

LIGHTING FOR HEALTH AND WELL BEING

Judith Heerwagen, PhD
US General Services Administration
DesignLights Conference
July 12, 2017

IT'S 7 AM – MORNING IN AMERICA AND YOUR DAY BEGINS....









So how would you like your coffee...Small,
Large or Intravenous???







Later that morning....

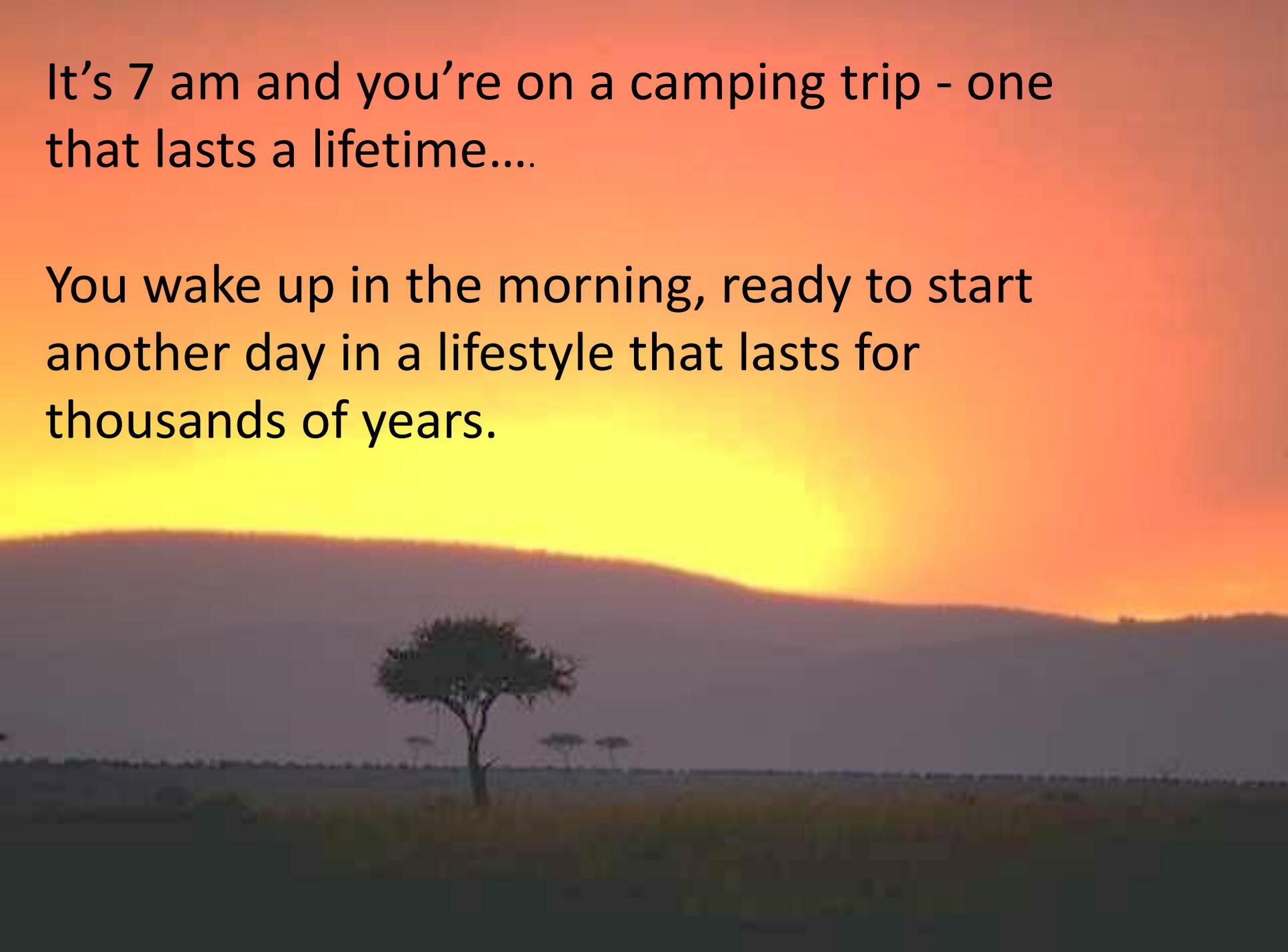


What's wrong with this picture?

