Memory Models and Short-Term Memory

Memory is central to most all cognitive processes

Overview

- Dualist Models of Memory
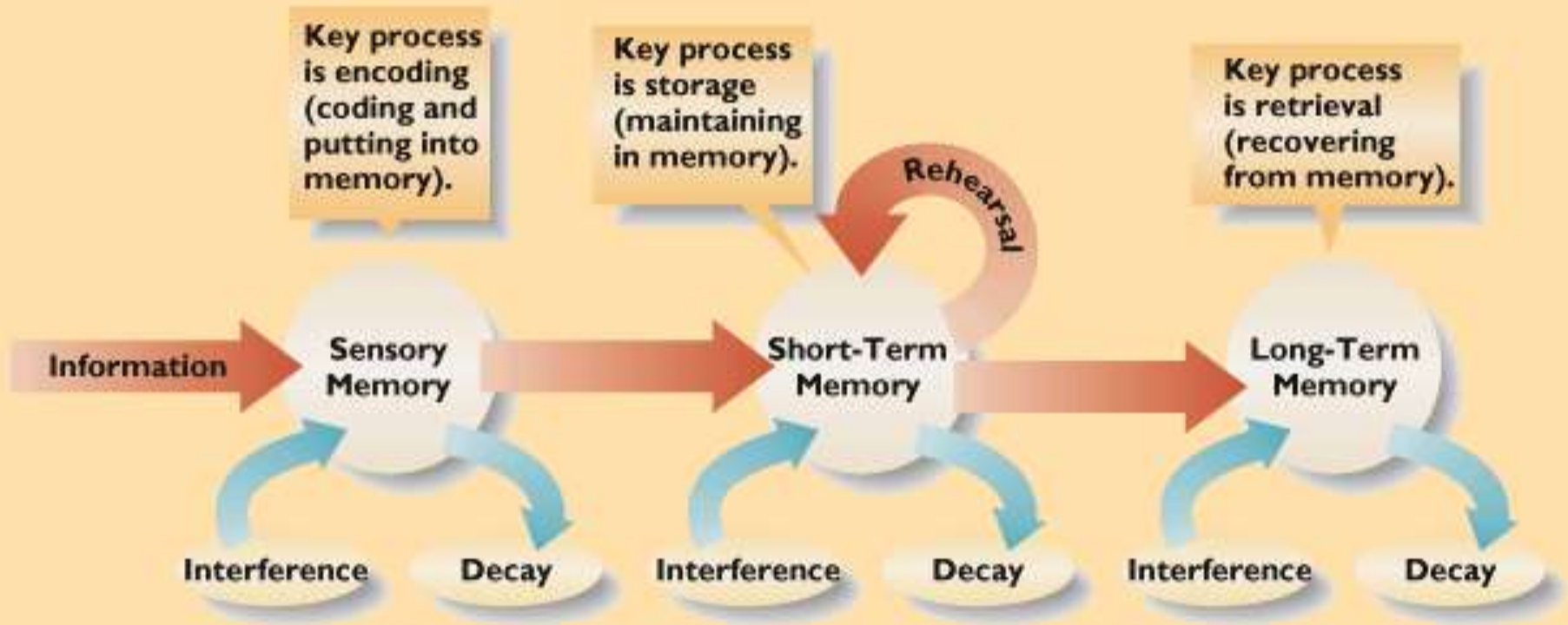- Short Term Memory

Early Studies

- William James
- Dualistic Memory
- Primary memory-immediate memory
  - Short term memory (STM)
- Secondary memory-experienced information not readily accessible
  - Long term memory (LTM)

