Introduction to HCI
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Mental Models

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Logistics

- Milestone 1 presentation
  - Brief introduction of your team
  - Problem definition
    - Why is this problem important?
  - Existing solutions
  - Two personas
  - Three tasks

- 4 + 1 minutes

Learning goals

▸ Define mental models, describe their characteristics.
give examples of how a mental model can be acquired

▸ Explain what Norman's 7-stage model is good for:
use gulfs/stages to analyze interactions with a system

▸ Be able to identify a mismatch in mental models
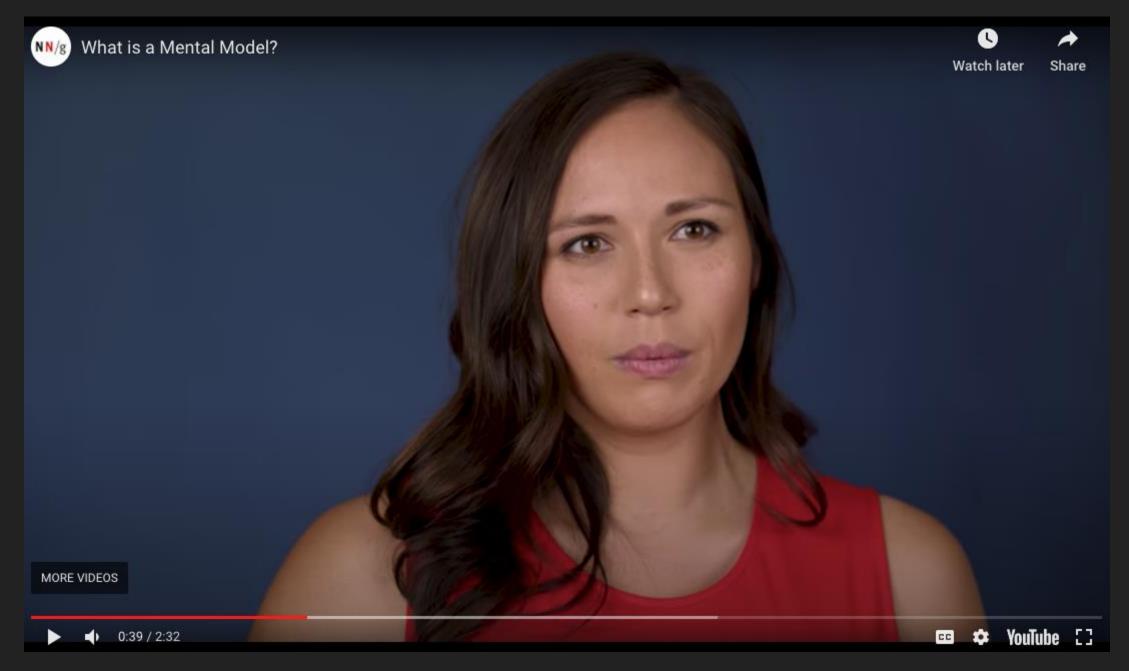give examples of situations or interfaces where mismatch occurs

Mental models

▶ "In interacting with the environment, with others, and with the artifacts of technology, people form internal, mental models of themselves and of the things with which they are interacting. "
                                          -Norman (in gentner & stevens, 1983)

▶ People use their mental models to:
  ▶ Reason about a system
    ▶ How to interact with it; how it works
  ▶ Figure out what to do when things go wrong

Gentner, D., & Stevens, A. L. (Eds.). (2014). *Mental models*. Psychology Press.

https://www.nngroup.com/articles/mental-models/

Why look at cognition?

▸ Part of creating good design is understanding how people reason and react to interface experiences

▸ Cognitive frameworks helps us do this!
  ▸ Theories of cognition provide predictive and explanatory power for understanding user behavior

▸ Internal frameworks:
  ▸ The mental process inside users' head

▸ External frameworks:
  ▸ Interactions with technologies, environment, context

Mental models vs. Conceptual models/design

▸ **Mental models: something the user has (forms)**
  - ▸ Users "see" the system through mental models
  - ▸ Users rely on mental models during usage
  - ▸ There are various forms of mental models
  - ▸ Mental models can support users' interaction

▸ **Conceptual models and conceptual design**
  - ▸ This is what the designer does, to foster good mental model formation by the user

Recall our design concepts:

The basics:
(elements of these in many of the others)

- ▶ affordance
- ▶ signifiers
- ▶ mapping
- ▶ constraints
- ▶ feedback

Other concepts:

- ▶ findability
- ▶ transfer effects
- ▶ cultural associations
- ▶ individual differences

▶ All inform a user' mental model

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An object that helps you form a mental model: scissors

▸ Affordances:
  ▸ Holes for something to be inserted
▸ Constraints:
  ▸ Big hole for several fingers, small hole for thumb
▸ Mapping:
  ▸ Holes-for-fingers suggested / constrained by appearance
▸ Positive transfer and cultural idioms
  ▸ Learnt when young; constant mechanism

