

# A Social Perspective on Positive Psychobiology

Social rewards, social risk, social nerves, and social genomics

Steve W. Cole, Ph.D.

UCLA School of Medicine

Department of Psychiatry & Biobehavioral Sciences

Department Medicine, Division of Hematology-Oncology

Semel Institute for Neuroscience & Human Behavior

Norman Cousins Center for Psychoneuroimmunology

Jonsson Comprehensive Cancer Center



# A functional genomic perspective on human well-being

Barbara L. Fredrickson<sup>a</sup>, Karen M. Grewen<sup>b</sup>, Kimberly A. Coffey<sup>a</sup>, Sara B. Algoe<sup>a</sup>, Ann M. Firestone<sup>a</sup>,  
Jesusa M. G. Arevalo<sup>c</sup>, Jeffrey Ma<sup>c</sup>, and Steven W. Cole<sup>c,d,1</sup>

<sup>a</sup>Department of Psychology, University of North Carolina at Chapel Hill, Chapel Hill, NC 27599; <sup>b</sup>Department of Psychiatry, University of North Carolina School of Medicine, Chapel Hill, NC 27599; <sup>c</sup>University of California, Los Angeles, School of Medicine, Los Angeles, CA 90095; and <sup>d</sup>Jonsson Comprehensive Cancer Center, Norman Cousins Center for Psychoneuroimmunology, AIDS Institute, and Molecular Biology Institute, University of California, Los Angeles, CA 90095

Edited\* by Burton H. Singer, University of Florida, Gainesville, FL, and approved July 2, 2013 (received for review March 20, 2013)



How often do you feel **happy**?

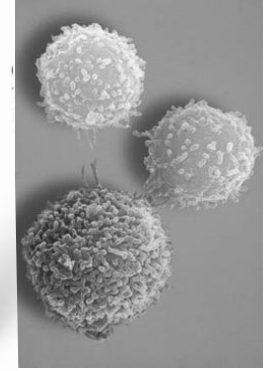
How often do you feel **satisfied**?

Keyes MHC-SF - Hedonic

Life has **direction** and **meaning**?

Grow and become a **better person**?

Keyes MHC-SF – Eudaimonic



2 key results for positive psychobiology:

1. Upregulated antiviral biology (Type I IFN)



# Type I Interferons

IFN- $\alpha$  IFN- $\beta$  IFN- $\omega$

“innate antiviral response”

# A functional genomic perspective on human well-being

Barbara L. Fredrickson<sup>a</sup>, Karen M. Grewen<sup>b</sup>, Kimberly A. Coffey<sup>a</sup>, Sara B. Algoe<sup>a</sup>, Ann M. Firestone<sup>a</sup>,  
 Jesusa M. G. Arevalo<sup>c</sup>, Jeffrey Ma<sup>c</sup>, and Steven W. Cole<sup>c,d,1</sup>

<sup>a</sup>Department of Psychology, University of North Carolina at Chapel Hill, Chapel Hill, NC 27599; <sup>b</sup>Department of Psychiatry, University of North Carolina School of Medicine, Chapel Hill, NC 27599; <sup>c</sup>University of California, Los Angeles, School of Medicine, Los Angeles, CA 90095; and <sup>d</sup>Jonsson Comprehensive Cancer Center, Norman Cousins Center for Psychoneuroimmunology, AIDS Institute, and Molecular Biology Institute, University of California, Los Angeles, CA 90095

Edited\* by Burton H. Singer, University of Florida, Gainesville, FL, and approved July 2, 2013 (received for review March 20, 2013)

Fredrickson et al., PNAS, 2013



How often do you feel **happy**?

