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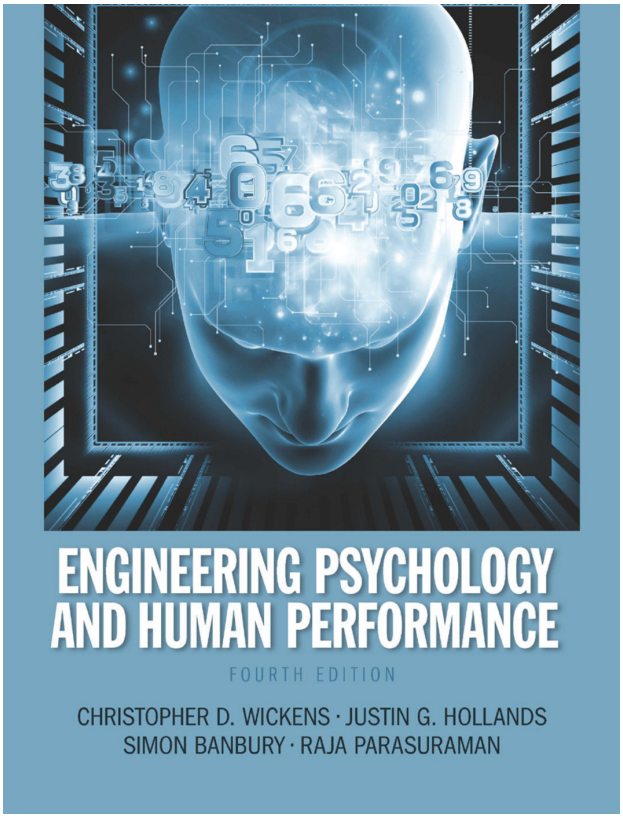

This book was written to address the gap between problems of system design and the results of theoretical research in the study of cognitive psychology, experimental psychology, and human performance. Many of the built human-machine systems do not work optimally due to forced demands or requirements on humans as users, which is not in accordance with the way humans observe, pay attention, understand, think, remember, and decide, as well as act, or in other terms the way people perform or process information. Over the past six decades, tremendous efforts have been made to understand and model human information processing and human performance. Another purpose of this book is to show how theoretical developments have taken place and been applied to improve productivity and safety of human-machine interactions.

A solid understanding of the theory will provide a solid foundation from which specific principles of good human factors can be more easily derived. Readers with a psychology background or psychology students will recognize through this book the relevance of many fields in real-world applications to principles of psychological theory that may be studied in other psychology courses. Readers from engineering backgrounds or engineering students can get up-to-date information based on recent research related to human information processing as they learn to design and build systems that interact with humans. They will better appreciate not only human limitations – which are at the core of human factors – but also the theoretical principles of human performance and information processing that underlie human performance. Furthermore, practitioners of engineering psychology, human performance, and human factors engineering, will be able to understand the close relationship between psychological principles and theories and issues in systems design.

The study of human factors engineering, including engineering psychology, is closely related to human-system integration, computer-human interaction, and user-interface design, which deals with issues of how humans interact

with technology. This discipline has thrived since its inception after World War II when experimental psychology was used to help understand why pilots suffered many well-crafted airplane crashes, why vigilance over enemy aircraft over the English Channel is sometimes weak, or how theory learning can be used to better train military personnel. Since then, over the last 70 to 80 years, the field has developed and expanded into areas such as consumer products, business, road safety, telecommunications, and most recently in healthcare technology.

In dealing with system design problems, engineers have found several answers or guidelines, either implicitly or explicitly, and are reviewed in this book. However, it is not intended to be a human-factor engineering handbook. There have been many references in other textbooks that provide more comprehensive tabulations of these guidelines and provide practical guidance on how to apply them. This book contains a more direct psychological perspective on human information processing. The chapters in this book generally discuss the flow of information as humans process – from the senses, through the brain, to actions – rather than looking at it from the perspective of system components or engineering design concepts, such as displays, lighting, controls, computers, and keyboards. The chapters towards the end contain recommendations for specific system design principles. Many of them are based on theory and laboratory research which, in some cases, need to be tested in real-world systems.

The book was published in 2016 and is the fourth edition of the book. Previously, this book was published in 1992, 2000, and 2013. In this fourth edition there are several changes, especially the joining of two new authors, namely Raja Parasuraman who brings his expertise in automation and neuroergonomy, and Simon Banbury, who contributes with his background expertise in cognitive, memory, and auditory processing areas.

The joining of the two experts who have varying expertise has the consequence of increasing the number of references, especially for medical and health care applications, as well as aspects of cognitive changes in the elderly human population. In addition, about 1,000 new references (approx. 50 percent of the citation list) have been added. Another change to the previously published books is the addition of 48 new pictures or tables of research results.

