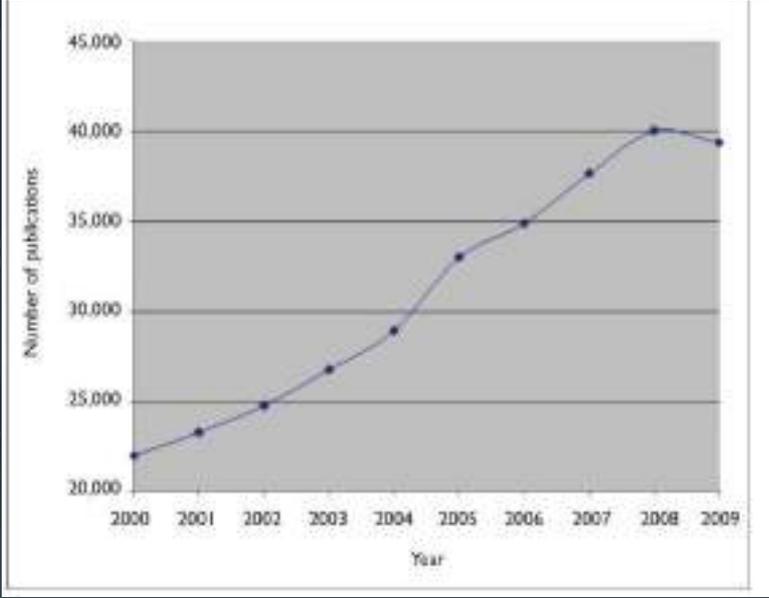


Biomarkers in the Social Sciences & The Biobehavioral Health Lab at UCSB



Nic Thompson González, PhD
Anthropology
Biobehavioral Health Lab Manager

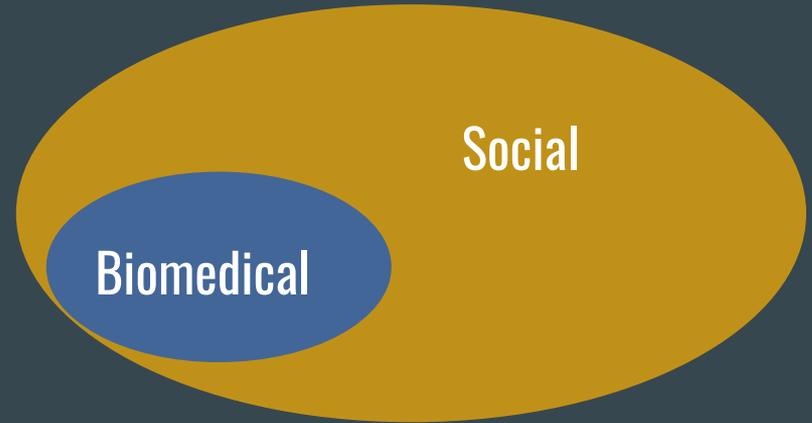
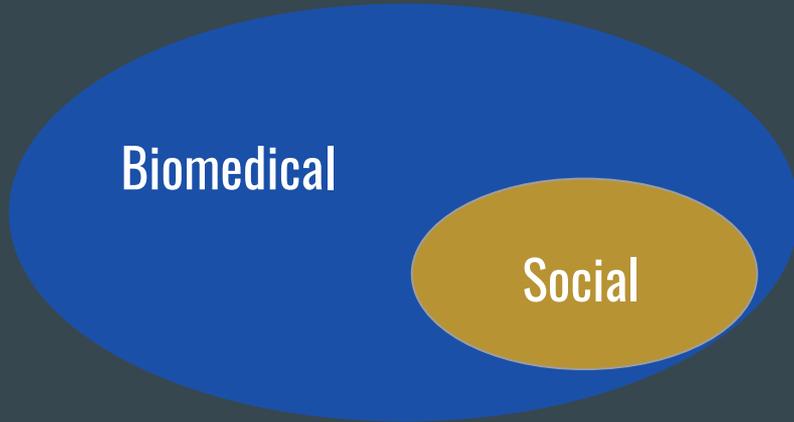


PubMed citations referencing
“biomarker” as a keyword 2000-2009

Development and use of biomarkers is on the rise...

Because biomarkers are important windows to physiological processes & how our environments “get under the skin.”

Growing synergy of biomedical & life sciences with social science



THE LANCET
Volume 363, Issue 9464, 19–25 March 2005, Pages 1099–1104

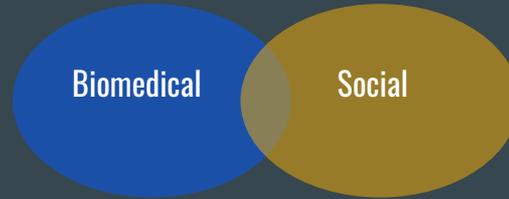


Public Health
Social determinants of health inequalities
Prof Michael Marmot ¹ 

SOCIOLOGY OF HEALTH & ILLNESS

ORIGINAL ARTICLE
Messengers of stress: Towards a cortisol sociology
Celia Roberts  Brigit McWade
First published: 31 May 2021 | <https://doi.org/10.1111/1467-9566.13261>

Myriad long-term studies



NHANES

Whitehall Study

MacArthur Study of Successful Aging

National Longitudinal Study of Adolescent Health

Atherosclerosis Risk in Communities Study (ARIC)

Reasons for Geographic and Racial Differences in Stroke (REGARDS)

Coronary Artery Risk Development in Young Adults (CARDIA)

Women's Health Initiative

Framingham Heart Study

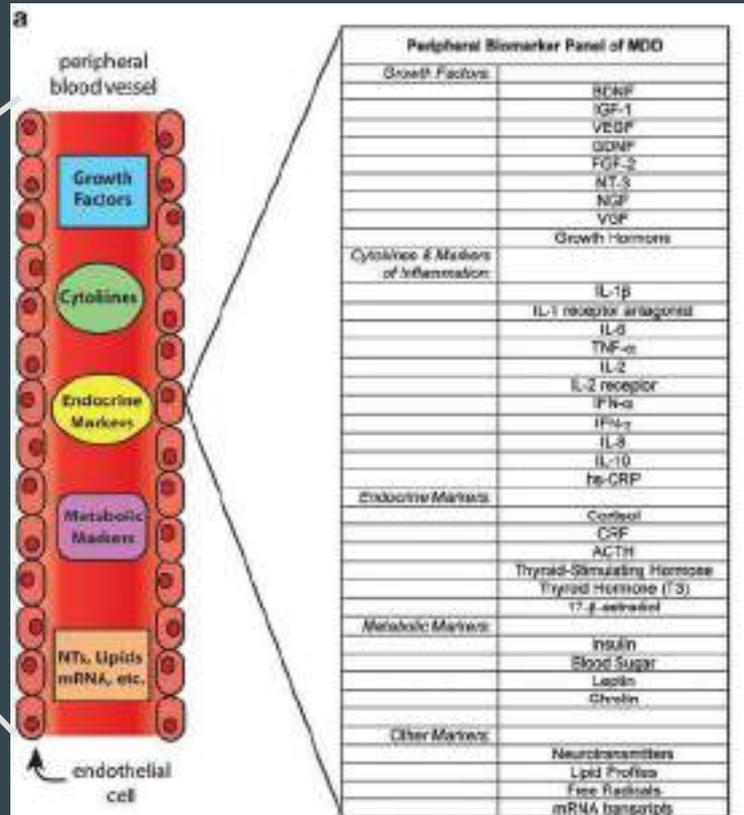
Multiethnic Study of Atherosclerosis

Midlife in the United States (MIDUS)

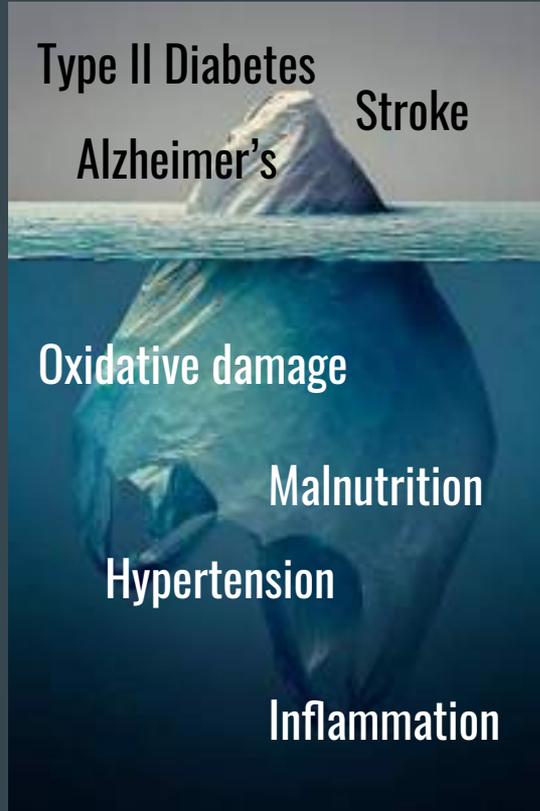
Tsimane Health and Life History Project

...

