

argued that having an adequate model of the functionality of programming is prerequisite to learning to program and that it is sensible pedagogical practice to base understanding of recursive flow of control on understanding iterative flow of control.

Auditory Icons: Using Sound in Computer Interfaces

William W. Gaver

There is growing interest in the use of sound to convey information in computer interfaces. The strategies employed thus far have been based on an understanding of sound that leads to either an arbitrary or metaphorical relation between the sounds used and the data to be represented. In this brief note, an alternative approach to the use of sound in computer interfaces is outlined, one that emphasizes the role of sound in conveying information about the world to the listener. According to this approach, auditory icons, caricatures of naturally-occurring sounds, could be used to provide information about sources of data. Auditory icons provide a natural way to represent dimensional data as well as conceptual objects in a computer system. They allow categorization of data into distinct families, using a single sound. This strategy has the advantage that it is based on the way people listen to the world in their everyday lives.

Volume 2, Number 3, 1986

Structure and Development of Plans in Computer Text Editing

Scott P. Robertson and John B. Black

When people learn a complex skill like computer text editing they are learning a set of goals and the plans for accomplishing those goals. In this experiment we examined the structure and development of simple text-editing goals and plans. Long interkeystroke times were found to be associated with plan boundaries. The longest times were found between keystrokes separating superordinate goals while less significant time increases appeared between keystrokes at subgoal boundaries. Changes in the patterns of interkeystroke times showed plan restructuring with experience.

Graphic Representation of Judgmental Information

Donald MacGregor and Paul Slovic

Graphic displays of information are an important link in the design of user/machine interfaces. However, research on general effectiveness of graphic displays as information organizing formats for judgment and decision making has produced mixed results; graphic formats appear to facilitate judgmental performance in some contexts, but not in others. The two studies reported here examine the relative efficacy of a set of basic graphic display formats, such as might be used to summarize data in an information system, in the context of a task calling for individuals to integrate a set of information cues into an overall judgment. A "lens model" is used as a decompositional framework for representing the relationship between the elements of the information displays and the psychological properties of the multi-cue judgment task. Combined results from the two studies suggest that judgmental performance is markedly enhanced or degraded by the degree to which the display format provides the user with an organizing structure that facilitates a matching between the relative importance of information and the psychological salience of the display's graphic features.

Softening Up Hard Science: Reply to Newell and Card

John M. Carroll and Robert L. Campbell

A source of intellectual overhead periodically encountered by scientists is the call to be "hard," to insure good science by imposing severe methodological strictures. Newell and Card (1985) have undertaken to impose such strictures on the psychology of human-computer interaction. Although their discussion contributes to theoretical debate in human-computer interaction by setting a reference point, their specific argument fails. Their program is unmotivated, is severely limited, and suffers from these limitations in principle. A top priority for the psychology of human-computer interaction should be the articulation of an alternative *explanatory* program, one that takes as its starting point the need to understand the real problems involved in providing better computer tools for people to use.

Straightening Out Softening Up: Response to Carroll and Campbell

Allen Newell and Stuart Card

Carroll and Campbell have exercised themselves over a straw man not subscribed to by us. In doing so, they have misrepresented our position and even the statements in our paper. In reply, we restate as