U.S. General Services Administration

Buildings and Health Program

Office of Federal High-Performance Buildings

October 24, 2017

Green Building Advisory Council

Buildings and Health Program (B+H)

Purpose

- Improve building design and support organizational practices through evidence-based design, standards and behaviors that enhance performance, human health and wellbeing in buildings.

Challenges

- A building's effect on employee's health is often overlooked
- Researchers and occupants rarely connect
- Building operators often perceive a lack of resources or control over circumstances to move beyond current practice
- Collaborative partnerships are essential in order for impactful professional practices in design, construction and operations.

B+H Program

Focus

- Move beyond risk elimination. Promote health and well-being.
- Collaborate with researchers, translators and implementers to make the case and put Buildings and Health Research into Practice.
- Leverage GSA's status as convener and building owner to develop and share actionable ideas.
- Make a difference for those who work in buildings

First Steps

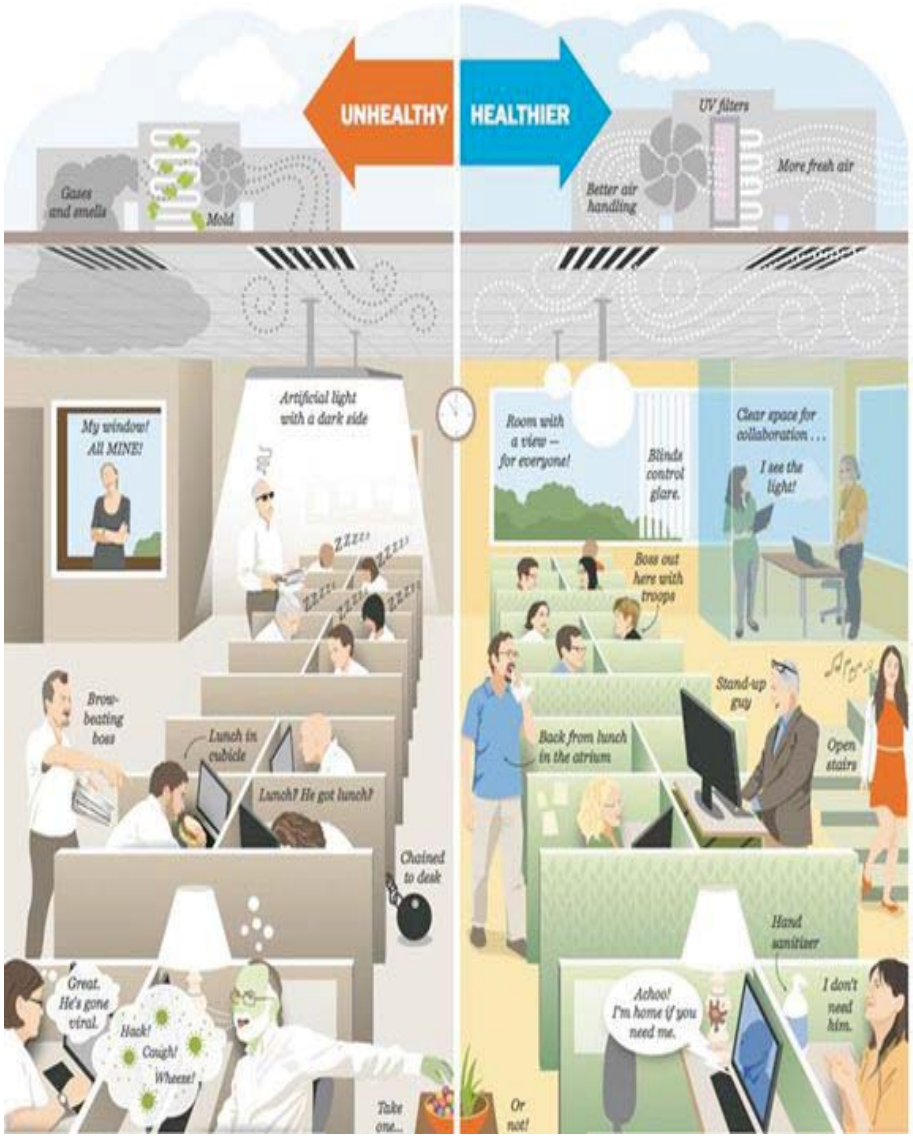
- Focus on developing pathways for putting research into practice by drawing heavily on two GSA projects
  - wellbuilt for wellbeing
  - Circadian-Effective Light in Buildings
- Convene B+H Workshops to kick-start impactful collaboration
- Map the B+H Research Network (FY18)
- Create a B+H Data and Resource Repository (FY18)

wellbuilt *for* wellbeing

The information in this presentation is not to be distributed or discussed with outside parties. The research project is ongoing and dissemination of this material before its conclusion and subsequent, official communication releases may jeopardize its impact.

Brian Gilligan, PE
Office of Federal High-Performance Buildings
U.S. General Services Administration

What role does the workplace play in health?



