



Two human mysteries, three core stories

May, 2013
presentation to the
Ktunaxa Nation



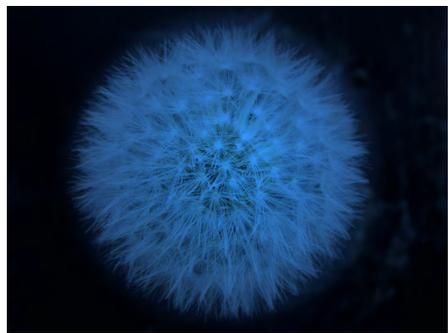
Two human mysteries

- The origins of our differences
- Why some are afflicted and some are not

Three core stories



- The Columbia space shuttle and the origins of human disease



- The dandelion and the orchid: Sensitivity to sociocultural context



- The affliction of social stratification

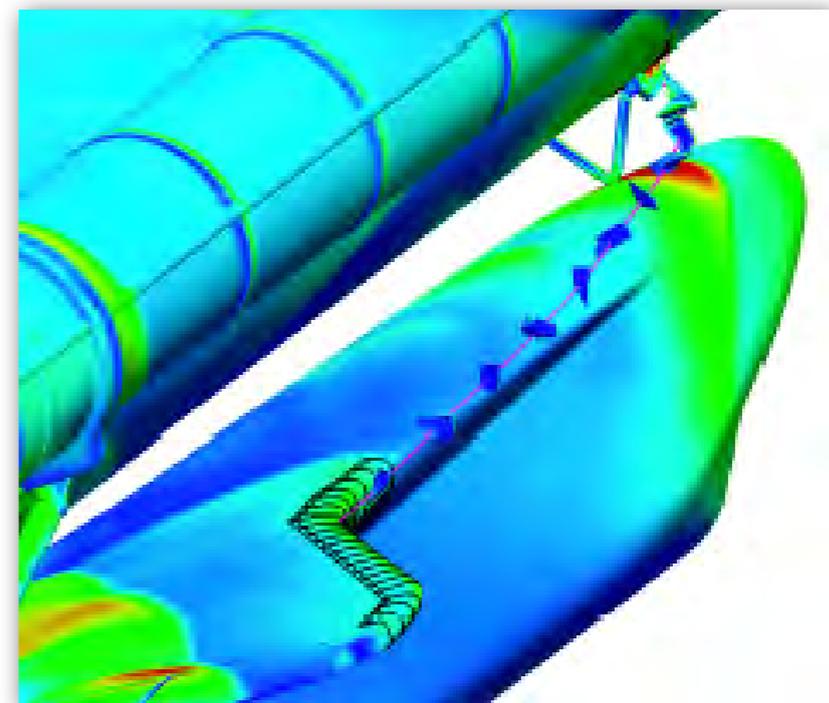
Story 1: The Columbia space shuttle and the origins of human disease



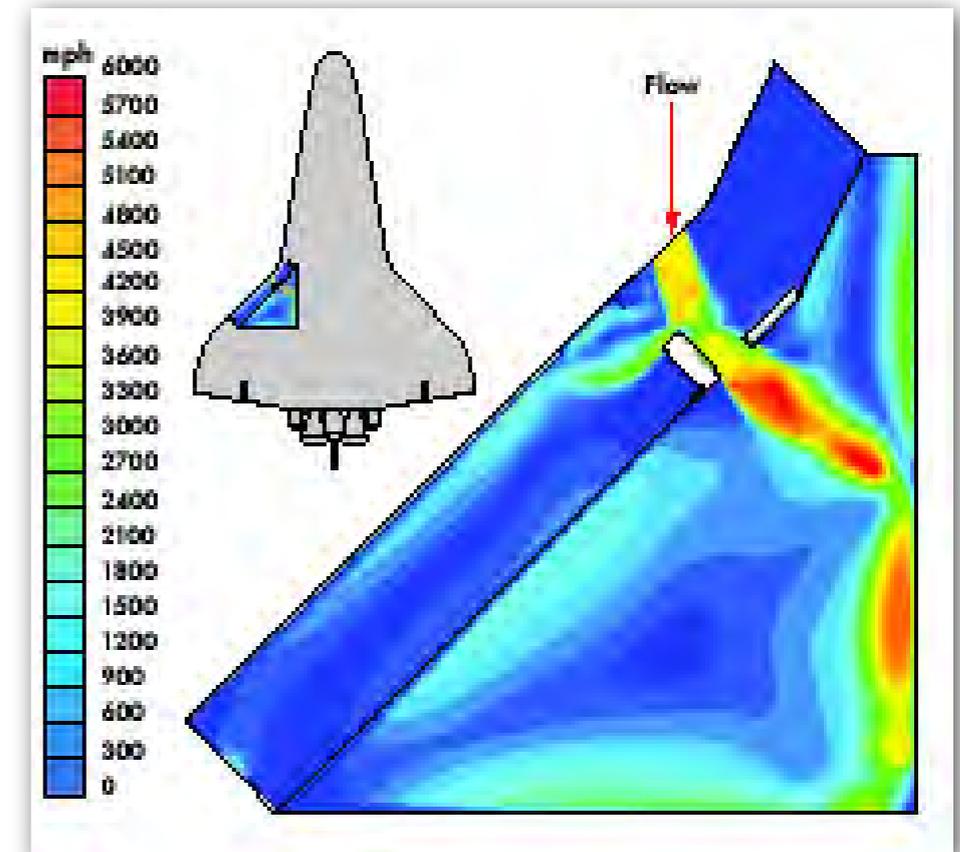
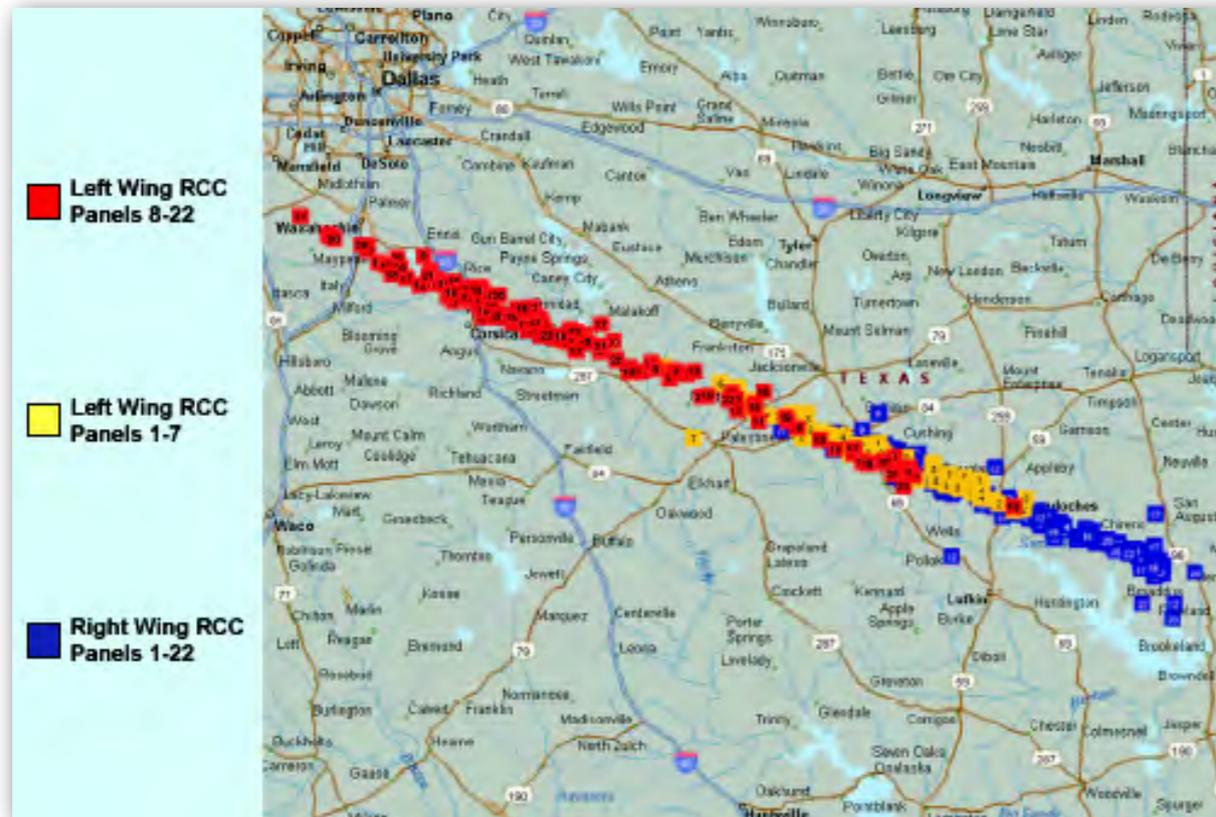
- January 16, 2003: Delayed launch
- Mission: international science experiments
- Seven crew members



- Foam insulating material from fuel tank struck leading edge of left wing
- Risk management analysis: insufficient evidence to indicate that the impact had jeopardized the safety of the shuttle or crew
- Uneventful and successful mission completion



- February 1, 2003:
 - 8:10 approved for de-orbit burn
 - 8:44 entered atmosphere
 - 8:48 sensor on left wing showed strain
 - 8:52 300 miles west of the California coastline
 - 8:54 signs of debris; crossed into Nevada airspace
 - 8:59 last communication from crew
 - 9:05 loud boom, concussion wave, smoke trails and debris
- Later analysis: superheating of the left wing interior at the site of foam impact



The conclusion is that Columbia re-entered Earth's atmosphere with a pre-existing breach in the leading edge of its left wing... This breach, caused by the foam strike on ascent, was of sufficient size to allow superheated air (probably exceeding 5,000 degrees Fahrenheit) to penetrate the cavity behind the [wing edge]... Once in the interior, the superheated air began to destroy the left wing.

—Columbia Accident Investigation Board
August, 2003



Debris kinetic energy (function of mass, velocity and angle of incidence)

+

Debris hits an area of special vulnerability on left wing



Threat to the Columbia during re-entry heating of wing

External, risk-producing contextual threat

+

Internal susceptibility to external threat



Human disease and disorder

Most traits and diseases, in most species, are derived:

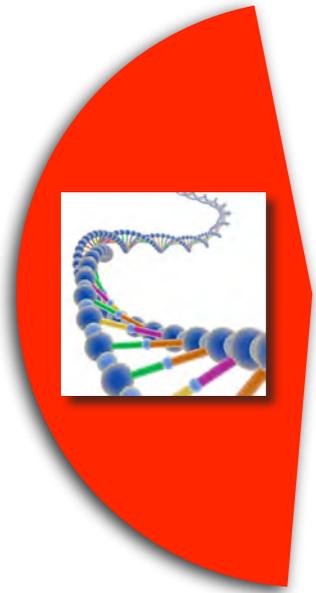
- Not just from nature (i.e., genes)
- Not just from nurture (i.e., environment)
- Not even from nature *plus* nature (i.e., genes + environment).



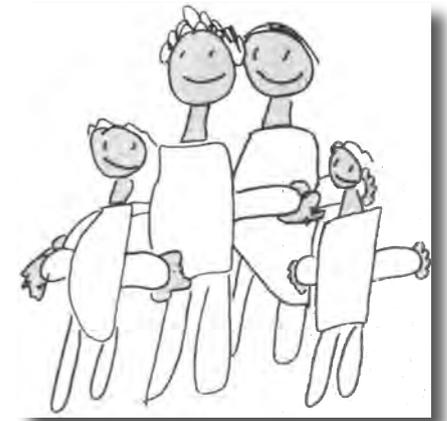
“So, how do you want to play this?
Nature, nurture, or a bit of both?”

