

Pathological Designs

Human Computer Interaction

Based on slide deck

Part 4: Designing and building visual interfaces. Pathological Designs

Human Computer Interaction I: Principles and Design

by

Saul Greenberg

Professor

University of Calgary, Canada

*The new slides are marked with a **

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Design of Everyday Things

Pathological designs

Many human errors result from design errors

Designers help through a good conceptual model

41 BC: Emperor tired of loosing to the Gauls



Slide idea from David Hill

Saul Greenberg

Advisor intuitively finds a solution ...



Slide idea from David Hill

Saul Greenberg

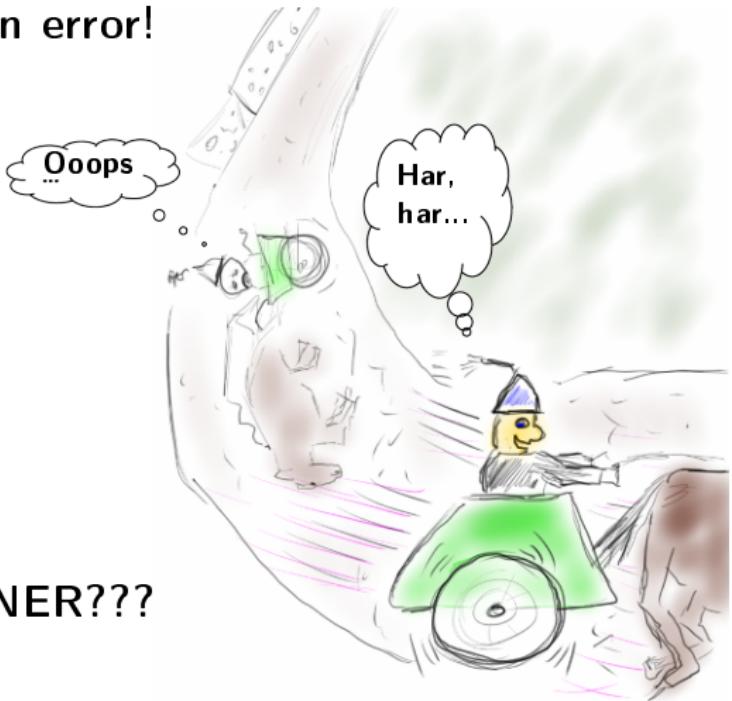
The Chariot Race

Notice aerodynamic efficiency of the faster chariot



The Chariot Race

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



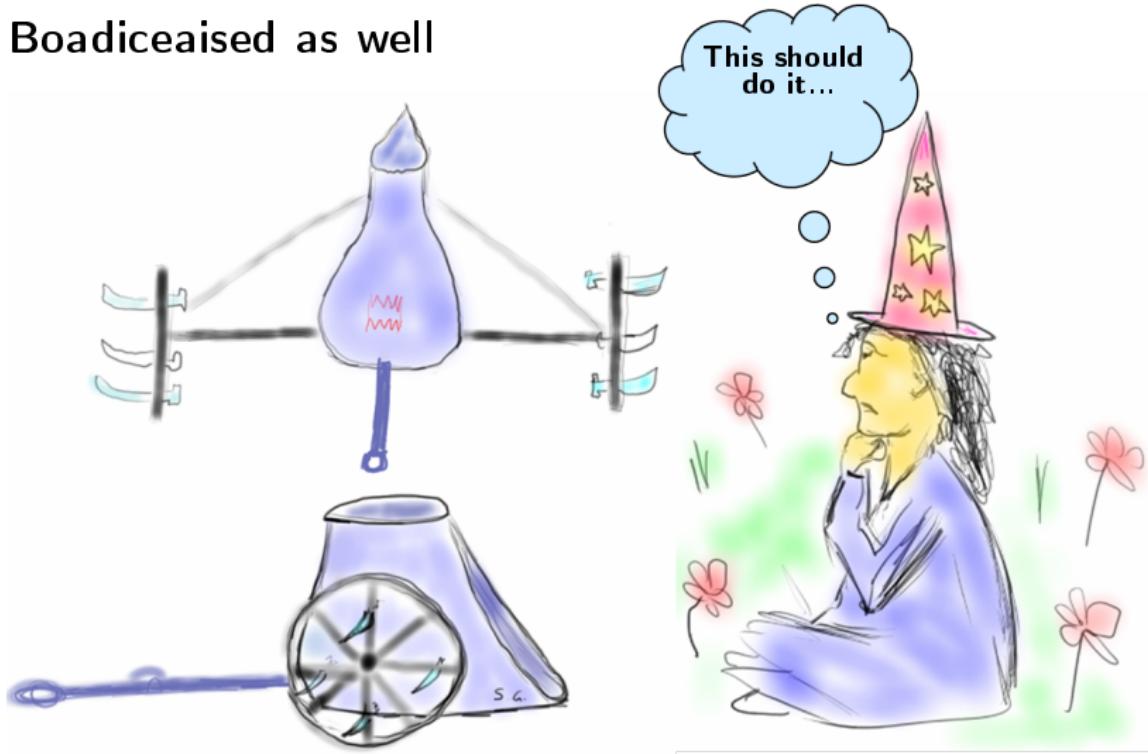
Or was it the DESIGNER???

