

Direct Manipulation

Scott Klemmer
Autumn 2009

Thursday, October 1, 2009

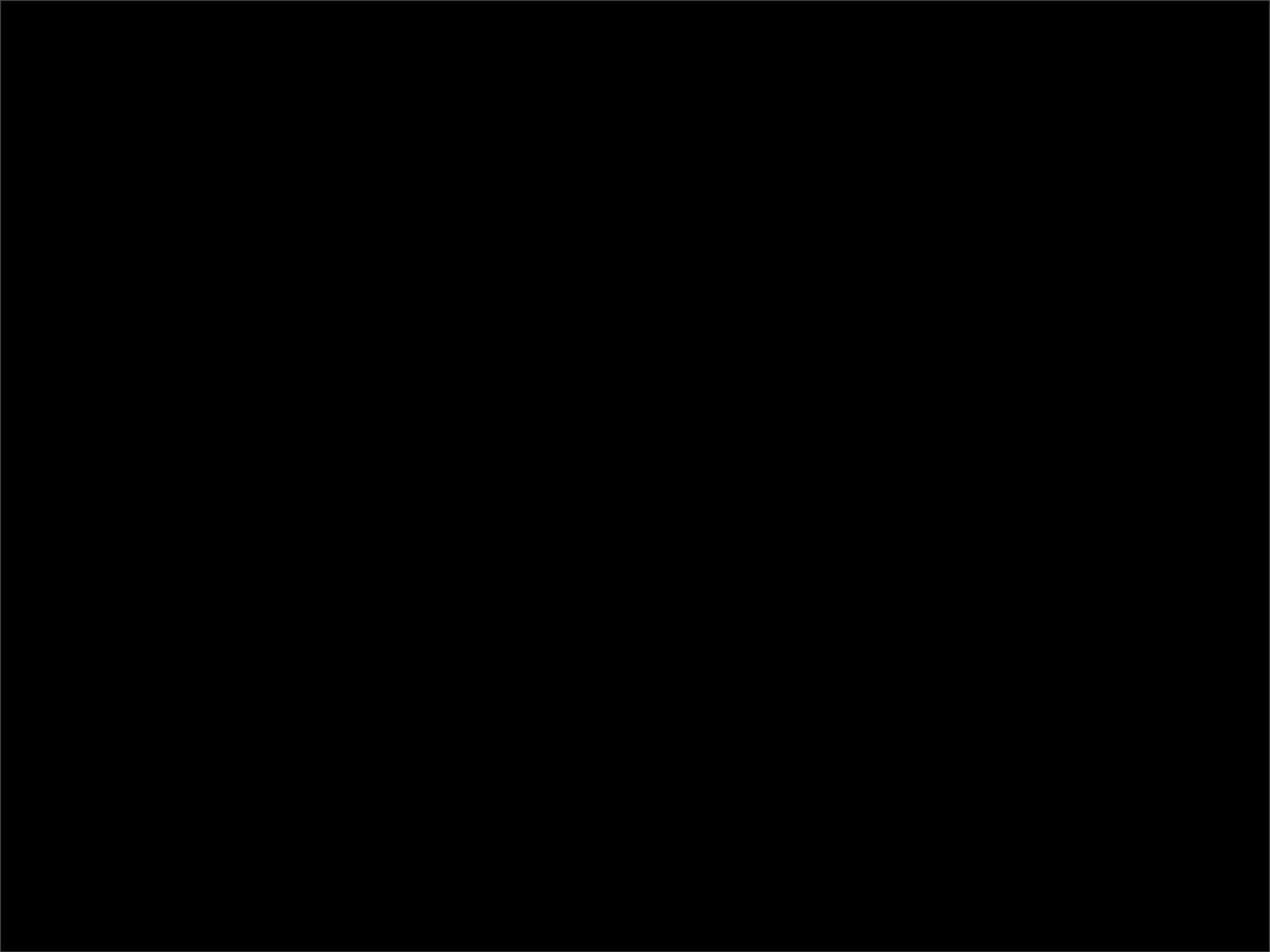
How might this measuring cup be improved?



