MIE 240: Human-centred system design
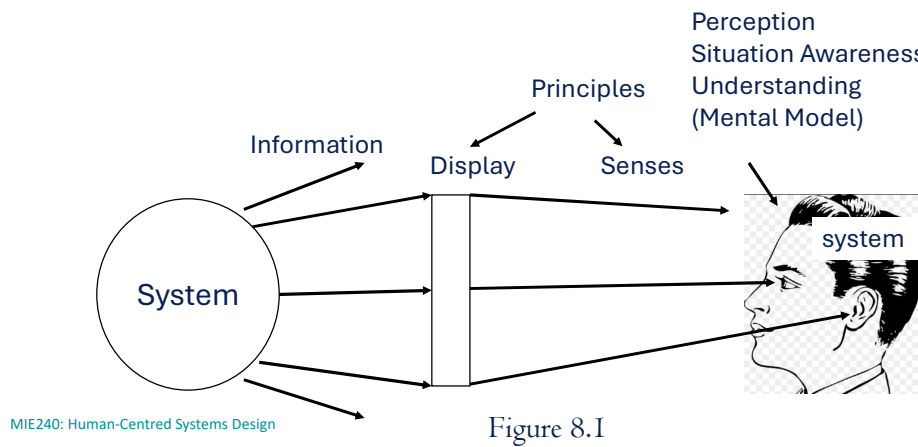
Displays

0

Learning Objectives

- Review displays and display classifications
- Discuss types of displays and examine examples of each

1

Review: Displays

Artifacts designed to guide attention to relevant system information, and then support its perception and interpretation.

Figure 8.1

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Cockpit

Mobile device

Transit map

Speedometer

Payment devices

Power plant control center

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Review: Display Design Principles

Attention principles

- Salience compatibility
- Minimize information access cost
- Proximity compatibility
- Avoid resource competition

Perception principles

- Make displays legible (or audible)
- Avoid absolute judgment limits
- Support top-down processing
- Exploit redundancy gain
- Make discriminable

Memory principles

- Knowledge in the world
- Support visual momentum
- Provide predictive aiding
- Be consistent

Mental model principles

- Pictorial realism
- Moving part

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Displays

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Classifying Displays

Classified along **three** different dimensions:
- Physical properties (*color, shape, position, motion, modality*)
- Tasks they are designed to support
- Characteristics of human user that dictate best mapping between display and task

Table 8.1

Task	Static or Dynamic	Data elements	Important principles
Alert	Dynamic	Few	Attention
Label	Static	Few	Perception
Monitor	Dynamic	Many	Attention, Mental model
Integrate	Dynamic	Very many	Memory, Mental model
Navigate, Guide	Dynamic	Many	Perception, Mental model
Visualize	Static	Many	Attention, Perception

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Types of displays
- Alerts
- Labels
- Monitoring
- Integrative displays
- Navigation displays and maps
- Data visualization and graphs

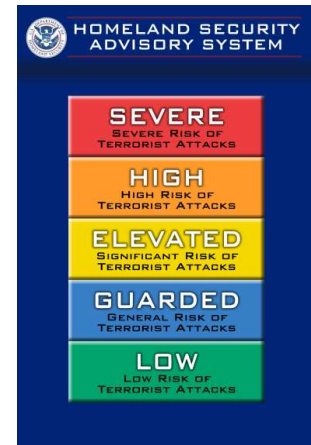See these as assemblies of principles to achieve specific goals

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Alert

Alerts are displays meant to signal danger
Conventionally: 3 alert severity levels: **warnings**, **cautions**, and **advisories**

- _[handwritten]_ (attention)
- _[handwritten]_ (perceptual)
- _[handwritten]_ (memory)
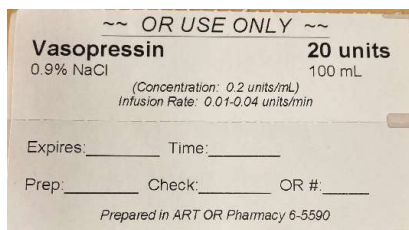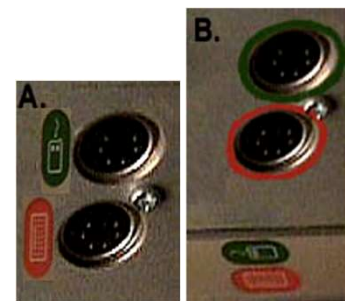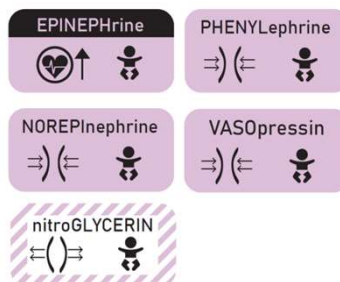- _[handwritten]_ (perceptual)
- _[handwritten]_ (perceptual)

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Labels

Convey identity, function, or use

- Knowledge in the world (memory)
- Discriminability (perceptual)
- Proximity compatibility principle (attention)
- Legibility (perceptual)
- Top-down processing (perceptual)

