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Thermostat wars and other tales from the field

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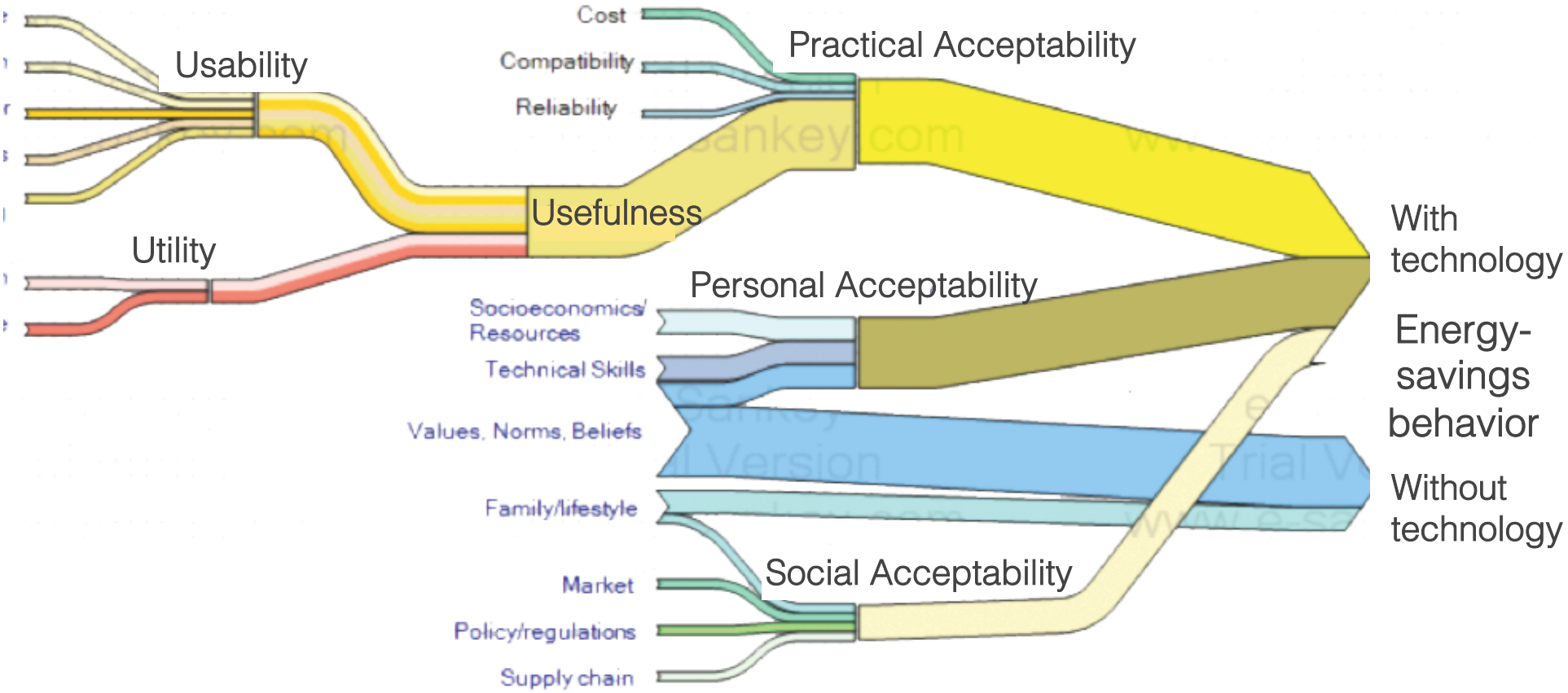
Goal: facilitate energy-savings behavior



(expanded from Jakob Nielsen, 1993, p.25)

Thermostat wars—one household, different comfort/values

- 87% of households have more than one person adjust the thermostat
- With manual, programmable thermostat, smart phone interface
- between parents & kids, husband & wife, etc
  - *Someone in the house is resistant to adjusting the thermostat during the day*
  - *I don't adjust the temperature at night because husband just changes it back if he hasn't gone to bed*
  - *my husband gets grumpy if the temperature is not comfortable for him.*
  - *my wife gets chilly and ups the temperature from that programmed*
  - *Wife not willing to follow my program*
  - *my husband complains that its too cold in the house, so I bump up the temp for a bit to appease him. I don't change the fixed settings for this, just use the hold or temporary mode, so I don't have to reset my preferred settings.*
  - *The women can't agree on the proper temperature!*
  - *energy wasting kids sometimes turn up the heat too much in the winter and sometimes make it too cold during the summer.*
  - *I don't use the programmable function. My wife needs full control of the thermostat. Her warm and cool comfort zones are incredibly small.*
  - *I wish I could program it so my husband can't change it.*

