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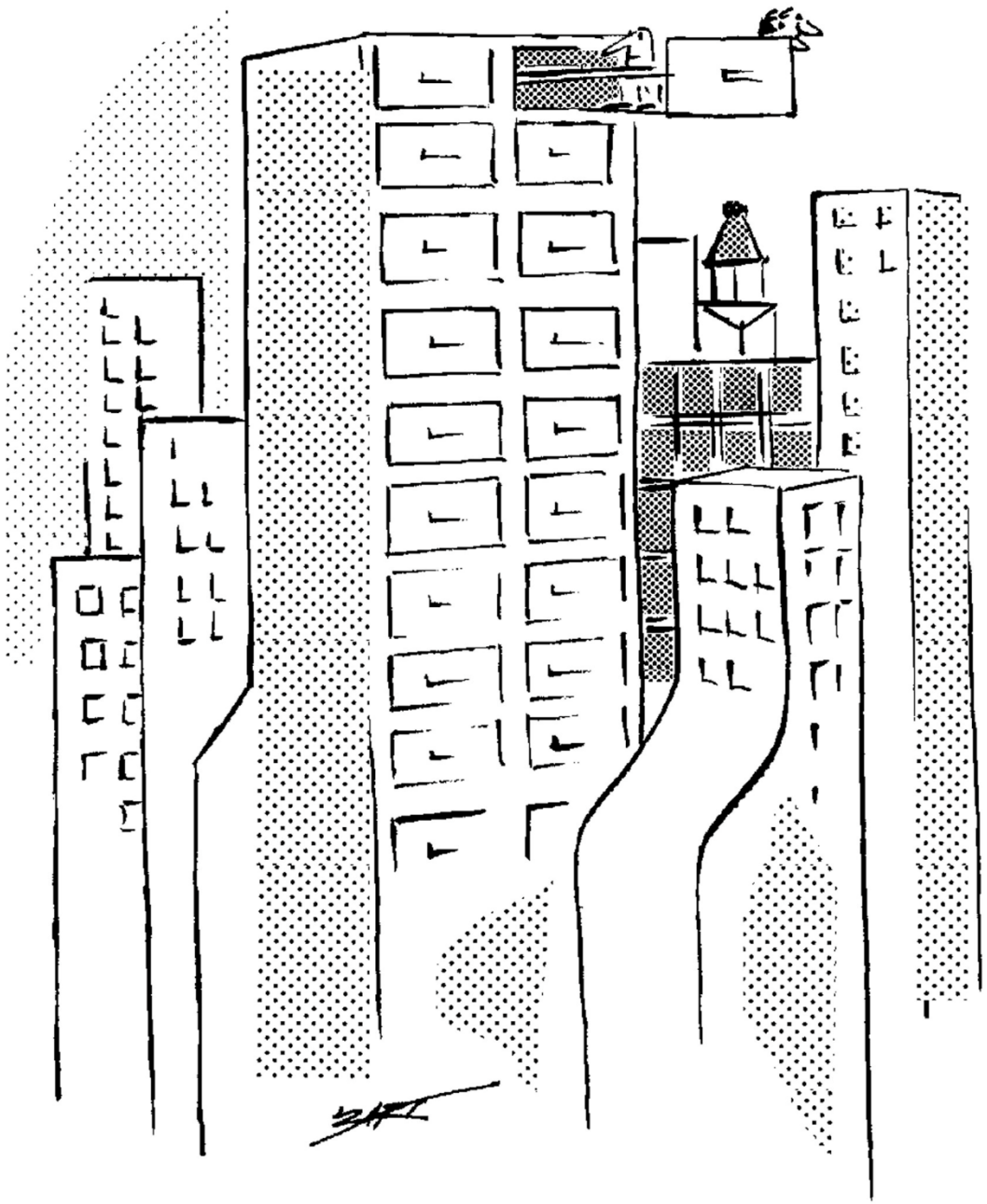
A River of Energy Solutions

Evaluating Behaviors Impacts on Energy Consumption: Set Benchmarks, Use Meters and Lead by Example

Kevin Kampschroer, GSA



Open the door and see all the people…..

Many people, many roles, perspectives & needs..

Decision makers set the agenda

Workers Have different comfort preference s and work styles.

IT person - keeps the energy consuming computers & devices up and running.