Slide idea from David Hill

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Human factors engineered

- Boadiceaised as well

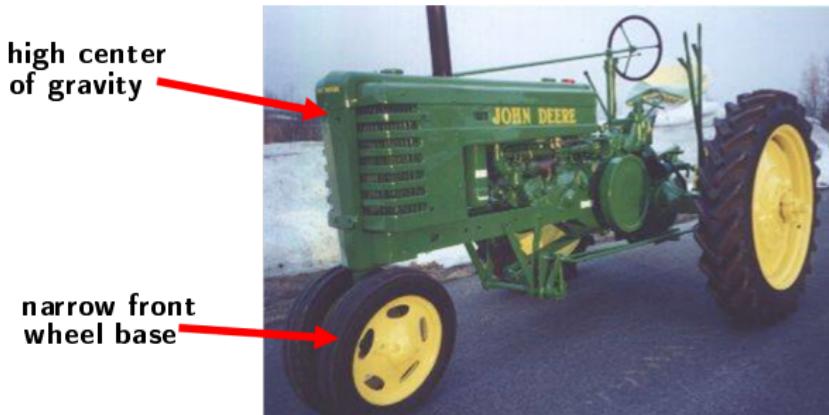


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Tractors

Early design



Terrain

- unsurfaced and rough
 - hilly

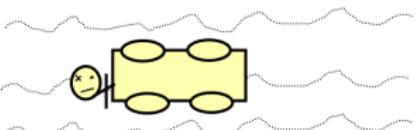
Farmer

- works long hours
 - works quickly



Tractors

Result



Quotes from National AG Safety Database

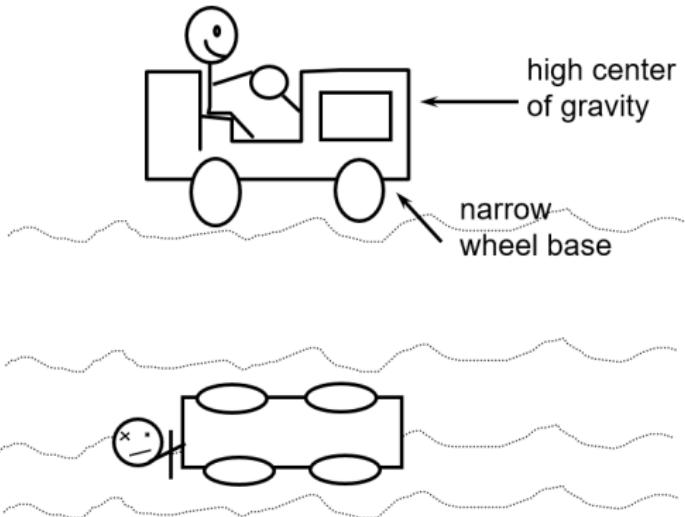
- **older** tractors have narrow front ends that are easily upset
- tractor upsets cause more fatalities than other farm accidents
- injuries often include a broken or crushed pelvis

Tractors

Original design

Terrain

- un-surfaced
- rough
- hilly



Result

Used to be called driver's error

Tractors

But:

- accidents less frequent as modern designs have:

- roll cage
- low center of gravity
- wider wheel bases



So what does this teach us?