But rather from their
interaction!
G x E

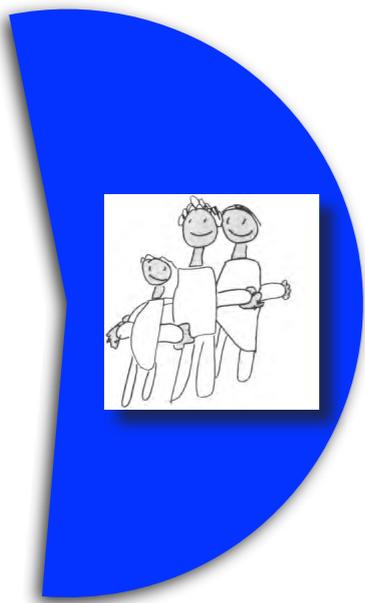
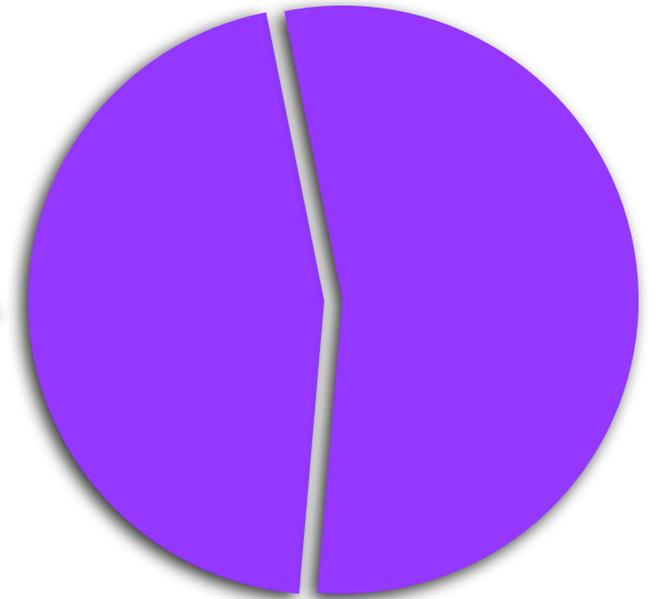
Brief history of disease causation



**Genetic
Determinism**

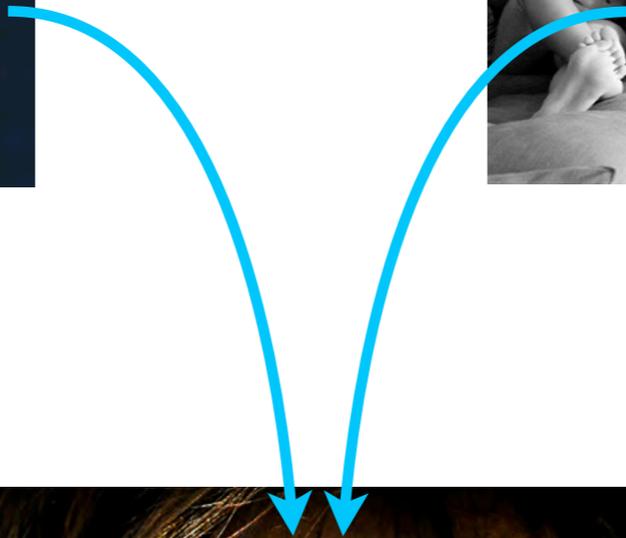
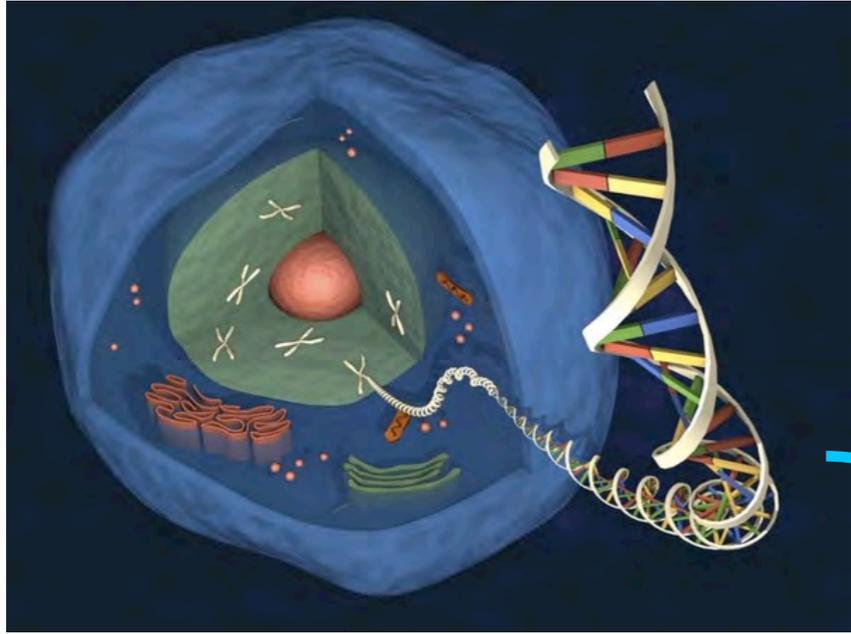


**Behavior
Genetics**



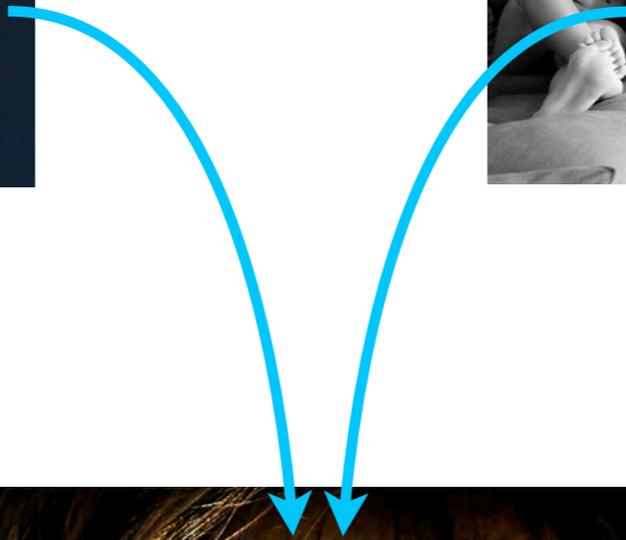
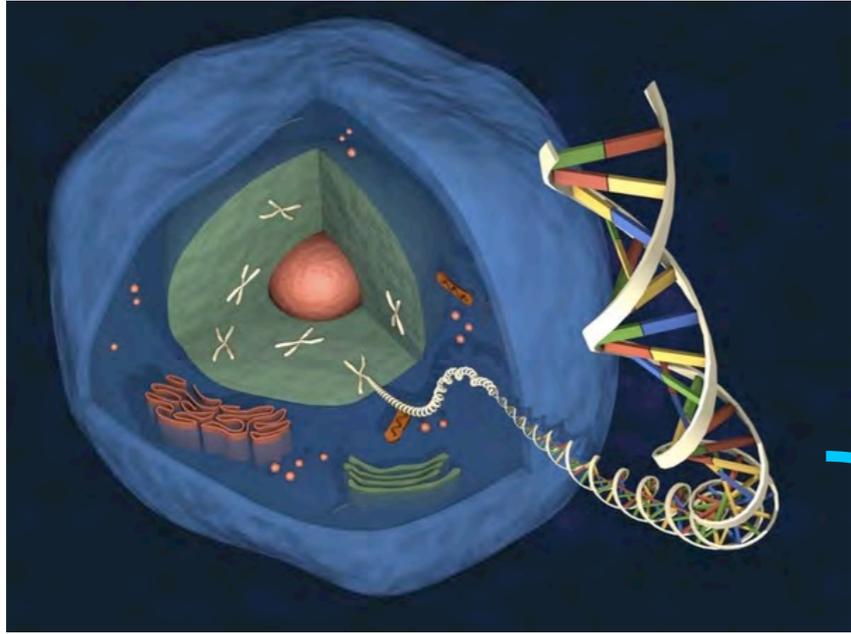
**Environmental
Determinism**

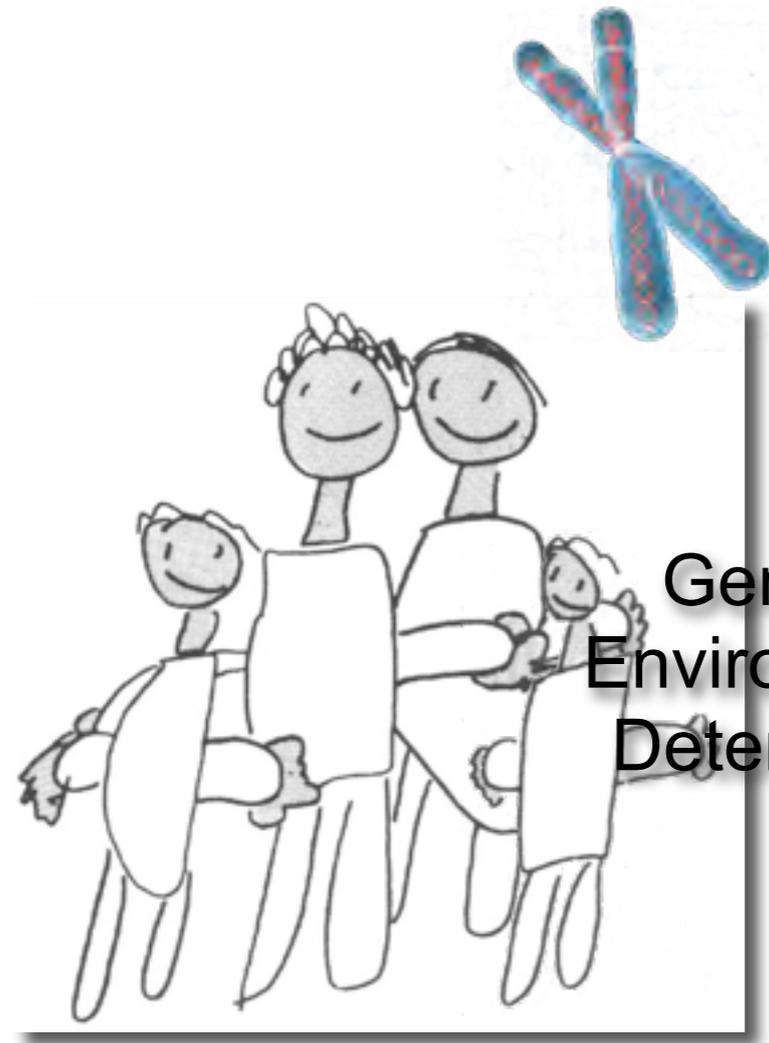
**G - E
Interplay/
Epigenetics**



Story I: The Columbia space shuttle and the origins of human disease—finishing up







Genetic v
Environmental
Determinism

Behavior
Genetics

GxE
Interactions

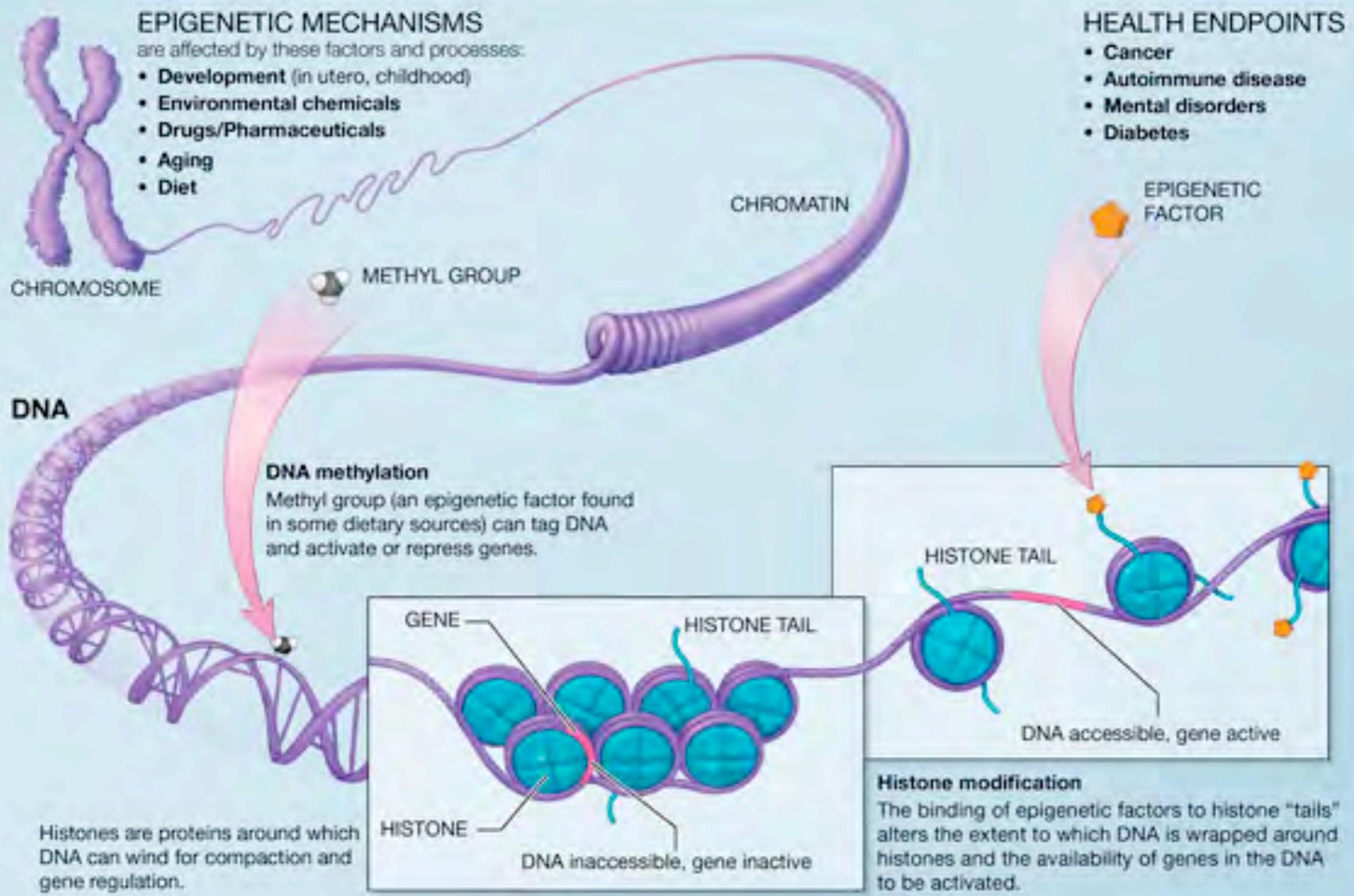
G - E
Interplay/
Epigenetics

Within the professional lifetime of a single generation, extraordinary advances in the understanding of how social environments and constitutional vulnerabilities operate together to produce or abate risk of disease.