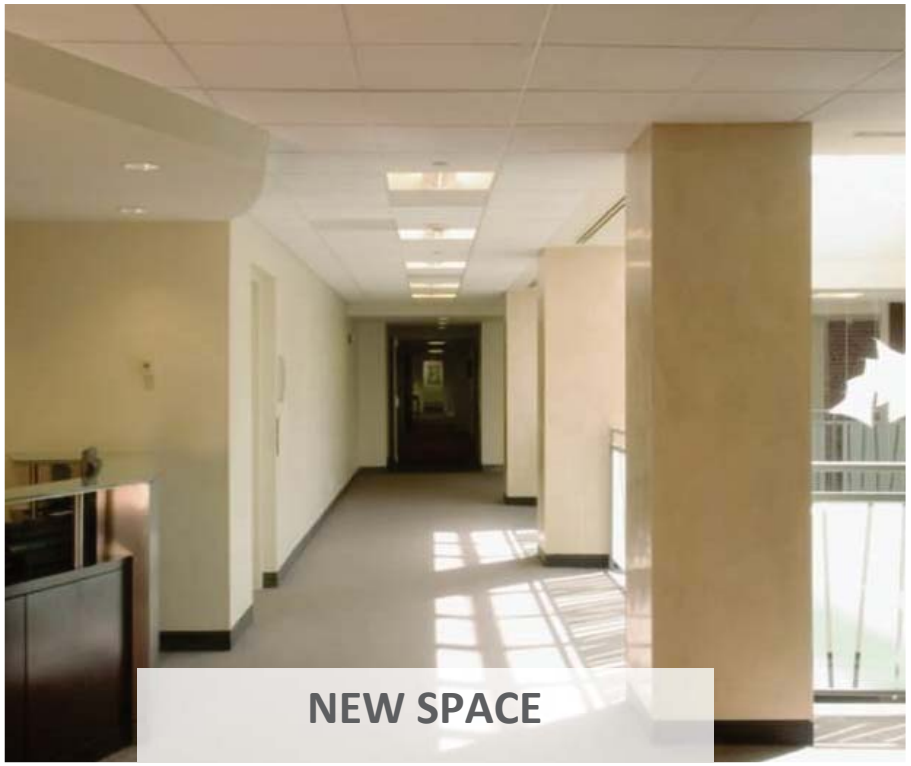
We spend 90% of our time indoors

Workplace-related illness costs the U.S. $225B per year

Our design and operating decisions can make a difference

"Are You in an Unhealthy Office Relationship?"
Washington Post, June 2014

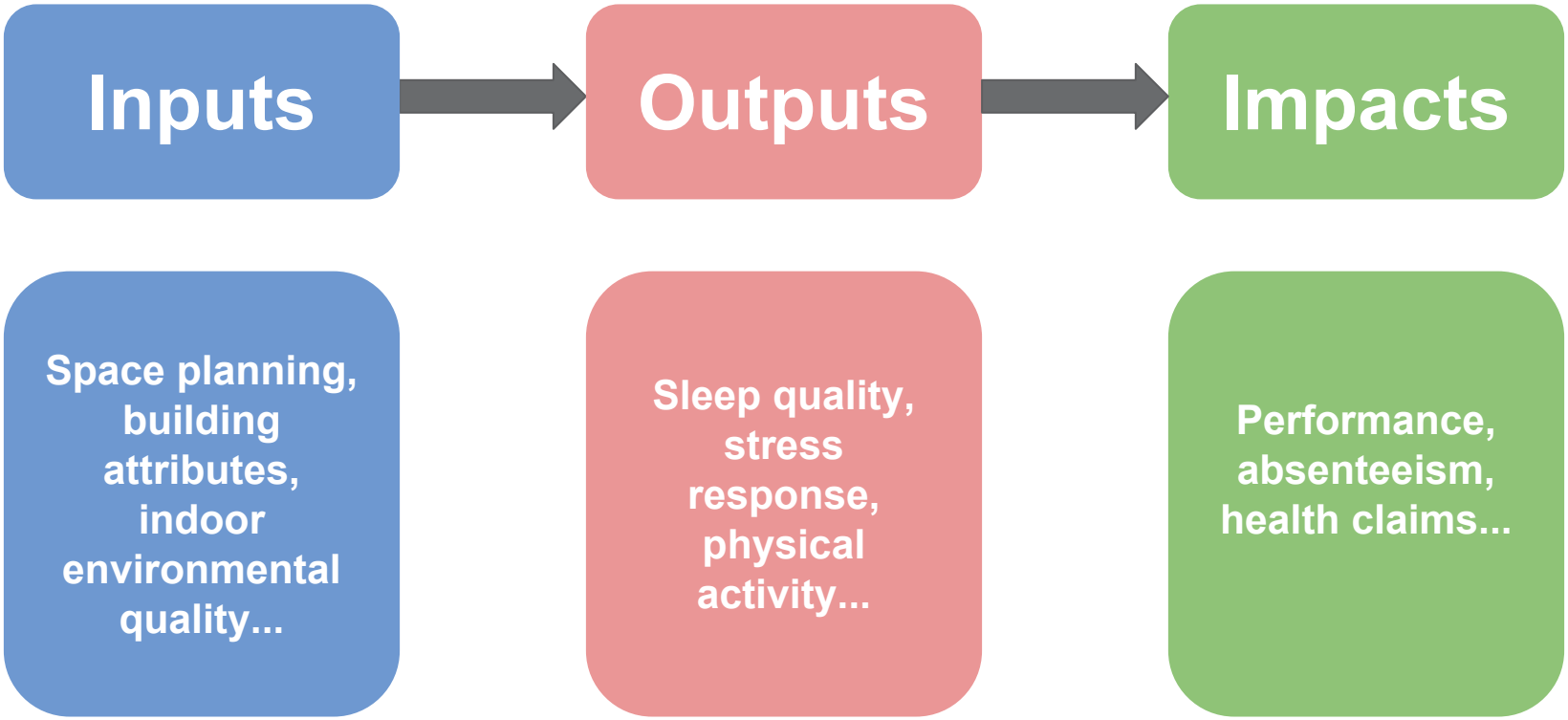
Previous work - Denver Federal Center study



Results:
New Space: Lower Neuronal Stress Response (HRV)
New Space: Lower Hormonal Stress Response (salivary cortisol)

**Thayer et al European J. Cardiovascular Prevention & rehabilitation, 2010*

Linking buildings to health

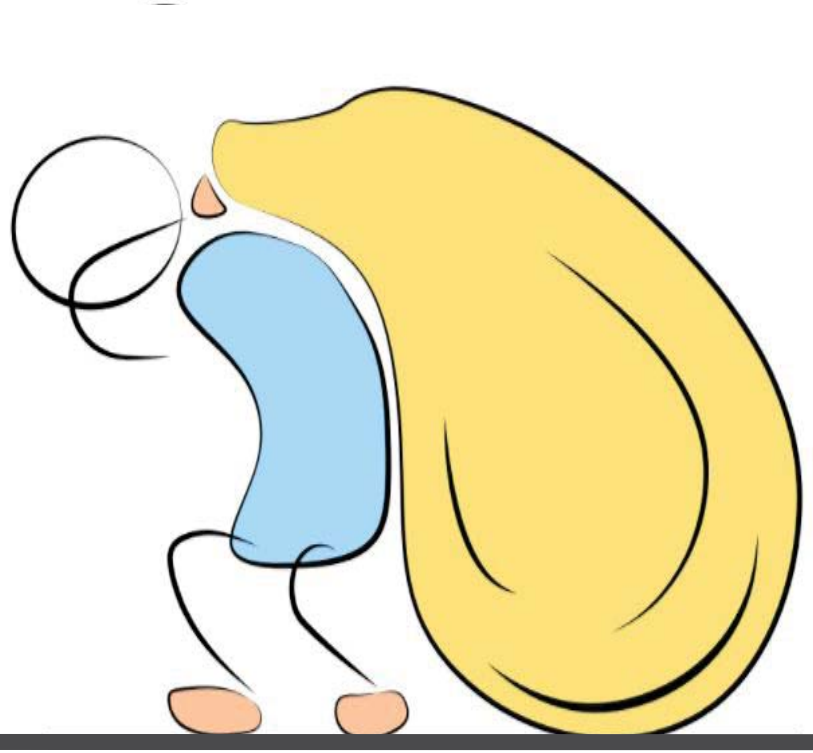


Some perspective on stress

"We need a culture shift in the way we think and talk about stress"

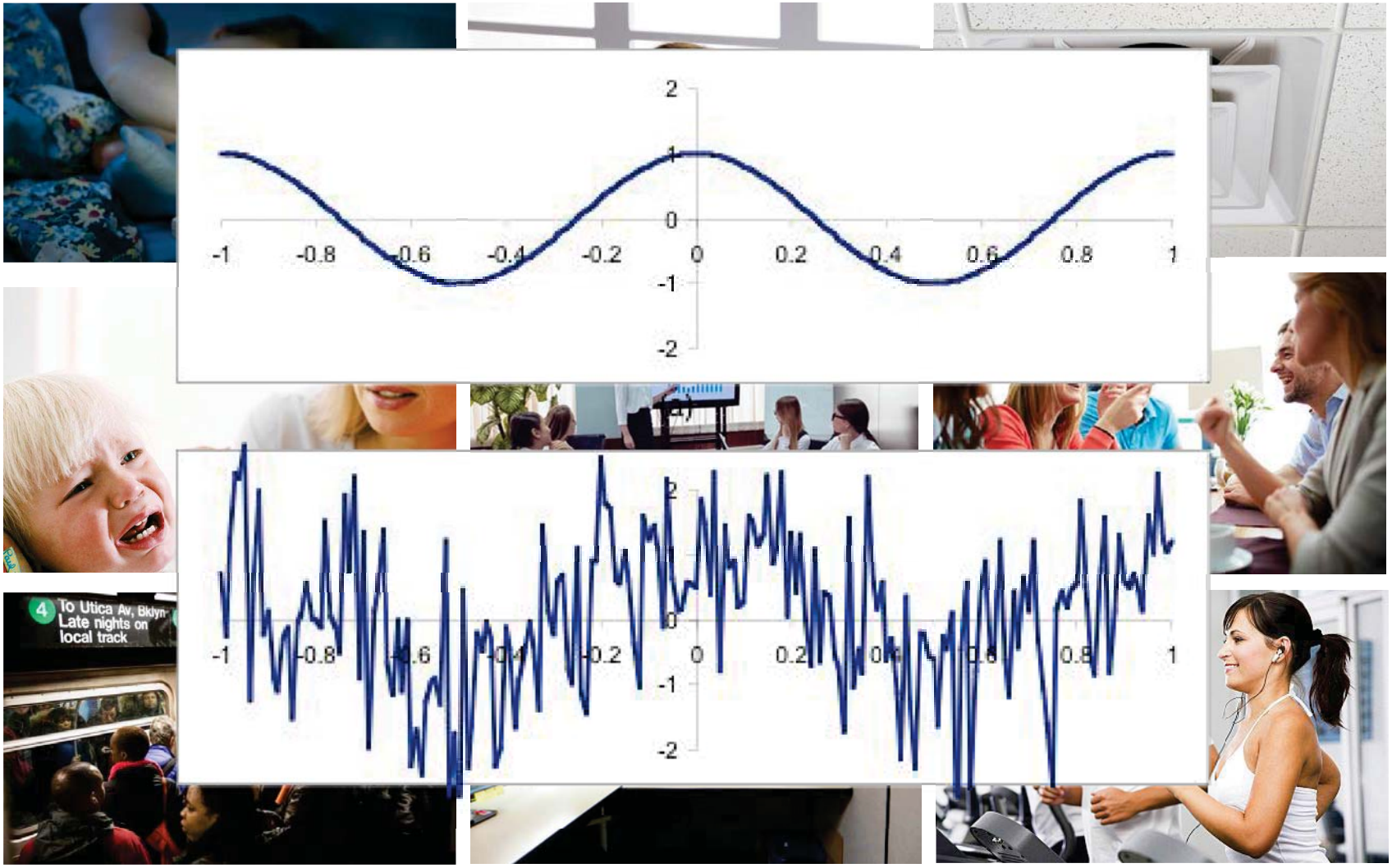
- *Dr. Vivek Murthy (former U.S. Surgeon General)*

