Laboratory for Automation Psychology and Decision Processes

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INTRODUCTION

The Laboratory for Automation Psychology and Decision Processes (LAPDP) focuses on the cognitive/psychological aspects of human/computer interaction and pursues both basic and applied research in this area. It was founded in 1984 by Kent Norman and Nancy Anderson and is affiliated with the Human/Computer Interaction Laboratory (HCIL) in the University of Maryland Institute for Advanced Computer Studies (UMIACS). Our graduate students are in the area of cognitive psychology and have an interest in psychological topics such as judgment and decision-making, learning and memory, and attention and performance. They are also interested in topics in human/computer interaction dealing with interface design and usability testing. Our Website shown in Figure 1 gives details on our work, access to online surveys and experiments, lists of publications, and information about current graduate students.

LINES OF RESEARCH

Our research has dealt with issues of user performance as a function of cognitive ability and interface design. Early research focused on judgment and decision making in menu selection and navigation of hierarchical databases. Since then, we have covered a wide range of research interests.

Menu Selection and Navigation

Our initial research in the 1980's was on the use of menu selection as a user interface for computer systems and applications. We were interested in how users learned to find information or to select functions presented as nodes in a hierarchical network. We found that showing a global map during training was superior to trial-and-error exposure or even memorizing paths [18]. We were also involved in the depth versus breadth issue and helped to show empirically that breadth is superior to depth in menu design consistent with theories of choice latency in cognitive psychology. In addition, we investigated patterns of search relative to the structure of the menu [12]. This research resulted in the publication of the *Psychology of Menu Selection* in 1991 [5]. We continue to do research on menu selection and navigation, now in the context of the World Wide Web.

Metaphors and Apparency

The importance of metaphors in understanding and using computers has been stressed in our lab [6]. We have investigated the metaphor of menu selection as a way of choosing alternatives in computer interfaces and have even related computer menus to restaurant menus [13]. We found interesting differences and similarities between computers and restaurants in terms of layout, clustering, and order of items. For example, in both computer menus and restaurant menus, items that are not listed in alphabetical or sequential order are often listed merely in the order that the programmer or the chef thought of them.

In addition, we have been interested in how the operations of complex systems can be made apparent to users through graphic techniques that show hidden relationships. Complex underlying contingencies (e.g., when menu items are grayed out) can be shown graphically using lines and arrows to greatly reduce the time that it takes users to perform tasks [1].

Usability and User Satisfaction

The Questionnaire for User Interaction Satisfaction (QUIS) was developed in the LAPDP in conjunction with Ben Shneiderman in 1988 [2]. It was designed to be a standardized, general use instrument that allowed researchers to assess users' overall satisfaction with software and to rate the software on a number of subscales. Since its inception, the QUIS has been continually revised and extended to keep up with changes in technology. It is currently licensed through the Office of Technology Commercialization at the University of Maryland (http:lap.umd.edu/quis) and has been used by dozens of major corporations, government agencies, and professional usability laboratories as well as academic research laboratories.