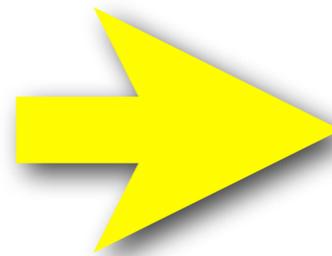
Developmental calibration of neurobiological circuitry: How does it happen?



- Same species of buckeye butterfly
- Polyphenism driven by temperature and length of daylight
- A conditional adaptation involving differential epigenetic regulation of genes determining wing coloration and pattern



DNA is like books packed in boxes and stacked in a library.



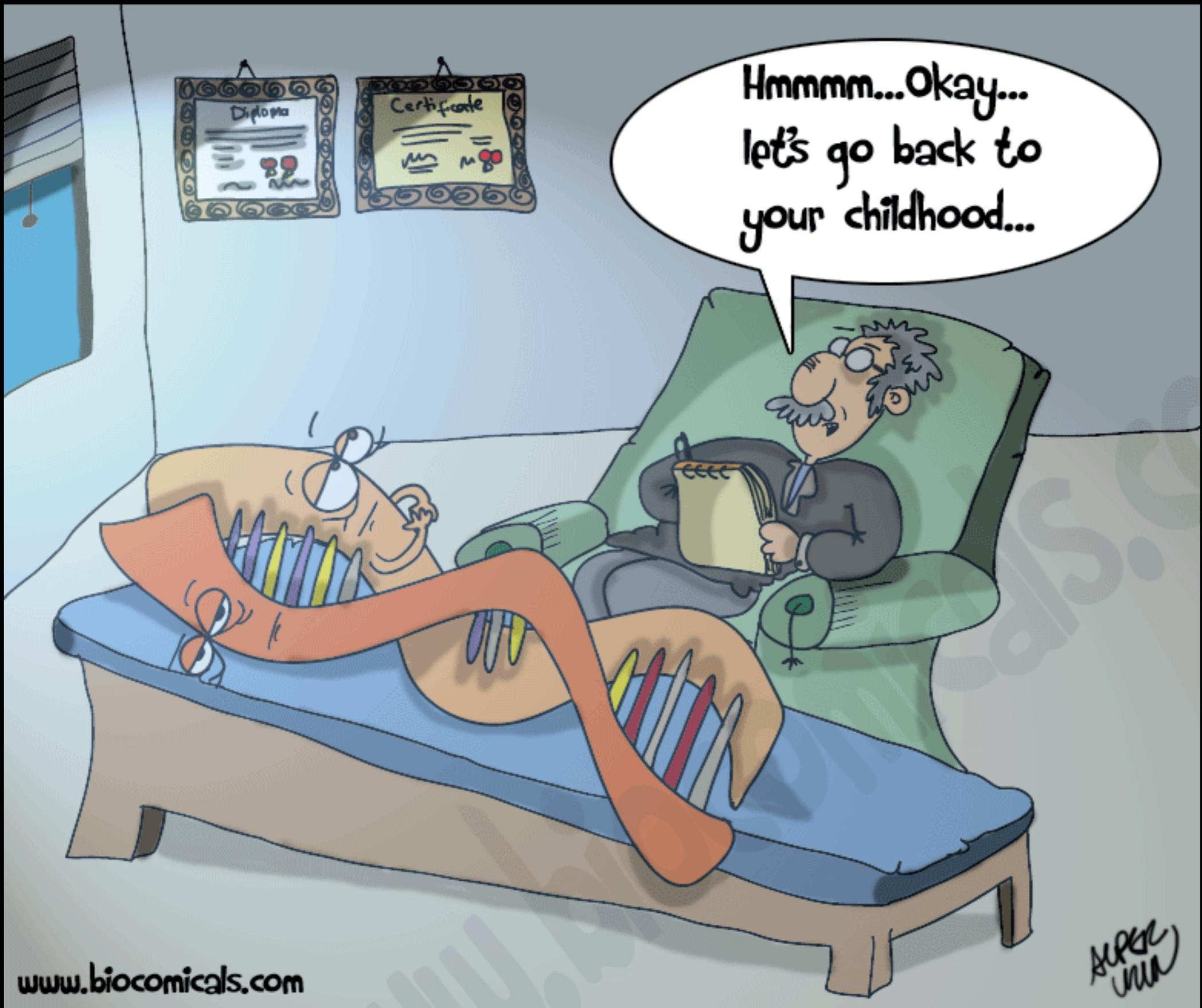
Limitless potential to inform and inspire...
but they need to be unpacked and read.





Adversity in young children's lives becomes 'biologically embedded' in the epigenetic packaging of DNA, rendering silent and 'unreadable' some of the genes that guide brain development.

Exposures to stress are thus *embodied* in the epigenome.





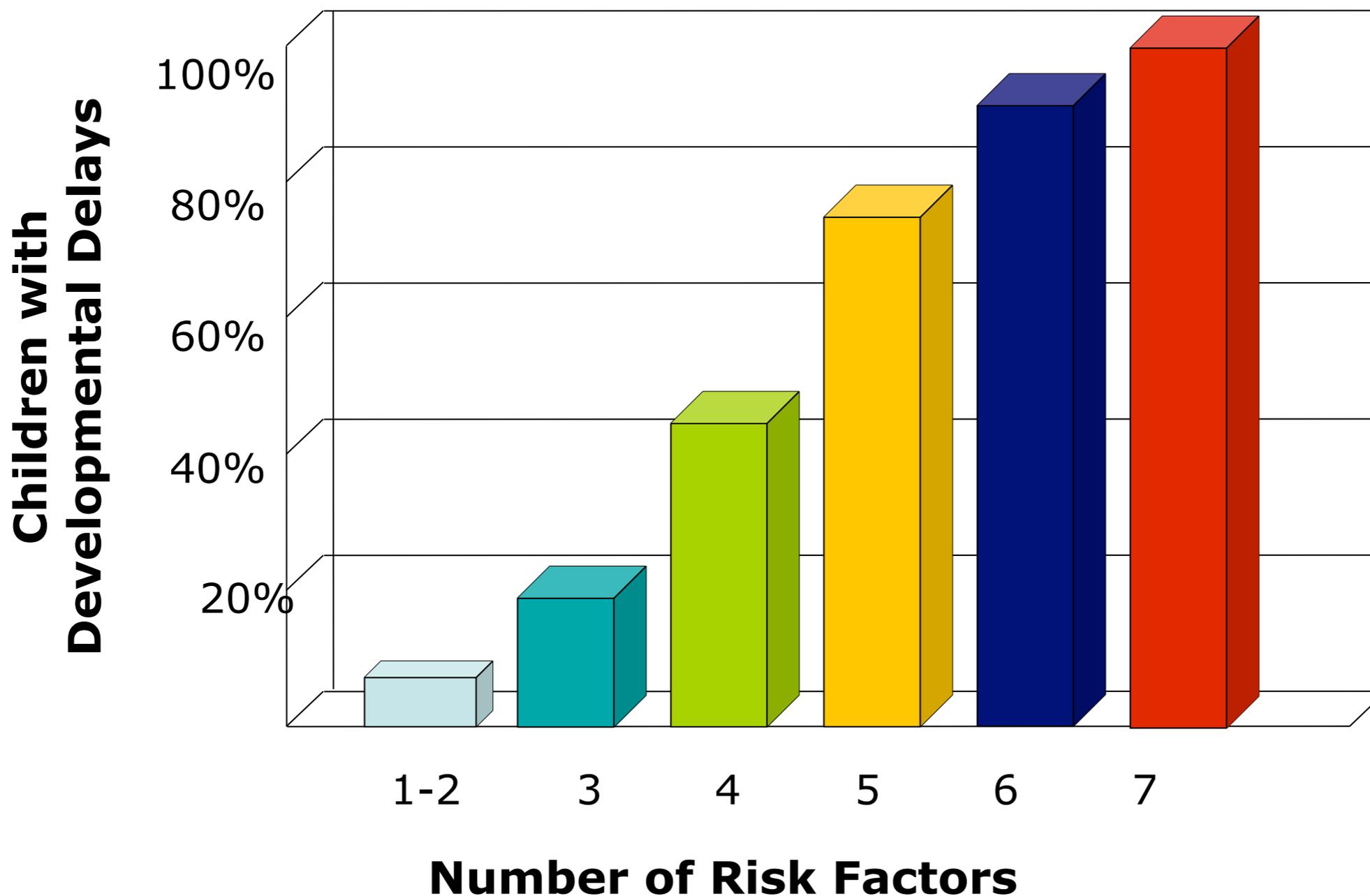
Biological embedding

Story 2: The dandelion and the orchid: Sensitivity to sociocultural context

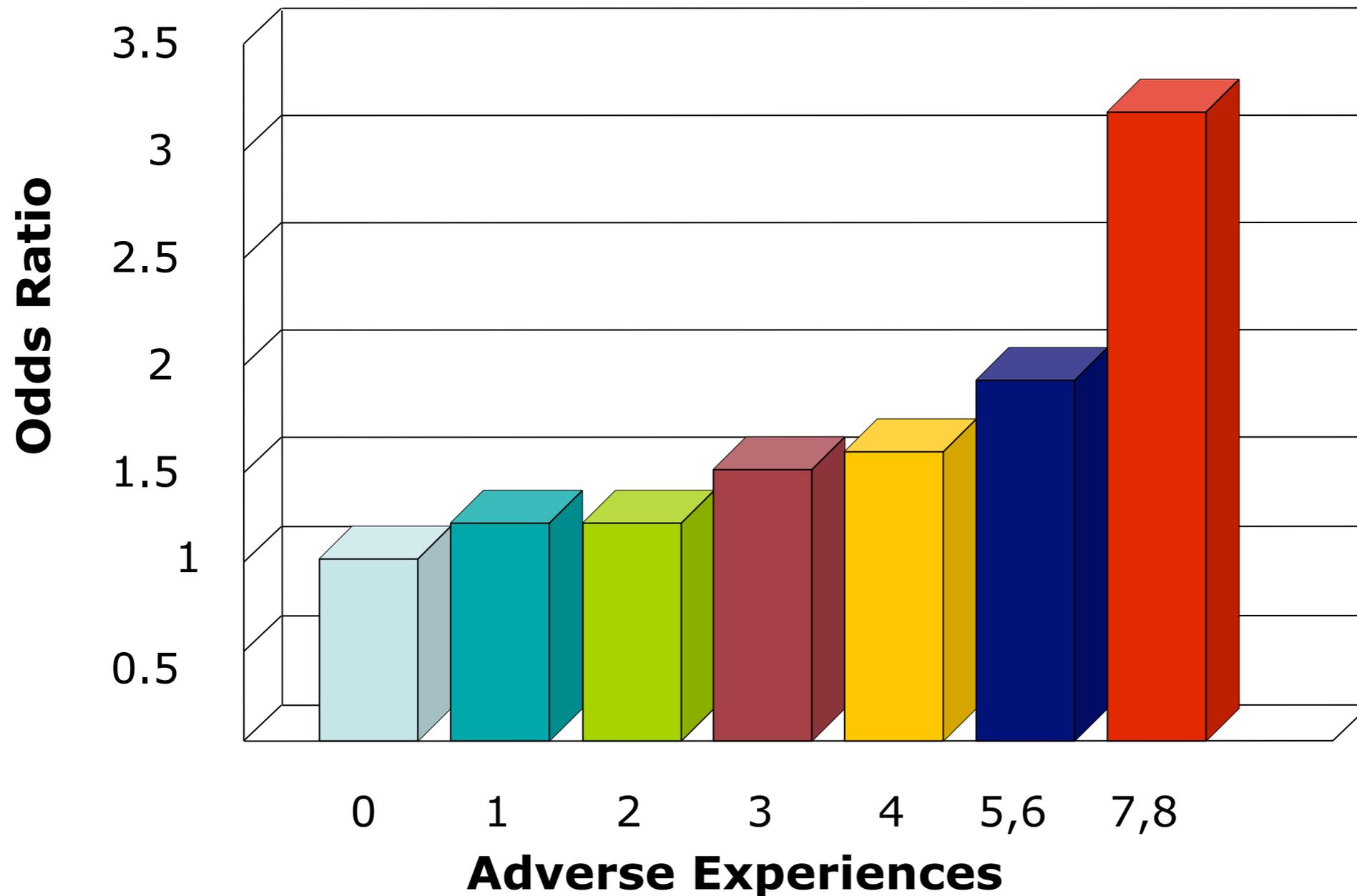
- Broad range of diversity in children's individual responses to stress and adversity
- Biological sensitivity to sociocultural contexts
- Implications?



