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# IPM 10/11 – T1.3

## Design Concepts

Licenciatura em Ciência de Computadores

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**Acknowledgements:** Most of this course is based on the excellent course offered by Prof. Kellogg Booth at the British Columbia University, Vancouver, Canada. Please acknowledge the original source when reusing these slides for academic purposes.

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# Summary

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- **Design concepts**
  - Affordance
  - Mapping
  - Feedback
  - Visibility
- **Other factors**
  - Transfer effects
  - Cultural associations
  - Individual differences

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# Usable vs. Useful

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Thomas Landauer, *The Trouble with Computers: Usefulness, Usability, and Productivity*, 1995

- **Useful:** the system can do what I need it to do
- **Usability:** *I can get the system to do what I need it to do*
  - ease of learning, recall, productivity, minimal error rates, high user satisfaction
- **Not disjoint concepts**
  - e.g., system not useful because it is so difficult to interact with it

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# Design Concepts

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design concept is highest level and open to interpretation;  
*It is a starting point*

- **Affordance**
  - visible constraints
- **Mapping**
- **Feedback**
  - Causality (true and false kinds)
  - Understandable action
- **Visibility**
- **Conceptual models**

## Other factors:

- Transfer effects
- Cultural associations
- Individual differences

“Psychology of everyday things”,  
Don Norman, 1988

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# Design Concepts: Affordance

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# Affordance

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The perceived and actual fundamental properties of the object that determine how it could possibly be used (Gibson 1977)

- **Visual structure indicates how the object should be used**
  - Chair for sitting
  - Table for placing things on
  - Knobs for turning
  - Slots for inserting things into
  - Buttons for pushing
  - Computers for ???
- **Complex things may need explaining**
- **Simple things should not**
  - when simple things need pictures, labels, instructions  
-> Design has failed!



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# Physical affordance

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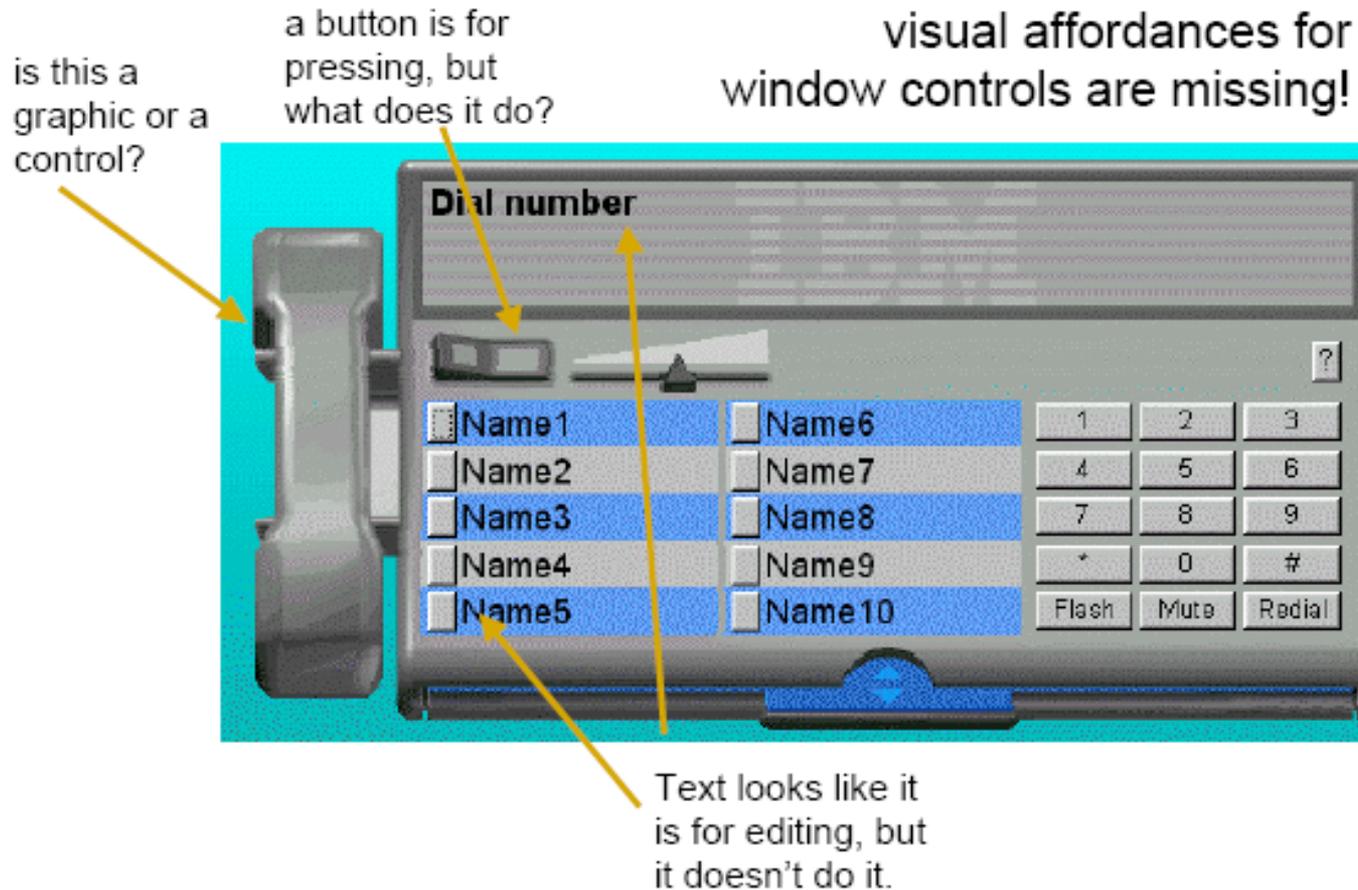