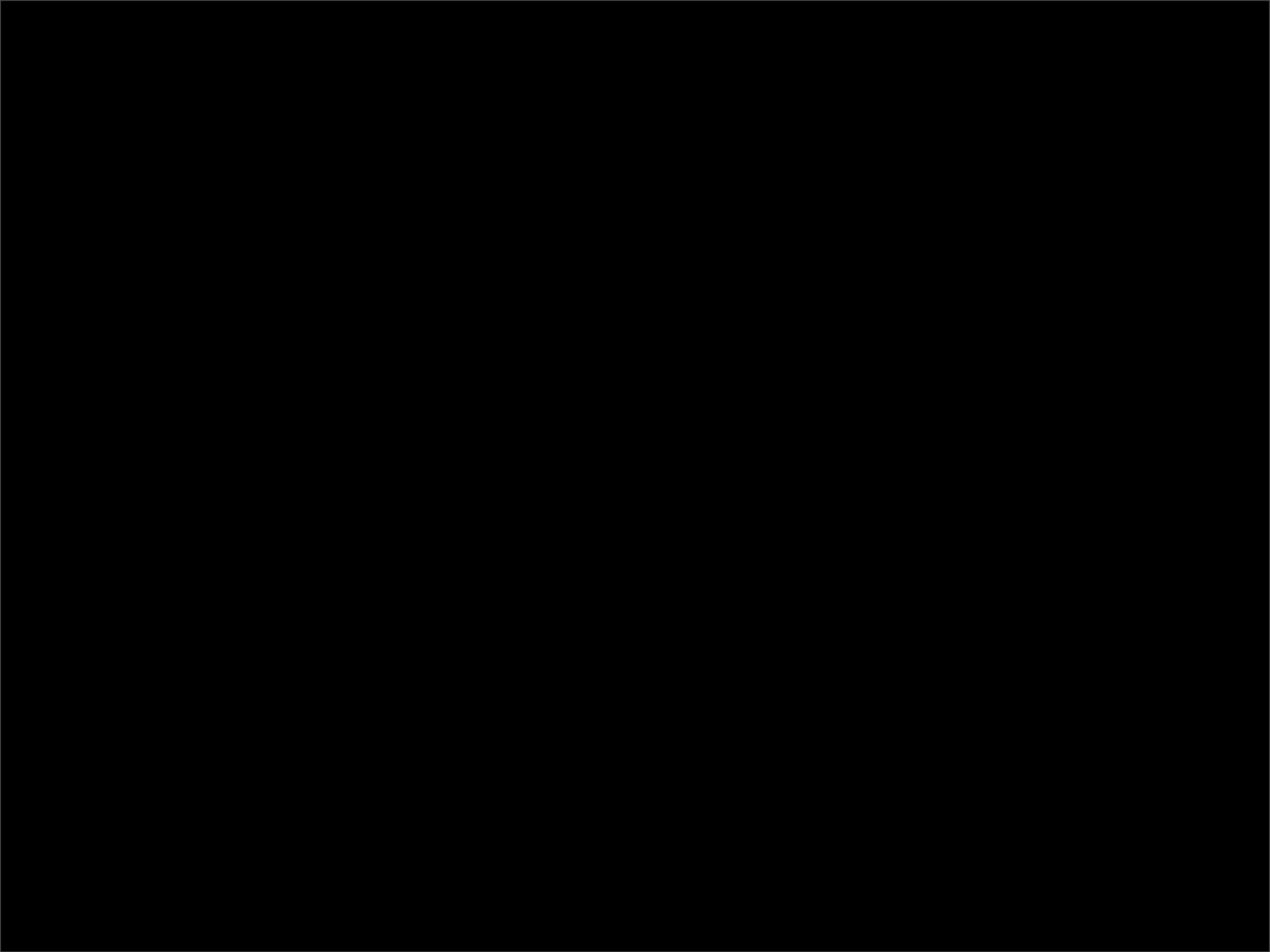
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- How do people learn interactive systems?
- What makes an interface easy or hard?
- Why do people make errors?
- What makes an interface “natural”