Significant Adversity Impairs Development in the First Three Years



Risk Factors for Adult Heart Disease are Embedded in Adverse Childhood Experiences



Three Levels of Stress

Positive

Brief increases in heart rate,
mild elevations in stress hormone levels.

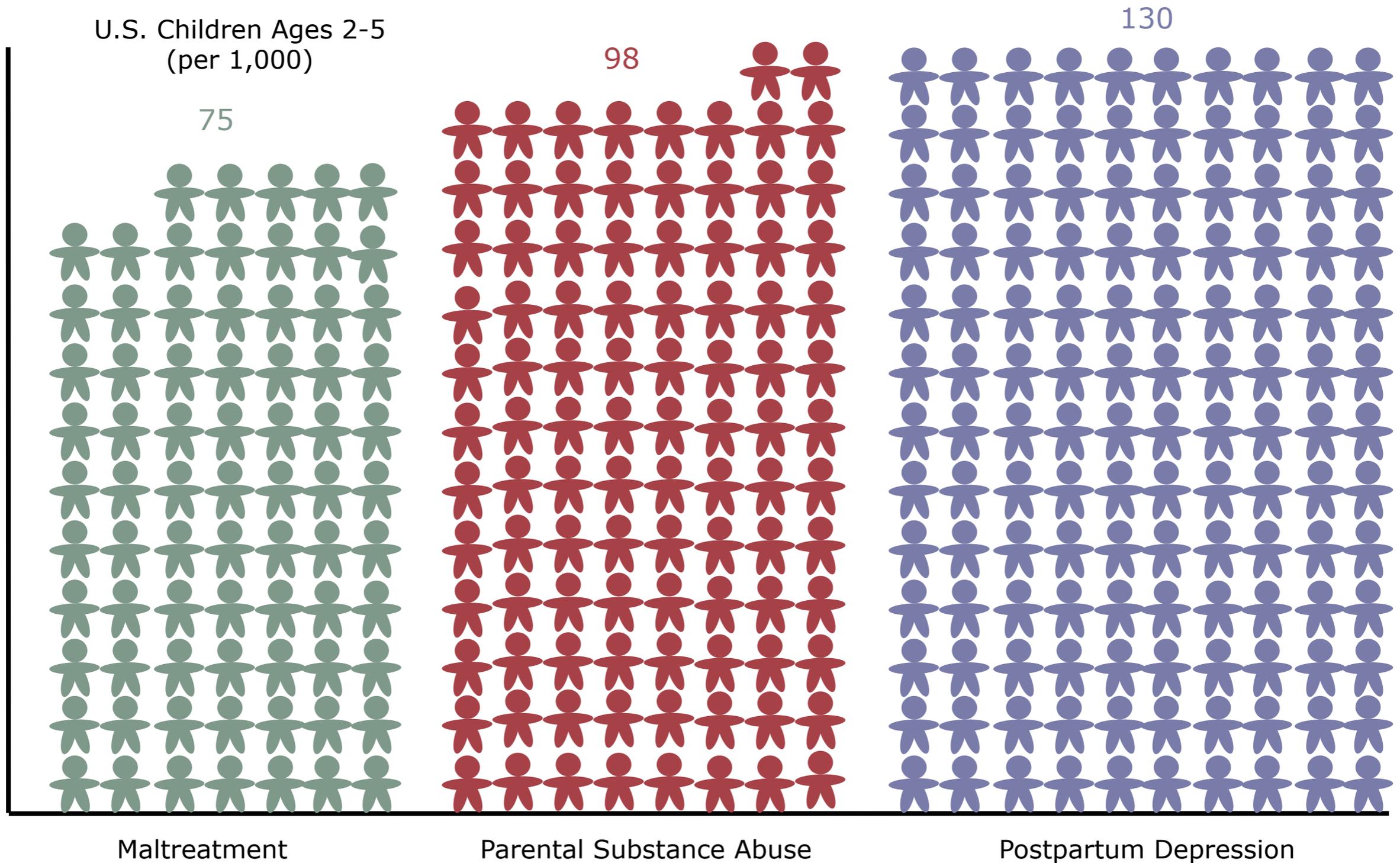
Tolerable

Serious, temporary stress responses,
buffered by supportive relationships.

Toxic

Prolonged activation of stress response systems
in the absence of protective relationships.

Sources of Toxic Stress in Young U.S. Children



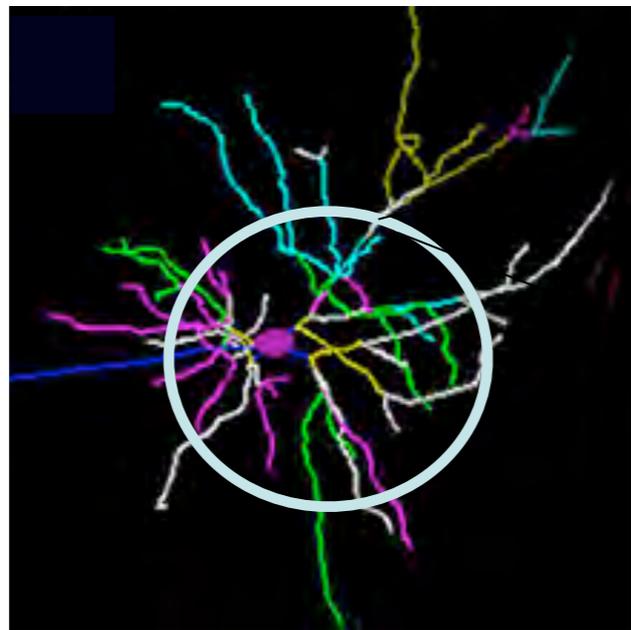
Source: Finkelhor et al. (2005)

Source: SAMHSA (2002)

Source: O'Hara & Swain (1996)

