

i213 User Interface Design and Development

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School of Information, UC Berkeley

September 17

Mental Models and
Affordances

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Cognitive approach to UI design

Focuses on cognitive aspects like

affordances, constraints, models,

feedback and visibility



PARADOX OF TECHNOLOGY

Technologies start off complex, while designers struggle to balance need and technical capabilities.

Eventually, a simple and elegant design wins.

Competitors introduce new features, at the expense of added complexity...





AFFORDANCES



AFFORDANCES

“actual and perceived properties... that determine how the thing could be used.”

Based on J.J. Gibson's research in psychology

Focused on immediate cognitive aspects of the environment, as opposed to memory-based information processing

AFFORDANCES

“Affordances are properties of the world that are compatible with and relevant for people’s interactions”

Physical affordances are relevant for hardware and product designers

On a virtual display, *perceived affordances, conventions and constraints* play an equal if not bigger role







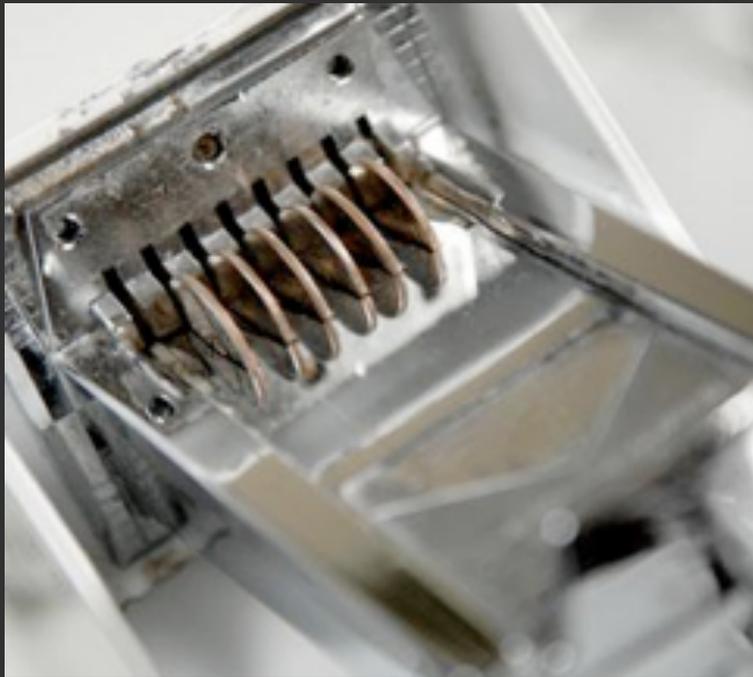
FALSE AND HIDDEN AFFORDANCES

Useful to separate existence of an affordance with its perception

	Perceived	Not Perceived
Affordance	Perceptible Affordance	Hidden Affordance
No Affordance	False Affordance	Correct Rejection

NESTED AFFORDANCES

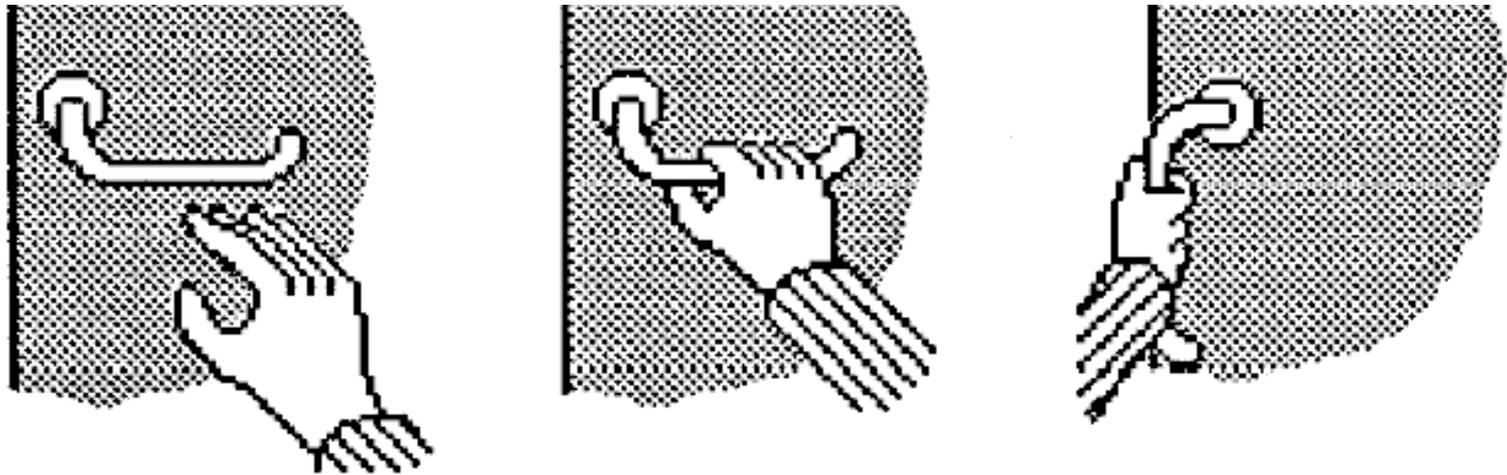
Affordances that are grouped in space, where knowledge of one improves understanding of another



