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HUMAN ABILITIES

...and their implications for design

human-computer interaction CSE 440 WINTER 2015

JAN 29 - WEEK 4 - THURSDAY



Today

- Re-cap for Assignment 2f and final report [10m] -sketches, storyboards, scenarios
- Re-cap design principles (cont'd from Tue) [30m]
- Human abilities [40m]
- Q&A about assignments [10m]





Jan 26	Jan 27	Jan 28	Jan 29	Jan 30
WEEK 4 Maya Office Hour 1:30 - 2:30 CSE 542	Design principles 10:30 - 11:50 EEB 045 2e - Task Review		Human Performance 10:30 - 11:50 EEB 045	Sections 10:30 - 11:20 MGH 287 1:30 - 2:20 MGH 254 2f - Design Check-in
Feb 2	Feb 3	Feb 4	Feb 5	Feb 6
Reading1: Research Paper Maya Office Hour 1:30 - 2:30 CSE 542	Paper prototyping 10:30 - 11:50 EEB 045		Presentations 10:30 - 11:50 EEB 045	Presentations 10:30 - 11:20 MGH 287 1:30 - 2:20 MGH 254
	2g - Getting the Right Design Report			



Assignment 2f: Design check-in

- Revise the tasks (if needed)
- Brainstorm three designs, describe and sketch -Should be significantly different



Design sketches

Communicating ideas visually





Design sketches

Include only what is required to render the intended purpose or concept





Design sketches

Highlight relevant functionality

Show relations between different sketches





Design sketch example I



Figure 1: Tracking Liquid Intake Over Time

Figure 2: Finding Motivation for Proper Hydration





Figure 4: Convenient Reminders to Drink Water



Design sketch example 2



Figure 1 Tracking Liquid Intake Over Time

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Design sketch example 3

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Storyboard

- You will do this for the final report, due next Tue.
- Can include some design details, but still focus is on the task.



Storyboard example I



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Storyboard example 2



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Scenario example I

Annie is a junior student at University of Washington lives in an apartment in Udistrict. Annie wakes up at 8:00 AM, and drinks some water from her Aqueous water bottle. The bottle then sends a data to her mobile app about what kind of liquid she drinks and the amount. On her way to school, Annie stops by a coffee shop and gets a cup of Latte for herself. Since Annie doesn't want to pour the coffee to Aqueous bottle, she opens her Aqueous app and manually input her coffee drink for tracking. In the afternoon, Annie refills her bottle with orange juice. As she drinking the juice from the bottle, her phone app keeps tracking her beverage intake by data received from the bottle. Annie finishes her day in school, and she opens her Aqueous app as she is waiting for the bus. The app tells her that she has finished her liquid intake goal for today, and also shows a line chart of her weekly liquid intake.





Scenario example 2

Bob is a senior designer at Google. Bob starts working at 9:00AM with his design work. Bob has a Aqueous bottle with him at the office. Latter in the morning, the bottle turns red to remind Bob to drink some water. But Bob is too busy with his work, and just ignores the bottle. After three hours of working, it is 12:00 PM and Bob decides to get some lunch. Then, Bob's phone is vibrating and sending him a reminder to remind him take some water during lunch break. Bob then realizes that he didn't take any water for morning, and grabs his bottle to drink water.





DESIGN PRINCIPLES



Design principles

Don Norman, Design of Everyday Things.







Fundamental concepts/principles

- Conceptual/mental models
- Affordances
- Signifiers
- Mappings
- Feedback
- Constraints







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Affordances



Handles afford pulling

- Jointly determined by:
 - -qualities of the object
 - -abilities of the agent
- They exist even if they are not visible



Affordances





Affordances





Signifiers new!

- Affordances determine what actions are possible
- Signifiers **communicate** what actions are possible and where/how the action should take place
 - -Touch displays: which parts can be touched, tapped, slid up/down/sides...







Signifiers new!



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V8









• We are very sensitive to contingency



• We are very sensitive to contingency





- Beeps
- Sounds
- Lights
- Progress bars



- Beeps
- Sounds
- Lights
- Progress bars

Neilsen's heuristics: - Good error messages - Visibility of system status



Everyday actions

Gulf of execution and evaluation





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Everyday actions

Gulf of execution and evaluation



Bridge of execution and evaluation





Everyday actions

Bridge of execution and evaluation





Three levels of processing

Three Levels of Processing






Seven principles

- Conceptual model
- Discoverability
- Feedback
- Affordances
- Signifiers
- Mappings
- Constraints



Knowledge in the world

• Precise behavior from imprecise knowledge





Knowledge in the world

• Precise behavior from imprecise knowledge



Neilsen's heuristics: - Recognition rather than recall



Errors: Slips vs. Mistakes

MISTAKES

errors in **choosing** an objective or **specifying** a method of achieving it

SLIPS

errors in **carrying out** an intended method for reaching an objective



Constraints

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Neilsen's heurístics: - Error prevention



Error prevention

Internet Explorer			
Do you want to close all tabs or the current tab?			
Close all tabs	Close current tab		
Always close all tabs			



Metaphors

- Familiar example: the desktop metaphor
 - -Not an attempt to simulate a real desktop
 - -Leverage knowledge of files, folders, trash
 - -Explains why some windows seem hidden

Neilsen's heuristics: - Match between system and real world



Metaphors





Mail metaphor

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Calendar metaphor

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Mechanical-Age Metaphors





Shallow/inappropriate metaphors





Microsoft Bob



Broken metaphors







Dead metaphors





- Beer
- Wine



Exercise

• Comment on design principles



EE/CSE elevators



HUMAN ABILITIES

...and their implications for design



Human abilities

- Humans:
 - -Perception
 - Color, shape
 - Patterns (Gestalt principles)
 - -Memory
 - -Motor
 - Movement speed/precision (Fitt's law)

Every artifact is the way it is because of human morphology or physiology.