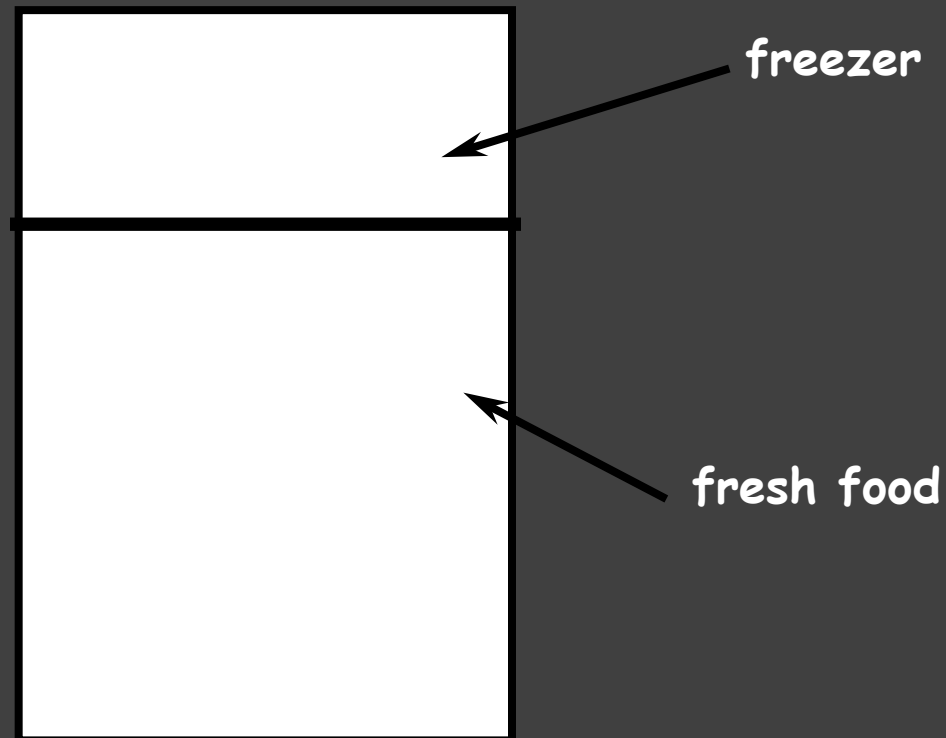
Handles

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Begin with breaking glass

Two kinds of errors: slips & mistakes

Examples (Bad) : Old Refrigerator



Problem: freezer too cold, but fresh food just right

Source: Norman, Don. The Design of Everyday Things. Currency, 1990. James Landay, CS160 UC Berkeley, Mental Models Lecture.

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Example (bad): Refrigerator Controls

Normal Settings

Colder Fresh Food

Coldest Fresh Food

Colder Freezer

Warmer Fresh Food

OFF (both)

