COGNITIVE SCIENCE (MEMORY)

HCI & WEB DESIGN – ROSANNE BIRNEY

MEMORY

- Memory stages:
  - Sensory Memory, Short-term Memory (STM), Long-term Memory (LTM)
- Memory processes:
  - Encoding, Storage, Retrieval
- Memory types:
  - Procedural/Declarative
  - Retrospective/Prospective

- Design implications for memory

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ACTIVITY

- Try to remember the dates of your grandparents' birthday
- Try to remember the poster of the last movie you saw
- Which was easiest? Why?
- People are very good at remembering visual cues about things
  - e.g. the colour of items, the location of objects and marks on an object
- They find it more difficult to learn and remember arbitrary material
  - e.g. birthdays and phone numbers

- We need to understand memory so that we can design for what people are good at

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WHAT IS MEMORY?

- Memory refers to our ability to retain information about past experiences

- It encompasses the processes by which we:
  - acquire, record and encode information
  - store information in an accessible format
  - retrieve that information at a later stage

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MEMORY STAGES
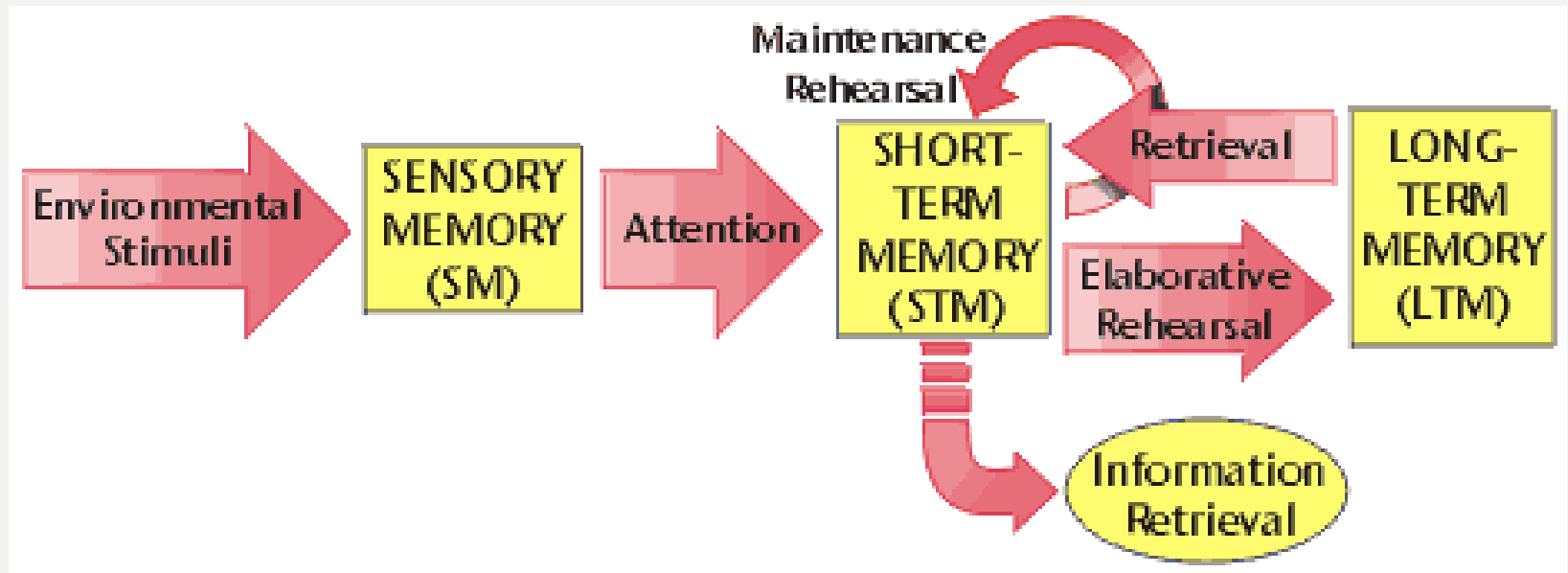
SENSORY MEMORY

- Sensory memory is a 'transient' type of memory that holds information when it first comes in

- A large amount of information can be taken in, but is stored very briefly

- Our attention process filters the incoming information (as discussed in the last section)

SHORT-TERM MEMORY (STM)

- See 'short-term memory exercise' slides which will test your short-term memory

SHORT-TERM MEMORY (STM)

- Short-term memory (STM) is a temporary store of recently encountered information
  - Limited capacity (approx. 7 (+/- 2) items)
  - Limited lifetime (seconds or minutes)

  - N.B. the terms 'short-term memory' and 'working memory' are used interchangeably, but refer to the same concept

- Information in STM can come from sensory memory or from LTM

CHUNKING

- We can boost STM by 'chunking' information – dividing it into groups/units

- For example, remembering chess patterns rather than individual pieces

- Or linking items together by forming mental images

- STM capacity = 7 chunks of information

THE PROBLEM WITH THE CLASSIC '7±2'

- George Miller's (1956) theory of how much information people can remember

- People's immediate memory capacity is very limited

- Many designers think this is useful finding for interaction design

- But…

WHAT SOME DESIGNERS GET UP TO...