This book consists of 12 chapters covering knowledge of the various components of human performance and their potential applications in human-automation interactions. Although the 12 chapters are interrelated (as are the human information processing components), the book is structured in such a way that each chapter can be adapted to the interests and needs of the reader. For example, to understand the application of cognitive psychology, it may be important to read Chapters 1 through 8 and Chapters 10; and to explore engineering or engineering applications, it is advisable to read Chapters 1, 2, 4, 5, 9, 10, 11, 12, and Epilogue.

This 12-chapter book covers various components of human performance. In Chapter 1, after reviewing the limitations and scope of studies on engineering psychology, it also reviews them into a broader framework of human factors and systems design. Chapters 2 through 8 cover perception, attention, cognition (both spatial and verbal), memory, learning, and decision making. The discussion in the chapters here also emphasizes the potential applications of the field of cognitive psychology, including reviews of new techniques for fuzzy signal detection theory, spatial cognition, navigation and manual control. Chapters 9 and 10, the discussion covers the theme of selecting and implementing control measures and integrating them to explain human error. It also discusses the problem of time sharing and human multitasking activities. Chapter 10 also discusses the study of distraction driving with an emphasis on sources and solutions. Chapter 11 includes a review of three integrated concepts, namely: mental workload, stress, and individual differences in cognitive and neuro-ergonomic perspectives. This chapter also describes the neuro-ergonomic approach, and the integration of human factors with human neurophysiology. Chapter 12 which is the last chapter discusses

the topic of automation and human interaction. The scope of the discussion in this last chapter is devoted to describing human-automation interactions and their impact on accidents and incidents, including the factors associated with automation, levels and stages of automation, automation complexity, feedback and automation behavior. Finally, in the fairly succinct epilogue chapter, the discussion highlights certain critical issues from the previous chapters as well as the integration of some of the central themes reviewed repeatedly from the book.

This book provides comprehensive information in overcoming the gap between systems design problems and theoretical research studies of cognitive psychology and experimental psychology related to human performance. The reviews in this book are based more on a psychological perspective on human information processing than on looking at it from the perspective of system components or engineering design concepts. This book reveals various theoretical developments on engineering psychology in the context of human factors engineering and its application in increasing productivity and safety of human-machine interactions.

Although the reviews and discussions in this book are divided into 12 interrelated chapters, it is structured in such a way that reading it can be adapted to the interests and needs of the readers. This book is suitable for readers with a background in psychology or engineering. Readers in psychology will gain an idea of the relevance in many fields of the application of the principles of psychological theory. Readers with an engineering background can get up-to-date information related to human information processing that can be applied when they learn to design and build systems that interact with humans.

BOOK AUTHOR PROFILE:

Chris Wickens is Professor Emeritus of the University of Illinois Department of Psychology, Professor in the University of Colorado Department of Psychology, and Senior Scientist at Alion Sciences Company Boulder, Colorado. He taught engineering psychology and experimental psychology, human factors engineering and aviation psychology for 30 years at the University of Illinois. He is also the head of the Aviation Human Factors program in Illinois. He is productive in writing both text books, scientific articles and journals. He has received many awards from various institutions such as teaching places as well as professional organizations and the scientific community. His main research interests are applied attention theory and human performance modeling.

Justin G. Hollands is a Defense Scientist and Senior Advisor at the Center for Defense Research and Development, Canada. He is also a Professor of Mechanical and Industrial Engineering at the University of Toronto, and an Assistant Professor of Psychology at the University of Idaho. A PhD in cognitive psychology was obtained from the University of Toronto in 1993, and an MA in psychology of human factors from the University of Guelph in 1989. His work experience at the Ontario Ministry of Transport and Communications, Bell-Northern Research, and IBM Canada sparked his interest in field of human factors and engineering psychology. He has written more than 50 articles. Focus areas of study include display design and interface design, human dependence on automation systems, visual momentum, visual attention, and human perception and psychophysical scaling.

Simon Banbury is the owner and president of Looking Glass HF, Inc., an independent Canada-based Human Factors consulting firm that specializes in optimizing the way people interact with technology. He is also a Professor at the Université Laval School of Psychology (Canada) and supports research on teamwork and medical decision-making. Simon has twenty years of experience conducting consultancy in the field of human factors and applied research in defence, industry and academia. He has also worked as a human factors consultant in defense and industry, lecturer in Psychology at Cardiff University (United Kingdom), and defense scientist for the UK Defense Research and Evaluation Agency. Simon has published widely on the applied aspects of the study area of attention and memory; including the effect of noise on performance in the office and on the flight.

Raja Parasuraman is Professor of Psychology at George Mason University. In addition, he is Director of Human Factors and Applied Cognition and Director of the Center of Excellence in Neuroergonomics (CENTEC). His research interests are in the study areas of attention, automation, neuroimaging, and genetics. He has published more than 150 peer-reviewed journal articles and 10 books. He is also a member of a number of professional and academic organizations and has received numerous awards for his scientific achievements and dedication in the academic community in the United States.