photo from Don Norman's "good design" gallery:  
<http://www.jnd.org/GoodDesign.html>

# Low level affordances: needs familiar idiom and metaphor to work

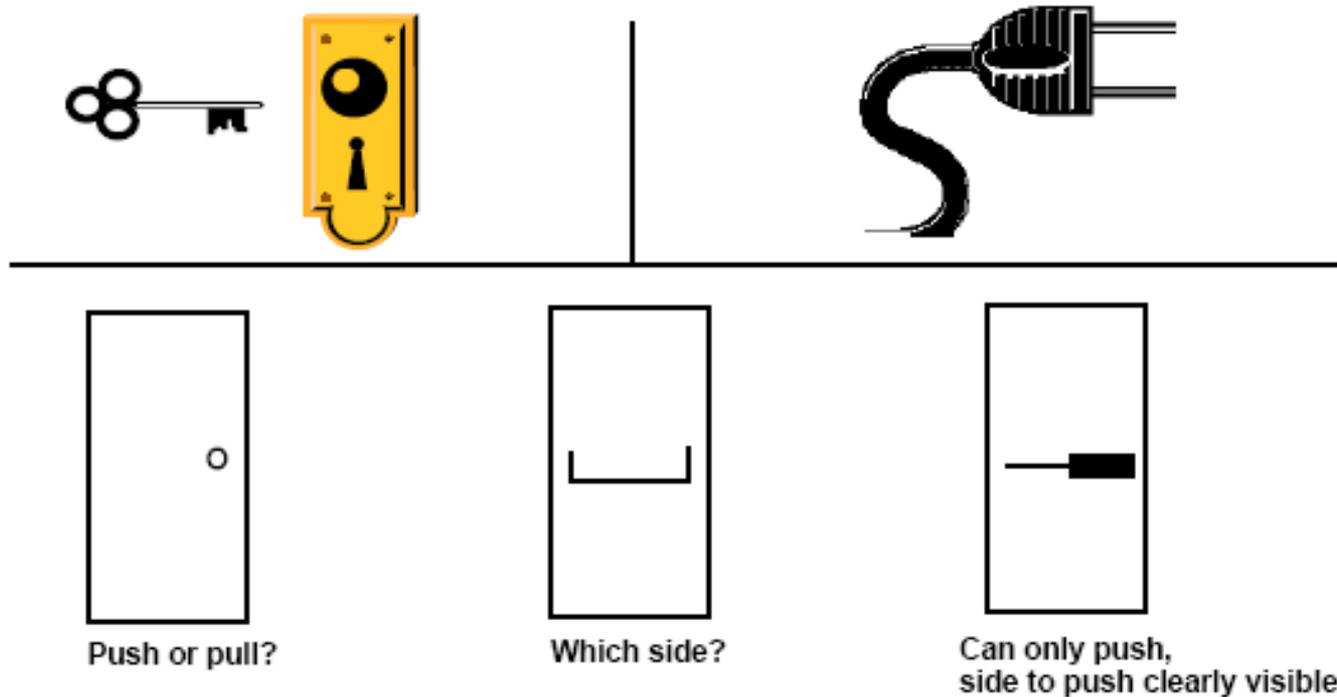


# Visual “affordance” can be misleading!



# Affordance: visible constraints

Object's appearance indicates *limitations of possible actions*



# A progression of visible constraints to enter a date

The screenshot shows a window titled "Form1" with a "Date:" label and an empty text box. Below it are three separate text boxes for "Month", "Day", and "Year". A second set of three text boxes shows the date "May 22 1997". At the bottom, there are three dropdown menus for "Month", "Day", and "Year", with "May", "22", and "1997" selected.

