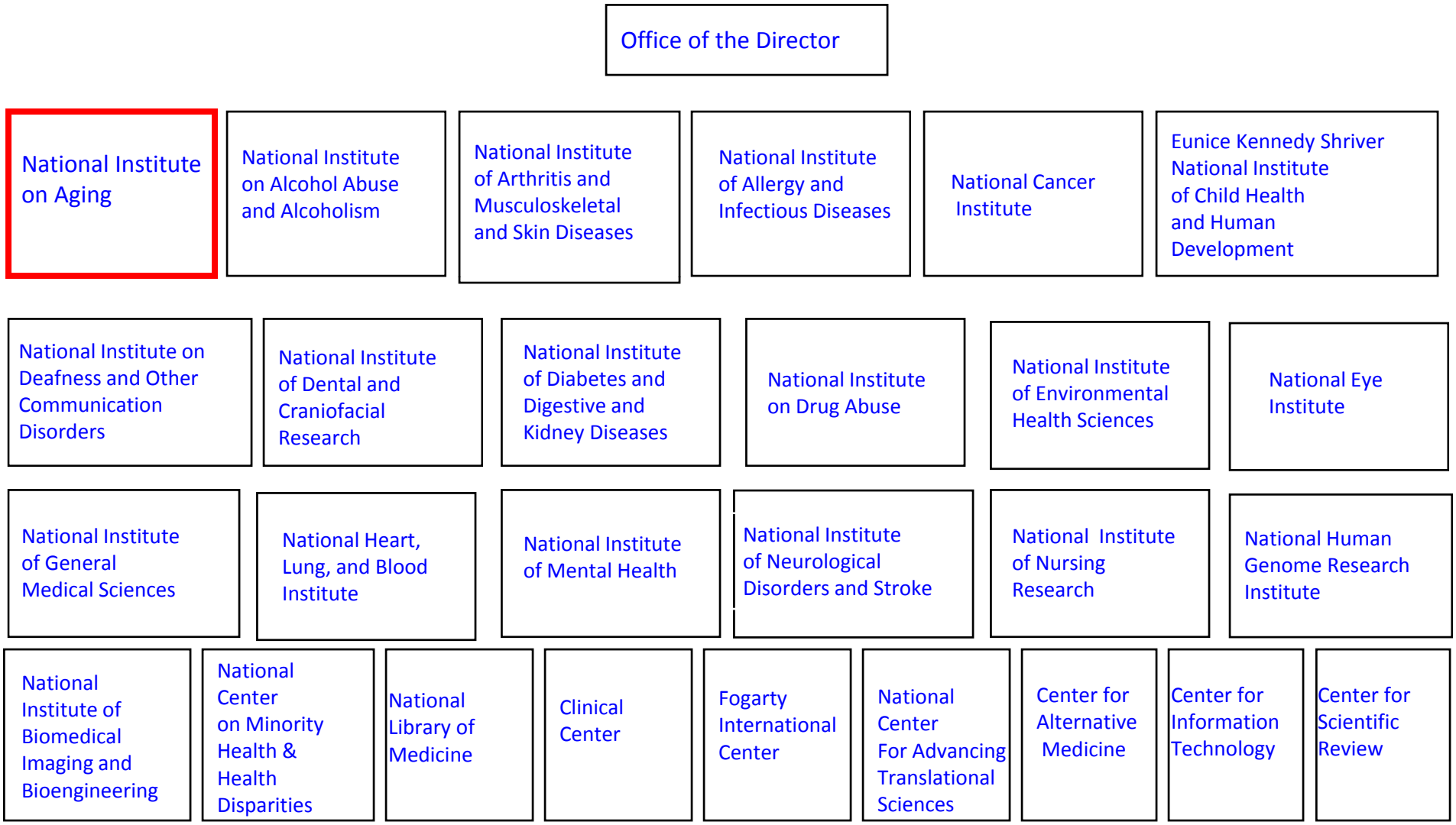


Source: Gruber J, Wise DA, eds. *Social Security and Retirement around the World.* Chicago, IL: University of Chicago Press, 1999.

Francis Collins, MD, PhD

- High-throughput technologies
- Translation of science
- Science for the benefit of health care reform
- Global Health
- Reinvigorate & empower the biomed research community

National Institutes of Health



2008

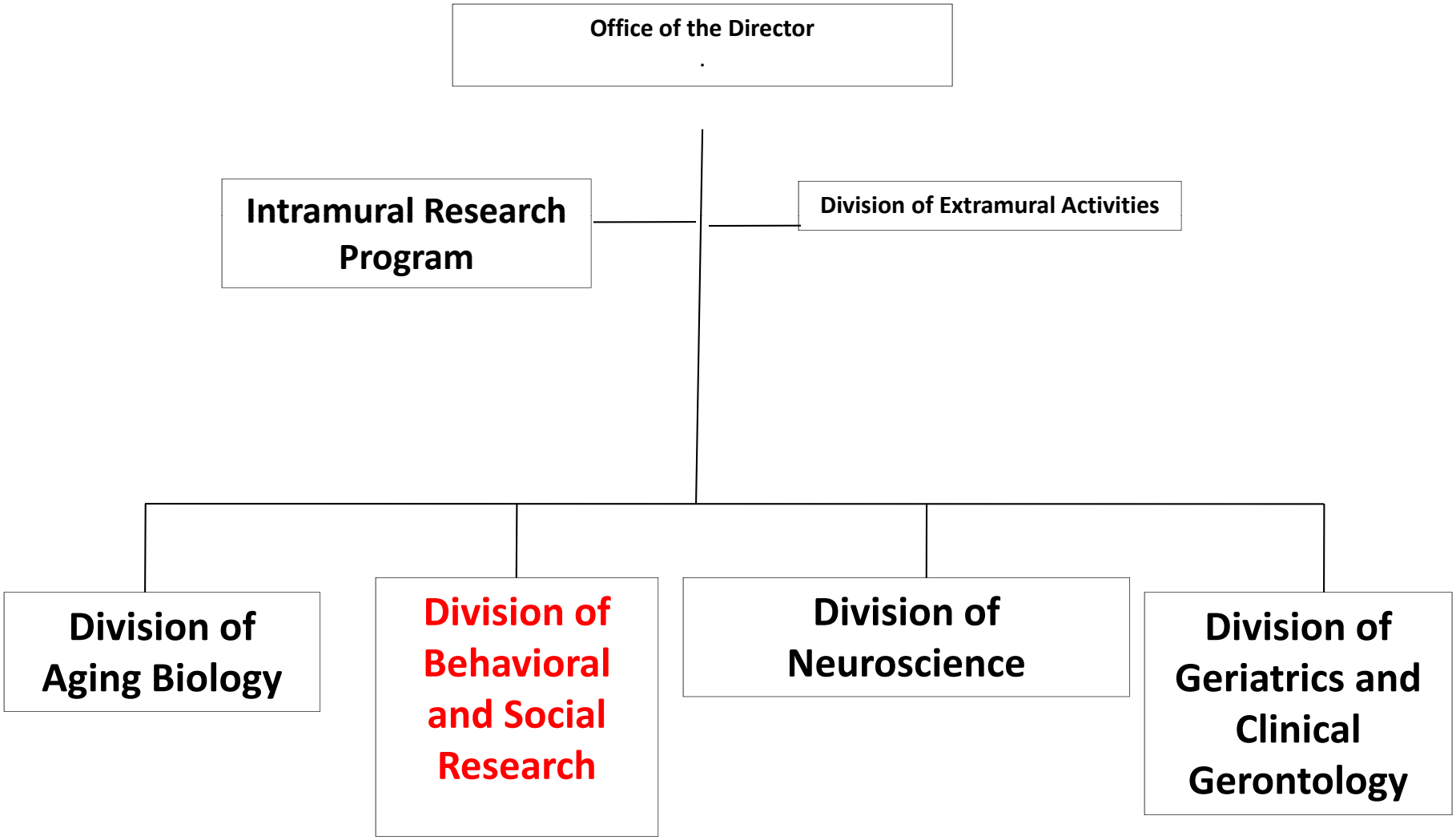
NIA Mission

- Established in 1974 to support and conduct ***research*** on:
  - **aging processes**
  - **age-related diseases**
  - **special problems and needs of the aged**
- ***Train*** and develop research scientists
- Provide research ***resources***
- ***Disseminate information*** on health and research advances

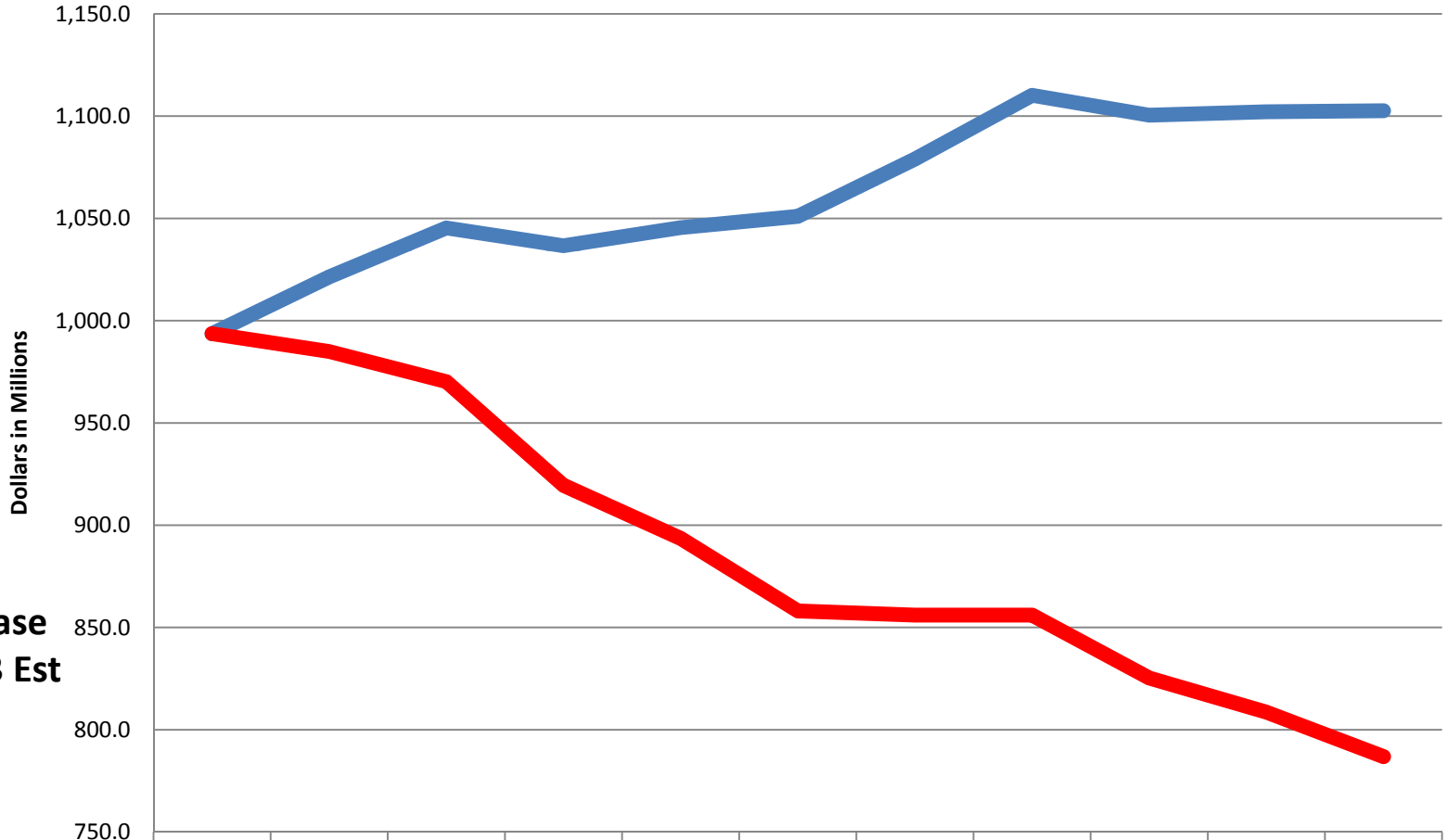
NATIONAL INSTITUES OF HEALTH

National Institute on Aging

Organizational Structure



NIA Appropriations - FY12 Enacted, FY13 President's Budget
Current versus Constant, FY03 Base Year

