

# Human Computer Interaction

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Models of Human Thoughts  
and Behavior – Part 1



# Class Updates

- › Grades for A2 and A3 released!

Visibility

Feedback

Constraints

**Consistency**

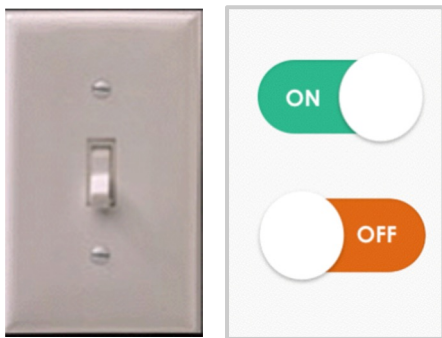
**Affordances**

**Mapping**

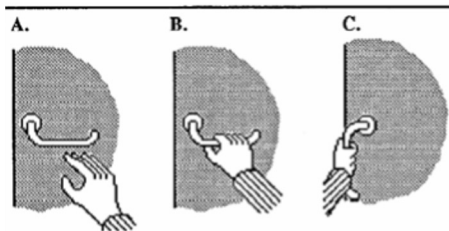


Last Class

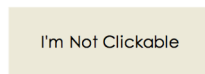
# Last Class



Switches afford flipping. In the digital world, we communicate affordances by mimicking the physical world and maintaining external consistency.



some affordances are sequential, revealed in sequence



false & hidden affordances = bad;  
signifiers communicate affordance

[click here](#)



visit [Canvas](#)



knowing what will happen when you interact with the system is a sign of good mapping



Search

Become a Host

No time to host?

Trips

Messages

Help



About Press Careers Blog

About Us

Founders

## About Us

Founded in August of 2008 and based in San Francisco, California, Airbnb is a trusted community marketplace for people to list, discover, and book unique accommodations around the world — online or from a mobile phone or tablet.

Whether an apartment for a night, a castle for a week, or a villa for a month, Airbnb connects people to unique travel experiences, at any price point, in more than 65,000 cities and 191 countries. And with world-class customer service and a growing community of users, Airbnb is the easiest way for people to monetize their extra space and showcase it to an audience of millions.



Total Guests  
150,000,000+



Cities  
65,000+



Castles  
1,400+



Countries  
191+

not  
clickable!?



false  
affordance?

not  
clickable!?



opens a  
popup  
messaging  
app

moves  
page down

expands a  
list... +  
sign helps

## About this listing

Ready for the new DC? This apartment will put you right in the heart. I have spared no expense putting this place together. Suitable for corporate clients and families. The unit is plush, eclectic and spacious. Free on-site parking!



[Contact Host](#)



### The Space

Accommodates: 6  
Bathrooms: 2  
Bedrooms: 2  
Beds: 4  
[House Rules](#)

Check In: **Anytime after 4PM**  
Check Out: **11AM**  
Property type: **Apartment**  
Room type: **Entire home/apt**

### Amenities

 Kitchen  
 Internet  
[+ More](#)

 TV  
 Essentials

### Prices


Extra people: **No Charge**  
Cleaning Fee: **\$100**  
Security Deposit: **\$500**




Weekly discount: **10%**  
Monthly discount: **20%**  
Cancellation: **Strict**

### Description

#### Sleeping Arrangements

  
**Bedroom 1**  
1 king bed

  
**Bedroom 2**  
1 queen bed

    
**Common spaces**  
2 single beds, 1 couch

#### The Space

City Center is a town in itself. Cosmopolitan, convenient and with every amenity you can think of. Not only is it steps from all the major tourist attractions in DC, it is its own attraction! The Capital, Washington Monument, Convention Center,

poor  
mapping?

opens a  
different  
page

# Models of Human Thoughts and Behavior

High-level, widely applicable frameworks  
to draw on during design/eval as well as to  
support communication and teaching

Theories

Principles

Guidelines

General



Specific



Each theory is just one  
(hopefully useful) way of  
*representing* real-world  
phenomena



# Human As...

- › Information processor machine
- › Rational decision maker
- › Reflective, situated actors
- › ...