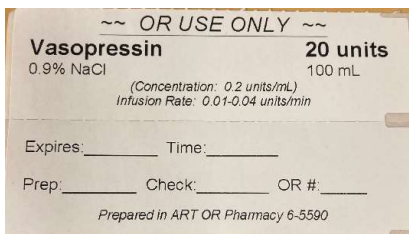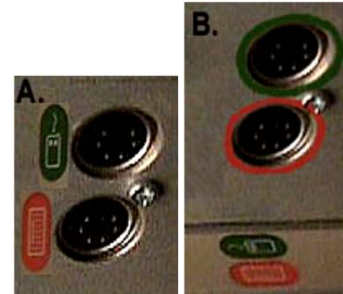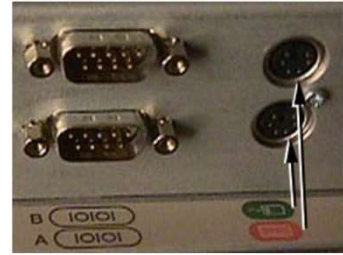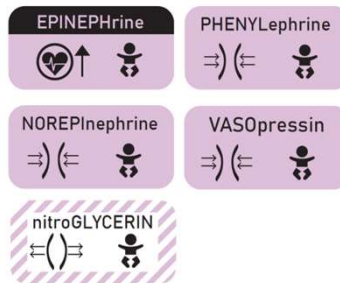Medication labels and icons

Input device labels

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Labels

Convey identity, function, or use

- _____(memory)
- _____ (perceptual)
- _____ (attention)
- _____ (perceptual)
- _____(perceptual)

Medication labels and icons

Input device labels

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Monitoring

Support the viewing of quantities which can change - may need to be set, watched, or tracked

- Absolute judgment and display markings legibility (perceptual)
- Principle of _____and _____(mental model)
– Analog vs. digital displays
– Cyclical vs. linear variables
- Prediction for sluggish systems (memory)
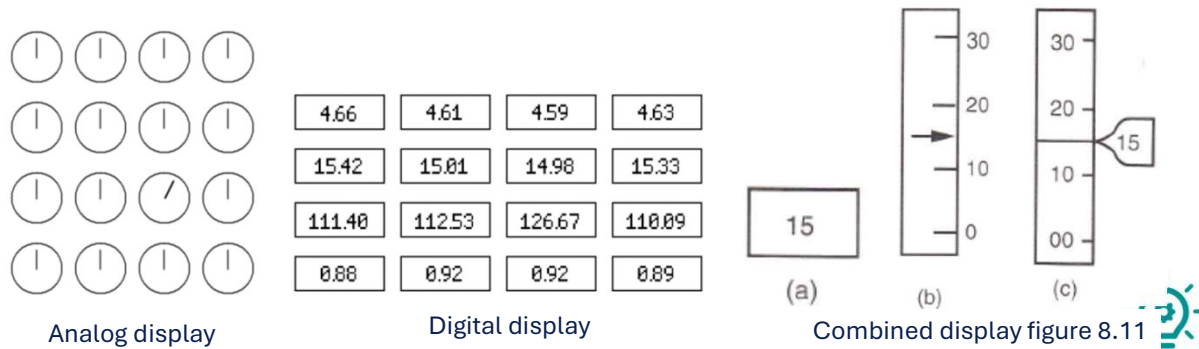

Control room at nuclear power plant

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Monitoring

Analog vs. Digital:

• Analog displays can be more easily read at a short glance

• The value of an analog display can be more easily estimated when the display is changing and it is also easier to estimate the rate and direction of the change

• Digital displays are better if very precise readings are required

4.66	4.61	4.59	4.63
15.42	15.01	14.98	15.33
111.40	112.53	126.67	110.09
0.88	0.92	0.92	0.89

Analog display   Digital display   Combined display figure 8.11

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Monitoring

Prediction and sluggishness

• Monitored variables (such as in chemical processes) may change slowly

• Changes made by the operator can have delayed effects

    • *Human struggle with predictions, particularly under stress*

• Display should show prediction of future state, not current conditions

• Prediction should provide measure of uncertainty
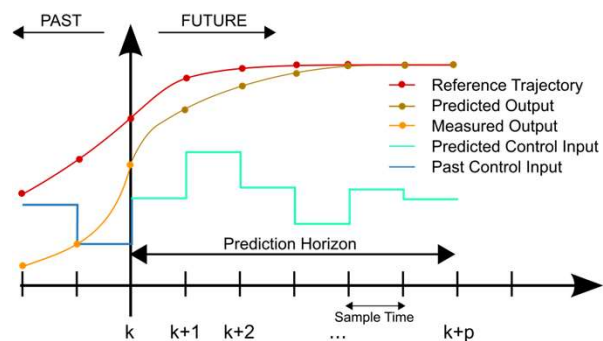
Example of model predictive control for process control
(By Martin Behrendt - Own work, CC BY-SA 3.0,
https://commons.wikimedia.org/w/index.php?curid=7963069)

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Navigation displays and maps