Lesson 1

- many failures of human-machine system result from designs that don't recognize peoples' capabilities and fallibilities
- this leads to apparent machine misuse and human error

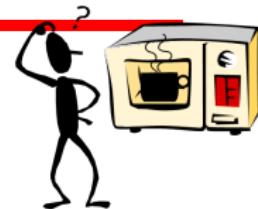
Lesson 2

- good design always accounts for human capabilities

Lesson 3

- look for examples of 'human error'
- critique them for possible 'design error'
- propose designs that limit / remove these errors

Psychopathology of everyday things

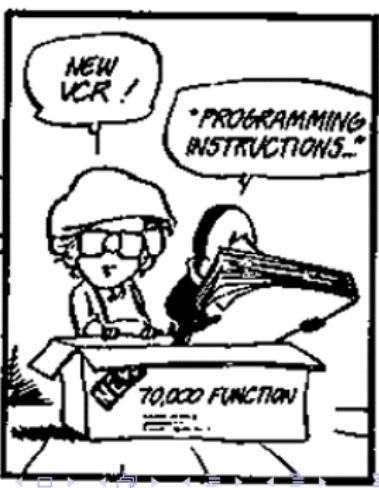


Typical frustrations

- The engineer who founded DEC confessed at the annual meeting that he can't figure out how to heat a cup of coffee in the company's microwave oven

- How many of you can program or use all aspects of your
 - digital watch?
 - VCR?
 - sewing machine?
 - washer and dryer?
 - stereo system?
 - cell phones?





Remote Controls

The phone rings...

- hit pause



Pioneer DVD Remote

Remote Controls

The phone rings ...

- hit pause

Why is it easier?

- big button easier to hit (Fitt's Law)
- visually distinctive (color)
- reasonably different from other buttons
- shape and central position means its easy to find by feel in zero light conditions



TiVo DVR

TiVo designed for usability

- part of early product development

Remote Controls

But of course I'll just learn it quickly...

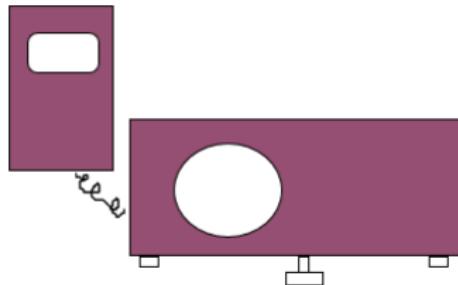


cable box digital video recorder DVD television audio amplifier VCR
six remote controls required to operate a modest home theater

Other pathological examples

Remote control Leitz slide projector

- How do you forward/reverse?



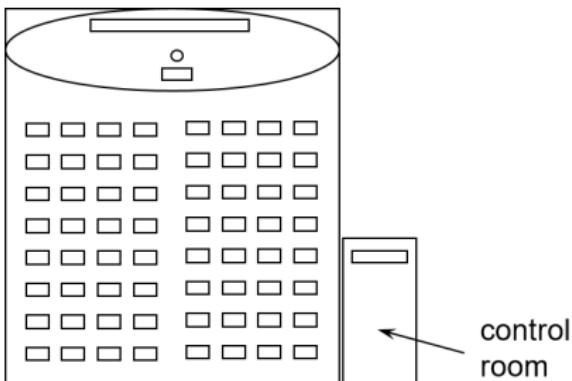
Instruction manual:

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

Other pathological examples

Amphitheater Louis-Laird in Sorbonne

- beautiful room with murals on ceiling
 - but murals are right side up only for lecturer!
 - electric projection screen
 - controls in other room out of sight of screen!