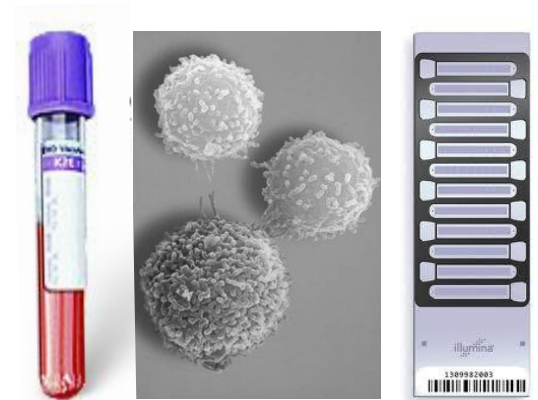
How often do you feel **satisfied**?

Keys MHC-SF - Hedonic

Life has **direction** and **meaning**?

Grow and become a **better person**?

Keys MHC-SF – Eudaimonic



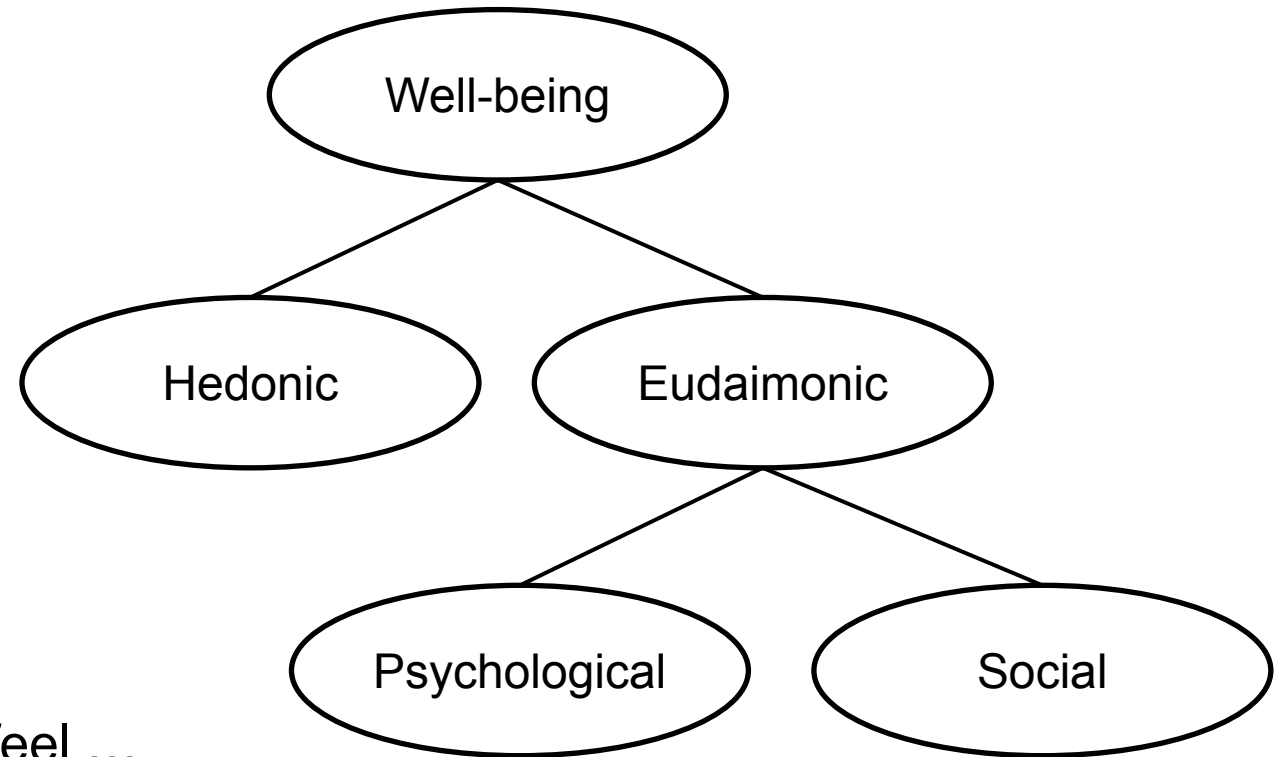
2 key results for positive psychobiology:

1. Upregulated antiviral biology (Type I IFN)

2. Central correlate: Eudaimonic *Social Wellbeing*

# Social Well-Being

Keyes, Social Psych Quarterly, 1998  
Keyes, Health and Social Behavior, 2002



During the past month, how often did you feel ...