To understand, let's go back in time. Way back.....

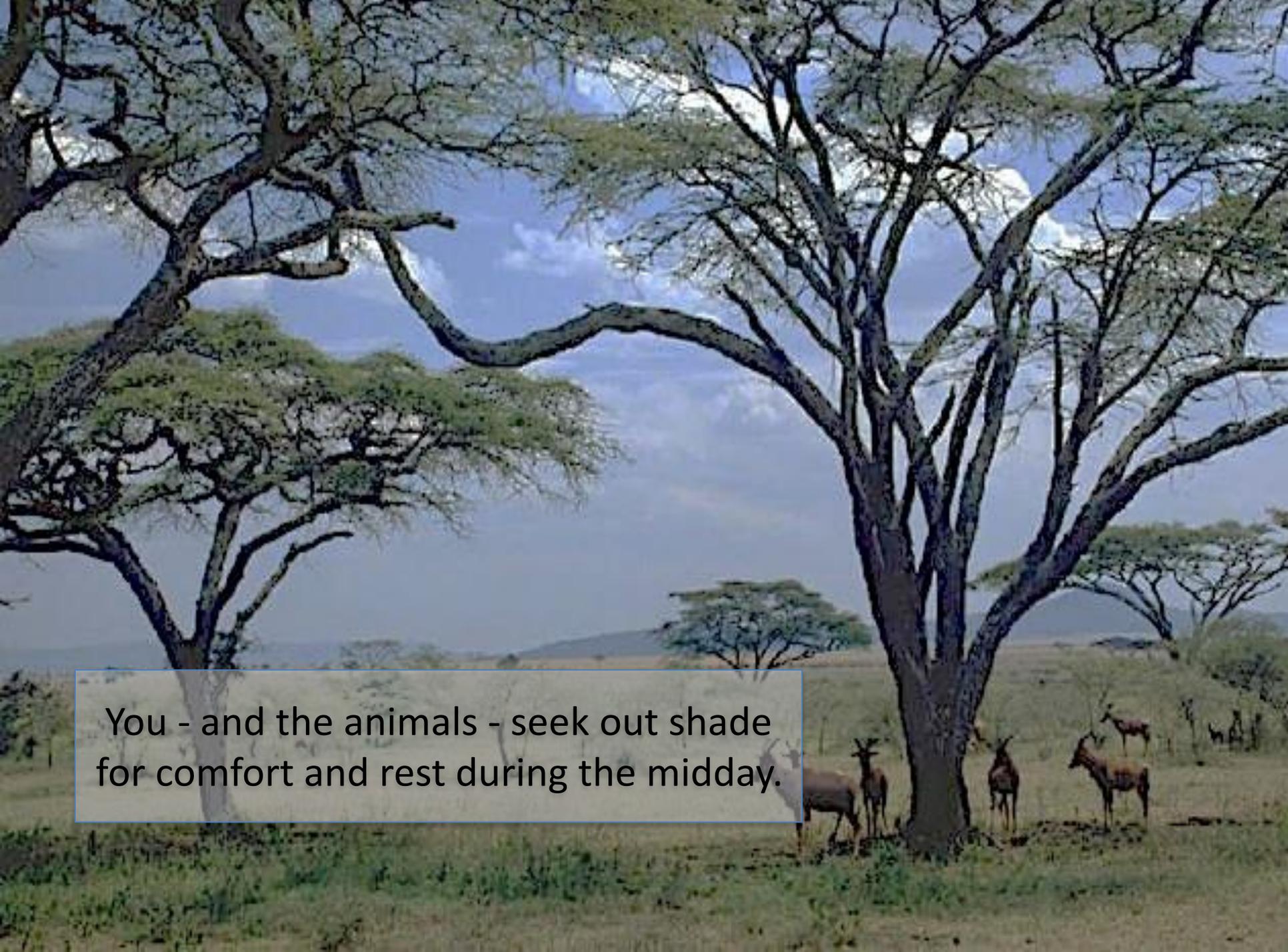
It's 7 am and you're on a camping trip - one that lasts a lifetime....

You wake up in the morning, ready to start another day in a lifestyle that lasts for thousands of years.



You follow the well worn path to
The hunting and foraging sites.