Other pathological examples

Modern telephone systems

- standard number pad
- two additional buttons * and #



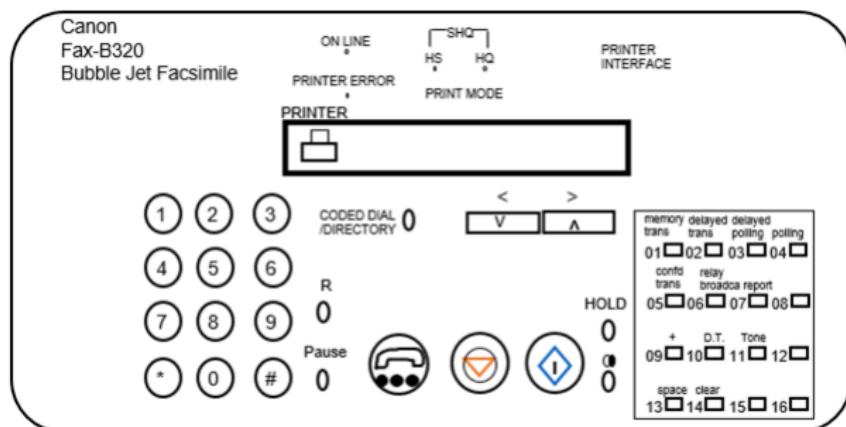
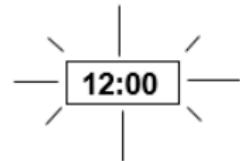
Problem

- many hidden functions
- operations and outcome completely invisible
 - *72+number = call forward
 - can I remember that combination?
 - if I enter it, how do I know it caught?
 - how can I remember if my phone is still forwarded?
 - Ok, I'll read the manual
 - but what does call park mean? What's a link?
 - where is that manual anyway?

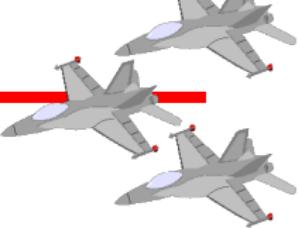
Other pathological examples

VCR's, camcorders, fax machines, ...

- most people learn only basic functions
- most functionality goes untouched



Other pathological examples



World War II

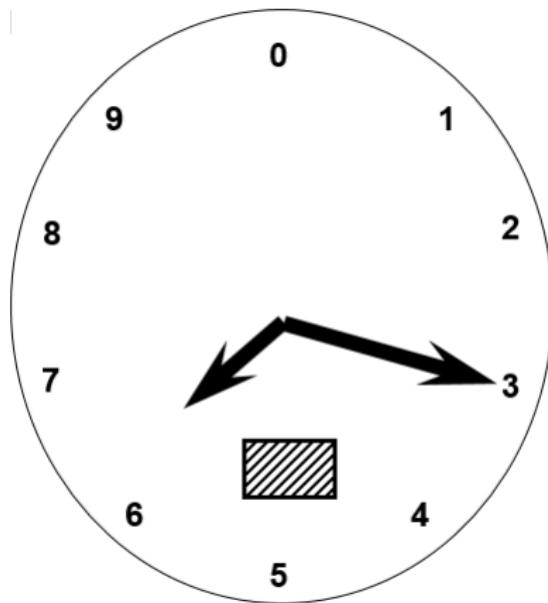
- complex machines (airplanes, submarines...)
 - taxed people's sensorimotor abilities to control them
 - frequent (often fatal) errors occurred even after high training
- example airplane errors:
 - if booster pump fails turn on fuel valve within 3 seconds
 - test shows it took five seconds to actually do it
 - 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

Other pathological examples

What's the altitude?



- Early days (< 1000'):
 - only one needle needed
- As ceilings increased over 1000'
 - small needle added
- As they increased beyond 10,000'
 - box indicated 10,000' increment through color change

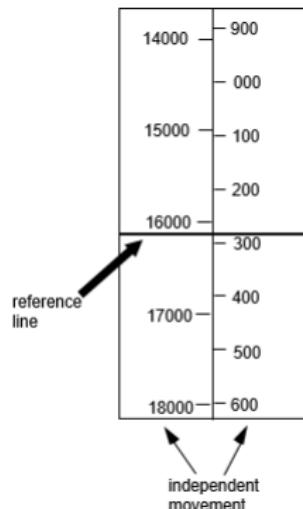
< 10,000'

> 10,000'

Slide ideas from David Hill

Other pathological examples

Tape altimeter



- Human factors test showed:
 - eliminate reading errors
 - was faster to read

- But not in standard use! Why?