C and 4

C and 5-6

B and 7

D and 6-7

C and 3-1

0

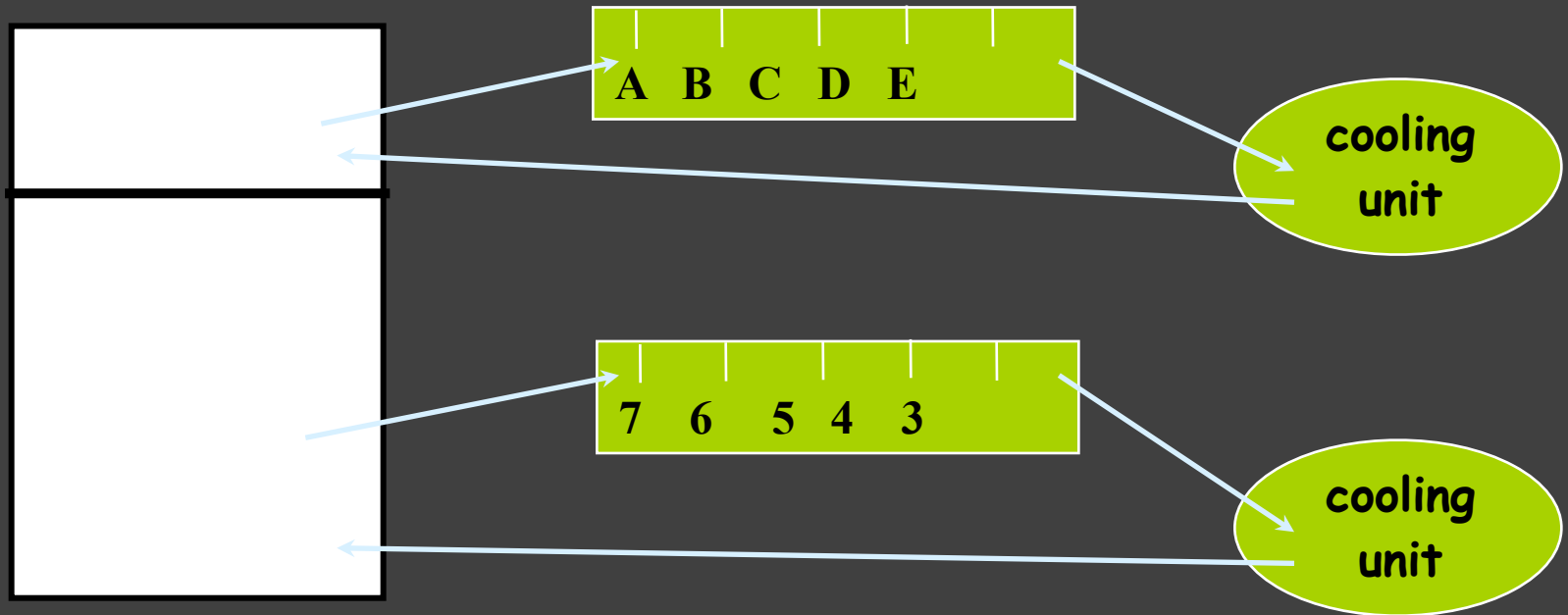


What is your conceptual model?

Source: Norman, Don. *The Design of Everyday Things*. Currency, 1990. James Landay, CS160 UC Berkeley, Mental Models Lecture.

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Example (bad): Most Likely Conceptual Model

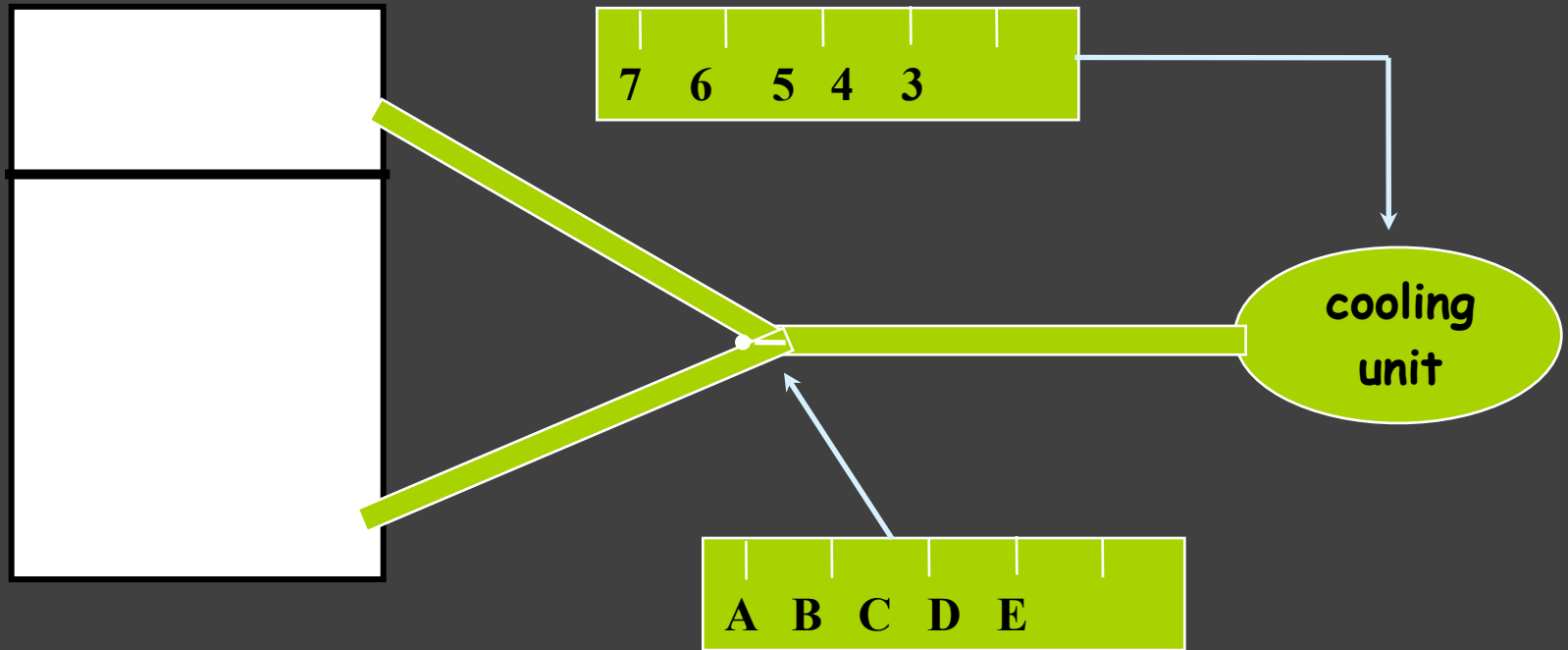


i.e., independent controls

Source: Norman, Don. *The Design of Everyday Things*. Currency, 1990. James Landay, CS160 UC Berkeley, Mental Models Lecture.