Some perspective on stress - allostatic load



McEwen & Stellar, 1993

Some perspective on stress - a typical day



How Wellbuilt worked - study locations

jjkllc.com

GSA Central Office Building, Washington, DC
New, Modernized, & Legacy Spaces, Bench Seating

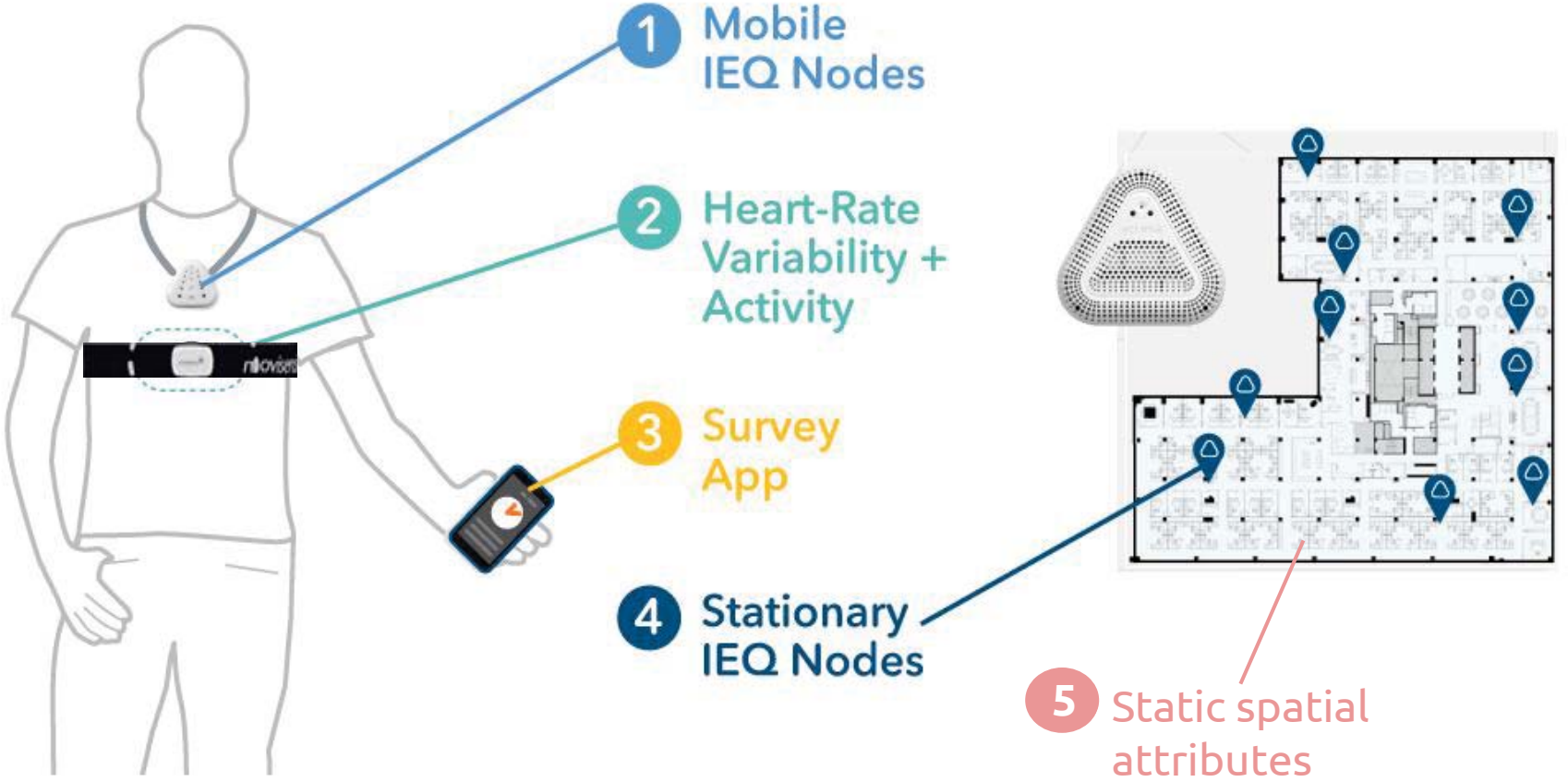
GSA NCR Regional Office Building, Washington, DC
Modernized & Legacy Spaces, Bench Seating & High-Walled Cubicles

GSA Lanham Federal Building, Fort Worth, TX
Legacy Space, High-Walled Cubicles

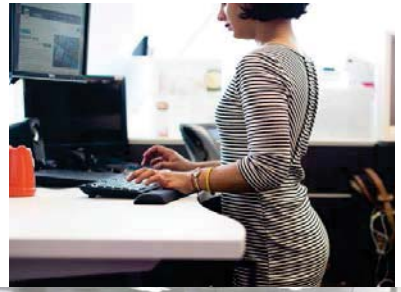
NCI

NIH Rockledge Facility, Bethesda, MD
Modernized, Private Offices & High-Walled Cubicles

