Flexible Use of Prospective and Retrospective Memories

Horatiu Voicu (hv2@duke.edu)
Department of Psychological and Brain Sciences, 9 Flowers Dr
Durham, NC 27708 USA

Experimental data show that when animals are interrupted while executing a task, they optimize the use of prospective memory and retrospective memory in order to improve the performance of the task. This work describes a computational model of information retrieval from prospective and retrospective memories. The model includes a mechanism of memory load optimization that selects which memory participates in the decision making process. Computer simulations show that the model produces behavior similar to that found in rats and pigeons. Preliminary experimental results concerning memory load optimization in humans show a similar behavioral pattern.

Imagine that you go to the grocery store to buy 12 items for a special recipe you want to prepare. While you gather the items in your cart you meet a friend that asks you to help jumpstart her car because she has a discharged battery. After you help your friend you return to the store. Because you already spent too much time with your friend and your cart is located far away from the entry point of the store, you decide to take a new cart and pick up the remaining groceries. Then, you go to the location of the first cart that you used and notice that you have the complete list of groceries. What are the variables that influenced your behavior? Two important variables are the amount of time you spent with your friend and the number of groceries gathered until the point of interruption. Other factors are the degree of familiarity with the grocery store and the 12 items you intended to buy. Then, an important question is whether the number of groceries gathered until the point of interruption and the duration of time spent with your friend have an influence on holding a complete list of groceries (no duplicates or missing items) at the time you reach the first cart.

Answers to similar questions have been provided in studies with animals. For example, Cook et al. (1985) designed a study to find what type of encoding rats use to solve a 12 arm radial maze. Subjects were trained to find food in the maze so that they have an internal representation of the maze. At the beginning of each trial all the arms of the maze are baited. Rats are placed in the maze and allowed to explore 2, 4, 6, 8, or 10 arms before they are removed from the maze. After a certain amount of time has elapsed they are placed back in the maze and allowed to explore the maze until all food is collected. The number of errors committed by the subjects during one trial measures their performance.

The results show that subjects can shift their coding strategy to optimize their memory load. An interruption after the 6th arm produces an error larger than that generated by an interruption close to either the beginning or ending of the task. Similar results have been obtained with pigeons (Zentall et al., 1990) in an analog task of the radial arm maze.

This work introduces a computational model that describes how animals can achieve memory load optimization. The model contains a retrospective memory, a prospective memory and a mechanism for deciding which memory is used for producing action.

Figure 1 shows the performance of the model when the point of interruption and the delay are varied. Figure 2 shows experimental data for interruptions of 15 and 60 minutes. These data are similar to those presented in figure 1 (see delay 8 and 25). Both theoretical and experimental studies suggest that while short delays affect only the performance interrupted halfway, long delays affect any performance interrupted after the 6th arm.

The computer simulations suggest that prospective memory decays faster than retrospective memory. This might happen because prospective memory is not used as often as retrospective memory. Prospective memory can be used only when a complete representation of the task exists in memory.

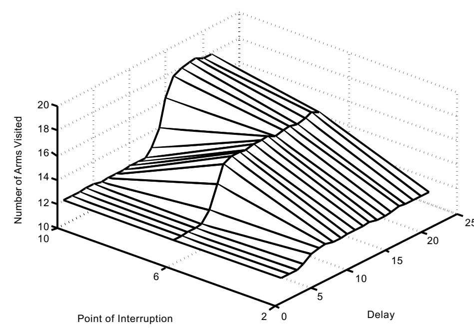

Figure 1. Performance of the model when exploration is interrupted after the 2nd, 6th and the 10th arm while the delay increases.

A B

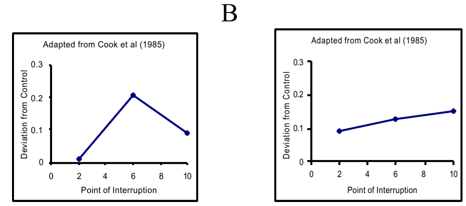

Figure 2. Experimental data that show the performance of rats when delay is 15 minutes (A) and 60 minutes (B).

Cook, R.G., Brown, M.F. and Riley, D.A. (1985). *Journal of Experimental Psychology,* 11, 653-469.

Zentall, T.R., Steirn, J.N., and Jackson-Smith, P. (1990). *Journal of Experimental Psychology,* Vol. 16, No. 4, 358-371.