- Present only 7 options on a menu

- Display only 7 icons on a tool bar

- Have no more than 7 bullets in a list

- Place only 7 items on a pull down menu

- Place only 7 tabs on the top of a website page

  - But this is wrong… Why?

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WHY?

- Inappropriate application of the theory
- People can scan lists of bullets, tabs, menu items for the one they want
- They don't have to recall them from memory having only briefly heard or seen them
- Sometimes a small number of items is good
- But depends on task and available screen estate

RECOGNITION VERSUS RECALL

- Command-based interfaces require users to recall from memory a name from a possible set of 100s

- GUIs provide visually-based options that users need only browse through until they recognize one

- Web browsers, MP3 players, etc., provide lists of visited URLs, song titles etc., that support recognition memory

LONG-TERM MEMORY (LTM)

- Information transferred from STM to LTM

- Long-term memory (LTM) is more permanent
  - Virtually limitless
  - Lasts from a few minutes to a lifetime

- Long-term memory can be subdivided into several different sections which will be discussed later on

MEMORY PROCESSES

- Memory comprises three main processes that encode, store and retrieve information

Encoding	→	Storage	→	Retrieval

Put into memory   Maintain in memory   Recovery from memory

ENCODING & STM

- In order for information to be encoded into STM we must pay attention to it

- Recall 'selective attention' – only a certain amount of what we are exposed to goes on to be processed

- Maintenance rehearsal can aid STM
  - e.g. repeating a phone number to yourself

DEPTH OF PROCESSING

- The 'depth' at which we process items in STM can affect how well we can recall them shortly afterwards

- Depth of processing exercise
  – http://www.psychologypress.com/ek5/resources/flash/ch06-IE-05.swf
  – Examples of Surface processing vs. Deep processing (and somewhere in between)

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ENCODING & LTM

- Elaborative rehearsal of information can help the encoding process from STM to LTM as it involves imposing meaning or structure on material to be learned

- When encoding to LTM, the main type of coding is semantic (based on meanings)

STORAGE

- Storage of memories must be efficient so that we can access and retrieve them quickly

- Organising information makes it easier to remember

- Subjects in a study were asked to remember lists of words

  - Words were either organised into

    - Hierarchical tree (65% recall)

    - Random list (19% recall)

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CONTEXT

- It is easier to retrieve a fact or episode if you are in the same context in which you encoded it
    - If we experience an event while under the influence of a particular drug (e.g. alcohol), we can best retrieve it when we are in a drug-induced state once again (Overton, 1972)
    - Scuba divers remembered word lists learned underwater more effectively when underwater once more (Godden & Baddeley, 1975)

RETRIEVAL AND STM

- The more information in STM, the longer it takes to retrieve information
- The way we retrieve information from STM is known as an 'exhaustive search'

RETRIEVAL & LTM

- Many cases of forgetting from LTM result from a loss of access to the information, rather than loss of the information itself

    - i.e. Retrieval failure rather than Storage failure

- To examine an item in LTM we must first retrieve it and put it into STM

- Retrieval cues such as organisation and context can help

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FORGETTING AND STM

- Items in STM are remembered briefly, but are forgotten eventually
- Older items are displaced:
  - by new ones (interference)
  - over time (decay)
- Research shows that we forget a lot of information very soon after learning, but the remaining information is retained almost indefinitely (in LTM)

FORGETTING & LTM

- LTM is more permanent but we still often forget information from LTM

- Forgetting information from LTM is usually due to interference

  – There are two types of interference:

    - Retroactive: new learning disrupts older memories

    - Proactive: existing information that inhibits learning of new information

MEMORY TYPES

- Procedural memory
  - Remembering how to do things
  - Walking, cycling, driving
- Declarative memory
  - Remembering facts/events
  - Can be further divided into:
    - Episodic memory (remembering events)
    - Semantic memory (facts, word meanings etc.)

MEMORY TEST

- Multiple memory types test:
  - Test your memory for different types of information: numbers, objects, abstract art, faces, and words, and see how you compare to others.
  - https://www.testmybrain.org/consent_all.php?exp=8
  - Takes about 20 minutes

DESIGN IMPLICATIONS FOR MEMORY

- Don't overload users' short-term memories with complicated procedures for carrying out tasks
- Design interfaces that promote recognition rather than recall
- For learning and long-term memory, use organisation and context cues to aid the users' retrieval processes

TED TALKS ON MEMORY

- How your working memory makes sense of the world (Peter Doolittle)
  - https://youtu.be/UWKvpFZJwcE

- How reliable is your memory? (Elizabeth Loftus)
  - Examines false memories
  - https://youtu.be/PB2OegI6wvI