How Wellbuilt worked - study method



Health outputs form a reciprocal relationship



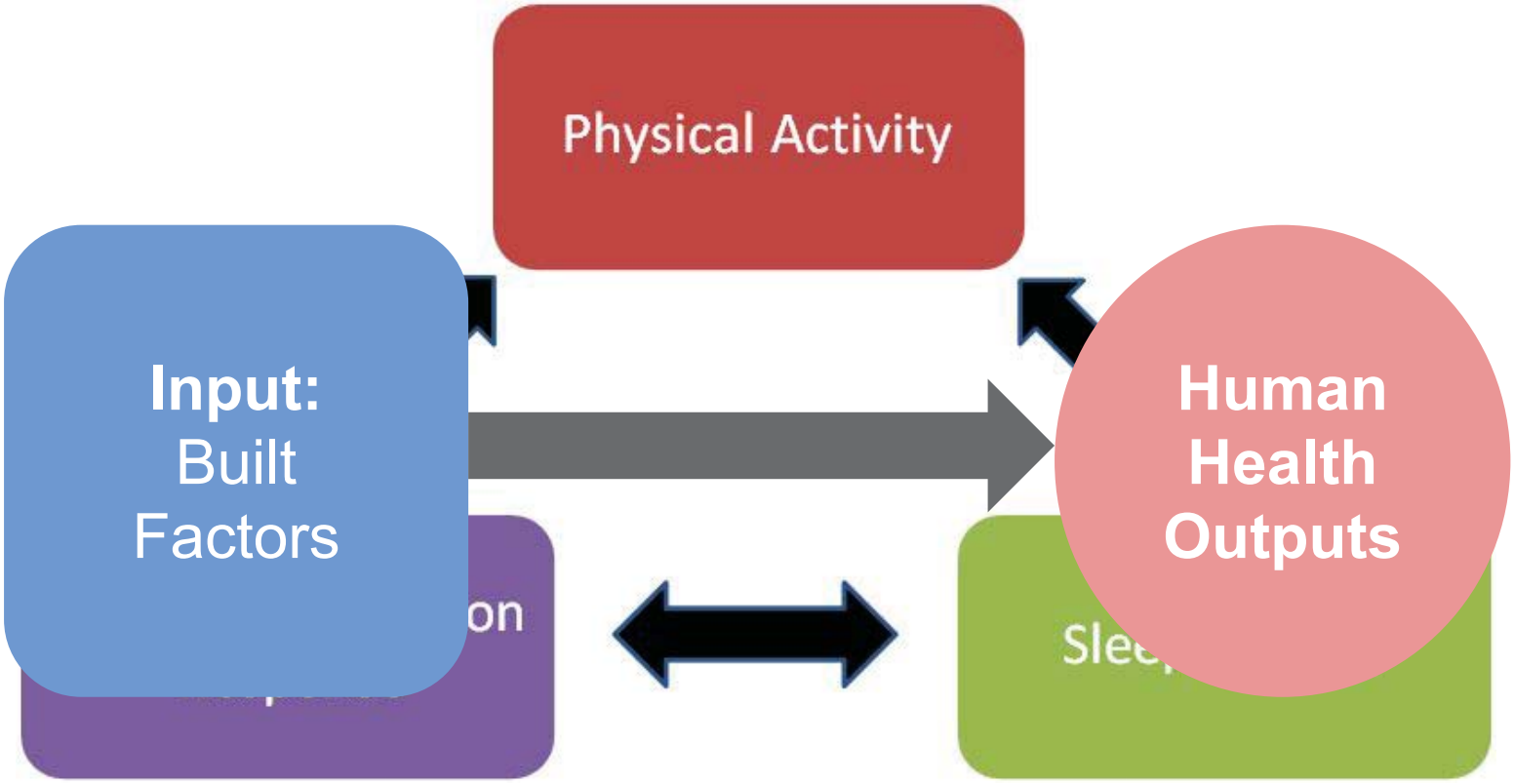
Physical Activity

Stress & Relaxation Response

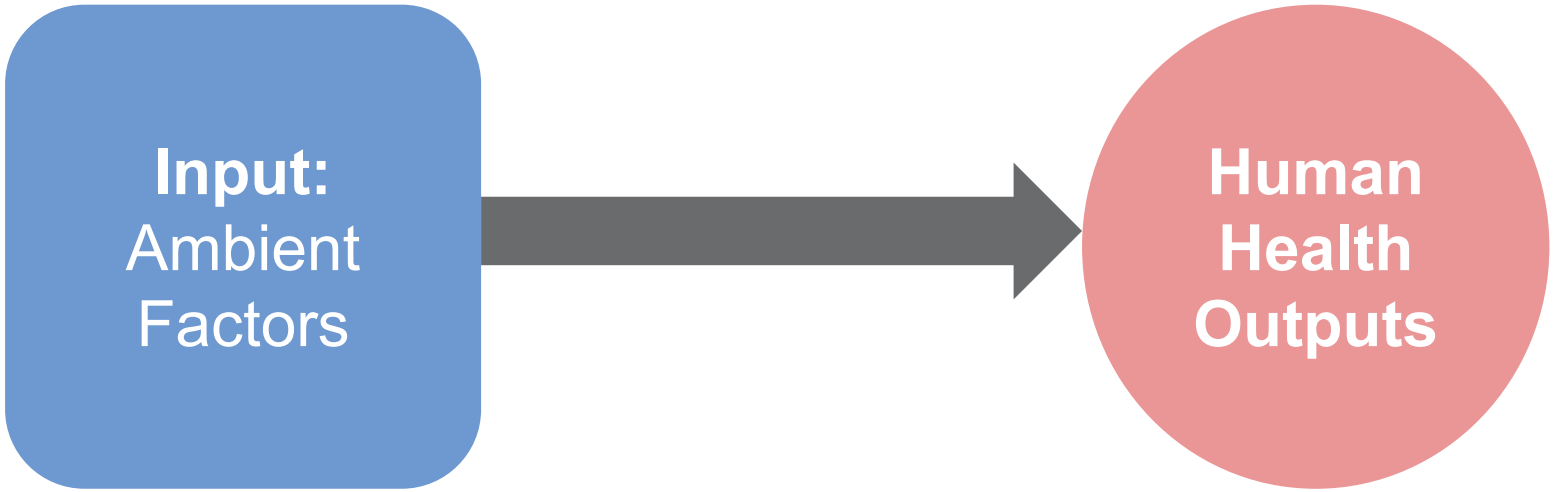
Sleep Quality

Consider allostatic load and virtuous and vicious cycles

What did we find about static characteristics?



What did we find about dynamic characteristics?



wellbuilt *for* wellbeing

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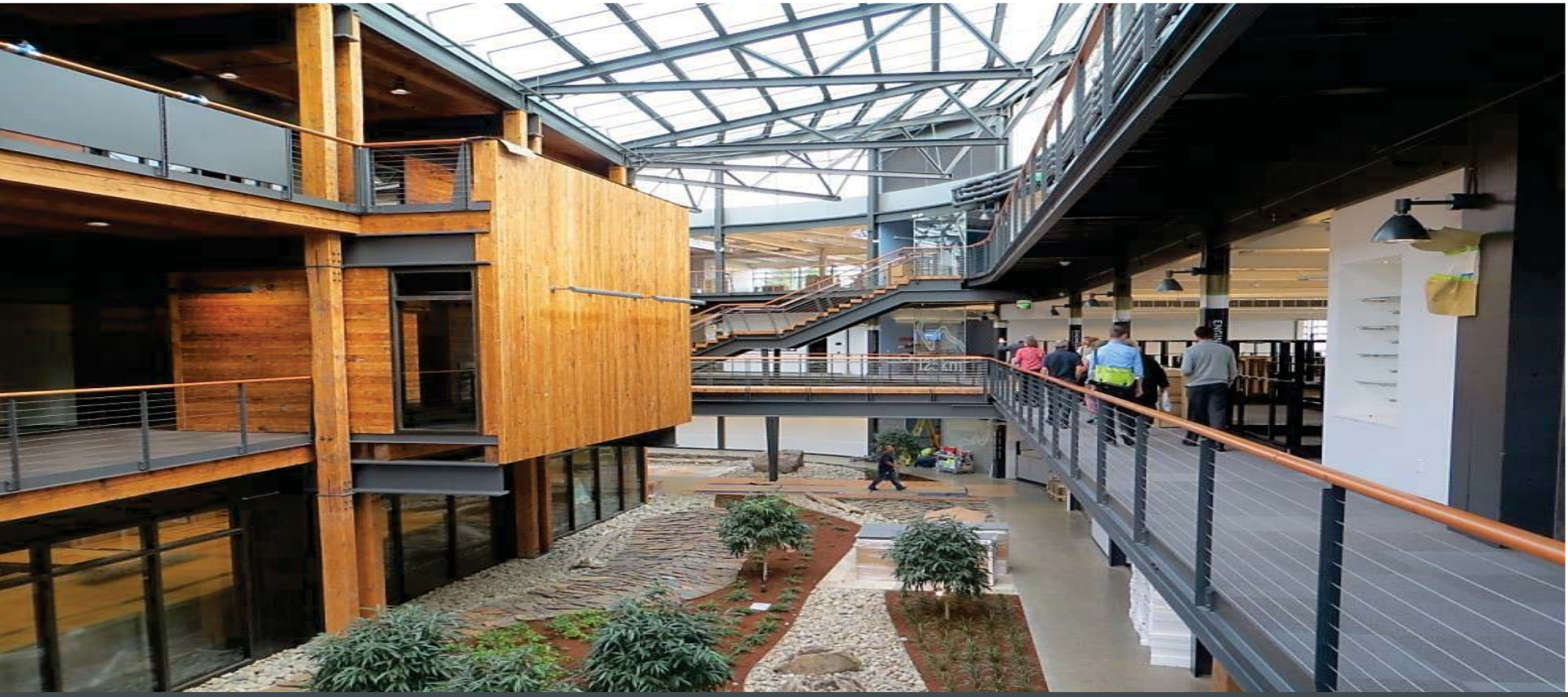
Thank you!

