

# CMSC 434

## Psychology and Psychopathology of Everyday Things

### Psychology of Everyday Things

Many so-called human errors and “machine misuse” are actually errors in design.

Designers help things work by working with users and iterating through prototypes to provide a good conceptual model and set of features.

Designers must identify and decide upon a range of users as the design audience.

Design can be difficult for a variety of reasons that go beyond pure visual design issues.

# Humans and Psychology

There are several basic cognitive principles to be aware of while designing interfaces...

- Visual affordances can help users.
- The use of artificial constraints in software tied to real world constraints can have value.
- Quick feedback can provide a good mental model of cause and effect with technology.
- One should not underestimate the role cultural standards might play in the design and use of technology.

## 41 BC

Head Goucho is tired of loosing to the Gauls



Win me  
the  
Chariot Race

# Science to the rescue!

Advisor intuitively finds a cause and solution...



Drawings and story by Saul Greenberg

# Chariot Race, 40 B.C.

Notice the aerodynamic efficiency of the faster chariot!

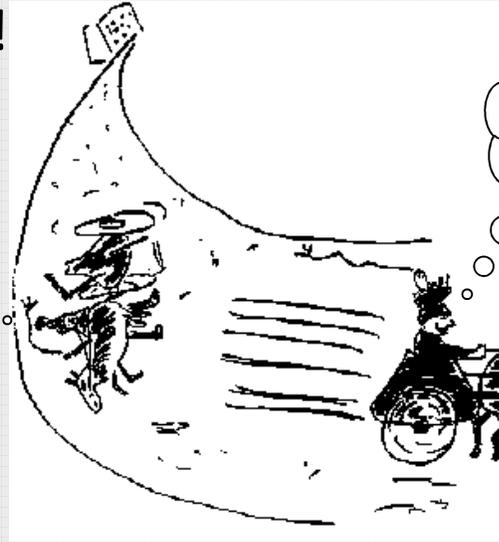


## Ooops...

But, in maneuvering for position on the turn, the DRIVER makes an error!!!



Or was it  
the DESIGNER???



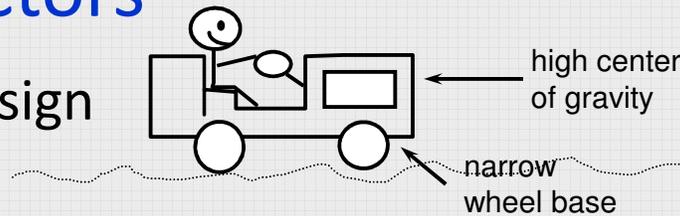
## Trade-offs

Human Factors in engineering...

There are often trade-offs between performance and usability.

## Early tractors

Original design



Terrain: un-surfaced, rough, hilly

Result:



Used to be always be called "Driver's Error" but accidents are now infrequent (except for with Homer) as designs typically have a low center of gravity and wider wheel bases.

## Therac-25 (mid-1980s)

- Radiation therapy machine.
- Several patients between 1985 and 1987 were given incorrect treatments (eg: 100x dose).
- Several even complained of pain and burning and were essentially ignored and told it was normal.
- There were *at least* 5 patient deaths as a result of these errors.
- Mechanical engineering and programming errors combined to allow "user errors" to happen.

## USS Vincennes (1988)

- The crew of the USS Vincennes fired two guided missiles at, and shot down, a civilian aircraft (Iran Air Flight 655) during a battle.
- The Vincennes was being attacked at the time.
- The highly-advanced defense system identified the passenger jet as possibly being an attacking F-14 jet fighter.
- Warnings were sent several times on military and civilian channels with no response over a period of around 5 minutes.
- Human error and HCI errors. 290 civilians dead.

## Did this continue to happen? Yes 😞

- NASA's Mars Rover locked up due to too many files being opened by operations it was instructed to do in 2004 (problem was fixed).
- When gasoline prices jumped in 2008, there were stories about gas station attendants incorrectly entering the price per gallon, and at least one set of pumps that couldn't be set to charge more than \$2 a gallon.
- The Costa Concordia in 2012 when the captain was able to (incorrectly) steer into dangerous waters.

## SpaceShipTwo (2014)

The co-pilot of VSS Enterprise unlocked the system meant for slowing the ship down in the upper atmosphere during the return portion of the flight during the launch and acceleration portion, it deployed, the resulting forces tore the ship apart.

NTSB Ruling: Co-Pilot error.

– *Why wasn't there an interlock to prevent it being deployed at that stage of the flight?*

## Indonesia AirAsia Flight 8501 (2014)

Indonesia AirAsia Flight 8501 – the flight crew did something they had seen done by ground crews (rebooting the software) but in mid-flight it took out the automated systems and “unexpectedly” put the pilot in full manual control in the middle of a crisis.