Toxic Stress Changes Brain Architecture

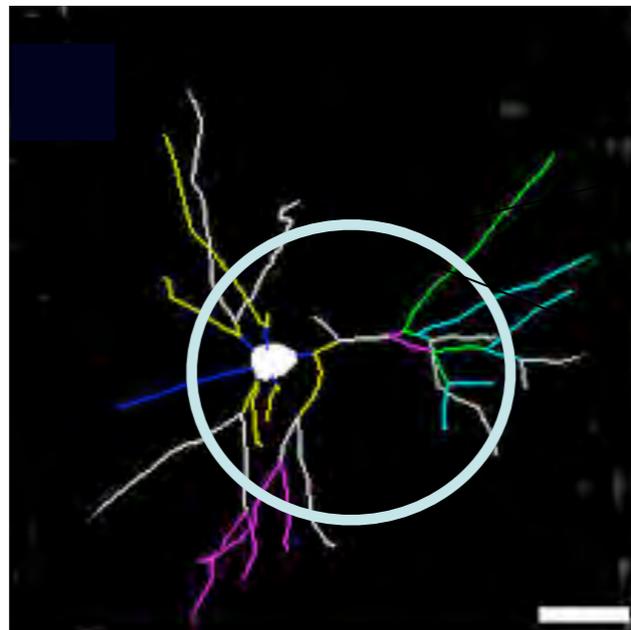
Normal



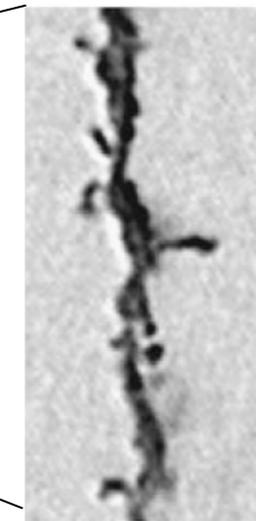
Typical neuron—
many connections



Toxic
stress



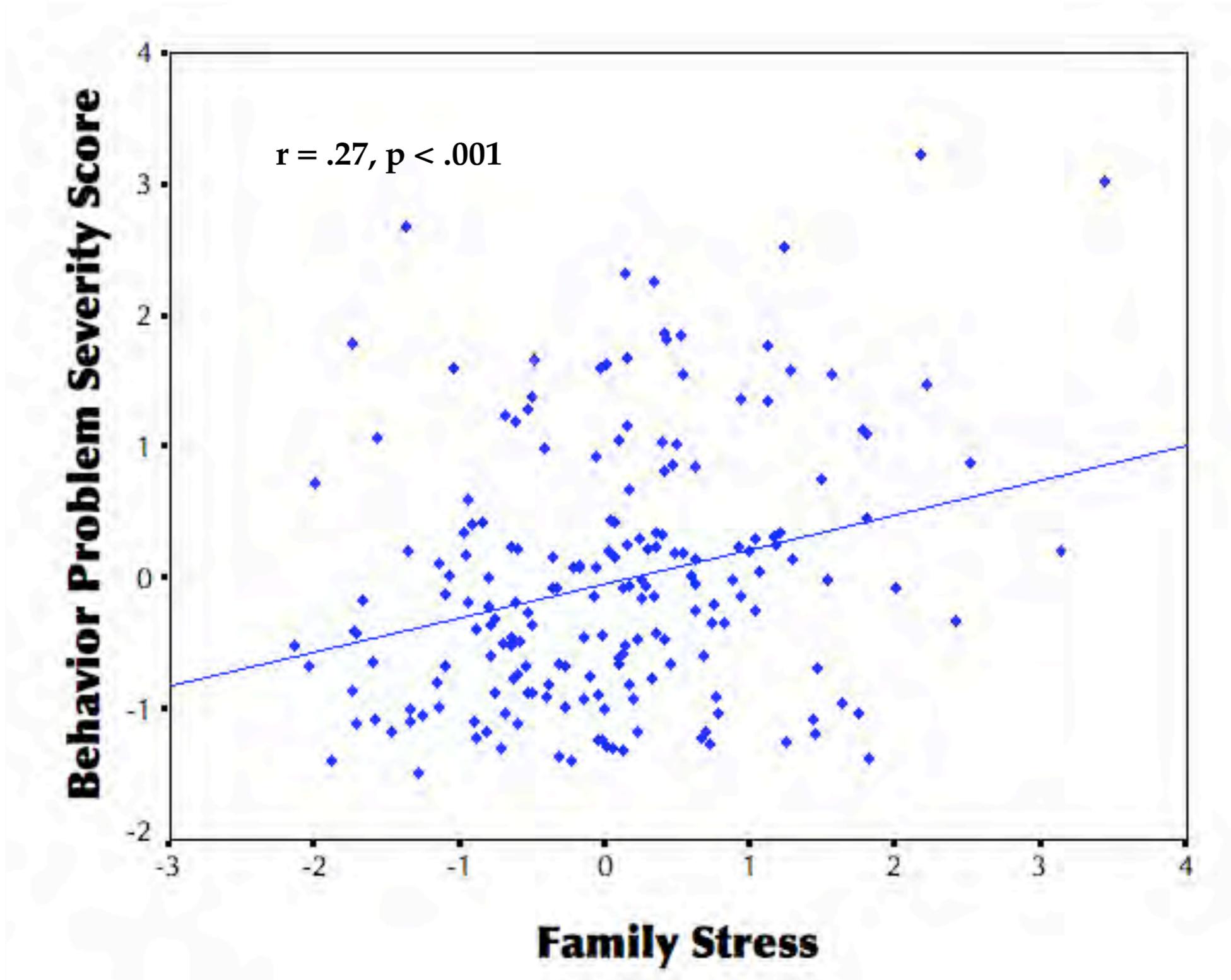
Damaged neuron—
fewer connections

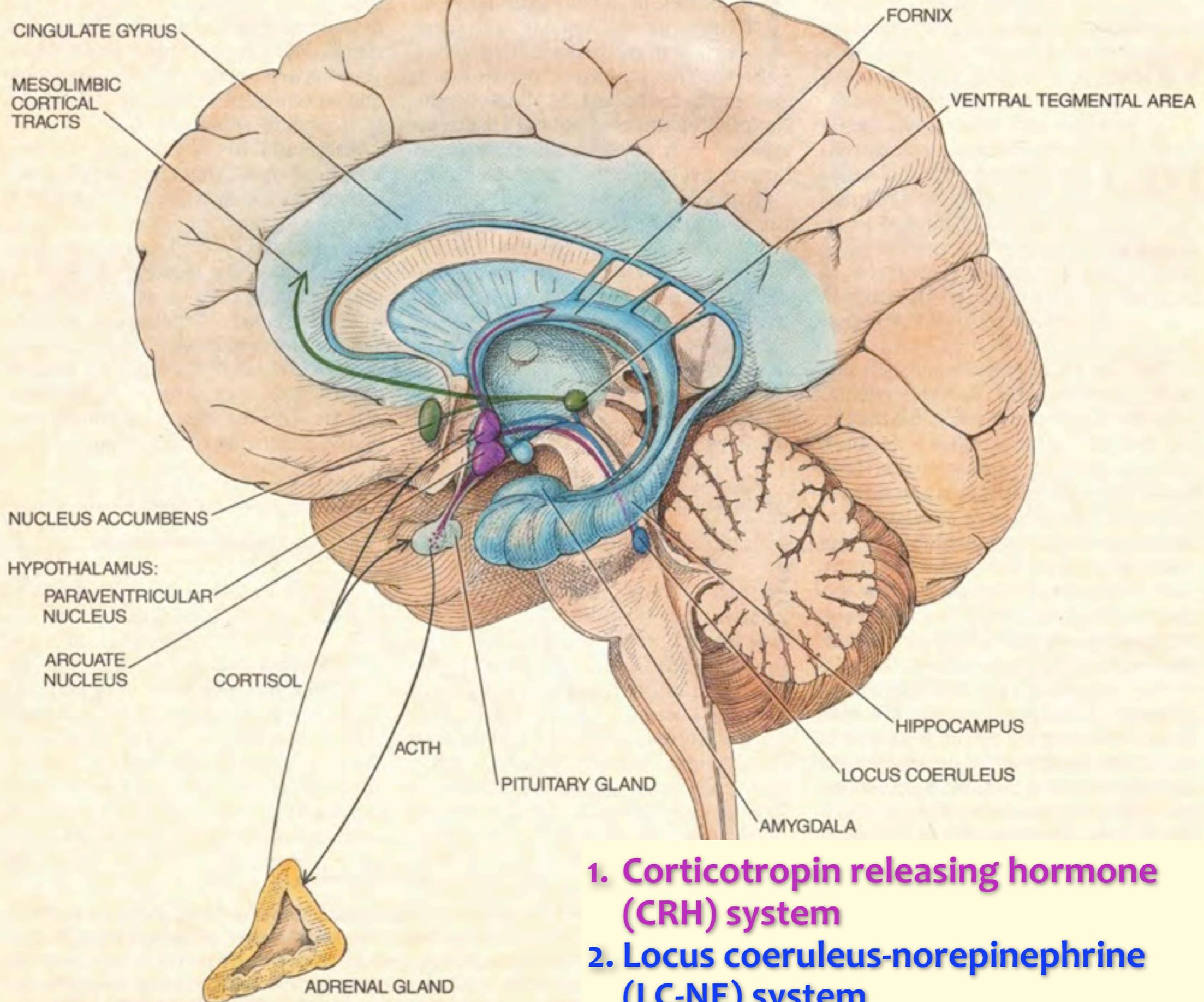


Prefrontal Cortex and
Hippocampus



Variability in health by levels of family stress





1. Corticotropin releasing hormone (CRH) system
2. Locus coeruleus-norepinephrine (LC-NE) system



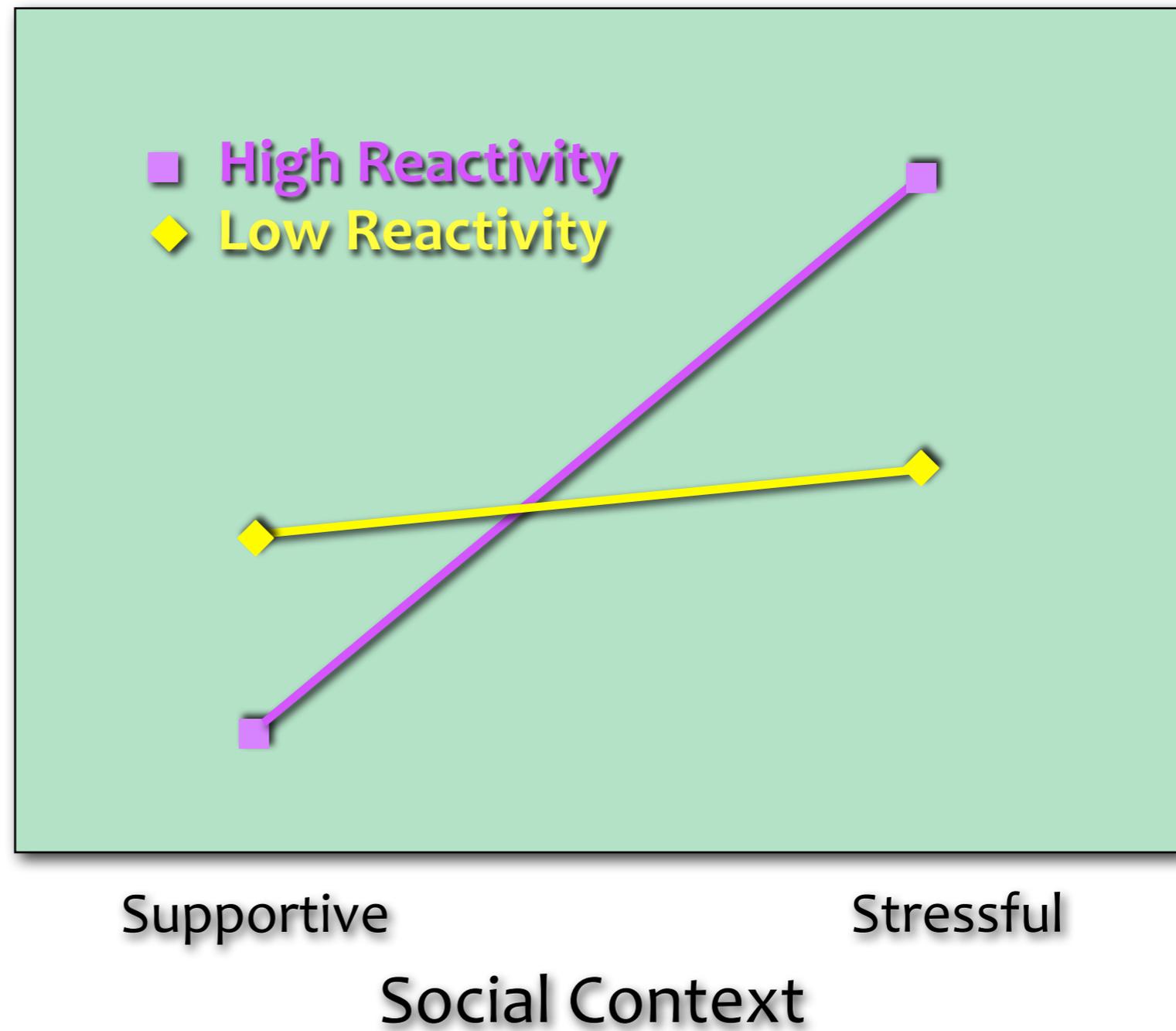
Individual differences in susceptibility to adversity

- Highly variable biological responses to laboratory challenges
- Such 'stress reactivity' the product of both genetic and environmental variation
- Outcomes driven by how reactivity and naturally occurring stress work together



Stress Reactivity and Child Health

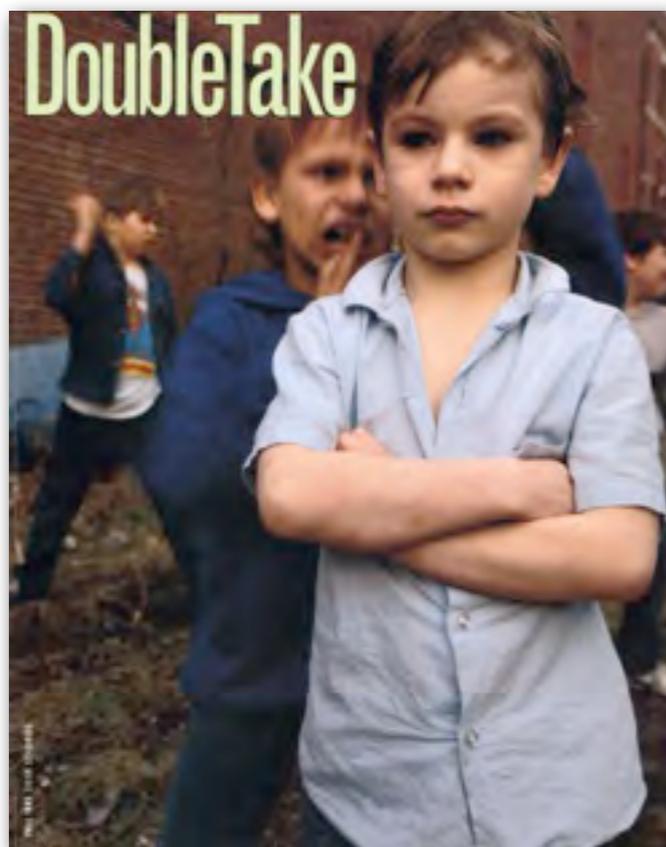
- Behavior Problems
- Respiratory Illnesses
- Injuries



Neurobiological Sensitivity to Social Context



**Maskrosbarn (Sw):
dandelion child**

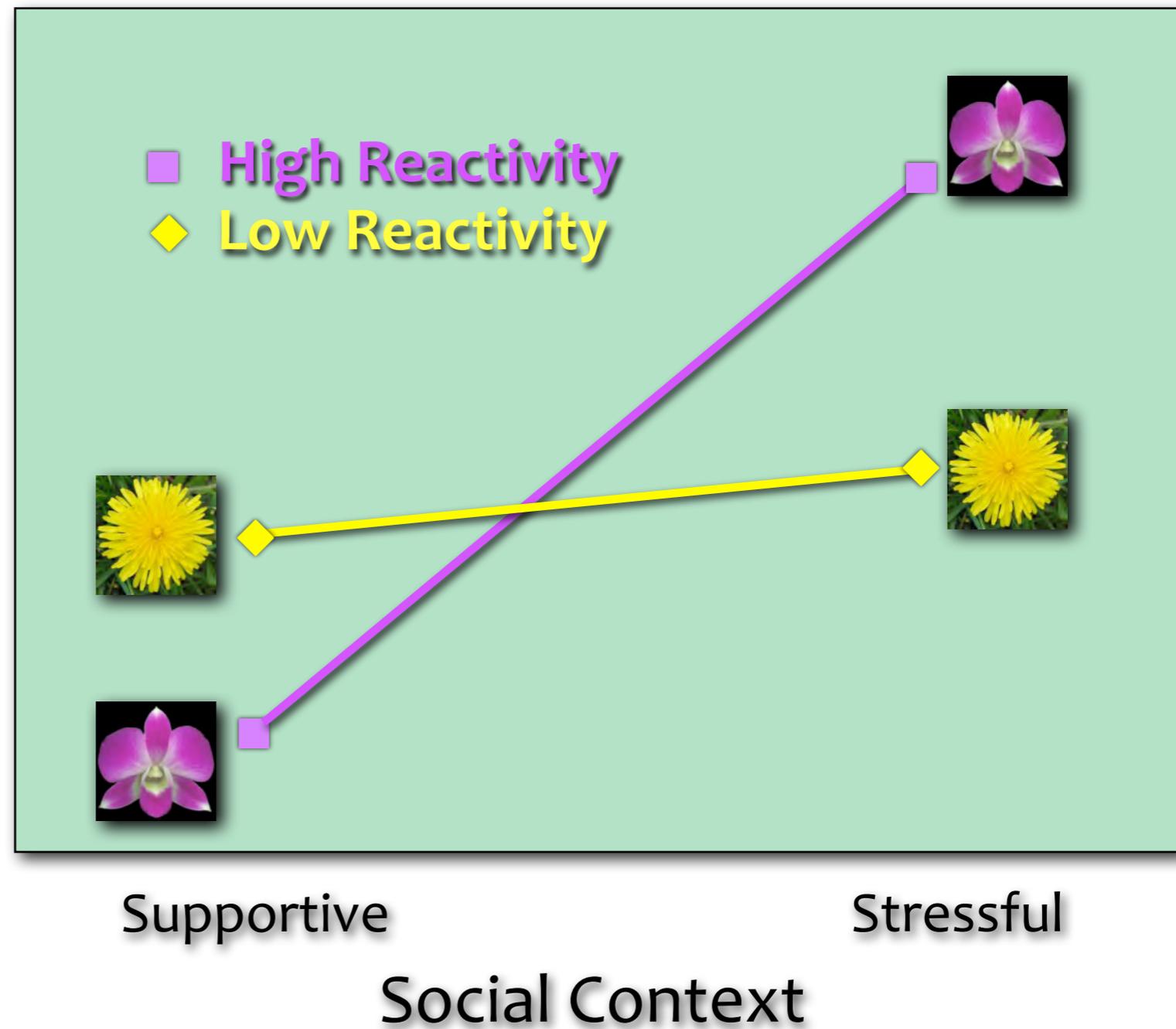


**Orkidebarn: orchid
child**



Stress Reactivity and Child Health

- Behavior Problems
- Respiratory Illnesses
- Injuries



So what?

