Direct Manipulation

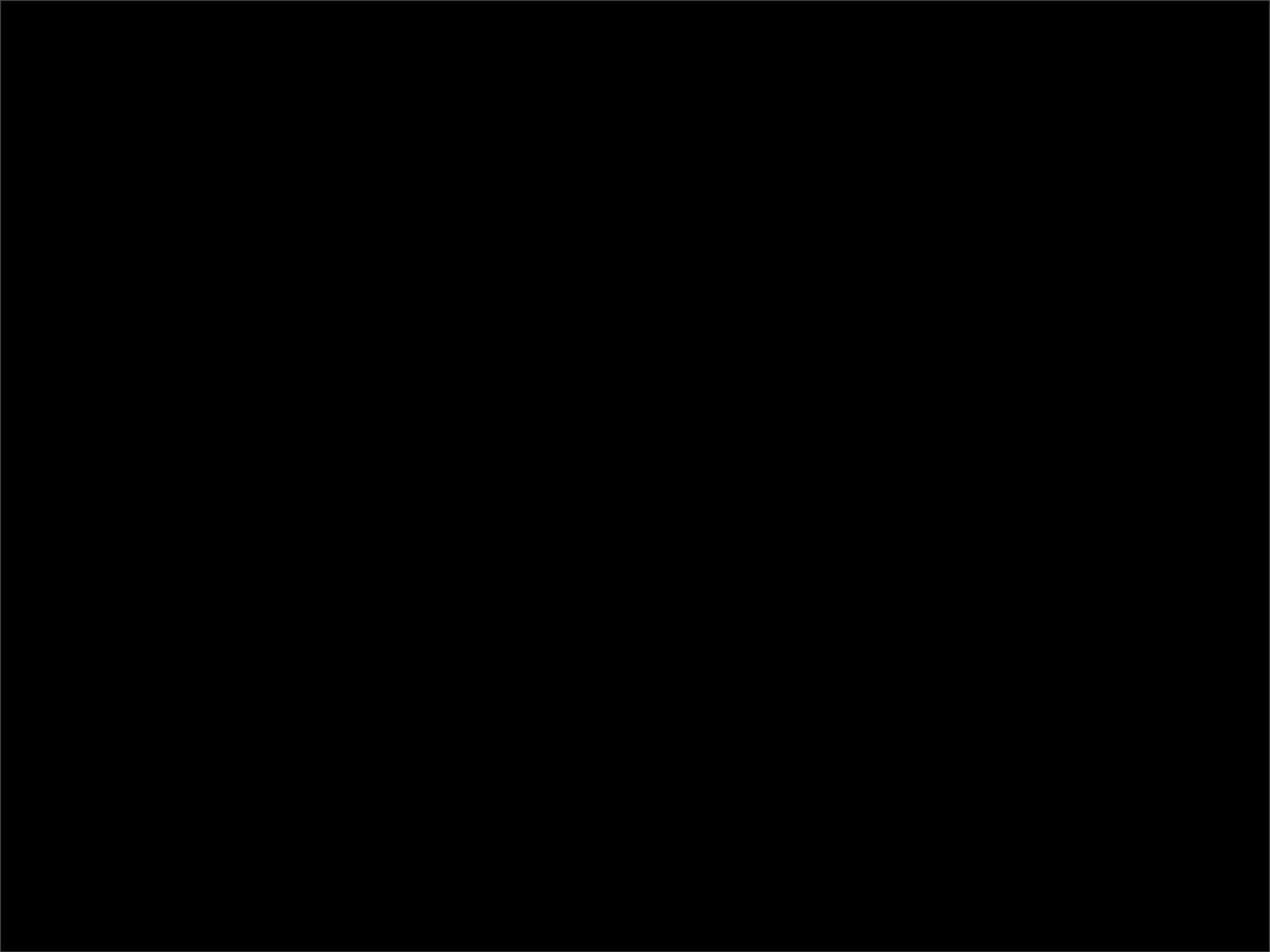**Scott Klemmer**
Autumn 2009

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How might this measuring cup be improved?
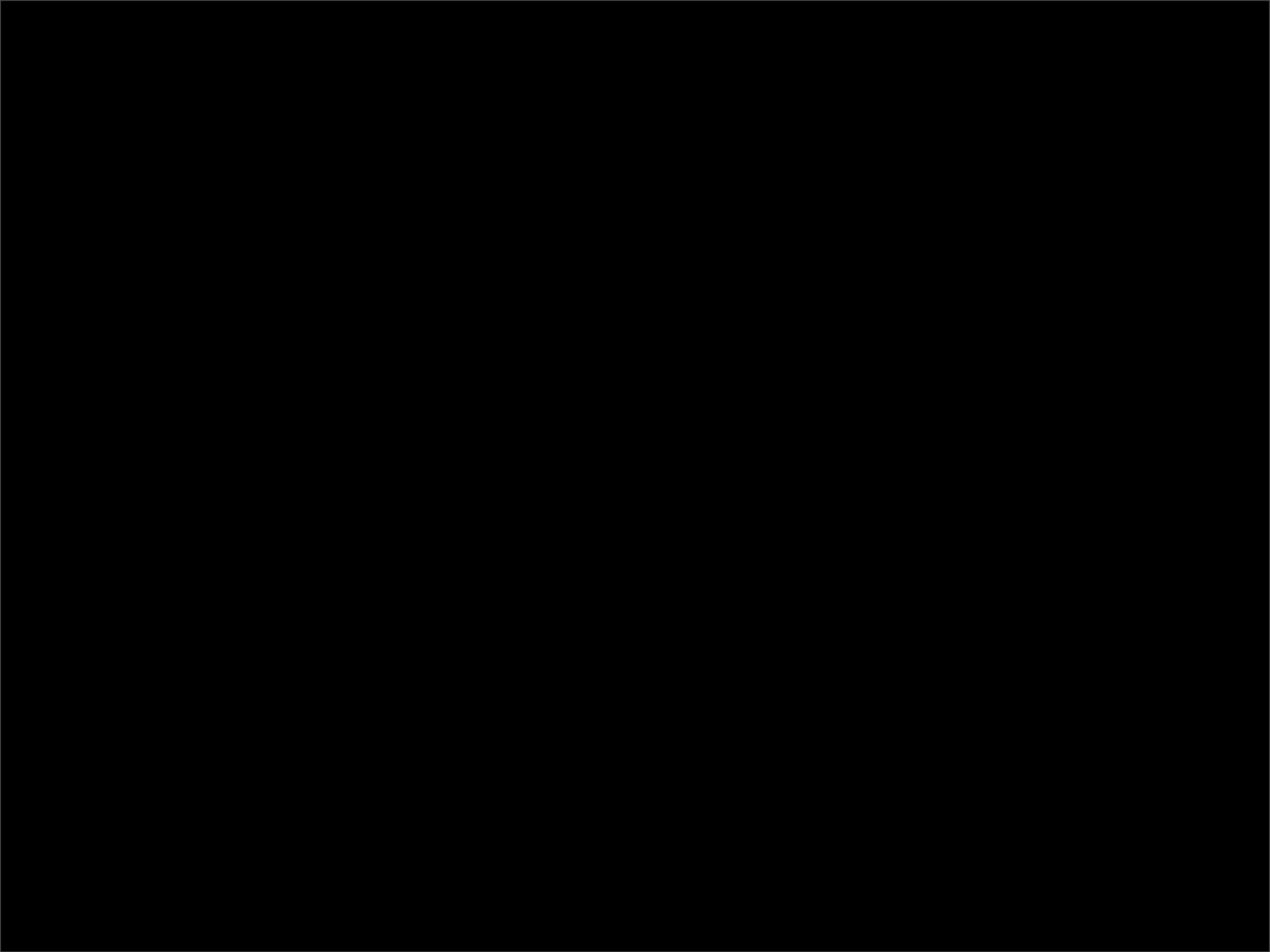
