Design of Everyday Things

Characteristics of good UIs

The User Action Cycle
Mistakes

We often blame *users* when we should blame *designers*.
Tractors

Early design

Terrain
- unsurfaced and rough
- hilly

Farmer
- works long hours
- works quickly

Images from www.co.lawrence.tn.us and www.uni-magdeburg.de
Tractors

Result

Quotes from National AG Safety Database

- *older tractors* have narrow front ends that are easily upset
- tractor upsets cause more fatalities than other farm accidents
- injuries often include a broken or crushed pelvis.

Accident image from //www.osh.dol.govt.nz/
Tractors

Used to be called *driver’s error*

But

- accidents less frequent as modern designs have
  - roll cage
  - low center of gravity
  - wider wheel bases

Tractor from www.historylink101.com
Getting serious about design

World War II

• complex machines (airplanes, submarines...)
  • taxed people’s sensorimotor abilities to control them
  • frequent (often fatal) errors occurred even after high training

• example airplane errors:
  • if booster pump fails, turn on fuel valve within 3 seconds
    • test shows it took ~five seconds to actually do

  • Spitfire: narrow wheel base
    • easy to do violent ground loops which breaks undercarriage

  • Altimeter gauges difficult to read
    • caused crashes when pilots believe they are at a certain altitude

Result

• human factors became critically important
Harvard Airplane (World War II)

Undercarriage crashes
- pilots landed without dropping undercarriage!
- undercarriage warning horn
  - sounds if wheels up and power low (landing condition)

Stalls
- plane airspeed drops too low to maintain lift
- if occurs just before landing, will crash

Training
- deliberately stall and recover
- but sometimes similar to landing with undercarriage up
  - horn sounds, annoyance
  - installed “undercarriage horn cut-out button”

Oops! Now why did I do that?
The Harvard Control Panel

Problem #1: Conditioned response

stall -> push button; therefore stimulus nullified
Problem #2: Negative transfer
T-33’s: tip-tank jettison button in same location
Don Norman – Design of Everyday Things
A good interface should have:

- Effective affordances
- Visibility
- Natural mappings
- Feedback to the user
Affordances

- Physical affordances:
  How do the following physical objects afford?
  Are they obvious?
UI Affordance

• It should be obvious how a control is used.
• Does the user perceive that clicking on that object is a meaningful, useful action?

From Palmiter
Affordances

• Virtual affordances
  How do the following screen objects afford?
  What if you were a novice user?
  Would you know what to do with them?

Preece 2002
Visibility

• This is a control panel for an elevator.
• How does it work?
• Push a button for the floor you want?

• Nothing happens. Push any other button? Still nothing. What do you need to do?

It is not visible as to what to do!

From: www.baddesigns.com

Preece 2002
Visibility

...you need to insert your room card in the slot by the buttons to get the elevator to work!

How would you make this action more visible?

- make relevant parts visible
- make what has to be done obvious

Preece 2002
Visibility
Affordance vs. Visibility

• Affordance: how do you interact with these?

hyperlink

• Visibility: what do they do?

Class Roster
Natural Mappings
Natural Mappings

• Which controls go with which burners?

Preece 2002
Why is this a better design?

Preece 2002
Mapping

1.5 to 2 million votes were "lost" in the controversial 2000 Presidential election due to ballot design (CalTech/MIT Voting Technology Report, July, 2001).
Feedback

• Is the action I just took, understood by the device or system?
• Did I do the right thing?
• Is the system ready for the next step?
Feedback

• Let the user always know where they are in the process
• Feedback about where you can go and where you are (feedback and feed forward)
• Tell them what’s happening
• Tell the user how to recover
• Make error messages clear with alternatives for action
What does `bunny.move(forward, 10)` do?
Unhelpful feedback

Message From the Host

Confirmation #: UIx00012003082261730358

Error Code : 17
Error Processing Your Request. Please Try Again Later. (UIx00012003082261730358)

Call Customer Service for assistance. (217) 278-7700

OK
Feedback

• What did my action do?

  • User susieQ has been added to the class roster.
Design a Terrible Email Client

• You should incorporate example violations of:
  • Effective affordances
  • Visibility
  • Natural mappings
  • Feedback to the user
The Action Cycle

https://www.youtube.com/watch?v=ahtOCfyRbRg
Execution-Evaluation cycle

Norman (DOET, p. 46)
3 Stages: Goals, Execution, Evaluation

1. **Goals**
   - What we want to happen

2. **Execution**
   - What we do to the world

3. **Evaluation**
   - Comparing what happened with what we wanted to happen

*Physical System*
Stage 2. Execution

Goals
What we want to happen

An intention to act
so as to achieve the goal

The actual sequence of actions
that we plan to do

The physical execution of that
action sequence

Physical System
Stage 3. Evaluation

Goals
What we want to happen

Evaluation of the interpretations with what we expected to happen

Interpreting the perception according to our expectations

Perceiving the state of the world

Physical System
7 Steps: All Together

1. **Goals**
   1. What we want to happen

2. An intention to act so as to achieve the goal

3. The actual sequence of actions that we plan to do

4. The physical execution of that action sequence

5. Perceiving the state of the world

6. Interpreting the perception according to our expectations

7. Evaluation of the interpretations with what we expected to happen

2. **Execution**

3. **Evaluation**

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Physical System
Revisit: Reading a Book Example

• 1. Forming a Goal
  I can’t read my book because the room is dimly lit. I need more light in order to read my book.

• 2. Intention to Act
  There is a light next to my chair. Turning on the light would allow me to read my book.

• 3. Planning the Action
  I need to reach over and turn on the light.

• 4. Executing the Action
  I reach over to turn on the light.

• 5. Feedback from the Action
  The light turns on.

• 6. Interpret the Feedback
  Am I now able to see the text and can read my book?

• 7. Evaluate the Outcome
  Positive – I’m able to read my book. No further action is needed.
  Negative – The light doesn’t work. The Action Cycle is either repeated or a new goal is formed.

http://petekinser.com/norman-action-cycle/
The Psychopathology of computers

Britain 1976

- Motorway communication system operated 40% of its highways
- Police controlled it in real time to
  - change lane signs, direction signs, speed limits, etc

- On December 10th, failure to change the speed limit signs when fog descended
  - 34 vehicles crashed
  - 3 people killed
  - 11 people injured and trapped in their vehicles
  - Motorway closed for 6.5 hours
Example problems

cryptic input codes
• XR300/1: change (X) sign 300 on highway M5 (R) to code 1
  • i.e. change particular sign to indicate fog condition

no feedback
• operator entered command, no visible effect of system response

cryptic error messages
• “Error code 7”

teletype machine was old, text illegible
• people could not see what they typed or system’s reply

operator overloaded with other chores
• also handled radio and telephone traffic
Some quotes

Police (at inquest)
  • “The system did not accept the instruction”

Dept of Transport (after examining computer logs)
  • “There is no evidence of technical failure”

System designers
  • after emphasizing that they have no responsibility for the system
    • “We supplied it over 5 years ago and have never been called to look at that problem”

The Coroner’s court
  • judged it as "operator error"
    • the police operator:
      “failed to follow written instructions for entering the relevant data”