# Human As...

- › Information processor machine
- › Rational decision maker
- › Reflective, situated actors
- › ...

deep dive  
today



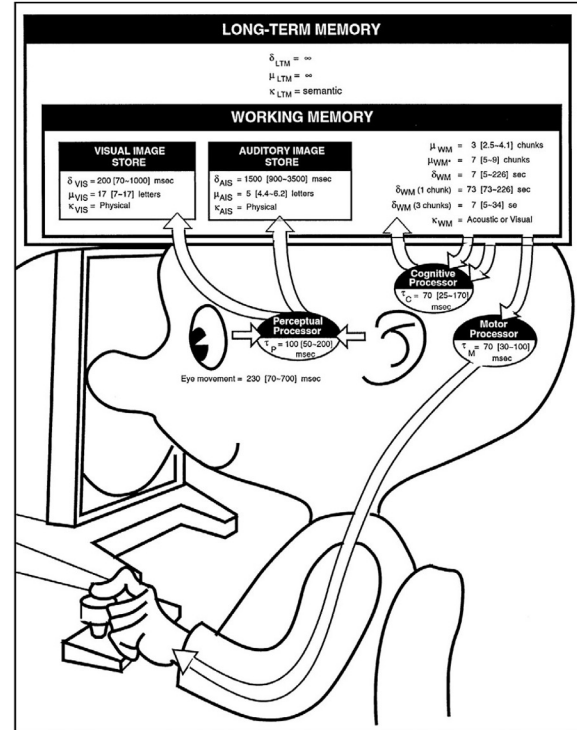


# Are Humans (Like) Machines?

- › 4 min, groups of 2-3
- › Brainstorm 2 lists:
  - How are humans like computers?
  - How are humans different from computers?

# Theory 1: Humans as Info. Processors

- › Humans comprise 3 systems:
  - Perceptual
  - Cognitive
  - Motor
- › Each has its own memories and processors
- › There are principles of operation (e.g., the Rationality Principle)



Parameter	Mean	Range
Eye movement time	230 ms	70-700 ms
Decay half-life of visual image storage	200 ms	90-1000 ms
Visual Capacity	17 letters	7-17 letters
Decay half-life of auditory storage	1500 ms	90-3500 ms
Auditory Capacity	5 letters	4.4-6.2 letters
→ Perceptual processor cycle time	100 ms	50-200 ms
Cognitive processor cycle time	70 ms	25-170 ms
Motor processor cycle time	70 ms	30-100 ms
Effective working memory capacity	7 chunks	5-9 chunks
Pure working memory capacity	3 chunks	2.5-4.2 chunks

## Example 1: Visual Frame Rate

**60 fps?**  
**frame rate test**

**15**

**30**

**60**

**120**



# Frame Rates for Video

- › If we want to achieve **visual fusion**, frame rate needs to consider the human perceptual system.
- › Cycle time of perceptual processor = 100msec =  $1/10$  sec
  - Frame rate  $> 1/(\text{cycle time})$
  - Frame rate  $> 10$  frames/sec
- › So, any frame rate greater than ~10 fps should achieve visual fusion





## Example 2: Memory

- › Types of memory:
  - **Declarative:** Remembering *what*
  - **Procedural:** Remembering *how*
- › Encoding: committing something to long-term memory
- › Repetition: a means of encoding

R T J V P

**Can you recite the letters?**

R G I A W A  
O C R D D O B  
C T B T I B

**Can you recite the letters?**

Cow

Dog

Bird

Cat

Rabbit

**Can you recite the animals?**

which was  
easiest to  
remember?

**Can you recite 5 letters?**

**Can you recite 19 letters?**

**Can you recite 5 animals?**



Parameter	Mean	Range
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# Memory in Each System

## > Motor system:

- Muscle memory



VS.