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- How do people learn interactive systems?
- What makes an interface easy or hard?
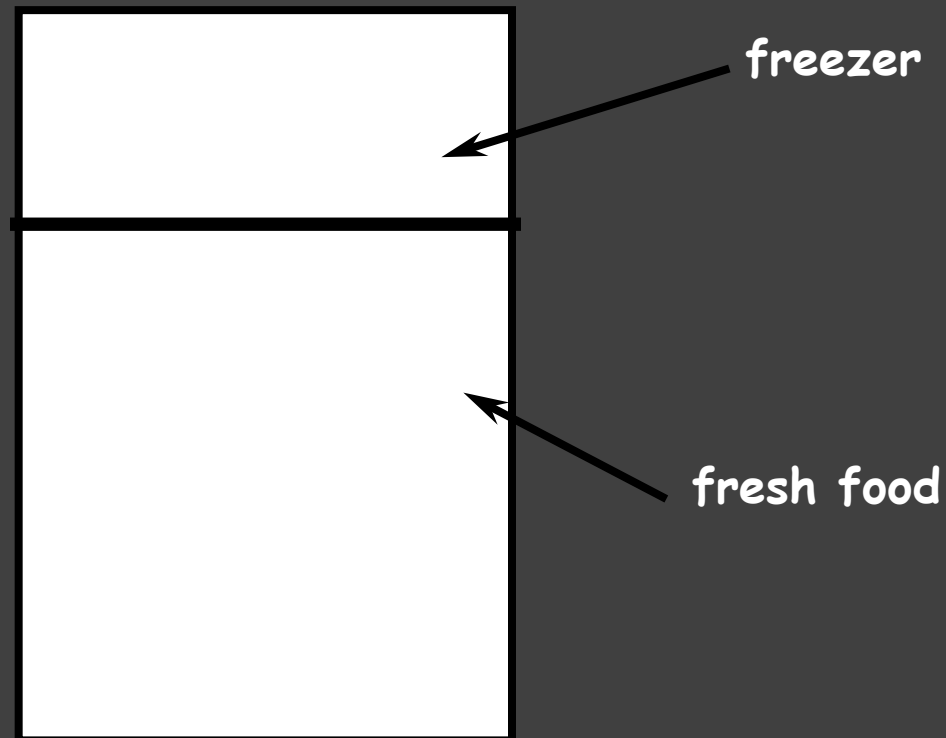- Why do people make errors?
- What makes an interface "natural"