Human visual system



Light passes through lens Focussed on retina



Human visual system

- Retina covered with light-sensitive receptors –rods
 - primarily for night vision & perceiving movement
 - sensitive to broad spectrum of light
 - can't discriminate between colors
 - sense intensity or shades of gray

-cones

used to sense color



Human visual system

- Center of retina has most of the cones -allows for high acuity of objects focused at center
- Edge of retina is dominated by rods

 –allows detecting motion of threats in periphery





- Powerful tool to improve user interfaces by communicating key information
- Inappropriate use can severely reduce the performance of systems



Visible spectrum





Color perception

- "Photopigments" used to sense color
- 3 types: blue, green, "red" (really yellow) —each sensitive to different band of spectrum
 - -ratio of neural activity of the 3 determines color
 - other colors are perceived by combining stimulation



Color perception





Color sensitivity

not as sensitive to blue!

Wavelength



Color sensitivity

- Not distributed evenly
 - -mainly reds (64%) & very few blues (4%)
 - -insensitivity to short wavelengths (blue)
- No blue cones in retina center (high acuity)
 - -"disappearance" of small blue objects you fixate on
 - -As we age lens yellows & absorbs shorter wavelengths, sensitivity to blue is even more reduced



Color sensitivity

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Design implication:



don't rely on blue for text or small objects

Focus

- Different wavelengths of light focused at different distances behind eye's lens
 - -need for constant refocusing
 - -causes fatigue
- Pure (saturated) colors require more focusing then less pure (desaturated)



Focus

- Different wavelengths of light focused at different distances behind eye's lens
 - -need for constant refocusing

-causes fatigue

• Pure (saturated) colors require more focusing then less pure (desaturated)

Design implication:

be careful about color combinations

don't use <u>saturated colors</u> in UIs unless you



really need something to stand out (stop sign)

- Avoid simultaneous display of highly saturated, spectrally extreme colors
 - e.g. no cyans/blues at the same time as reds, why?refocusing!
- desaturated combinations are better (pastels)





- Using the hue circle: Pick non-adjacent colors
 - -opponent colors create contrast
 - (red & green) or (yellow & blue)





- Size of detectable changes in color varies
 - hard to detect changes in reds, purples, & greens
 easier to detect changes in yellows & blue-greens
- Hard to focus on edges created by only color -use both brightness & color differences
- Avoid red & green in the periphery (no RG cones)
- Older users need higher brightness levels



- Avoid pure blue for text, lines, & small shapes
 —also avoid adjacent colors that differ only in blue
- Avoid single-color distinctions
 - -mixtures of colors should differ in 2 or 3 colors
 - -helps color-deficient observers



Color blindness

- Trouble discriminating colors -besets about 9% of population
- Two main types
 - -different photopigment response most common
 - reduces capability to discern small color diffs
 - -red-green deficiency is best known
 - lack of either green or red photopigment can't discriminate colors dependent on R & G



Attention/saliency





Attention/saliency






Patterns





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Gestalt principles

- Closure
- Good continuation
- Proximity
- Similarity



Gestalt principles - proximity

Elements that are **closer together are perceived to be more related** than elements that are farther apart.





Gestalt principles - similarity

Elements are **similar are perceived to be more related** than elements that are dissimilar.





Gestalt principles - closure

A tendency to perceive a set of individual elements as a single, recognizable pattern, rather than multiple, individual elements.





Gestalt principles - good continuation

Elements arranged in a **straight line or a smooth curve** are perceived as a group and are interpreted as being more related than elements not on the line or curve.





Exercise

- Comment on Gestalt principles
- -Closure
- -Good continuation
- -Proximity
- -Similarity





Perception of time/change



How soon must red ball move after cue ball collides with it?

must move in < Tp (100 msec)



Perception of time/change

- Stimuli that occur within one cycle fuse into a single concept
 - -frame rate needed for movies to look real?
 - -time for I frame < Tp (100 msec); that is 10 frame/sec.
- Perceptual causality
 - -two distinct stimuli can fuse if the first event appears to cause the other
 - -events must occur in the same cycle





Memory

- Working memory (short term)
 - -small capacity (7 ± 2 ''chunks'')
 - -6174591765 vs. (617) 459-1765
 - -DECIBMGMC vs. DEC IBM GMC
 - -rapid access (~ 70ms) & decay (~200 ms)
 - -pass to LTM after a few seconds of continued storage
- Long-term memory
 - -huge (if not ''unlimited'')
 - -slower access time (~100 ms) w/ little decay



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Speed of accessing memory

Paper

Home

Back

Schedule

Page

Change

Yellow White Black Blue Red Green

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Speed of accessing memory

- Interference
 - -two strong cues in working memory
 - -link to different chunks in long term memory
- Why learn about memory?
 - -know what's behind many HCI techniques
 - -helps you understand what users will "get"
 - -aging population of users



Recall versus recognition

Input	×
Enter local directory name:	Ok
	Cancel
	<u>H</u> elp

Recall

reproduce information from memory

Recognition

discriminate among provided info

