Design of Information Displays

- **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,

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Display Design Principles

- **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
     - The most important principle of display design. Every display must be legible 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.

Visibility

- **Image clarity (previously)**
- **Location in field of vision**
  - See pp. 66-67 of your textbook

- **Proximity** (how close) to the operator will affect the desired size of the display. Viewing distance also affects distinguishability.
What’s wrong with these pictures?

Distinguishability

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”)
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

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

Panel Organization
- Group displays by
  - FUNCTION
  - FREQUENCY
  - ORDER OF USE
  - Things that are used together
- Determine sequence and frequency of use through link analysis
- In general,
  - Most frequently used displays should be in the center of the field of vision
  - Scanning is
    - Top to bottom (always)
    - Left to right (mostly)
    - Other common patterns
      - “F”
      - “Z”
  - Larger and more attention-grabbing displays will compel the operator’s attention.
Monitor saccadic eye movement across a display panel.

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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.

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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.
   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.

   ![Temperature Scale Example](image)

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   VS.
   | 116 |
   | 114 |
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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 frames of reference is followed.

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Other examples to discuss

![Other Examples](image)
8. Minimizing information access cost.
   - Example:

   - Promote integration of information (where appropriate.)
   - Recall gestalt - human tendency to perceive complex configurations as complete entities

   ![Image](image_url)

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

    - We'll discuss this when we discuss multiple resource theory.

11. Principle of knowledge in the world.
    - Knowledge “in the world” is more reliable than knowledge “in the head”.
    - Tradeoff: space constraints, information overload (requires careful design.)

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

   ![Image](image_url)
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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Your turn ....
- Alerting displays
- Labels
- Monitoring
- Multiple displays
  - Layout issues
  - Head-up displays
  - Head-mounted displays
  - Configural displays
- Maps
- Quantitative information