Slide ideas from David Hill

Other pathological examples

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

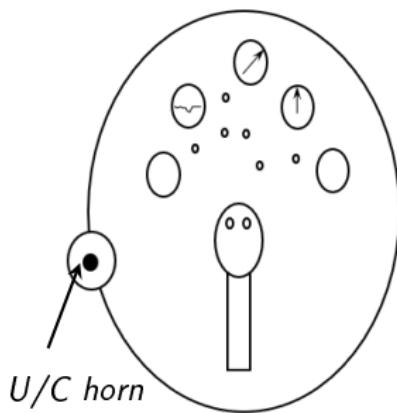


Training

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

Other pathological examples

Harvard Airplane (World War II)



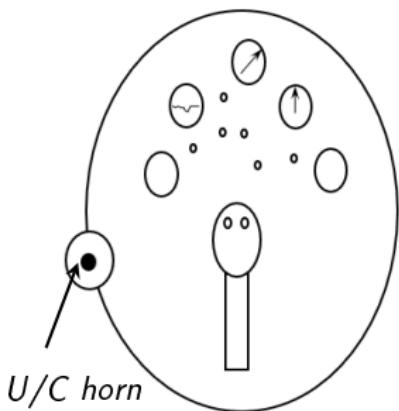
cut-out

button

Problem #1: Conditioned response
stall → push button; therefore stimulus nullified

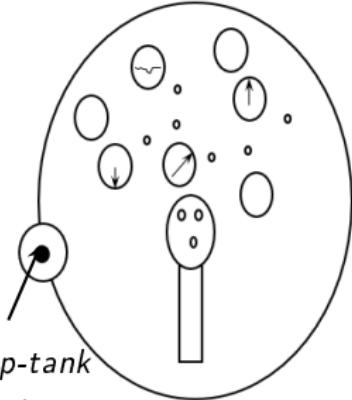
Other pathological examples

The Harvard Control Panel



*cut-out
button*

The T-33 Control Panel



*Tip-tank
jettison
button*

Problem #2: Negative transfer

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

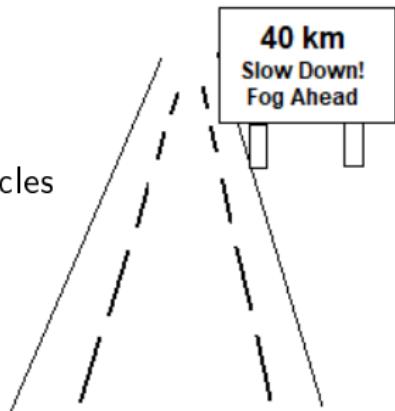


Darn these hooves! I hit the wrong switch again!
Who designs these instrument panels, raccoons?

The psychopathology of computers

Britain 1976

- Motorway communication system operated 40% of it's highways
- police controlled it in real time to
 - change lane signs, direction signs, speed limits, etc.
- On December 10th, police failed 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



The psychopathology of computers

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"

Where have we heard this before?



The psychopathology of computers

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

The psychopathology of computers

Psychopathology of the single key press

from InfoWorld, Dec '86

– "London–

An inexperienced computer operator pressed the wrong key on a terminal in early December, causing chaos at the London Stock Exchange. The error at [the stockbrokers office] led to systems staff working through the night in an attempt to cure the problem"

The psychopathology of computers

Psychopathology of the single key press

from *Science* magazine

- In 1988, the Soviet Union's Phobos 1 satellite was lost on its way to Mars, when it went into a tumble from which it never recovered.

"not long after the launch, a ground controller omitted a single letter in a series of digital commands sent to the spacecraft. And by malignant bad luck, that omission caused the code to be mistranslated in such a way as to trigger the [ROM] test sequence [that was intended to be used only during checkout of the spacecraft on the ground]"

The psychopathology of computers

The PC Cup Holder

A true (?) story from a Novell NetWire SysOp

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.

At this point the Tech Rep had to mute the call, because he couldn't stand it.

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

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Reported in the Human Factors Society Bulletin, 1981

- ▶ the manager of a system installation for police departments reported that one day he received the call "Your terminal is dead. Come and get it."
- ▶ He suggested that the repair service should be contacted, but the caller insisted.
- ▶ The terminal had two bullet holes in it.
- ▶ Apparently, an officer got a "*Do not understand*" message on the screen once too often.