Memory

- Sensory Memory
  - Iconic: The momentary persistence of visual impressions and their brief availability for further processing
  - Echoic: The persistence of auditory impressions and their brief availability for further processing
- Short term memory
  - 7 +/- 2, 12 seconds
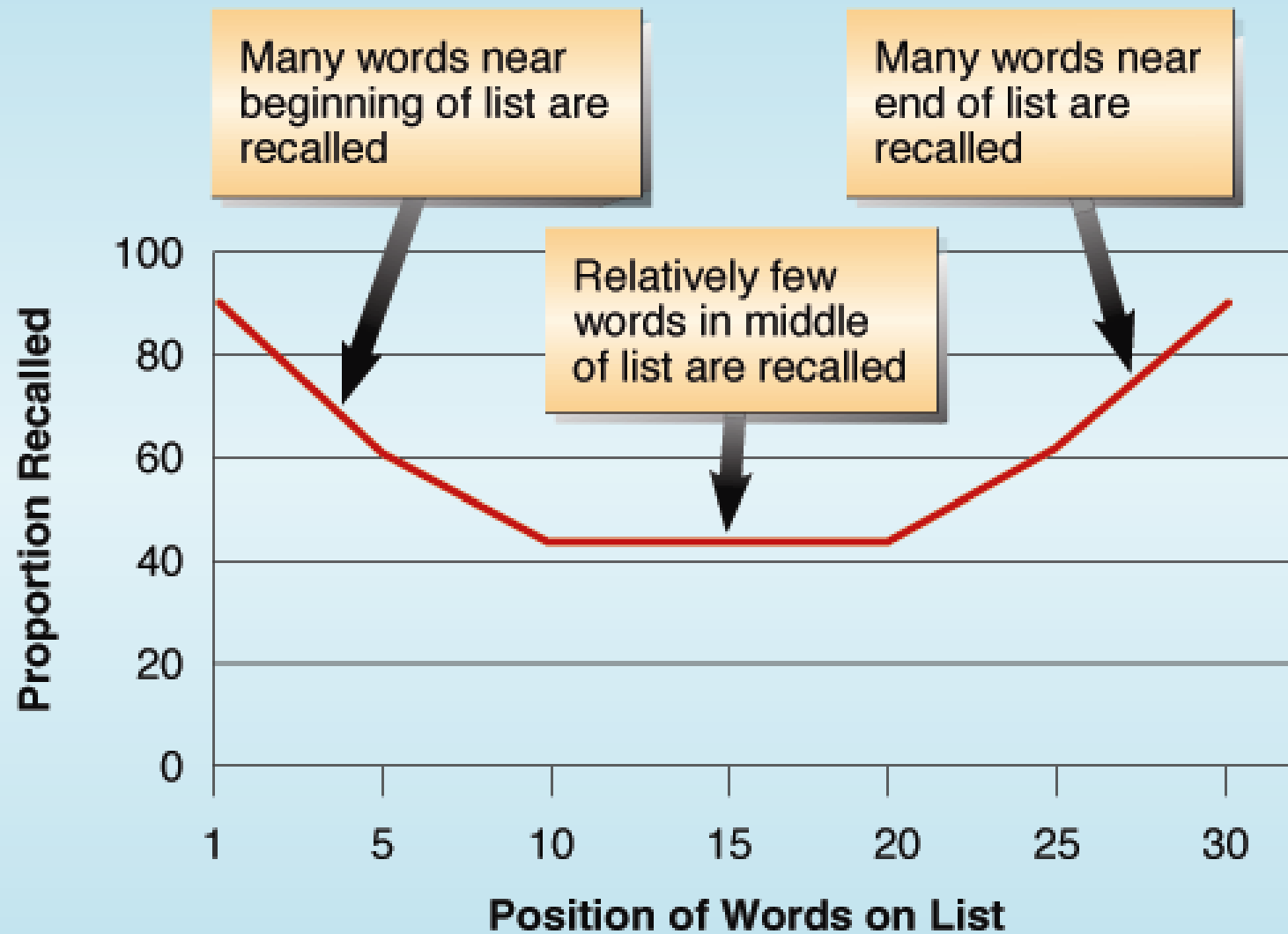- Long term memory
  - Virtually unlimited, indefinite

Basic Memory Process

Key process is encoding (coding and putting into memory).