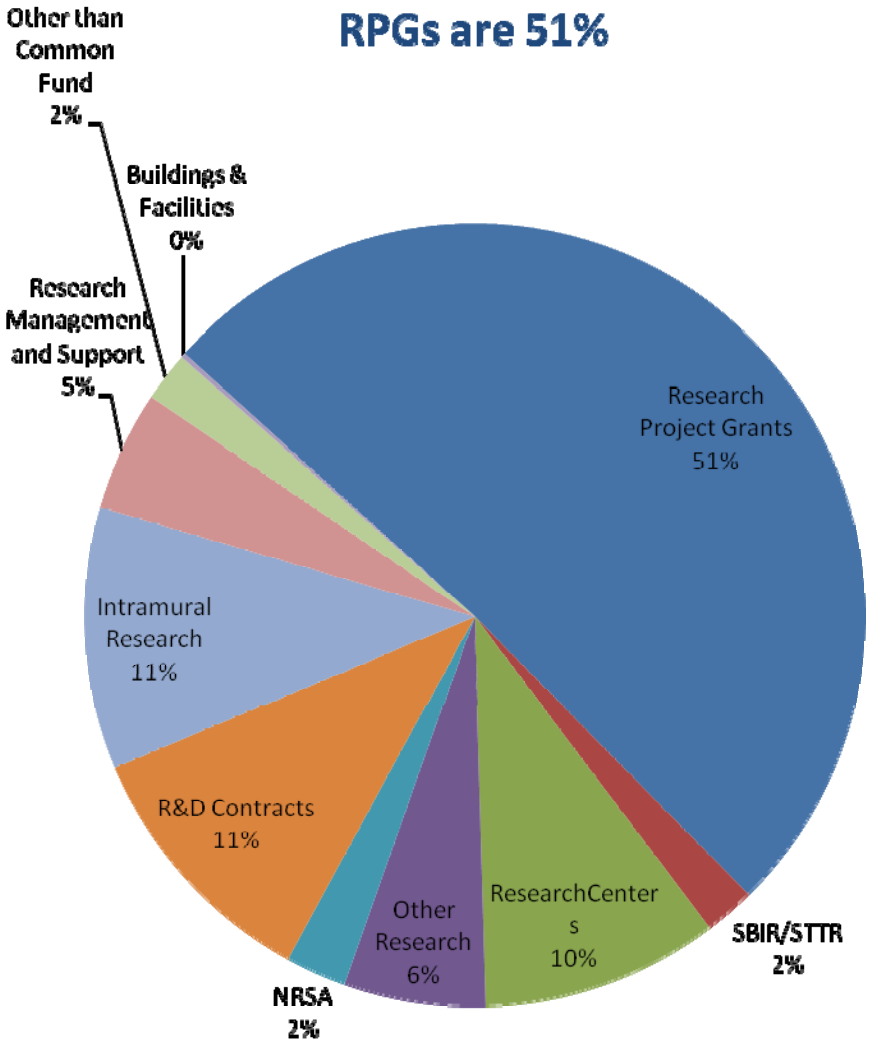


	FY03	FY04	FY05	FY06	FY07	FY08	FY09	FY10	FY11	FY12	FY13 Est
Series1	993.6	1,021.4	1,045.3	1,036.6	1,045.5	1,051.0	1,079.0	1,110.2	1,100.5	1,102.1	1,102.7
Series2	993.6	984.9	970.2	919.5	893.5	858.0	856.1	856.0	825.3	808.6	786.9

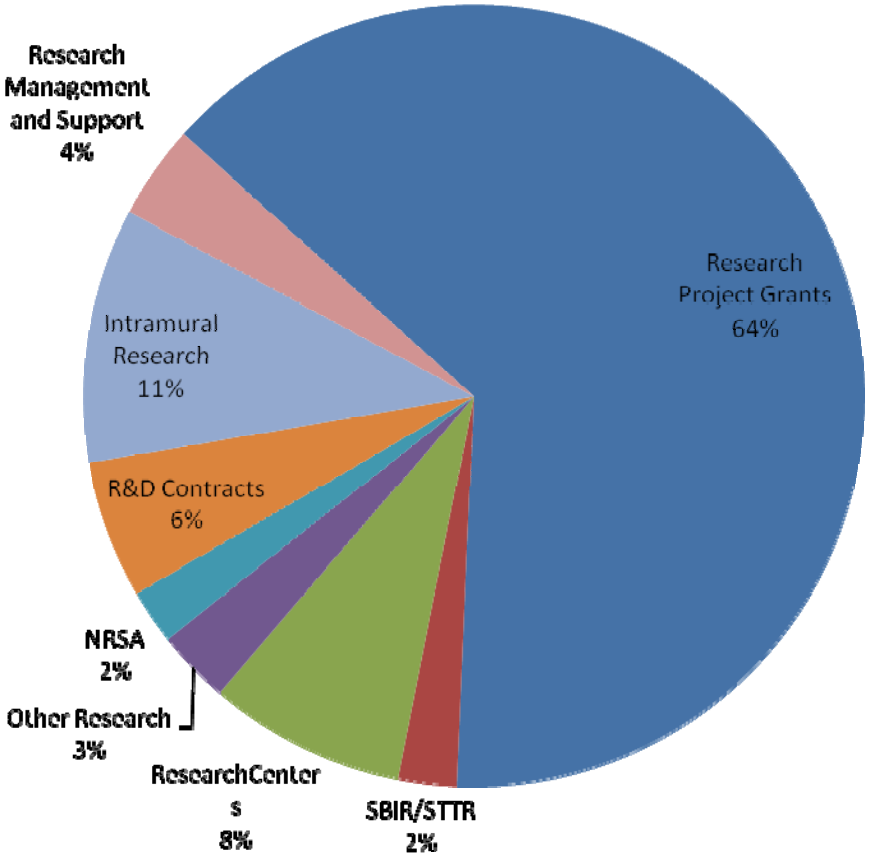
20.8% decrease FY2003-2013 Est

Source: http://officeofbudget.od.nih.gov/spending_hist.html

Proportion of Total NIH Budget, FY2011 RPGs are 51%



Proportion of Total NIA Budget, FY2011 RPGs are 64%



Source: http://officeofbudget.od.nih.gov/spending_hist.html

Division of Neuroscience

- Basic Neurobiology
- Alzheimer's Disease
- Sensory Processes
- Learning and Memory
- Sleep
- Cognitive Health
- Alzheimer's Disease Neuroimaging -**ADNI**

ADNI 2 Private Partner Scientific Board

23 companies, 1 government entity and 2 non-profit organizations

FNIH
Foundation for the National Institutes of Health

Abbott
A Promise for Life

amorfix
Life Sciences Ltd

AstraZeneca
UNITED KINGDOM

BIOCLINICA

biogen idec

Bristol-Myers Squibb

Eisai

elan

GE

Genentech
IN BUSINESS FOR LIFE

INNOGENETICS

JANSSEN
Alzheimer Immunotherapy

Lilly

MEDPACE

MERCK

MSD
Meso Scale Diagnostics, LLC.

NOVARTIS

Pfizer

Roche

SERVIER

SYNARC
Start here, finish first.

Takeda

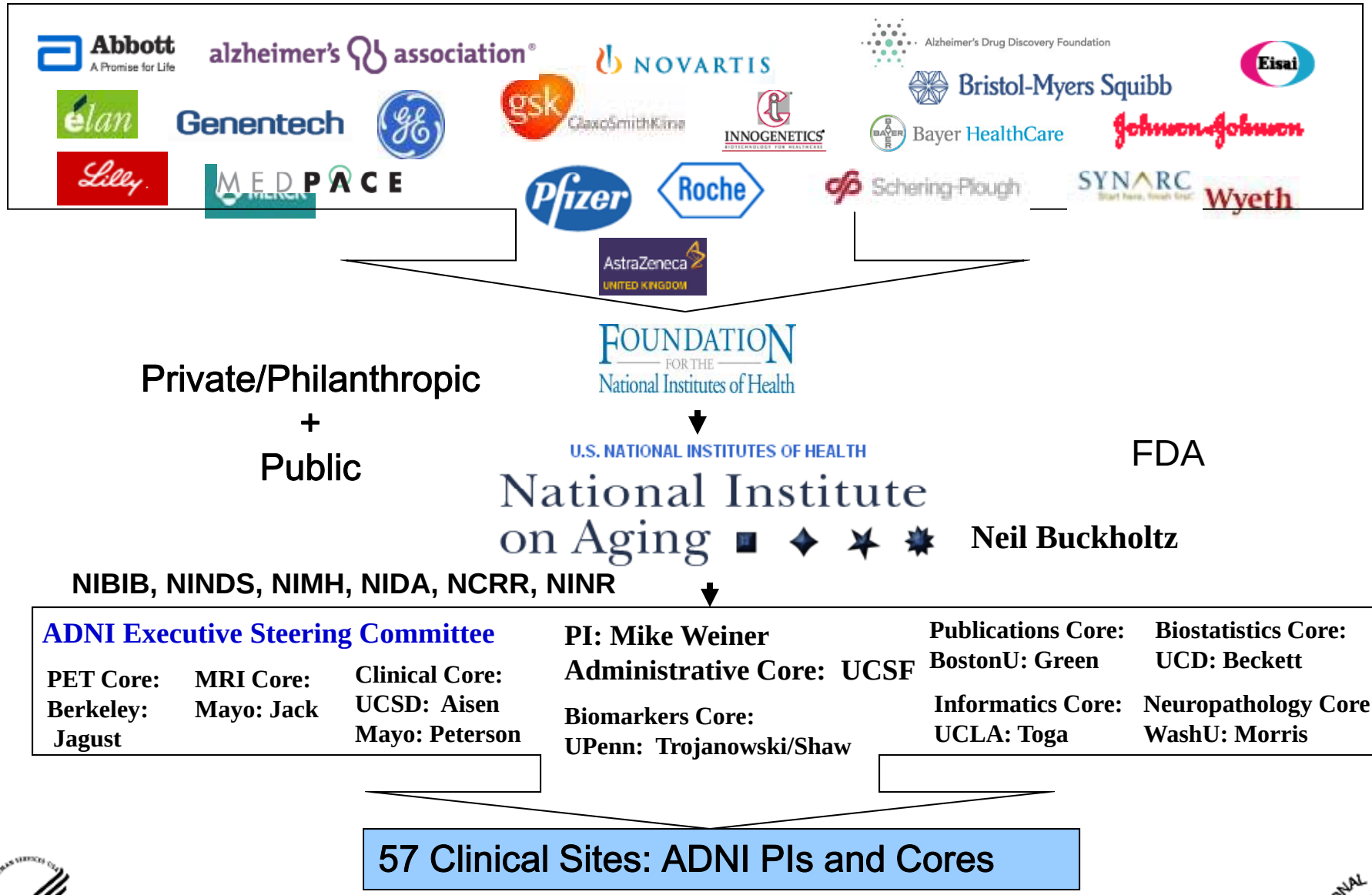
Johnson & Johnson

Canadian Institutes of Health Research
Instituts de recherche en santé du Canada

alzheimer's association

Alzheimer's Drug Discovery Foundation

ADNI Public-Private Partnership Structure



Division of Behavioral and Social Research

- Demography and Economics psychology
- Aging Minds -Cognitive Science
- Behavior Genetics
- **Longitudinal Studies** –
  Health and Retirement Study
- **Interventions** –
  ACTIVE, REACH, Experience Corps, Behavioral Economics, Oregon Lottery, MTO

c/o Gerontology Society of Iowa

Economics of Aging Section

- One of the largest funders of economic research
- Support and develop research and data on topics including:
  - Implications of population aging for public and private retirement and health insurance programs and for income security of future retirees
  - Allocation of family time and financial resources across generations
  - Determinants of retirement, family labor supply, and saving
  - Behavioral economics and the effects of psychological factors and mental health characteristics on economic behaviors
  - Evaluations of the impact of changes in Federal programs
  - Health and long-term-care insurance and expenditures
  - Interrelationships between health and socioeconomic status
  - Cost-effectiveness of interventions to improve the health and well being of the elderly
- Collaborate with other federal and private entities to support the development of research on economics of aging

What would this meeting suggest for BSR and Industry?