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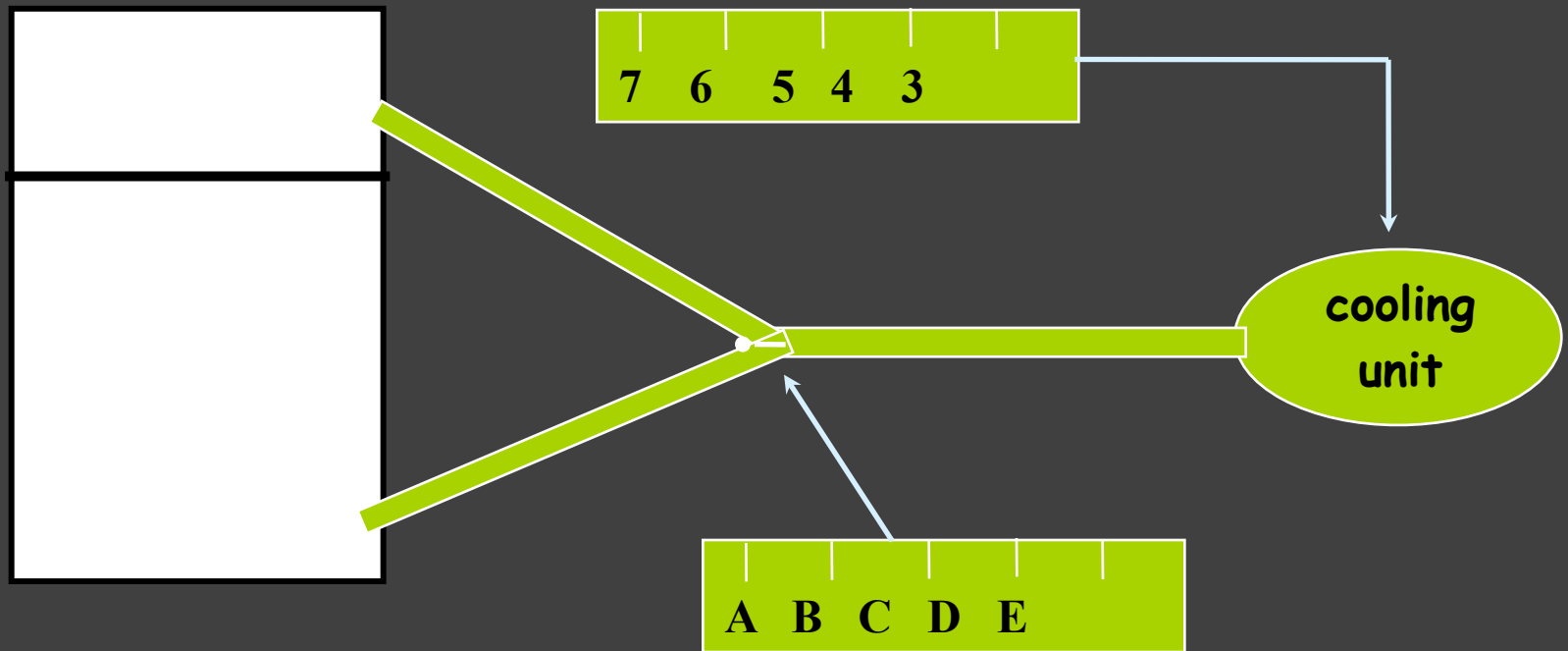
Example (bad): Actual Conceptual Model



Source: Norman, Don. *The Design of Everyday Things*. Currency, 1990. James Landay, CS160 UC Berkeley, Mental Models Lecture.

