King Saud University

College of Engineering

IE – 341: "Human Factors"

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Chapter 3. Information Input and Processing Part – II*

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Chapter Overview

- Information:
  - How it can be measured (part I)
  - How it can be displayed (part II)
  - How it can be coded (part II)

DISPLAYING INFORMATION

- Human information input and processing depends on the sensory reception of relevant **external stimuli** which contain the information

- The original source of information (the **distal stimulus**) is some object, event, or environmental condition.

- Information from the distal stimulus may come to us:
  - **directly** (e.g. direct observation of plane), or
  - **indirectly** (e.g. radar or telescope).

Cont. DISPLAYING INFORMATION

- In the case of **indirect sensing**, the new distal stimuli may be
  - **coded stimuli** (e.g. visual or auditory displays), or:
  - **reproduced stimuli** (e.g. TV, radio, hearing aids)
  - In both cases the coded or reproduced stimuli become the actual distal stimuli to the human sensory receptors.

- Human factors are required when *indirect* sensing applies.

- **Display** is a term that applies to any indirect method of presenting information (e.g. highway traffic sign, radio).

INFORMATION PRESENTED BY DISPLAYS (General)

- Information presented by displays can be **dynamic** or **static**.

- **Dynamic information**: changes continuously or is subject to change through time. Examples are: traffic lights, radar displays, temperature gauges.

- **Static information**: remains fixed over time. e.g: alphanumeric data, traffic signs, charts, graphs, labels.
  Note that static information presented through **VDT**'s (video display terminals) is considered static information.

INFORMATION PRESENTED BY DISPLAYS (Detailed)

- **Quantitative**: such as temperature or speed.
- **Qualitative**: represents approximate value, trend or rate of change.
- **Status**: reflects the condition of a system (such as on or off, and traffic lights).
- **Warning and signal**: indicating danger or emergency.

INFORMATION PRESENTED BY DISPLAYS (Detailed)

- **Representational**: pictorial or graphical representation of objects, areas, or other configurations, e.g. photographs, maps, heartbeat oscilloscope.
- **Identification**: used to identify a condition, situation or object, e.g. traffic lanes, colored pipes.
- **Alphanumeric and symbolic**: e.g. signs, labels, printed material, computer printouts.
- **Time-phased**: display of pulsed or time-phased signals. The duration and inter-signal intervals are controlled.

SELECTION OF DISPLAY MODALITY

- Visual or auditory displays? Tactual sense? The selection of the **sensory modality** depends on a number of considerations.
- Table 3.1 helps in making a decision regarding visual or auditory presentation of information.

TABLE 3-1
WHEN TO USE THE AUDITORY OR VISUAL FORM OF PRESENTATION

Use auditory presentation if:	Use visual presentation if:
1 The message is simple.	1 The message is complex.
2 The message is short.	2 The message is long.
3 The message will not be referred to later.	3 The message will be referred to later.
4 The message deals with events in time.	4 The message deals with location in space.
5 The message calls for immediate action.	5 The message does not call for immediate action.
6 The visual system of the person is overburdened.	6 The auditory system of the person is overburdened.
7 The receiving location is too bright or dark-adaptation integrity is necessary.	7 The receiving location is too noisy.
8 The person's job requires moving about continually.	8 The person's job allows him or her to remain in one position.

Source: Deatherage, 1972, p. 124, Table 4-1.

CODING OF INFORMATION

- **Coding** takes place when the original stimulus information is converted to a new form and displayed symbolically.

- Examples are:
  - radar screens where the aircrafts are converted and presented as dots on the screen
  - maps displaying populations of different cities with different symbols.

CODING OF INFORMATION (Cont.)

- Information is coded along various dimensions.

- Examples:
  - Varying the size, brightness, color and shape of targets on a computer screen.
  - Varying the frequency, intensity, or on-off pattern of an audio warning signal.

- Each of the above variations constitutes a dimension of the displayed stimulus, or a **stimulus dimension**.

CODING OF INFORMATION (Cont.)

- The usefulness of any stimulus dimension in conveying information depends on the ability of people to:
  - Identify a stimulus based on its position along the stimulus dimension (such as identifying a target as bright or dim, large or small)
    - This is an example of **absolute judgment.**
  - Distinguish between two or more stimuli which differ along the stimulus dimension (such as indicating which of the two stimuli is brighter or larger)
    - This is an example of **relative judgment.**

CHARACTERISTICS OF A GOOD CODING SYSTEM

- **Detectability** of codes:
  - stimulus must be detectable by human sensory mechanisms under expected environmental conditions
  - e.g. is worker able to see the control knob in mine?
- **Discriminability** of codes:
  - every code symbol must be discriminable (differentiable) from other symbols
  - the number of coding levels is important
- **Meaningfulness** of codes:
  - coding system should use codes meaningful to user
  - Meaning could be
    - **inherent** in the code (e.g. bent arrow on traffic sign)
    - or **learned** (e.g. red color for danger)
  - Meaningfulness: related to **conceptual compatibility**

CHARACTERISTICS OF A GOOD CODING SYSTEM (cont.)

- **Standardisation** of codes:
  - when a coding system is to be used by different people in different situations, it is important that the codes be standardised, and kept the same for different situations
  - e.g. meaning of the red color in different parts of a factory

- Use of **multidimensional codes**:
  - this can increase the number and discriminability of coding stimuli used.

COMPATIBILITY

- It is the relationship between the stimuli and the responses to human expectations.
- A major goal in any design is to make it compatible with human expectations.
- It is related to the process of **information transformation**
  - the *greater* the degree of compatibility, the *less* recording must be done to process information
  - This leads to faster learning and response time, less errors, and reduced mental workload.
  - People like things that work as they expect them to work.

COMPATIBILITY (Cont.)

- Four types of compatibility:
  - Conceptual
  - Movement
  - Spatial
  - Modality
- **1. Conceptual compatibility:**
  - related to degree that codes, symbols correspond to conceptual associations people have.
  - It relates to how meaningful codes and symbols are to people who use them.
  - e.g.: airplane symbol to denote an airport on a map means much more than a square or circle
  - e.g.: creating meaningful abbreviations and names for computer applications

COMPATIBILITY (Cont.)

- **2. Movement compatibility**:
  - relates to the relationship between the movement of the displays and controls and the response of the system being displayed or controlled.
  - e.g.: to increase the volume on the radio, we expect to turn the knob clockwise.
  - e.g.: upward movement of a pointer is expected to correspond to an increase in a parameter
- **3. Spatial Compatibility**
  - Refers to the physical arrangement in space of controls and their associated displays
  - e.g. how displays are lined-up with respect to corresponding control knobs

COMPATIBILITY (Cont.)

- 4. **Modality compatibility**:
  - refers to the fact that certain stimuli-response modality combinations are more compatible with some tasks than with others.
  - e.g.: responding to a verbal command that needs verbal action is faster than responding to a written or displayed command requiring the same verbal action.