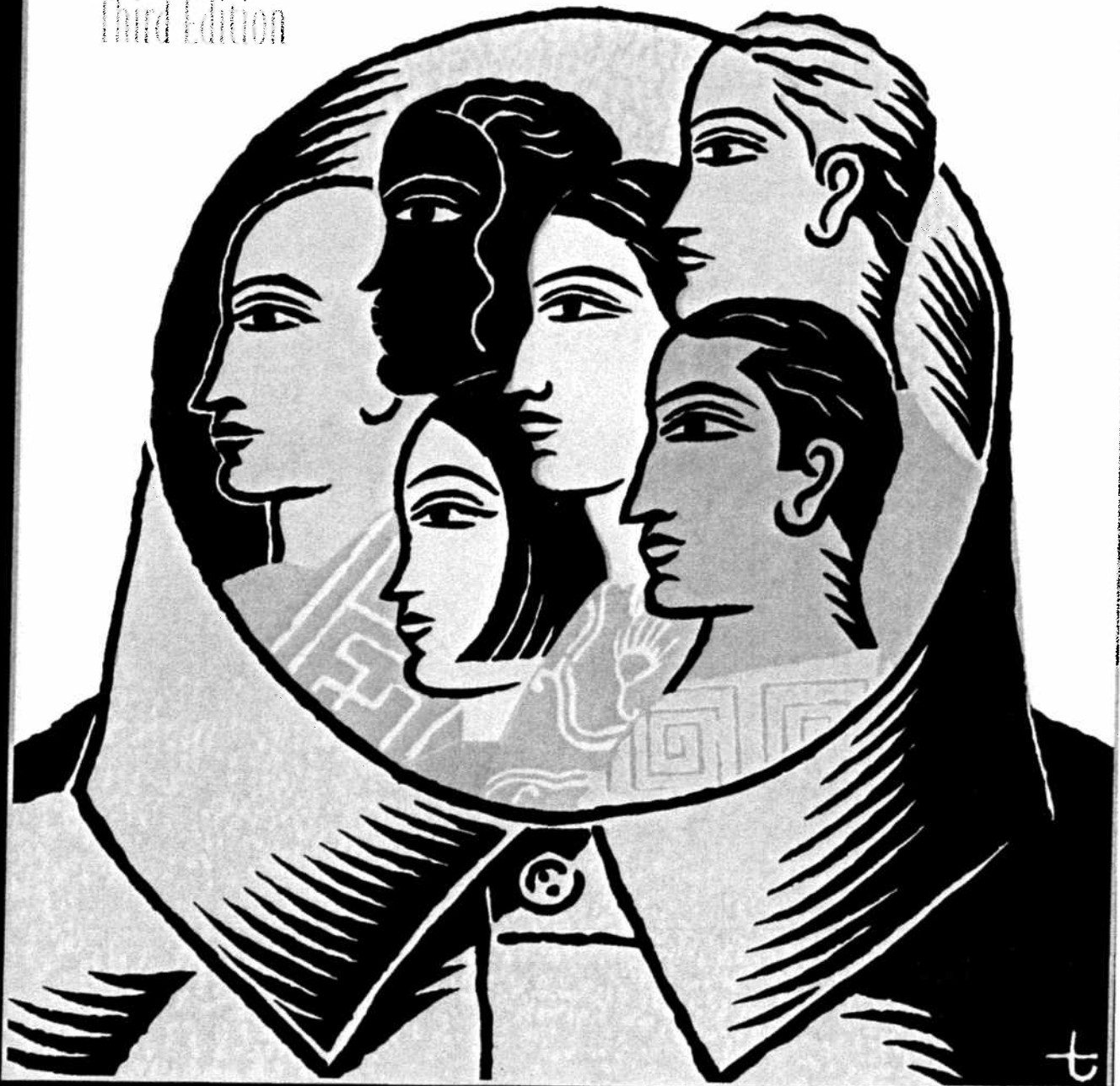


ENGINEERING PSYCHOLOGY AND HUMAN PERFORMANCE

Third Edition



Christopher D. Wickens Justin G. Hollands

Engineering Psychology and Human Performance

THIRD EDITION

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P R E F A C E

This book was written, both the first and second editions, because of a perceived need to bridge the gap between the problems of system design and much of the excellent theoretical research in cognitive and experimental psychology and human performance. Many human-machine systems do not work as well as they could because they impose requirements on the human user that are incompatible with the way people attend, perceive, think, remember, decide, and act, that is, the way in which people perform or process information. Over the past five decades, tremendous strides have been made in understanding and modeling human information processing and human performance. Our goal is to show how these theoretical advances have been, or might be, applied to improving human-machine interactions.