Biomarker literacy increasingly valuable to social scientists



Biomarkers help identify subclinical signs of disease



Determine high risk individuals *before* major sickness

Target social and medical interventions

Reveal environmental & lifestyle risk factors of morbidity and mortality

Field-friendly techniques with broader impacts to communities



Photos: Mike Gurven

Who am I?



I'm a primate behavioral ecologist.

I use biomarkers, behavioral observations, and demographic data to evaluate

- Social & physical changes with age & exposures
- The hidden costs and benefits of sociality



Stronger social bonds do not always predict greater longevity in a gregarious primate

Nicole A. Thompson^{1,2} | Marina Cords^{1,2}

Urinary markers of oxidative stress respond to infection and late-life in wild chimpanzees

Nicole Thompson González^{1,2*}, Emily Otali², Zarin Machanda^{1,2}, Martin N. Muller^{1,2}, Richard Wrangham^{1,2}, Melissa Emery Thompson^{1,2}

Roadmap

- **What are biomarkers and what do they measure?**

Roadmap

- What are biomarkers and what do they measure?
- **How do biomarkers add value to the social sciences?**

Roadmap

- What are biomarkers and what do they measure?
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Roadmap

- What are biomarkers and what do they measure?
- How do biomarkers add value to the social sciences?
- What is the Biobehavioral Health Lab at UCSB?
- **What are the ethics and logistics of biomarker data collection?**

What are biomarkers?

A biological measure of a biological state.



“A characteristic objectively measured and evaluated as an indicator of normal biological processes, pathogenic processes, or pharmacological responses to a therapeutic intervention”

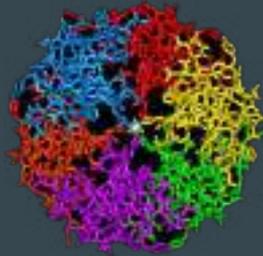
- National Institutes of Health

What are biomarkers?



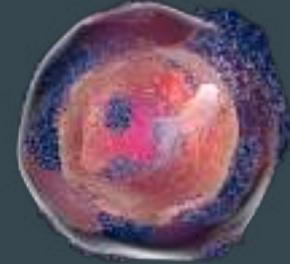
Physical attributes

- Height
- Body Mass Index
- Blood pressure
- Respiratory rate
- Skin fold thickness



Biochemical actors

- Hormones
- Cytokines
- Cells (e.g. immune)
- Their by-products & metabolites



Products of physical damage

- ... to cells, DNA, proteins, and lipids

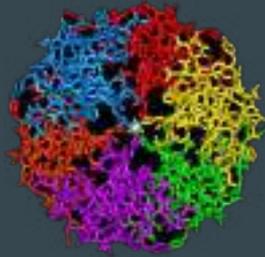
What are biomarkers?

“Dry”



Physical attributes

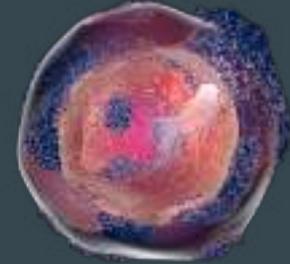
- Height
- Body Mass Index
- Blood pressure
- Respiratory rate
- Skin fold thickness



Biochemical actors

- Hormones
- Cytokines
- Cells (e.g. immune)
- Their by-products & metabolites

“Wet”



Products of physical damage

- ... to cells, DNA, proteins, and lipids

Perspectives: no biomarker is simply “good” or “bad”



Health

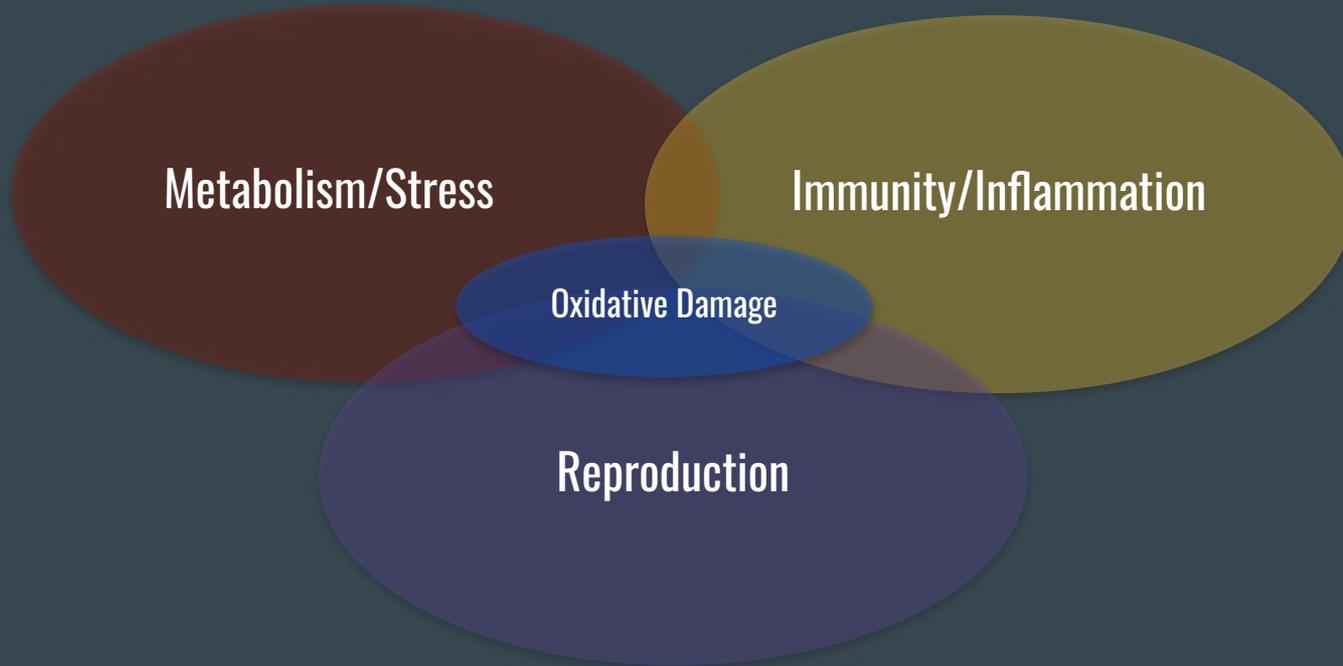
Physiological processes
relative to a standard or
baseline