Circadian-Effective Light in Buildings



Bryan Steverson
Office of Federal High-Performance Buildings
U.S. General Services Administration

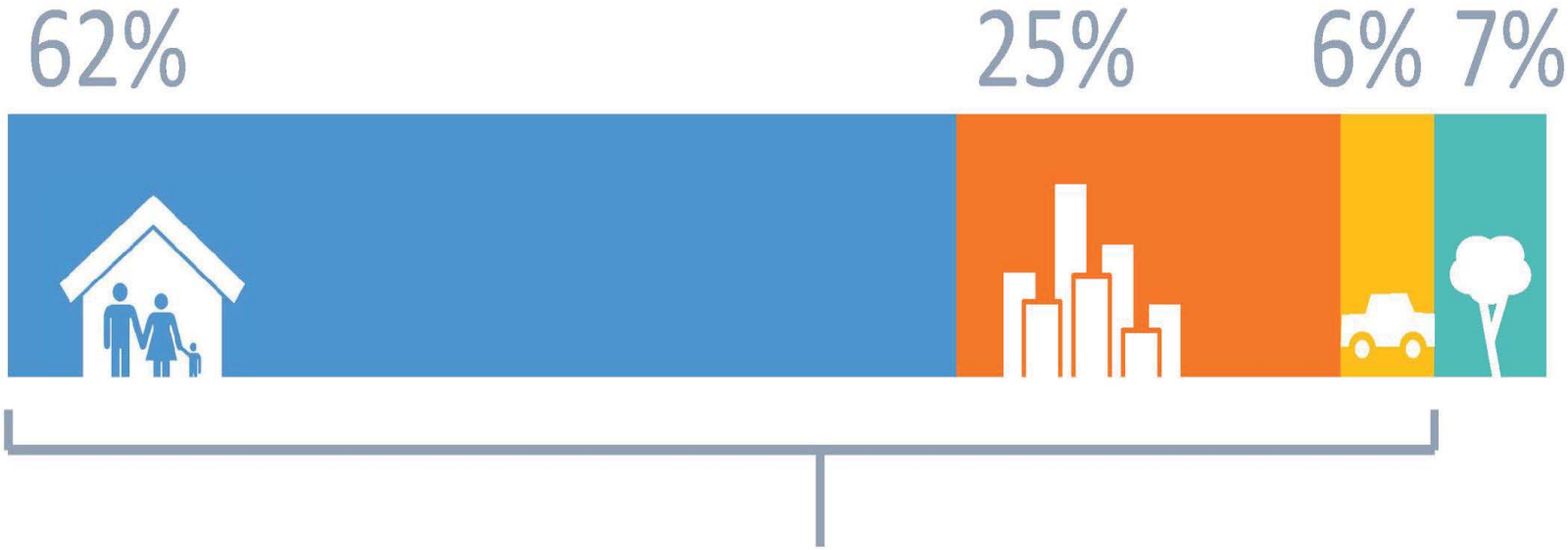
https://www.gsa.gov/circadianlight

We know that daylight can help light our buildings and reduce energy.

Can it also provide circadian health benefits, improving sleep, daytime alertness and mood?

Why is Light So important?

Light reaching the eye has several impacts



We spend about **93%** of our time indoors

J. Spengler, Harvard School of Public Health, 1983

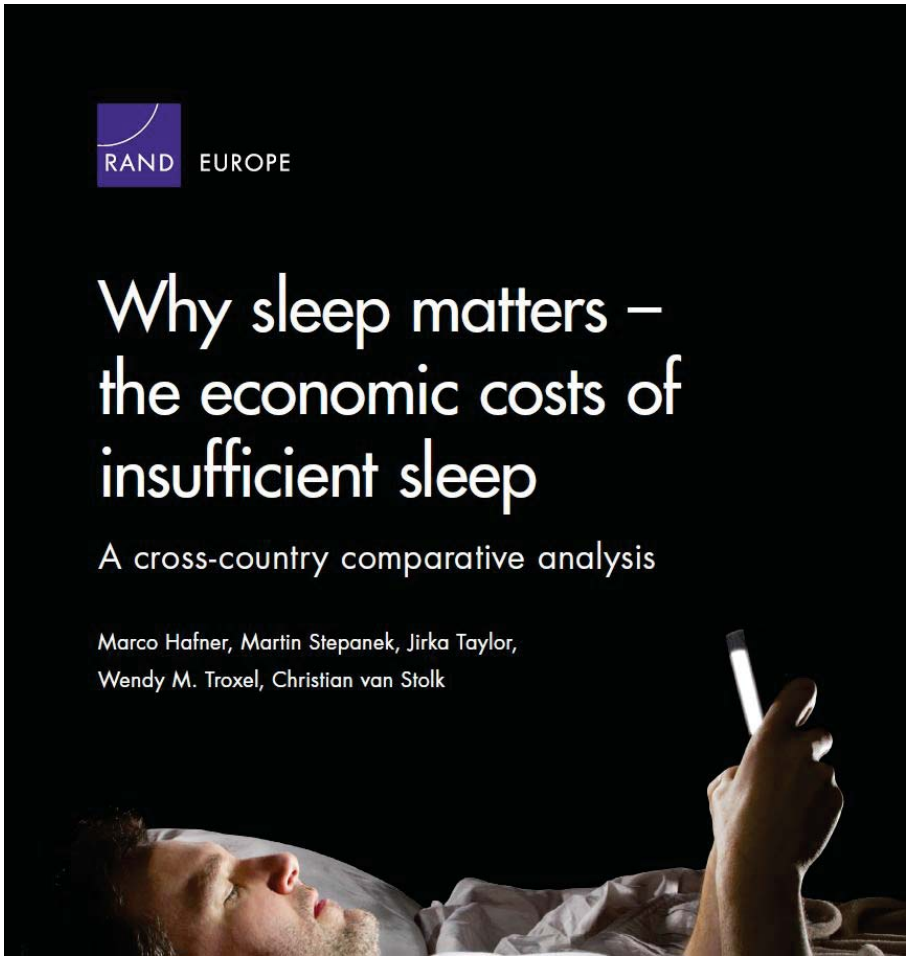
Circadian disruption has been associated with:

- **Poor sleep, poor performance and high stress**
- **Increased anxiety and depression**
- **Increased smoking**
- **Cardiovascular disease**
- **Type 2 diabetes**
- **Higher incidence of breast cancer**

Sleep Matters

Insufficient sleep reduces workplace productivity due to absenteeism and presenteeism.