Building Operator – Tracks, adjusts conditions

Office manager – Makes purchasing decisions

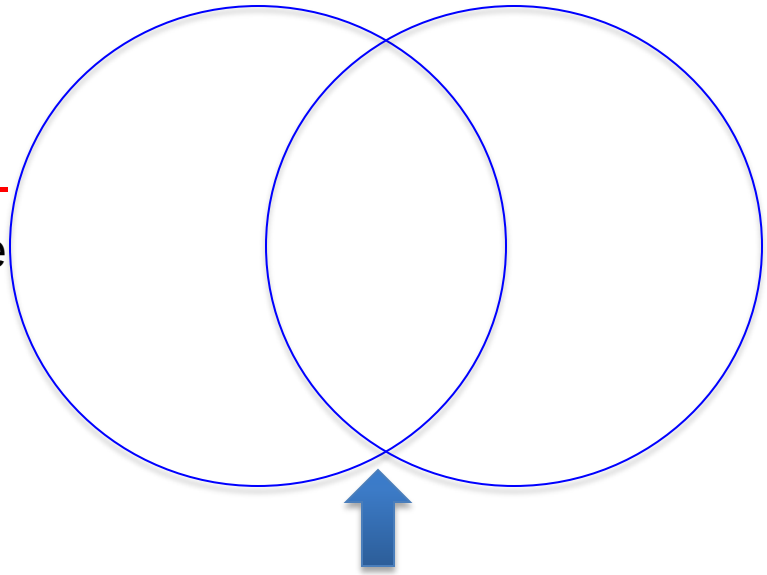
Facility mgr –deals with complaints.

Building Systems

Social System –

The system of people

- Behavior
- Culture
- Mission



Physical system–

The system of things

- Technologies
- Operations
- Design

Influence of social system on building performance

Influence of physical system on human health, comfort and performance

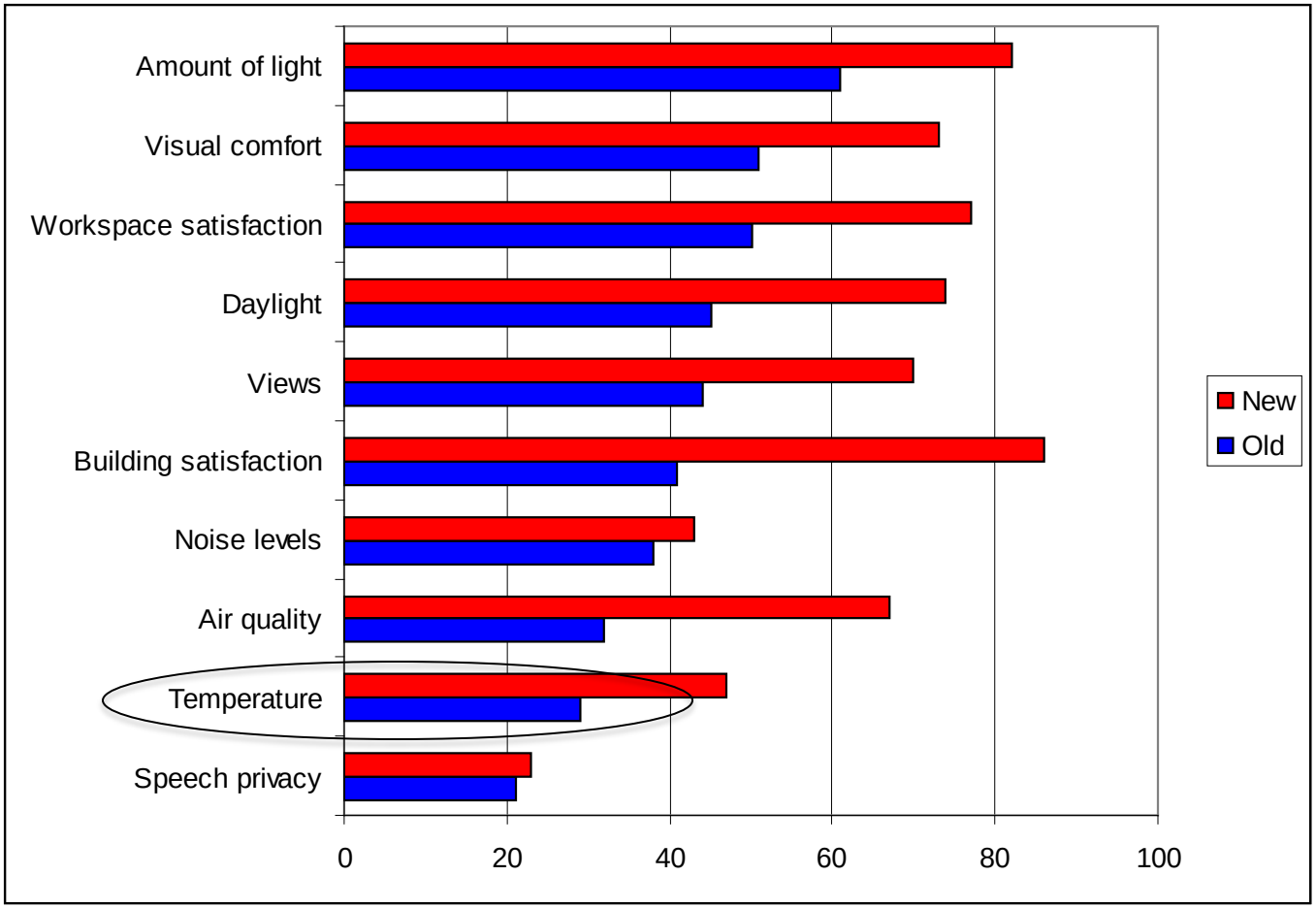
What do we know now about
the interaction of the social system
and the physical system?