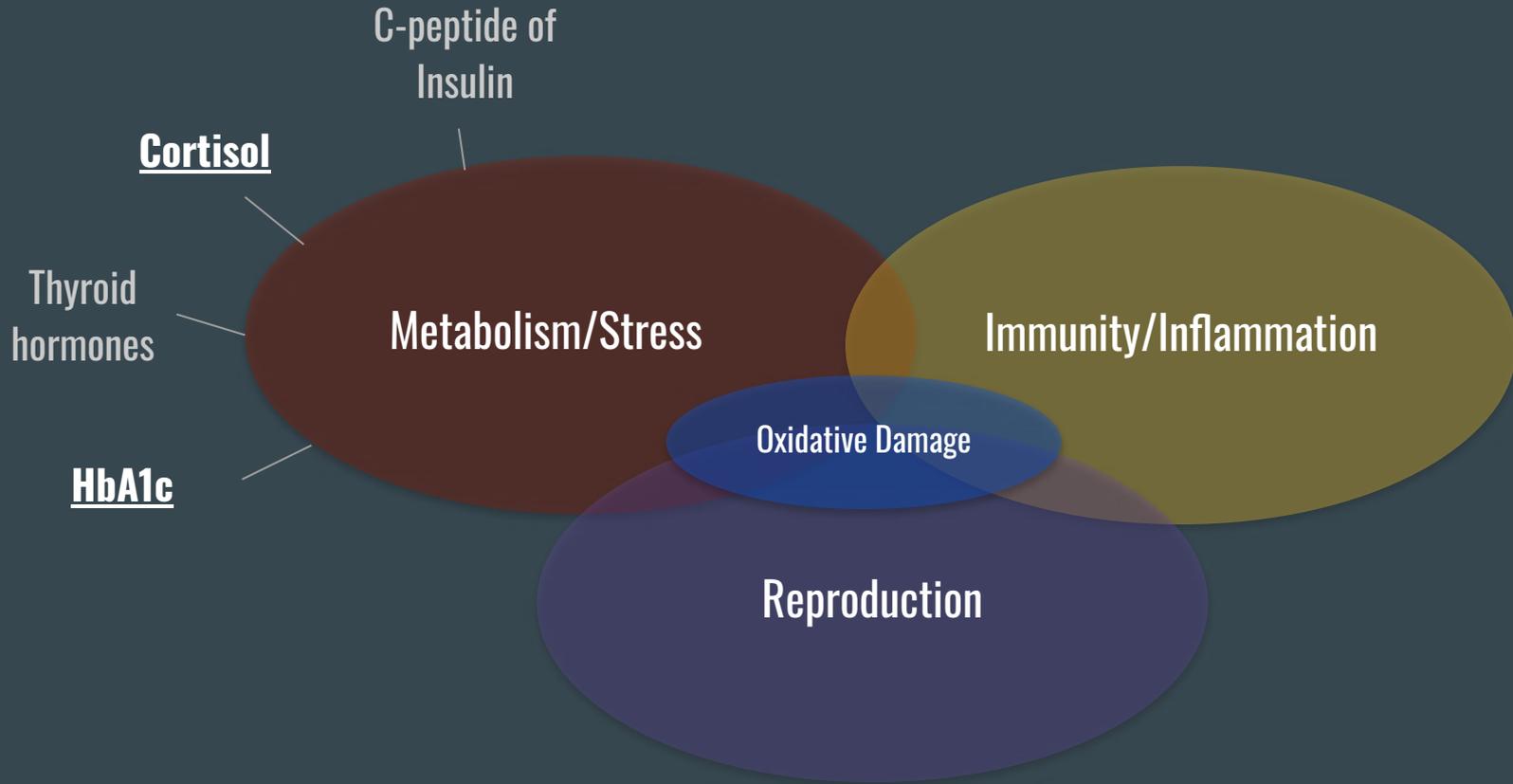


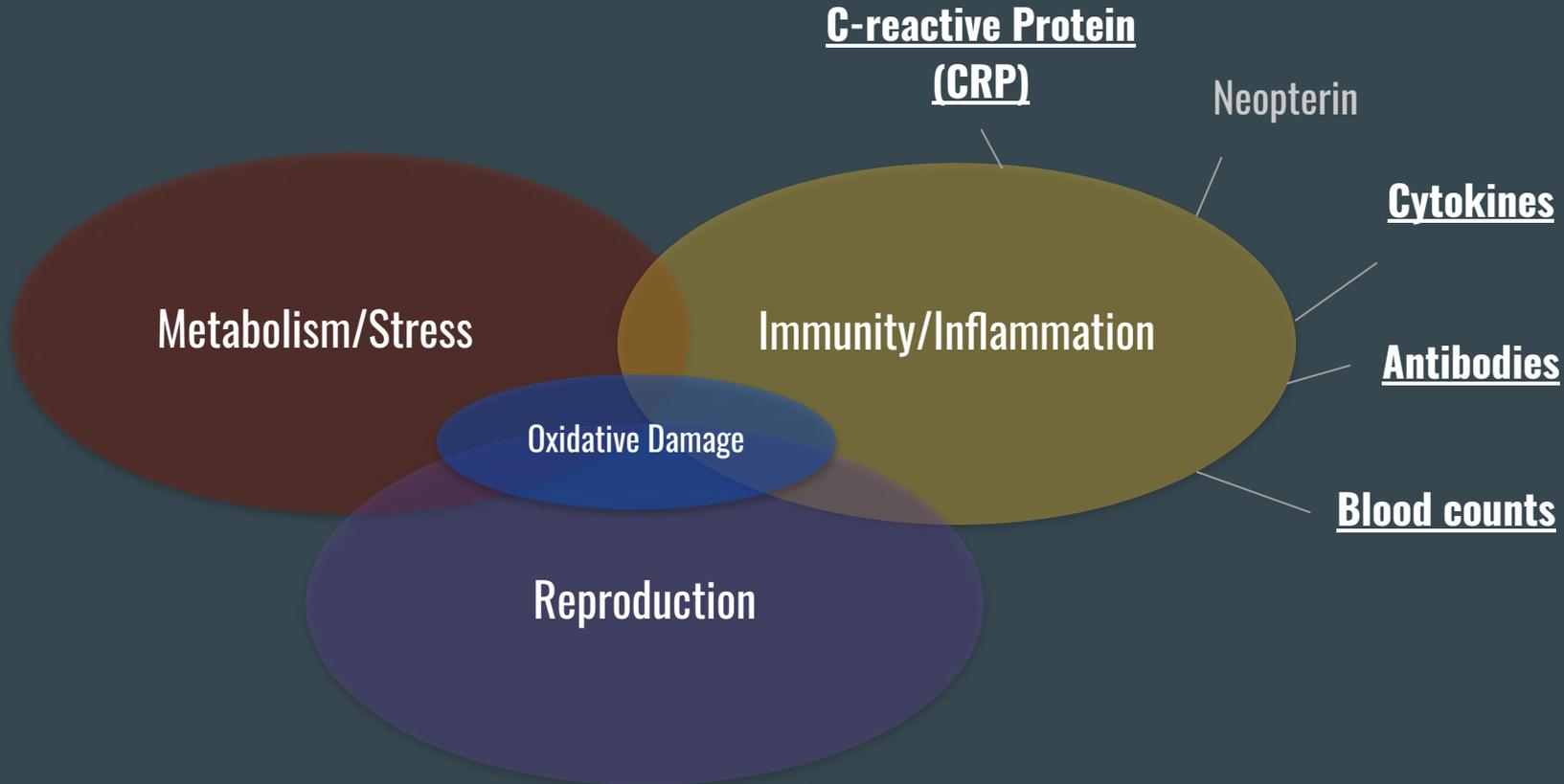
Evolutionary Life History

Relative investment in
different processes
given finite energy

What do biomarkers measure?







C-reactive Protein (CRP)