Handles

Begin with breaking glass

Two kinds of errors: slips & mistakes

Examples (Bad) : Old Refrigerator

freezer

fresh food

Problem: freezer too cold, but fresh food just right

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Example (bad): Refrigerator Controls

Normal Settings	**C and 4**	
Colder Fresh Food		**C and 5-6**
Coldest Fresh Food		**B and 7**
Colder Freezer		**D and 6-7**
Warmer Fresh Food		**C and 3-1**
OFF (both)		**0**

A B C D E

7 6 5 4 3

What is your conceptual model?

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Example (bad): Most Likely Conceptual Model
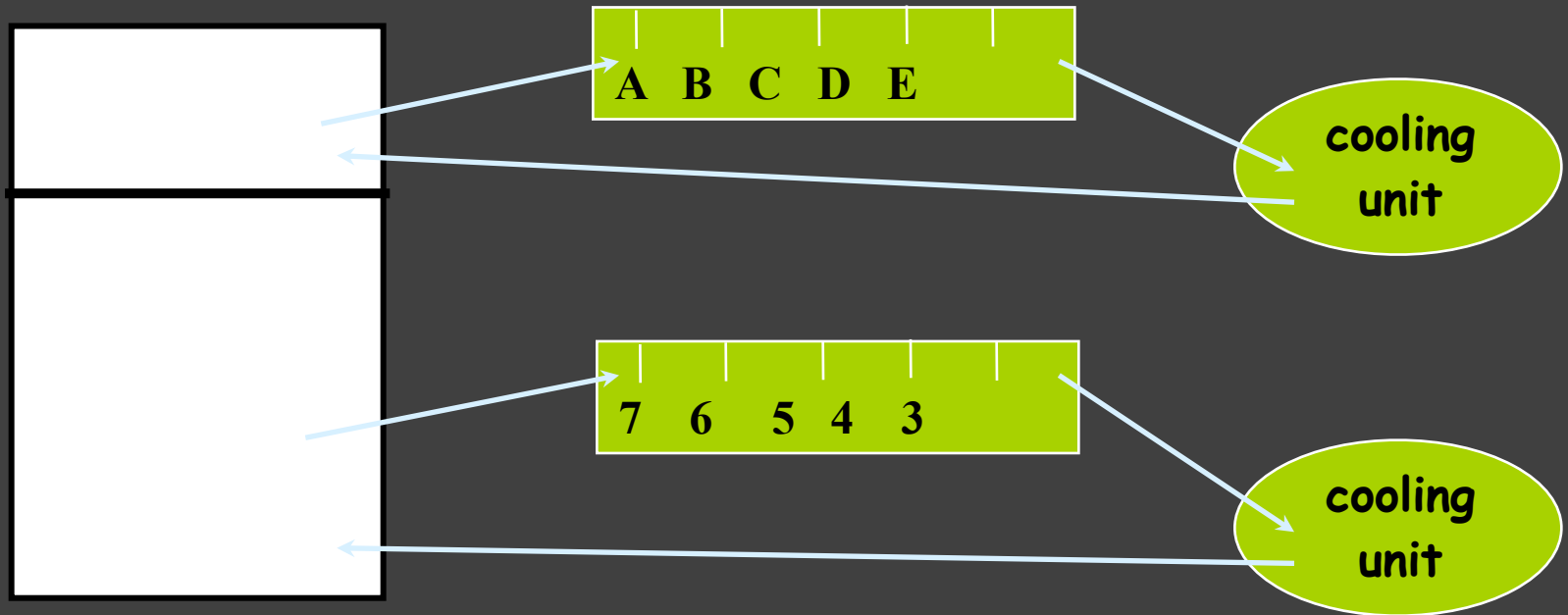
i.e., independent controls