*The psychopathology of computers

Iran Air 655

- ▶ USS Vincennes shot down an Iran Air A-300 Airbus with 290 people aboard (1988)
- ▶ it used the Aegis weapons system with **sophisticated software** for identifying and tracking potential targets
- ▶ however, the large-screen display did not show altitude information
- ▶ so altitude had to be read from separate consoles
- ▶ the Airbus which had levelled off at 12 500 feet, was taken to be an F-14 fighter descending from 9 000 feet
- ▶ ironically, an escort ship with older equipment was able to read the plane's altitude quite correctly, but could not intervene in time.

*The psychopathology of computers

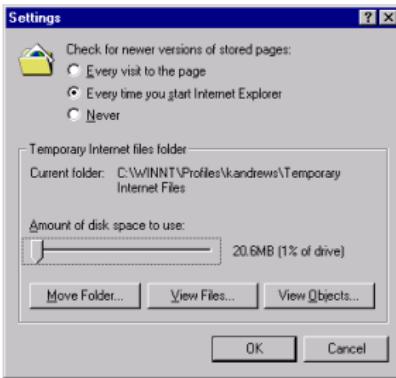
Beware Unix Commands

- ▶ intend to type: rm *~ to remove Emacs backup files
- ▶ actually type: rm * ~ which removes everything!
- ▶ and there is no undo ...

*The psychopathology of computers

Smallest Setting is 1%

- ▶ Internet Explorer 4.0 cache size could only be set in increments of 1% of the size of the hard disk
- ▶ "*The smallest setting is 1%. I have a 4 Gig drive, and don't need 40 MB of cache, thank you.*" (Ross Cormier)



*The psychopathology of computers

Horizontal Scrolling

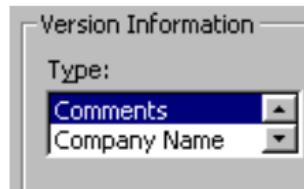
- ▶ Internet Explorer 4.0 certificate authority selection panel uses horizontal scrolling
 - ▶ humans can scan written material **faster from top to bottom** rather than left to right



*The psychopathology of computers

Two Item List Box

- ▶ Visual Basic 5.0 used a two item list box
- ▶ a drop down list or radio buttons would have been preferable



*The psychopathology of computers

Two Thousand Item List Box

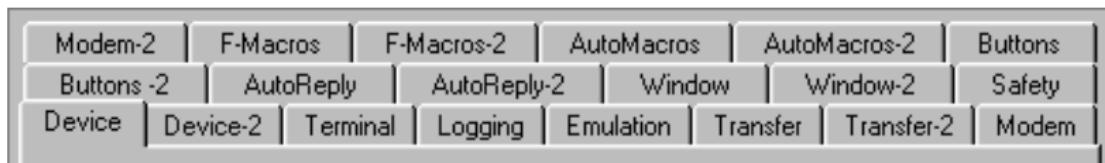
- ▶ do not put hundreds or thousands of items into a list box, either
 - ▶ "*I want to fill a list box with 2000 items ... This takes incredibly long ... over 20 minutes. Any ideas?*"
(a Visual Basic programmers forum, 1996)



*The psychopathology of computers

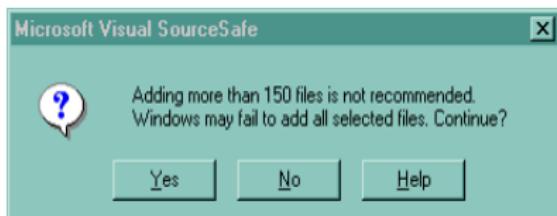
Multi-Row Property Sheets

- ▶ tab controls are among the best user interface elements ever devised
 - ▶ multi-row tab controls are perhaps one of the worst interface elements ever!
 - ▶ clicking one of the tabs other than from the bottom row, causes a major reorganisation of the complete set of tabs