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Example (bad): Actual Conceptual Model



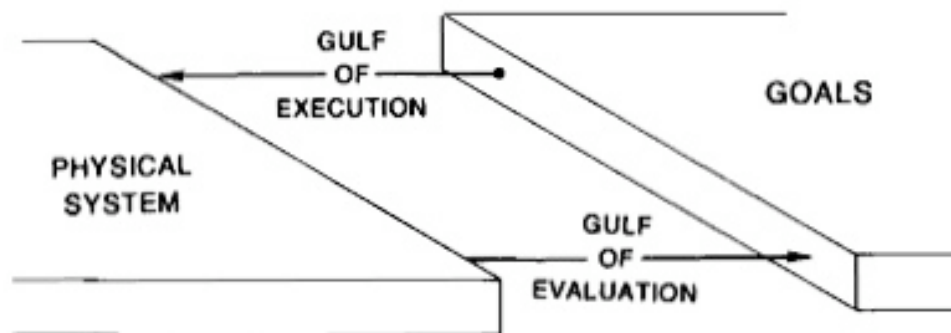
Now can you fix the problem?

Source: Norman, Don. *The Design of Everyday Things*. Currency, 1990. James Landay, CS160 UC Berkeley, Mental Models Lecture.

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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 mapping 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

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Butterfly Ballot

Confusion over Palm Beach County ballot

Although the Democrats are listed second in the column on the left, they are the third hole on the ballot.

(REPUBLICAN)	
GEORGE W. BUSH - PRESIDENT	3 ➔
DICK CHENEY - VICE PRESIDENT	
(DEMOCRATIC)	
AL GORE - PRESIDENT	5 ➔
JOE LIEBERMAN - VICE PRESIDENT	
(LIBERTARIAN)	
HARRY BROWNE - PRESIDENT	7 ➔
ART OLIVIER - VICE PRESIDENT	
(GREEN)	
RALPH NADER - PRESIDENT	9 ➔
WINDA LADUKE - VICE PRESIDENT	
(SOCIALIST WORKERS)	
JAMES HARRIS - PRESIDENT	11 ➔
MARGARET TROWE - VICE PRESIDENT	
(NATURAL LAW)	
JOHN HAGELIN - PRESIDENT	13 ➔
NAT GOLDBERGER - VICE PRESIDENT	

Punching the second hole casts a vote for the Reform Party.

(REFORM)	
PAT BUCHANAN - PRESIDENT	4 ←
EZOLA FOSTER - VICE PRESIDENT	
(SOCIALIST)	
DAVID McREYNOLDS - PRESIDENT	6 ←
MARY CAL HOLLIS - VICE PRESIDENT	
(CONSTITUTION)	
HOWARD PHILLIPS - PRESIDENT	8 ←
J. CURTIS FRAZIER - VICE PRESIDENT	
(WORKERS WORLD)	
MONICA MOOREHEAD - PRESIDENT	10 ←
GLORIA LA RIVA - VICE PRESIDENT	
WRITE-IN CANDIDATE	
To vote for a write-in candidate, follow the directions on the long stub of your ballot card.	

Sun-Sentinel arabic/Daniel Niblock

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VISIBILITY E-Voting



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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?

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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

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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
- affordances disclose how to performing an action
- sense making: user problem solving allows the user to make sense of the interface
- analogies / examples play a key role in communicating how a design works

Source: Norman, Don. The Design of Everyday Things. Currency, 1990. Klemmer, Scott, Examples Research.

