Modeling Free Recall

Michael B.W. Wolfe and **Walter Kintsch**
Institute of Cognitive Science
University of Colorado
Boulder, CO 80309
{mwolfe / wkintsch}@clipr.colorado.edu

Introduction

The goal of this project was to model the process of comprehension and recall of narrative stories. Currently, no single model simulates both the comprehension process and the subsequent recall process.

First, comprehension of the narrative stories was simulated using the Construction Integration model of Kintsch (in press). This model takes as its input a propositionalized representation of a text, and simulates the comprehension process in a series of cycles, resulting in a memory representation of the text. Next, the free recall model of Gillund and Shiffrin (1984) was used to simulate recall of from the memory structures that were the result of the comprehension process. Recall in this model is simulated in two phases. In the first phase, an image is sampled from the memory structure based on the association strengths of the images to each other. The model then uses a recovery probability for the image to determine if the item contained within the image can be recovered.

Recall Data

Free recall data from two short narrative stories was collected for 32 subjects and compared to the performance of the simulations. Subject recall was coded in complex propositions, corresponding to the level of a sentence. These recall data were compared to the recall of complex propositions resulting from 100 simulations by the model.

Simulations

For these simulations, we are interested in examining the model both in terms of which propositions are recalled, and in terms of the order of recall. In the first set of simulations, the correlation between the propositions recalled from the simulation and the subjects was 0.63 and 0.73 for the two stories.

In the first set of simulations, no specific effort was made to constrain the order of recall. To score recall order, the stories were divided into three sections, introduction, problem, and resolution. For the first set of simulations, the recall order of the model did not correspond to subject recall.

For the second set of simulations, we propose that a person's ability to recall stories in order is a function of the recovery phase of recall. As a result, the recovery probability matrix was altered in three ways. First, the model was prevented from jumping ahead more than one story section at a time, or from returning to a section once it had left that section. Second, we lowered the probability of recovering a proposition from the story section subsequent to the one the model was currently recalling from. Third, the recovery probabilities that represent within category order reversals were lowered by reducing the probability of recovering a proposition that appeared earlier in that story section.

In this second set of simulations, the correlation between the propositions recalled by the simulations and the subjects was 0.66 and 0.68. Thus the model still provided good predictions of which propositions were recalled. In addition, for these simulations, the recall order of the model corresponded with the recall order of the subjects.

This study represents a successful integration of a comprehension model and a recall process model, thus extending work on both comprehension models and recall process models. Our results show that in order to model story recall one can successfully combine an off-the shelf comprehension model, which simulates the formation of the mental representation of a text, with an off-the shelf memory model, which simulates memory retrieval. The only change that had to be made in the memory model concerned the strategic component of recall: list recall has no order requirements, whereas story recall is inherently ordered; hence a different recall strategy must be used in story recall than in list recall. But, other than these strategic differences, the same basic memory processes appear to be involved in text recall that have been studied so well in the research on list learning.

References

Gillund, G., & Shiffrin, R.M. (1984). A retrieval model for both recognition and recall. *Psychological Review*, 91, 1-67.

Kintsch, W. (in press). *Comprehension: A Paradigm for Cognition*. Cambridge University Press.