The screenshot shows an "Appointment" dialog box with tabs for "General", "Attendees", "Notes", and "Planner". The "When" section has "Start" and "End" time and date pickers. The "Start" is "8:30 AM" on "Wed 5 /14 /97" and the "End" is "4:30 PM" on "Wed 5 /14 /97". There is an "All day" checkbox. A calendar for "May 1997" is open, showing the date "14" selected. The "Description" field contains "Smart Technology Ser". At the bottom, there is a "Where:" field with a home icon.

S	M	T	W	T	F	S
27	28	29	30	1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31
1	2	3	4	5	6	7

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# Design Concepts: Mapping

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“Psychology of everyday things”,  
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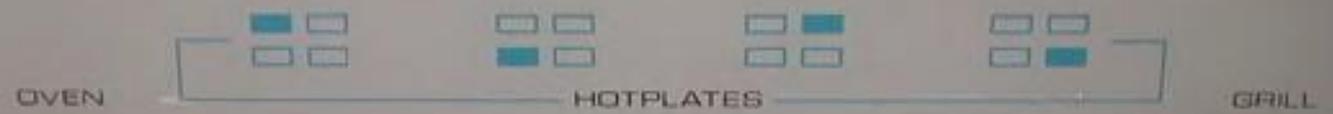
OFF OFF OFF OFF OFF OFF OFF OFF

