Designing Visual Interfaces

The Design of Everyday Things
Cognitive Principles for Interface Design

Hall of Fame or Shame
Homework Presentation

Psychology of Everyday Things

Don Norman – POET

Cognitive Principles of Designing Interfaces

- Adequate Visibility
  - Affordances
  - Visible Constraints
  - Natural Mappings
- Good Conceptual Model (Mental Model)
- Feedback – Causality
- Comfort
- Consistency /Cultural Standard
- Transfer Effects
Make the right things visible
What parts operate and how
How the users is to interact with it
Mapping between intended action & actual operation
Crucial distinctions

Affordances: “~ is for ~”
Perceived and actual properties
- Perceived affordance vs. Actual affordance
Provide strong clues to the operations of things
- A chair affords sitting. = A chair is for sitting.
- Buttons for pushing
- Knobs for turning
Simple things can be used without any need for words, symbols, trial and error
Visible Constrains

Limit the possible actions by appearance
Prevent errors

Physical Constraints
- Physical limitation and possible operation

Semantic Constraints
- Depending on our knowledge of situation

Cultural Constraints
- Allowable actions for social situations

Logical Constraints
- “Natural mapping” work by this constraints

Natural Mapping

Relationship between controls and actions should be apparent to users

Minimize the need for labels

Work by “logical constrains”

---

Natural Mapping: Gas Stove

---

Arbitrary

Paired
Natural Mapping: Gas Stove

Full natural mapping between controls and burners
- No labels!

Conceptual Model

Mental model of how things work

Formed by
- Affordances
- Constraints
- Mappings
- Experience
- Training
- Instruction
Three Conceptual Models

Three aspects of mental models

- Design model
- User’s model
- System image

Conceptual Model: Scissors

Affordances
- Holes for fingers to be inserted

Mapping by Constraints
- Fingers and holes (different size)

Transfer Effect
- Learnt constraints from adults

=> Good Conceptual Model
- Implication is clear
**Conceptual Model: Digital watch**

**Affordances**
- Four buttons for pushing

**Mapping by Constraints**
- No visible relationship

**Transfer Effect**
- No so similar to analog watch

=> Bad Conceptual Model
- Learning needed, no standard

---

**Feedback**

Inform users of what action’s done and what happened

Instantaneous response is preferred

**Type of feedback**
- Visual
- Auditory
- Haptic

Modern telephone: more features and less feedback
Feedback - Causality

Causality – interpretation of “feedback”

People assume that the thing that happens right after an action be caused by that action

False causality

- incorrect effect
  - causes “superstitious” behaviors
- invisible effect
  - command with no apparent result often re-entered repeatedly
  - e.g., mouse click to raise menu on unresponsive system

Adopted from Saul Greenberg’s slides

Comfort – Learning the Technology

People are intimidated by technology

Users are afraid of breaking the system

How do people learn the technology?

→ Support rapid, incremental, reversible actions
→ “Direct Manipulation”
→ Encourage exploration, increase comfort

Adopted from Ben Bederson’s slides
Consistency – Cultural Standards

People learn idioms that work in a certain way
- red means danger vs. green means safe

Idioms could be different from culture to culture
- Light switches - America: down is off vs. Britain: down is on
- Faucets - America: anti-clockwise on vs. Britain: anti-clockwise off

Ignoring/Changing standards?
- home handyman: light switches installed upside down

Difficulty of Changing Standards
- Qwerty keyboard vs. Dvorak keyboard

Cultural Standards

Because a trashcan in Thailand may look like this:

a Thai user is likely to be confused by this image popular in Apple interfaces:

Sun found their email icon problematic for some American urban dwellers who are unfamiliar with rural mail boxes.
Transfer Effects

People transfer their learning/expectations of similar objects to the current objects
- positive transfer: previous learning's also apply to new situation
- negative transfer: previous learning's conflict with the new situation

Adopted from Saul Greenberg’s slides

Principles of Design, Don Norman

Use both knowledge in the world and knowledge in the head
Simplify the structure of tasks
Make things visible
Get the mapping right
Exploit the power of constraints
Design for error
When all else fails, standardize
Modeling Human Errors

Categories of Error
- Mistake – from conscious deliberations
- Slips – when subconscious action go astray

Types of Error (Slip)
- Capture errors
- Description errors
- Data-driven errors
- Associative activation errors
- Loss-of-activation errors
- Mode errors

Capture errors
The intended action is suddenly replaced by a frequent activity
- 1,2,3,4,5,6,7,8,9,10,J,Q,K
- get into your car on Sunday to go to a store and find yourself at the office

Appears when two different action sequences have their initial stages in common
Unfamiliar vs. well-practiced activities
Description Errors

Intended action is replaced by another that has much in common

Internal description of intended action is not precise
- Throwing dirty shirts to toilet instead of laundry basket
- Pouring Coke into beer glass

Data-driven Errors

Data-driven activities intrude into the current action sequence
- Clerk looking at a hotel room number dial the room number instead of the secretary
**Associative Activation Errors**

Similar internal thoughts (associations) trigger actions intended by external stimulus

- My office phone rang. I picked up the phone and said “Come in.”
- Think something that ought not to be said, and then you say it.

---

**Loss-of-activation Errors**

Why did I do this?

Forget the goal – just forgetting

- When you don’t remember why you opened the refrigerator door
Mode Errors

Mode: a distinct state within a system in which the same user input has a different meaning
- Caps Lock, Insert key
- Vi

Make every mode visible
If impossible, distinctive action in each mode

Who do you design for?

Adapted from Saul Greenberg’s slides
Who do you design for?

People are different
It is rarely possible to accommodate all people perfectly
- design often a compromise
  - ceiling height: 8'
  - but tallest man: 8'11"

Rule of thumb:
- cater to 95% of audience (5th or 95th percentile)
  - but means 5% of population may be (seriously!) compromised
- designing for the average a mistake
  - may exclude half the audience

Examples:
- cars and height: headroom, seat size
- computers and visibility:
  - font size, line thickness, color for color-blind people?
Why design is hard

Over the last century

- the number of things to control has increased dramatically
  - car radio: AM, FM1, FM2, 5 pre-sets, station selection, balance, fader, bass, treble, distance, mono/stereo, dolby, tape eject, fast forward and reverse, etc (while driving at night!)

- “paradox of technology”
  - Added functionality => added complexity
  - More features and less (natural) feedback

- errors increasing serious and/or costly

Marketplace pressures

- adding functionality (complexity) now easy and cheap
  - computers

- adding controls/feedback expensive
  - physical buttons on calculator, microwave oven
  - widgets consume screen real estate

- design usually requires several iterations before success
  - product pulled if not immediately successful
Psychology of Everyday Things

Cognitive Principles of Designing Interfaces

- Adequate Visibility
  - Affordances
  - Visible Constraints
  - Natural Mappings
- Good Conceptual Model (Mental Model)
- Feedback – Causality
- Comfort
- Consistency /Cultural Standard
- Transfer Effects

Readings