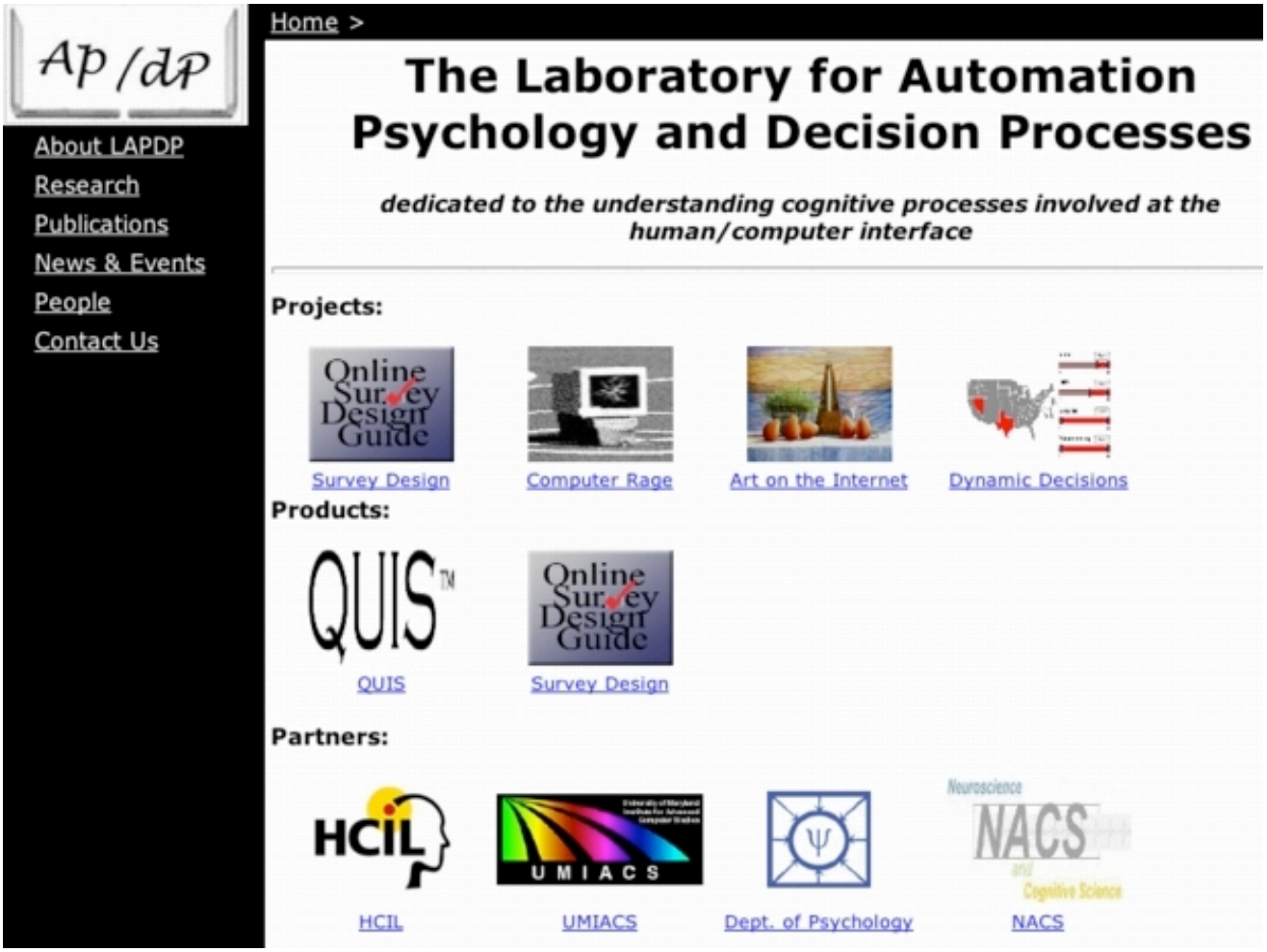

Figure 1. Laboratory Website at http://lap.umd.edu.

Electronic Educational Environments

When the University of Maryland started to explore the use of electronic classrooms in 1990 following a grant from AT&T Information Systems, the LAPDP became involved in the assessment and development of new educational technologies and environments [4]. The University has now built four state-of-the-art "Teaching Theaters." Each Teaching Theater provides a personal workstation for each student and the instructor and includes two 4x6 foot video displays that act as blackboards. The classrooms are networked to allow sharing of screens and other information.

We developed HyperCourseware™ as a prototype platform for hosting the electronic educational environment both in the classroom and on the World Wide Web. This work is reported in the online book *Teaching in the Switched On Classroom* [8]. We continue to work in this area and host college courses on our own desktop Web server (http://cognitron.umd.edu) [9] and we are active in developing new ways to facilitate collaborative learning activities in electronic educational environments [10].

