Rumelhart Symposium: Honoring Richard Shiffrin

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This symposium honors Rich Shiffrin's contributions to cognitive science. Four former students will present highlights of their current work shaped in various ways by their mentor.

Data-Driven Approaches to Information Access (Susan Dumais)

Several lines of research that are motivated by the practical problem of helping users find and manage information in external data sources, most notably computers, will be described. The application areas include: information retrieval, text categorization, and question answering. A common theme in all these efforts is the analysis of the statistical properties of words in large volumes of real world texts. Simple statistical analyses and machine learning algorithms are used to solve practical information access problems. In addition these same statistical properties of objects in the world constrain human performance. Thus solutions to practical problems can shed light on human knowledge representation and reasoning.

A Bayesian Approach to the Evolution of Perceptual Systems (W. S. Geisler and R. L. Diehl)

Perceptual and cognitive systems, including the developmental and learning mechanisms that shape them during the lifespan, are the result of evolution by natural selection. Yet historically most approaches to the study of perception and cognition acknowledge only implicitly the role of natural selection. We propose a Bayesian theoretical framework that makes explicit the relationship between the statistical properties of the environment, the evolving genome, and the design of perceptual and cognitive systems. The proposed framework grew out of recent applications of Bayesian statistical decision theory in perception and cognition and recent efforts to measure the statistical properties of natural environments; however, the Bayesian framework encompasses many of the most important insights of previous theoretical approaches in perception and cognition. We first summarize the formal Bayesian framework and show how it can be used to formulate and test specific hypotheses about the design of perceptual and cognitive systems. We then describe the connections between the Bayesian framework and other theoretical approaches.

SAM as a General Theory for Memory (Jeroen G. W. Raaijmakers)

The SAM theory for memory retrieval will be briefly reviewed. We show how the theory (including the extension proposed by Mensink & Raaijmakers, 1988, 1989) may be used to provide a new model for spacing and repetition effects. The resulting model can be seen as a mathematical formulation of the Component-Levels theory proposed by Glenberg (1979). It is assumed that on a second presentation of an item information is added to an existing trace if the episodic memory image corresponding to that item is retrieved. If it is not retrieved, a new image is stored. It is shown that the model predicts many standard findings including findings that were thought to be inconsistent with the Component-Levels theory. This application demonstrates how SAM may be used to provide quantitative formulations for verbal theories, making it easier to examine the exact predictions of such theories.

Inferring Causal Structure from Intervention (Mark Steyvers)

Information about the structure of a causal system can come in the form of observational data - random samples of the system's autonomous behavior - or interventional data - samples conditioned on the particular values of one or more variables that have been experimentally manipulated. Here we study people's ability to infer causal structure from intervention, and to choose informative interventions on the basis of purely observational data. We develop computational models of how people infer causal structure from data and how they plan intervention experiments, based on the representational framework of causal Bayesian networks and the inferential principles of optimal Bayesian decision-making and maximizing expected information gain. These analyses suggest that people can make rational causal inferences, subject to certain processing constraints and representational assumptions that may vary across participants.