Key process is storage (maintaining in memory).

Key process is retrieval (recovering from memory).

Rehearsal

Information → Sensory Memory → Short-Term Memory → Long-Term Memory

Interference   Decay   Interference   Decay   Interference   Decay

Short Term Memory

- Evidence for 2 memory stores
  - Introspection suggests that some things are remembered for a short time, and others for a long time
  - Physiological studies indicate that short term functions can be interrupted, whereas long term functions seem to remain intact
  - Psychological experiments suggest two memory stores (recency and primacy)

►The Serial Position Curve

Many words near beginning of list are recalled

Relatively few words in middle of list are recalled

Many words near end of list are recalled

As shown here, we tend to remember recent events in our lives more frequently than events that occurred longer ago. However, this function is interrupted by a "bump" for our early adult years: We remember more events from that period than from other periods. (Source: Based on data from Rubin, 1982.)
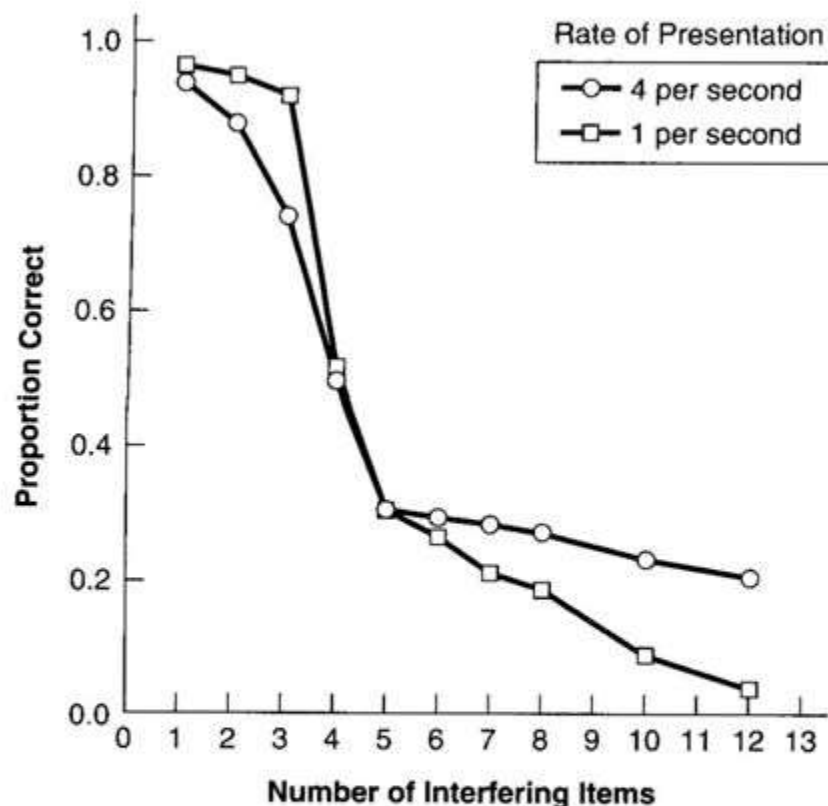
Models of Memory-Waugh & Norman

- Dualistic
- Primary memory-short term storage system
- Secondary memory-longer term storage system
- Boxes in the head
- Different than James because they quantified properties of primary memory
- Loss of information in primary memory due to time, but also displacement of old items by new ones
- Decay and interference **(Interference is a greater factor than decay)**

Waugh & Norman (1965)

Rate of Presentation
- 4 per second
- 1 per second

FIGURE 4.9   Results from Waugh and Norman Experiment

Source: Waugh & Norman, 1965—adapted by Ashcraft

Results:

- Recall ⬇ w/ # of intervening items
  - consistent w/ both decay & interference

- Recall (more or less) unaffected by presentation rate
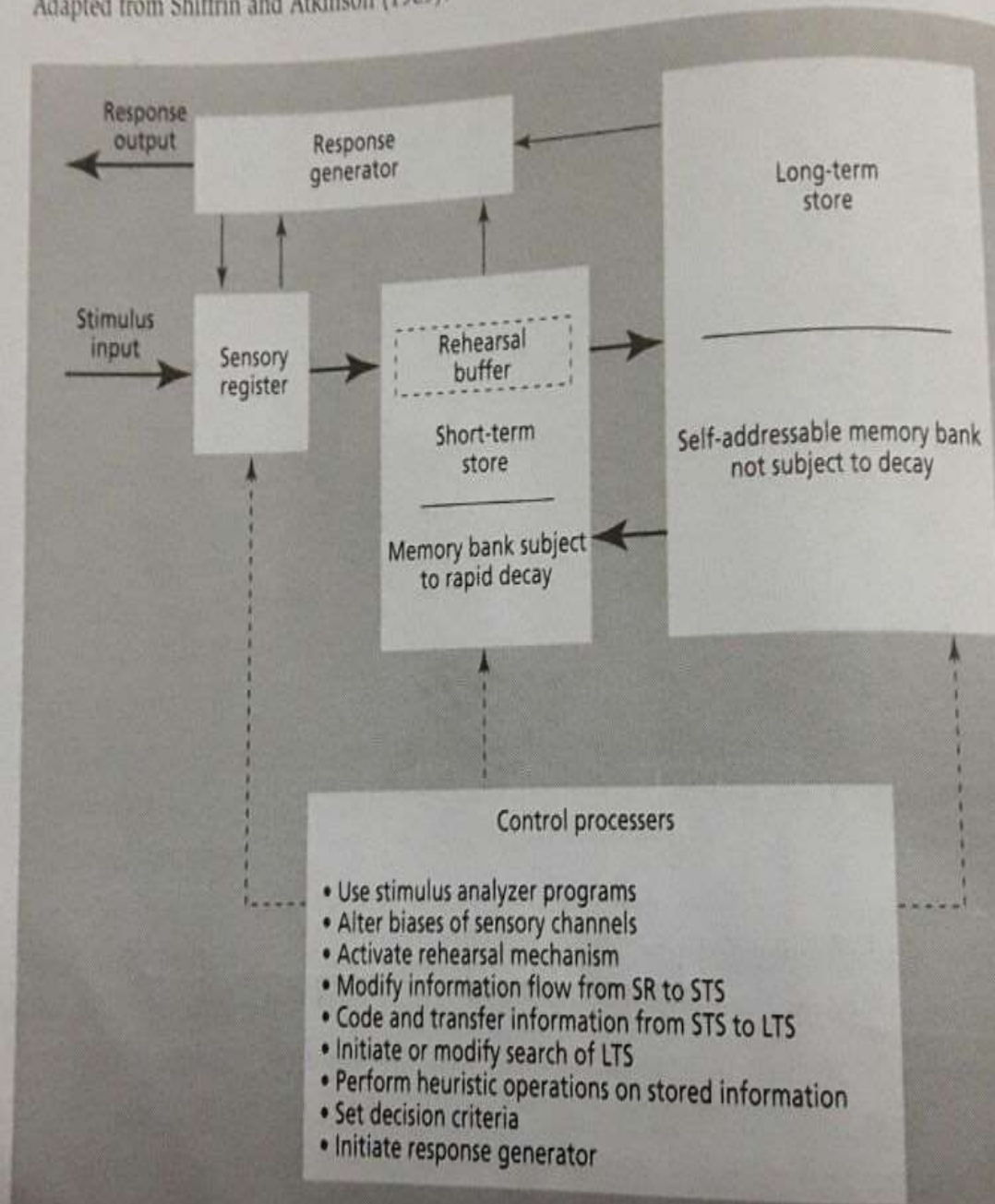 - Consistent only w/ interference

Models of Memory-Atkinson & Shiffrin

- Memory structures fixed-control processes variable
- Dualistic model
- More subsystems within STM and LTM
- As earlier models were too simplistic and not powerful enough to handle the complexities