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Example (bad): Actual Conceptual Model

7 6 5 4 3

cooling unit

A B C D E

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Example (bad): Actual Conceptual Model

7 6 5 4 3

cooling unit

A B C D E
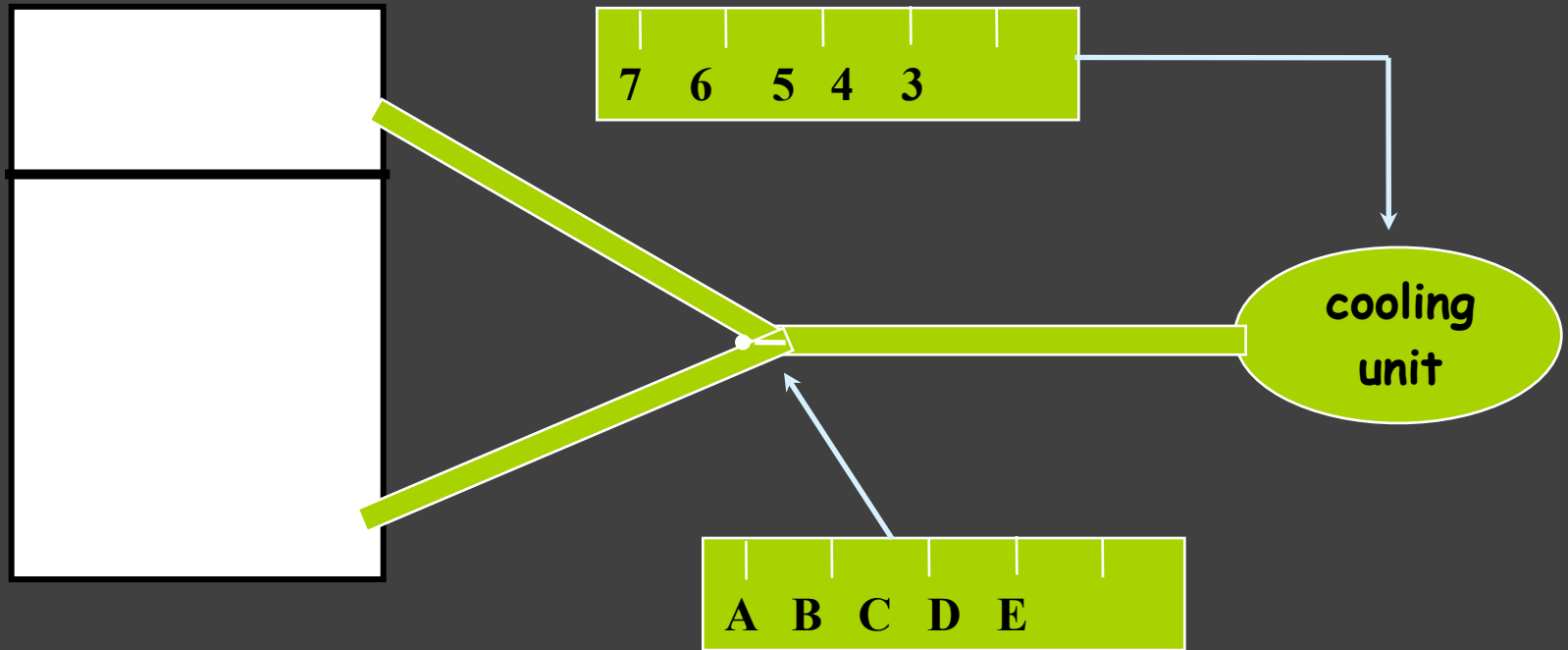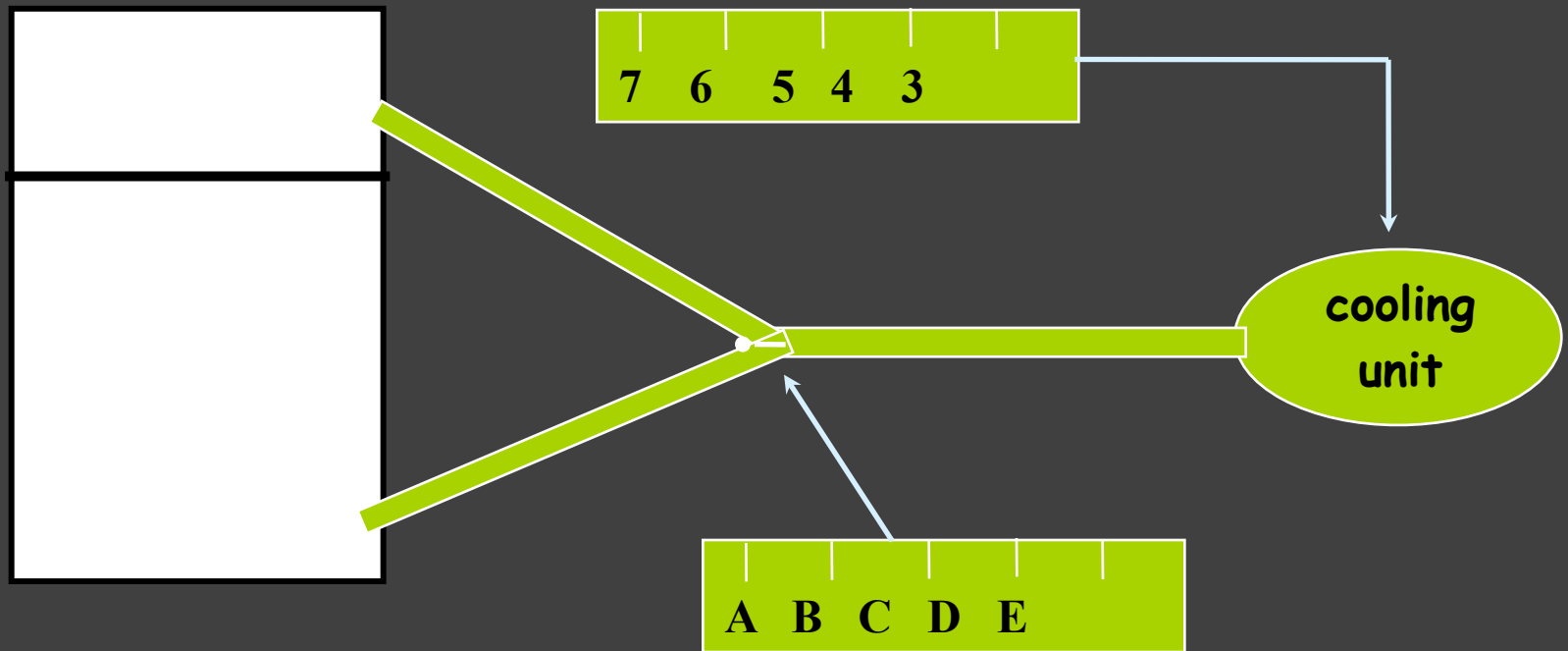
Now can you fix the problem?

