PROGRAM ABSTRACTS/ALGORITHMS

A HyperCard program to track information-search strategies

MARTIN J. BOURGEOIS and DAVID DEL CASTILLO
University of Toledo, Toledo, Ohio

In many decision-making studies, subjects are given a body of material to review and then their search strategies are assessed. Research paradigms in such studies exhibit varying degrees of artificiality and obtrusiveness, and data collection is often cumbersome. The present paper describes a Macintosh application using the HyperCard program that tracks subjects' search strategies in a less obtrusive and artificial manner than those used in previous studies. The program records the order in which the material is reviewed as well as the duration of subjects' access to each part of the material. Data collection is also greatly simplified by the program. An experiment using the program is described, and suggestions for other uses of the program are discussed.

In our research program, we have recently attempted to test the impact of various procedural innovations on juries' decision making. In our most recent study, we wanted to determine whether or not allowing subjects to review evidence by accessing the trial transcripts after hearing the case would alter the decision-making process in any way (Bourgeois, Horowitz, & ForsterLee, 1993). For example, would subjects review the transcript in the same order in which the evidence was presented on audiotape, or would they review the information in some other systematic order, perhaps related to the difficulty or importance of the evidence?

To address this question, we developed a HyperCard stack containing the trial transcript parsed into a number of informational chunks. This program allowed us to record the order in which the subjects reviewed the transcripts, as well as the amount of time spent reviewing specific components of the transcript. Prior research on decision making suggests that search strategies are influenced by a variety of factors. For example, Johnson (1988) has shown that experts and nonexperts use different search strategies during a decision-making task.

Unfortunately, the methods used in many decision-making studies that have tracked information-search strategies generally have a number of traits that made them un-

desirable for our purposes. To minimize demand characteristics, we needed an unobtrusive method for tracking the search. Many decision-making studies involve videotaping or audiotaping subjects, or observing them through one-way mirrors and having observers code the order and timing of the subjects' information search (e.g., Jacoby, Speller, & Berning, 1974). In addition to the intrusiveness of these methods (i.e., the subjects may be distracted by the observation methods, or act differently when they know they are being taped or observed), they make data collection extremely cumbersome. Moreover, these types of observations typically require at least two independent judges to score the data, and interrater reliability is often problematic.

One method that researchers have used to circumvent such problems is to have subjects speak aloud while searching the information (e.g., Payne, 1976). Alternatively, subjects have been instructed to retrieve each piece of information from an information board (Payne), or from index cards displayed on a table (Jacoby et al., 1974). In another method, subjects are given information on audiotape that has been obscured by static, and instructed that they can eliminate the static by pressing a button (e.g., Brock & Balloun, 1967). It is assumed that they will eliminate more static on the parts containing important or relevant information than on the parts containing less important, or irrelevant information. In addition to being cumbersome, these methods seem highly artificial and, again, may alter the way in which subjects make decisions.

The use of relevant information has also been assessed by testing subjects' recall of presented information. Presumably, subjects are more likely to recall information that they have attended to than information they have ignored. However, Petty and Cacioppo (1986) have noted that indirect measures such as recall are unreliable indicators of depth of processing, or amount of attention paid to information. For example, subjects' prior knowledge may interact with search strategies to contaminate their recall of the material.

In order to avoid many of these problems, presenting the information to be reviewed on a computer seemed to provide an ideal solution. Computers can be programmed to store all of the information to be presented in subsets of any size; subjects can be instructed to press assigned keys to navigate from any chunk of information to another, in any order. The computer can also be programmed to record the time spent on each chunk of information, as well as the order in which the material is searched, without the subjects' knowledge that such data are being collected.

Goldman and Saul (1990) reported details of two Macintosh programs, "READIT!" and "SELECT THE TEXT," which permit subjects to read sentences from a text in any

This research was supported by National Science Foundation Grant SES 9007741 to I. A. Horowitz. Address correspondence to M. J. Bourgeois, Department of Psychology, University of Toledo, Toledo, OH 43606.

order. These programs also provide a record of processing time and reading strategies (e.g., the order in which information was retrieved). Unfortunately, these two programs seem best suited for presenting small amounts of reading material (perhaps one page or less), and not as useful for the amount of information included in a simulated trial transcript. The text of the trial we used in the aforementioned jury study was 40 typewritten pages in length. Because of length limitations, and the fact that these programs were written in Pascal, modifying either READIT! or SELECT THE TEXT did not seem to be feasible.

