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SPECIAL SECTION: KNOWLEDGE ACQUISITION

Preface

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The exploration of information acquisition and learning has a long history within ergonomics and human factors. A stimulus–response model of learning that was called the "black box" approach drove much of the early human factors research on information acquisition. Proponents of this approach did not seek to understand the internal workings of system components, human or otherwise, because consideration of such factors seemed to be an unnecessary and wasteful exercise that was best ignored. The goal was to design interfaces that were so effective that users could "walk up and use them," without instruction, and training was considered to be the fallback approach to be used when design goals had not been met.

Another hallmark of early research on information acquisition is that learning was considered to be a unitary and solitary concept. The concept of learning as a singular process is evidenced by the fact that no distinction was made between the type of material to be learned. Most early training work focused on the training of individuals to perform a specific task, typically a physical task that required complex motor skills. It left little room for consideration of the fact that individuals often perform in teams and that successful teamwork requires the learning of additional information and skills. The fact that trainees were often required to perform these jobs in a team setting was mostly ignored, with the exception of some early work on the sequencing of information between team members.

Today, it has become clear that the black box approach to information acquisition can no longer be considered adequate. It cannot be used to design superior interfaces and systems. Several factors have conspired to render the black box approach meaningless. The first of these factors was the realization that the functions and processes of the human are even more complex than originally thought and that complex processes are required to identify and categorize information and to make decisions about how to respond. The realization that human cognition is complex was accompanied by the increasing complexity of the systems with which humans interact. This, in combination with advances in technology that have allowed many tasks to be automated, has greatly increased the cognitive demands that are placed on humans as they interact with systems. Although automation is often advertised as a mechanism for reducing operator workload, it typically changes the role of the worker from physical performer to cognitive monitor and decision maker, thereby producing different kinds of cognitive demands on human operators.

The relatively high cognitive demands imposed by modern tasks has required researchers and practitioners to move inside the black box and to determine the processes by which humans detect and decipher information. Knowledge of these processes is needed to glean the principles of design that create systems that allow users to extract and synthesize information rapidly and accurately. This, of course, has made the task of understanding and enhancing learning more complex and difficult, and it has been said that advances in technology are occurring faster than our ability to understand the demands imposed on users by advanced systems.

Despite the lag between the development of new technologies and the creation of design principles that allow the new technologies to be used optimally, researchers and practitioners have had some success exploring the concepts of information acquisition that are important for enhancing the effectiveness of advanced systems. It is now acknowledged that people learn in many different ways, and the effectiveness of the various training methods appears to vary among individuals. It has also been suggested that the type of information to be learned (e.g., verbal or spatial information) may have an impact on the training methods that will be most effective for enhancing information acquisition.

The fact that the cognitive demands of tasks are increasingly rapidly has also caused researchers and practitioners to revisit their attitude toward training. No longer is training seen as an unfortunate remedy for inadequate design. The complexity of many modern systems makes it difficult, if not impossible, to design an interface that the user can walk up and use. Today, even the best interfaces often require that users undergo some training before they can interact successfully with the system. This fact has stimulated research that attempts to identify the best methods of training people to use systems that impose heavy cognitive demands on users that may vary in severity and character over the course of task performance.

Information acquisition is no longer viewed as a solitary enterprise, or an interaction between teacher and student only. Today, many people work in teams rather than individually. This has caused researchers and practitioners to explore the special demands that working in a team setting impose on team members. Many skills that are required for successful teamwork have been discussed. These are skills such as anticipation of workload conditions for teammates, conception of team members' responsibilities and tasks, and understanding of the procedures required for tasks performed by other team members as well as by oneself. Research that seeks to identify the types of knowledge that team members must possess to work together well, and to devise the best methods of training these skills, is ongoing, as is research designed to evaluate the relation between team members' knowledge of various aspects of the team task and the quality of team performance.

The purpose of the special section on knowledge acquisition and learning is to provide a forum for research on topics that would be of use to researchers and practitioners alike. The special issue contains articles that address three important aspects of information acquisition: learning of route knowledge, team training, and the development of training systems in computer-aided instruction. In the first article, Barlow considers the learning of route knowledge and reports a study that explored the mechanisms by which route knowledge is learned in a virtual environment. In the second article, Cooke, Kiekel, and Helm evaluate methods for eliciting and assessing knowledge that members of teams use during the performance of a complex task. This article represents the growing trend of researchers of team performance to evaluate the effectiveness of measures of knowledge and learning to predict performance. In the final article, Fletcher introduces the concept of sharable instructional

objects and poses some intriguing questions about what these sharable instructional objects should be and how they should be developed.

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