- **BSR Has No Commercial Partnerships**
- **BSR funds big economics research program**
- **BSR funds 12 Roybal Translation Centers some do research activities with e.g. Gallup, Express Scripts, Intel, GE, Health and Auto Insurers, Weight Watchers, Humana, CVS, Mckinsey, mutual funds**
- **BSR funds SBIRs/STTRs -- quality?**
- **BSR commissioned NRC Report "Technology for Adaptive Aging" 2004**

Pasteur's Quadrant –Roybal Translation Centers

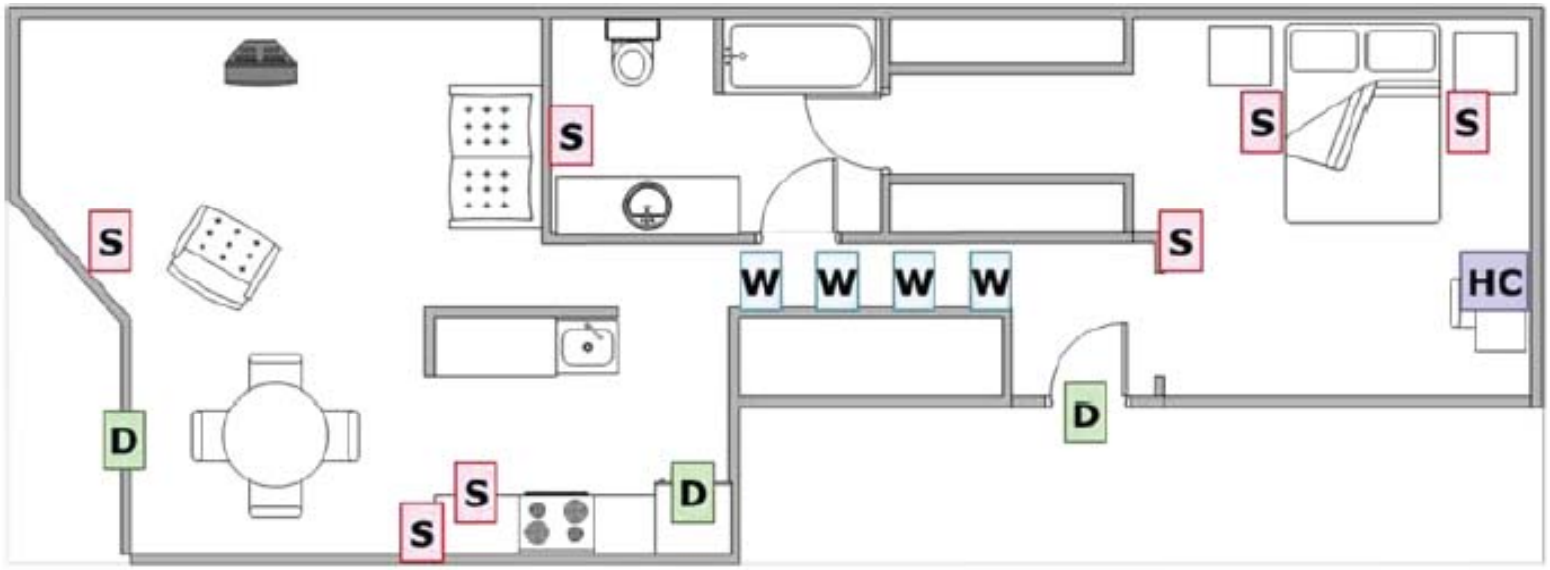
- *Mobility (Driving) -- Birmingham -- Ball
- *Networks -- Harvard -- Christakis
- *Research on Experience and Wellbeing- - Princeton – Kahneman/Krueger/Stone – (NAS Panel/Health Accounts/UK)
- * Home Monitoring -- Oregon Health Science --Kaye
- *Beh. Change in Health & Saving – NBER/Harvard --Laibson
- *Behavioral Economics and Health – PENN --Volpp

Roybal Centers

- **Financial Decision Making --RAND --Kapteyn**
- **Advancing Decision Making in Aging -- Stanford – Garber**
- **Health Policy Simulation-- RAND – Goldman**
- **Health Promotion -- Illinois Chicago --Hughes**
- **Managing Pain in Later Life -- Cornell --Reid**
- **Chronic Disease Self-Management -- Purdue -- Calhan**

Source: http://www.nih.gov/news/health/feb2010/nia-04.htm

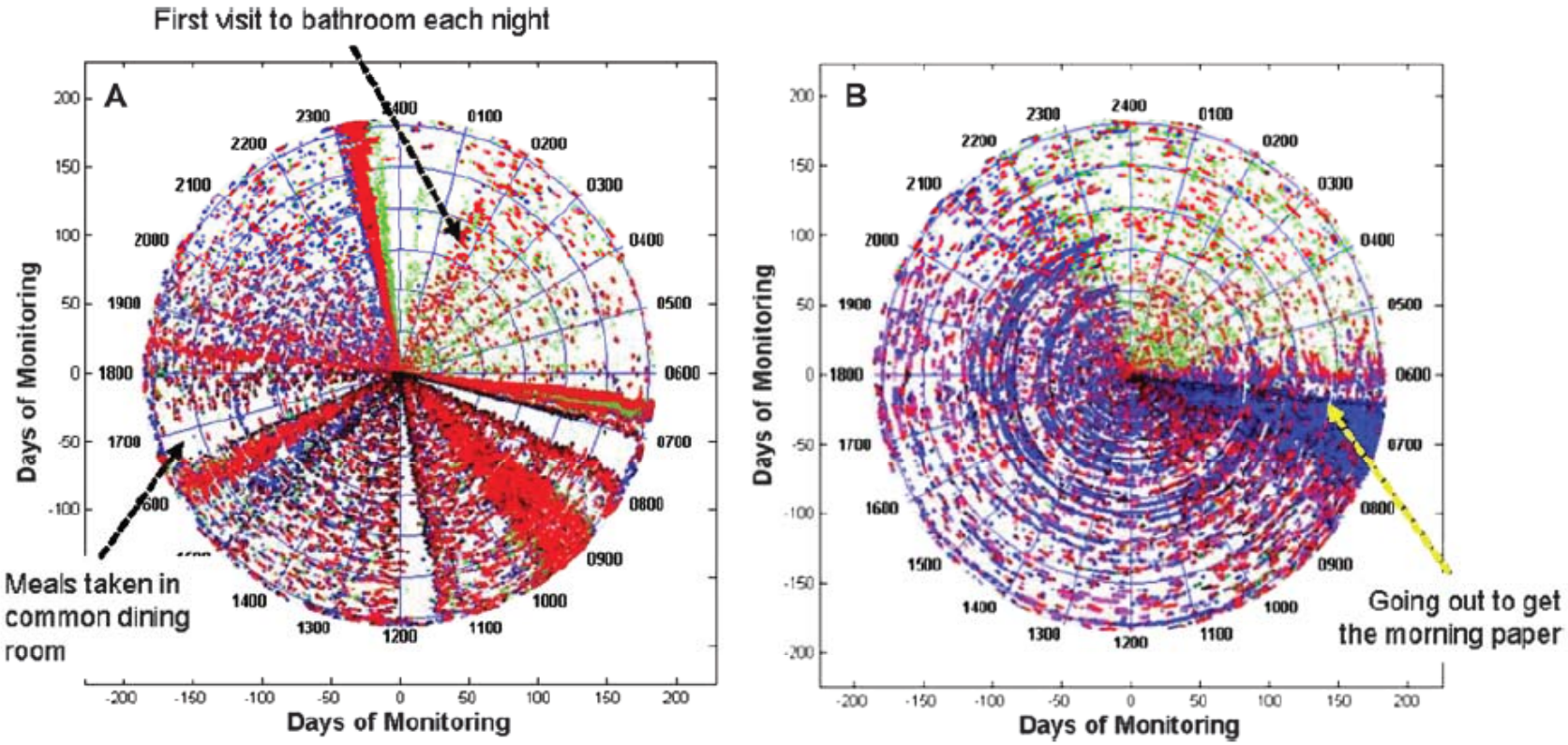
Kaye -ORCATECH Roybal Center: Continuous In-home Monitoring



Sensor locations in a small apartment include infrared motion detectors (**S**), walking speed sensors (**W**), contact sensors on doors including the refrigerator (**D**); **HC** marks the location of the home computer. (Kaye et al., 2011)

ORCATECH is co-funded by NIA and the Intel Corporation.

Activity Graphs from In-home Monitoring



"Spiral plots" of 24-hour monitoring; **bathroom, entering bedroom, entering living room, and leaving the dwelling are color-coded**. Left: resident in a continuing care community. Right: living alone, rarely leaves apartment. (Kaye et al., 2011)

Health and Retirement Study (HRS)

- Nationally representative sample with oversamples of African and Hispanic Americans
- Longitudinal (since 1992) with refreshment to represent population 50+ in steady state, N~20,000
- Public use
- Multidisciplinary -- includes DBS assays
- Viral spread -- similar studies in 35+ countries

Health and Retirement Study (HRS) Key Features

Premier data source for retirement.

Very rich data on behavioral and social variables, plus administrative linkages to SSA and CMS data.

Genotyping of 13,000 participants for 2.5M SNPs available later at dbGaP this month; genotyping on 7,000 additional participants by the end of 2013.

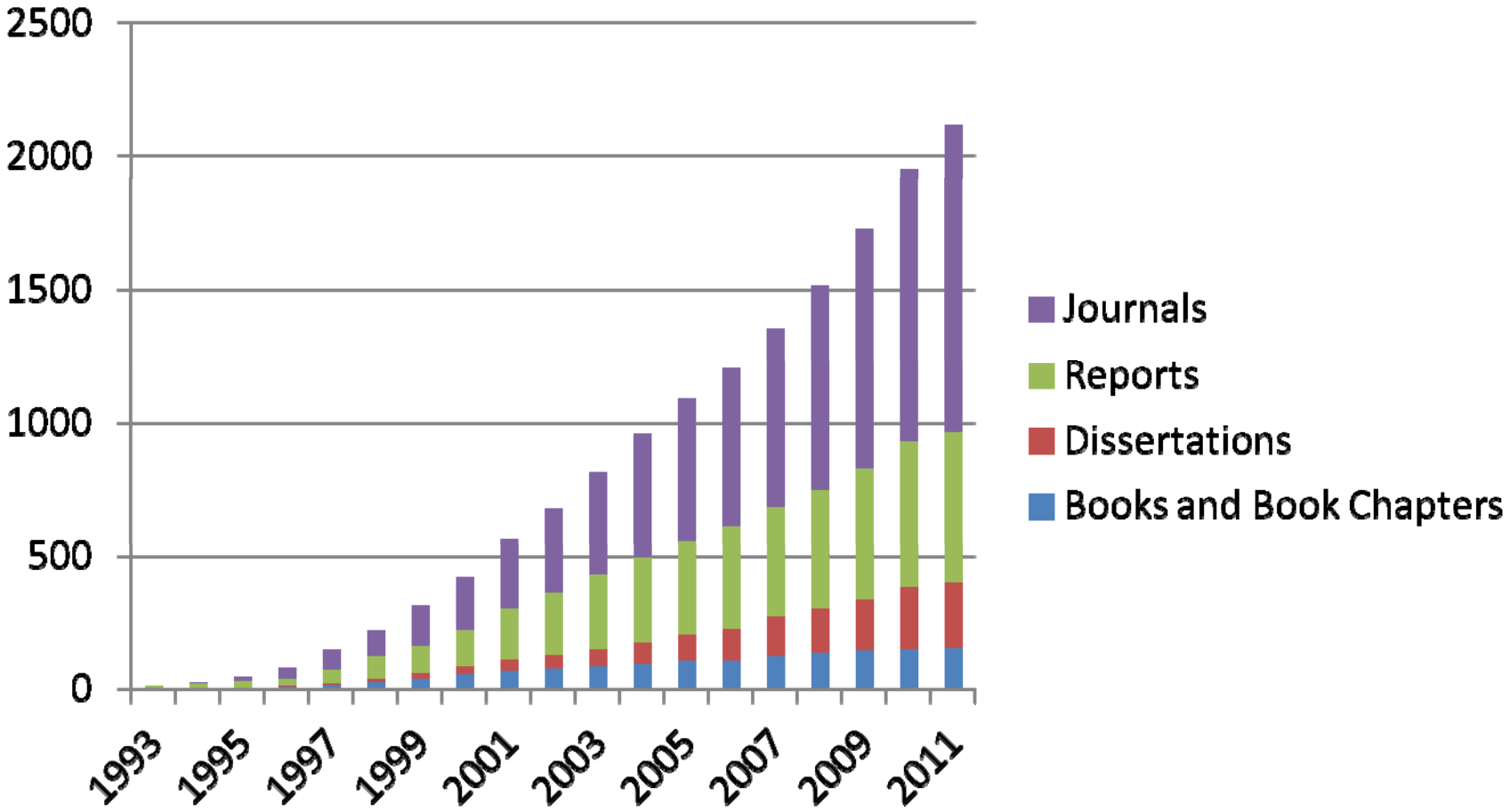
Genotyping participants with the Illumina exome chip 2013. (240,000+ rarer but likely functional variants in the coding regions of genes.)