SEQUENTIAL AFFORDANCES

“...situations in which acting on a perceptible affordance leads to information indicating new affordances”

“Affordances are not passively perceived, but explored... Learning is a matter of attention rather than inference.”



AFFORDANCES ACROSS SENSES

Visual
Tactile
Auditory
(can be sequential)



MAPPING

Mapping is the relationship between controls, their movements and results in the world. Natural mappings draw upon physical analogies and cultural standards, leading to immediate comprehension







VISIBILITY

Make the important functions immediately visible to the user

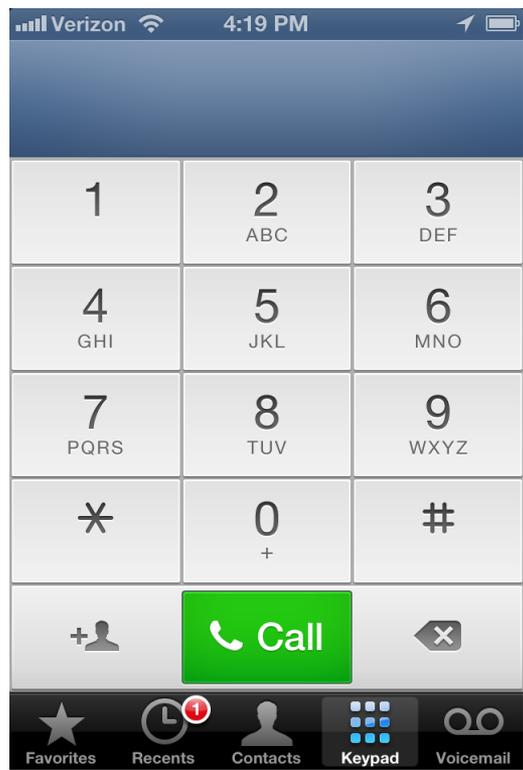
Becomes more difficult when the number of functions exceeds the number of controls

















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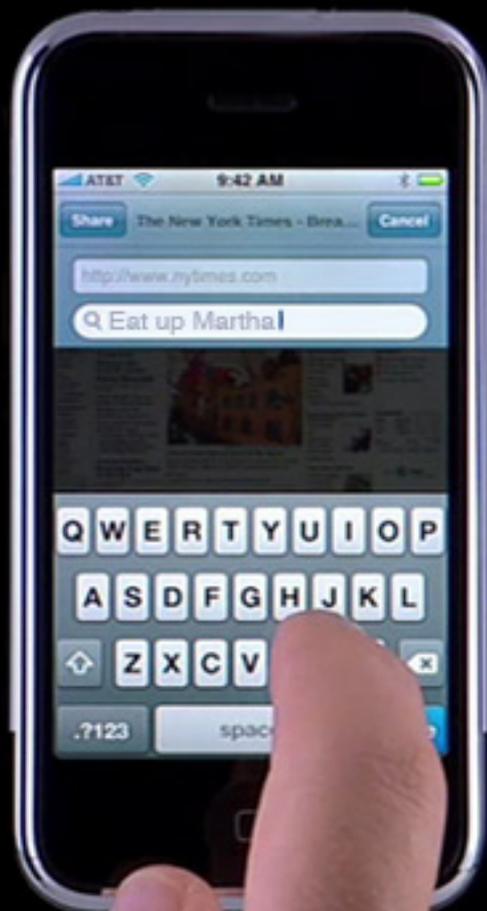
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“Sending information back to the user about what action has been done, what result has been accomplished”