- People who sleep less than 6 hrs lose an average of 6 days/year of work time than a person who sleeps between 7 and 9 hrs
- People who sleep between 6 and 7 hrs lose an average of 3.7 days



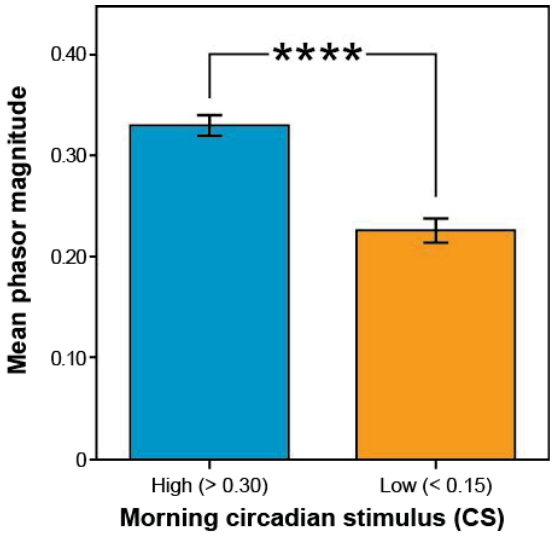
Phase 1

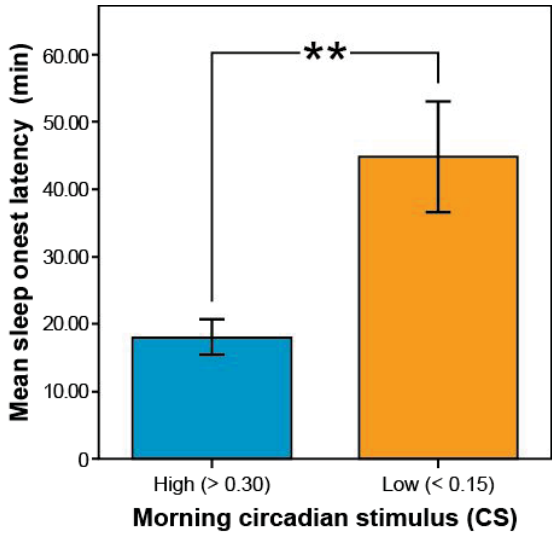
Can we improve employee health through improved indoor daylight?

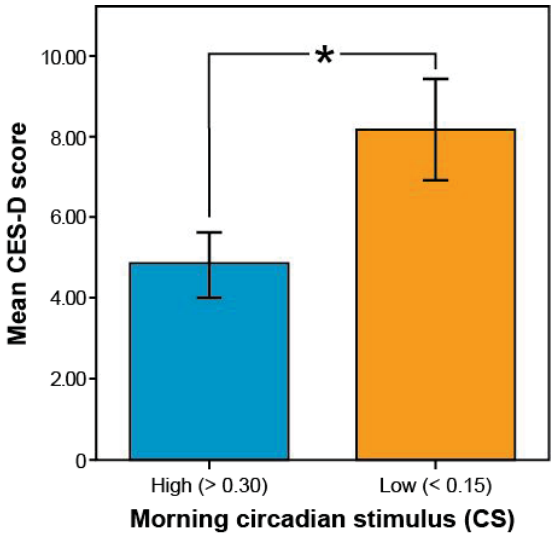
Buildings designed for max daylight penetration

Typical Federal Buildings

GSA Phase 1 – Results (Morning-only)

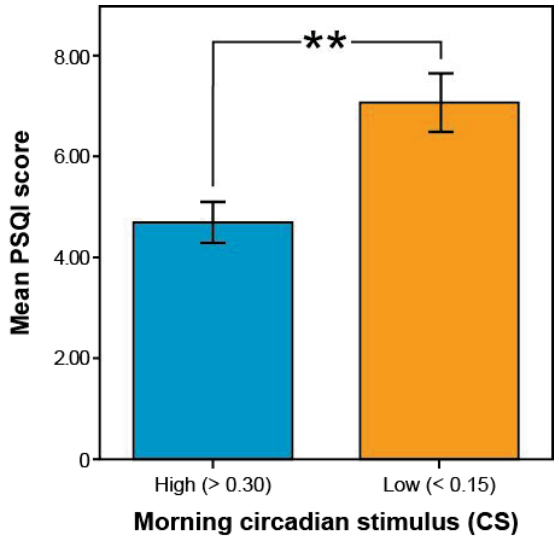






Morning CS > 0.3 was associated with increased entrainment, decreased sleep onset latency, decreased depression, and improved sleep quality

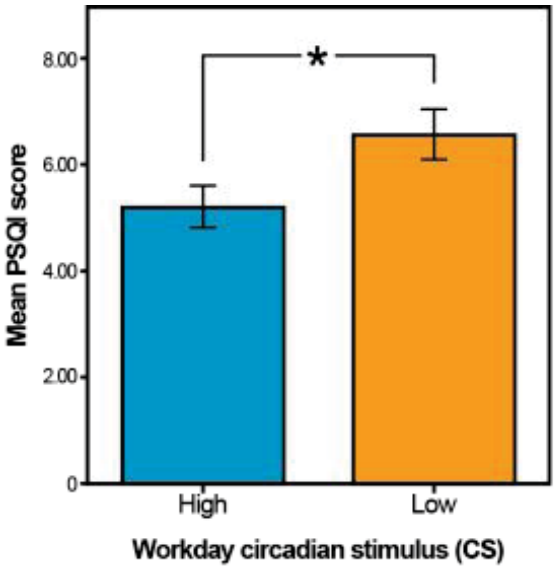
(**** = p < 0.0001; ** = p < .01; * = p < 0.05)

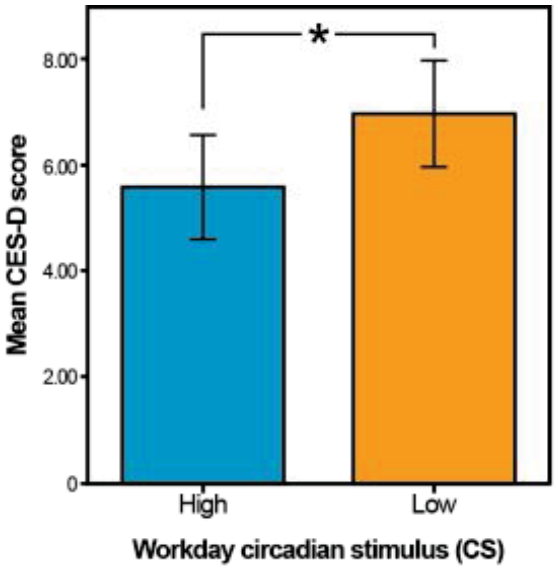


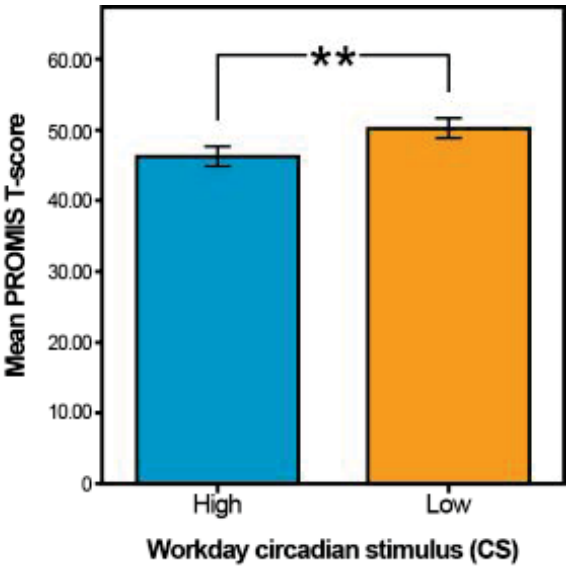
Figueiro M.G., Steverson B., Heerwagen J., Kampschroer K., Hunter C.M., Gonzales K., Rea, M.S. (2017). The impact of daytime light exposures on sleep and mood in office workers. *Sleep Health,* 3(3):204–215.

GSA Phase 1 – Results (All-work day)

Those exposed to higher daytime circadian stimulus (CS) reported better sleep quality and feeling less depressed







(** = p < .01; * = p < 0.05)

Figueiro M.G., Steverson B., Heerwagen J., Kampschroer K., Hunter C.M., Gonzales K., Rea, M.S. (2017). The impact of daytime light exposures on sleep and mood in office workers. *Sleep Health,* 3(3):204–215.