HI LO HI LO HI LO HI LO

250 100 200 150

ON

200 230 260  
400 450 500

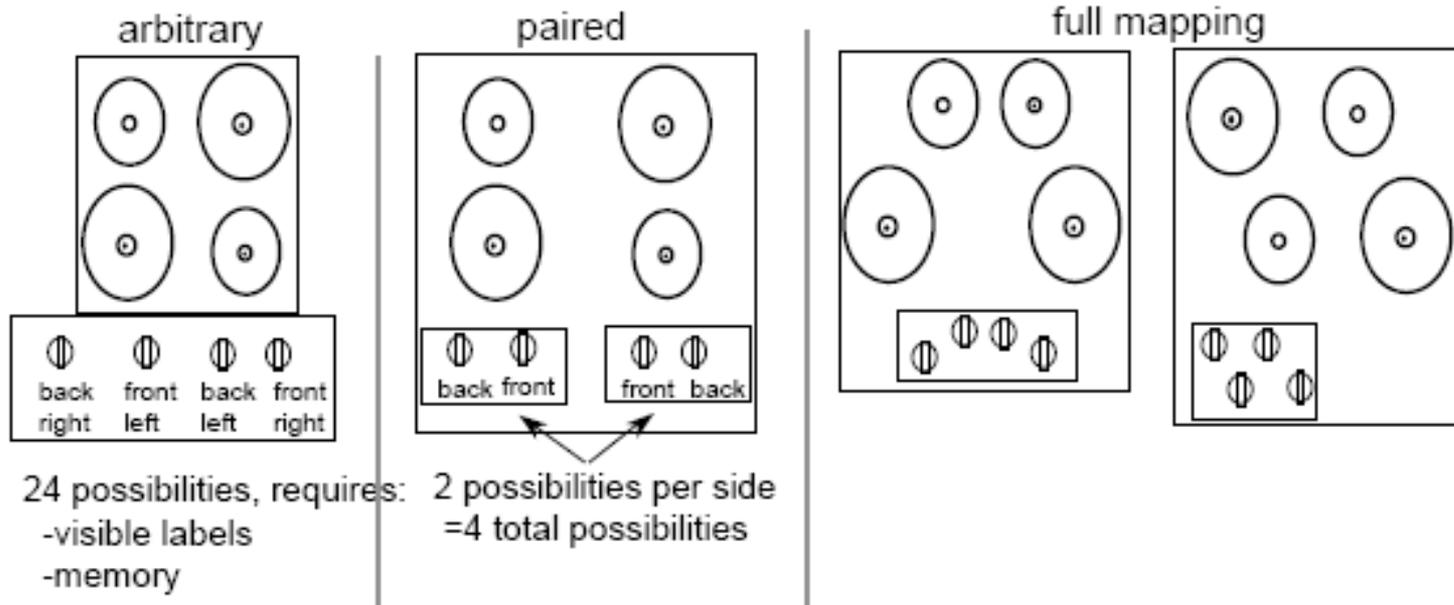


Centenary

# What is mapping?

The set of possible / natural relations between objects

- e.g. control-display compatibility:
  - Visible mapping and mimic diagrams: stove and controls
  - Cause and effect: steering wheel-turn right, car turns right



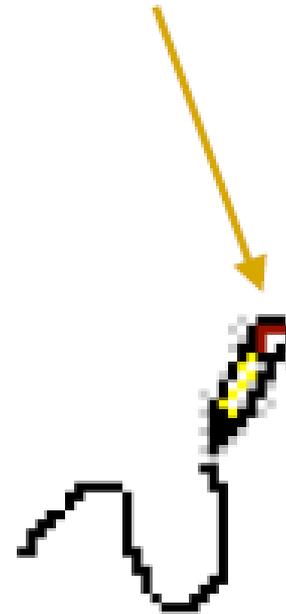
# Example of mappings

Only active  
palette items  
visible

Depressed  
button  
indicates  
current  
mapped item



Cursor re-enforces  
selection of current  
item



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# Design Concepts: Feedback

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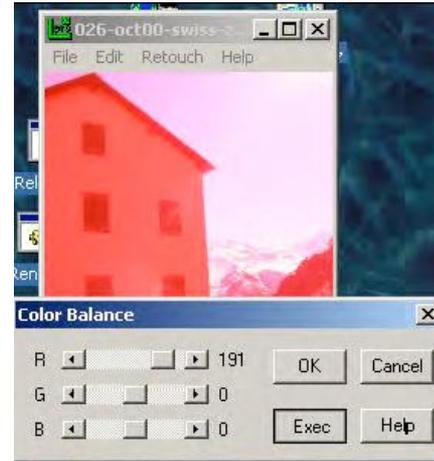
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# Feedback & understandable action

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Effects visible only after 'Exec' button is pressed:

- OK does nothing! Exec THEN OK (action is **not understandable**)
- When hit OK, action is irreversible.



- So... just remove the Exec button, right?

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# Feedback and causality

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*Causality: A caused B to happen*

## **True causality != perceived causality**

- We usually assume that the thing that happens right after an action was caused by that action.
- Interpretation of “feedback”.

## **False causality**

- Incorrect effect:
  - Starting up an unfamiliar application just as computer crashes causes “superstitious” behaviors.
- Invisible effect:
  - Command with no apparent result often re-entered repeatedly.
  - e.g., hitting esc, or alt-ctrl-del, on unresponsive system.

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# Design Concepts: Visibility

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  - Causality (true and false kinds)
  - Understandable action