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The gulfs of execution & evaluation

Figure 3. The gulfs of execution and evaluation. Each gulf is unidirectional: The gulf of execution goes from goals to system state; the gulf of evaluation goes from system state to goals.
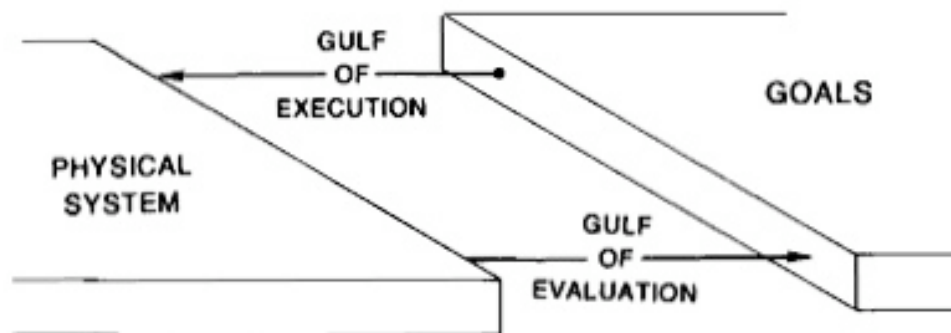
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How do I know what I can do?
How do I know what the system has done?
(go through a mock conversation)

Good design reduces the gulfs

- How easily can one:
- Determine the function of the device?
- Tell what actions are possible?
- Determine mappng from intention to physical movement?
- Perform the action?
- Tell if system is in desired state?
- Determine mapping from system state to interpretation
- Tell what state the system is in?