Specifically, what do we know about energy
and behavior?

How Satisfied are the People Inside Those Buildings?

Satisfaction and Comfort

(US General Services Workplace Program)

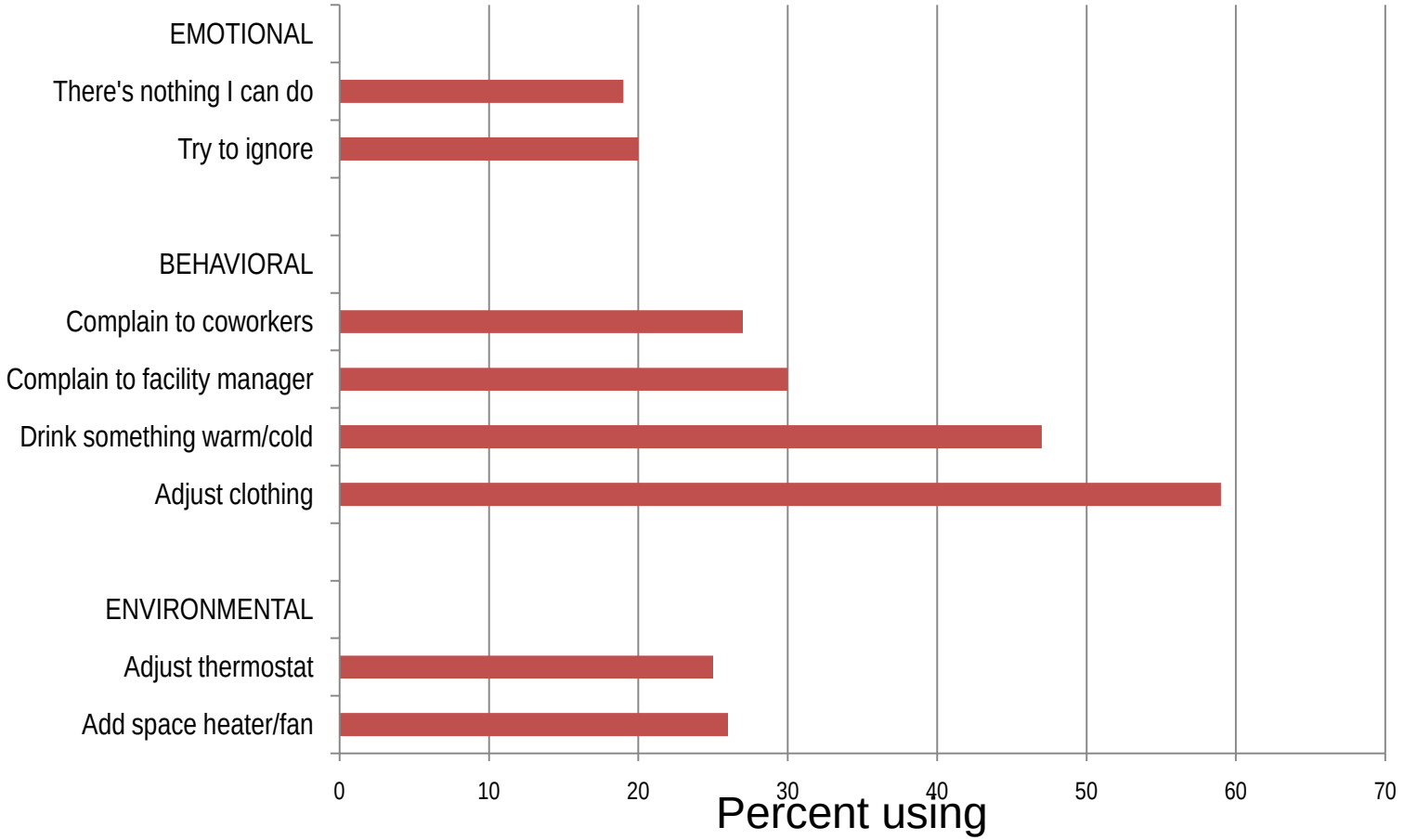


Percent Satisfied Pre and Post occupancy
(data from approximately 600 occupants)