- that you had something important to contribute to society
- that you belonged to a community (like a social group, or your neighborhood)
- that our society is a good place, or is becoming a better place, for all people
- that people are basically good
- that the way our society works makes sense to you

Why would social well-being connect to antiviral biology?

**Microbial allostasis**

## 2 “social genomic programs” in immune cells

attached/safe



isolated/danger



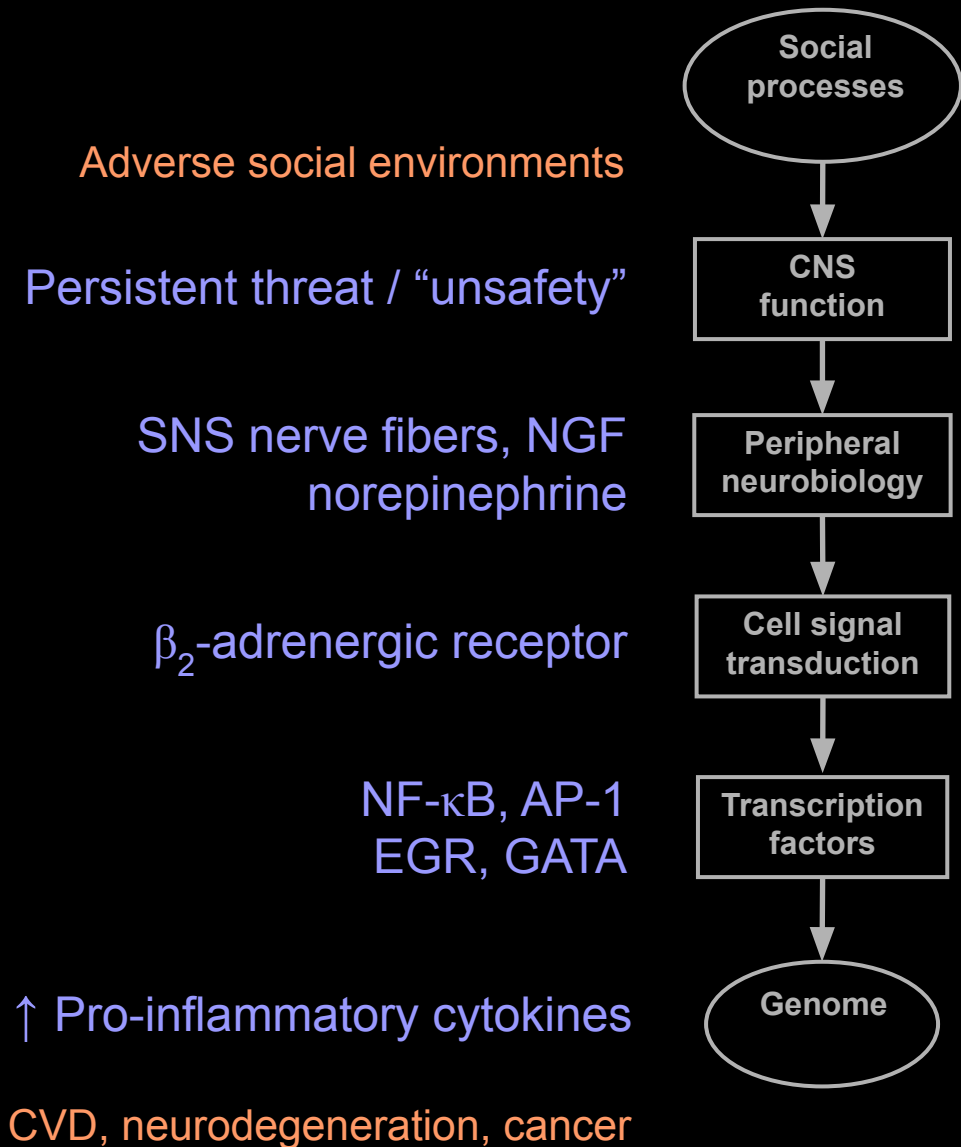
(stress)