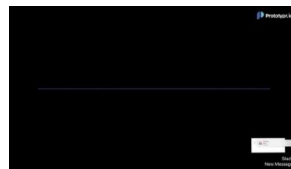
breakdown when  
typing password on  
phone

## > Perceptual system:

- Visual & audio memory



what does  
this signify?



this?

## > Cognitive system:

- Short & long term  
memory storage

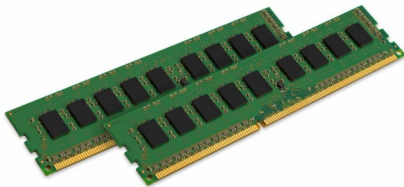
SMS with 24273  
Yesterday, 6:17 PM

Thank you for adding your Chase  
credit card to your digital wallet.  
Please use this one-time activation  
code to complete enrollment:  
271510

two-factor  
authentication vs.  
your password

# Memory in Each System

- › Can't remember things for long w/o practice
- › Can keep limited # items in short-term memory:  
**7 plus or minus 2** (Miller's "magic number")
- › Grouping and hierarchy Mnemonics



RAM (short-term)

VS.



SSD/HDD (long-term)

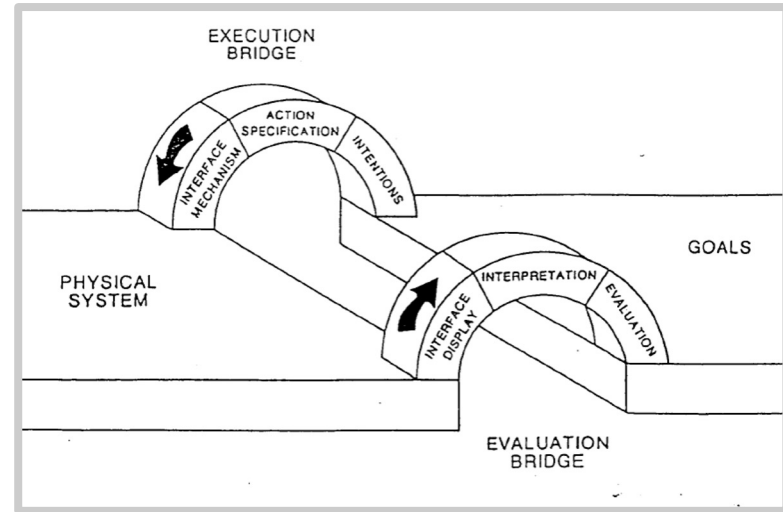


# Human Processor Model: Big Picture

- › It's a metaphor!
- › Uses computers as a model for humans
  - Long tradition of these metaphors
- › Short & long-term memory
  - e.g., RAM vs. disks
- › Helps us predict and understand human performance

## Theory 2: Humans as Rational Decision Makers

- › Slightly different theory that explains how people **act** in the world
- › Every action is a transition between the current state of the world and a future intended state of the world



