What’s Behavior Got to Do With IT?
4 Ways Understanding People Can Improve Technology

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University of California, Irvine
Underlying assumptions

1. **Technology and new media** are significantly changing how we interact with our natural, built & social worlds.

2. There are **potential opportunities** to leverage these changes for pro-social / pro-environmental benefit.

3. A **psychological approach** provides a theoretical base and empirical methods to understand this potential.
Mission:
Our lab studies how media is (and can be) used to transform individuals, communities, and systems.

Issue-based Media Campaigns

Smart Grid-Enabled Energy Efficiency

CUSAt Center for Unconventional Security Affairs

B. Karlin, 2012
Four Thoughts on Behavior

1. Look beyond either/or.
2. Seeing can be believing.
3. Ask the right questions.
4. It’s not what you say, it’s how you say it.

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B. Karlin, 2012
What is a dichotomy?

A pair of categories that are both mutually **exclusive & exhaustive**.

A B

B. Karlin, 2012
<table>
<thead>
<tr>
<th>Option A</th>
<th>Option B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply Side</td>
<td>Demand Side</td>
</tr>
<tr>
<td>Adaptation</td>
<td>Mitigation</td>
</tr>
<tr>
<td>Technical solutions</td>
<td>Behavioral solutions</td>
</tr>
<tr>
<td>Acceptance</td>
<td>Denial</td>
</tr>
<tr>
<td>“________” works</td>
<td>“______” doesn’t work</td>
</tr>
<tr>
<td>Environmental</td>
<td>Apathetic</td>
</tr>
</tbody>
</table>

B. Karlin, 2012
Potential Solutions

Technology

People

A B

B. Karlin, 2012
People use technology

Energy use in identical houses has been found to vary by up to 260% (Parker, Mazzara, & Sherwin, 1996)

B. Karlin, 2012
<table>
<thead>
<tr>
<th>Media approaches</th>
<th>Holistic</th>
<th>Individual</th>
</tr>
</thead>
<tbody>
<tr>
<td>SAVE ENERGY</td>
<td><img src="image1.png" alt="Holistic Image" /></td>
<td>HELP CONSERVE ENERGY...</td>
</tr>
<tr>
<td>THE WORLD IS IN YOUR HANDS</td>
<td><img src="image2.png" alt="Holistic Image" /></td>
<td>TURN OFF LIGHTS WHEN LEAVING</td>
</tr>
<tr>
<td>A</td>
<td><img src="image3.png" alt="Individual Image" /></td>
<td>OFF</td>
</tr>
<tr>
<td>B</td>
<td><img src="image4.png" alt="Individual Image" /></td>
<td></td>
</tr>
</tbody>
</table>

B. Karlin, 2012
Conservation = many behaviors

Example:

- Insulation
- Lighting
- Water
- Appliances and power
- Heating and cooling

B. Karlin, 2012
Behavior Dimensions

Curtailment  Efficiency

Suffer  Spend

A  B

B. Karlin, 2012
### Behavior Dimensions

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Curtailment</th>
<th>Efficiency</th>
</tr>
</thead>
<tbody>
<tr>
<td>COST</td>
<td>No/Low Cost (11)</td>
<td>Require financial outlay (12)</td>
</tr>
<tr>
<td>FREQUENCY</td>
<td>Repetitive / Frequent (12)</td>
<td>Infrequent / one-time (15)</td>
</tr>
<tr>
<td>LIFESTYLE</td>
<td>Loss of amenities (6)</td>
<td>No lifestyle changes (2)</td>
</tr>
<tr>
<td>ACTIONS</td>
<td>Behavior / usage (6)</td>
<td>Structural / purchases (12)</td>
</tr>
<tr>
<td>PERMANENCE</td>
<td>Reversible (4)</td>
<td>Durable (7)</td>
</tr>
<tr>
<td>MOTIVATION</td>
<td>Saving energy / moral (2)</td>
<td>Saving money / rational (3)</td>
</tr>
<tr>
<td>OUTCOME</td>
<td>Less impact/savings (2)</td>
<td>Greater savings (5)</td>
</tr>
</tbody>
</table>