Telomeres on subsample

Scientific Productivity of HRS

HRS Publications, 1993-2011

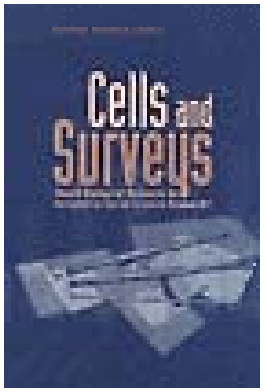
Cumulative Count by Type -- 2000+



Source:
http://hrsonline.isr.umich.edu/index.php?p=bibstat

NRC Reports on Biomarkers & GWAS

- **Biosocial Surveys (2007)**
- **Cells and Surveys (2001)**



- **Expert Panel– "Using GWAS to Explore Fundamental Questions About Aging in the Health and Retirement Study Sample"**

- **Panel on Collecting, Storing, Accessing, and Protecting Biological Specimens and Biodata in Social Surveys**

NRC/National Academy of Science

Preparing for an Aging World

Recommendations for a research agenda on aging in Sub-Saharan Africa.

In Progress -- reports on:

Aging in Asia

Epidemiological Transition

Next:

Aging in Latin America

Middle East ?

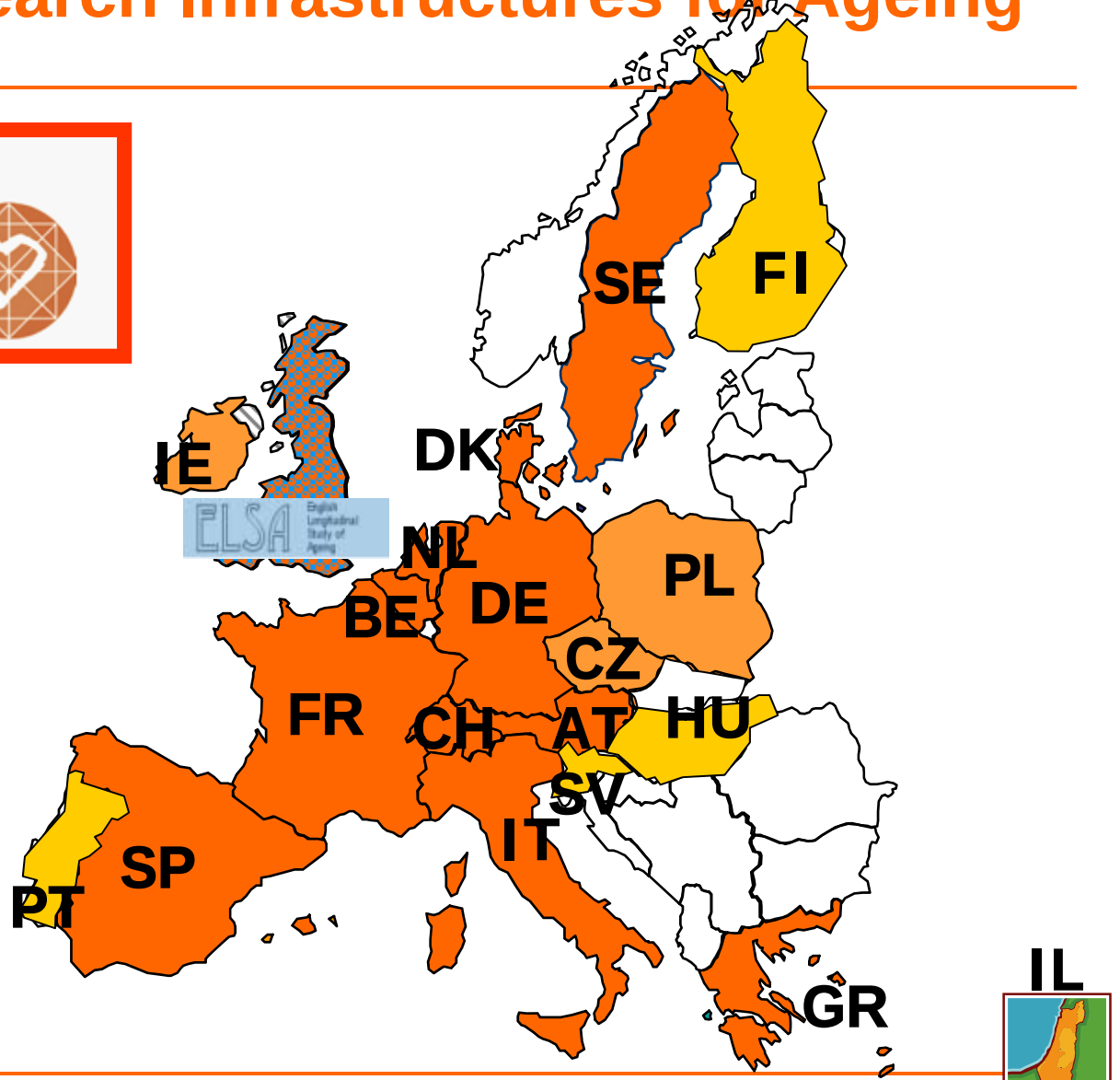
Research Infrastructures for Ageing

SHARE
Survey of Health, Ageing and Retirement in Europe

Wave 1: 2004/05
11 countries,
32,000 resp. 50+

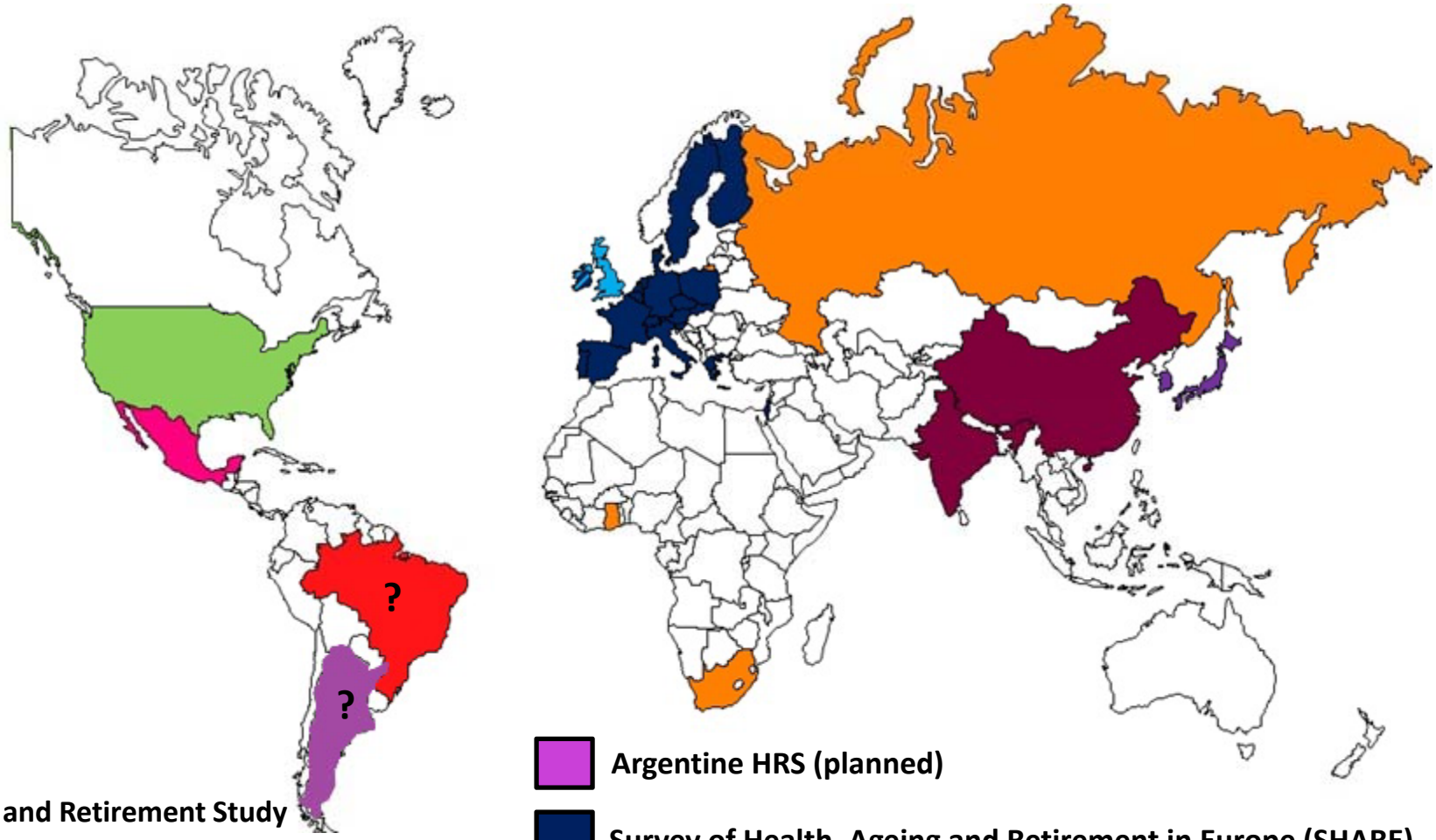
Wave 2: 2006/07
15 countries,
38,000 responds.

Wave 3: 2008/09
19 countries,
43,000 est. responds.



2007 - 2013

HRS-like Global Harmonized Coverage



Health and Retirement Study

Survey of Ageing Globally (SAGE)

Brazil HRS (planned)

Asian HRS Sites (in development)

Argentine HRS (planned)

Survey of Health, Ageing and Retirement in Europe (SHARE)

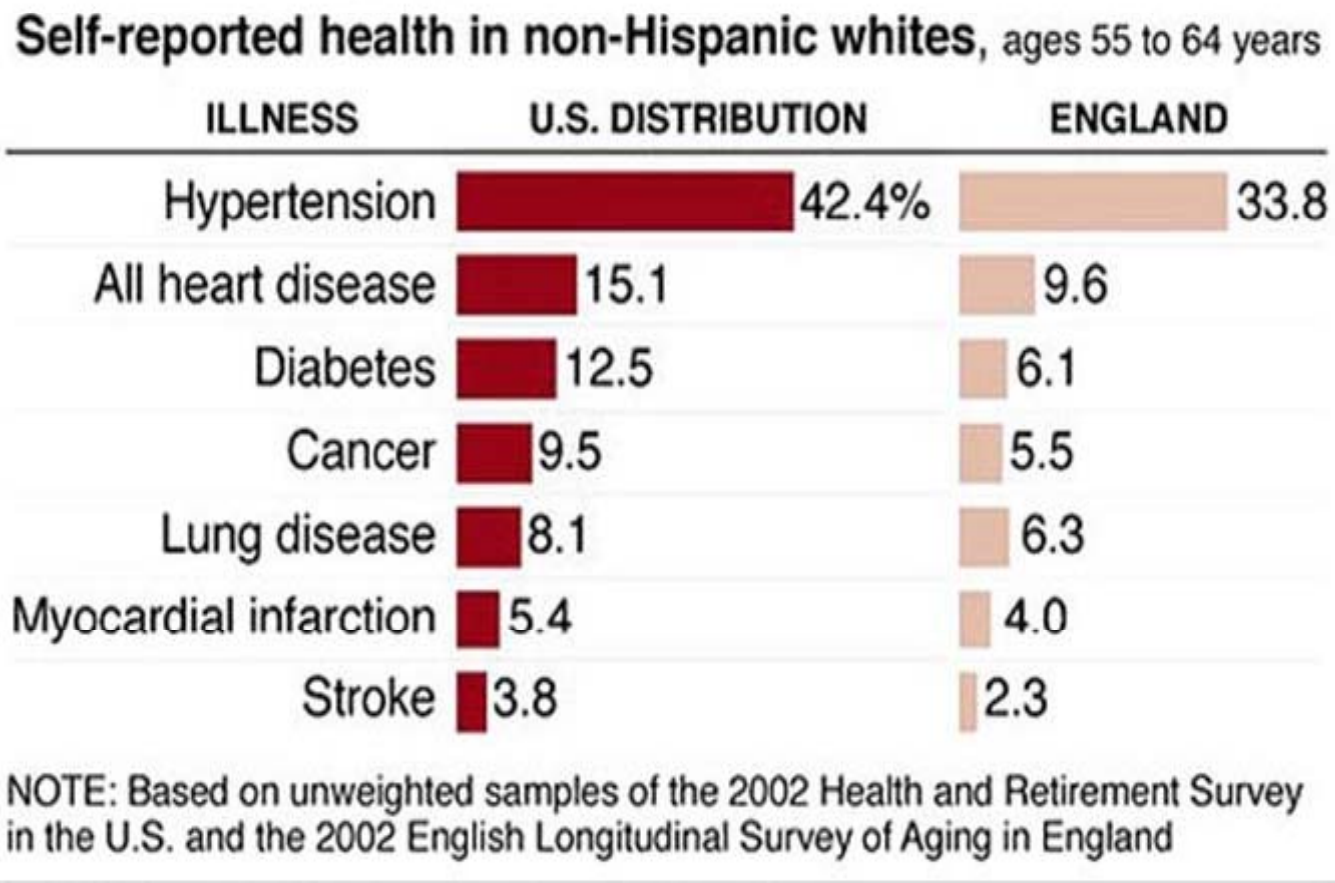
English Longitudinal Study of Ageing (ELSA)