Implications of differences in susceptibility to
environmental conditions



- Some children more affected by stressors than others



- One size does not fit all



- If we make the world safe for the most sensitive, susceptible, we make it safe for all

Story 3: The affliction of social stratification

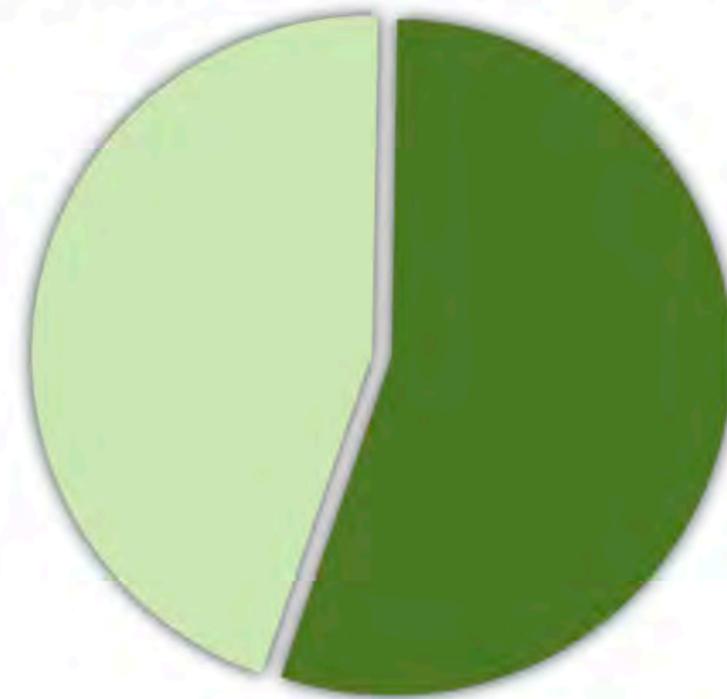
- Socioeconomic status the most powerful predictor of health, illness and development
- Social hierarchies in the organization of species from fruit flies to human children
- Do children occupying low, subordinate social positions have more morbidity?



The Nonrandom Distribution of Childhood Morbidities



**Biomedical/psychiatric morbidities
& Health care utilization**

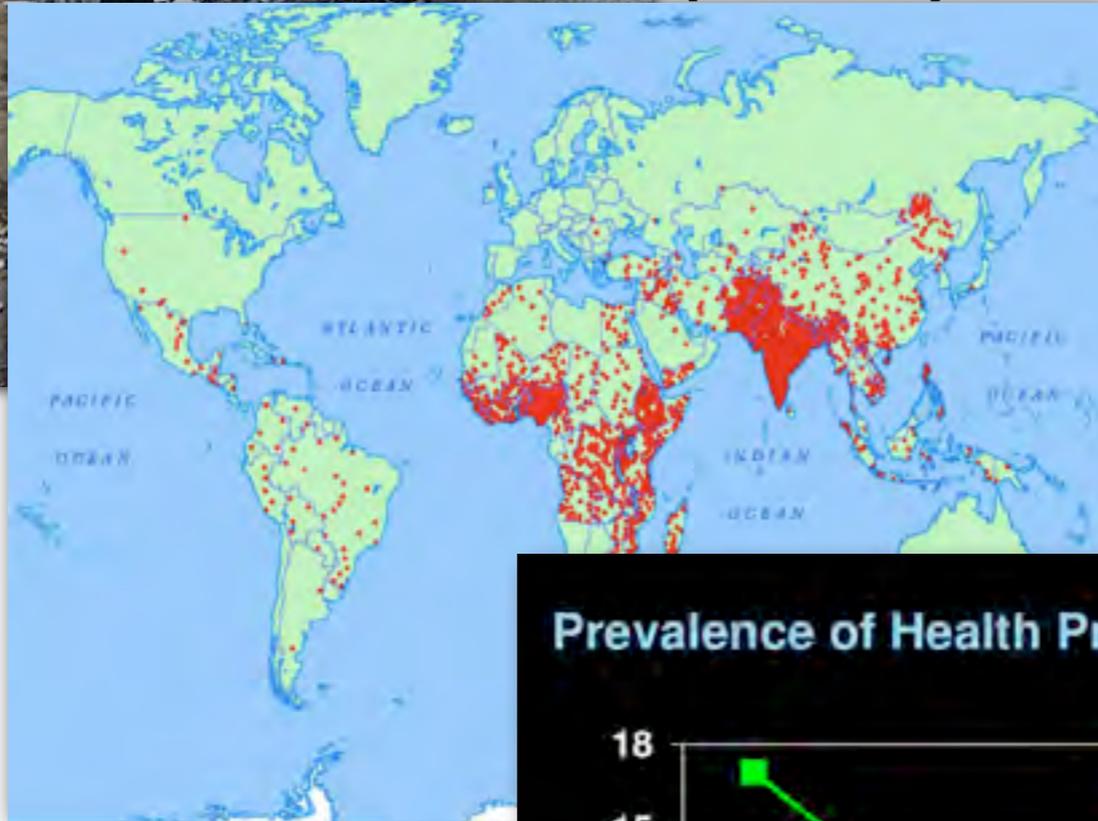


 = 80-85%  = 15-20%

We live in a world in which...

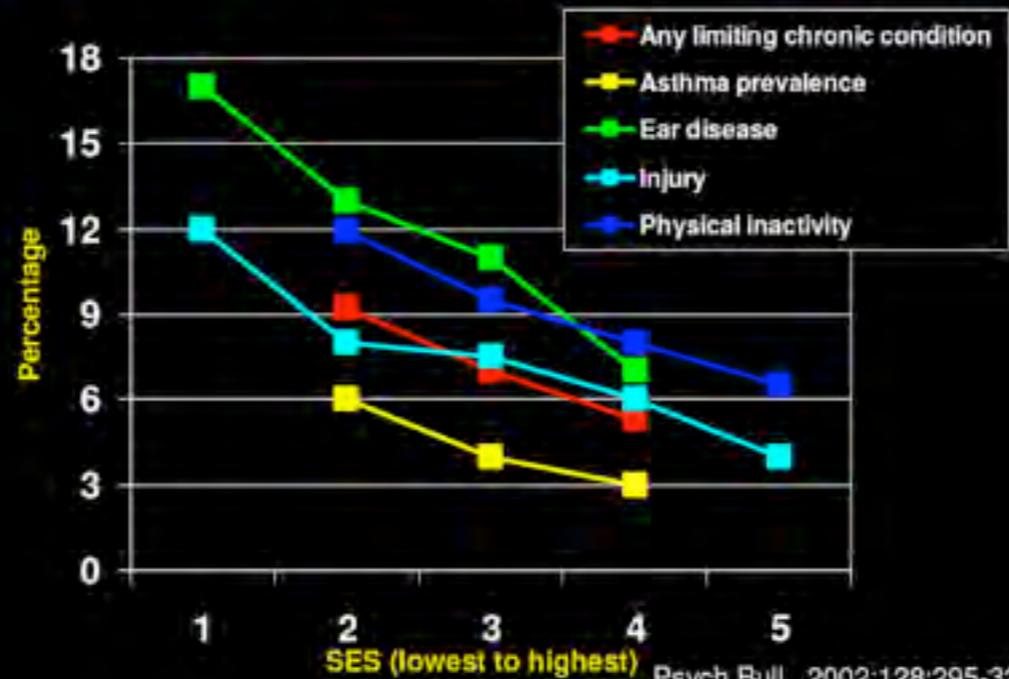


Half the earth's children live in poverty



10 million children die each year, most of them in impoverished countries

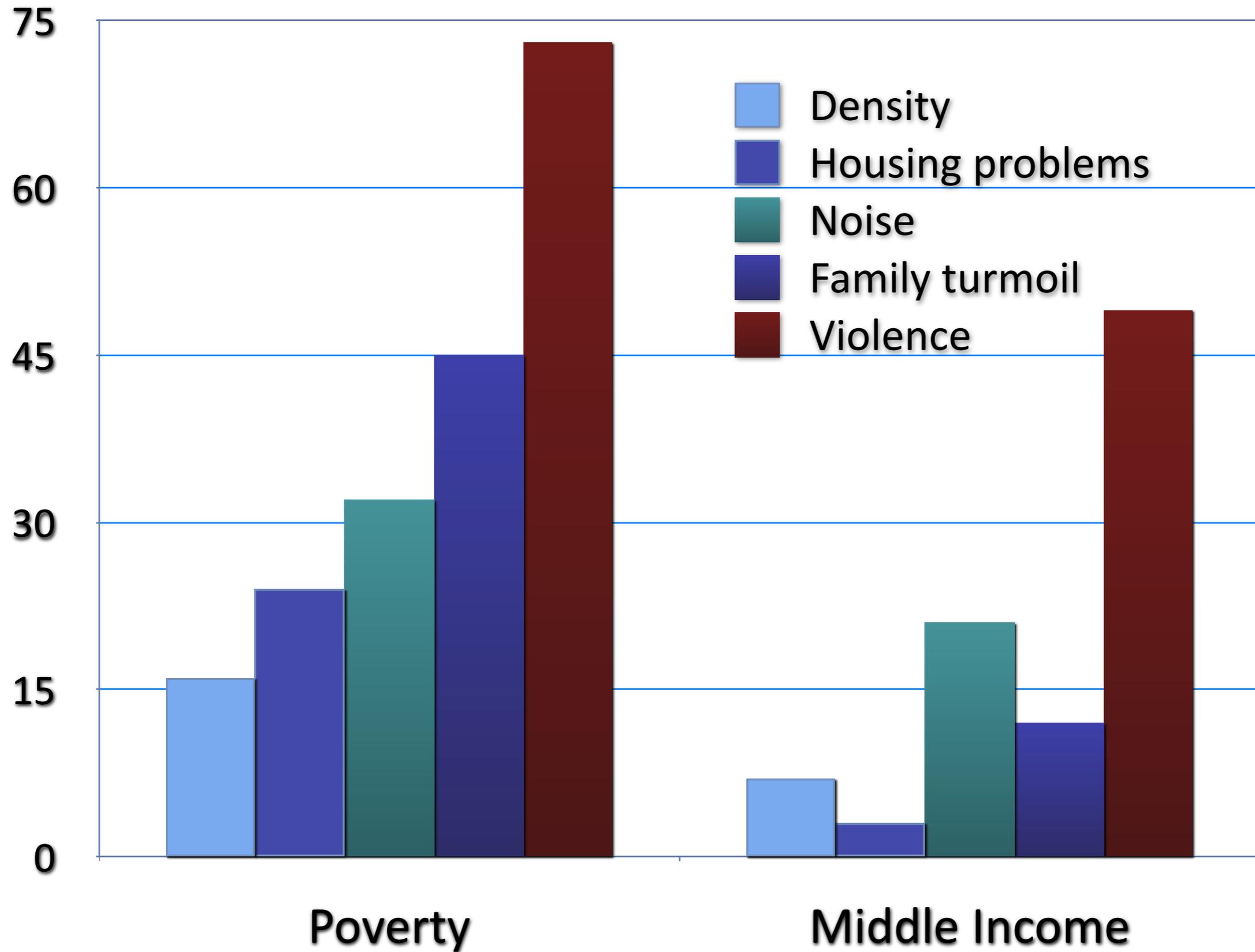
Prevalence of Health Problems in Children



Poor children have substantially higher rates of chronic, disabling diseases, most of which are poorly understood.

