# Review 1

Information input and processing
(Wickens Ch6)

Information processing model

- Models are not correct/incorrect, but useful
- There are various breakdowns of information processing model, but most include:
  - sensory register
  - attention resources
  - perception
  - memory
    - working memory
    - long-term
  - response selection
  - response execution

Information processing model
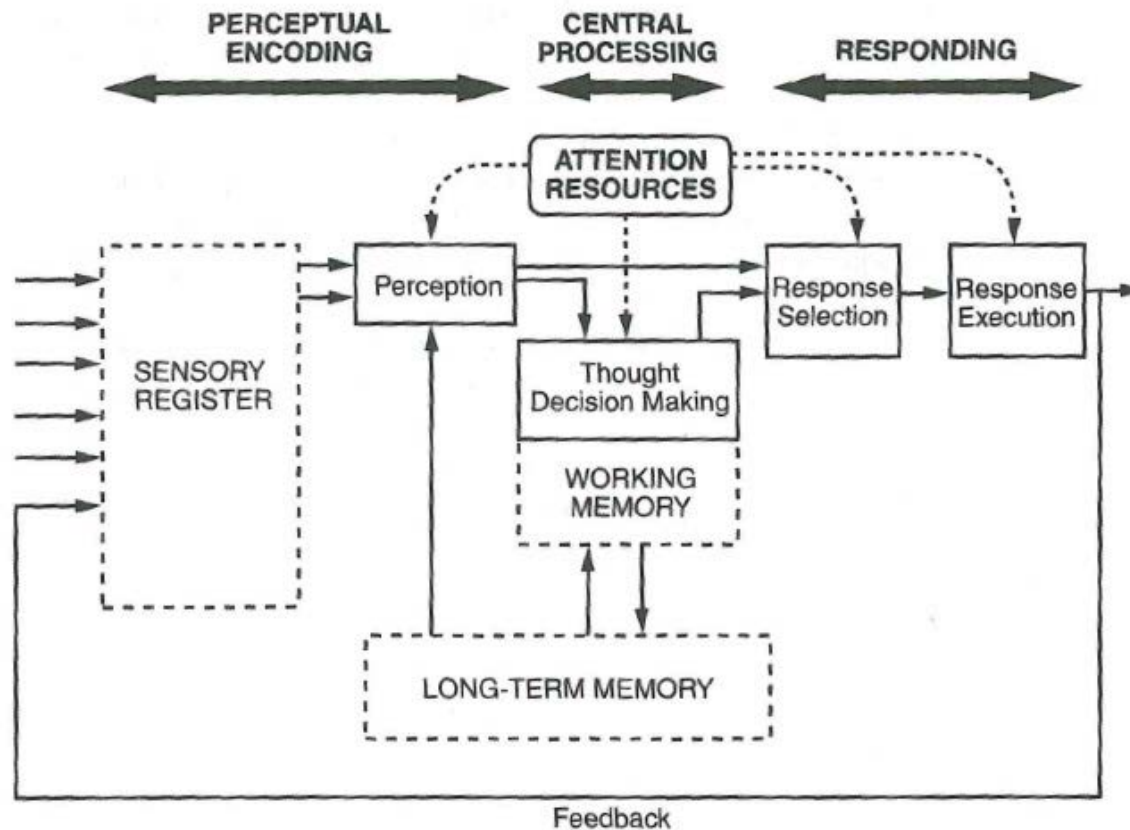
FIGURE 6.1
A model of human information processing.

Wickens et al. An Introduction to Human Factors Engineering, Figure 6.1

Selective attention

- Selective attention: the selection of channels to attend
- Selective attention does not guarantee perception (e.g., drivers' look but not see)
- The selection of channels can be driven by four factors
  - salience
  - effort
  - expectancy
  - value
- Attention blindness
  https://www.youtube.com/watch?v=vJG698U2Mvo

Perception

- There are three perceptual processes
  - bottom-up feature analysis
    - is it a word, a symbol on a map, or a sound
  - unitization
    - unitize the features of the stimulus
  - top-down processing
    - the ability to correctly guess what a stimulus or event is

Working memory

- Working memory: the gateway to long term memory

- Attention must be directed to working memory

- It stores two types of information
  - verbal: phonological loop (e.g., remember a cell phone number)
  - spatial: visuospatial sketch pad (e.g., remember the spoken navigational instructions)