Coping with Discomfort

Methods: survey and observations

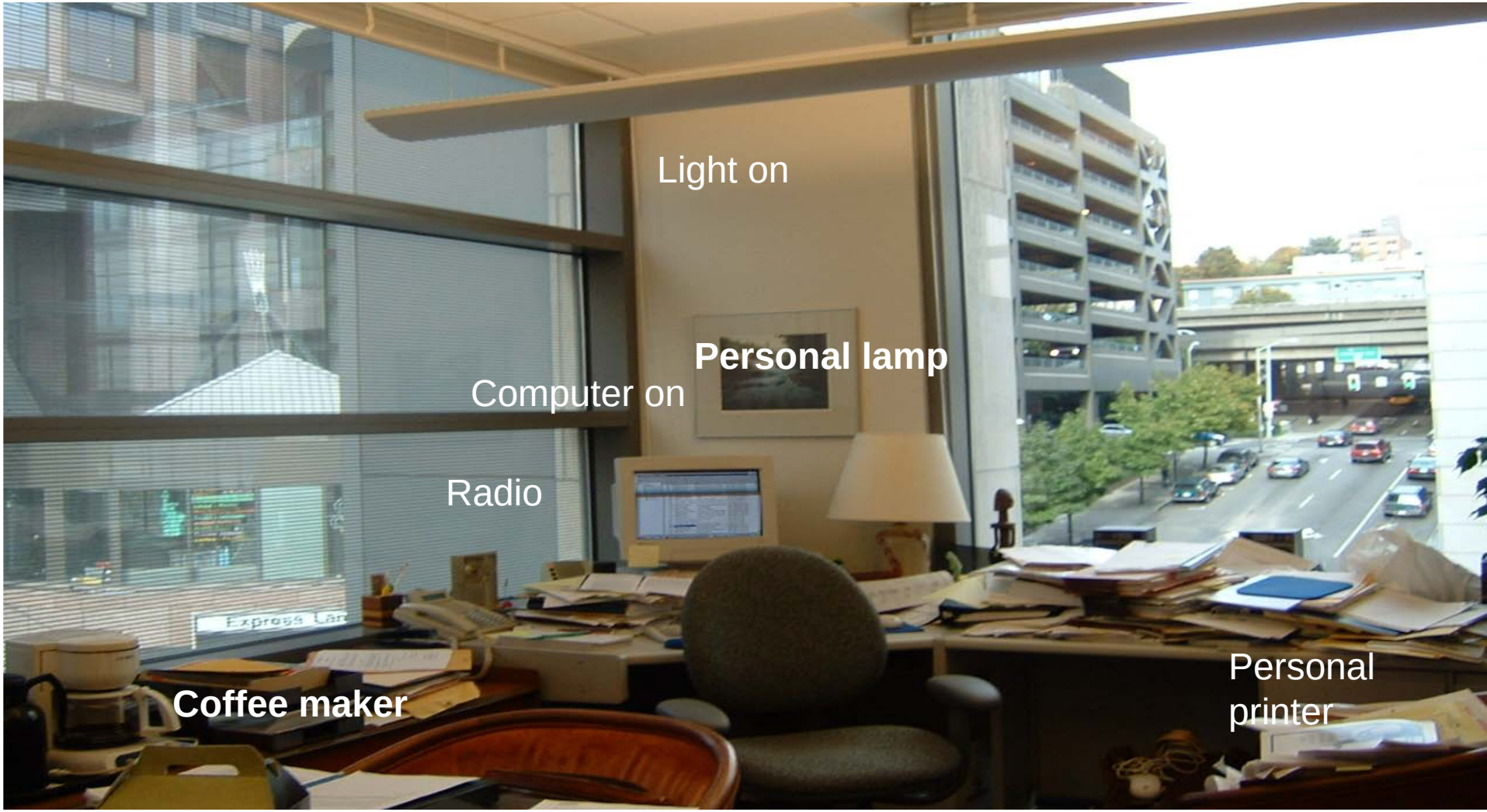
What people do when they experience thermal discomfort