No social support?  
Defend against bacteria

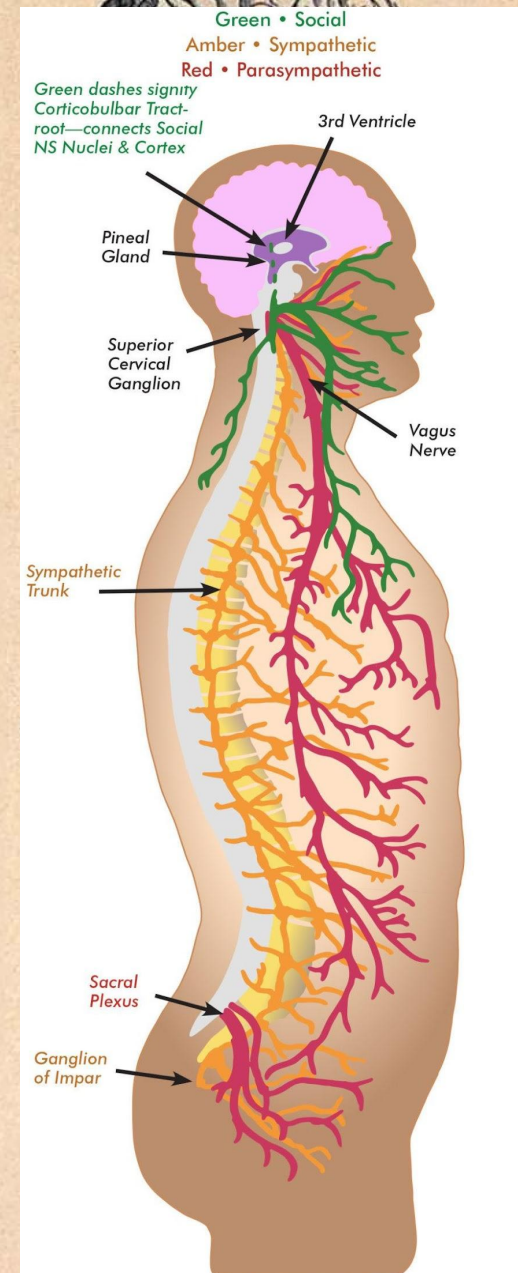


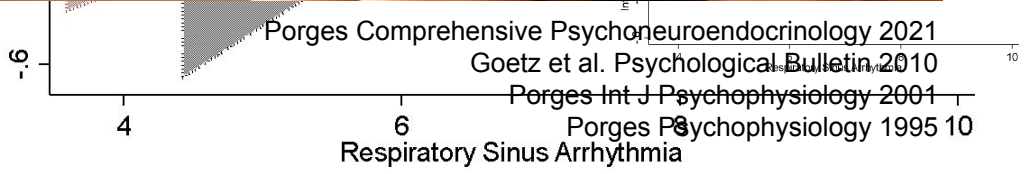
How does the immune cell genome “sense” our social state?