## Other factors:

- **Visibility**
- Conceptual models

- Transfer effects
- Cultural associations
- Individual differences

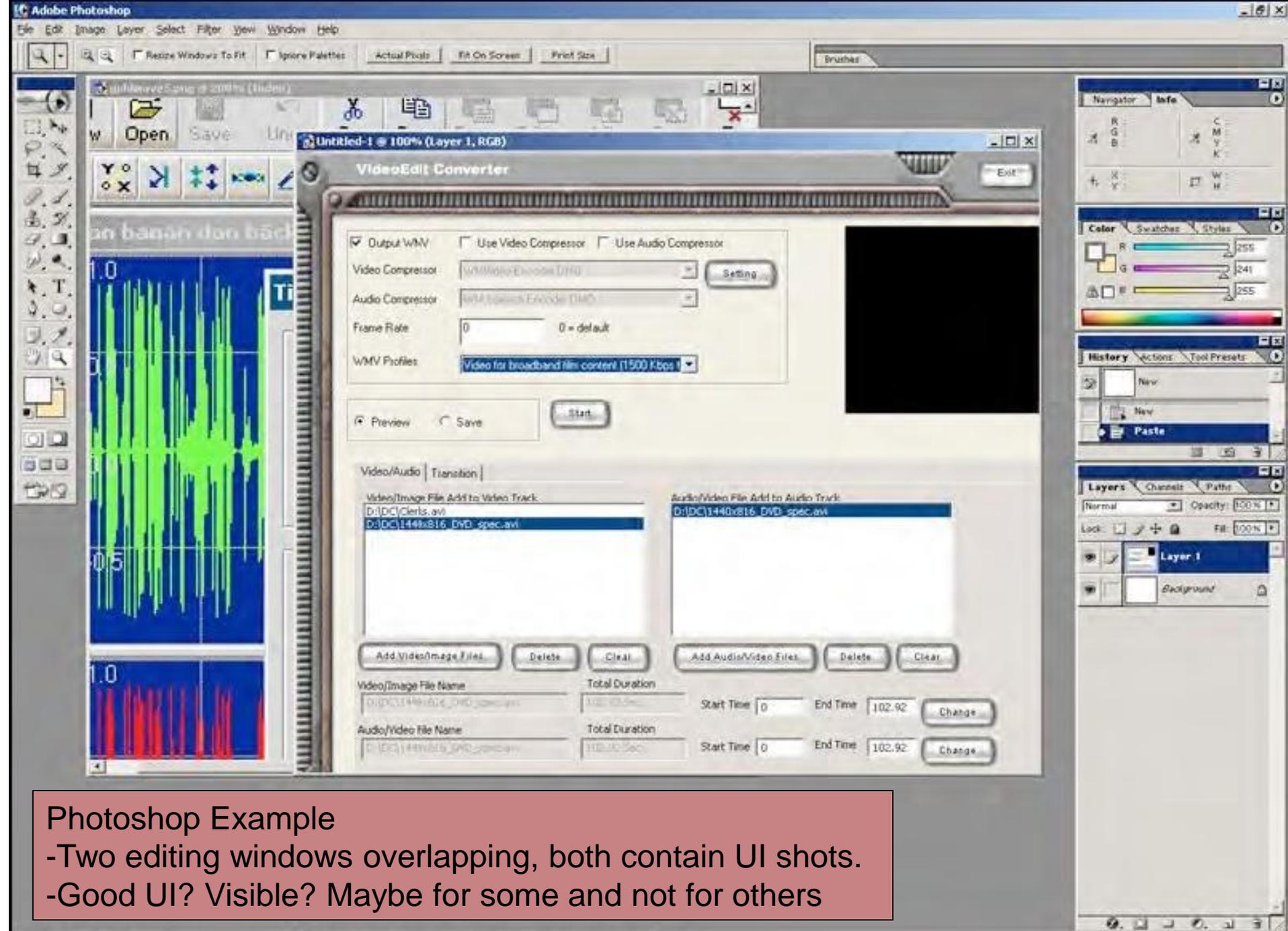
“Psychology of everyday things”,  
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# Visibility: what can it do?



Too many buttons (most unused)  
Poor mappings  
Obscure labels  
Overlapping functions

[www.useit.org](http://www.useit.org)



Photoshop Example  
-Two editing windows overlapping, both contain UI shots.  
-Good UI? Visible? Maybe for some and not for others

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# Other factors

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## Other factors:

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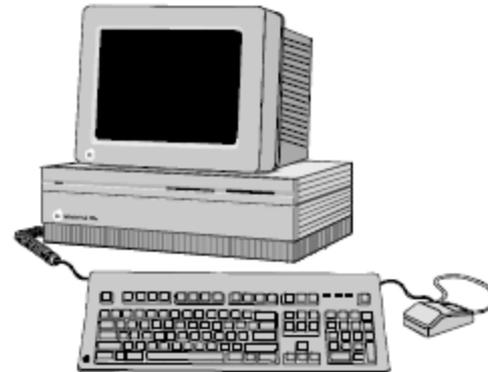
“Psychology of everyday things”,  
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# Transfer effects

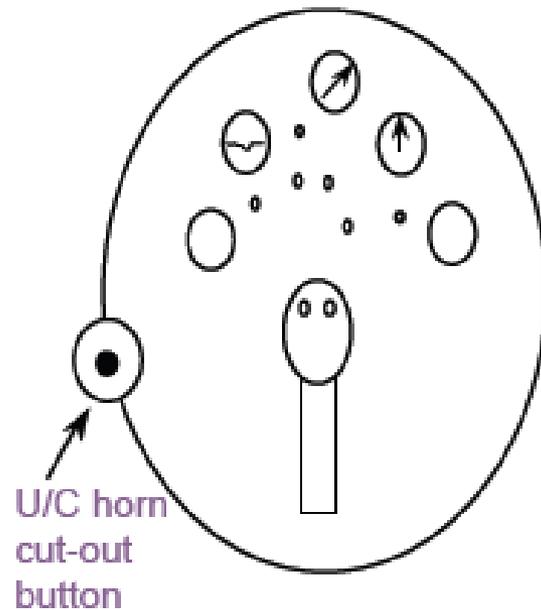
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- People transfer their learning/expectations of similar objects to the current objects
  - **Positive transfer**: previous learning **applies** to new situation
  - **Negative transfer**: previous learning **conflicts** with new situation

