Design of Information Displays, pt.1

- **Display**: a human-made artifact "designed to support the perception of relevant system variables and facilitate the further processing of that information." (Wickens et al., pg.185)
- Classified by:
  - physical properties of the display
  - tasks they support
  - characteristics of the user
  - for example,

	Coded	Reproduced
Static	chart, stop sign	photograph
Dynamic	speedometer, flight path displays	video image, film

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DISPLAY DESIGN PRINCIPLES, pt.1

- Perceptual Principles
  - The perceptual principles deal with the way a user initially perceives the material presented. The information needs to be presented in a clear and unambiguous manner so as to avoid confusion by the user.

1. Make the display legible (or audible).
   - *The* most important principle of display design. Every display must be legible (or audible, if needed) to allow the user to interact with it successfully.
   - The correct combination of colors, contrasts, and sounds should be used to ensure that the user gets the necessary information from the display.

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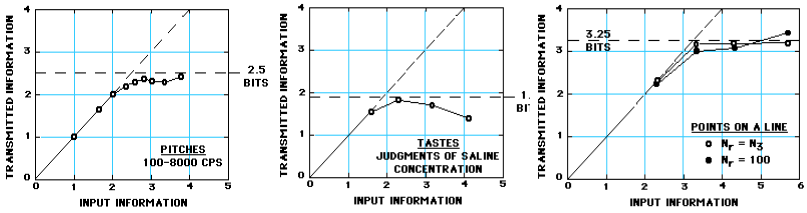
2. Avoid absolute judgment limits.
   - Coding based on a single sensory variable
   - 5-7 levels max
     - research examples from the literature



   - Consider *relative* judgements (where appropriate) instead
     - (e.g., darker hues of the same color indicate "more")

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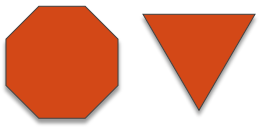
3. Top-down processing.
   - Will cause people to interpret cues based on *expectations*
   - Design displays and controls that meet expectations to maximize performance
   - *More physical evidence* will be required for signals that are contrary to people's expectations



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4. Redundancy gain.
   - Example: traffic lights

5. Discriminability:
   - Similarity causes confusion.
   - The degree of similarity depends on the ratio of similar features to dissimilar ones

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- Mental Model Principles
  - When a user sees a display, they usually interpret the display based on their expectations of the system being displayed. These expectations come from past experiences which have formed a mental model of the system and how it works. It is important to design displays that are consistent with the mental models of the user.

6. Principle of pictorial realism (Roscoe, 1968).
   - Displayed quantities should correspond to the human's internal model of these quantities.
     - Continuous variables should have analog displays; discrete variables should have digital displays.
     - Also, high values of the variables should be on the top of the display (or right); low values on the bottom (or left).
     - Other factors to consider: required precision, rate of change information.
     - Examples to discuss: altimeter, thermometer, scale, watch, speedometer.

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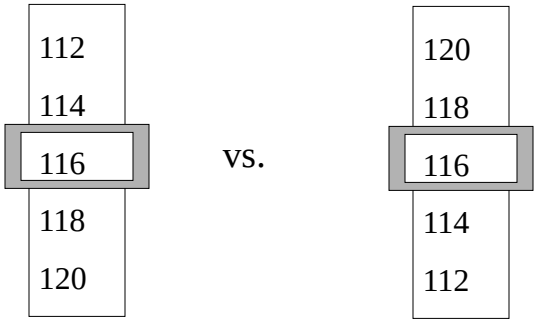
7. Principle of the moving part (Roscoe, 1968).
   - The direction of movement of an indicator on a display should be compatible with the direction of movement of an operator's internal representation of the variable whose change is indicated.
     - Example: Thermometer's mercury rises as temperature rises.
     - Violation: Fixed pointer-moving scale display.