Mexican Health and Aging Study and SAGE

SAGE and Pilot HRS site

Source: Elizabeth Hamilton, MPH

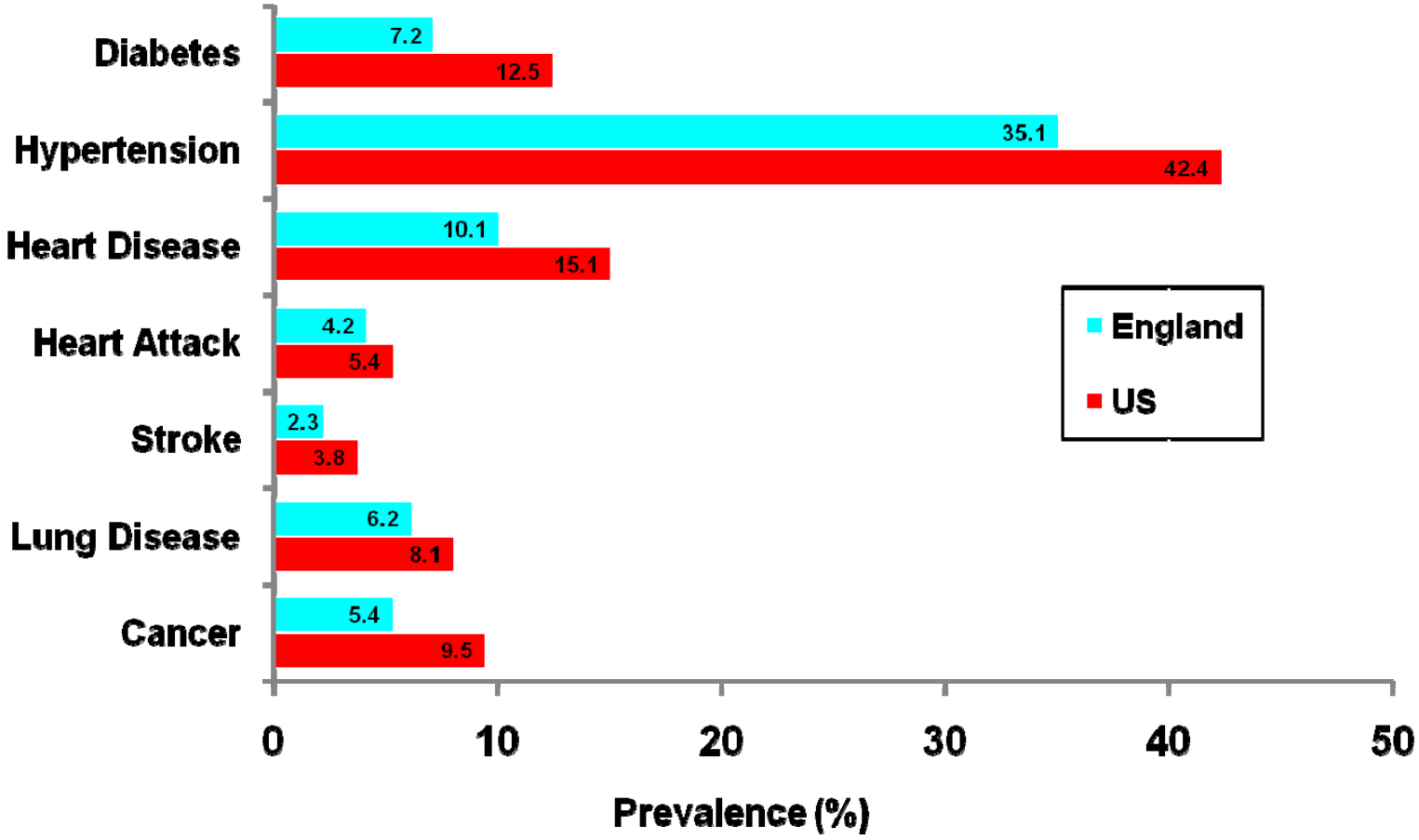
Health Differences Between US and English Men exploited HRS/ELSA



Banks, Marmot, Oldfield, and Smith (2006), "Disease and Disadvantage in the United States and in England," JAMA.

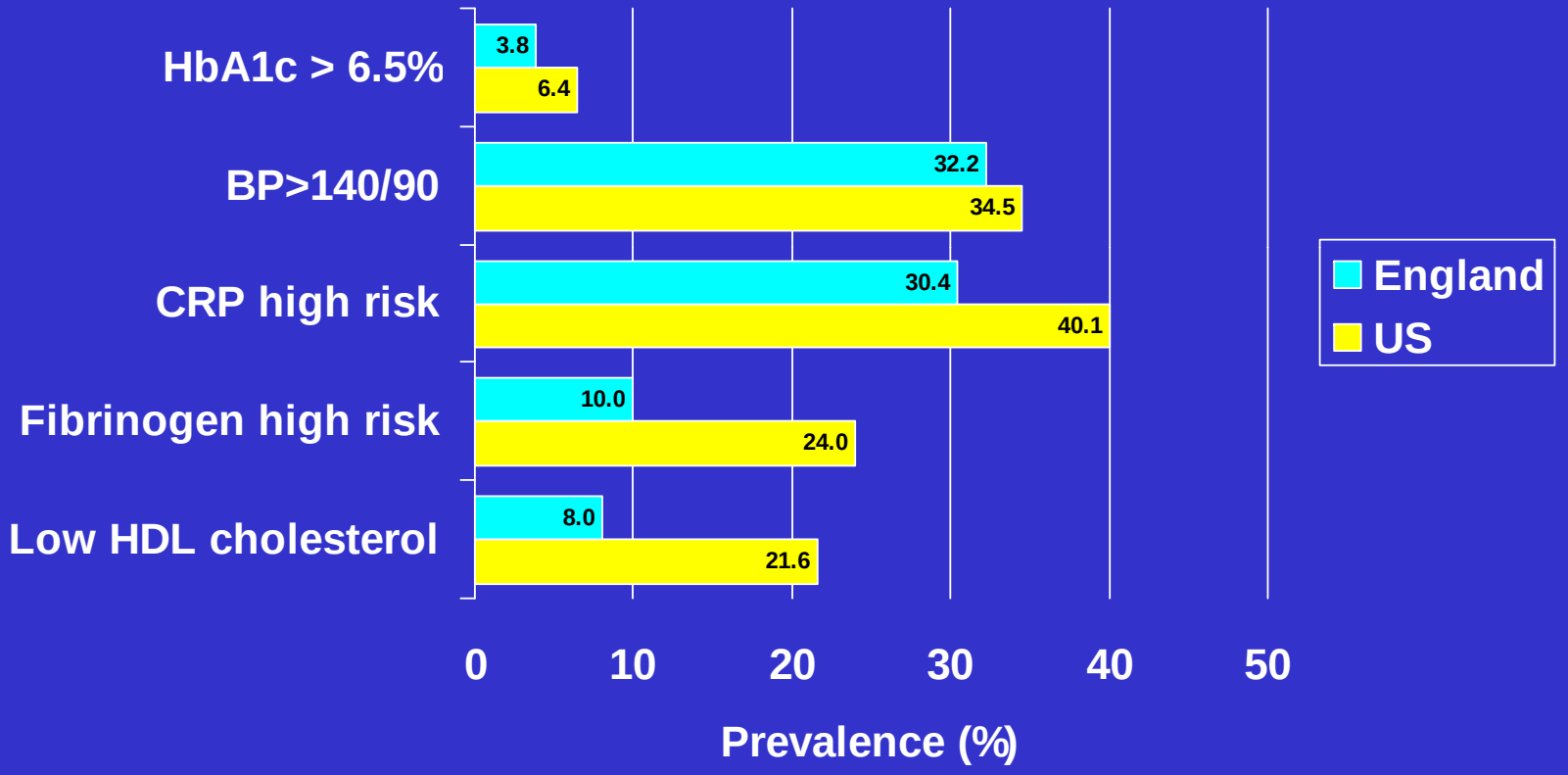
Americans are Sicker than the English

55-64 year olds; controlling for differences in risk factors



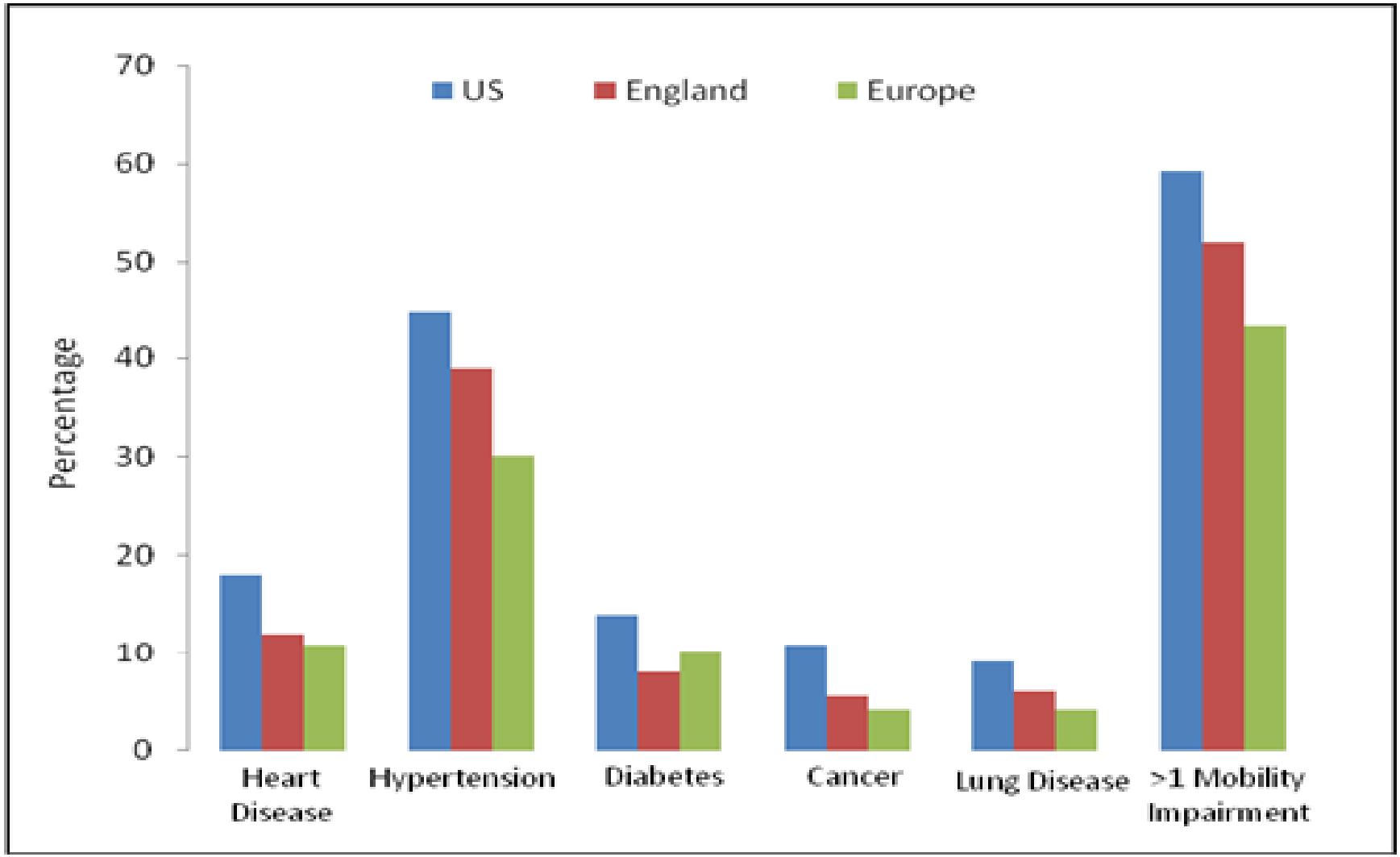
Source: Banks, Marmot, Oldfield, and Smith, 2006.