# Social signal transduction

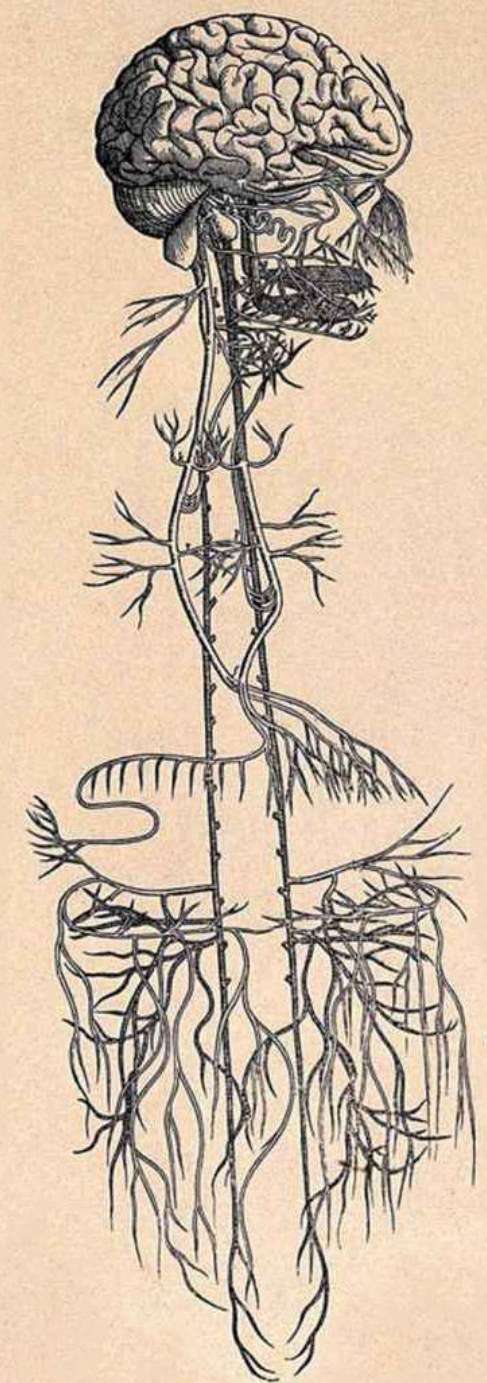


# Pro-social signal transduction





Ricon et al. Comprehensive PNE 2021  
Rahal et al. Brain, Behavior & Immun. 2021  
Sloan & Cole, Brain, Behavior & Immun. 2021

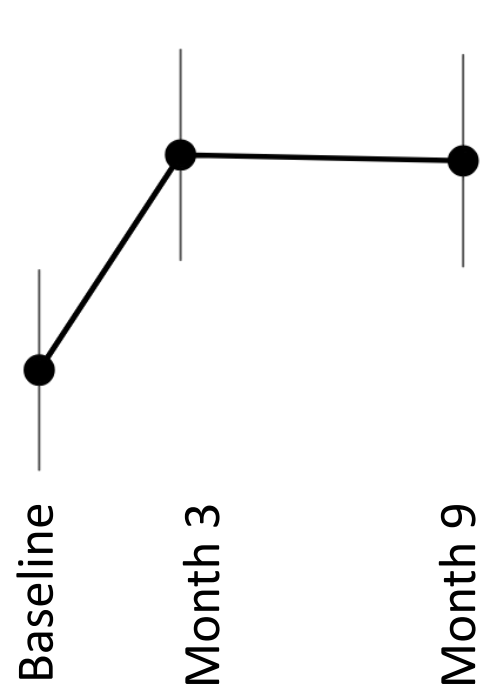


How to make more Social Well-Being?