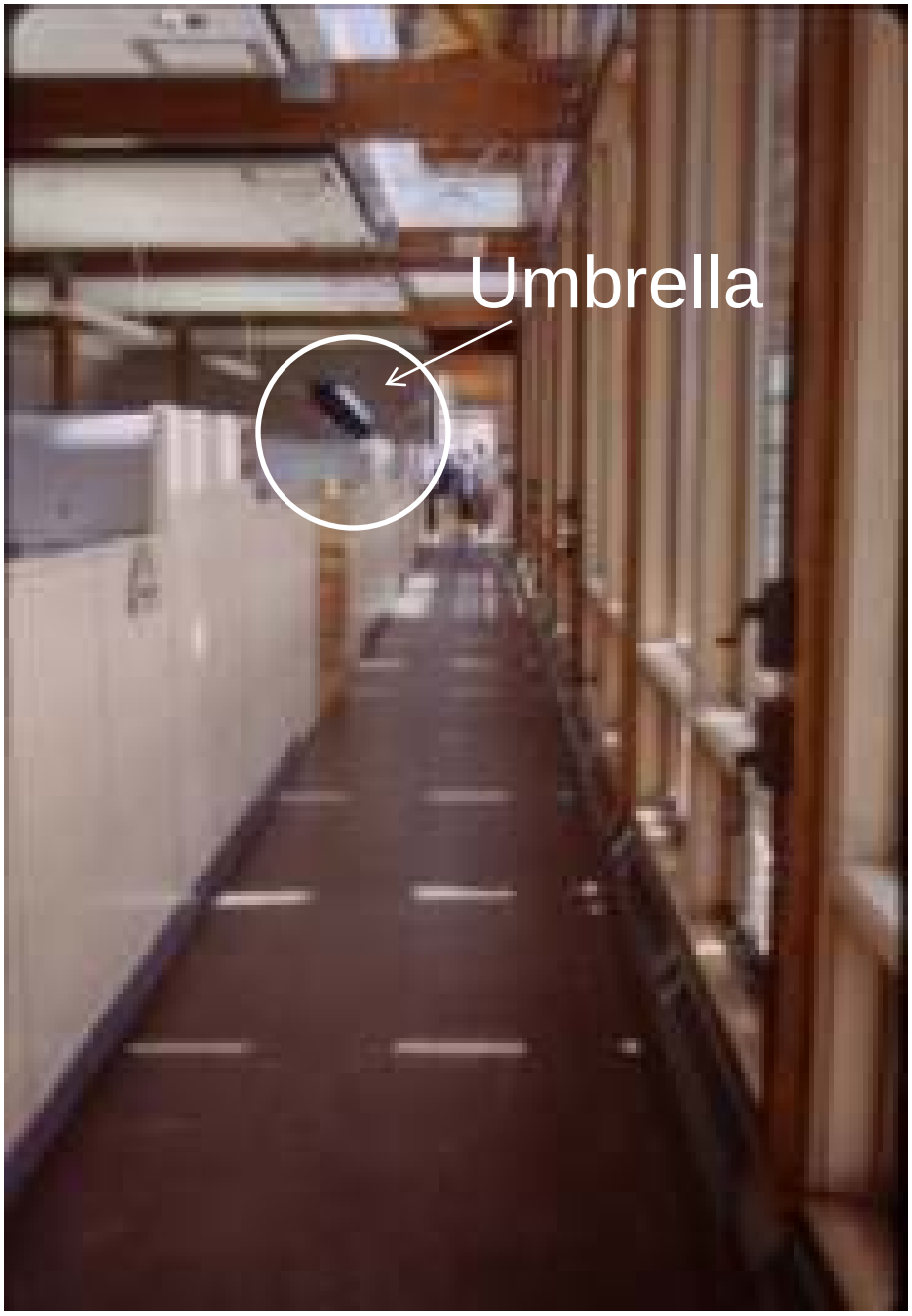
J. Heerwagen, R. Diamond and J. Loveland 1993. Post occupancy of Seven Energy Edge Buildings, US Department of Energy.

They alter thermal conditions.

They operate the space and add devices to improve comfort and convenience.



They use umbrellas when it’s too bright.



They disable daylight sensors, de-lamp fixtures, add task lamps, and turn lights back on when automatic sensors turn them off.

J. Heerwagen, R. Diamond, and J. Loveland, 1993. Post Occupancy Evaluation Of Seven Energy Edge Buildings, US Department of Energy.

People are not passive recipients of design… they actively alter the environment to increase their comfort.

We want to save energy.
They want to be comfortable.

Implications for energy reduction

Energy reduction goals and technologies are at risk when they are perceived as interfering with personal goals and perceived needs.

How do we counteract this problem?

How do we support and encourage change?

A Framework for Creating and Maintaining Behavioral Change

Behavior Change = Motivation + Ability + Context

What behavior? Whose?

