Informatics 1 Cognitive Science – Tutorial 9

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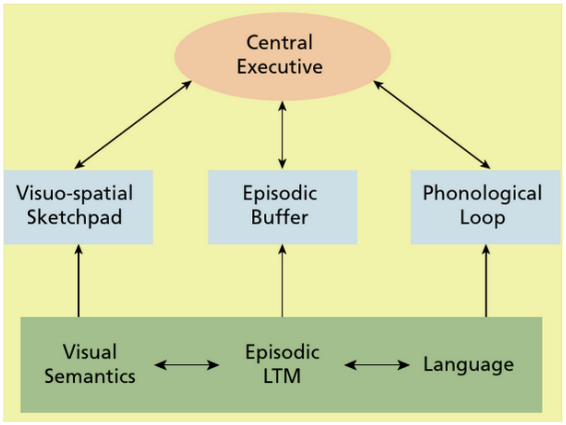
Week 10

In the lectures we discussed two different memory systems: short term memory and long term memory. Short term memory is characterised by a limited capacity and a short retention duration, whereas long term memory has a much larger capacity and a much longer duration. In this tutorial we will discuss models of these two memory systems.

Part 1

In the lecture you saw some evidence (Meredyth Daneman and Patricia Carpenter, 1980) that short term memory does not appear to be a simple buffer with limited capacity, but has multiple subsystems from which stored information can be selected. Moreover, information is not maintained in its raw sensory form, but is transformed into a more abstract form that can be manipulated and combined with other information. This is formalised in a model by Alan Baddeley and Graham Hitch (first published in 1974 and updated in 2000), who proposed that short term memory is composed of several components, summarised in the following figure:



Short-term systems are shown in blue, and long-term memory systems are shown in green. You can find a brief description of this model in the recommended reading for week 9 (The Student's Guide to Cognitive Neuroscience: Chapter 11 - The remembering brain).
Questions:

1. Describe the components of the model and their function.

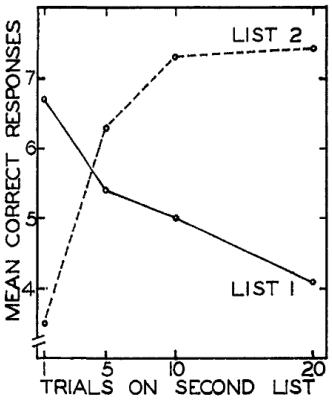
2. A key insight this model provides is that short-term memory is not a simple buffer, but has multiple subsystems that can be selectively accessed. What does this model predict in the following situations:
   (1) You are listening to a lecture and trying to remember the main points. The lecturer often

includes unnecessary additional words in their sentences. Does this model predict this will impact comprehension?
(2) You are cooking a meal and listening to the news at the same time. Does this model predict that you will be able to remember the news?

Part 2

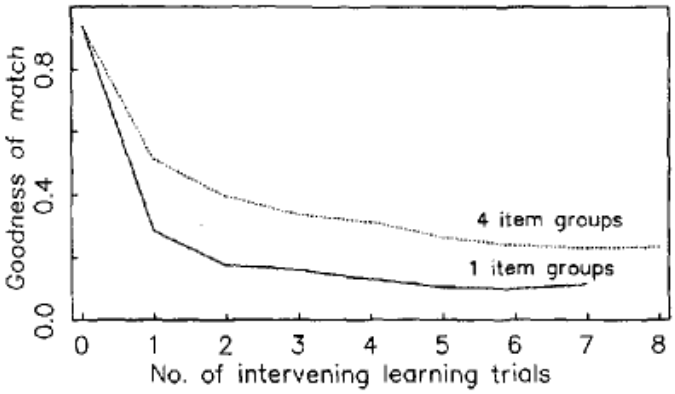
Questions:

1. The following figure summarises the results of the study: *Barnes, J.M. and Underwood, B.J., 1959. "Fate" of first-list associations in transfer theory. Journal of Experimental Psychology, 58(2), p.97.*.



In this experiment, participants were asked to learn a list of word pairs, where the first word consisted of two nonsense syllables and the second was a two-syllable adjective. Participants first learned a list of word pairs, and then a second list for a given number of trials (x-axis in the graph). After the leaning the recall of the pairs was tested for both lists, where they had to recall the second word of each pair when presented with the first word. What does this figure tell us about the nature of forgetting?

2. Now let's compare this to a result from a connectionist model. The following figure shows the results of a simulation of a simple MLP trained with the backpropagation algorithm to associate a set of input patterns with a set of output patterns. The network was trained with a first set of patterns until it performed well, and then on just one additional pattern pair. The following figure shows the performance of the network on the first set of patterns as a function of the number of training trials on the final pattern:



(from *Ratcliff, R., 1990. Connectionist models of recognition memory: constraints imposed by learning and forgetting functions. Psychological Review, 97(2), p.285.*)

What does this figure tell us about the nature of forgetting in the MLP, and how does it differ from the human result?

3. Discuss the implications of these differences for the design of artificial systems.