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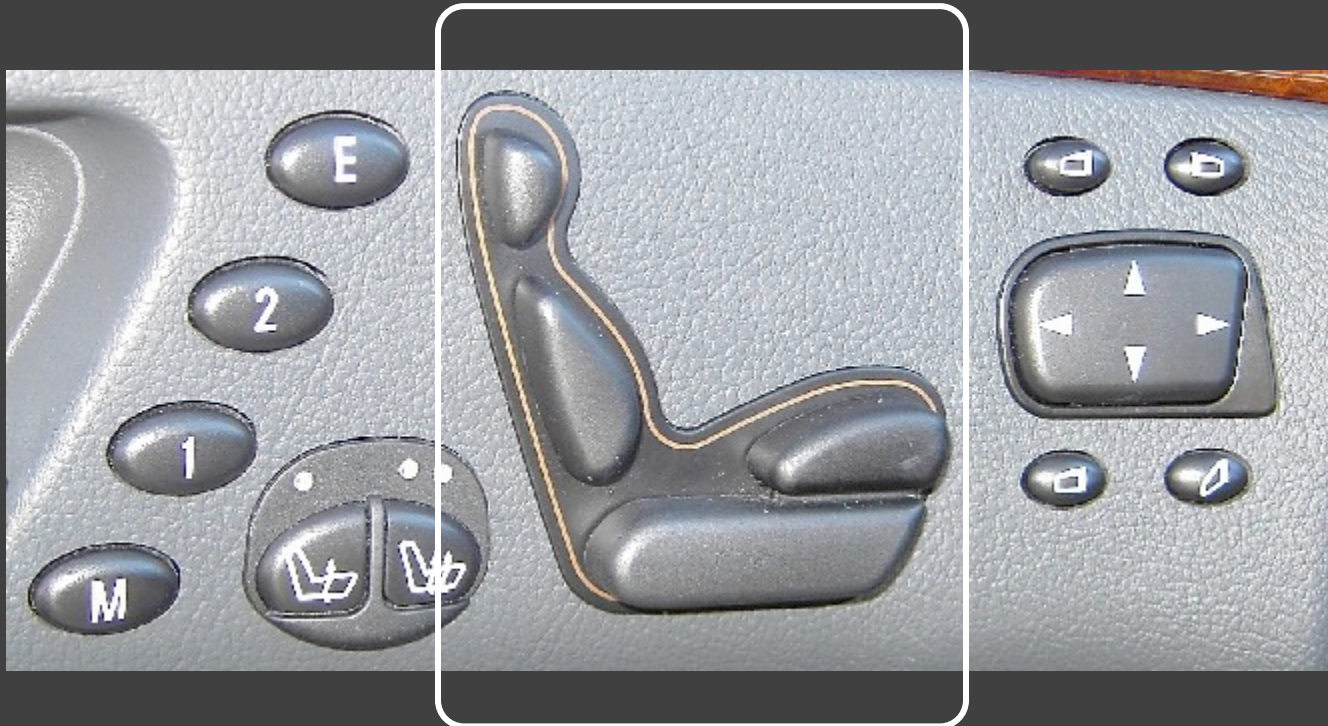
What happens in good designs

- 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

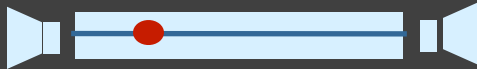
Source: <http://www.lilviv.com/motoring/cars/s500/seatcont.jpg>

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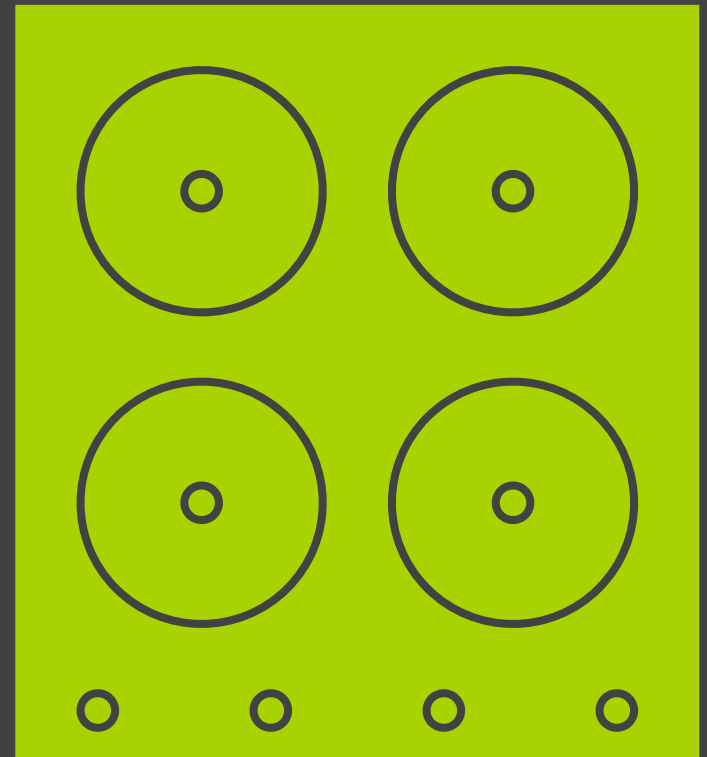
Map Interface Controls