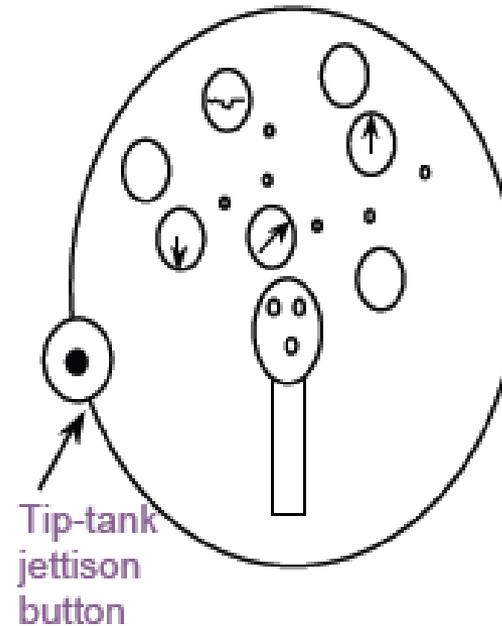


# Negative transfer

The Harvard Control Panel



The T-33 Control Panel



Problem #2: Negative transfer

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

# Intentional inconsistency



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# Cultural idioms

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**Idiom:** A standard with a meaning that cannot be derived from the conjoined meanings of its elements.

Populations learn idioms that work in a certain way

- red means danger, green means safe

But idioms vary in different cultures!

- Light switches: up is (N America) **on** (Britain) **off**
- Faucets: clockwise is (N America) **off** (Britain) **on**

Ignoring/changing stereotypes?

- Home handyman: light switches installed upside down
- Calculators vs. phone number pads:
  - which should computer keypads follow?

Difficulty of changing stereotypes

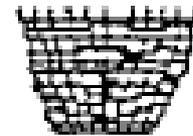
- Qwerty keyboard: designed to prevent jamming of keyboard
- Dvorak keyboard ('30s): probably faster to use

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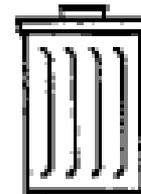
# Cultural Idioms

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Because a trashcan in Malaysia may look like this:



a Malaysian user might be confused by this image popular in Apple interfaces:



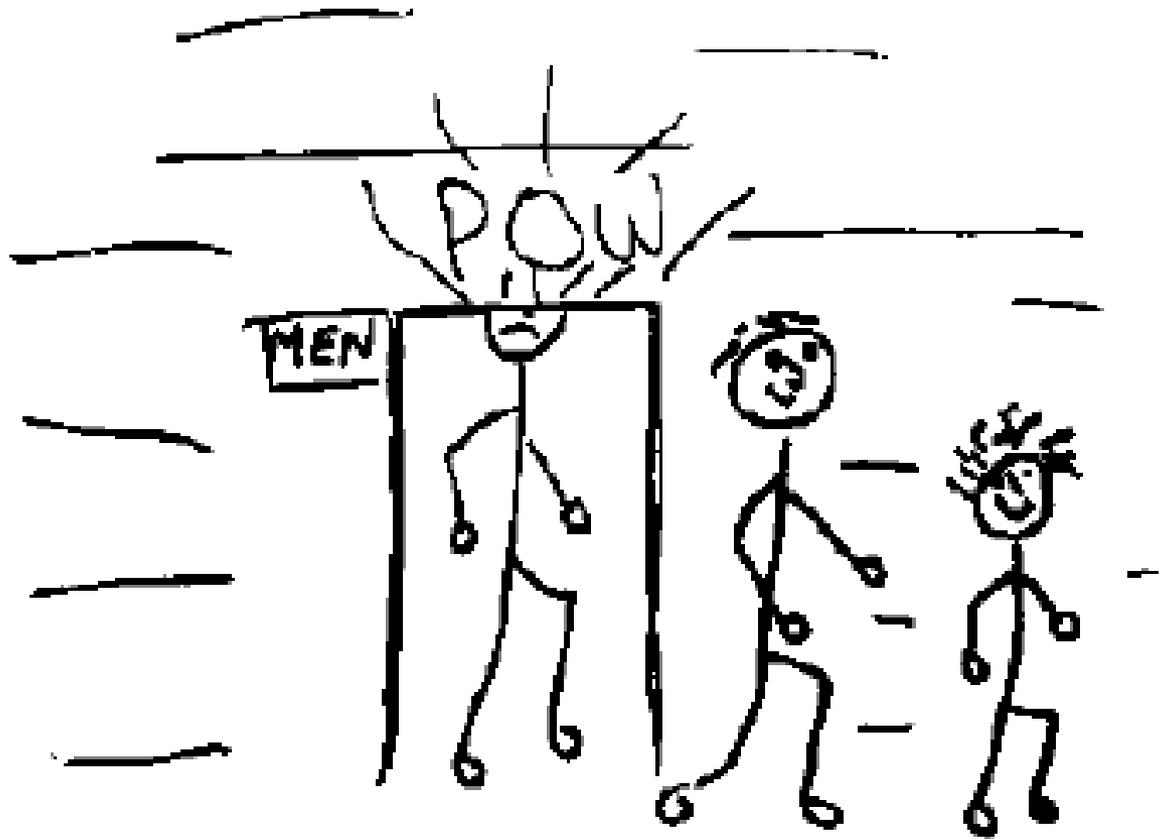
Sun found their email icon problematic for some American urban dwellers who are unfamiliar with rural mail boxes.



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# Individual differences

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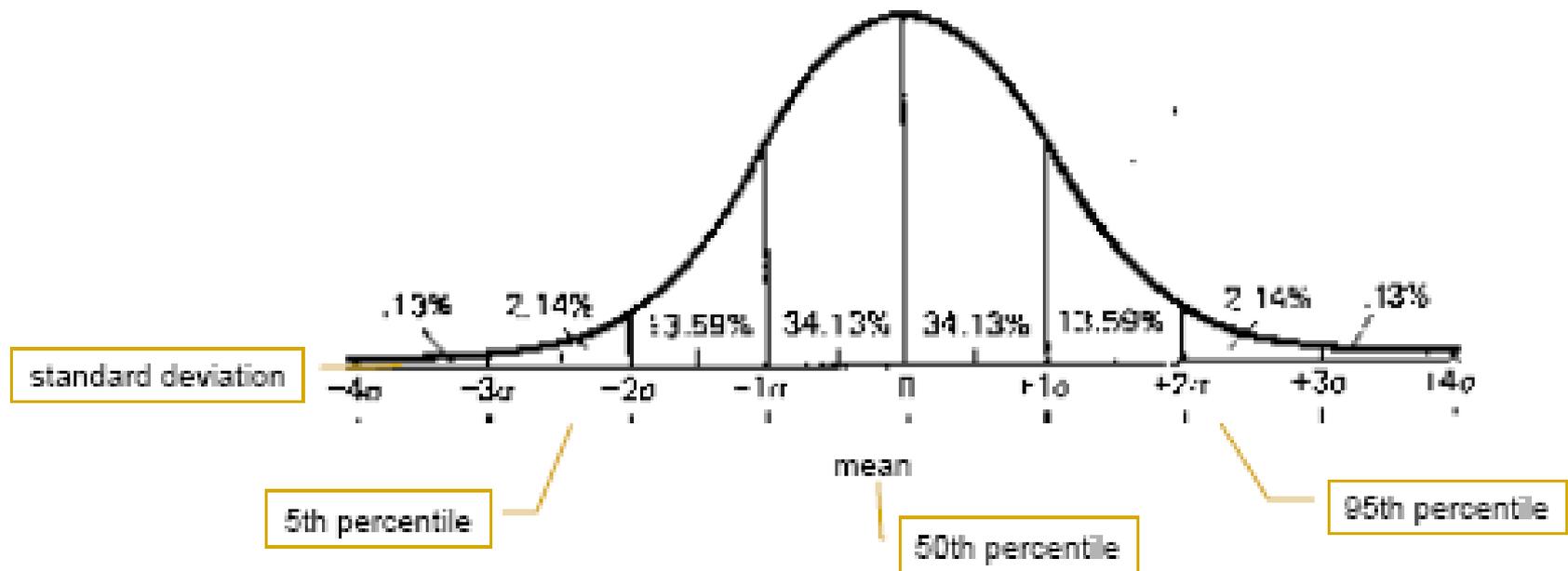
# Individual differences: physical

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## 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:
  - Design should cater to 95% of audience (5th or 95th percentile)
    - 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?