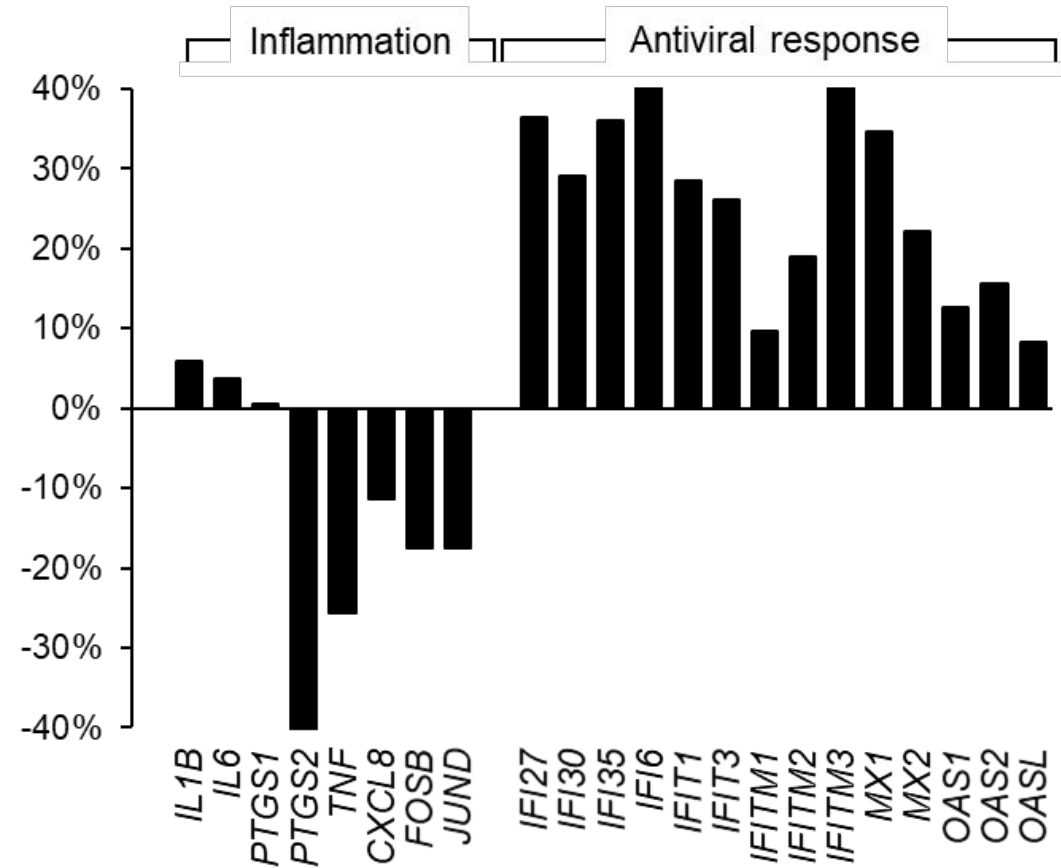
# Can pro-social engagement up-regulate Type I IFNs?

## GenEx inter-generational mentoring program

Type I IFN gene expression  
(34-gene composite log<sub>2</sub> mRNA)



Change in RNA expression  
(Follow-up average – baseline)