Abrahamse et al., 2005; Attari et al., 2010; Ayres et al., 2009; Barr et al., 2005; Black et al., 1985; Butler & Hope, 1995; Cialdini & Schultz, 2003; Curtis et al., 1984; Dietz et al., 2009; Dillman et al., 1983; Geller et al., 1982; Gardner & Stern, 1996; Kempton et al., 1984; Kempton et al., 1992; Macey & Brown, 1983; Nair et al., 2010; McKenzie Mohr, 1994; Oikonomou et al., 2009; Poortinga et al., 2003; Samuelson, 1990; Stern, 1992; Stern & Gardner, 1981; Van Raaij & Verhallen, 1983

B. Karlin, 2012
Features of a dichotomy:
1. Exclusive
2. Exhaustive
<table>
<thead>
<tr>
<th>Behavior Dimensions</th>
<th>Low Cost</th>
<th>High Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Infrequent</td>
<td>Maintenance</td>
<td>Efficiency</td>
</tr>
<tr>
<td>Frequent</td>
<td>Curtailment</td>
<td>???</td>
</tr>
</tbody>
</table>

Van Raaij & Verhallen, 1983; Kempton et al., 1984; Kempton et al., 1992; McKenzie Mohr 1994; Stern, 1992
<table>
<thead>
<tr>
<th>Curtailment</th>
<th>Efficiency</th>
<th>Maintenance</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1.png" alt="Curtailment" /></td>
<td><img src="image2.png" alt="Efficiency" /></td>
<td><img src="image3.png" alt="Maintenance" /></td>
</tr>
</tbody>
</table>

What’s the third option?

Curtailment

Efficiency

Maintenance

B. Karlin, 2012
Are there more?

- **High-vs. Low-cost** (Black et al., 1985)
- **Building Envelope** (Nair et al., 2010)
- **WEMAD: Weatherization, Equipment, Maintenance, Adjustments, and Daily behavior** (Dietz et al., 2009)
- **Energy behavior clusters** (Flora et al., in preparation)
Can we test them?

- Curtailment
  - Turn off/unplug
  - Run full loads
  - Turn off lights

- Efficiency
  - Insulate home
  - Efficient Appliances
  - Change light bulb
  - Check for thermal leaks
  - Check toilet for leaks
## What did people do?

<table>
<thead>
<tr>
<th>Behavior</th>
<th>% reported</th>
</tr>
</thead>
<tbody>
<tr>
<td>Insulation</td>
<td>33.1%</td>
</tr>
<tr>
<td>New Appliance</td>
<td>61.3%</td>
</tr>
<tr>
<td>Replace Light Bulbs</td>
<td>80.9%</td>
</tr>
<tr>
<td>Check for Toilet Leaks</td>
<td>47.8%</td>
</tr>
<tr>
<td>Check for Thermal Leaks</td>
<td>21.1%</td>
</tr>
<tr>
<td>Turn off Lights</td>
<td>49.1%</td>
</tr>
<tr>
<td>Run Full Loads</td>
<td>77.6%</td>
</tr>
<tr>
<td>Shut Down Appliances</td>
<td>30.7%</td>
</tr>
</tbody>
</table>

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Did they cluster in dimensions?

- Two primary components found:
  - Efficiency
  - Curtailment
## How were they different?

<table>
<thead>
<tr>
<th>Variable</th>
<th>Curtailment</th>
<th>Efficiency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td>.031</td>
<td>-.099*</td>
</tr>
<tr>
<td>Age</td>
<td>-.012</td>
<td>.370***</td>
</tr>
<tr>
<td>Race</td>
<td>-.086*</td>
<td>.028</td>
</tr>
<tr>
<td>Married</td>
<td>-.077</td>
<td>.272***</td>
</tr>
<tr>
<td>Education</td>
<td>-.019</td>
<td>.107*</td>
</tr>
<tr>
<td>Income</td>
<td>-.052</td>
<td>.172***</td>
</tr>
<tr>
<td>Home Type</td>
<td>-.021</td>
<td>.284***</td>
</tr>
<tr>
<td>Homeowner</td>
<td>.004</td>
<td>.425***</td>
</tr>
<tr>
<td>Home Size</td>
<td>-.030</td>
<td>.281***</td>
</tr>
</tbody>
</table>
# How were they different?