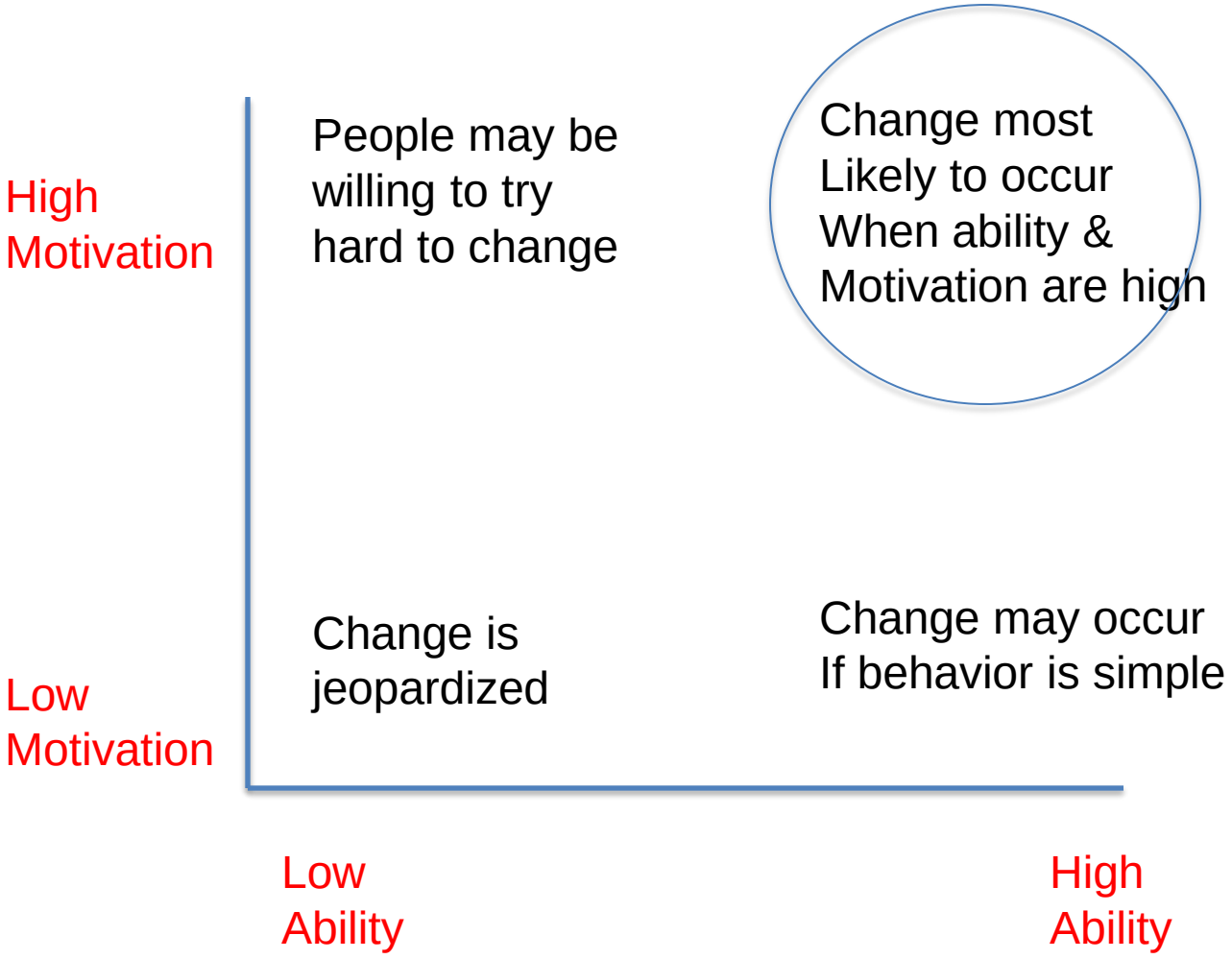
Do you want to change the behavior?

Are you able to? Do you have control?

Does the context aid or inhibit the change?

In order to change a system, you need to change the behaviors of many people in many roles.

	Behavior	Core motivators +	Ability +	Context
Who?	Occupants/users Operations Procurement Policy makers	Pleasure/pain Hope/fear Acceptance/rejection	Time Effort Control Cost Familiarity	Culture Environment
What?	Equipment use Vehicle use Building conditions Purchasing Alternative work Space sharing	Payoff to self/group (can $ savings be Reinvested?)		A new environment offers Opportunity to change Habits; an existing Environment acts against Habit change because It triggers familiar behaviors.
How?	Social comparison Social reciprocity Eco-feedback Training Context change Policy			


High Motivation
Low Motivation
People may be willing to try hard to change
Change most Likely to occur When ability & Motivation are high
Change is jeopardized
Change may occur If behavior is simple
Low Ability
High Ability

A Key Barrier:

Energy not only supports an organization’s mission and work. It also makes our desires possible – comfort, status, convenience. This is why it’s hard to change.

Key Questions

- Can deliberate behavioral modifications change energy habits?
- What is the impact on energy use compared to existing conditions? (Need pre and post data)
- How do we know behavioral change efforts work and which strategies were most effective?
- How do we maintain change over time? (tendency to revert to old habits is strong)

Examples: Behavioral Change Methods

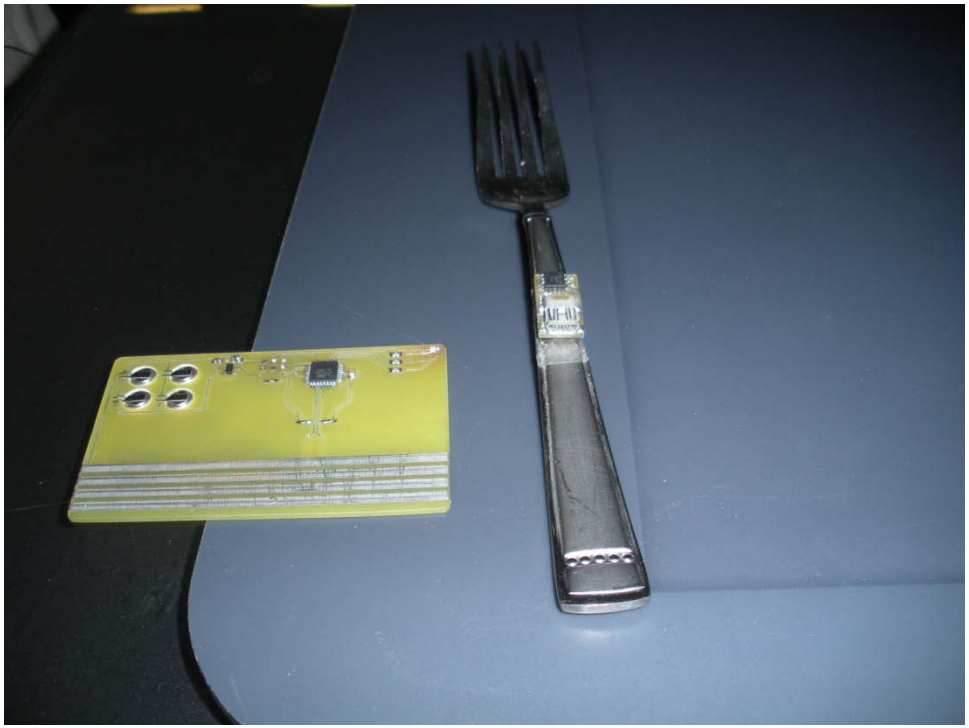
- Cognitive approaches
- Social approaches

