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Human Mental Workload

Models and Applications

First International Symposium, H-WORKLOAD 2017
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Revised Selected Papers

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Preface

The pervasive use of technologies in daily activities and working environments in the last decade is defining a changed environment where the requirement for cognitive resources seems to be increasing while the level of physical effort seems to be decreasing. The rapid developments in the Internet of Things (IoT) and its novel automation archetypes in cyber-physical systems as well as the upscaling of big data analytical requirements are a few examples of underpinning elements marking an increased cognitive demand on individuals to perform control tasks and achieve an overview of the distributed systems we are required to monitor. The principal reason for measuring mental workload is to quantify the mental cost of performing tasks and its implications on human performance. The modeling of human mental workload (MWL) can be used to inform the design of interfaces, technologies, and information-processing activities better aligned to the human mental limited capacities. Understanding the mechanisms of MWL, its main drivers, and how MWL affects human performance is an open fundamental problem. Research on mental workload can be traced back to the early 1960s; since then there have been hundreds of studies on the measurement of mental workload. However, as pointed out by Wickens in this volume, the scientific and industrial communities still need to be provided with a validated set of models and metrics for MWL. There are many operational definitions of MWL from various fields but they often disagree about its main contributing factors, its dimensions, and the mechanism to aggregate these dimensions and their impact on human performance. This trend is also confirmed by the best papers selected in this book from the proceedings of H-WORKLOAD 2017: the First International Symposium on Human Mental Workload. The selected papers went through a strict review process, with an average of four reviews for each paper. Some authors considered task-specific dimensions, while others chose a combination of task- and user-specific dimensions. Primary researchers have mainly employed self-reporting measurements or a combination of psychophysiological techniques. However, the development of a generally applicable model that manages to incorporate task, user, and context-specific dimensions is yet to be achieved.

As pointed out by Hancock in one of the chapter in this volume, the development of new models should consider subjective, task-objective, and physiological measures together and not in an isolated way, so as to address the scope of cross validation. Brookhuis's contribution at the symposium recommended further efforts in the area of convergence of various measurement techniques for MWL. Past and present research on MWL modeling has had a tendency to focus on complex safety-critical systems generating a plethora of simulations and applications that seems to be rather "ad hoc" and specific to the domain or area of application (such as the models and measures adopted in the rail, aviation, and nuclear industry etc.). However, various researchers in other fields are now highlighting the need for robust and transferable MWL models for predicting human performance employable for design purposes in everyday activities

and in domains like manufacturing of electronic goods, human–device interaction, teaching, learning, and training, which are significantly different from the original safety-critical ones.

This book endeavors to stimulate and encourage further discussion on mental workload, its measures, dimensions, models, applications, and consequences. We believe this discussion should be multidisciplinary, and not only confined to ergonomics. It should be at the intersection of the fields of human factor, computer science, psychology, neuroscience, and statistics. This book presents recent developments in the context of theoretical models of MWL and practical applications aimed at task support and MWL management in operations. Thus, the contributions have been organized in two sections: models of MWL and applications.

The idea for the book and its central theme arose in the context of the First International Symposium on Mental Workload, Models and Applications (H-WORKLOAD 2017. We wish to thank all the people who helped in the Organizing Committee of the First International Symposium on Mental Workload, Models and Applications (H-WORKLOAD 2017), in particular Dr. Nora Balfe, Dr. Dervla Horgan, Dr. Sarah Sharples, Dr. Bridget Kane, Ms. Paula Hicks, Mr. Rory Carrick, Dr. Leonard O'Sullivan, Dr. Matjaz Galicic, Mr. Maurice Wilkins, Ms. Alison Kay, Ms. Eileen Murphy, and many more of the members of the Scientific Committee. We want to also thank the sponsors of the event, the Irish Ergonomics Society, The ADAPT Center (Global Center for Excellence in Digital Content and Media Innovation), without whom neither the conference nor the book would have been realized. Our gratitude is extended to the Chartered Institute of Ergonomics and Human Factors, the Dublin Institute of Technology, Science Foundation Ireland, as well as all the reviewers of the Program Committee who provided constructive feedback. A special thanks goes to the researchers and practitioners who submitted their work and attended the event allowing us to meet and share our experiences on this fascinating topic.

May 2017

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Contents