Neopterin

Cytokines

Antibodies

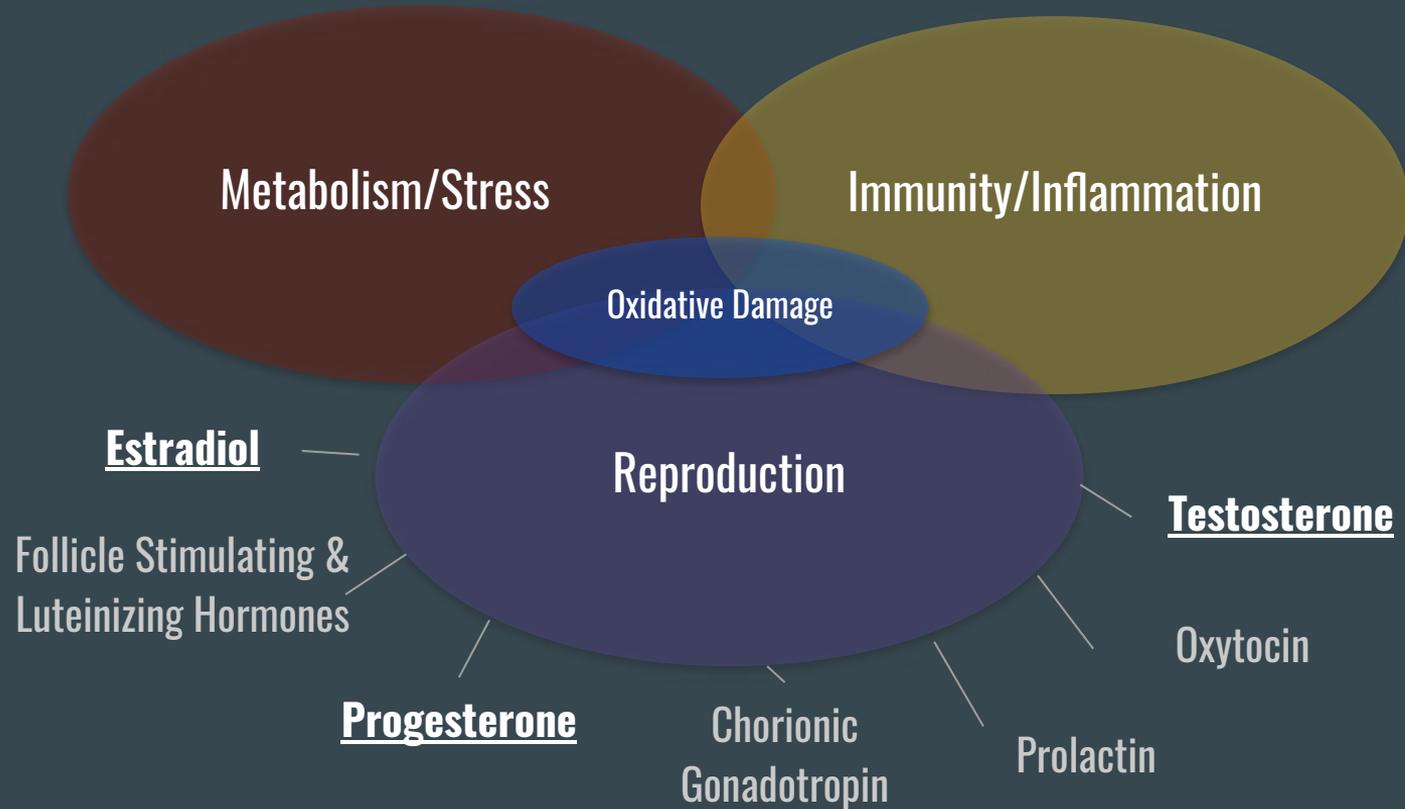
Blood counts

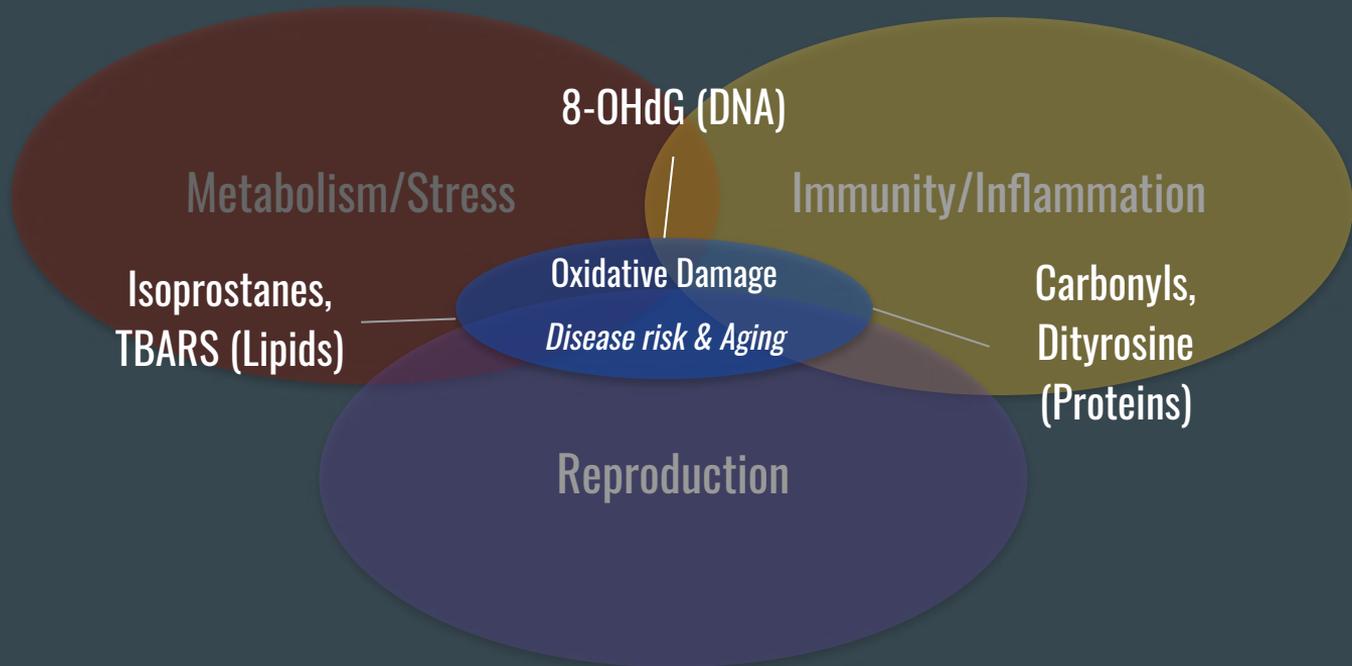
Metabolism/Stress

Immunity/Inflammation

Oxidative Damage

Reproduction





Where do we get biomarkers? 💧



Where do we get biomarkers?



Cortisol, Estradiol,
Testosterone,
Oxytocin, Cytokines



Damn near everything:
metabolic, immune,
reproductive, oxi-damage

Most metabolic &
reproductive hormones,
Oxidative damage



Metabolites of metabolic &
reproductive hormones,
mucosal immunity

Roadmap

- What are biomarkers and what do they measure?
- **How do biomarkers add value to the social sciences?**

How do biomarkers add value to the social sciences?



- Not the “real” picture - a more holistic one



Nuances of self-rated health (SRH)

- SRH widely used (excellent to poor)
- **Education** can bias individual standards/expectations of health
- In study, biomarkers of cardiovascular health aligned closely with SRH
- But within each SRH category, respondents with more education had healthier levels of biomarkers.

How do biomarkers add value to the social sciences?



- Not the “real” picture - a more holistic one
- Develop interdisciplinary collaboration
 - Can lead to novel approaches to important questions

How do biomarkers add value to the social sciences?



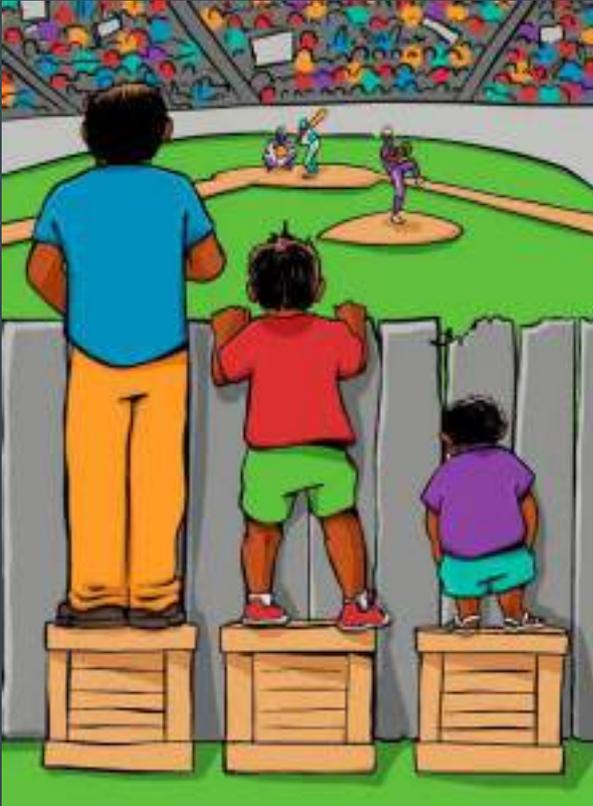
- Not the “real” picture - a more holistic one
- Develop interdisciplinary collaboration
 - Can lead to novel approaches to important questions
- Delineating pathways between social experience and health outcomes better informs policy & targeted interventions