Design of Web-Based Surveys

For the past seven years, we have worked with the U.S. Census Bureau to support their work in human/computer interface design and to conduct research on the design of Web-based surveys. We have investigated the navigation of item-based (paged) versus form-based (scrolling) surveys and report no difference in time to complete the survey or in accuracy of the answers on the first pass through the questionnaire. However, when respondents are reviewing answers, we find advantages for the form-based survey as users find it easier to scroll back to check or change answers than to repeatedly page backward [14]. We have studied the dual navigation using two browser windows, one with the survey and the other with a database of information. Users browse through the database to find answers to questions and/or browse through the survey to find questions to be answered given information found [15]. We have also investigated the design of conditional branching in surveys and methods

of editing and correcting answers [3]. This research continues in preparation for the U.S. Decennial Census in 2010.

Attitudes About Computers

Since the beginning of the LAPDP, we have been interested in attitudes about the power of computers [16], the fear of computers, and aggression toward computers. Our current project is on "computer rage." We are collecting survey data at http:lap.umd.edu/surveys/computer_rage on violent acts and attitudes against computers. We are also posting video clips of simulated rage episodes against computers suggesting that there is a humorous side to this serious issue.

Individual Differences

We have long been interested in tracking individual differences in our research on user performance. In particular, we have studied spatial visualization ability (SVA) and its relationship to performance on tasks requiring information search in hierarchical databases and the manipulation of files, windows, and other graphical objects [7]. Spatial visualization ability correlates with user performance on many different tasks. The implication is that computers facilitate performance of individuals with high SVA while computers hamper those with low SVA. The result is a greater variance in the population of users. The question is whether human/computer interfaces can be designed that attenuate these differences rather than augment them.

Dynamic Query and Decision Making

In conjunction with the HCIL, we are investigating the design of dynamic query systems for usability in database search and for decision aids. In one application, a map of the United States is shown. Sliders allow the analyst to select states within ranges on a set of variables; mousing over a state displays the data for that state; and chloropleth maps provide color-coding on one variable [17]. We are investigating the patterns of use of such maps and ways that they alter decision-making processes. A current challenge is to make such maps accessible to the visually impaired user. One version called "AudioYMap" uses tones varying in pitch and location to give map information. We are currently doing usability testing and refining the interface [19].

Finally, we are interested in how people infer relationships between variables as a function of their knowledge of other relationships. For example, if we know the relationship between A and B, and between B and C, what sort of relationship might we infer between A and C. We are exploring these inferences in a number of different contexts using as environmental indicators, economic factors, and sociological variables [11].

FACILITIES

The LAPDP is housed in the Department of Psychology and occupies 600 square feet divided into four rooms: a library/entrance, a main work/control room, a user testing theater, and an observation room. Three workstations are used for running participants in experiments. Each workstation has two flat panel monitors. Instructions and tasks are presented on one monitor and the user is allowed to work on the other monitor. In some cases, both monitors are used for dual navigation tasks. Three computers for lab personnel also have two flat panel monitors to provide similar environments for programming experiments. Two Web servers are used for testing, information dissemination, and data collection. Digital video cameras and software are used for video capture of user interaction. We conduct from four to six major experiments in-house each year as well as a number of ongoing Web-based surveys and studies.

FUTURE

The academic environment makes the Laboratory for Automation Psychology and Decision Processes an ideal location for research that spans the gulf between basic and applied topics. Our graduate students have pursued research careers in academics, government, and industry. We look forward to continued support and interest in the emerging technologies that require interaction between the human cognitive processes of judgment and decision-making and technological systems for information dissemination, communication, and command and control.