*as depicted in Norman's book*

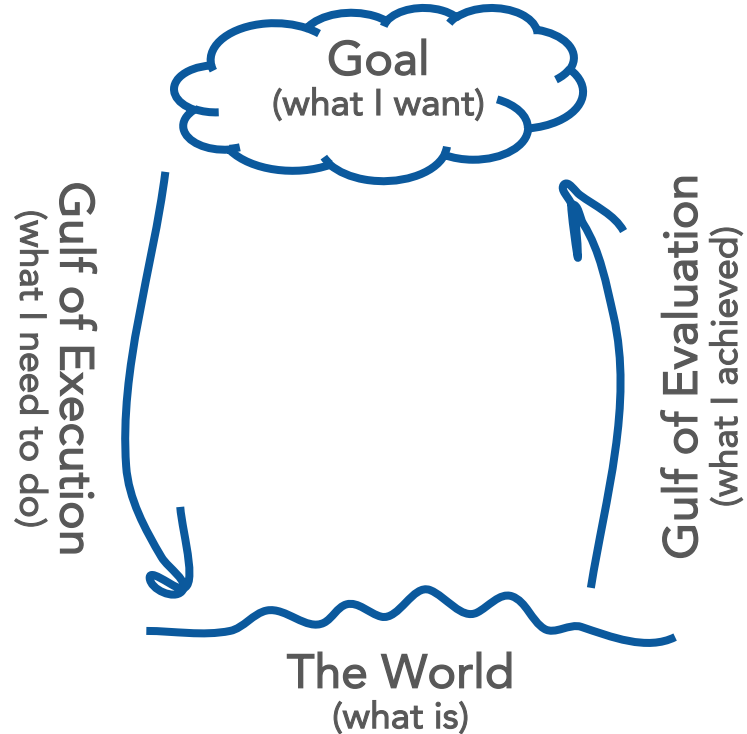
# Gulfs of Execution and Evaluation

## > Gulf of Evaluation:

- Is the world the way I want it?

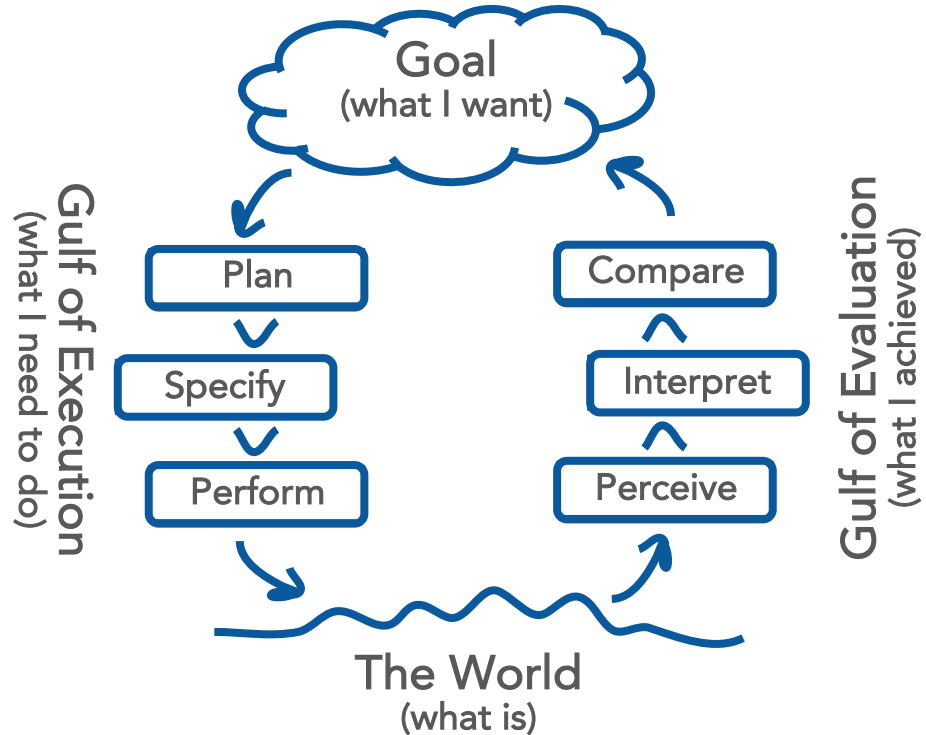
## > Gulf of Execution:

- How do I make the world be as I want it to be?



# The Seven Stages of Action

1. Forming the goal
2. Forming the plan
3. Specifying an action
4. Performing the action
5. Perceiving the state of the world
6. Interpreting the state of the world
7. Comparing the outcome to the initial goal





**CANVAS**

Activity 04

15 minutes

## A04: Tell a UX Story From a Particular Theoretical Perspective

Consider password creation UIs on the following slide. Choose ONE interface (A,B,C, or D) and describe ONE good or bad design aspect using ONE of the theories:

- › Human Processor Model
- › Seven Stages of Action



A

Password

.....