Socioeconomic partitioning of stressors and adversities

Evans & English, 2002



Pervasive differences in the experiences of everyday life





Paying a premium not to mingle at sea

Large ships offer the rich ways to avoid rubbing elbows with the hoi polloi

BY MICHAEL HEALING FOR ENR

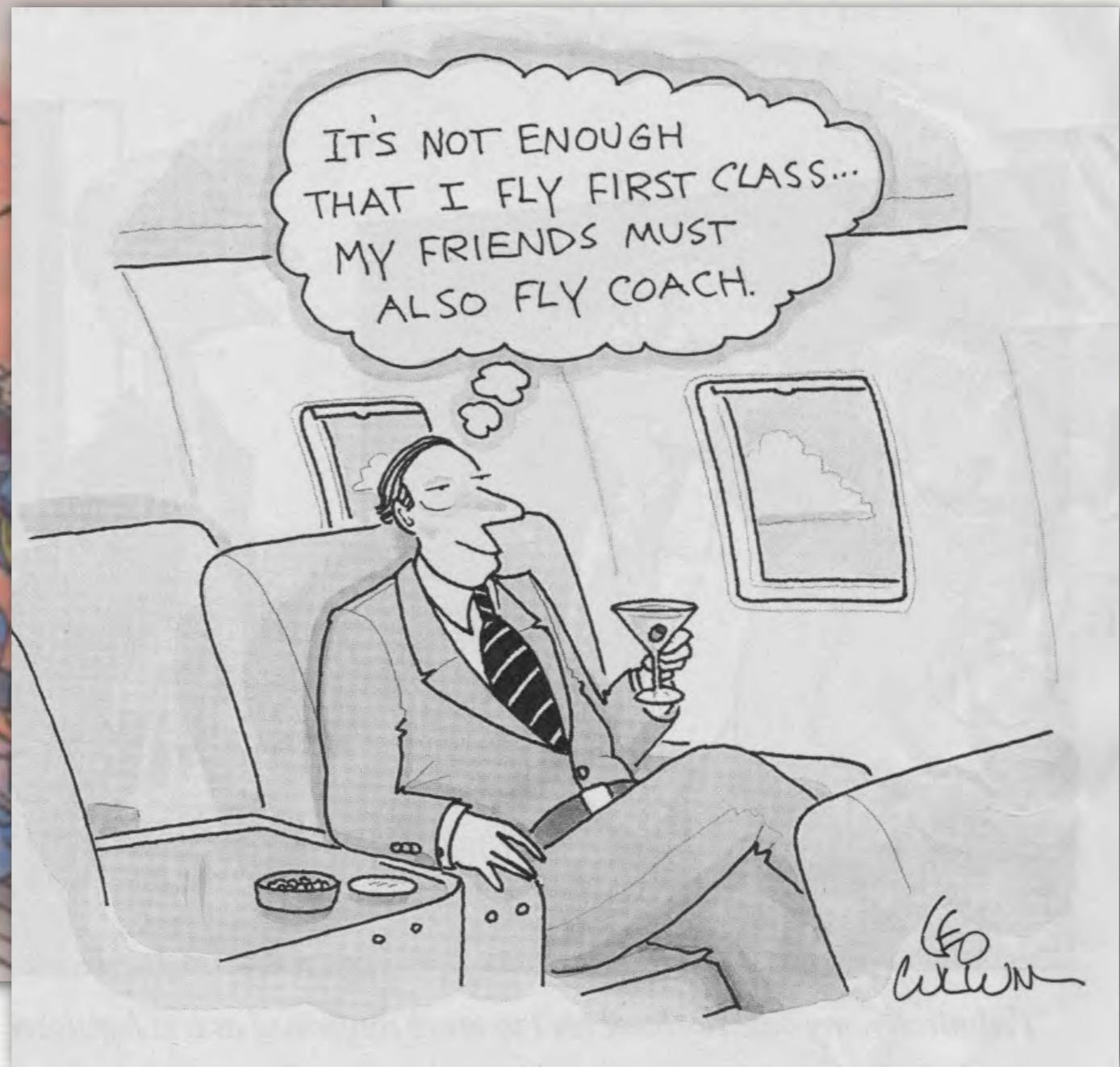
By now, cruise lines have had to be sophisticated. That's because no longer is a cruise simply a vacation; it's a way to escape with the masses at the beach. The lines are now the past with hundreds of other passengers and go down with complete strangers.

That's beginning to change. In a sense that harks back to the golden days of the Titanic, when passengers were segregated into first and second classes (with everyone else thrown into steerage), cruise lines are discovering that there are still people who want to pay a premium to avoid the masses. They're offering staterooms and VIP perks, and offering cruise lines an opportunity to show who's willing to pay.

Over the past few years, the major cruise lines have been rolling out a new category of staterooms called Concierge and Concierge Plus. They offer a private concierge, a deck, a lounge and gym. A lot of staterooms, called "staterooms with a view," have their own butler and gourmet service. Some have even come with a private deck and a private cabin. They're also offering a private butler and a private deck.

Recently, Royal Caribbean is offering a VIP area called the "Royal Suite" that will include a private butler, a private deck and a private cabin. The Royal Suite is a private butler, a private deck and a private cabin.

and Carnival is offering the "Carnival Suite" which includes a private butler, a private deck and a private cabin. The Carnival Suite is a private butler, a private deck and a private cabin.





- African cichlid fish maintain severe hierarchical organization in which only dominant males have reproductive access to females



- Rats in subordination paradigm show pro-inflammatory shifts in cytokine signaling pathways

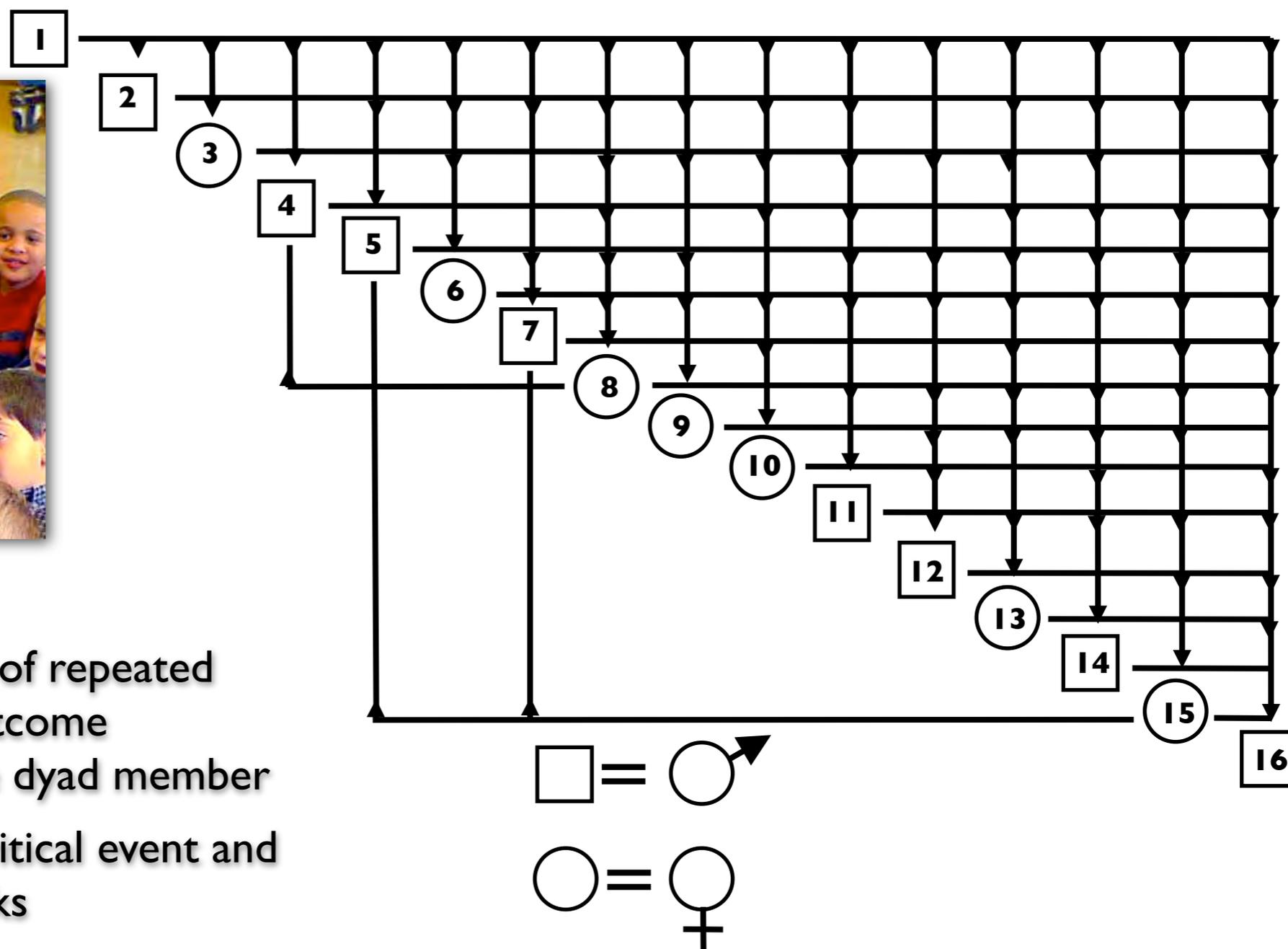


- Primate species form stable, linearly transitive social hierarchies
- Subordinate positions: upregulated adrenocortical function, impaired immune competence, decreased resistance to disease



- Young children form social orders within weeks of entering new social groups
- Are subordinate positions in early peer hierarchies associated with greater stress, exaggerated reactivity, and excessive, stress-related morbidity?

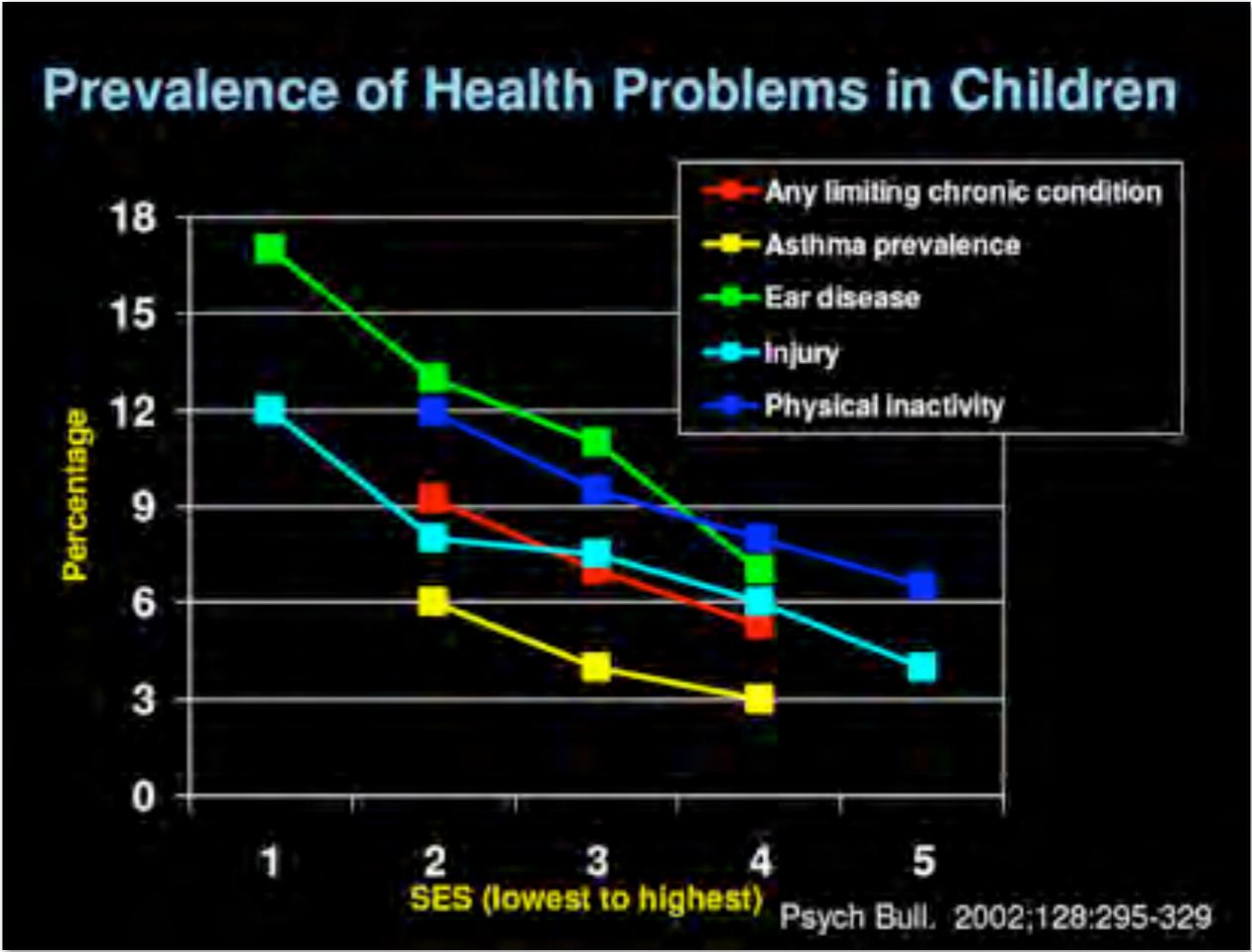
Naturalistic measures of dominance/ subordination behavior