Anglo-US Risk factors



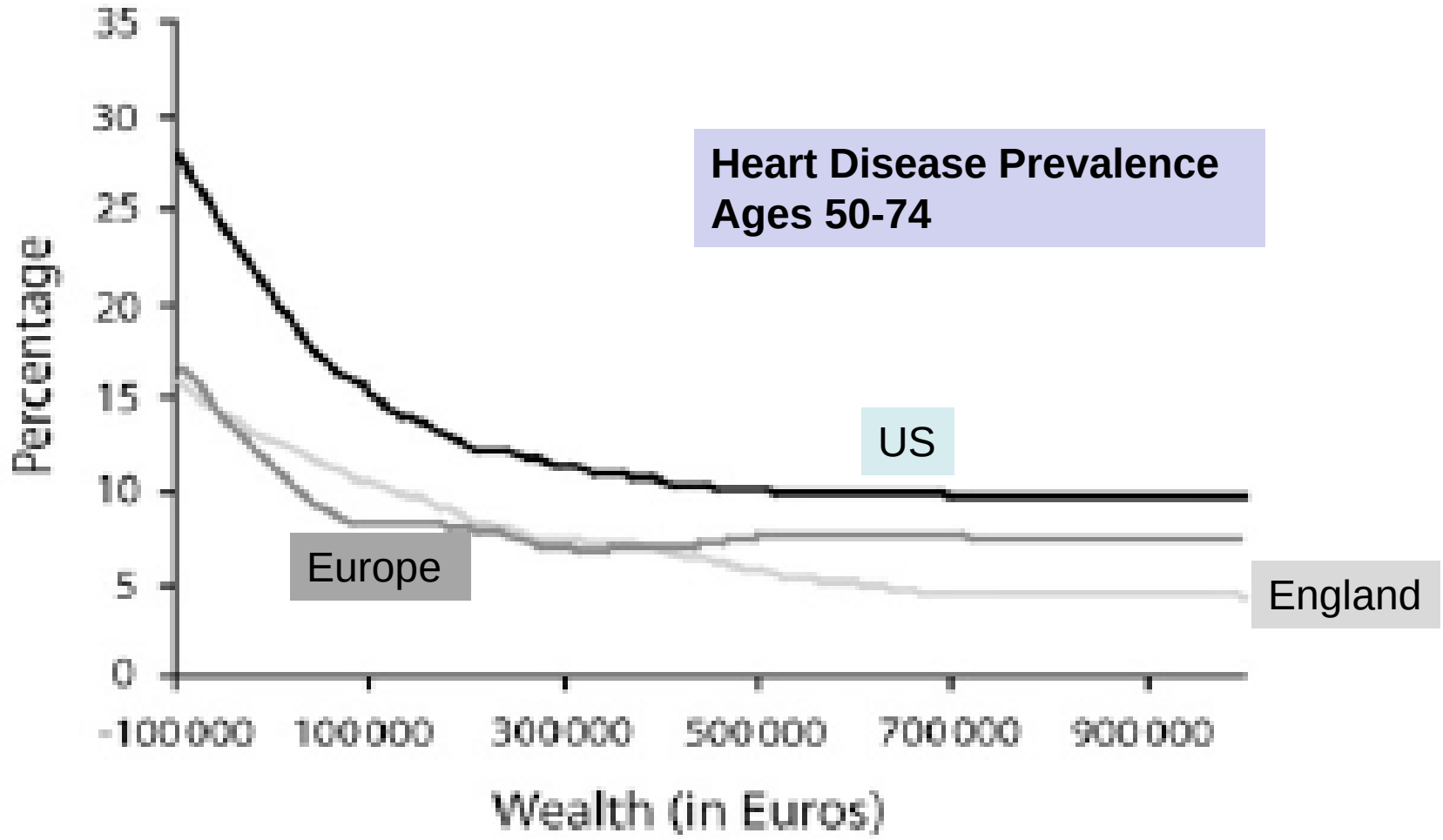
Source: Banks et al., JAMA, 2006.

Prevalence of Chronic Disease and Disability among People Aged 50-74 in the US, England, and 10 Other European Nations: 2004



Source: Adapted from Avendano, Glymour, Banks, and Mackenbach, AJPH, 2009.

Disparities Persist Even Among the Affluent



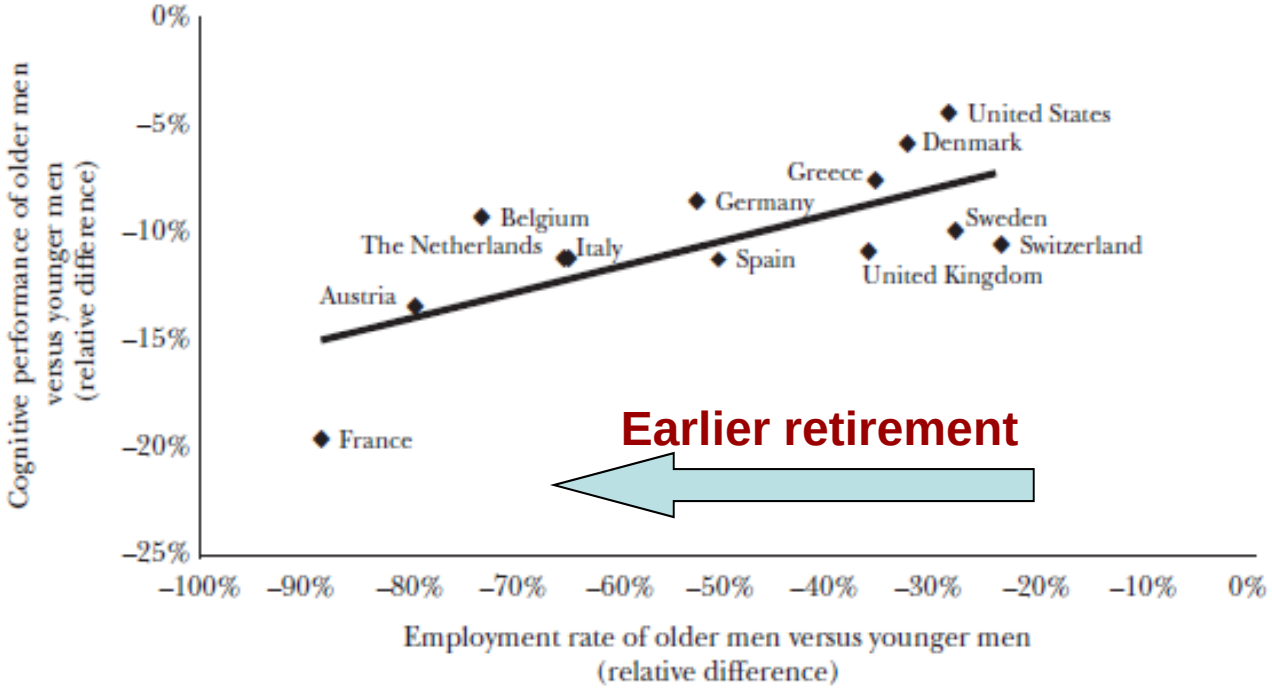
Source: Avendano et al., AJPH, 2009.

Pattern of Early Retirement and Cognitive decline: Men Aged 50-64 vs. 60-54 in each Country

Decreasing Cognition

Figure 1

Drop in Cognitive Performance as a Function of Drop in Employment Rate between Men 50–54 and 60–64 Years Old



Source: Adam, Bay, Bonsang, Germain, and Perelman (2007). Reproduced with permission. Data drawn from ELSA for England, HRS for the United States, and SHARE for other countries for 2004.

Moving Away from Social Astronomy
Social and Behavioral Interventions:

- **Cognitive Training for Independent and Vital Elderly (ACTIVE)**
- **Resources for Enhancing Alzheimer's Caregiver Health (REACH)**
- **Experience Corps:** Cog. & health benefits of volunteering in schools
- **Health benefits of workplace policies and practices** (with NICHD):
- **Pension Reform:** automatic enrollment in 401Ks - Pension Prot. Act of 2006.
- **Behavioral Economics applied to Health**
- **Oregon Lottery for Medicaid – health impact of health insurance**
- **MTO – neighborhood impact on obesity and diabetes**

ACTIVE Clinical Trial

Domain Specific Memory Training and Impact on Cognitive Decline

Desired outcomes:

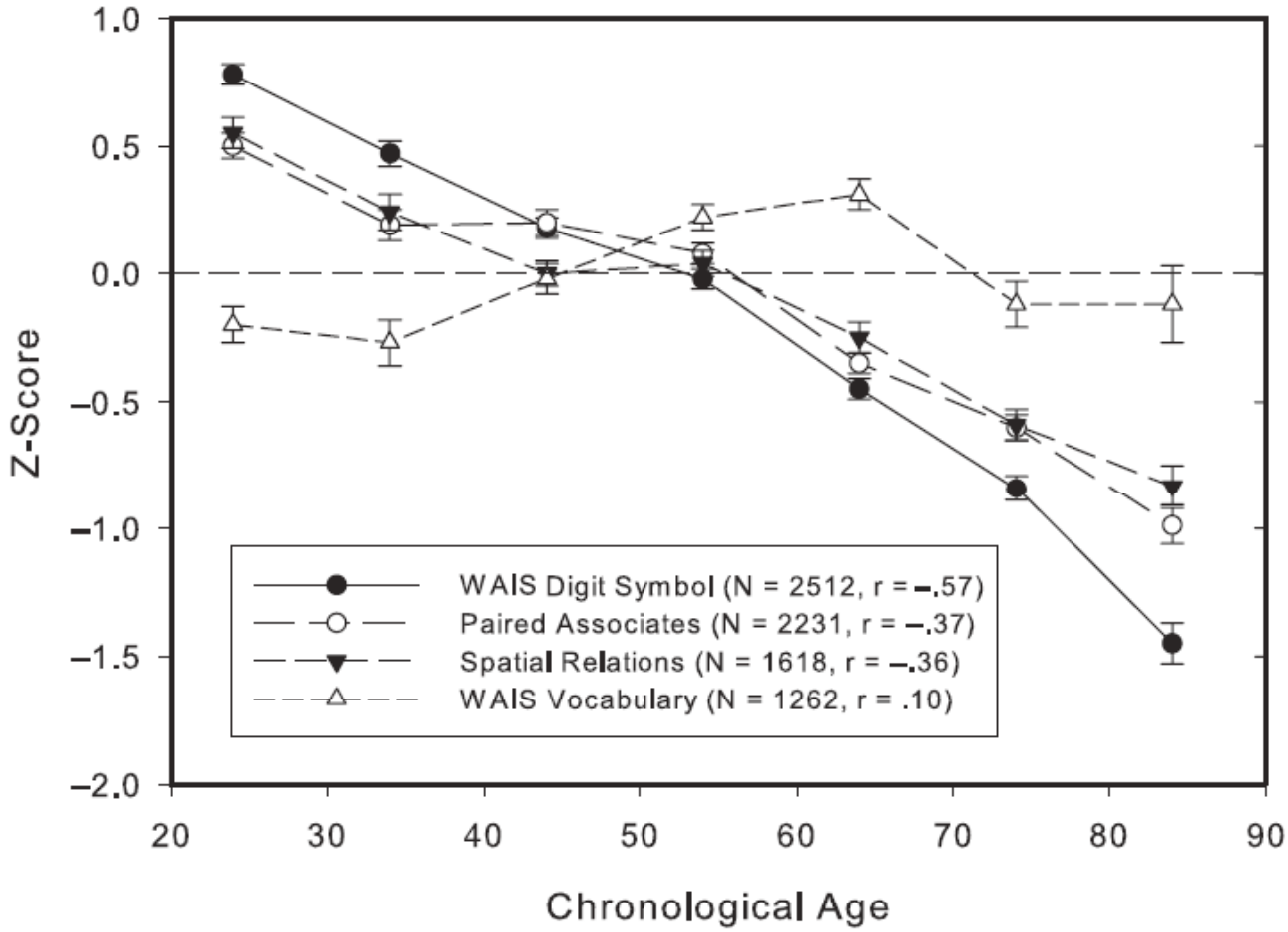
- Transfer of training between tasks
- Training would buffer decline in basic ADLs, IADLs, higher order IADL of driving, everyday problem solving