Show password

Password must contain numbers

Password must contain uppercase letters

Password must have at least one @#\$ symbol

Length must be greater than 8 characters

Password should not contain strings

Password must not contain repetitions

C

Need a password? Try the 1Password Strong Password Generator.

Generate secure, random passwords to stay safe online.

pascal - legacy - bumpy - mignon

Memorable Password

Copy Secure Password

Length 4

Capitalize

Full Words

D

Password

Confirm Password

Security Questions

Select three security questions that you know the answer to. Your identity should you forget your password.

Security Question

Answer

Security Question

Answer

Use: 8-20 characters Upper & lowercase letters Number(s)

.....

Retype password

Password must:

- Have at least one lower case character
- Have at least one capital letter
- Have at least one number
- Your password must not contain more than 2 consecutive identical characters.
- Not be the same as the account name
- Be at least 8 characters
- Not be a common password

B

My Account password

.....

Security level of this password: Not very secure

At least 6 alphanumeric characters.

Show password

Personalize your deals

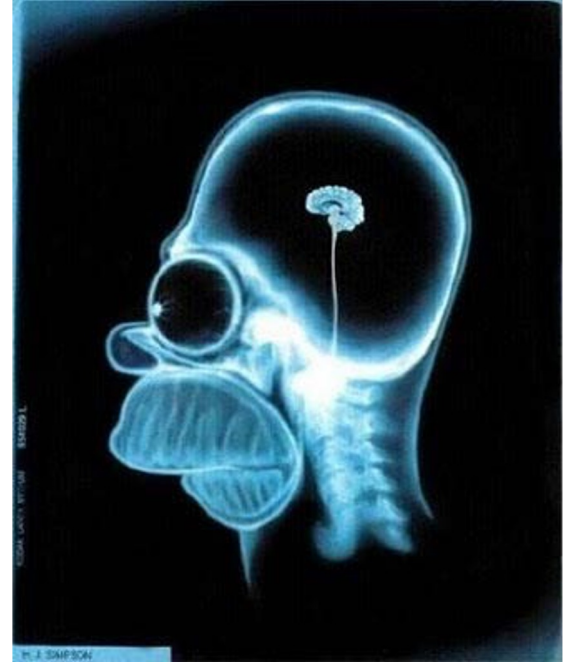
Book faster

Strong

Include capital letters, special characters, and numbers to increase your password strength

# Cognition

Acquiring knowledge and understanding through thought, experience, and the senses





# Systems of Cognition

Subconscious  
(visceral/behavioral):

- › Fast
- › Automatic
- › Multiple resources
- › Controls skilled / expert behavior

Conscious (reflective):

- › Slow
- › Controlled
- › Limited resources
- › Invoked for novel situations (learning, danger, error)



# Norman's 3 Levels of Processing

## > Visceral

- fast, subconscious, often tied to motor system

## > Behavioral

- trained actions, largely subconscious

## > Reflective

- conscious cognition, slow



CHECK FOR UNDERSTANDING

Which cognitive system is being used?

- A. Visceral
- B. Behavioral
- C. Reflective



Assembling furniture using instruction manual



CHECK FOR UNDERSTANDING

# Which cognitive system is being used?

- A. Visceral
- B. Behavioral
- ☒ C. Reflective



Assembling furniture using instruction manual



CHECK FOR UNDERSTANDING

Which cognitive system is being used?

- A. Visceral
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- C. Reflective



Judit Polgár, chess International Master, preparing for her next move



CHECK FOR UNDERSTANDING

Which cognitive system is being used?

- A. Visceral
- ☒ B. Behavioral
- C. Reflective



Judit Polgár, chess International Master





CHECK FOR UNDERSTANDING

Which cognitive system is being used?