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Good conceptual model; good mappings; good feedback.

Direct manipulation

- Immediate feedback on actions
- Continuous representations of objects
- Real world metaphors / mental models
- Directness: reduces the information processing distance
- Two kinds of directness:
  - Semantic
  - Articulatory

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Semantic distance and mental models are the same thing
Semantic: WYSIWYG
Articulatory: WYDIWYS

Slips v. Mistakes

Butterfly Ballot

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One of the most surprising proponents of tangibility is the Verified Voting Foundation. Their assertion is that the only acceptable voting method is one that leaves a paper record. Their reason is that electronic voting machines "pose an unacceptable risk that errors or deliberate election-rigging will go undetected". The argument is *not* that touch-screen voting is less efficient, but that it is more difficult for one to tell when an electronic vote has been manipulated. Because *tampering is made visible* with physical systems, the Verified Voting Foundation suggests that they are more appropriate for catching attempted election fraud.

What kinds of mental models?

What kinds of mental models?

- My own behavior

What kinds of mental models?

- My own behavior
- Someone else's behavior

What kinds of mental models?

- My own behavior
- Someone else's behavior
- A software application

What kinds of mental models?

- My own behavior
- Someone else's behavior
- A software application
- ...or any information process that's mediated

Learning Mental Models

- "A text processor is a typewriter"
- "Indeed, the models that learners spontaneously form are incomplete, inconsistent, unstable in time, and often rife with superstition"
  - Olson and Carroll

Consider the above metaphor model that someone might hold. It's been found that the aspects of a system that match the metaphor are learned quickly, but those that don't take a lot longer.

Users / designers communicate through their mental models

- Designer's model = mental/conceptual model of the system
- User's model = mental model developed through interaction with the system
- Designer expects user's model to be the same as the designer's model

- But often it isn't!

Conceptual Model Mismatch

- Mismatch between designer's & user's conceptual models leads to...
  - Slow performance
  - Errors
  - Frustration
  - ...

Principles of mental models

- Controls mapped to actions in an understandable way
- <u>affordances</u> disclose how to performing an action
- <u>sense making</u>: user problem solving allows the user to make sense of the interface
- <u>analogies / examples</u> play a key role in communicating how a design works

Source: Norman, Don. <u>The Design of Everyday Things</u>. Currency, 1990. Klemmer, Scott, Examples Research.
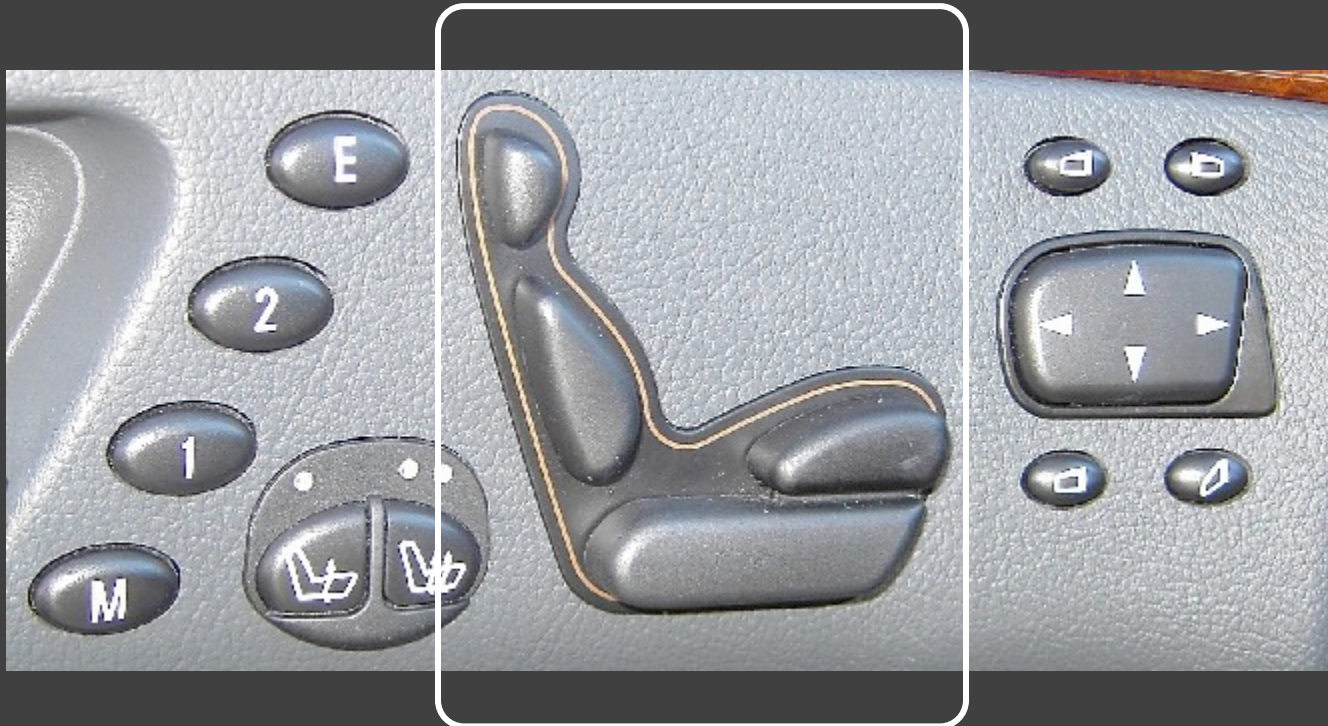
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What happens in good designs