Working memory

- Limitations of working memory
  - "magic number" 7±2 chunks
    - A chunk is the unit of working memory space
    - FBICIAU
      FBI CIA USA
    - Chunking reduces the number of items in working memory; aids human in retention of the information; helps maintain the information in long term memory
  - time (the strength of information decays over time)
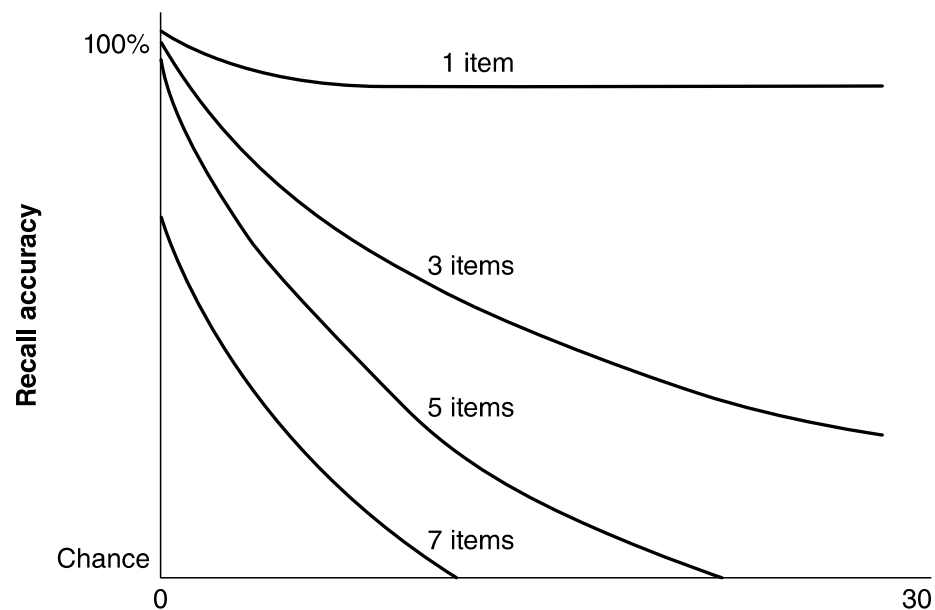
Wickens et al Engineering Psychology and Human Performance, Figure 7.3

Working memory

- Limitations of working memory
  - confusability and similarity
    - E D G—potential confusion
  - attention and similarity
    - the decay of the information will be rapid, when attention is diverted away, especially to similar tasks

Long term memory

- Long term memory can be classified as:
  - semantic memory (for facts or procedures)
  - event memory (for specific events)
- The ability to retrieve key information from long-term memory is important
- The ease of later material retrieval was determined by
  - the strength of an item: frequency and recency
  - the association between items

Long term memory

- Organization of information in working memory can ease to transfer to long term memory

- Associations could interfere with each other, resulting in human's confusion

- Recall is lost faster than recognition (e.g., short-answer question versus multiple choice question)

Long term memory

- The organization of information in long-term memory can be classified as
  - semantic network
  - schemas and scripts
  - mental models
  - cognitive maps

Situation awareness (SA)

- SA: characterize users' awareness of the meaning of dynamic changes in their environment

- Three levels of SA
  - perception
  - comprehension
  - projection

- Distinction between SA and performance (that operators' performance is good does not necessarily indicate high SA)

Situation awareness (SA)

- Measuring SA
  - Implicit performance-based measures
  - Questionnaires
    - SAGAT

- Importance of SA to human factors
  - designing principle easy-to-interpret displays of dynamic systems
  - tool for accident analysis
  - training for maintaining sufficient SA

Attention and time-sharing

- Selective attention: monitoring to determine if an event has occurred

- Divide attention: support the ability to do two tasks

- Four factors contribute to the success or failure of divided attention:
  - resource demand
  - structure
  - similarity
  - resource allocation

Attention and time-sharing

- Mental effort : the high mental effort of one activity degrades the ability to carry out a second activity at the same time

- Automaticity: a task is said to be automated. (e.g., signing your name, enter your Clemson ID into the computer)

Attention and time-sharing

- Structural similarity is the similarity between key processing structures of both tasks in a concurrently performed pair

- Single Resource Theory
  - an undifferentiated source of resources shared by all mental processes

- Multiple Resource Theory
  - multiple pools of resources that independent of one another

- Two tasks demand separate resources, time-sharing improved

Attention and time-sharing

TABLE 6.1   Four Dimensions of Multiple Resources

Dimension	Two Levels	Examples
Modalities	Auditory vs. Visual	Synthesized voice display, spatially localized tones
		Print, electronic map
Codes	Spatial vs. Verbal	Tracking, hand pointing, mental rotation, imaging (visuospatial scratchpad)
		Listening to speech, rehearsing (phonetic loop), speaking
Stages	Perceptual– Working Memory vs. Response	Searching, imaging, reading, rehearsing, listening
		Pushing, speaking, pointing, manipulating
Visual Channels	Focal vs. Ambient	Reading, interpreting symbols
		Processing flow fields, visual perception to maintain balance

(From Wickens, 2000).

Attention and time-sharing

- Confusion: concurrent performance of two tasks that both have similar material increases inference

- Primary task versus secondary task
  - primary task should receive the highest priority
  - secondary task is the task that is degraded

Attention and time-sharing

- Method to address time-sharing overload
  - task redesign
    - avoid too many tasks and reduce the required mental resource for each task
  - interface design
    - avoid overloading heavily demanded resources
  - training
    - develop automaticity and increase attention management skills
  - automation
    - replace humans for some tasks and assist humans in dividing attention