Three training groups (speed, reasoning, episodic memory) and a matched control group

Ten 60- 75 minute sessions over 5 to 6 weeks

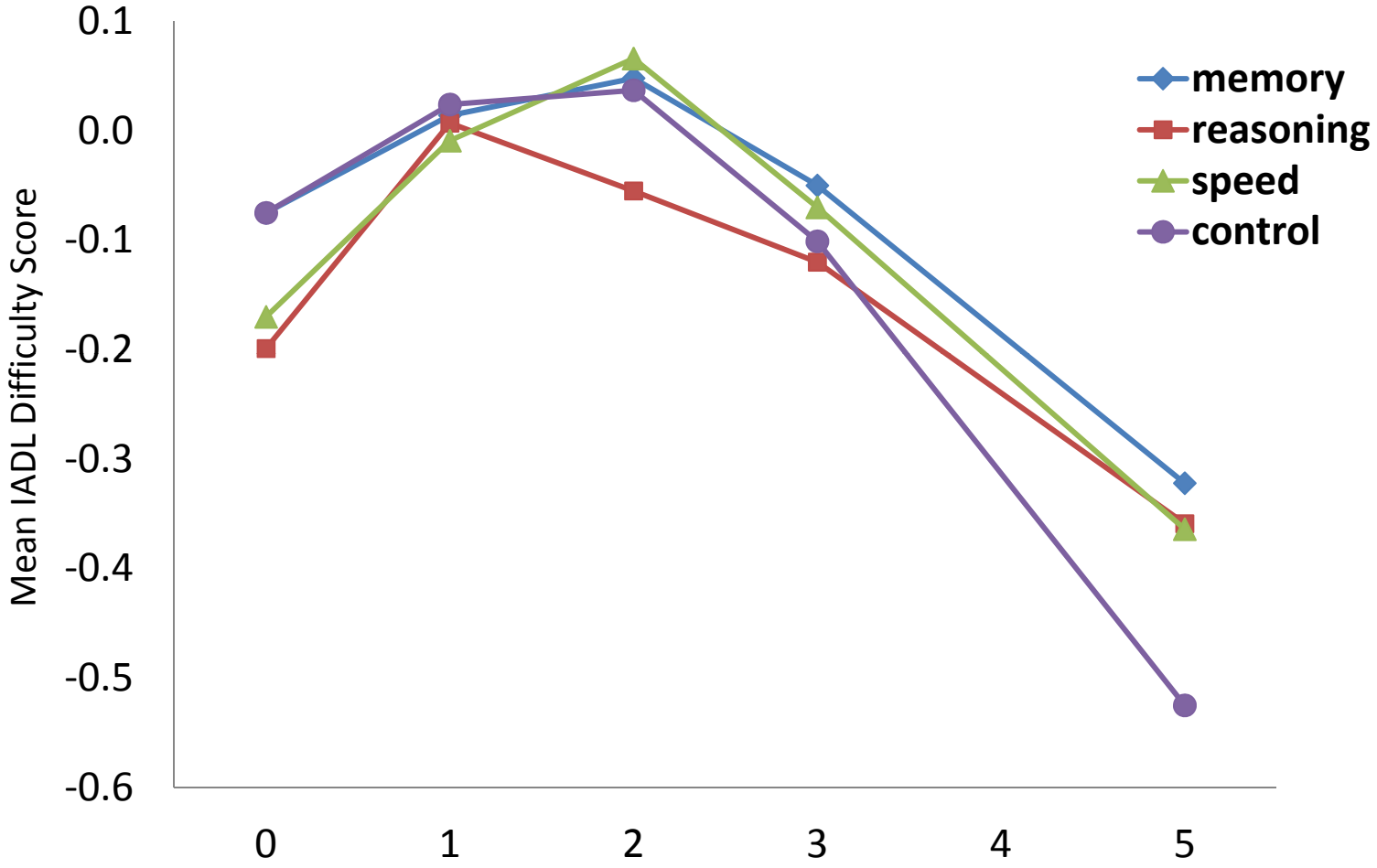
Six field sites –2832 randomized

Age-related Cognitive Decline



Salthouse (2006) *Perspectives on Psychological Science*

IADLs over time in ACTIVE RCT



NIA and NINR supported. Self-reported IADLs for ACTIVE interventions (**only about 10 hours of training**) trend towards an improvement over the control group after five years (significant for reasoning). (S. Willis et al., 2006)

Cognitive Training Decreases Motor Vehicle Collision Involvement of Older Drivers

Karlene Ball, PhD,[*†] *Jerri D. Edwards, PhD,*[‡] *Lesley A. Ross, PhD,*[*†] *and Gerald McGwin, Jr., MS, PhD*[†§‖]

Table 3. Association Between Intervention Group and Motor Vehicle Collision (MVC) Involvement

	Rate Ratio (95% Confidence Interval)					
	Memory Training		Reasoning Training		Speed-of-Processing Training	
At-Fault MVC	Crude	Adjusted*	Crude	Adjusted*	Crude	Adjusted*
Person-time	0.86 (0.56–1.32)	0.82 (0.53–1.27)	0.67 (0.40–1.12)	0.44 (0.24–0.82)	0.55 (0.33–0.92)	0.52 (0.31–0.87)
Person-miles	0.93 (0.61–1.44)	0.93 (0.60–1.45)	0.74 (0.44–1.24)	0.50 (0.27–0.92)	0.58 (0.35–0.97)	0.57 (0.34–0.96)

Control = reference.

* Adjusted for age, sex, race, education, Mini-Mental State Examination score, self-rated health status, vision, depression, and site.

Note: there were only 139 at-fault collisions in this data set, at-faultness is a somewhat subjective variable (although it was assessed by raters blind to the conditions, and this data only covers the first five post-RCT years. (Ball et al., 2010 *JAGS*)

Experience Corps RCT

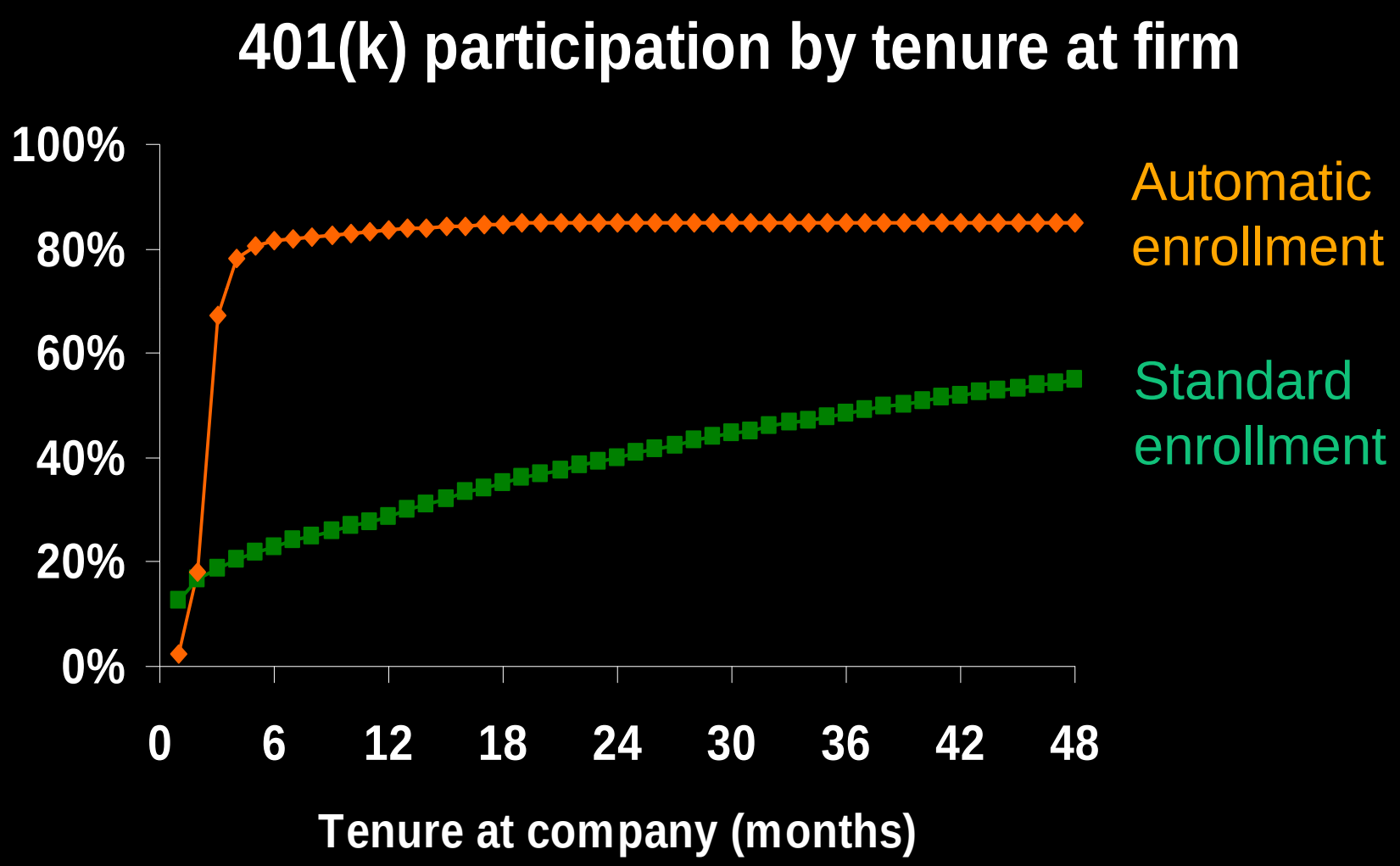
RCT at the Baltimore site (19 elementary schools) is investigating the pilot findings that physical activity, strength, and cognitive ability increased significantly for Experience Corps members.

People recruited into study are either integrated as volunteer teacher aides or placed on a control waiting list.

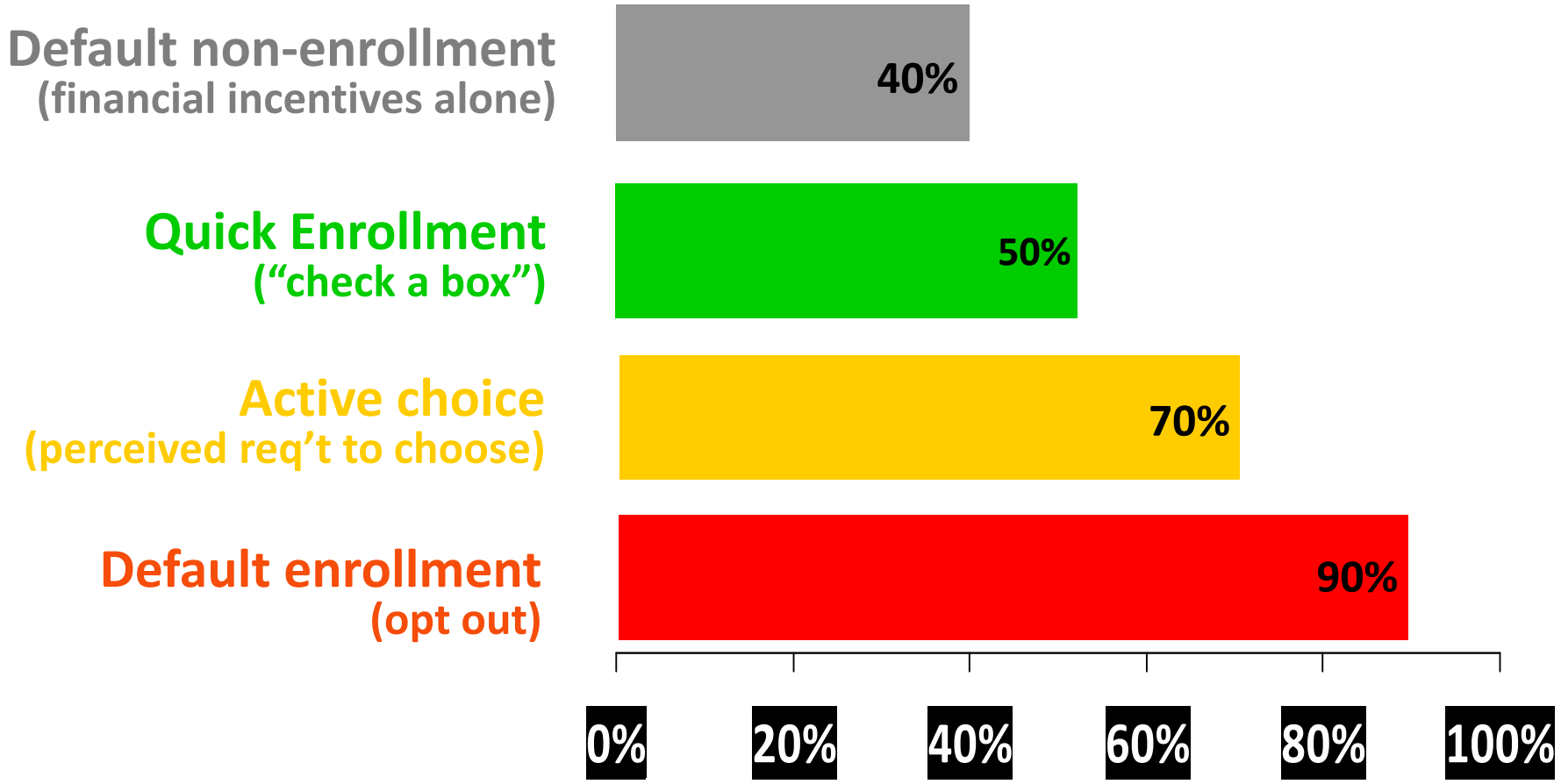
For all participants (1300+), measures of cognitive and physical function are collected at entry into study and at 2-4 follow-up points over a year, along with measures of social activity.