Fortunately, HyperCard, the program included with every Macintosh, proved to be suited to our needs. The potential of HyperCard for psychological research has been described by Geisler-Brenstein and Brenstein (1989), who provide an excellent general description of the program and its potential for applications in psychological research. HyperTalk, the scripting language used to control HyperCard, is easily mastered with even a minimal knowledge of programming.

Description of the Program

With HyperCard, a body of information may be parsed into chunks of any size, each chunk being placed on a different "card" in a HyperCard stack. HyperCard II allows the user to set the size of cards to fit any screen size, from the traditional 9-in. screen to the larger monitors used on the Macintosh II series. If all the material within a chunk will not fit onto the screen at the same time, it can be placed into a scrolling field so that subjects can read the material in either direction by clicking the scrolling arrows on the display with the mouse, as in many other Macintosh programs. In addition to text, cards may also display graphic or pictorial information, either alone or in conjunction with the text material.

In our experiment, the testimony of each witness defined a separate chunk of information, each with its own card in the transcript stack. However, the size of a chunk of information is completely under the control of the experimenter. The goals of each individual research project should guide decisions about how to segment the information between cards. For example, if we had desired a finer-grained analysis of each witness's testimony (e.g., how much time subjects spent reviewing direct versus cross-examination), we would have broken down the information onto additional cards.

Once the information is segmented in a manner best suited to the researcher's needs, each card can be linked to a separate HyperCard button to enable the subjects to access them in any order. Buttons, one of the main features of HyperCard, allow users to move between cards in a stack. In HyperCard, buttons can be customized in a variety of ways to suit virtually any research project. Buttons can be placed on a background field so that they are accessible from all cards sharing the same background, or they can be made visible and accessible only on selected cards. Subjects may use the mouse to select the appropriate buttons as they navigate between information

chunks. Keys on the computer keyboard may also be programmed to duplicate button functions for subjects who are inexperienced with the use of a mouse.

HyperCard can be programmed to track the order and inspection time of each information unit reviewed by the subject. Inspection time is coded and stored in an invisible field on each card. Each card and button in the program was programmed with five or fewer lines of HyperTalk script statements. For example, the button script below directs HyperCard to select one of the cards containing a chunk of information, hide the field assigned for storing the time when the card was accessed, and then record the start time in that field.

```
on mouseUp
    go to card id 2875
    hide card field "time 1"
    put the long time after card field "time 1"
end mouseUp
```

Each time a subject selects one of the buttons assigned to a card in the stack (or, alternatively, presses a function key linked to that card), the time is recorded in a special field that is invisible to the subject.

Buttons placed on the last card (inaccessible and invisible to the subjects) permit the experimenter to access the stored inspection times and order of retrieval for each card at the end of an experimental session. Once each time field is revealed and printed out, the simple operation of subtraction will allow the researcher to reconstruct each subject's access pattern. Figures 1 and 2 show examples of cards with and without the time fields revealed.

The subjects in our jury study found the program easy to use, even those who had no previous computer experience. Even the few subjects who had problems using the mouse found the alternative command keys easy to use. The subjects also learned to use the program quickly, so learning curve effects were not a problem in our study. However, it may be that subjects access information differently on HyperCard than if they had been reviewing written case transcripts. Although we did not specifically test this possibility, the subjects in our jury study seemed to

Figure 1. Sample witness card with time field hidden.

Figure 2. Sample witness card with time field revealed.

actually find it easier to search HyperCard transcripts than did pilot subjects using written transcripts, who had to flip through 40 pages to look for appropriate testimony. For this reason, we feel that there is probably less process loss in HyperCard search than there would be in searching written documents. However, future research should test for possible differences in information-search strategies between written and computer-presented information.

Other Suggested Applications

Although our HyperCard information-search program used relatively large chunks of information, each one averaging eight typewritten pages that could be scrolled, the program can be modified easily to parse the information into units of any size. The experimenter need only create additional buttons and cards, each of which consist of nearly identical HyperTalk scripts. Thus, the program may prove useful for any decision-making study in which the researcher is interested in recording the details of the subjects' strategies for reviewing information that is relevant to the task.

The HyperCard information-search program may also be useful in other research areas. For example, many recent studies of persuasion (summarized in Chaiken, Liberman, & Eagly, 1989; Petty & Cacioppo, 1986) have examined the extent to which subjects use central (systematic) versus peripheral (heuristic) processing. That is, under some conditions people pay more attention to the persuasive message itself, whereas at other times they base their decisions on such peripheral aspects as the status or attractiveness of the source. Whereas many of these studies use indirect techniques such as recall or thought-listing, the HyperCard information-search program allows researchers more direct access to the amount of time spent reading the message itself versus time spent attending to peripheral cues, as well as the order in which they access the information. This program may be especially useful in studies that present subjects with both sides of a persuasive message in order to determine when they will spend

more time reading arguments that they agree with and when they will look at counterattitudinal arguments.