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REFERENCES

1. Alonso, D. L., & Norman, K. L. (1998). Apparency of contingencies in single panel and pull-down menus. *International Journal of Human-Computer Studies, 49*, 59-78.
2. Chin, J. P., Diehl, V. A. & Norman, K. L. Development of an instrument for measuring user satisfaction of the human-computer interface. *Proceedings of CHI '88*, ACM Press (1988), 213-218.
3. Nichols, E., Murphy, E., Norman, K., Rivadeneira,A. & Eaton, C. (2003). Design issues in web-based electronic business surveys. *Proceedings of the Federal Committee on Statistical Methodology Research Conference,* Arlington, VA., 62-94.
4. Norman, K. L. (1990). The electronic teaching theater: Interactive hypermedia and mental models of

the classroom. *Current Psychology Research and Reviews* (Special Issue: Hypermedia and artificial intelligence). *9*, 141-161.

5. Norman, K. L. *The psychology of menu selection: Designing cognitive control at the human/computer interface*. Ablex Publishing Corporation, Norwood, NJ, USA, 1991. (http://lap.umd.edu/poms)
6. Norman, K. L. (1991). Models of mind and machine: Information flow and control between humans and computers. In M. C. Yovits (Ed.) *Advances in Computers*, Academic Press, New York, NY, USA, 201-254.
7. Norman, K. L. (1994). Spatial visualization: A gateway to computer-based technology. *Journal of Special Education Technology, 12*, 195-205.
8. Norman, K. L. (1999). *Teaching in the switched-on classroom: An introduction to electronic education and HyperCourseware*. Laboratory for Automation Psychology, College Park, MD, USA. (http://www.lap.umd.edu/SOC/)
9. Norman, K. L. (2000). Desktop distance education: Personal hosting of Web courses. In A. Aggarwal (Ed.). *Web based learning and teaching technologies: Opportunities and challenges*. Ideal Press.
10. Norman, K. L. (2001). Collaborative interactions in support of learning. In R. R. Hazemi & S, Hailes (Ed.) *The Digital University: Building Learning Communities.*
11. Norman, K. L. (2002). Cognitive functional processing system: Reasoning about quantitative relationships. *Proceedings of Twenty-Fourth Annual Conference of the Cognitive Science Society*, George Mason University, VA, 1025.
12. Norman, K. L. & Chin, J. P. (1988). The effect of tree structure on search in a hierarchical menu selection system. *Behaviour and Information Technology, 7*, 51-65.
13. Norman, K. L. & Chin, J. P. (1989). The menu metaphor: Food for thought. *Behaviour and Information Technology, 8*, 125-134.
14. Norman, K.L., Friedman, Z., Norman, K. D., & Stevenson, R. (2001). Navigational issues in the design of on-line self-administered questionnaires. *Behaviour and Information Technology, 20,* 37-45.
15. Norman, K. L. & Pleskac, T. (2002). Conditional Branching in Computerized Self-Administered Questionnaires: An Empirical Study. *Proceedings of the Human Factors and Ergonomics Society 46th Annual Meeting*. Baltimore, MD, 1241-1245.
16. Norman, K. L. & Singh, R. (1989). Expected performance at the human/computer interface as a function of user proficiency and system power. *Journal of Behavioral Decision Making, 2*, 179-195.
17. Norman, K. L., Zhao, H., Shneiderman, B. & Golub, E. (2003). Dynamic Query Choropleth Maps for Information Seeking and Decision Making. *Proceedings of the11th International Conference on Human-Computer Interaction*, Crete, Greece.
18. Parton, D., Huffman, K., Pridgen, P., Norman, K. L., & Shneiderman, B. (1985). Learning a menu selection tree: Training methods compared. *Behaviour and Information Technology, 4*, 79-80.
19. Zhao, H., Smith, B. K., Norman, K. L., Plaisant, C., & Shneiderman, B. (2004). Listening to maps: User evaluation of interactive sonifications of geo-referenced data. Submitted to IEEE multimedia special issue on interactive sonification, Technical Report HCIL-2004-23, University of Maryland, College Park, MD, 20742.