Outcome measures are physical disability (IADLs), mobility, falls, declines in memory.

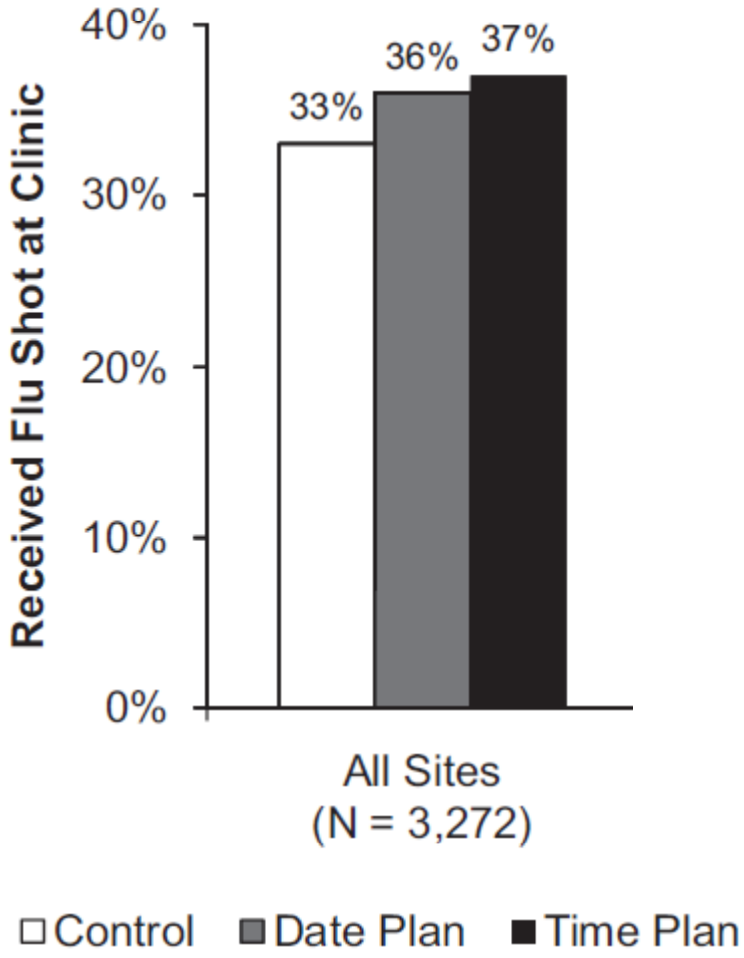
Changing the World to Change Behavior
Madrian et. Al. and Choi et. Al.



Improving participation in 401K plans (for a typical firm)

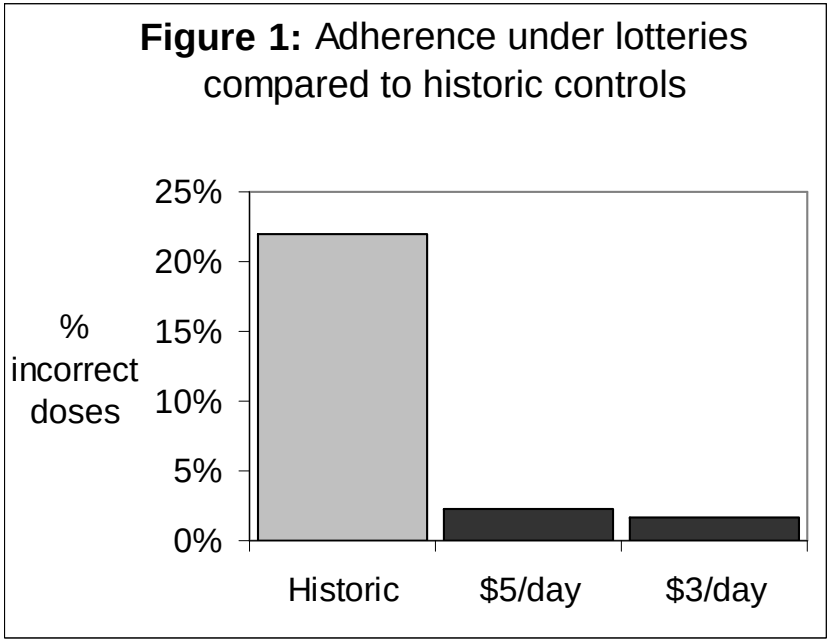


Nudging Vaccination Rates Higher



Work from David Laibson's BSR-funded Roybal Center has demonstrated that one can increase flu vaccination rates in large companies by 3-4% simply by having employees state an "implementation intention" by writing down the Date or the actual Time when they intended to be innoculated. (Figure 2 from Milkman et al., 2011 *PNAS*.)

Lottery Incentives for Adherence



Clinician and behavioral economist Kevin Volpp devised a trial coupling automatic reminding with a chance to win a daily lottery if you were adherent to your prescribed dose of the blood thinner Warfarin (Volpp et al., 2008)

How Does Insurance Affect Health?

- Widespread belief that insurance improves health, but little agreement on magnitude
- Most Evidence from Observational Studies
  - IOM review[1] of evidence – suggestive of health improvement, but much uncertainty
  - Observational studies confounded by selection, concern over whether they overstated the effect on health
- Until Oregon, only one RCT: Rand HIE
  - 1970s RCT in a general population; randomized cost-sharing, not coverage itself; found little effect on health
- Oregon findings based on randomized cohorts confirms causal improvement in self-reported health

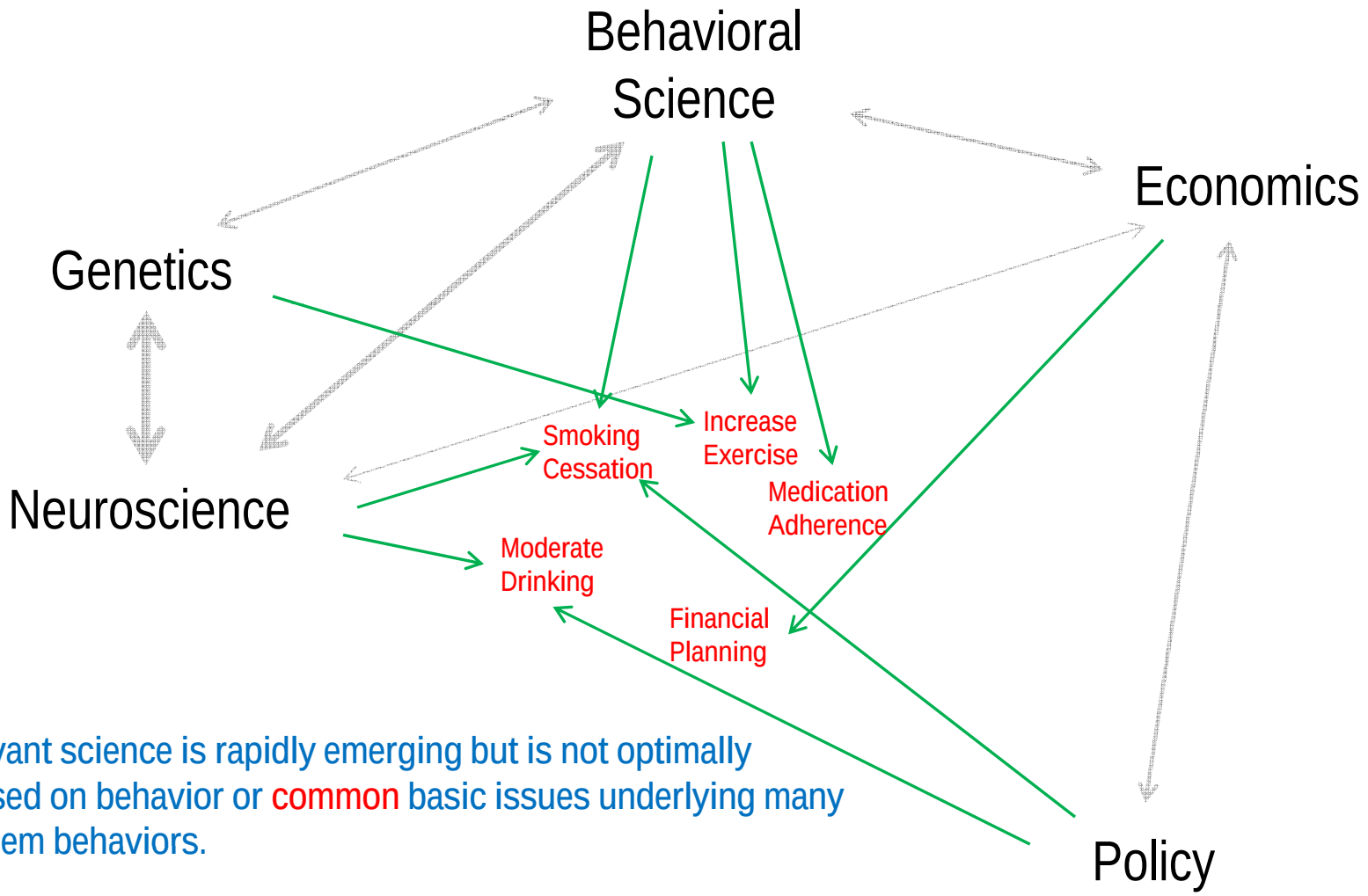
1. Institute of Medicine, America's Uninsured Crisis: Consequences for Health and Health Care, February 2009.

NIH Science of Behavior Change

June 15-16, 2009

Bethesda, Maryland

Science of Behavior Change



- Relevant science is rapidly emerging but is not optimally focused on behavior or common basic issues underlying many problem behaviors.

Using emerging new fields behavioral economics, cognitive neuroscience, behavior genetics

Source: John King, PhD

SOBC Roadmap RFA-RM-10-002
Focused on Mechanisms of Change

Mechanisms of decision-making

e.g., risk perception, temporal discounting

Mechanisms of control and self-monitoring:

e.g., executive function, interoceptive awareness, emotion regulation;

Mechanisms of social and cultural transmission of behaviors and of interpersonal transaction:

e.g., contagion, mimicry, modeling, norms, peer effects, competition;

Structural mechanisms:

e.g., choice architectures, defaults, environmental affordances;

Neurobiological and genetic mechanisms:

e.g., related to these processes, including those associated with individual differences in biophysiologic capacity or psychological resilience/vulnerability.

Ongoing NAS Panels Commissioned by BSR

- **Measuring Subjective Well-Being in a Policy Relevant Framework (with UK ESRC)**
- **Workshop on the Continuing Epidemiological Transition in Sub-Saharan Africa**
- **Policy Research and Data Needs to Meet the Challenge of Aging in Asia**
- **New Directions in the Social Demography, Social Epidemiology, and the Sociology of Aging**

What would this meeting suggest for BSR and Industry?

- **BSR Has No Commercial Partnerships**
- **BSR funds big economics research program**
- **BSR funds 12 Roybal Translation Centers some do research activities with e.g. Gallup, Express Scripts, Intel, GE, Health and Auto Insurers, mutual funds**
- **BSR funds SBIRs/STTRs -- quality?**
- **BSR commissioned NRC Report "Technology for Adaptive Aging" 2004**