Allows the user to understand the incremental results of his actions





MAPPING, VISIBILITY & FEEDBACK

Mapping: Maintain logical or semantic correspondence between controls and their effects

Visibility: Make relevant parts visible

Feedback: Give each action an immediate and obvious effect

(Sounds can and should also be used for visibility and feedback)



CONSTRAINTS

CONSTRAINTS

Affordances provide opportunities for action

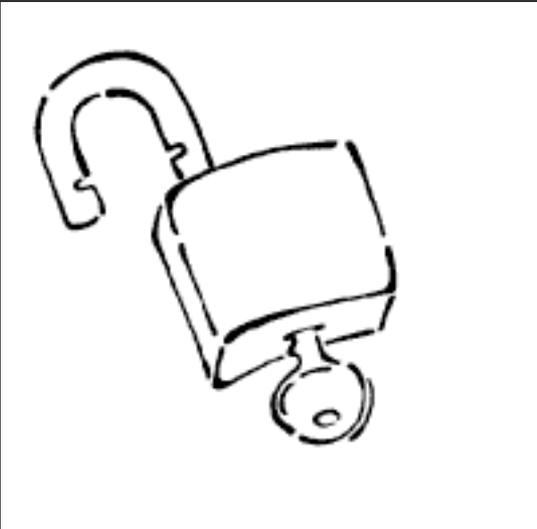
Constraints limit the acceptable actions; allowing the designer to guide the user

- Physical constraints
- Logical constraints
- Cultural constraints

PHYSICAL CONSTRAINTS

Physical constraints physically limit the possibilities for action

“Closely related to affordances”





LOGICAL CONSTRAINTS

“Use reasoning to determine the alternatives”

“Go hand in hand with a good conceptual model”



CULTURAL CONSTRAINTS

“Rely on accepted cultural conventions”

“They evolve and require a community of practice”

facebook

I Am:

✓ Female
Male

Show my sex on my timeline

Google+

Gender

Female ▼

Male

Female

Other

Mental Models

THE TROUBLE WITH MEMORY

It is hard to remember things! (especially arbitrary, detailed things)

Short-term memory is small and unreliable

Long-term memory is slow and complicated to access

It is difficult to get stuff from STM into LTM, and vice versa

KINDS OF MEMORY

For Arbitrary Things

- Requires rote learning
- Cannot be extrapolated

Based on Analogy

- Analogy to something we know makes it easier to learn and remember
- Only need to remember the relation / difference

Based on Understanding

- Allows for extrapolation
- Can be self-evident

KNOWLEDGE IN THE WORLD

We don't have to memorize every detail about what we do, because there are reminders in the world

- Labels
- Affordances
- Mappings
- Constraints
- Conventions

Examples: Hunt-and-Peck Typing, mnemonics

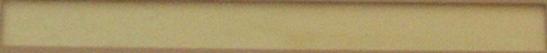


**SMITH
CORONA**

Spell-Right Dictionary
WordProcessing Typewriter
XD 7700



End of Page Pitch Line Indentation Keyboard



Contrast **AUTO** **TAB** **AUTO** Cursor Back



ON



Tab 9	1	2	3	4	5	6	7	8	9	0	Back Space
Tab	Q	W	E	F	T	Y	U	I	O	P	Return
Lock	A	S	D	F	G	H	J	K	L	:	Retoc
Caps Lock	Stop	Find	KB II	List	:	:	:	:	:	:	Retoc
Shift	Paper In	Z	X	C	V	B	N	M	?	?	Shift
Code	Margin	L	R	Half Space	Word Eraser	Line Eraser	Correct	Adv			