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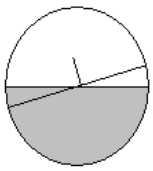
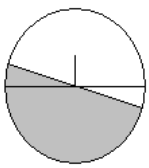
- "Sticky" example from aviation: the display of the aircraft's bank angle to pilots.
  - "Outside-in" "ground-referenced" "bird's-eye" display (moving plane, fixed ground) - conforms to the principle of the moving part, but violates the pilot's frame of reference.
  - "Inside-out" "pilot's eye" "moving horizon" display - violates the principle of the moving part but congruent with the pilot's frame of reference.
  - A compromise: The Frequency-Separated Display
    - Rapid control movement induces "outside-in" display change.
    - When the pilot enters into a gradual turn, the horizon and plane slowly rotate to an "inside-out" format.
  - Thus, at high frequencies, when motion perception is dominant, the principle of the moving part is followed. At low frequencies, the static principle of compatibility of frame of reference is followed





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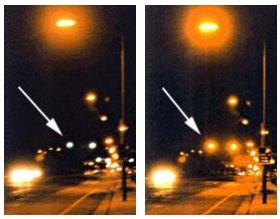
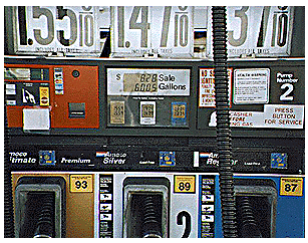
Other examples to discuss





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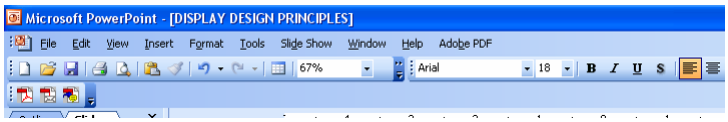
- **Principles Based on Attention**
  8. Minimizing information access cost.
     - Recall problems of selective, focused, and divided attention.
     - Example:



vs.

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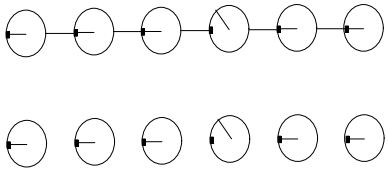
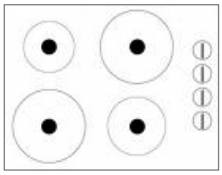
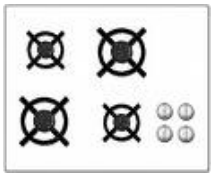
9. Proximity compatibility principle (Wickens & Carswell, 1995).
   - Promote integration of information (where appropriate.)
   - *gestalt* - human tendency to perceive complex configurations as complete entities



   - Note: This carries over into design of controls, in that the spatial arrangement of displays should be preserved in the controls. (Example: stove controls.)





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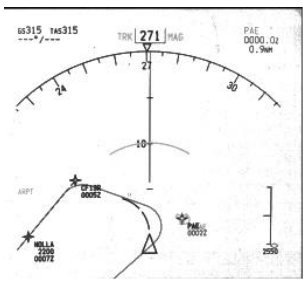
10. Principle of multiple resources.
    - We'll discuss this when we discuss multiple resource theory.

- **Memory Principles**

11. Principle of knowledge in the world.
    - The "penny" experiment
    - Tradeoff: space constraints, information overload (requires careful design.)

12. Principle of predictive aiding.
    - Example: predictive display for aircraft



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13. Principle of consistency.
    - Consistent with other systems as well as other displays for "this" system.
    - Consistent with user's mental model of how things work.

- **Others?**

Displays for Specific Purposes

- Types of Information Display:
  - Direct
  - Indirect

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Dynamic	speedometer, flight path displays	video image, film

Your turn ....

- Alerting displays
- Labels
- Monitoring
- Multiple displays
  - Layout issues
  - Head-up displays
  - Head-mounted displays
  - Configural displays
- Maps
- Quantitative information