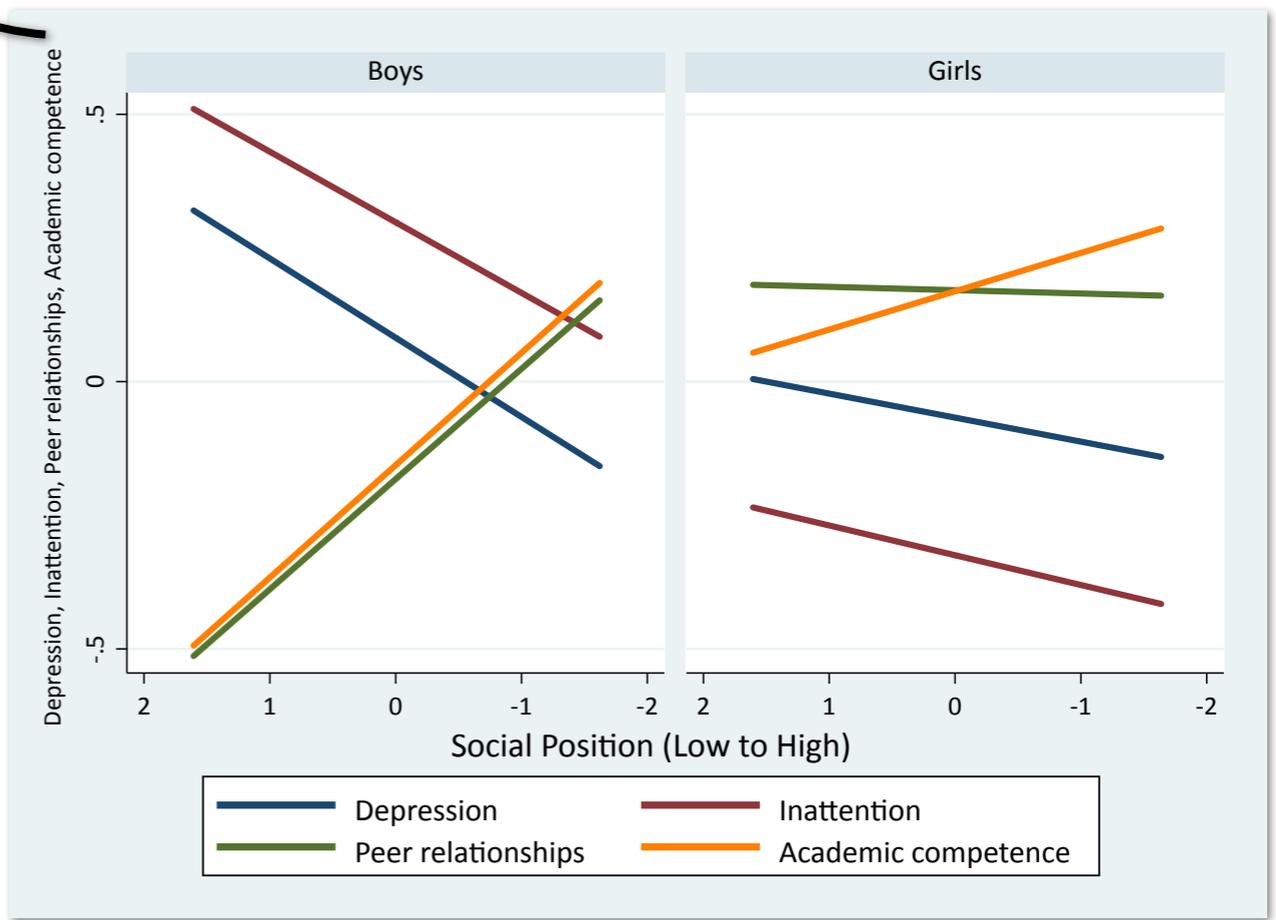
- Social dominance: a pattern of repeated encounters in which the outcome consistently favors the same dyad member
- Dominance observations: critical event and scan sampling over 3-5 weeks
- Behaviors: physical attack, imitation, directing, threat, relational aggression

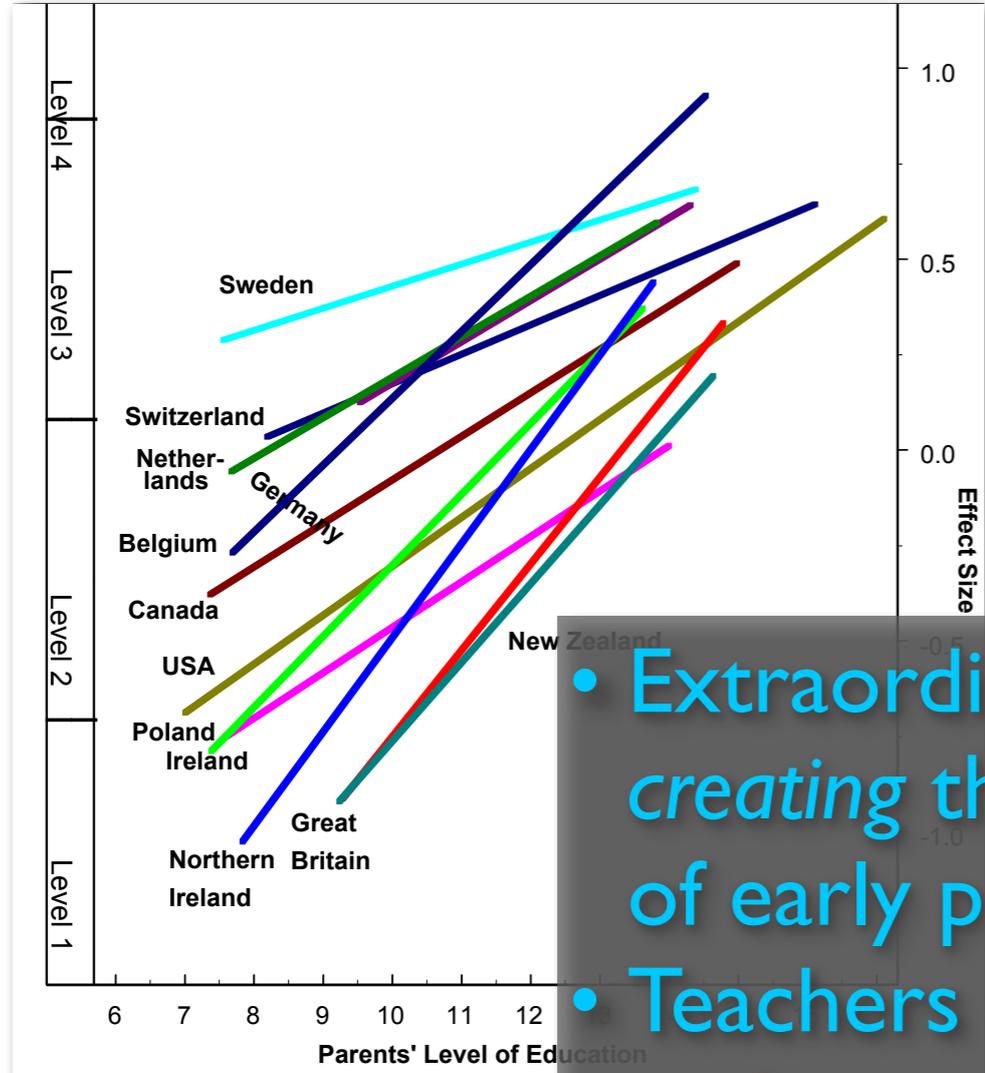


n
of
peer
academic



338 kindergarten children; 29 public school classrooms

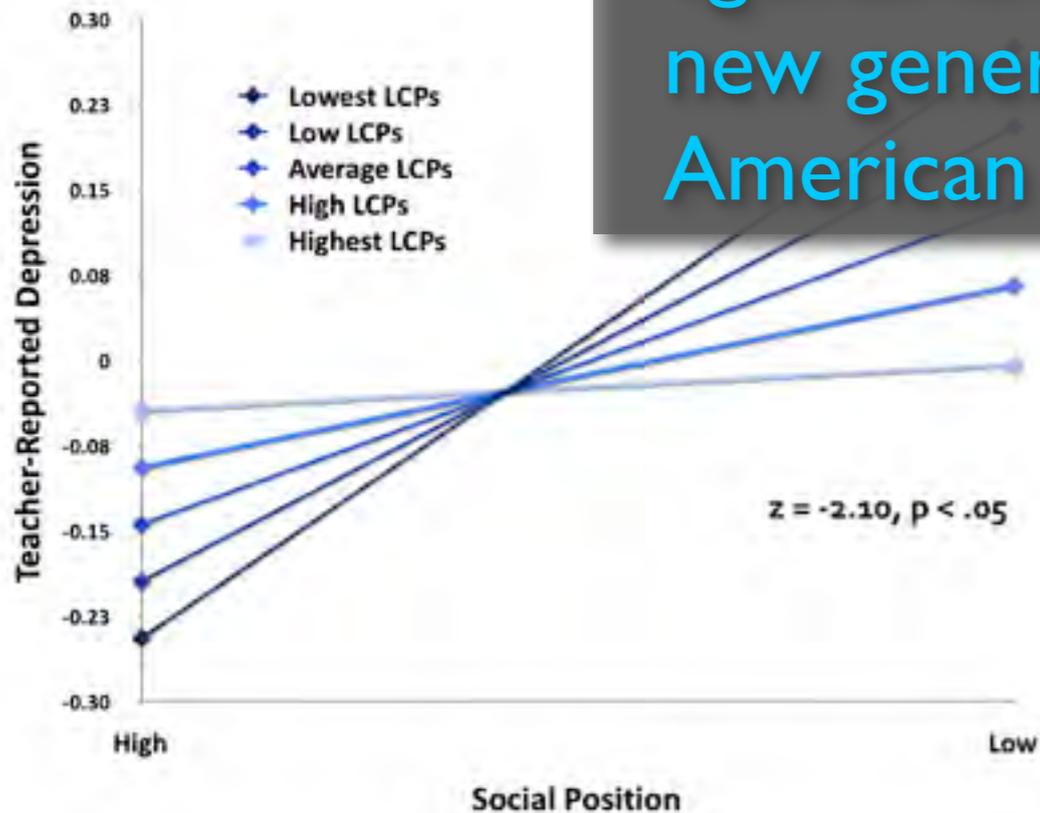




- Variability in slope of SES-development relation from nation to nation
- Slope flattest in countries with more egalitarian social policies

• Extraordinary role of teachers in creating the social environments of early primary school

• Teachers as the purveyors of egalitarian, democratic values to new generations of North American children



- Variability in social position-development gradient by classroom 'climate': level of learner-centered practices (LCPs)
- At highest level of classroom LCPs, almost no relation between social position and depression



- A conserved predisposition, across species, to hierarchical social organization
- Social subordination *per se* associated with diminished health and development, irrespective of the scale or complexity of the social context
- The consequences of inequality can be tempered, however, by the social climate and culture shaped by those who teach and lead.

DoubleTake