▸ Mental model:
  ▸ Physical object implies how the operating parts work

An object that helps you form a mental model: scissors

A reasonable mental model can be formed by just looking at and perhaps holding the object.
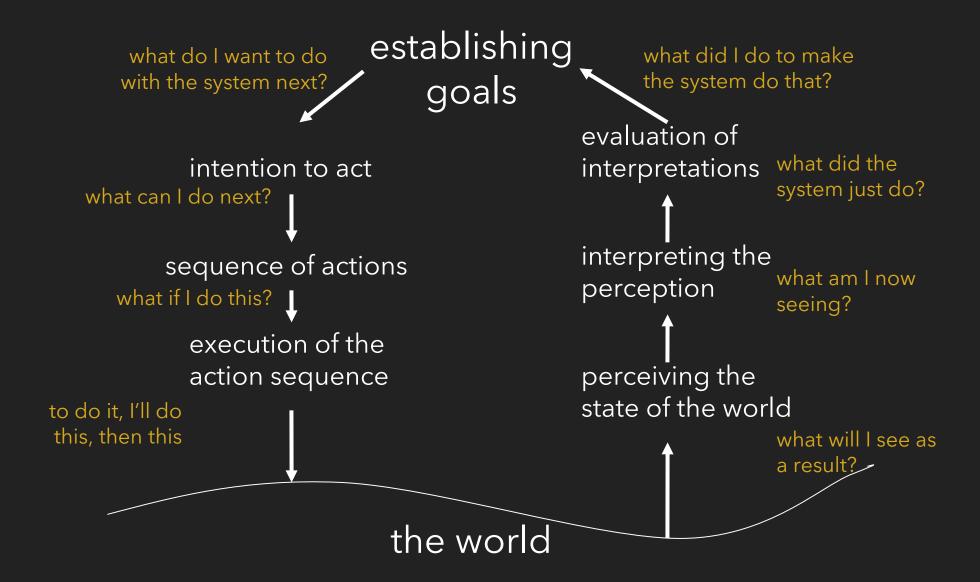
Some things you don't understand you do anyway: why is the larger blade at the bottom?

An object that hinders mental model formation: "old style" digital watch

12:00

- Affordances - mixed:
  - Four buttons are clearly for pushing and the screen shows a number – but unclear what the entire object affords
    telling time? Setting alarms, timers, viewing heartrate, other data?
- Visibility – lousy:
  - What will happen if you push each button? What mode is watch in?
- Constraints and mapping - unknown:
  - No visible relation between buttons, possible actions and end result
- Transfer of training:
  - Little relation to analog watches. But, maybe from other digital devices.
- Cultural idiom:
  - Some standardized core controls and functions but others variable

- Mental model:
  - Must be taught, or learned by trial/error

What mental models tell the user

establishing goals

what do I want to do with the system next?

what did I do to make the system do that?

intention to act

what can I do next?

evaluation of interpretations

what did the system just do?

sequence of actions

what if I do this?

interpreting the perception

what am I now seeing?

execution of the action sequence

perceiving the state of the world

to do it, I'll do this, then this

what will I see as a result?

the world

Norman's seven-stage model

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Norman's seven-stage model: What is it good for?

- Internal framework: best for exploratory learning
  - But this is just one way to form a mental model of a system

- Less applicable to highly learned, semiautomatic behavior
  - User has already developed strong expectation of what will happen/how it will happen

Model mismatches

▸ Misconceptions happen when user's model differs in critical ways from how the system actually works.

  ▸ e.g., "more is more" belief about interactions.

  ▸ press 'walk button' repeatedly -> light changes faster

  ▸ high oven temperature makes oven heat faster

  ▸ folk theories and remedies for computing

  ▸ rebooting computer to make projector work

▸ We do these things because it feels like it makes a difference, but we don't have a correct model of how they work!

The Designer's Model, the User's Model, and the System Image

The designers also has a mental model but they do not necessarily match with the users' mental model.

Acquiring mental models

- During system usage:
  - The user's own activity leads to a mental model
  - Explanatory theory, developed by the user
  - Often used to predict future behavior of the system

- Observing others using the system:
  - Casual observation of others working
  - Asking someone else to "do this for me"
  - Formal training sessions

- Reading about a system
  - Documentation, help screens

- This is done by the user (not the designer)

Some characteristics of mental models

▸ Incomplete

▸ Constantly evolving

▸ Not accurate representation
  ▸ (contain errors and uncertainty measures)

▸ Provide a simple representation of a complex phenomena

▸ Can be represented by a set of if-then-else rules

Work-in class

▸ Break out in teams

▸ Discuss the project progress and milestone 1

▸ Consult with the teaching staff about any questions you might have

Optional reading

▸ Gentner, D., & Stevens, A. L. (Eds.). (2014). *Mental models*. Psychology Press.

▸ Mental Models - https://www.nngroup.com/articles/mental-models/