Navigational displays support travelers' ability reach a destination

- Legibility (perceptual)
- Clutter and overlay - minimize info cost (attn), proximity compatibility (attn)
- 3D map - pictorial realism (mental model)
- *map orientation* - pictorial realism (mental model)
- _____ - visual momentum (memory)
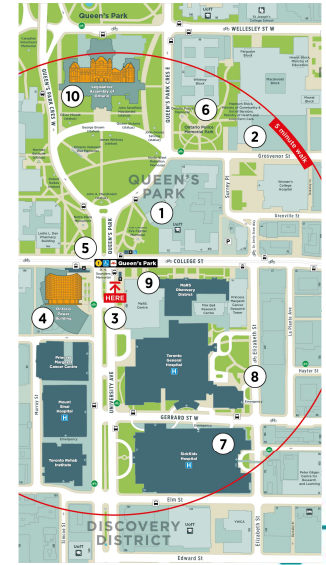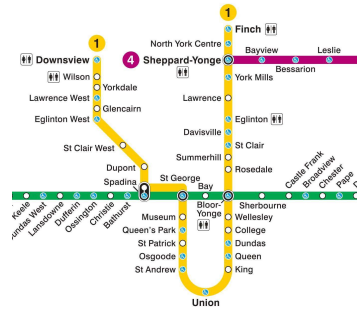
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Data visualization and graphs

Displays meant to a range of numbers and the relationship among these numbers
- Match type to question
- Map data to display dimension – color, shape, position – interval, ordinal and nominal

- Legibility, discriminability (perceptual)
- Minimizing clutter (perceptual)
- Proximity compatibility (perceptual)
  - Legend proximity
  - Data proximity
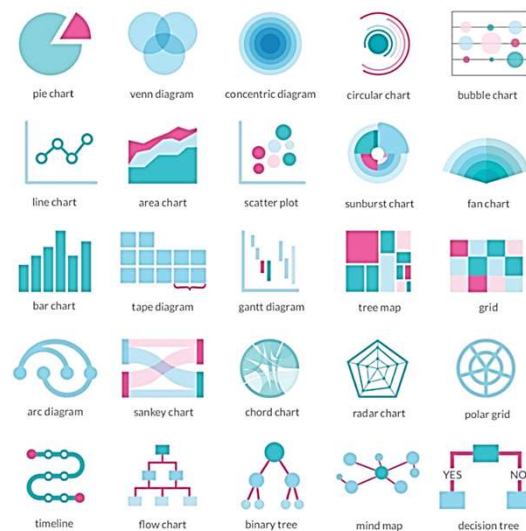
MIE240: Human-Centred Systems Design
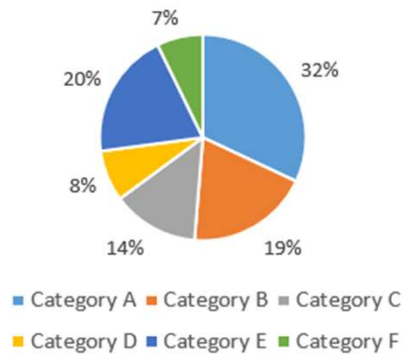

Different types of graphs

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Data visualization and graphs
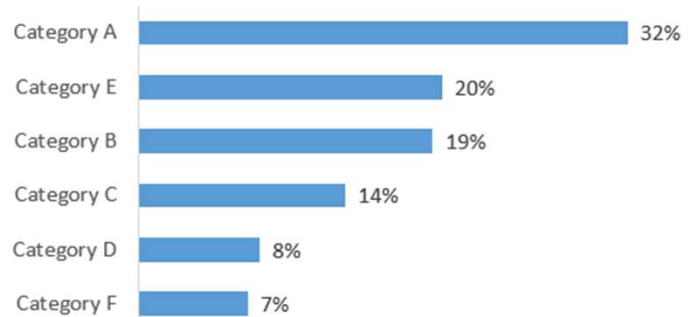
Which graph is better?

A — Product Sales % by Category (pie chart)

B — Product Sales % by Category (bar chart)

- Category A: 32%
- Category E: 20%
- Category B: 19%
- Category C: 14%
- Category D: 8%
- Category F: 7%

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Summary

- Displays classified along three dimensions: physical properties, tasks they support, and characteristics of human user that dictate best mapping between display and task
- 15 principles of display design grouped under four distinct categories: attention, perception, mental model, and memory.
- Display types can be viewed as an assembly of those principles
    - Alerts
    - Labels
    - Monitoring
    - Integrative displays
    - Navigation displays and maps
    - Data visualization and graphs

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Next lecture (Fri., Jan. 31st)

Topic: Case study: Act of God
Review: Ch. 8.2
Upcoming assignments: Act of God QQTT due tomorrow, 11:59pm

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Data-ink Ratio

Five Laws of Data Ink (Edward Tufte)
1. **Above all else, show the data**
2. **Maximize the data-ink ratio** (ratio of elements conveying information to the total elements in the image)
3. **Erase non-data ink**: erase elements that do not contribute any info
4. **Erase redundant data ink**: Delete redundant elements
5. **Revise and edit**

Avoid:
•Use of 3-D and shadow effects
•Use of background images
•Unnecessary borders and grid lines don't convey any information to the user
•Redundant legends, bold labels, and other decorative elements

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