Eco-Feedback

- Awareness of cumulative effects of behavior
- Feedback on progress toward goals at the point of decision making

Fork counts bites

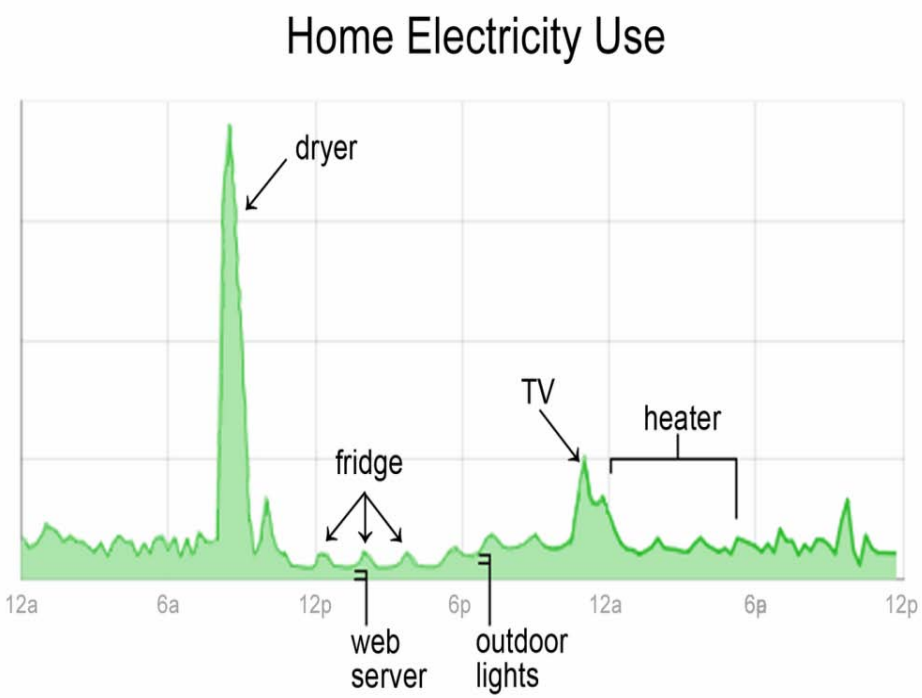
Card tracks budget goals



MIT Media Lab – feedback fork and credit card.

Info feedback & sensing systems

- Interactive feedback
- Real-time displays
- But, problems with info overload and loss of interest when novelty wears off



Graph from GoogleBlog. 2/9/2009, Power to the People.

Making energy visible

- Dashboards showing energy use – but who knows what a kWh means?
  - Dashboards need to be easy to access – problems with firewalls for external web sites
- Glowing/dimming orbs and happy vs sad mascots as stand-ins for energy
- Phone apps that show growing flowers as goals are met

Reducing Workstation Plug Loads

Methods: Observation, automated tracking

What are plugs attached to?

Printers

Coffee makers

Fans

Computers

Speakers

Phones

Chargers

Radios

Clocks

EPA Plug Load Research

Target Behavior: turn off devices and equipment at desk top when away

Motivation: intrinsic motivation related to agency mission

Ability: training on how to access dashboard, information on energy consumed by devices

Outcomes: Energy use under different experimental conditions and return on investment (including technology costs, design, implementation, commissioning).

(Next phase: energy consumed by other equipment - copiers, printers, video conferencing, refrigerators, microwaves, security equipment, etc)

Social Approaches to Behavioral Change

Our brains evolved as social calculators – can we use this embedded calculus to change behavior?

Using our need to belong to a tribe, to get ahead, and to reciprocate

- Social comparison – keeping up with the neighbors, fitting in
- Social competition – doing better than others, winning (the most highly used strategy)
- Social cooperation – working toward a mutually beneficial solution
- Reciprocity – little research – but would an internal “cap and trade” program work?

KEY CHALLENGES:

Moving from behavioral change within specific processes to widespread, systemic change.

- How do we measure systemic, institutional change?
- How do we know when we have achieved the goal of institutionalizing change? What does it look like?