So what have we learned?

1. Behavior matters - People close shades when it is too bright and leave them closed, reducing indoor daylight

2. Computers are a key driver of shade use and other daylight reducing behaviors

3. **Daylighting alone is insufficient for circadian stimulus in some spaces due to interior design choices and the difficulty in achieving adequate daylight penetration**

Phase 2 – Goals of the study

Test whether additional circadian-effective lighting would increase alertness and improve subjective scores of vitality and energy during the workday

Hypothesis: Circadian effective lighting would increase subjective alertness, vitality, and energy levels

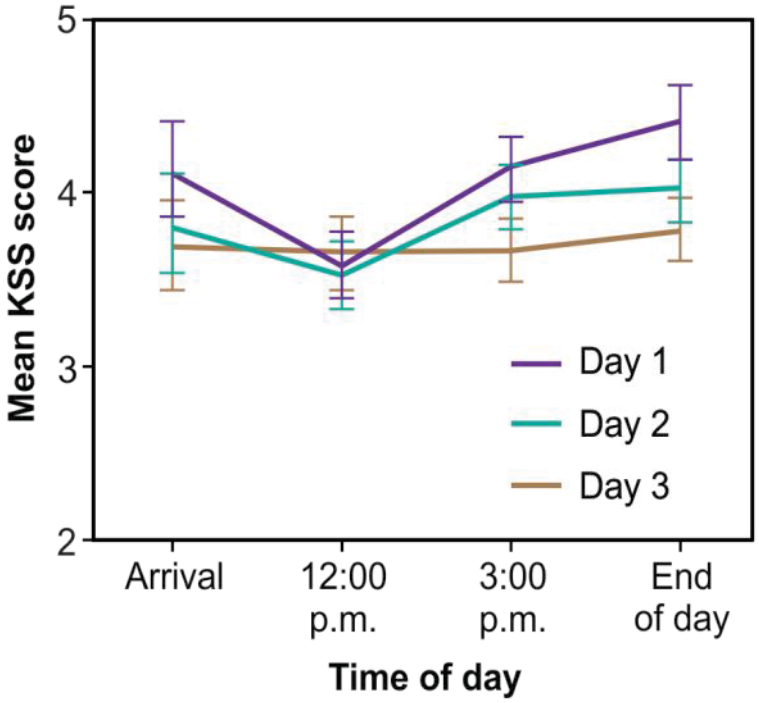
Phase 2 - Study Sites

FHWA - Turner Fairbank Highway Research Center, McLean, VA

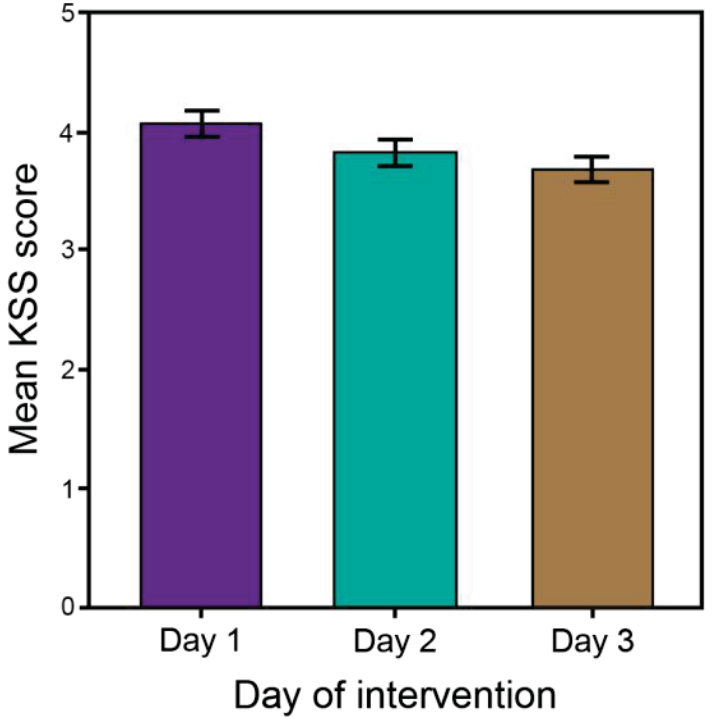
White River Junction VA Medical Center, White River Junction, VT

Federal Highway Administration

Results (Phase 2, FHWA/VA buildings)
KSS scores (subjective sleepiness)

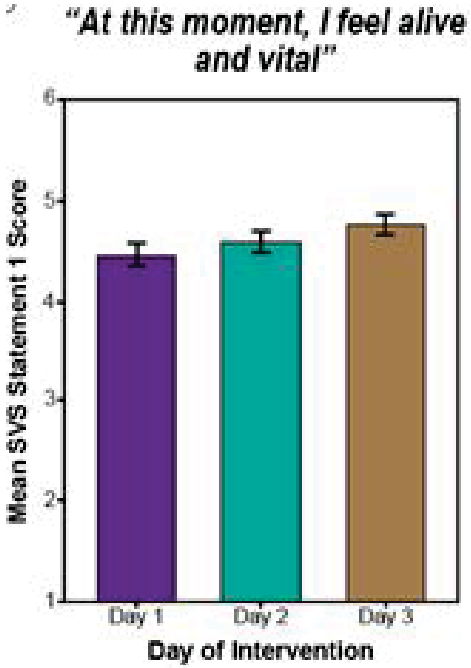


Significant main effect of time of day ($F_{3, 593}$ = 4.03, p = 0.007)



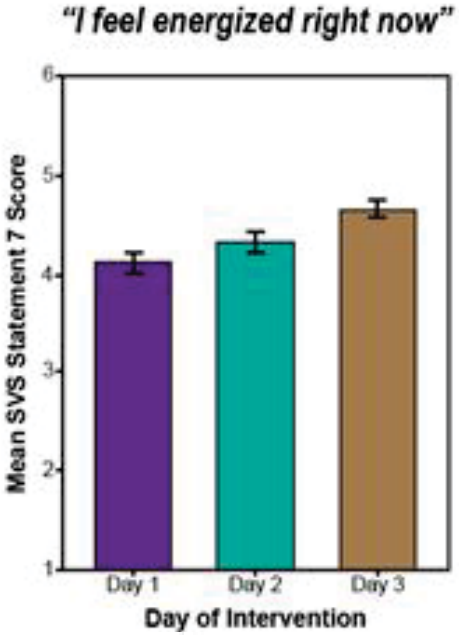
Almost significant main effect of day of intervention ($F_{2, 597}$ = 2.81, p = 0.061)

Results (Phase 2, FHWA/VA buildings, combined analyses)
Subjective Vitality Scale (SVS)



Mean ± standard error of the mean (SEM) response scores for each intervention day. Day of intervention had a statistically significant effect ($F_{2, 601} = 6.18$, $p = 0.002$) on participants' responses. The scores increased throughout all times of day, for each day, from Day 1 (mean ± SEM = 4.40 ± 0.098) through Day 2 (mean = 4.53 ± 0.090) to Day 3 (mean = 4.73 ± 0.090). Scores were significantly higher on Day 3 than on Day 2 ($p < 0.01$).

With LEDs on, people felt more alive and vital



Mean ± standard error of the mean (SEM) response scores for each intervention day (left) and by season (right). Day of intervention significantly affected ($F_{2, 609} = 9.02$, $p < 0.0001$) participants' responses. Across all times of day, their scores increased from Day 1 (mean ± SEM = 4.26 ± 0.11) through Day 2 (mean = 4.35 ± 0.10) to Day 3 (mean = 4.70 ± 0.10). Scores were significantly higher on Day 3 than on Day 2 ($p < 0.0001$) and Day 1 ($p < 0.0001$).