Response
output

Response
generator

Long-term
store

Stimulus
input

Sensory
register

Rehearsal
buffer

Short-term
store

Self-addressable memory bank
not subject to decay

Memory bank subject
to rapid decay

Control processers

- Use stimulus analyzer programs
- Alter biases of sensory channels
- Activate rehearsal mechanism
- Modify information flow from SR to STS
- Code and transfer information from STS to LTS
- Initiate or modify search of LTS
- Perform heuristic operations on stored information
- Set decision criteria
- Initiate response generator

Short-term
memory

•How in
'Estimat

Models of Memory-Atkinson & Shiffrin

Memory has three stores

1. Sensory register   2. Short term store

3. Long term store

- Memory=data being retained
- Store=structural component that contains the information
- Information entering in short-term store decays and disappears rapidly

Models of Memory-Atkinson & Shiffrin

- Information in the long-term store is envisioned relatively permanent, even though it might be inaccessible because of interference of incoming information

- The function of the long-term store was to monitor stimuli in the sensory register (and thus controlling information entering the short-term store) and to provide storage space for information in the short-term store.

Short Term Memory

- Minimal storage capacity

- Limited processing capacity

- This memory system can store information, but if not rehearsed, it drops out of memory

- We "live" in STM, as it processes the sensory events that constitute the ongoing present

TABLE 1

Characteristic Sensory and STM Storage Systems.

Storage Structure	Processes				Cause of Failure to Recall
	Code*	Capacity	Duration	Retrieval	
Sensory "store"	Sensory features	12–20 items† to huge	250 msec–4 sec	Complete, given proper cueing	Masking or decay
Short-term memory	Acoustic, visual, semantic, sensory features identified and named	7 ± 2 items	About 12 sec; longer with rehearsal	Complete, with each item being retrieved every 35 msec	Displacement, interference, decay

*How information is represented

†Estimated

susceptible to loss if we do not have the opportunity to rehearse the information. Their experiment represented a turning point in our experimental conceptualization of STM and, ... seminal experiments, books, and studies, helped launch what was to be- ... to this time the distinction between STM and LTM had ... Hebb, 1949] and psychological

Capacity of STM

- Magic number +/- 7

- (e.g. marbles on floor and recalling a sequence of numbers)

- Chunking-T,V,K,A,M,Q,B,R,J,L,E,W

- MUSIC, TOWEL, BOSS, TARGET, SALAD, CHURCH, MONEY, HELIUM, SUGAR, APRROT, CHICKEN

Capacity of STM

- Chunking-T,V,K,A,M,Q,B,R,J,L,E,W
- MUSIC, TOWEL, BOSS, TARGET, SALAD, CHURCH, MONEY, HELIUM, SUGAR, APRROT, CHICKEN
- Miller postulated a model of memory in which seven units or chunks of information could be held.

Capacity of STM

- LTM and Chunking:
- CA   TF   LY   BU   G
- CAT FLY BUG
- The capability of STM to handle vast amount of information, is facilitated by our ability to chunk information into meaningful units.
- Chunking cannot occur until our LTM has provided the meaning of these units.

Rehearsal

- Helps maintain short term memories indefinitely through the use of internal repetition
- Telephone numbers, names, tests

Coding of Information in STM

- Auditory Code
- Predominant coding of even nonauditory information
- So much of STM is reliant on your inner voice—you see the word "MONEY" or "$" and you say "MONEY" in your head.

Coding of Information in STM

- Conrad (1963) presented letters that sound like..(e.g. B.V)

- It was hypothesized that the associated memory is primarily acoustic and that more errors would occur with the participants who heard the letters

- Information can also be coded visually and semantically

Coding of Information in STM

- <mark>Visual coding</mark> example: AA and Aa

Took more time in responding to Aa than in recalling AA.

As the decay increases, the advantage for the same form pairs diminishes as the STM has the opportunity the visual code into auditory code.