Measurement questions

- Do the target behavior(s) change?
- If change occurs, is it due to the intervention – or something else?
- If multiple interventions are tried, which is the most successful and why?
- Are there unintended consequences – either positive or negative?
- What degree of validation is good enough?

Key Methods

Basic Approach: Pre and post research to capture the changes in energy and behavior

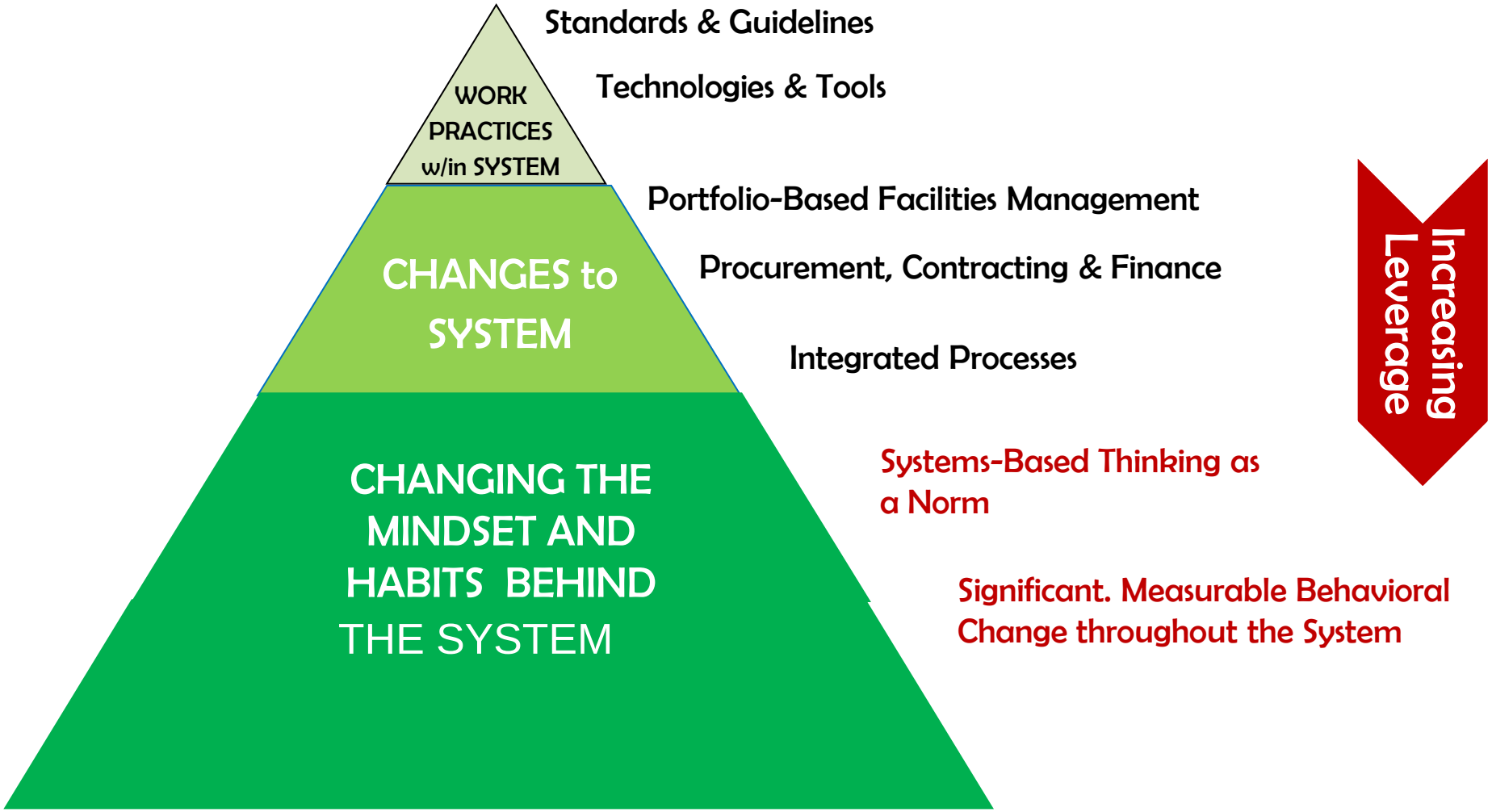
Specific Methods:

- Self report (surveys)
- Behavioral observation (temp settings, lights on/off, devices/technology in use, space use)
- Automated tracking (real time energy use)
- Organizational data (monthly energy bills, space use)

What are you trying to accomplish with a measurement program?

- Find out if a behavioral change intervention worked and whether the effects are long lasting.
- Identify the costs and benefits of a change program.
- Use findings as a basis for developing policy.
- Use findings to implement a change program more broadly.
- Test your “theory of change” – how things should work if your theory is right.

GSA Office of Federal High Performance Green Buildings Framework



Derived from NAS report: *Achieving High Performance Federal Facilities: Strategies And Approaches for Transformational Change*, 2011.