Similarly, many studies on the effects of stereotyping (e.g., Bodenhausen & Lichtenstein, 1987; Pratto & Bargh, 1991) have given subjects information that is either consistent or inconsistent with a stereotype (e.g., ethnicity of a person). The information-search program would allow researchers to determine how subjects distribute their time looking at stereotype-consistent and stereotype-inconsistent information.

In person-perception studies (see Fiske & Neuberg, 1990, for a review), subjects are presented with various traits of a hypothetical person and are asked to form impressions of them. Again, although many such studies have used recall as a dependent measure, recording the time that subjects spend reviewing different types of trait information may reveal processing strategies that cannot be detected with other types of research methods.

In general, the present program may show itself to be useful to virtually any researcher who presents information to subjects and then allows them to review that information in the context of some task requirement. Even when researchers are primarily interested in other dependent measures, it may be useful to assess subjects' information-search strategies. The program's ease of use, widespread availability (i.e., any laboratory equipped with a Macintosh computer), and flexibility make it a very attractive research tool, either as a primary dependent measure or as a way of obtaining corroborative or ancillary data.

Availability

The HyperCard information-search program can be obtained by sending a blank 3.5-in. disk to either of the authors at the University of Toledo, Department of Psychology, Toledo, OH 43606. Any questions about the program can be addressed to either of the authors, or by contacting the first author by e-mail (mbourge@uoft02.utoledo.edu).

REFERENCES

- BODENHAUSEN, G. V., & LICHTENSTEIN, M. (1987). Social stereotypes and information-processing strategies: The impact of task complexity. *Journal of Personality & Social Psychology*, **52**, 871-880.
- BOURGEOIS, M. J., HOROWITZ, I. A., & FORSTERLEE, L. (1993). The effects of technicality and access to trial transcripts on verdicts and information processing in a civil trial. *Personality & Social Psychology Bulletin*, **19**, 220-227.
- BROCK, T. C., & BALLOUN, J. L. (1967). Behavioral receptivity to dissonant information. *Journal of Personality & Social Psychology*, **6**, 413-428.
- CHAIKEN, S., LIBERMAN, A., & EAGLY, A. H. (1989). Heuristic and systematic information processing within and beyond the persuasion context. In J. Uleman & J. Bargh (Eds.), *Unintended thought: Limits of awareness, intention, and control* (pp. 212-252). New York: Guilford.
- FISKE, S. T., & NEUBERG, S. L. (1990). A continuum of impression formation, from category based to individuating processes: Influence of information, motivation, attention, and interpretation. In M. Zanna (Ed.), *Advances in experimental social psychology* (Vol. 23, pp. 1-74). San Diego, CA: Academic Press.
- GEISLER-BRENSTEIN, E. G., & BRENSTEIN, R. J. (1989). The poten-

- tial of HyperCard for psychological research and instruction: A general discussion and description of two research applications. *Behavior Research Methods, Instruments, & Computers*, **21**, 307-311.
- GOLDMAN, S. R., & SAUL, E. U. (1990). Applications for tracking reading behavior on the Macintosh. *Behavior Research Methods, Instruments, & Computers*, **22**, 526-532.
- JACOBY, J., SPELLER, D. E., & BERNING, C. K. (1974). Brand choice behavior as a function of information load: Replication and extension. *Journal of Consumer Research*, **1**, 33-42.
- JOHNSON, E. J. (1988). Expertise and decision under uncertainty: Performance and process. In M. Chi, R. Glaser, & M. Farr (Eds.), *The nature of expertise* (pp. 209-228). Hillsdale, NJ: Erlbaum.
- PAYNE, J. W. (1976). Task complexity and contingent processing in decision-making: An information search and protocol analysis. *Organizational Behavior & Human Performance*, **16**, 366-387.
- PETTY, R. E., & CACIOPPO, J. T. (1986). *Communication and persuasion: Central and peripheral routes to attitude change*. New York: Springer-Verlag.
- PRATTO, F., & BARGH, J. (1991). Stereotyping based on apparently individuating information: Trait and global components of sex stereotypes under attention overload. *Journal of Experimental Social Psychology*, **27**, 26-47.

(Manuscript received June 17, 1992;
revision accepted for publication January 25, 1993.)