TRADE OFFS

	Knowledge in the World	Knowledge in the Head
Retrievability	Whenever present in the location	Requires memory search or reminder
Learning	Not needed	Needed
Efficiency	Requires finding and interpreting	Can be immediate
Immediate Usability	Yes	No, requires learning
Aesthetics	Can be cluttered	Can be elegant

GUI versus KEYBOARD SHORTCUTS

	GUI	Keyboard Shortcuts
Retrievability	Apparent from the design	Requires memorization
Learning	Not needed	Needed
Efficiency	Requires visual search	Can be immediate
Immediate Usability	Yes	No, requires learning
Aesthetics	Can be cluttered	Can be elegant

MENTAL MODELS

A mental model allows users to understand and remember the mapping between actions and the resulting effects

Based on analogy and understanding

Affordances, Mapping, Feedback, Constraints, Conventions and Visibility can help users establish a mental model

COOPER'S THREE MODELS

Implementation Model: The way the thing actually works

Manifest Model: How the designer intends the user to believe it works

Conceptual Model: The way the user actually thinks it works

MANIFEST MODELS

“The closer the manifest model comes to the user’s mental model, the easier it will be to use and understand”

Many software UIs are designed by engineers, so conform to the implementation model

By making the manifest model *simpler and closer to current practice*, we can make it easier to learn and understand

METAPHOR

Metaphors build on analogy with some existing concept or idea

- “Files” , “Folders” , “Windows” , “Trash” ...
- User must *recognize* the metaphor, and understand how to *translate* it
- Can be hit or miss...
- Physical world metaphors can limit their virtual equivalents

Do visual metaphors help us understand file systems?



My Computer

Set Up The
Microsoft
Network



Network
Neighborhood



Inbox



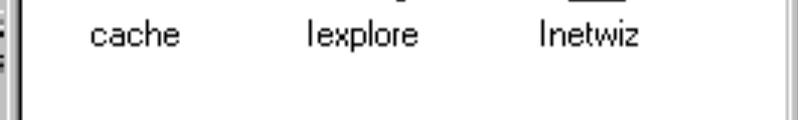
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Internet



The Internet



My Briefcase



WINDOWS 7

52°
Fair
55° - 37°
Redmond, WA

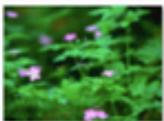
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Customize your page
Hotmail
http://login.live.com

Computer > Pictures > Sample Pictures

Organize | New Folder | Share with | Slide show | Burn

Pictures library | Arrange by: Folder | 2 library locations

 Autumn Leaves.jpg	 Creek.jpg	 Desert Landscape.jpg	 Dock.jpg
 Forest Flowers.jpg	 Forest.jpg	 Frangipani Flowers.jpg	 Garden.jpg
 Green Sea	 Humpback	 Oryx	 Toco Toucan.jpg

15 items

Windows 7 taskbar with icons for Start, HomeGroup, Internet Explorer, Mail, People, Windows Media Center, and system tray (volume, network, clock: 10:10 AM 9/30/2010)

Apps

- Calendar
- Camera
- CineTrailer
- Desktop
- Euro Cup
- Finance
- Internet Explorer
- Mail
- Maps
- Messaging
- Music
- News
- People
- Photos
- SkyDrive
- Sports
- Store
- The
- Twee
- Vide
- Wea
- Winc
- Winc
- Xbox

Search

Apps

- Apps
- Settings
- Files
- Store
- CineTrailer
- Euro Cup
- Finance
- Internet Explorer
- Mail



IDIOMS

“All idioms must be learned. Good idioms only need to be learned once”

Idioms focus on being easy to learn and recognize

Many UI features become idioms, rather than metaphors

The WIMP metaphor succeeded because of its visual idioms and limited vocabulary of primitive actions

Tap

Briefly touch surface with fingertip.



CORE GESTURES

Double Tap

Rapidly touch surface twice with fingertip.