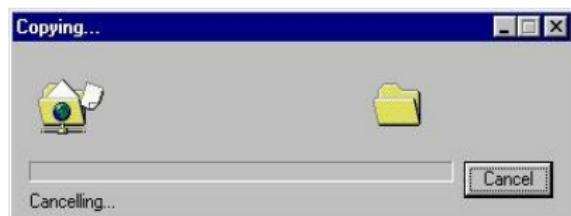


The psychopathology of computers

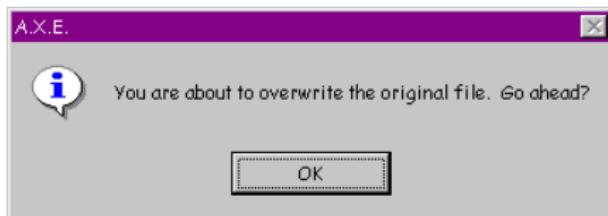
Inane Dialog Boxes



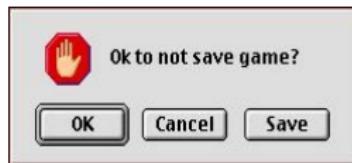
Umm, thanks for the warning,
but what should I do?



What happens when you cancel a
cancelled operation?



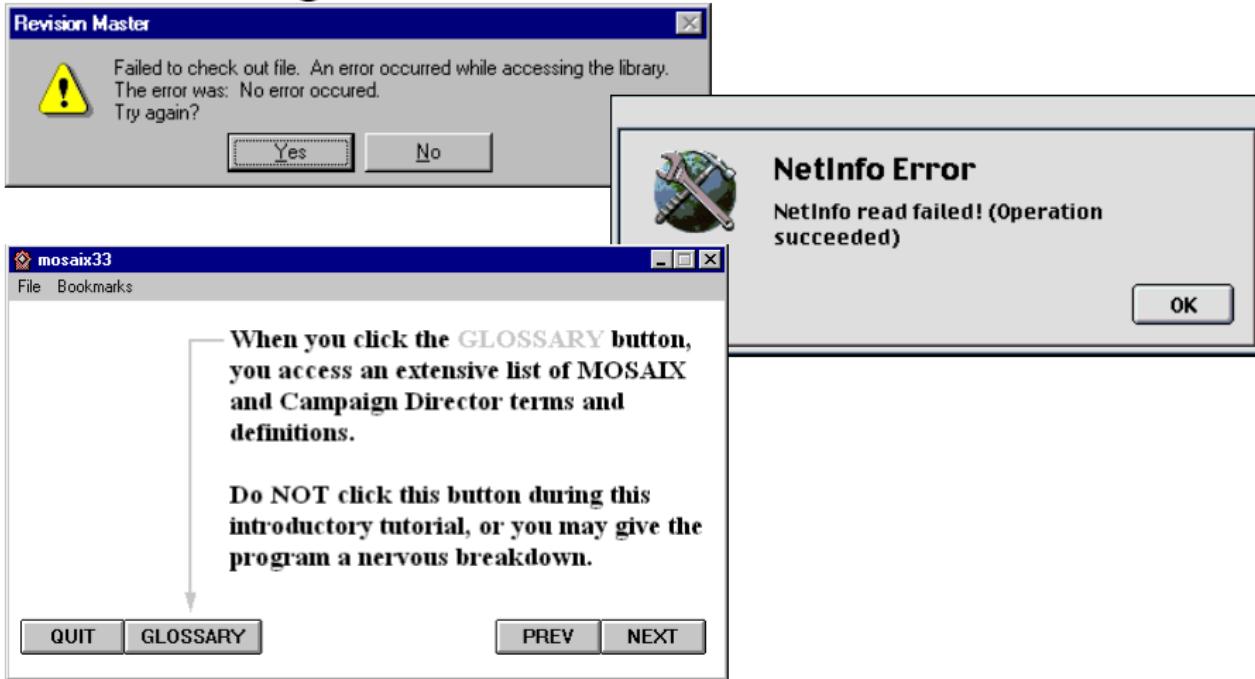
Do I have any choice in this?