Although engineers encountering system design problems may find some answers or guidelines either implicitly or explicitly stated in this book, it is not intended to be a handbook of human factors or engineering psychology. Many of the references in the text provide a more comprehensive tabulation of such guidelines. Instead, we have organized the book directly from the perspective of human information processing. The chapters generally correspond to the flow of information as it is processed by a human being—from the senses, through the brain, to action—and are less clearly organized from the perspective of different system components or engineering concerns, such as displays, illumination, controls, computers, and keyboards. Furthermore, although the following pages contain recommendations for certain system design principles, many of these are based only on laboratory research and theory; they have not been tested in real-world systems.

It is our firm belief that a solid grasp of theory will provide a strong base from which the specific principles of good human factors can be more readily derived. Our intended audience, therefore, is (1) the student in psychology, who will begin to recognize the relevance to many areas in the real-world applications of the theoretical principles of psychology that he or she may have encountered in other courses; (2) the engineering student, who, while learning to design and build systems with which humans interact, will come to appreciate not only the nature of human limitations—the essence of human factors—but also

the theoretical principles of human performance and information processing underlying them; and (3) the actual practitioner in engineering psychology, human performance, and human factors engineering, who can understand the close cooperation that should exist between principles and theories of psychology and issues in system design.

The 13 chapters of the book span a wide range of human performance topics. Following the introduction in Chapter 1, in which engineering psychology is put into the broader framework of human factors and system design, Chapters 2 through 8 deal with perception, attention, cognition (both spatial and verbal), memory, learning, and decision making, emphasizing the potential applications of these areas of cognitive psychology. Chapters 9 through 12 cover the selection and execution of control actions, time-sharing, error, and stress, thereby addressing areas that are more traditionally associated with the engineering field. Finally, Chapter 13 is systems-oriented, discussing process control, complex systems and automation. This chapter shows how many of the principles explained in earlier chapters are pertinent to one specific application of rapidly growing importance.

Although the 13 chapters are interrelated (just as are the components of human information processing), we have constructed them in such a way that any chapter may be deleted from a course syllabus and still leave a coherent body. Thus, for example, a course on applied cognitive psychology might include Chapters 1 through 8, and another emphasizing more strictly engineering applications might include Chapters 1, 2, 4, 5, 6, 9, 10, 11, 12, and 13.

In addition to incorporating new experiments and studies where appropriate, we have made a number of changes in the third edition that set it apart from the second. First, most prominently, we have added a chapter, reflecting the growth of computer-based graphics systems, and their relevance for human performance issues in virtual environments and data visualization. Second, our chapters on decision making and automation and process control have been substantially rewritten, reflecting many of the changes in knowledge that our field has experienced since 1991 when the second edition was written. Third, throughout other chapters, substantial sections have been added describing important research developments in expertise, situation awareness, display integration, multimedia, the learning process and long term memory representation, planning and problem solving, voice control, and stress models.

In any project of this kind, one is indebted to numerous people for their assistance. For both of us the list includes several colleagues who have read and commented on various chapters, provided feedback on the second edition, and have stimulated our thinking. In addition to all acknowledgments in the first two editions (the text of which, of course, remains very much at the core of the current book), we would like to single out the extensive and helpful feedback on the second edition offered by Doug Gillan, Melody Carswell, Joe Goldberg, and Dan Fisk. We also thank countless students who, in one form or another, offered feedback regarding either good or bad elements of the second edition.

Christopher Wickens would like to acknowledge the contributions of faculty colleagues – in particular, Art Kramer and Gary Bradshaw who provided feedback on early drafts of chapters. He also acknowledges the contributions of four specific individuals who contributed to the development of his interest in engineering psychology: Delos Wickens, stimulated an early interest in experimental psychology; Dick Pew provided an introduction to academic research in engineering psychology and human performance;

Stan Roscoe pointed out the importance of good research applications to system design; and Emanuel Donchin continues to emphasize the importance of solid theoretical and empirical research. Also, it is impossible to do justice in crediting Karen Ayers' and Mary Welborn's contributions to this book. Without their hours of dedication at the word processor of a sometimes hostile computer, the project never would have succeeded. Chris's wife, Linda, was supportive during the hours of preparation for all three editions.

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Christopher D. Wickens and Justin G. Hollands