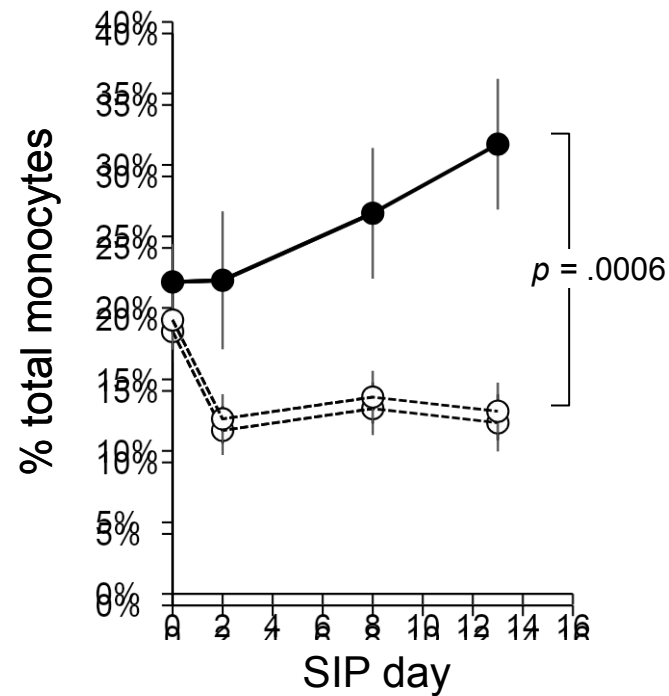


# Can pro-social engagement up-regulate Type I IFNs?

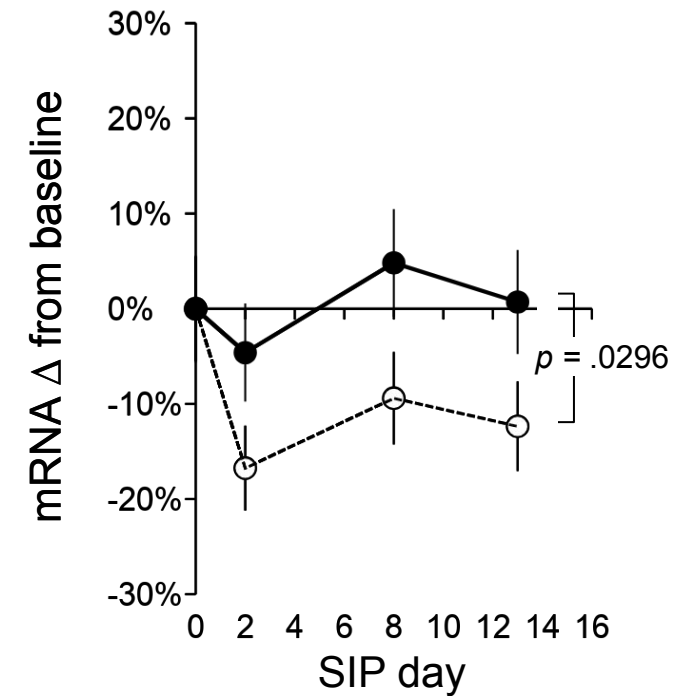
Monkey lockdown



Non-classical monocytes

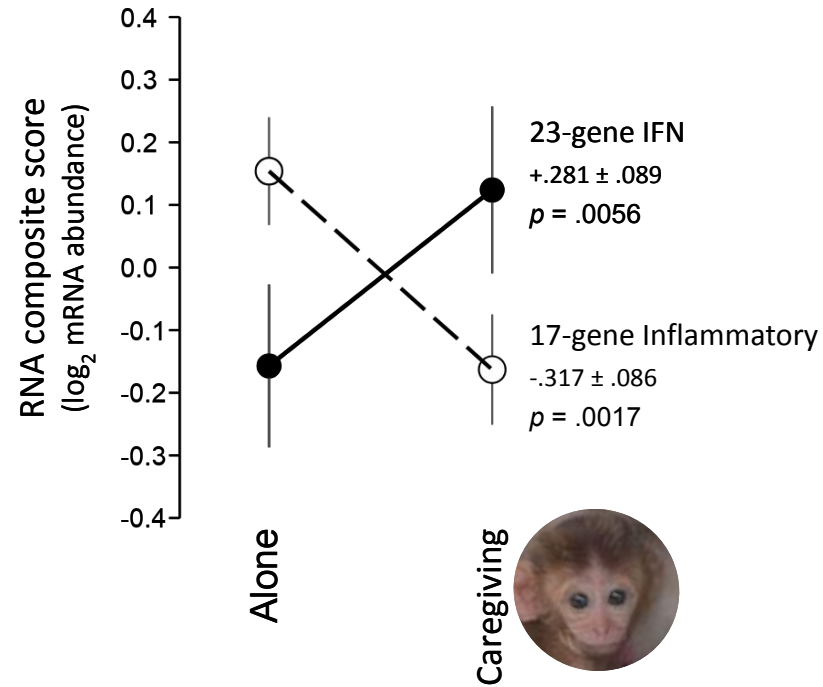
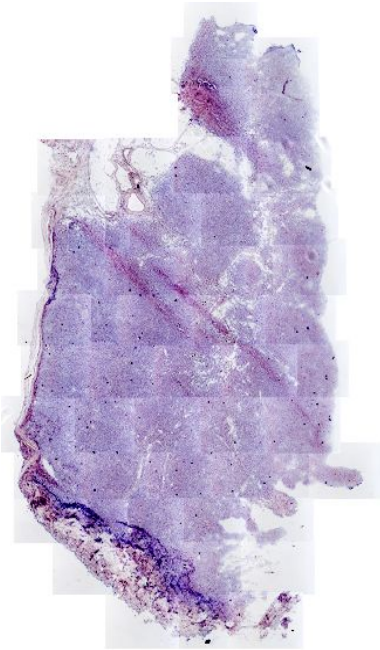