Key areas of value

Social Inequalities

Cooperation & Competition

Social Inequality yields Health Disparities



Falling along lines of

Socioeconomic Status

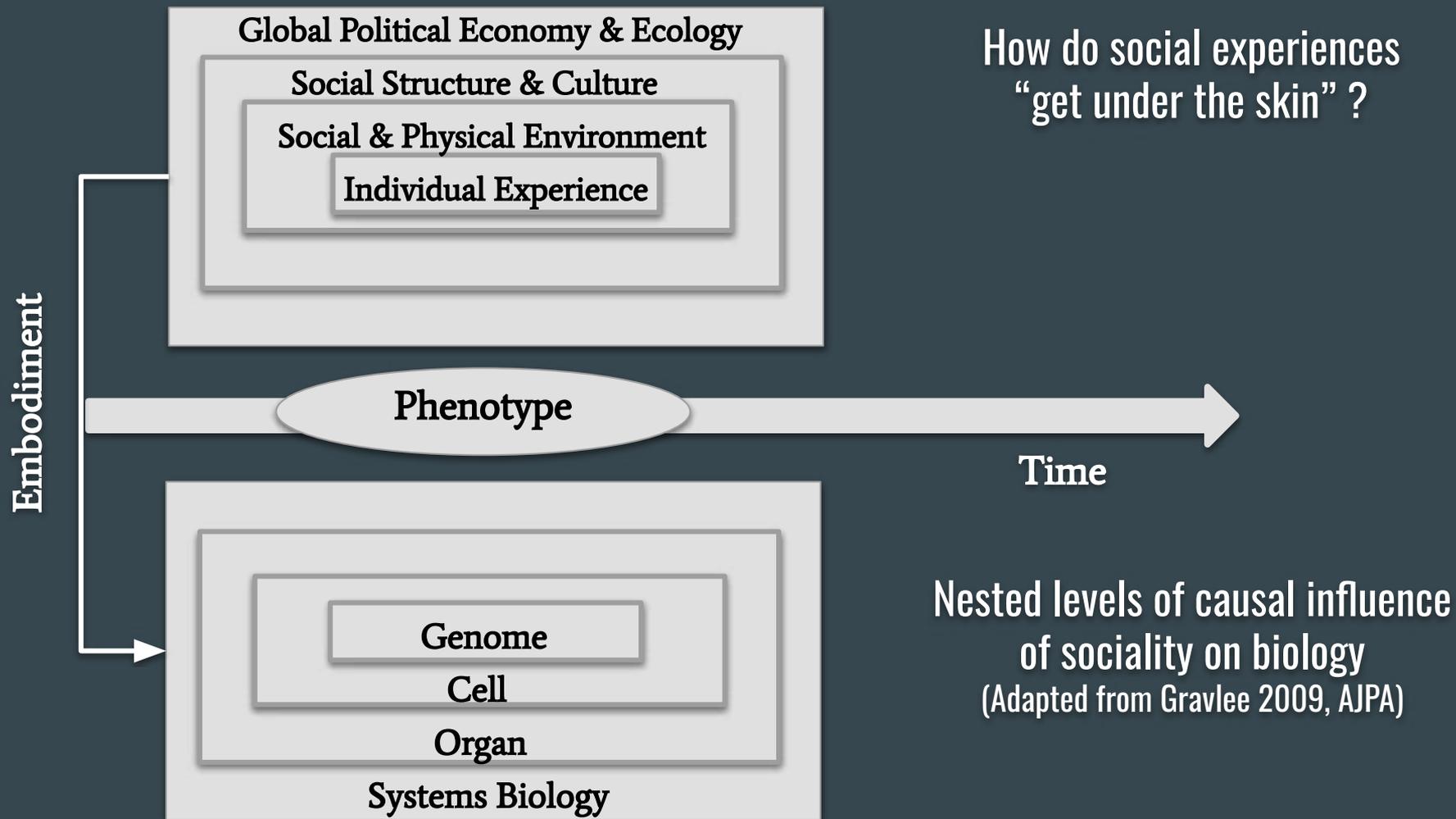
Income

Education

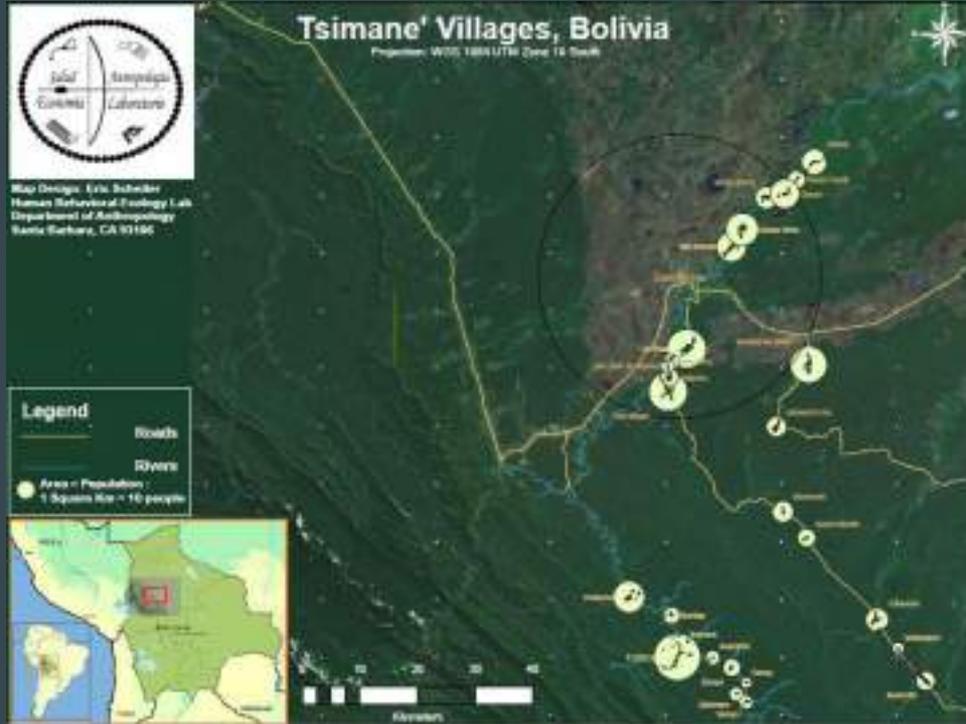
Gender Inequality

Immigration

Racialization



Socioeconomic Status: Wealth

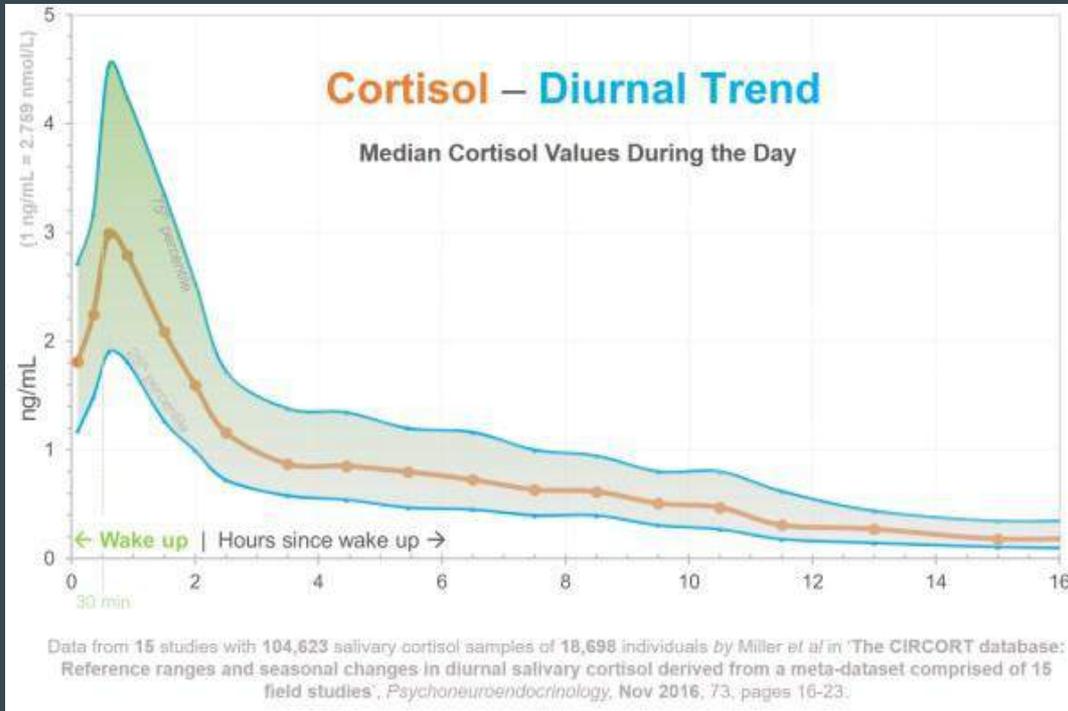


Wealth inequality corresponds with higher blood pressure in the absence of large lifestyle differences.

Jaeggi, Blackwell, ... Gurven 2021 eLife

- Tsimane of Bolivia
- Risk of hypertension increase with lower household wealth and community-wide inequality (Gini)

Socioeconomic Status: Wealth



Blood pressure increases with cortisol

Background: Cortisol regulation

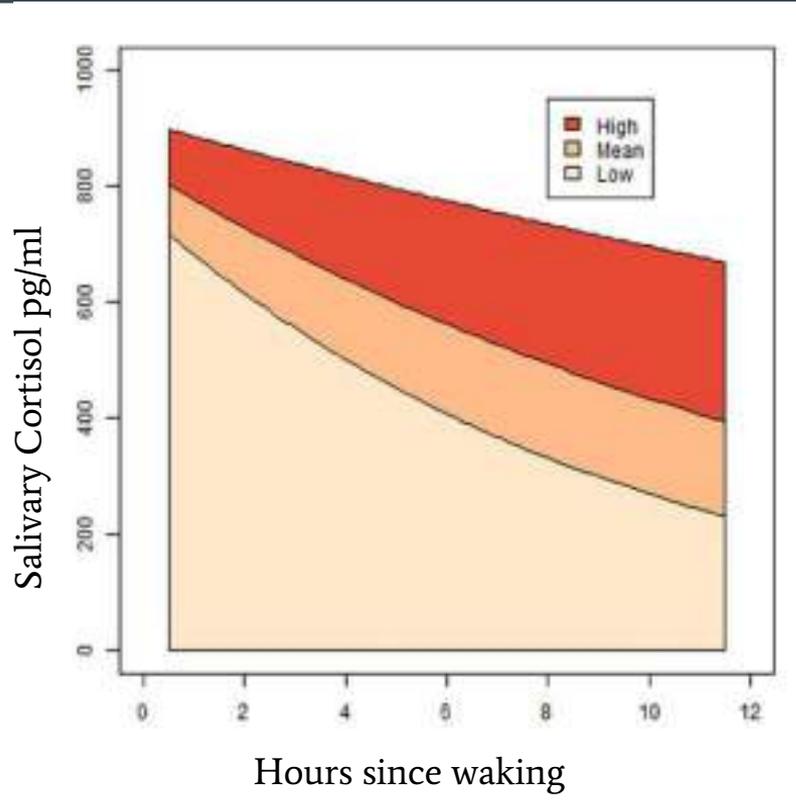
Cortisol follows a circadian rhythm

Peak at waking, then decline

Slope of decline indicates regulation, total area under the curve indicates absolute exposure

Both predict metabolic and cardiovascular health outcomes

Socioeconomic Status: Wealth and Prestige



Perceived SES corresponds with salivary cortisol & its regulation.

Utala Island; Garcia, Blackwell, Gurven 2017 AJHB

Perceived lifestyle discrepancy:

How great is your inability to meet your perceived needs?

High Medium Low

Categories correspond with “area under the curve”

Socioeconomic Status: Wealth and Prestige



Life at the top isn't always easy.