Coding of Information in STM

- Semantic coding:

- Proactive inhibition is a phenomenon whereby recall of a list of words is impaired if previous memorized lists were semantically related.

Example: Fruit lists

Localization and Distribution of LTM

- Memories are located in specialized areas <u>and</u> throughout the brain
- Permanent long term memories are stored in the cerebral cortex

Localization and Distribution of LTM

- Three main memory sites in the brain
    - Memory functions though are distributed throughout the brain
- Cortex-thinking, problem solving, remembering
- Cerebellum-motor memory
- Hippocampus-processes new information and routes it to parts of the cortex for permanent storage
- Procedural memory
    - Motor skills (handwriting, typing skill, bike riding)
- Declarative memory
    - Information and knowledge of the world

Long Term Memory

- Stores our past
- Very diverse
  - Codes
  - Abstraction of information
  - Structure
  - Capacity
  - Permanence
- Capacity is essentially limitless
- Permanence is essentially endless

LTM: Storage and Structure

- Codes
- Acoustically, visually and semantically
- Classes of information stored in LTM
  - Spatial information
  - Physical laws
  - Beliefs
  - Values and social goals
  - Motor skills
  - Perceptual skills
- Emphasis tends to be on the semantic code

LTM: Storage and Structure

- Organization
- LTM feels like it is organized in some way. It is a such a basic assumption that researchers rarely ask whether it is organized, instead focusing on how.
- Metaphors of memory storage
  - File cabinets
  - DVDs, video tape, etc
- These capture the ideas of storage and accessibility, but imply that exact copies of experience are available-nope!
  - Puzzle-more accurate, memory as reconstructive
  - Neuronal change—the reality is that memories must be stored in the activity and change in neurons

Q1. Unattended information is stored briefly in:

- *a. sensory memory.
- b. short-term memory.
- c. long-term memory.
- d. working memory.
- e. secondary memory.

Q2. When information is first translated into a form that other cognitive processes can use, we say that _____ has occurred.

- a. retrieval

- b. storage

- c. forgetting

- *d. encoding

- e. remembering

Q3. Information is held in _____ for 20 to 30 seconds.

- a. sensory memory
- *b. short-term memory
- c. long-term memory
- d. secondary memory
- e. none of the above

Q4. Information such as the name of the person who sat in front of you in the fifth grade is stored in:

- a. sensory memory.
- b. short-term memory.
- c. working memory.
- *d. long-term memory.
- e. photographic memory.

Q5. The capacity of short-term memory was thought by George Miller to be:

- a. about 75% of a visual display.

- b. 7 (plus or minus 2) letters or numbers.

- *c. 7 (plus or minus 2) meaningful chunks of information.

- d. 12 (plus or minus 3) chunks of information.

- e. unlimited.

Q6. Words from the beginning of a list are more likely to be recalled than words from the middle of the list. This phenomenon is known as the _____ effect.

- a. recency
- *b. primacy
- c. forgetting
- d. interference
- e. memory trace

Q7. The recency effect is through to result from participants' use of:

- a. sensory memory.

- b. short-term memory.

- c. long-term memory.

- *d. either sensory or short-term memory.

- e. both short-term and long-term memory

Q8. The capacity of short-term memory was thought by George Miller to be:

- a. about 75% of a visual display.
- b. 7 (plus or minus 2) letters or numbers.
- *c. 7 (plus or minus 2) meaningful chunks of information.
- d. 12 (plus or minus 3) chunks of information.
- e. unlimited.

Q9. In the absence of rehearsal, short-term memory tends to:

- *a. last about 20 seconds.

- b. last about 8 seconds.

- c. decay slowly over 24 hours.

- d. decay slowly over a week.

- e. last for an unlimited amount of time.

Q10 In Waugh and Norman's probe digit task,

- a. faster presentation rates improved performance.
- b. faster presentation rates decreased performance.
- *c. presentation rate had no effect on performance.
- d. only rates slower than 3-second intervals decreased performance.
- e. only very fast rates improved performance.