People felt <u>more</u> energized as intervention proceeded

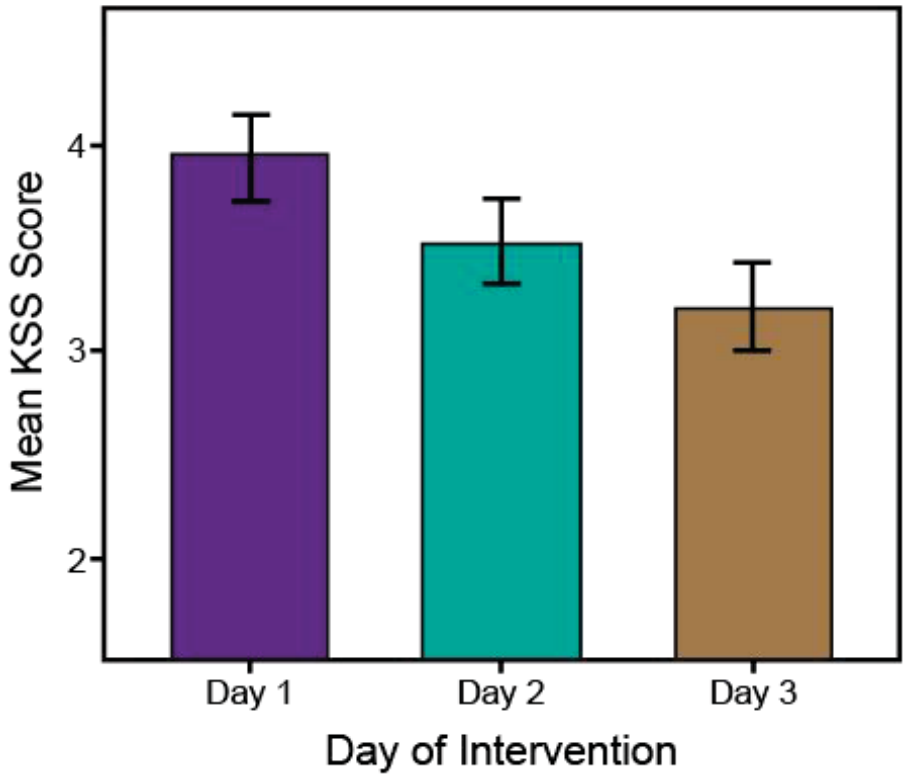
Collaboration with U.S. Department of State

- All secure facilities have fully enclosed artificially lit office spaces
  - Varying amounts of solar access based on worldwide locations and geography
- U.S. Embassy in Riga, Latvia and Reykjavik, Iceland

U.S. Embassy, Riga Latvia

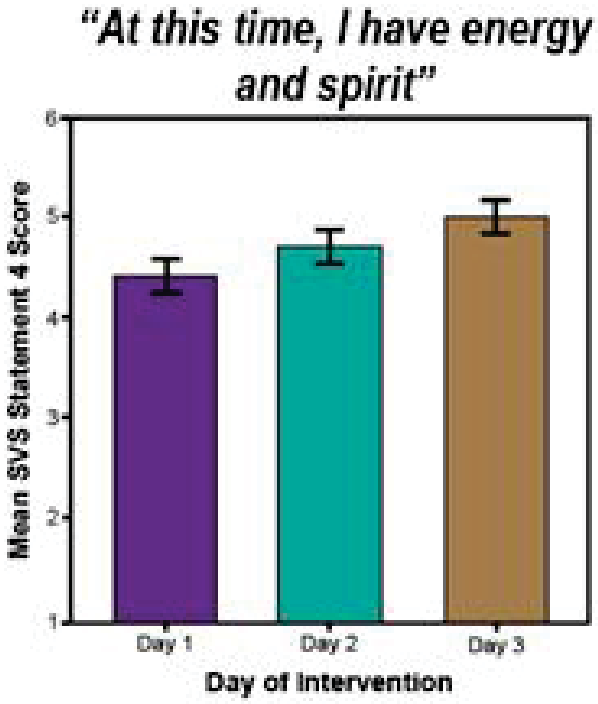
U.S. Embassy, Reykjavik Iceland

Results (Phase 2, US Embassies, combined analyses)
KSS scores (subjective sleepiness)

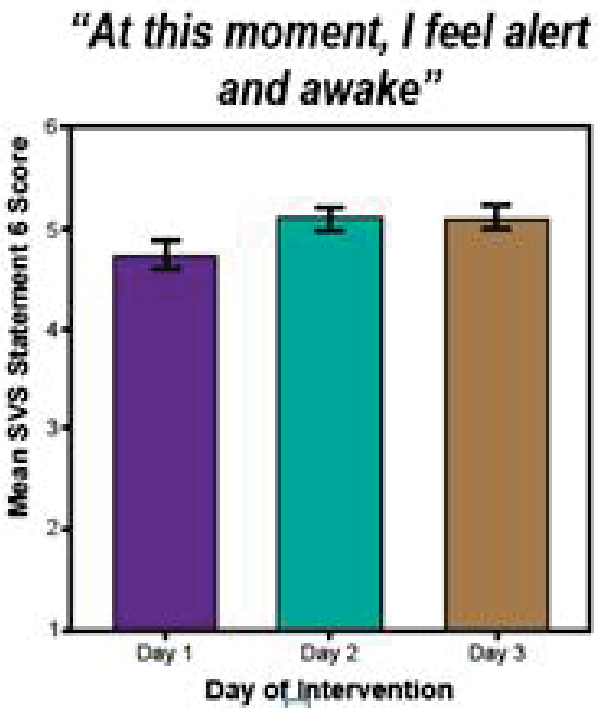


Day of intervention had a statistically significant effect on participants' KSS scores ($F_{2, 282} = 5.05$, $p = 0.007$). Scores declined from Day 1 to Day 3, from a mean ± SEM of 3.94 ± 0.15 on Day 1 to 3.53 ± 0.12 on Day 2 and 3.21 ± 0.12 on Day 3.

Results (Phase 2, US Embassies, combined analyses)
Subjective Vitality Scale (SVS)



People felt <u>more</u> energized and more spirited as intervention proceeded



People felt <u>more</u> alert and awake as intervention proceeded

In Summary

- Data shows benefits associated with increased circadian stimulus during day, especially in the morning
  - Falling asleep faster at night
  - Better sleep quality
  - Better moods
  - Less sleepy during the day
  - More alert during the day
  - More energy during the day

- Daylight penetration not always possible; may need to supplement with additional light sources
  - Must consider the daylight ecosystem

http://www.gsa.gov/circadianlight

Bryan Steverson

bryan.steverson@gsa.gov

Inaugural B+H Workshop

Workshop Goals:

- **Agree on key findings** that have the greatest potential to enhance health, well-being and performance if practiced and implemented in federal buildings.
- Develop specific **practices**
- Assess costs and benefits and policies that may **aid implementation**.
- Establish a basis for continued **partnership and collaboration.**

Attendees:

- Academics
- Researchers
- Designers
- Device and Real Estate Developers
- Architects
- Certification systems administrators
- Engineers
- Workplace Experts
- Health Practitioners
- Federal Agency Partners

Inaugural B+H Workshop: Actionable Ideas

Actionable ideas

- Education and Advocacy
- Client Engagement and Data Collection
- Policy and Guidance
- Collaboration and Partnerships

We must...

- Join building occupants, operators and designers with clear and actionable practices from the best building and health research available
- Create a convincing business case
- Develop and share a suite of design solutions that include simplified step-by-step guides for people in the field to execute
- Work with others to act on and prioritize ideas.

Inaugural B+H Workshop: Actionable Ideas

We should...

- Develop a **baseline** for buildings and health performance and a sharable data repository
- Focus on **outcomes** rather than technology implementation
- **"Slip in"** health and wellness initiatives to existing workplace, technology and design engagements
- **Avoid narrow focus** on individual solutions and specific environmental variables in favor of identifying **interacting and cumulative effects** of how the building environment and health impact each other.
- **Drive action** by organizations with broad constituencies

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Michael Bloom
michael.bloom@gsa.gov