# Gaussian distribution



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# Individual differences: expertise

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computer users:

novices	<i>walk up &amp; use systems</i> <i>interface affords restricted set of tasks</i> <i>introductory tutorials to more complex uses</i>
casual	<i>standard idioms</i> <i>recognition (visual affordances) over recall</i> <i>reference guides</i> <i>interface affords basic task structure</i>
intermediate	<i>advanced idioms</i> <i>complex controls</i> <i>reminders and tips</i> <i>interface affords advanced tasks</i>
expert	<i>shortcuts for power use</i> <i>interface affords full task + task customization</i>

most kiosk  
+ internet  
systems

most shrink-  
wrapped  
systems

custom  
software

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# Proverbs on individual differences

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*you probably aren't much like the "average" user of a system you've designed*

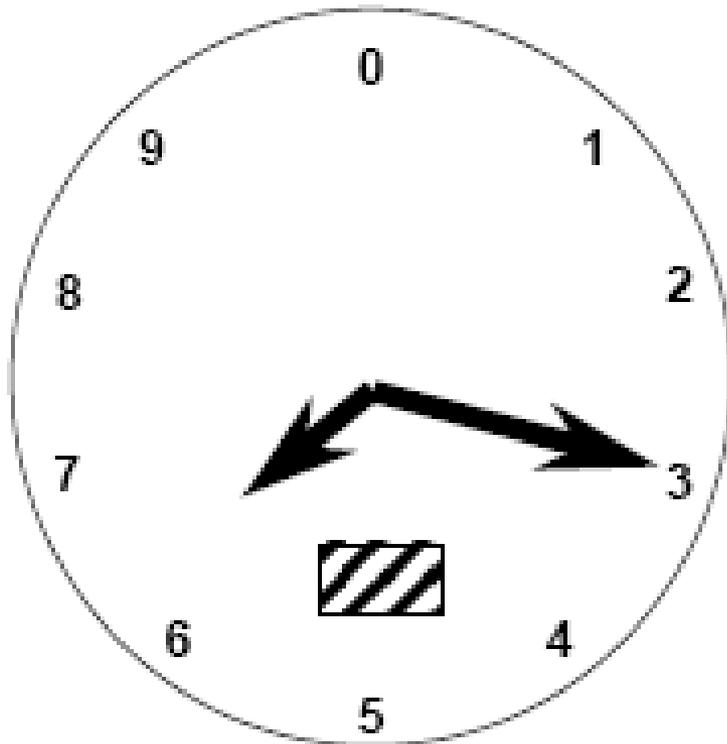
*don't expect others to think and behave as you do, or as you might *like them to*.*

*people are as different in the ways they think and behave, as they are physically*

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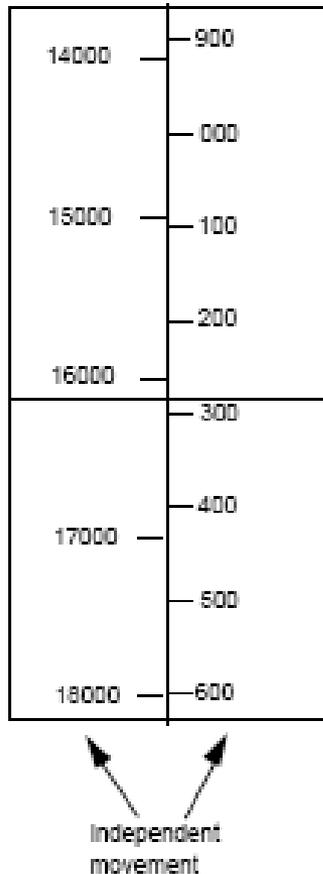
# Example: What's the altitude?

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

# A kind of tape altimeter



- Human factors test showed that this altimeter:
  - Eliminated reading errors
  - Was faster to read
- But it was not put into standard use!
  - Why?

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# Resources

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1. Kellogg S. Booth, Introduction to HCI Methods, University of British Columbia, Canada  
<http://www.ugrad.cs.ubc.ca/~cs344/current-term/>