CORE GESTURES

Drag

Move fingertip over surface without losing contact.



CORE GESTURES

Flick

Quickly brush surface with fingertip.



CORE GESTURES

Pinch

Touch surface with two fingers and bring them closer together.



CORE GESTURES

Spread

Touch surface with two fingers and move them apart.



CORE GESTURES

Press

Touch surface for extended period of time.



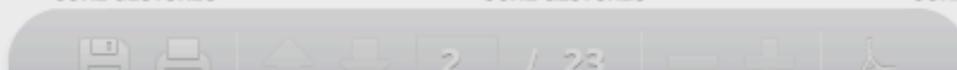
CORE GESTURES

Press+Tap

Press surface with one finger and briefly touch surface with second finger.



CORE GESTURES

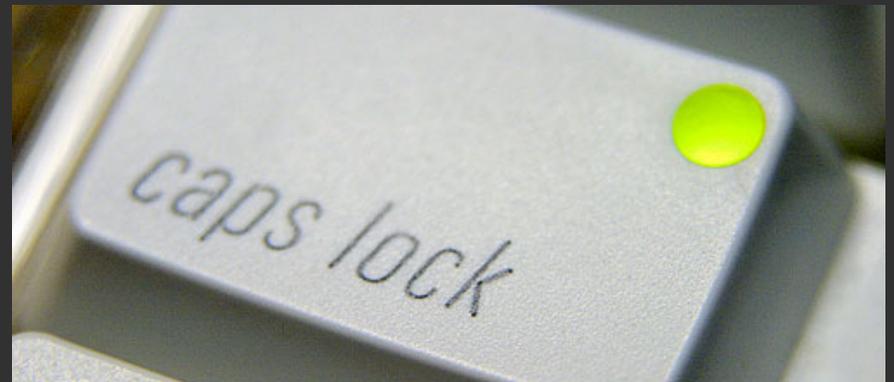


MODES

A mode is a state the program can enter where the effects of a user's actions change from the norm''

Active (SHIFT) or Passive (CAPS LOCK)