In Tsimane, salivary cortisol increases with income among men (*Von Reuden ... Gurven 2014 EMPH*)

Activity & pressure/vigilance associated with market integration

“Executive stress” apparent when hierarchies are unstable

Socioeconomic Status: Wealth and Prestige



Ronan Donovan



Jeanne Altmann

Mo \$ mo problems: A cross-species trend

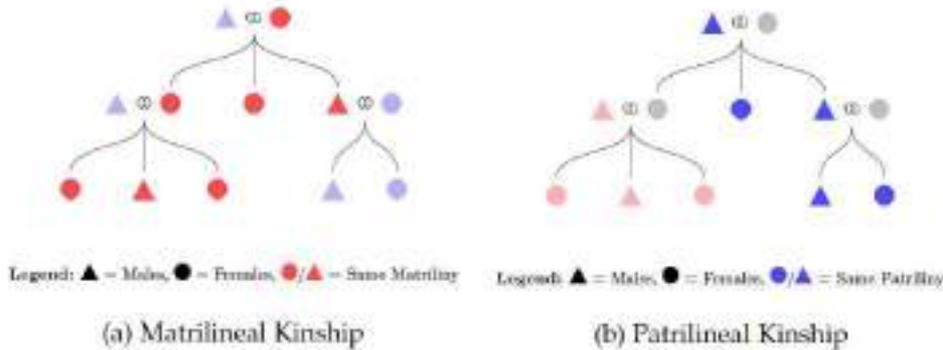
Mirrors stressors of highest rank in non-human primates: chimpanzees (*Muller Wrangham 2004 BES*), baboons (*Gesquiere et al 2011, Science*)

Why males? Common differences in male vs female hierarchies

Important to tease apart energetic and psychosocial stressors associated with status.

Gender Inequality

Figure 2: Diagram of Kinship Systems



Lowes 2020

Background: Matriliney & Patriliney

Systems for recognizing kinship

Allocating wealth/resources to kin

Under matriliney, wealth is passed to daughters' children

Opposite in patriliney

Women have greater authority over resources in matriliney vs patriliney

Gender Inequality



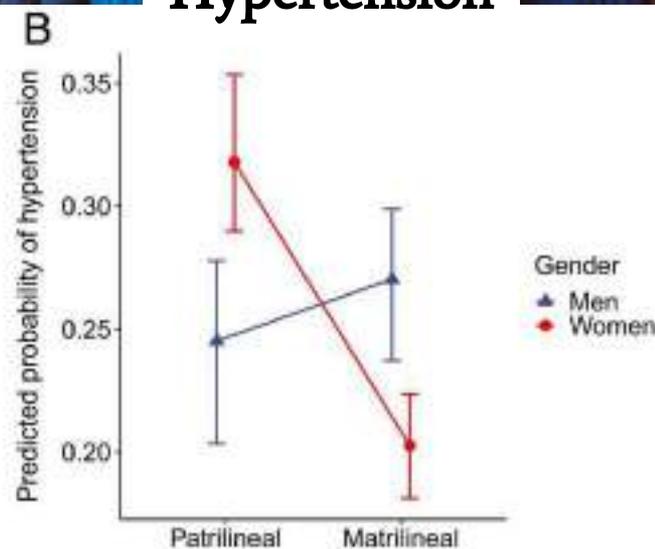
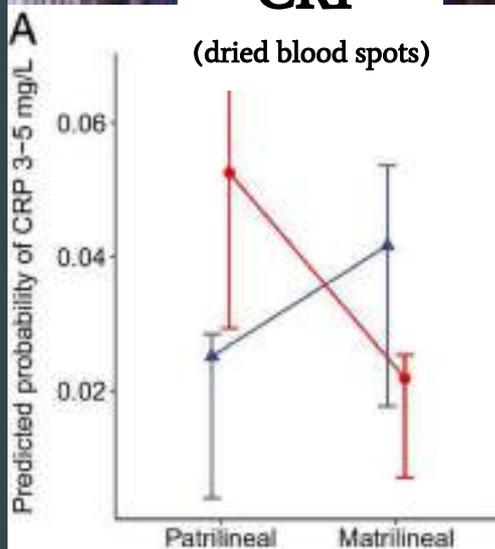
In Mosuo of China, women's health risks under patriliney reversed under matriliney.

Reynolds et al. 2020 PNAS



CRP

Hypertension

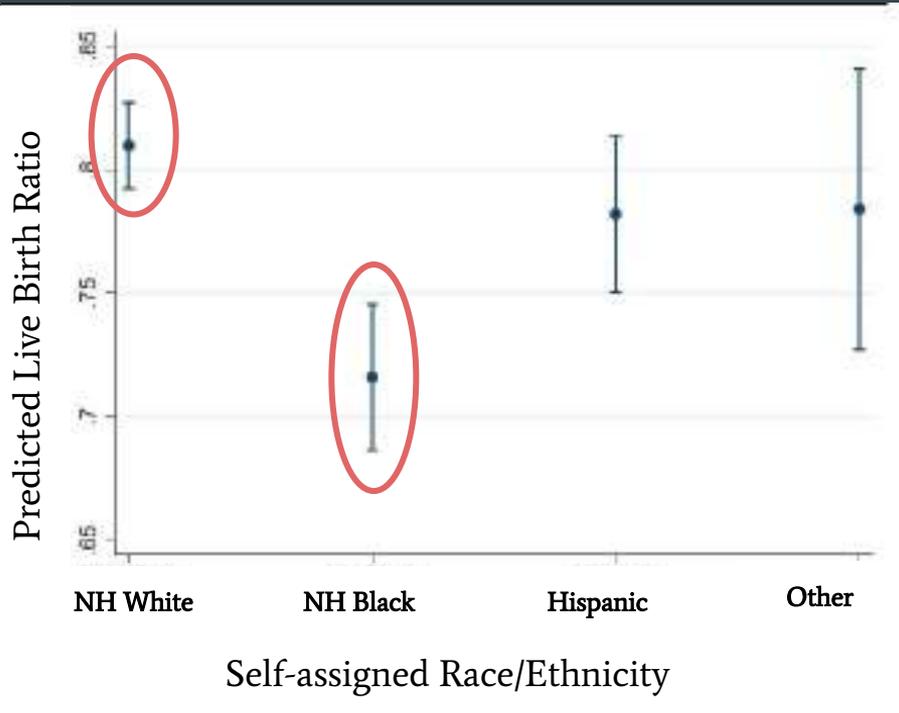


Racialization



- The assignment of a racial character to some one or thing
- A social categorization of physical differences
- Does not represent biologically meaningful categories

Racialization



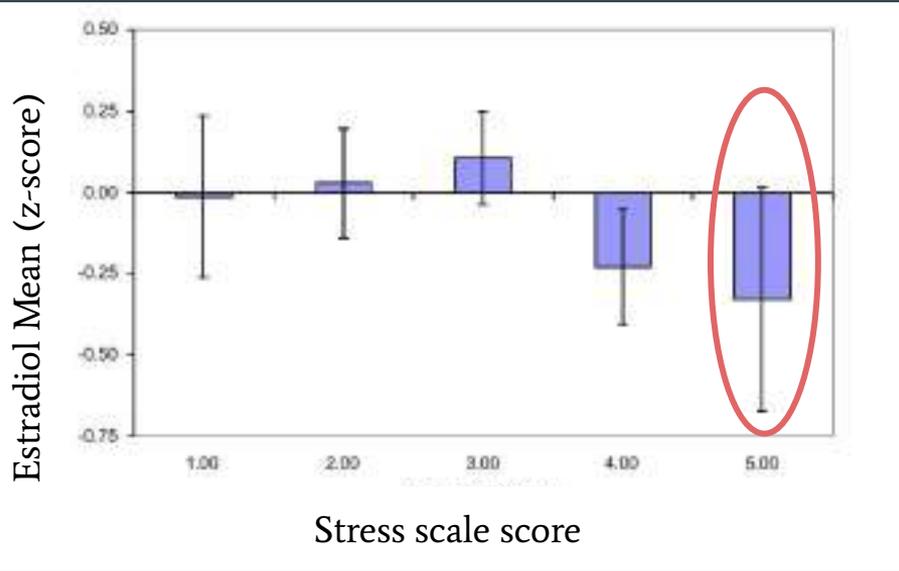
Assigned race predicted women's live birth ratios whereas SES did not.

Shirazi & Rosinger 2021, JREHD

NHANES 2007-2016: Non-Hispanic Black women 10% fewer live births to pregnancies than non-Hispanic White women.

Income and education no effect.

Racialization: possible mechanism on live birth ratio



Salivary estradiol decreases with greater self-reported stress.

Roney & Simmons 2014, AHBP

Low estradiol is key in miscarriage.

HPA axis interacts with HPG axis.

In NHANES study, greater perceived discrimination could complicate reproductive outcomes.