- A. Visceral
- B. Behavioral
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surprise response to immersive movie experience



CHECK FOR UNDERSTANDING

Which cognitive system is being used?



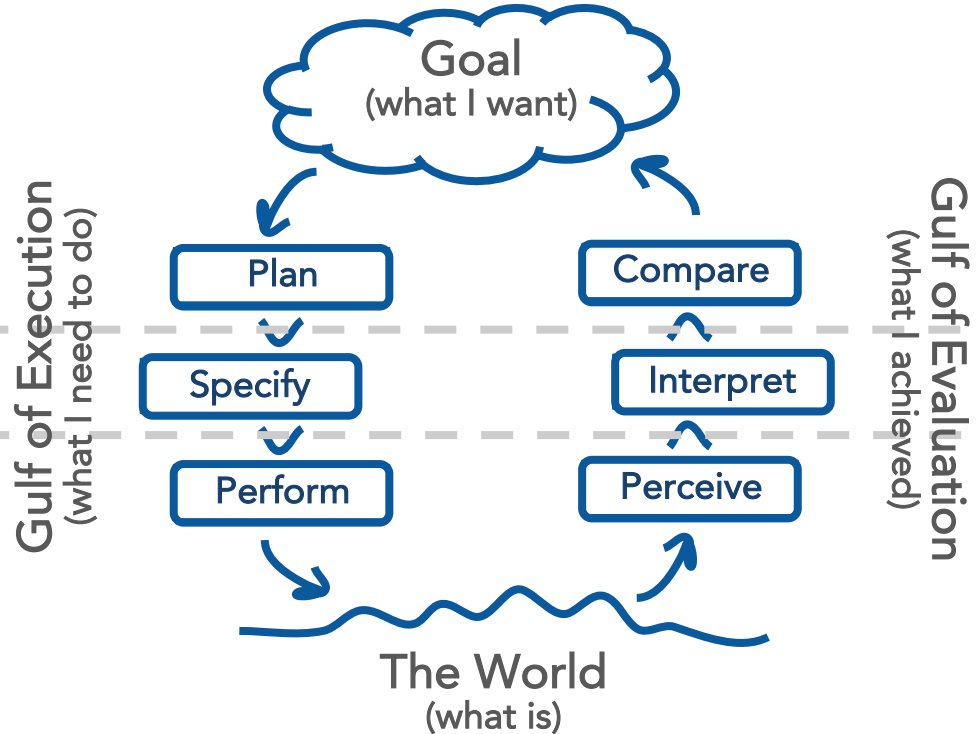
- A. Visceral
- B. Behavioral
- C. Reflective