Make it easy to change the mode and to see which mode you are in

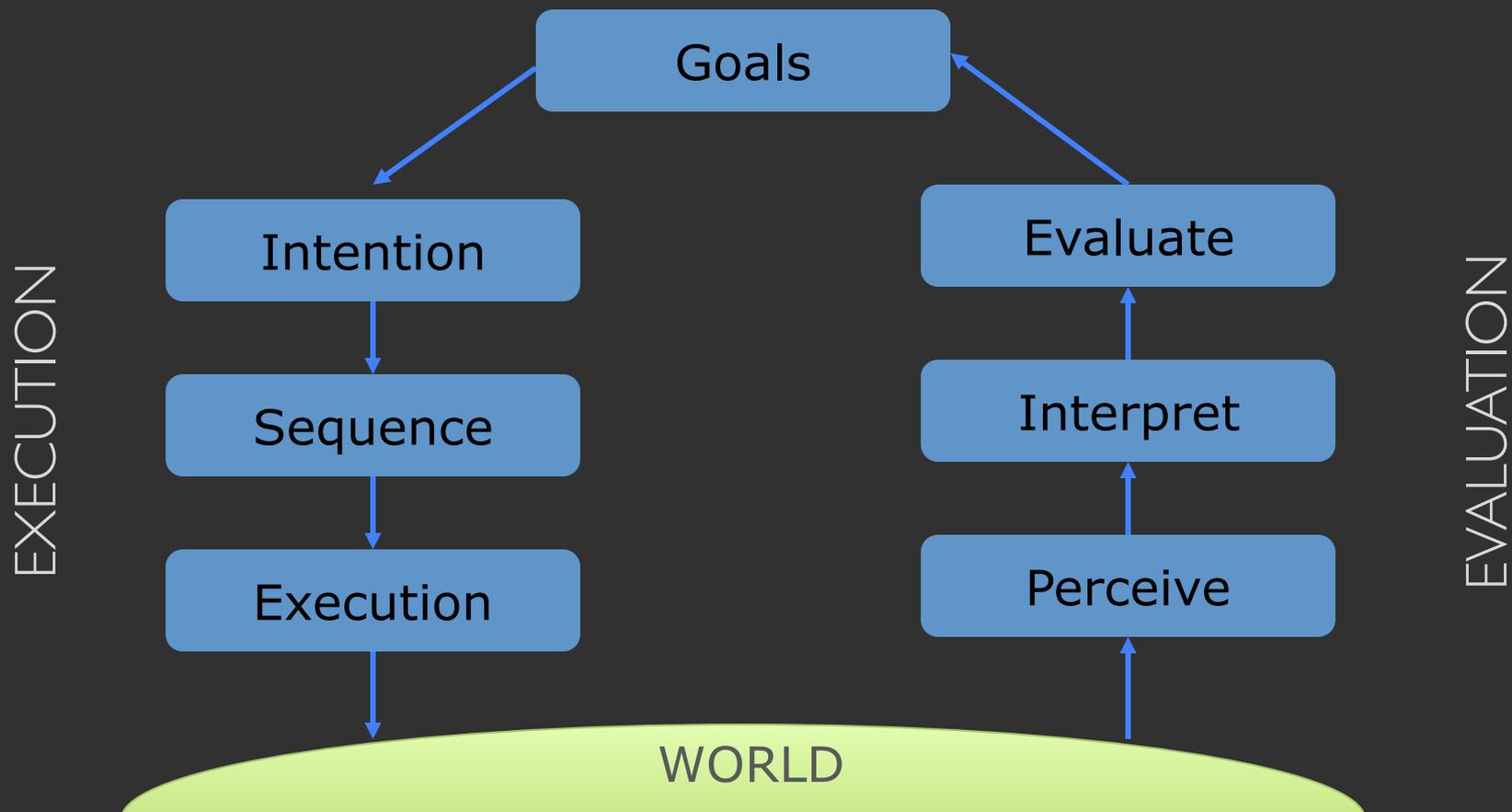


Action Cycle

ACTION CYCLES

EXECUTION: *Doing something to the World*

EVALUATION: *Compare what happened with what we wanted*



EXAMPLE: TURNING ON A LAMP

GOAL: Increase light in the room

INTENTION: Turn on the lamp

SEQUENCE: Walk to lamp, turn knob

EXECUTE: [*Walk to lamp, turn knob*]

PERCEIVE: [*Hear “click”, see light*]

INTERPET: Lamp clicked and started emitting light

EVALUATE: Light in the room increased. Success!

GULF OF EXECUTION

“What do I do now?”

By providing affordances, constraints, visibility and a good mental model, designers can bridge the Gulf of Execution





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THE Berkeley Blog

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FACULTY EXPERTS WEIGH

Critic's Choice highlights



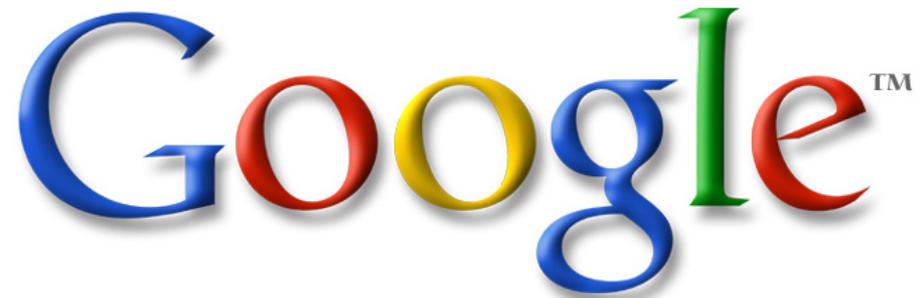
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GULF OF EXECUTION

“Did I succeed?”

By providing feedback and a mental model, designers can bridge the Gulf of Evaluation



DESIGNING FOR ERRORS

When a task *appears* simple or trivial, users will most often blame any errors or mistakes on themselves

When this happens repeatedly, the user may decide that they are *incapable* of performing this task (Norman calls this *learned helplessness*)

Designers should account for errors in their designs

For next time

Keep working on your CI

Due on September 29