Cooperation and Competition

Testosterone



Oxytocin

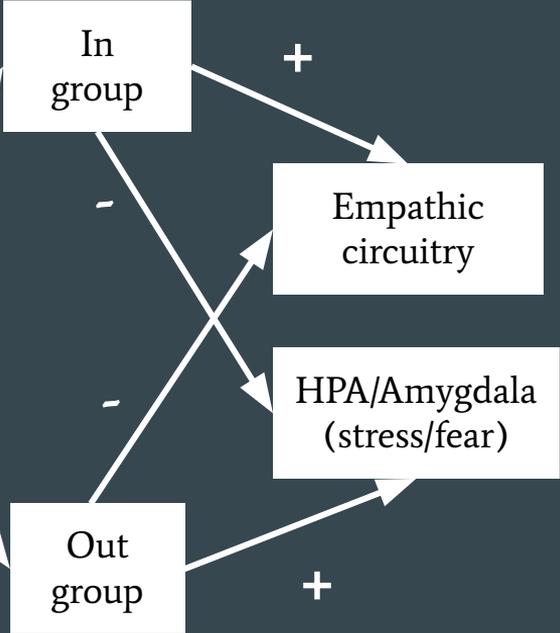


Oxytocin (OT): selective cooperation



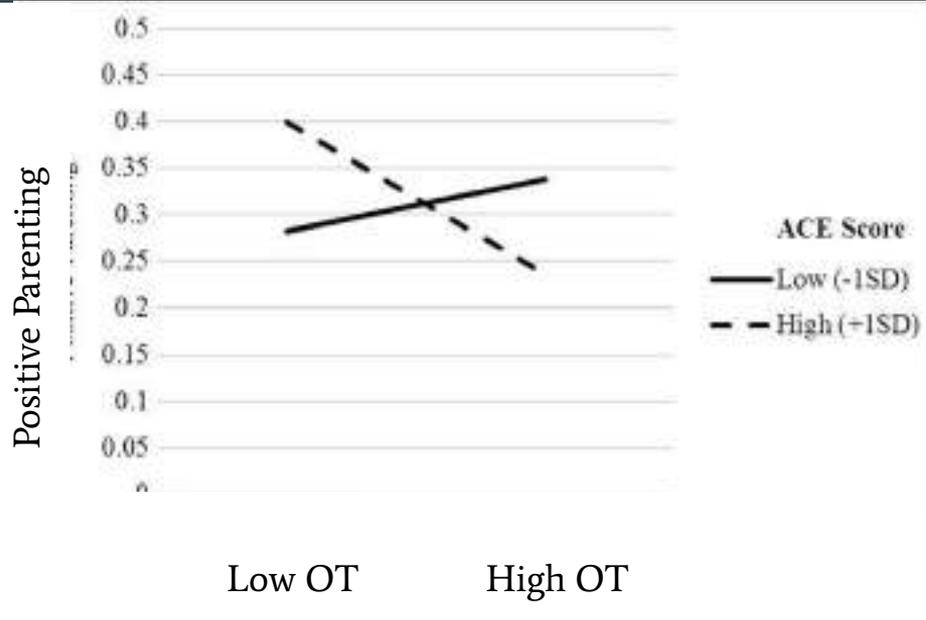
Hypothalamic
release of OT

Other?



- Oxytocin's prosocial effects appear parochial.
- OT release promotes social discrimination.
- Suppresses cooperation with out-group.
- Measurable in saliva.

Oxytocin (OT): selective positive parental behavior



Early life adversity moderates OT influence on maternal behavior.

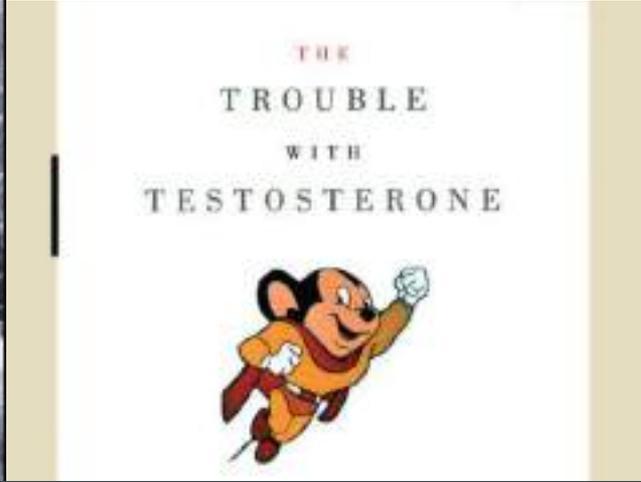
Among impoverished mothers,

Those without adverse childhood experience (ACE) increased positive parenting with OT.

Those with greater childhood adversity decreased positive parenting with OT. More guarding behavior.

Julian et al 2018, AWMH

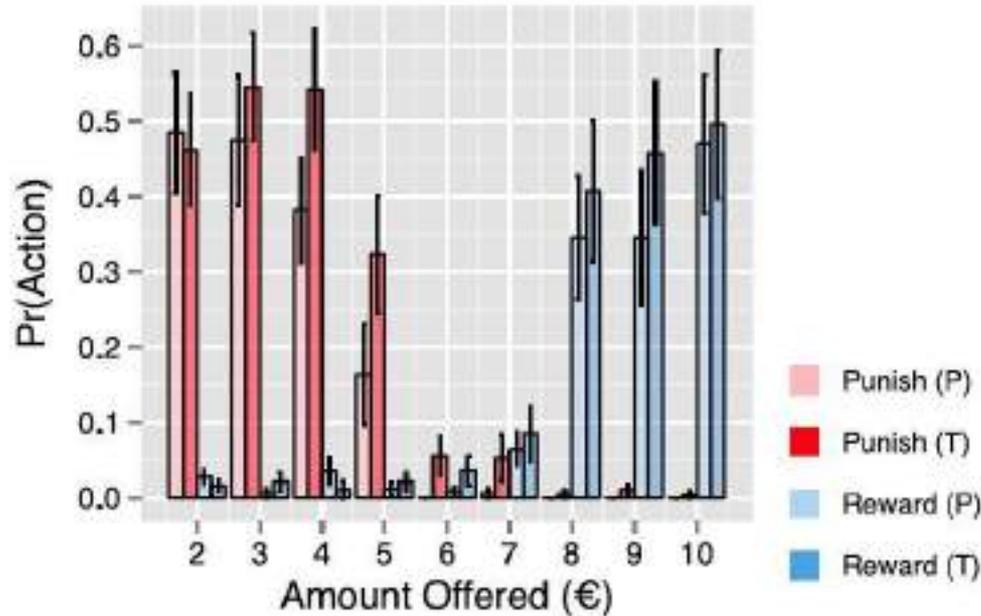
Testosterone



Robert Sapolsky *The Trouble with Testosterone*

Testosterone does not cause aggression.

Testosterone: competitive generosity



Testosterone enhances punishment and reward.

Ultimatum game

Dreher et al. 2016 PNAS

Men treated with testosterone v. placebo more frequently punish proposers that offer low amounts.

Likewise, more frequently reward proposers that offer high amounts.

Roadmap

- What are biomarkers and what do they measure?
- How do biomarkers add value to the social sciences?
- **What is the Biobehavioral Health Lab at UCSB?**

Biobehavioral Health Lab: Who we are and what we do



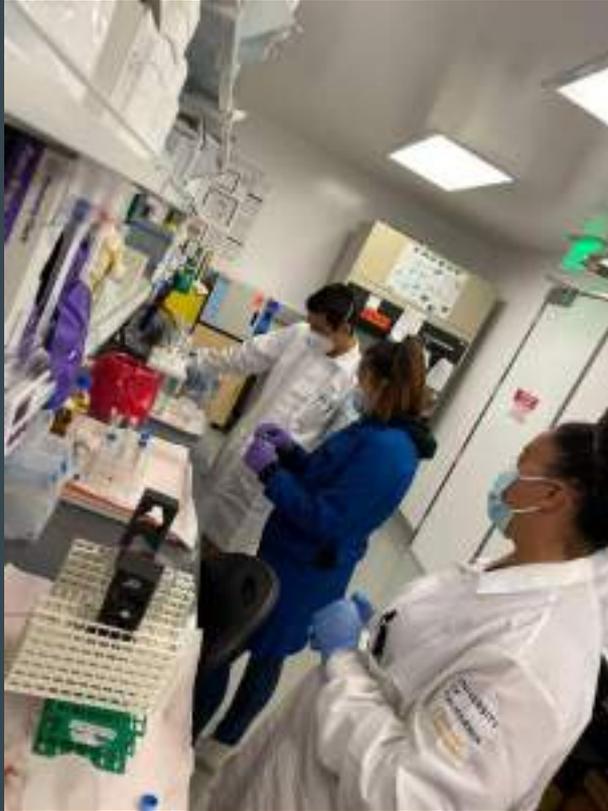
The Biobehavioral Health Lab at UCSB



- Specialize in radio- and enzyme- immunoassays for biochemical agents
 - Cortisol
 - Energy balance
 - Inflammation and immune activity
 - Reproductive hormones
 - Oxidative damage
- Ready to process and assay blood, saliva, urine, fecal samples
- High throughput
- Aim to purchase reagents and avoid more expensive kits



The Biobehavioral Health Lab at UCSB



Abundant training opportunities on sampling protocols, immunoassays, genotyping, and parasitology.