PBMC Type I IFN mRNA

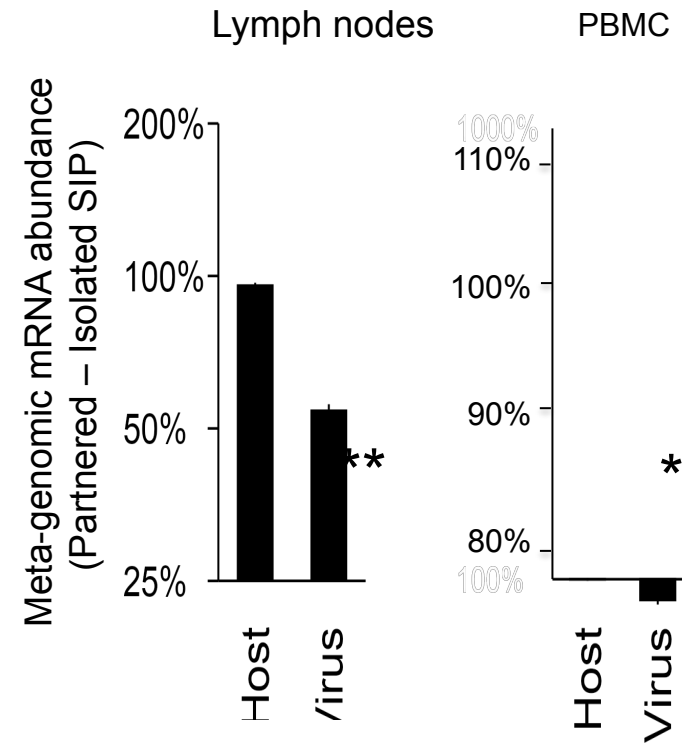


# Can pro-social engagement up-regulate Type I IFNs?

## Inguinal Lymph Nodes



## Viral load





## Take-home points:

1. Well-being is linked to enhanced Type I IFN immune biology
2. Most related to the “social” aspect of well-being
3. Possibly an immunologic adaptation to “social pathogens” - viruses
4. Mammalian “social” parasympathetic activity appears to mediate
  - PNS activation can enhance Type I IFN
  - Social well-being can enhance Type I IFN
5. Beyond stress/threat conceptions of mind-body connection:
  - Affordance for the risks of rewarding social connection



and healthy  
Those only are happy (I thought)  
who have their minds fixed on some object other than their own happiness,  
on the happiness of others,  
on the improvement of mankind.

– John Stuart Mill, Autobiography, 1909



## Collaborators

Michael Irwin, Julienne Bower, Patti Ganz  
John Capitanio, John Cacioppo, Stephanie Cacioppo  
Louise Hawkley, Bob Rose  
Erica Sloan, Don Lamkin, Alicia Collado-Hidalgo  
John Sheridan, Nicole Powell, Daniel McKim  
Greg Miler, Edith Chen  
Shinobu Kitayama, Satoshi Akutsu  
Jeffrey Snodgrass  
Brandon Kohrt, Carol Worthman

## Support

NIA AG043404, AG017265, AG033590, AG034679, AG051426, AG054365  
NCI CA116778, CA110793, CA109298, CA193249, CA237535, CA238562  
NIAID AI33259, AI36554, AI49135, AI52737  
NICHD HD092446, HD087061; NIMHD MD011749  
JSPS KAKENHI 25285113

Breast Cancer Research Foundation, MacArthur Foundation, HopeLab Foundation  
Foundation for Psychocultural Research, Norman Cousins Center