A savanna landscape featuring several acacia trees with thick, gnarled trunks and flat-topped canopies. The ground is covered in dry, yellowish-green grass. In the background, there are rolling hills under a blue sky with scattered white clouds. Several animals, likely antelope, are visible near the base of the trees, seeking shade.

You - and the animals - seek out shade for comfort and rest during the midday.

You sit around a campfire at night and
sleep under the stars..



What are the consequences
of this dramatic lifestyle change
and our modern relationship to
light?

WHY WE NEED TO CARE:

Circadian disruption is all too common and is associated with numerous health issues including:

Poor sleep

Higher stress, anxiety and depression

Cardiovascular disease

Type 2 diabetes

OUR CENTRAL QUESTION:

Can we **intentionally** design indoor light to enhance circadian functioning for health and well being?



GSA'S CIRCADIAN LIGHT PROGRAM

PHASE 1 METHODS

Photometric analysis

Individual light exposures

Actigraphy

Surveys

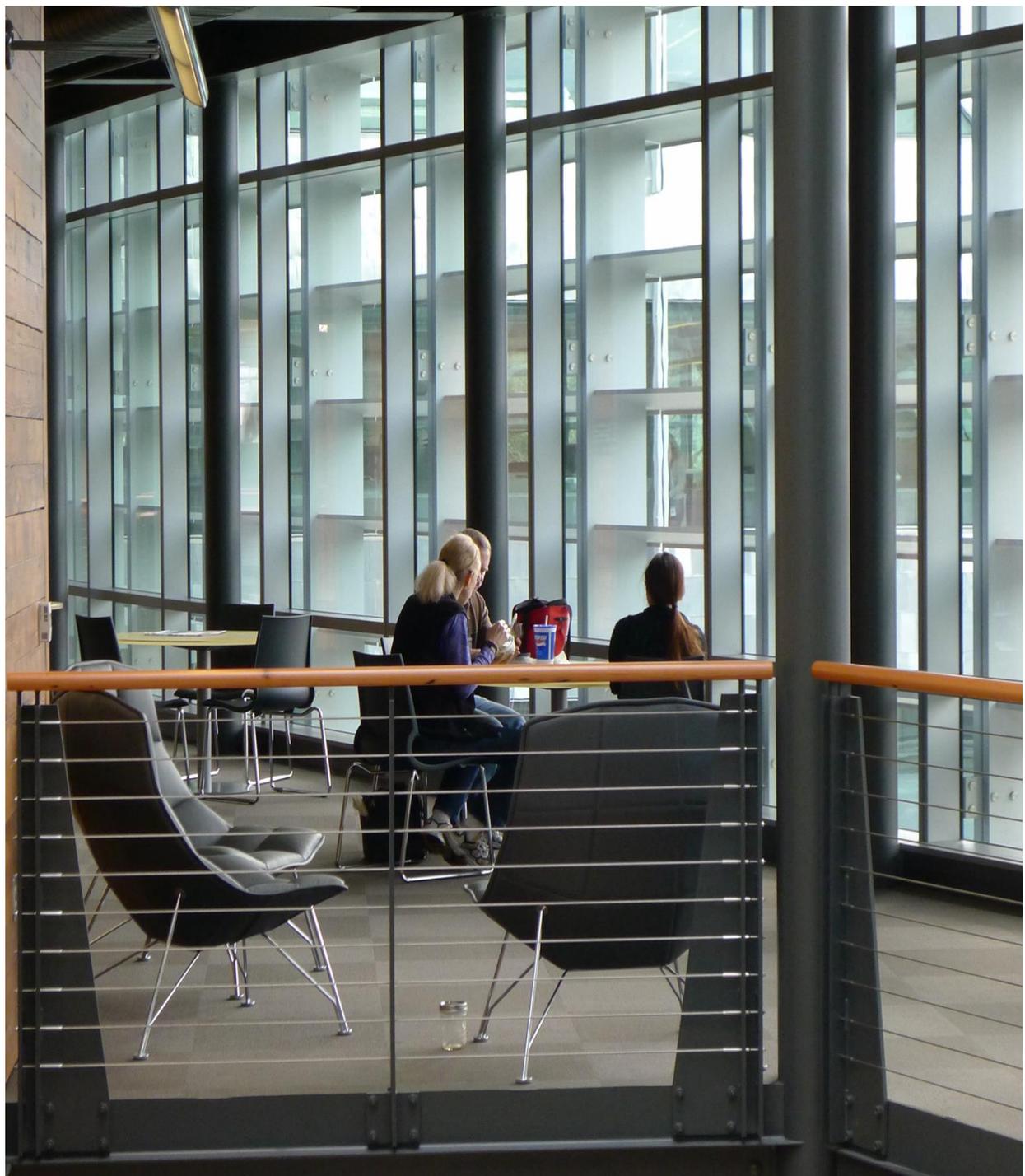
Sleep quality

Summer and winter

Analysis in 5 GSA buildings

Research team from RPI's

Lighting Research center



Study Sites for Phase 1



**Wayne N. Aspinall Federal Building and U.S. Courthouse
Grand Junction, CO**



Federal Center South, Seattle



**Edith Green-Wendell Wyatt
Federal Building, Portland, OR**



**GSA National Capital Region Regional
Office Building, Washington, DC**



**GSA Central Office
Washington, DC**

Photometric Analysis of the Workspace

Photometric analysis of light in different spaces – daytime and night



Daysimeter on a stick: tracks light exposures in the workspace



Daysimeter Measurement

The daysimeter is a calibrated device that continuously measures light and movement.

It provides a personal light-dark stimulus pattern and the corresponding activity-rest pattern. It uses this data to assess the degree of circadian entrainment experienced by each subject.



What did we learn?

1. Study participants got more light at work than anywhere else – even in summer.



2. Those with the most circadian stimulus, especially in the morning, experienced significantly better sleep at night and were less depressed.



3.

But many did not receive sufficient light during the day and were essentially in “biological darkness”.



4. Computers are a key driver of shade use and other light reducing behaviors.



Conclusions from Phase I

1. Achieving sufficient circadian stimulus with daylight alone is difficult.
2. BUT daylight is a critical psychological and aesthetic benefit – and can improve circadian health if designed with the indoor “ecosystem” in mind.
3. Improving circadian stimulus indoors is likely to require additional electric light solutions to supplement daylight.

Bringing light closer
to the people:

Phase 2 of the circadian light study

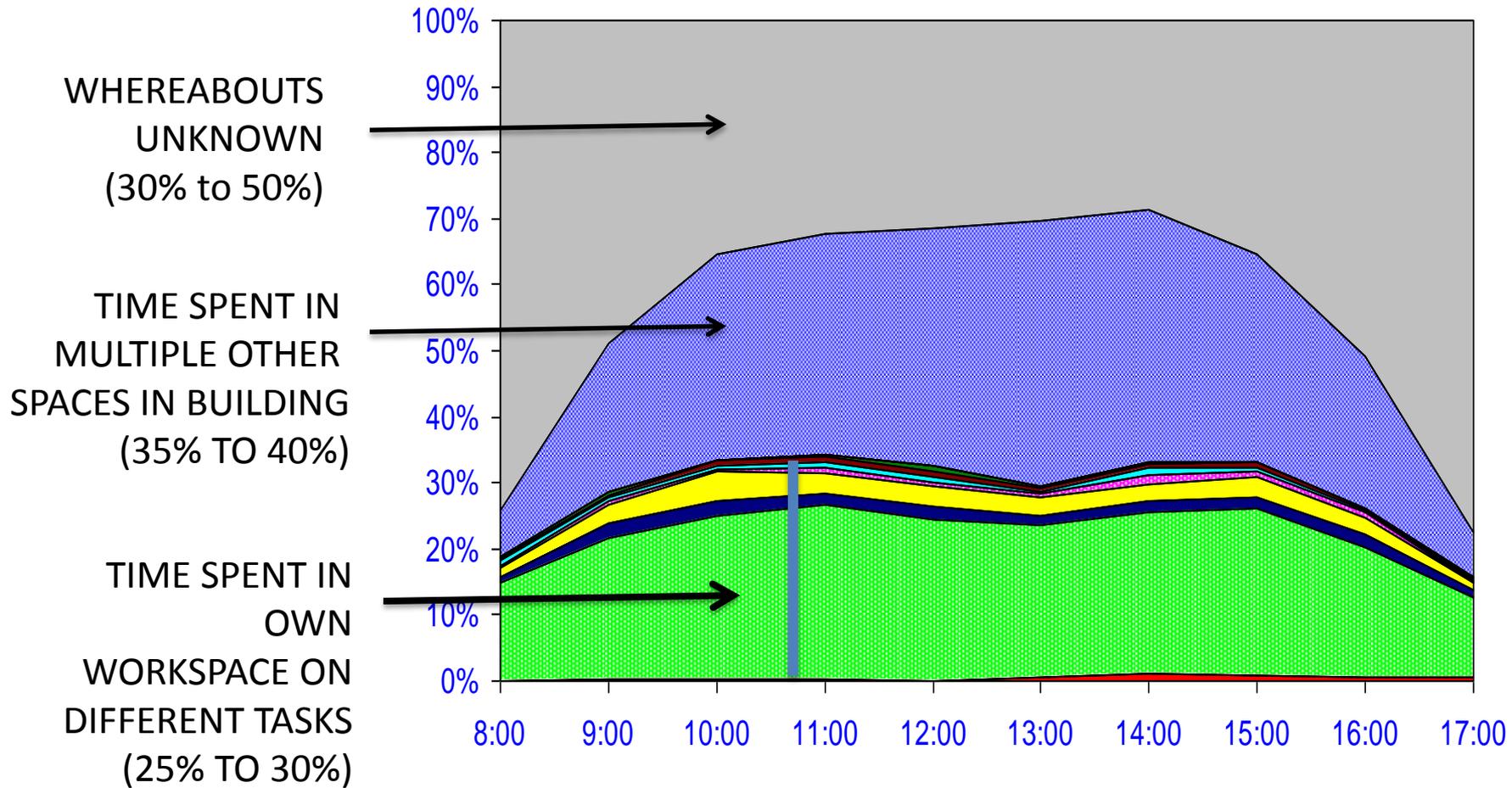
Creating desktop lighting solutions



Why the desktop?

1. People spend the most time at their desks.
2. And when at the desk, they are largely working on their computers – forward vision.
3. Light at the desktop can be designed to have maximum effect – it is more likely to enter the retina and it can be better controlled

Where people spend their time when at work from 9 to 5 – summary of GSA Workplace Research (2000 to 2008)



Study question

Can light delivered at the desktop enhance subjective sleep quality and alertness and can it do this within a short testing period?

Study Sites Phase 2



FHWA - Turner Fairbank Highway
Research Center,
McLean VA



White River Junction VA Medical Center,
White River Junction VT



U.S. Embassy, Riga Latvia



U.S. Embassy, Reykjavik Iceland



Federal Highway
Administration



Methods

1. Photometric analysis of the workspace
2. Daysimeter worn for 3 days at work
3. Desktop lights on for 2 days, off for 1 day
4. Surveys on alertness, sleep quality, mood and seasonal affective disorder (for embassies)

Light application

Light at eye level

Designed to achieve CS of at least 0.30

CS the same for blue and white

Allows choice for study participants

Lights are on all day at the desktop

No change in color or intensity



Design of lights

Development and testing at RPI

Lights designed to achieve a CS of 0.30

Study subjects choose the color they preferred

What did we learn?

Significant main effects, after 2 days, with experimental lights on:

- Increased sense of vitality
- Feeling more energetic
- Feeling more alert and awake
- Having energy and spirit
- Looking forward to each new day

(Subjective sleepiness ratings were almost significant at $p=0.06$)

Phase 3 (Fall 2017): Tunable light at desk top

- Blue light in the morning for entrainment
- Red light in the afternoon for alertness
- One week baseline, one week with lights on
- Measures:
 - Objective and subjective sleep quality
 - Alertness and vitality
 - Subjective assessments of stress, depression

What's Next?

- Create consensus around best evidence for links between indoor light and health outcomes
- Translate evidence into lighting design, interior design and operational practices
- Form a multidisciplinary coalition of experts
- Work with standards organizations to integrate health promoting lighting practices into existing standards.

Why is GSA doing this?

- We spend more than 90% of our time indoors
- With **10,000** buildings housing more than **1,000,000** federal employees, GSA can have a significant impact on health, well being and overall work performance through enhanced lighting

**But GSA can't do it alone...
send an email if you want to join this effort!**

judith.heerwagen@gsa.gov