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<tr>
<th>Variable</th>
<th>Curtailment</th>
<th>Efficiency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Self-Efficacy</td>
<td>0.162***</td>
<td>0.028</td>
</tr>
<tr>
<td>Social Motivation</td>
<td>0.079</td>
<td>0.026</td>
</tr>
<tr>
<td>Price Consciousness</td>
<td>0.134**</td>
<td>0.192***</td>
</tr>
<tr>
<td>Financial Motivation</td>
<td>0.038</td>
<td>0.030</td>
</tr>
<tr>
<td>Environmental Attitudes</td>
<td>0.165***</td>
<td>0.056</td>
</tr>
<tr>
<td>Environmental Norm</td>
<td>0.232***</td>
<td>0.101*</td>
</tr>
<tr>
<td>Environmental Motivation</td>
<td>0.196***</td>
<td>0.074</td>
</tr>
</tbody>
</table>
How were they different?

A four-step regression model was run for curtailment and efficiency. Significant predictors in the final models for each dimension were:

**Efficiency**
- Gender
- Age
- Marital Status
- Homeownership*
- Bill Consciousness

**Curtailment**
- Race
- # of people in home
- Bill Consciousness
- Environmental Norm*
- Environmental Motivation*

* Indicates strongest predictor in model

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What does it mean?

<table>
<thead>
<tr>
<th>Curtailment</th>
<th>Efficiency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Predicted by environmental attitudes</td>
<td>Predicted by home ownership</td>
</tr>
</tbody>
</table>

Bill consciousness predicts both – could providing improved feedback help?
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B. Karlin, 2012
What is Feedback?

“What information about the result of a process or action that can be used in modification or control of a process or system”

Oxford English Dictionary
What is Feedback?

“Information about the result of a process or action that can be used in modification or control of a process or system”

Oxford English Dictionary
Law of Effect (Behaviorism)

- Behavior depends on its effect
- Knowledge of results (KR) is required for behavior change.
- A positive response to behavior serves as reinforcement
- A negative response serves as punishment

Thorndike, 1927
How much energy does your washer use?
How about your whole house?
Our Window of Opportunity

RIP
Traditional Meter
Circa 1880 –2020

Automatic transmission to utilities
Feedback to consumers

Karlin 2012
Feedback is Effective

- 100+ studies conducted since 1976
- Reviews found average 10% savings
- Mean r-effect size = 0.1174 (p < .001)

I had no idea how much energy computers used

We installed power strips to easily power off all high energy items

Darby, 2006; Ehrhardt-Martinez et al., 2010; Fischer, 2008; Karlin & Zinger, in preparation
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Feedback *can be* effective...

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Darby, 2006; Ehrhardt-Martinez et al., 2010; Fischer, 2008; Karlin & Zinger, in preparation
Feedback *is* can be effective...

- Effect sizes from -.0830 to .4803
- Moderator Analysis
  - Study population
  - Home similarity (marginally significant)
  - Study duration
  - Frequency of feedback
  - Feedback medium
  - Disaggregation by appliance
  - Comparison message (marginally significant)

Karlin & Zinger, in preparation
Many Kinds of Feedback

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Improving Studies

- Not naturalistic
  - Participants recruited to participate
  - May be different from “active adopters”

- Not comparative
  - Most studies tests one type of feedback (vs. control)
  - Very few commercial products in studies

- Not testing mediation
  - DV is energy use, but studies rarely test possible mediators to explain effectiveness
HOW Is Feedback Effective?

- WHO
- WHAT
- WHEN
- WHERE
- WHY
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What is Framing?

Presentation of information in a way that encourages certain interpretations & discourage others.

“There is no value neutral way of presenting people with information.”

- Elke Weber, APA 2012
How much energy does your washer use?

1079 KwH/year

65.9 Billion

5.8% of average home

$$$.25/load

$85/year

B. Karlin, 2012
### Message Framing

<table>
<thead>
<tr>
<th><strong>Impacts of leaving your router on when not in use</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1</strong> Turning your router off when not in use saves energy.</td>
</tr>
<tr>
<td><strong>2</strong> A router left on all day uses .07 kWh of electricity.</td>
</tr>
<tr>
<td><strong>3</strong> A router left on all day costs $.06.</td>
</tr>
<tr>
<td><strong>4</strong> A router left on all day uses the equivalent of 37 AA batteries.</td>
</tr>
<tr>
<td><strong>5</strong> If all Americans switched off their router when not in use, we could save $2.8 billion a year.</td>
</tr>
</tbody>
</table>

B. Karlin, 2012
Framing in Visualizations

My Energy Use Last Week

My Energy Use Last Month

B. Karlin, 2012
"It is far better to adapt the technology to the user than to force the user to adapt to the technology."

– Larry Marine

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