Occupancy

- About half the households are occupied all day
  - Terms like “morn, day, eve” make less sense
- About half the households have the same schedule every day

House/equipment/environment issues

…making it difficult for thermostat control

- poor insulation, two stories
- poor balance, over/under sized HVAC
- wind, solar gain, extreme temperatures
  - *due to latent load in midwest, don't use setback on AC beyond mid-June.*

Thermostat settings—as opposed to comfort

- *Set at a constant*
- *I set my furnace to 55 and do not use it at all in the spring and most of the fall*
- *I wait until January 1 to turn on the heat unless it is extremely cold*
- *I don't program the thermostat but use the on/off switch (25% households—heating, 33%—cooling)*
- *The numbers on the dial rubbed off years ago, I just set it to where it feels comfortable.*
- *In the winter we do adjust. But in the summer, night is the time we really want the AC to help sleep*
- *When I was younger I kept the house at 65 during the day and 62 at night. I now find that too cold. At 65 years old I now keep the house at 68 during the day and 65 at night.*

Comfort based on outside conditions

- Diurnal swings
- Seasonal changes

The t-stat, any t-stat, can say 74 degrees and I may feel comfortable. A day later, or even an hour later, it may say 74 and I may feel too cold. Or too warm! What simply makes no sense to anyone is why we feel ok at say 68 in the wintertime wearing a polo shirt and jeans, but would be overwarm at 70, while in the summertime, we would be freezing at 70 and feel comfortable at 74 or 75? And t-stat sensors (most of them are co-located with the interface), whether or not they are accurate, are only point sensors and do not take into account the temp at other parts of the house. ***There is a lot more to comfort than the temp measured at the sensor.***

Why don't you adjust the temperature at night or when unoccupied?

- It is more comfortable/better sleep (28%)
- Not convenient (15%)
- It uses more energy/doesn't save energy (geothermal/radiant) (15%)
  - *keep the pipes from freezing at -30F outside takes more energy some days*
- The house takes too long to regain a comfortable temperature (15%)
- I was told never to change the settings (4%)
  - *Was told a constant temp is more energy efficient*
- I don't have time/we forget
- It is difficult
- It uses more energy
- Medical reasons
- Peak demand

Why do you place the thermostat in hold mode?

(Nearly a third have the programmable thermostat in hold mode most of the time (half never or a few times per year))

- Because I can control the temperature more effectively manually (36%)
- Our schedule is so variable (especially weekends), the programming doesn't apply (20%+)
- Too difficult to program (7%)
- Don't have time to program (4%)
- Visitors/parties
- Holidays/Vacation/Business trips
- Sick days
- Extreme weather
- opening windows for fresh air
- *the programmed setpoint temp is very low and we engage the hold mode to turn on the furnace when absolutely necessary*

What people want….

- calculated cost savings/expenditure of changing set temperature by one degreee up or down based on current electricity price; a smart thermostat that reduced energy use based on feedback from electricity producer
- built-in warnings to let you know if you're trying to set things in idiotic or impossible ways
- turn on the whole house fan rather than use the AC when appropriate.
- set the thermostat to 62 and then if anyone needs to warm it to 68 or 70, always set it back automatically after 15 or 20 minutes.
- includes controls for the hot-water heater in addition to the furnace. Includes customizable preset settings for different members of the family (depending on who is home at the time). It will be useful if the HVAC system and thermostat could work as a system and the thermostat could open/shut vents to control the control temps in individual rooms set to user preferences/needs.
- be controlled remotely by pc or phone
- someone explain how to operate and the various functions
- keep track of outside and wall temps and automatically compensate and keep the pipes from freezing
- sense occupancy and adjust the temperature when no one is home.
- multiple temperature sensors to keep the entire house (rather than merely the interior rooms) comfortable.

Summary

Certainly room for improvement in the technology:

- Usability (improved interfaces, smart phone (remote) and web interface)
- Wireless sensors (temperature, occupancy)
- Intelligence (learning house/equipment, user preferences, adaptive comfort)
- Feedback (comfort/setpoint vs. cost)
- One touch solutions (timers, away, home-awake, home-asleep)

But let's remember to accommodate the "irrational" nature of humans!

- Thermostat wars
- Values other than energy savings (need for control, comfort)
- Varying schedules
- Thermal comfort is a state of mind, influenced by behavior (clothing, activity), psychology (expectations), and physiology (diurnal, seasonal changes)

Role for education, social media, etc….

Thank you

I did buy a programmable thermostat, but I found that it did not have enough flexibility in programming. and I could not figure out how to override the settings when my schedule changed. So I just kept my old simple thermostat, put a note on the door "last one out turn down the heat", and now rely on manually setting the temp.