## TransAsia Airways ATR-72 (2015)

TransAsia Airways ATR-72 – one of the engines was thought to have flamed out (it was actually put into idle mode) and the pilot accidentally started to reboot the *working* engine.

## Hawaii "Ballistic Missile Threat" (2018)

Drop-down menu with different alert options (not in “plain English” wording.

Drop-down menu did not have a “false alarm, never mind” option or fill-in option so they couldn’t use the same system to reverse things.

The governor of Hawaii couldn’t remember his Twitter password to even Tweet out a “false alarm” message...

## Self-Driving Cars

What will happen with self-driving cars?

- Every accident so far that I've read about has been blamed on the other driver...

While there is a temptation to “remove” the human from the interaction, that isn't as simple (or as desirable) as it might seem...

*People are often blamed for “doing something stupid” that installed a virus on their computer, what if it happens in your car?*

## Self-Updating Operating Systems

With Windows 10, you either update everything or update nothing (and it is really not easy to pick the “update nothing” option).

- One of the big reasons is to “simplify” security.
- One of the big problems is that if there is one update that you do not want, you can't just skip that and continue to get the others (which is bad for security).

## Some Big Lessons to Learn

Lesson 1: Many failures of human-machine system are due to poor designs that don't recognize the capabilities and limitations of the people who will use them. This leads to apparent machine misuse and "human error" but it is often design error.

Lesson 2: Good systems design always accounts for human choices and capabilities, specifically the possible choices and capabilities of the humans who will be using it at the time they will be using it.

Lesson 3: Prototype things before you implement in code, role-play scenarios, think weird cases, have real users be part of the process.

## Psychopathology of everyday things

Credit card swipe units at grocery stores where users don't know which way to swipe, press incorrect buttons, have to press buttons to continue without an audio cue that the system is waiting, have the success and failure alerts sound the same, and have poor grammar...

How many people can program or use all aspects of their:

digital watch? VCR? DVR? BR/DVD player? camera? cable box?  
router? sewing machine? washer and dryer? stereo? phone?

Does something like an Amazon Echo rid of us problems or just alter the problems that we have?



## Classic pathological example:

The remote control from an old Leitz slide projector presented a challenge; how do you move forward versus backwards with a single-button remote?

The instruction manual explained:

- short press: slide change forward
- long press: slide change backward

but an error could eject the slide tray!

Now this is a potential issue with single-button mice or with touch interfaces (or with the ignition in a car?).

## Modern pathological examples...

With many modern technologies (DVR, cable box, digital cameras, cell phones, ...) many people only learn about the basic functions.

- Some people will refuse to upgrade because they know the device they have and newer ones seem too complex.
- Much functionality seems to go untouched by many.
  - How many “scene modes” does your digital camera have?
  - What can your multi-purpose remote really do?
  - What can you connect to and control from your cable box?

## What about a really simple machine?

- Have you ever planned a quick stop at a meter and inserted a nickel or dime rather than a quarter, only to be surprised when no time was given. Upon closer inspection you then read “Quarters Only”. Was this user error or design error? How could it be prevented or better handled?
- On a related note, why did the Susan B. Anthony dollar coin fail in its goal? Were enough changes made to the Sacajawea dollar coin? Is it considered a failure? Did the “Presidential Dollar” coins succeed?



- Why is the dime “out of order” in the size scale?

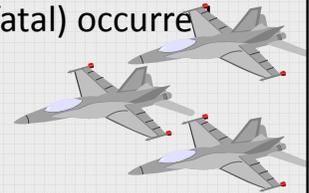
# Getting serious about design

## World War II

- invention of machines (airplanes, submarines...) that taxed people's sensorimotor abilities to control them
- even after high degree of training, frequent errors (often fatal) occurred

## Example airplane errors:

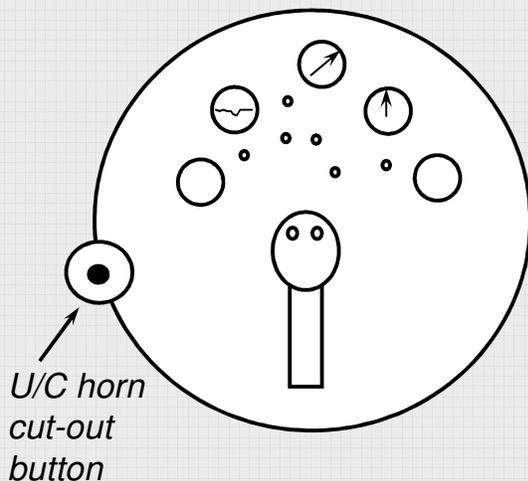
- If booster pump fails, turn on fuel valve within 3 seconds.
  - test shows it took at least five seconds to actually do it!
- Altimeter gauges difficult to read.
  - caused crashes when pilots believe they were at a certain altitude