Uhhh... I give up on this one

The psychopathology of computers

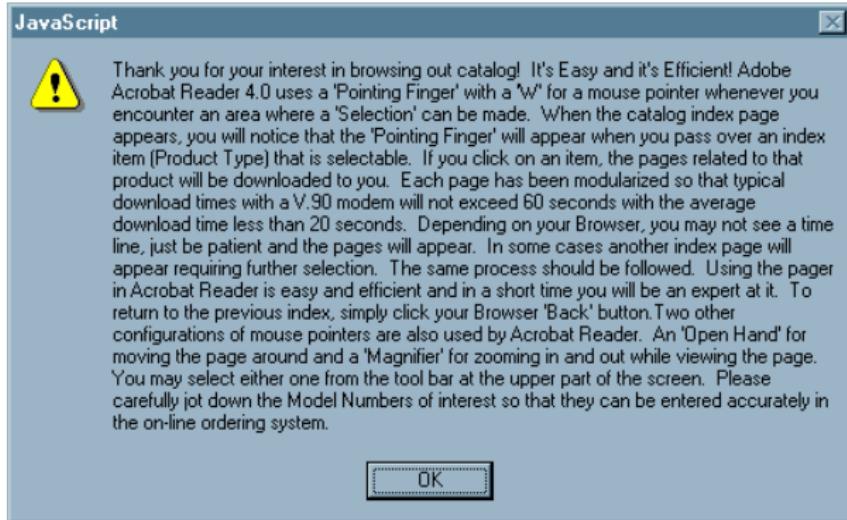
Inane Dialog Boxes



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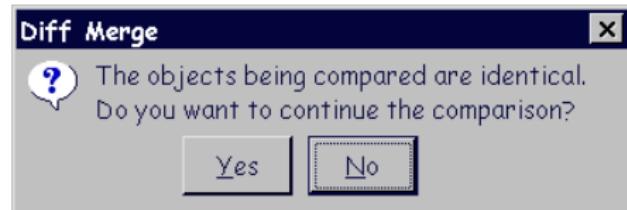
Inane Dialog Boxes

Midwest Microwave's online catalog

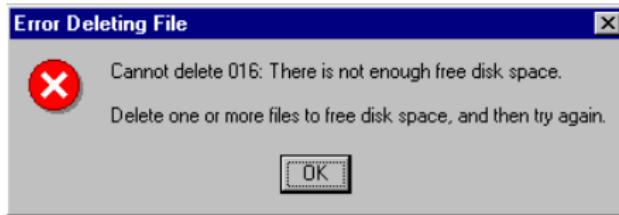
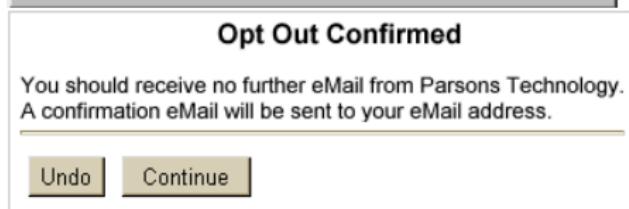


The psychopathology of computers

Inane Dialog Boxes



ClearCase, source-code control Rational Software





"HIT ANY KEY TO CONTINUE"

Why should you care?

Past

- manufacturers had little incentive to emphasize usability
- customers have no experience until after they buy the product
- early technology adaptors were ‘resilient’
 - willing to put up with annoyances
- consequences of bad design typically small (annoyances)

Why should you care?

Today: Usability sells

- product reviews emphasize usability (e.g., Consumer Reports)
- customers have used related products, and can often download trial versions (including competitors)
- today's users are impatient and intolerant of bad design

Consequences of bad design now large

- costly errors in serious systems (e.g. financial institutes)
- widespread effects (e.g. incorrect billing, failures)
- life-critical systems (e.g. medical, air traffic control)
- safety (e.g. in-car navigation systems)

Why should you care?

Professionalism

- software engineers are designers
- we are ultimately responsible for the products we build
- a history of ‘hack’ designs does not excuse our responsibilities

Compared to civil engineers

- What would happen to an engineer who built a bridge where people fell off of it into the river (because the guard rails were too low), and where accidents were high (because the bridge was too narrow)?
- We would call this incompetence.
- **The same standard should apply to software engineers.**

*Bibliography

- Saul Greenberg, **Designing and building visual interfaces. Pathological designs**, University of Calgary, Canada
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- Keith Andrews, **Human Computer Interaction, Chapter 2. The Psychology of Usable Things**, TU Graz, Austria
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