- Good idea of how each object works and how to control it
- Interface itself discloses how it is used

- The art in design is to translate users cognitive capabilities and existing mental models into interfaces that work!

Source: Norman, Don. The Design of Everyday Things. Currency, 1990.

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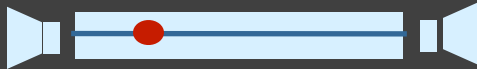
Example (good)

Mercedes S500 Car Seat Controller

Source: http://www.lilviv.com/motoring/cars/s500/seatcont.jpg
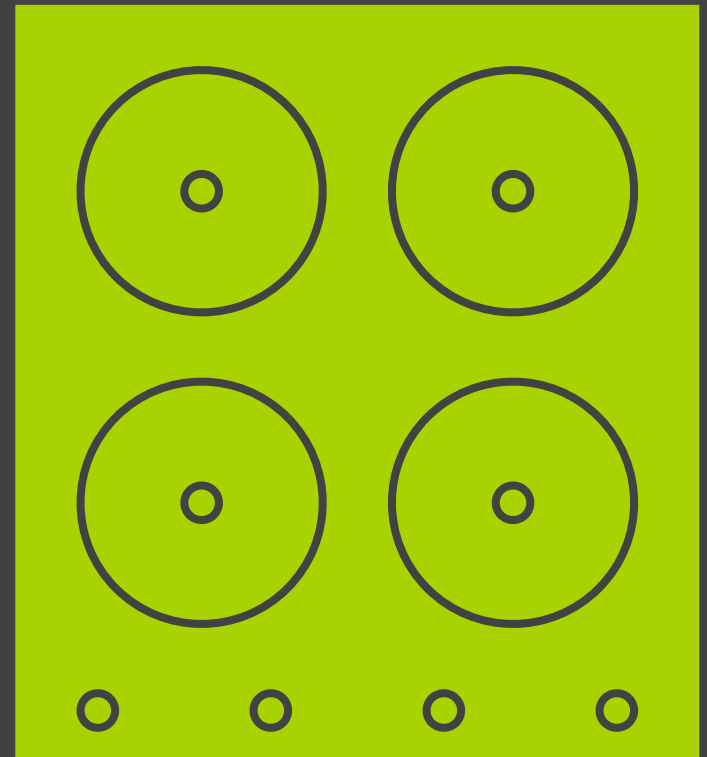
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Map Interface Controls