## Result

- human factors became critically important

# The Harvard Airplane (WWII) Control Panel



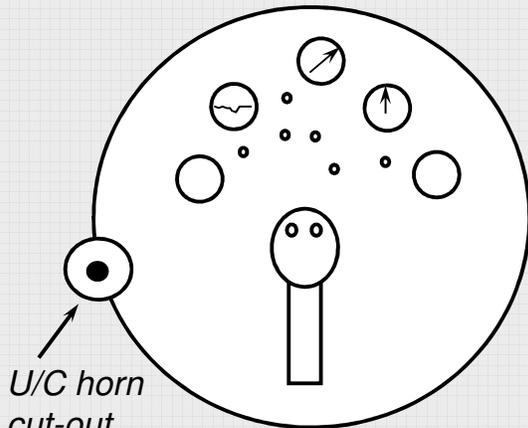
## Conditioned response

If the system thinks you are going to land with the wheels up, a horn goes off.

In training they would deliberately decrease speed and even stall the plane in-flight. The system thought they were about to land with the wheels up and the horn would go off. They installed a button to allow the pilot to turn it off. Also, if the plane did stall in-flight, they could turn off the annoying horn as they were trying to correct the situation.

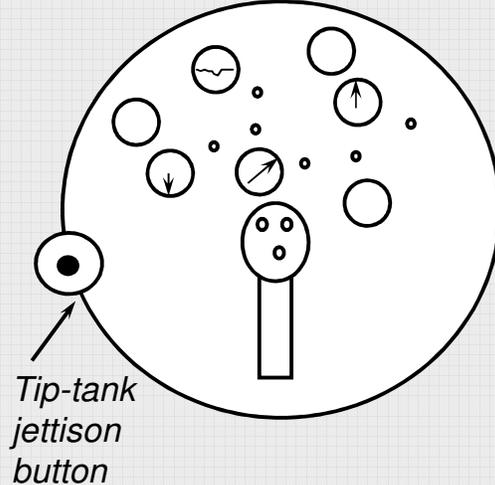
stall → push button  
*stimulus nullified*

The Harvard Control Panel



Negative transfer

The T-33 Control Panel



T-33's: tip-tank jettison button was in the same location!

Out of reflex, if you stalled you would quickly jettison fuel...



Darn these hooves! I hit the wrong switch again!  
Who designs these instrument panels, raccoons?

## Problem: People fall asleep on trains...



## The “PC Cup Holder” of the early 1990s.

Urban Legend - probably based on true stories:

Caller: "Hello, is this Tech Support?"

Tech Rep: "Yes, it is. How may I help you?"

Caller: "The cup holder on my PC is broken and I am within my warranty period. How do I go about getting that fixed?"

Tech Rep: "I'm sorry, but did you say a cup holder?"

Caller: "Yes, it's attached to the front of my computer."

Tech Rep: "Please excuse me if I seem a bit stumped, it's because I am. Did you receive this as part of a promotional, at a trade show? How did you get this cup holder? Does it have any trademark on it?"

Caller: "It came with my computer, I don't know anything about a promotional. It just has '4X' on it."

The caller had been using the load drawer of the CD-ROM drive as a cup holder, and snapped it off the drive.

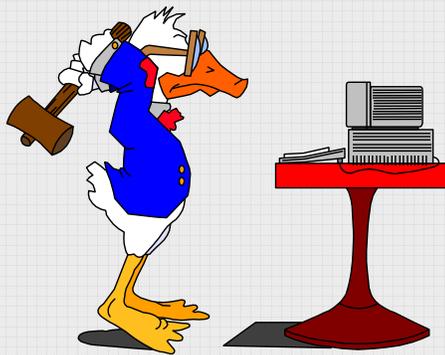
# Lost Sales

People return products as “broken” when often they simply are not being used correctly.

- “All my pictures look horrible.”
- “You have it set to the lowest JPG setting.”
- “I get more pictures on the included memory card that way.”

People return products when they are “missing” a feature their previous unit. While sometimes true, sometimes the feature is there, it’s that the controls have been changed or moved.

Salespeople can be unfamiliar with the details of the products they are selling in part because modern consumer electronics have many features, complex control systems, and change on a regular basis – would you take purchasing advice from a salesperson who knows less about the products than you do?



## “HIT ANY KEY TO CONTINUE”

- (1) I don’t have an “any” key on my keyboard, do you?
- (2) This instruction is not correct - I tried
  - shift
  - caps lock
  - control
  - print screen