Mental Model Interface Design: - Putting Users In Control

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Inspiration from Kempton (1986)

Feedback
Mental Model

Valve
Mental Model

Valve behaviour patterns may consume less energy
More variables need to be considered to understand the consequences of User Behaviour.

- **Broader system**: Building structure, Thermodynamics, External temperature
- **Goals**: Keep warm, Save energy, Safety
- **Strategy**: Combination of controls, Adjustment plan
- **Mental Model**: Model of heating system, Device models of controls
- **Device Design**: Heating system, Control devices, Interface
- **Consequence**: Comfortable? Wasted energy? Safe operation?
- **User Behaviour**: Set point changes
Exploring Relationship to inform energy conserving strategies

Mental Models → Hypothesis 1 → Device Design

Hypothesis 2

Hypothesis 3

Comfort/Energy

Behaviour Patterns → Heating Goals
Naturalistic home heating simulator

Goal 1: Your family are waking up & getting ready for the day. You want to be comfortable in the bedrooms and bathroom between 0700 and 0800.

Day 1, Time: 7:26, Exterior: 2.8C

Goal 5: You decide to study/work from home. You want to be comfortable in the lounge until 1600.

Day 1, Time: 14:58, Exterior: 4.1C
Mental Model promoting interface
More appropriate Functional UMMs at Device Level

Appropriateness by Condition, of Key Control Function Described in User Mental Models

- Realistic Programmer
- Design Boost
- Realistic Design Thermostat
- Realistic TRV

[Bar chart showing frequency and appropriateness for different conditions and control functions]
Key system elements in UMMs

![Bar chart showing the frequency of key system elements present in UMMs.](image)
Boiler Activation

Mean Thermostat Set Points, and Resulting Mean Hall and House Temperatures and Mean Boiler on Periods
Increased Duration of Goal Achievement
Statistically Significant Improvements with Mental Model Promoting Interface

Mental Model Content
- Improved awareness of home heating controls
- More appropriate mental models at Device and System level (Conditional Rule, TRV feedback)

System and Device Design
- Greater control of boiler activation
- Increased use of Frost Protection and Holiday Button
- More appropriate behaviour with TRV controls

Behaviour Patterns & Strategies
- Increased duration of goal achievement

Heating Goals
Further Information

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- Revell, K.M. and Stanton, N.A., 2016. Mind the gap—Deriving a compatible user mental model of the home heating system to encourage sustainable behaviour. *Applied Ergonomics*