surprise response to immersive movie experience

# Processing Systems & Stages of Action

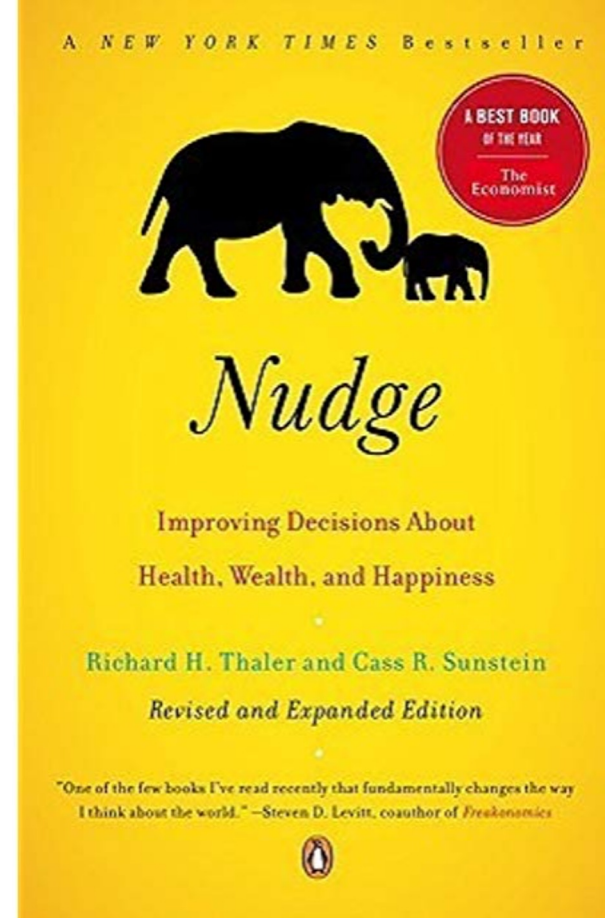
Reflective  
Behavioral  
Visceral



# **Other Models of Cognition**

# Bounded Rationality

- › Humans are *sort of* rational
  - Generally we act in our own best interests
  - But we don't always know what our best interests are
- › Specifically, rationality is limited by:
  - Cognitive abilities
  - Information
  - Time



popular design book that  
adopts this perspective

# Situated Cognition

- › Action is not determined just by cognition in the brain
- › Action is defined in the relationship between:
  - brain
  - environmental context

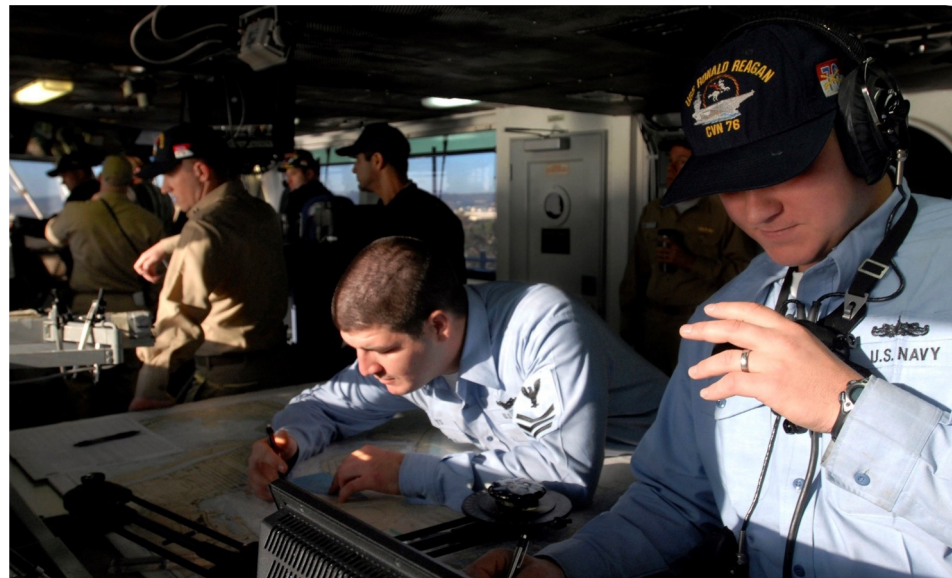


classic example: navigating river rapids;  
you come in with a plan, but take  
reactionary, situated action in the moment



# Distributed Cognition

- › Cognition isn't just inside the brain
- › Cognition resides in:
  - actors (i.e., people)
  - artifacts (e.g., a checklist)



classic example: air traffic controllers and the use of paper to indicate responsibility

# Embodied Cognition

- › Thinking isn't just in the mind, it's in the body



classic example: an experienced carpenter's reflexive use of a hammer





# Humans as People

- › In the end, models and metaphors are just tools
- › They help us during design, but are simplifications
- › Never forget: people are more complex, unpredictable, and interesting than the models can capture

# Human Computer Interaction

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Models of Human Thoughts  
and Behavior – Part 1

Materials in this course were compiled from courses taught by: Matt Bietz, Stacy Branham, Tyler Fox, Elena Agapie, Nigini Oliveira, Katharina Reinecke, Andrew Davidson, Jennifer Tums, Daniel Epstein, Andrea Hartzler. Thank you to all.