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

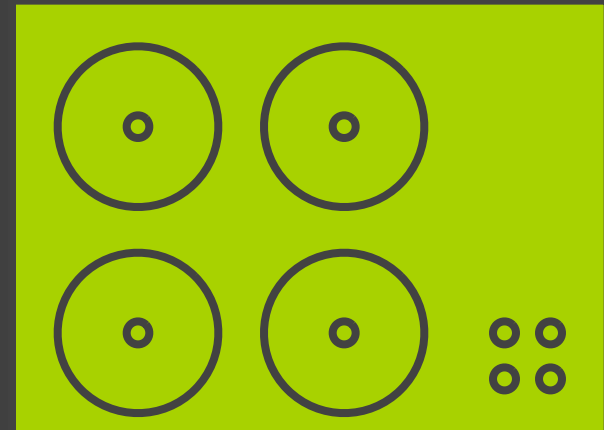
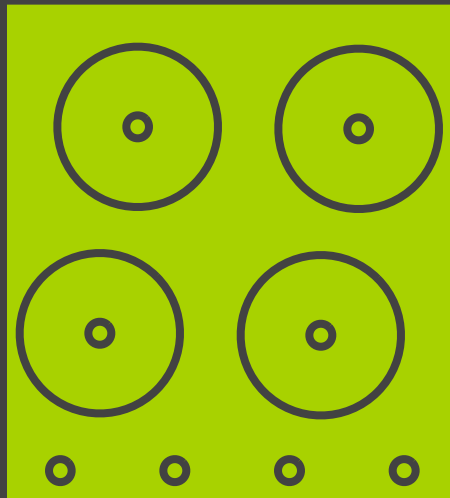
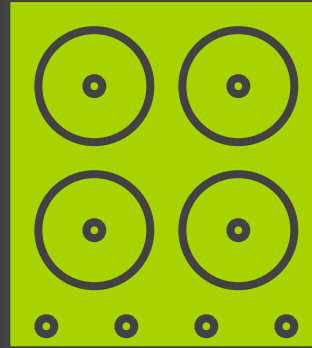
Dashboard



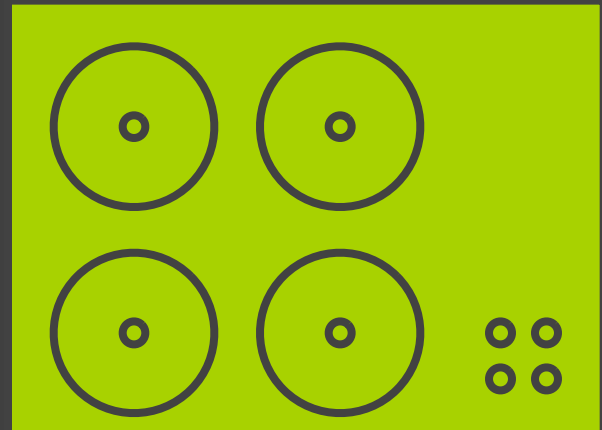
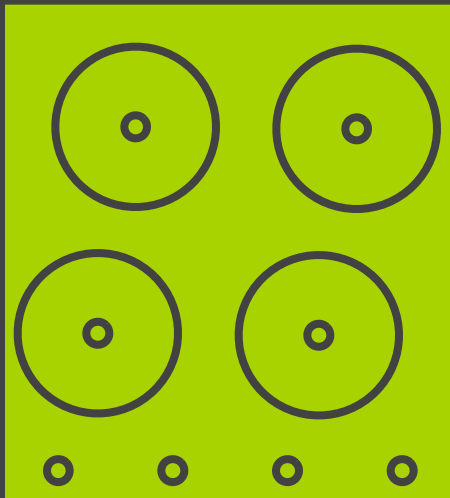
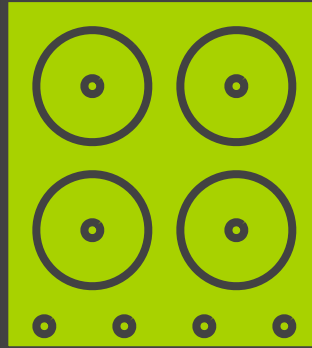
Map Interface Controls



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*

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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



A diagram on a dark gray background. On the left is a large blue circle containing the text 'CURRENT PRACTICE' in white. On the right is a smaller blue circle containing the text 'NEW TECHNOLOGY' in white. A white double-headed arrow points between the two circles. Below the arrow is the text 'minimize this distance'.

CURRENT
PRACTICE

NEW
TECHNOLOGY

minimize
this distance

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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)

THICK PRACTICE 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

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