- Control should mirror real-world
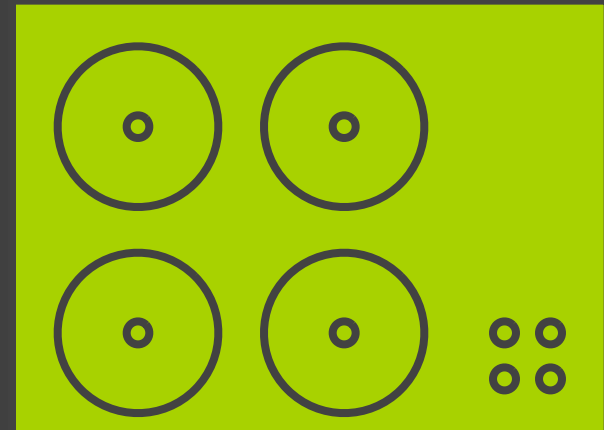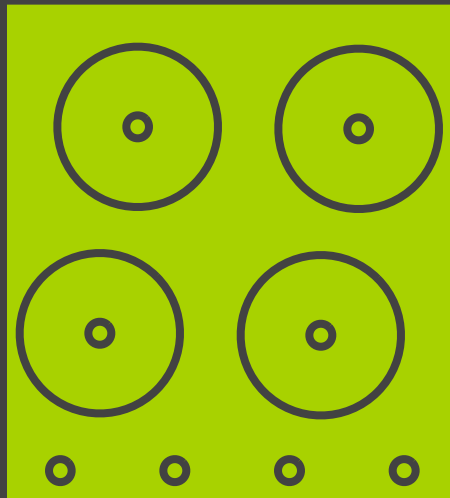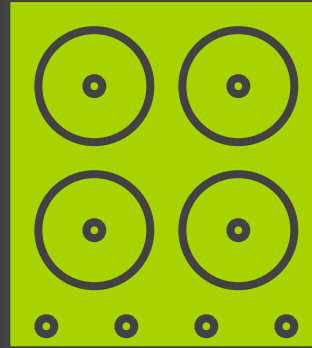- Which is better for dashboard speaker front / back control?
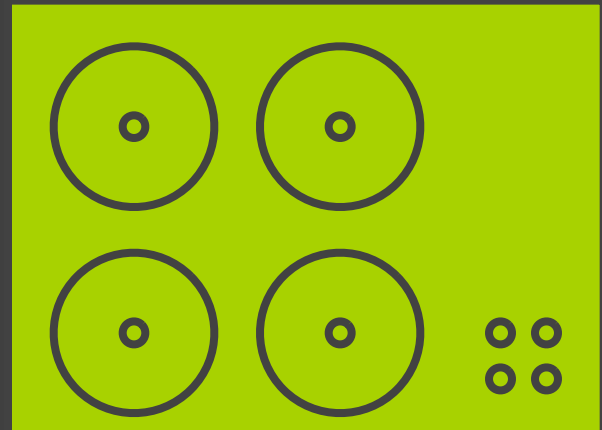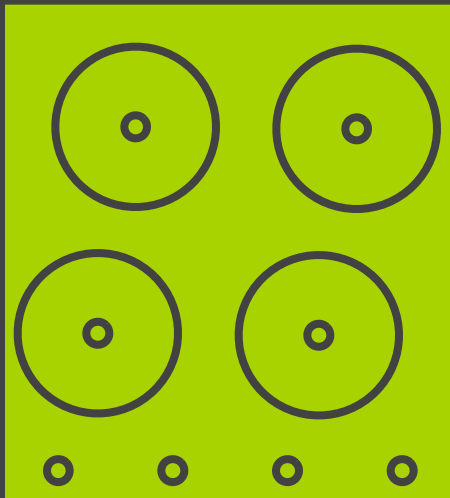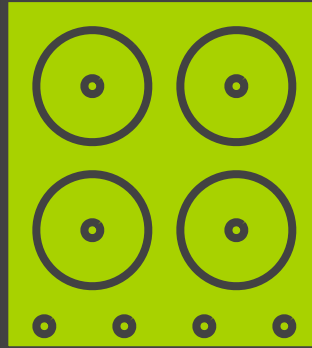
Dashboard

Map Interface Controls

Map Interface Controls

Map Interface Controls

> "If technology is to provide an advantage, the correspondence to the real world must break down at some point."
> — *Jonathan Grudin*

IF "if technology is to provide an advantage, the correspondence to the real world must break down at some point".

Tension: new functionality / drawing on existing human understanding of the world. In the creation of the new, much technology formalizes some aspects of a work practice.

Process/practice divide: "paved paradise and put up a parking lot" — the goals were noble, but important invisible aspects of work practice were denied by the new technology.

interfaces that **are the real world** can obviate many of the difficulties of attempting to *model all of the salient characteristics of a work process as practiced*. This

There exist two (related) arguments for minimizing that distance:

1) Leverage existing learned bodily intuitions and social practices

2) Don't run into the danger of modeling the wrong thing (or forgetting to model the right thing)

Final Scratch

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This is a picture Bjoern took in his prior life as a touring DJ.

You can see his label partner behind the interface of choice of professional DJs worldwide: Two Technics turntables a

What is the laptop doing in the picture?

It is running Final Scratch

FinalScratch affords continuity of practice — skills acquired over years of practice still apply since the physical interface has not changed.

Notice the gaze

Indirection