Undergrad and grad lab seminars

Come learn with me!

Winter:

- ANTH 197: Undergrad lab course on biomarkers and behavior

Spring:

- ANTH 253: Graduate lab course & seminar
- ANTH 123MG: Data analysis for the social sciences using R

Questions? Email me at natg@ucsb.edu

Roadmap

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- **What are the ethics and logistics of biomarker data collection?**

Ethics & Logistics



This ain't magic.

Requires community relationships

Careful thought

Some theoretical & logistical expertise

Ethics and community relationships



Specifics vary from project to project

Basics: ongoing transparency & trust

Broader impacts:

- Engagement
- Capacity building
- Education
- Clinical care
- Point of care data

Broader impacts in community



Blood glucose
HbA1c

Point of Care glucose data for the Shodagor in Matlab, Bangladesh

Kathrine Starkweather, UIC

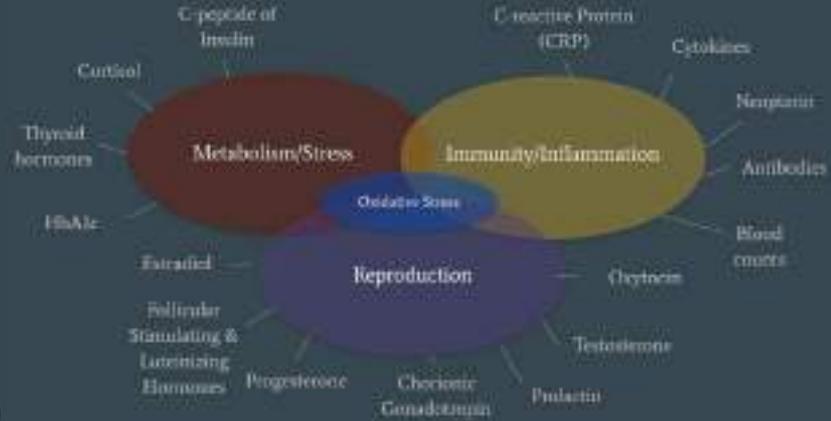
- Local physicians/trainees
- Communicating what's being measured
- Significance of individual scores (e.g. relative to other ranges)
- Opportunity for participant questions

Logistics of incorporating biomarkers

Consult with the Biobehavioral Health Lab!

We can help you consider

- Community relations and ethics
- Bodily function of interest
- Sample type (e.g. blood, saliva, urine)
- Sampling regime (timing, frequency)
- Sampling protocol (person power, equipment)
- And pipelines for data and sample management



Summary

- **Biomarkers are diverse set of proxies of important physiological processes ... and they are becoming widely used in social science.**

Summary

- Biomarkers are diverse set of proxies of important physiological processes.
- **Biomarkers provide a window onto the pathways by which environments get under the skin and further influence our behavior.**

Summary

- Biomarkers are diverse set of proxies of important physiological processes.
- Biomarkers provide a window onto the pathways by which environments get under the skin and further influence our behavior.
- **The Biobehavioral Health Lab is a vibrant center for advising projects, training students, and generating biomarker data.**

Summary

- Biomarkers are diverse set of proxies of important physiological processes.
- Biomarkers provide a window onto the pathways by which environments get under the skin and further influence our behavior.
- The Biobehavioral Health Lab is a vibrant center for advising projects, training students, and generating biomarker data.
- **Prioritize ethics and logistics require careful thought and they benefit from consultation.**



Thanks to

The Broom Center for Demography

Dean Hale

Integrative Anthropological Sciences lab group

Mike Gurven

Michelle Brown

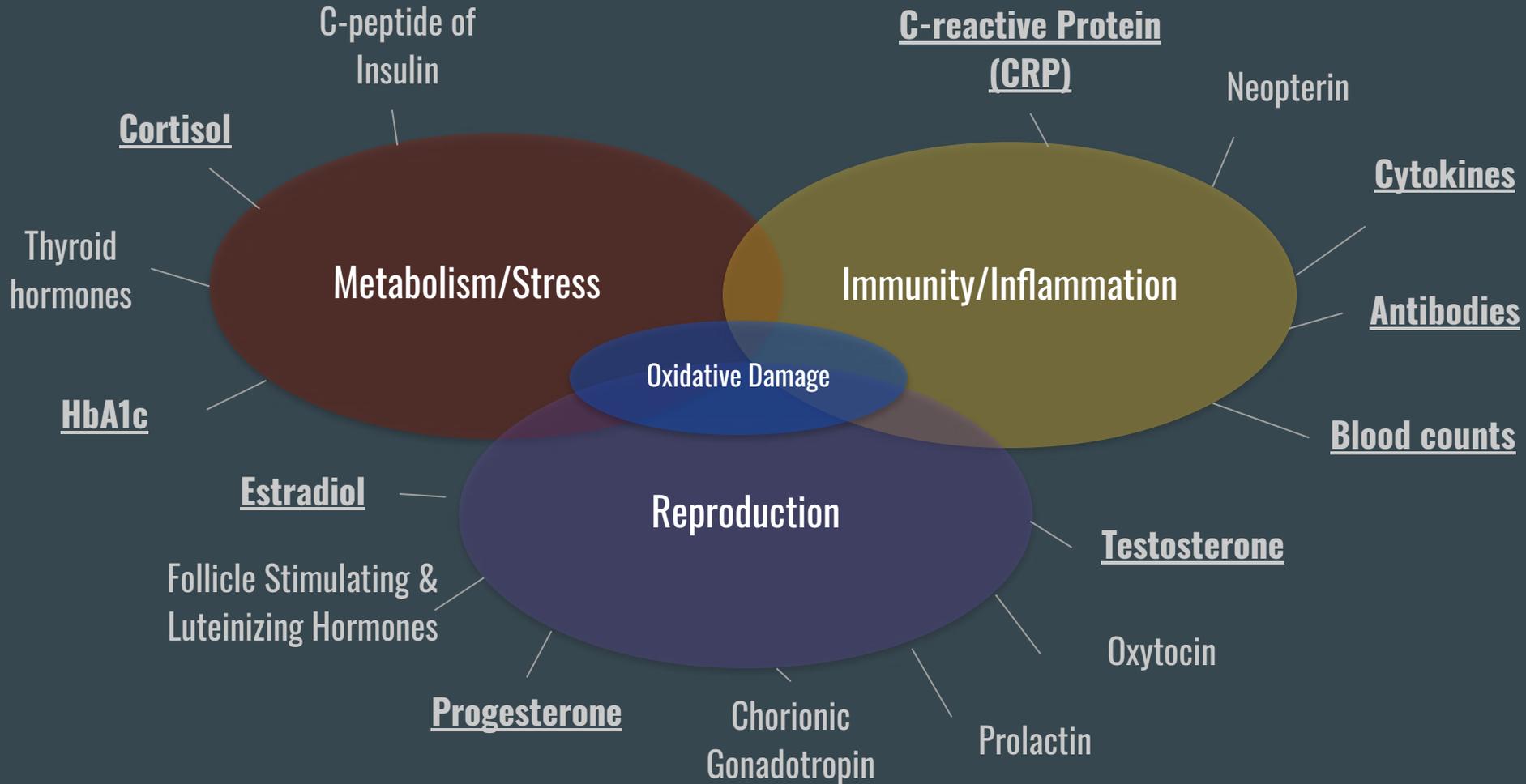
Amy Boddy

Lab undergrads and trainees

Reach me at natg@ucsb.edu

Twitter @NicoleAlineSci

Appendix slides



Logistics of incorporating biomarkers

Sample type: for physical and temporal scales



Hair (weeks/months)

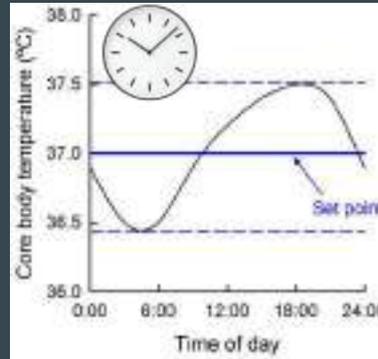
Feces (hours/days)

Urine (mins/hours)

Saliva (mins)

Blood (secs)

Sample timing: thinking in cycles



Logistics: Person power

Whole blood:

Certified phlebotomist

Nurse/Physician

Veterinarian



Blood spots, saliva, urine, stool: any trained researcher



Logistics: Planning your pipeline

We can help you plan...

Short term storage



Transport



Long term storage



Assays



-20° to -80°C



Data interpretation



Costs of assays

Immunoassays range from \$1.30 - \$15 per sample...

Finding bulk reagents instead of specialized kits saves money.