

To appear in: Ritter, F., Nerb, J., O'Shea, T., & Lehtinen, E. (Eds.). (2007). *In order to learn: Sequencing effects in humans and artificial systems*. New York, NY: Oxford University Press. [submitted version]

Note to typesetter: there are British and German words in the manuscript. Currently, all words are correctly spelled.

**Preface to: *In order to learn: Sequencing effects in humans and artificial systems***

2 June 2006

The order that material, for acquiring both facts and skills, is presented or explored by a learner can strongly influence what is learned, how fast performance increases, and sometimes, even whether the material is learned at all. This book proposes that these effects are more pervasive and important than they have been treated previously. The chapters explore the foundational topics in this area at the intersection of psychology, of machine learning, of AI and cognitive modeling, and of instructional design. We include some case studies and numerous questions that should lead to further research projects and provide stimulation and encouragement for professionals working in areas such as education. In some ways, the chapters raise more questions than they answer.

This book will interest experimental psychology types, educational design folks, and machine learning aficionados, as well as cognitive scientists in general. The audience also includes graduates and practitioners of computer science (particularly AI and machine learning), psychology and cognitive science, and educational technology who are interested in the order and learning, either as potential researchers or as informed consumers of future computing or instructional design products that support human learning or that deploy machine learning techniques. This book is intended for those seriously interested in these issues and with some training or a strong interest in one of these fields.

Each chapter is self-contained and relatively short. They are directly accessible to at least one of the three types of readers that the book is designed for, and should be useful for the others. We worked with the authors to help the book chapters integrate more like a textbook, and to appear less like an edited conference collection. Many argue a surprising point of view on the importance or irrelevance of ordering or sequencing for instructional design domains, and about human skill or machine learning mechanisms. Each chapter ends with clear conclusions, including generalizations, suggestions for action, and projects of various sizes. The book is also designed to be a source book for people at the early stages of their PhD work. It has started to be used in this way.

This book arose out of a task force created as part of the Learning in Humans and Machines (LHM) project. Hans Spada was the leader of this European Science Foundation (ESF) initiative.

The research programme was organized by means of five Task Forces on the following themes:

- Representation changes in learning (Task Force 1), Kayser
- Learning with multiple goals and representations (Task Force 2), van Someren
- Learning strategies to cope with sequencing effects (Task Force 3), O'Shea and then Lehtinen
- Situated learning and transfer (Task Force 4), Bliss
- Collaborative learning (Task Force 5), Dillenbourg

This book was discussed at several general meetings of the task force, including the first one in Milton Keynes where Tim O'Shea put forward the idea of a highly edited, accessible book to serve as an introduction to order effects in learning. Over time, chapters were added from members of other task forces, and from other prominent thinkers on learning. Thus, this book joins the other books produced by the other LHM task forces, including:

*Learning in humans and machines: Towards an interdisciplinary learning science.* Edited by P. Reimann and H. Spada. 1996. London: Pergamon

*Modelling changes in understanding.* Edited by D. Kayser, and S. Vosniadou. 1999. London: Pergamon.

*Learning with multiple representations.* Edited by M. W. van Someren, P. Reimann, H. P. A. Boshuizen, and T. de Jong. 1998. London: Pergamon.

*Learning Sites: Social and technological resources for learning.* Edited by J. Bliss, R. Säljö, and P. Light. 1999. London: Pergamon.

*Collaborative learning: Cognitive and computational approaches.* Edited by P. Dillenbourg. 1998. London: Pergamon.

### **Programme Structure: The Task Forces**

The initial set of chapter authors were selected by the steering committee of the LHM special programme to be members of a Task Force on "The effects of task order on learning in humans and in machines". Our task force's charge was to explore how the effect of the order that learning tasks are performed affects the final outcome of learning, and how each of the three areas of (a) psychology, (b) machine learning and cognitive modeling, and (c) instructional design can be fruitfully combined to understand and use order effects in learning. Thus, cross disciplinary results are common in the chapters. We invited members of other ESF task forces and other authors as appropriate who have a strong point of view on ordering and learning.

We would like to thank the members of the initial task force who were not able to contribute chapters but who contributed to our thinking and the design of the book: Eileen Scanlon, Nicolas Szilas, and Teresa del Soldato. Kurt VanLehn, Stellen Ohlsson, and Pat Langley provided invaluable council on editing books, and Wally Feurzeig and Oliver Selfridge provided crucial support at the end of this process. Katharina Scheiter nudged us when we needed the encouragement. Ying Guo provided valuable editorial assistance. We also have to thank our senior editors, Tim O'Shea and Erno Lehtinen for the guidance they provided, as well as our editor at Oxford, Catharine Carlin, who was very supportive as we pulled this project together. We are able to recommend her highly. Anonymous reviewers provided useful feedback on our book at the proposal stage, and Carlin helped us interpret and incorporate their suggestions. The graduate students at Penn State in an advanced seminar on learning (Mark Cohen, Joshua Gross, Sue Kase, Jong Kim, Andrew Reifers, and Bill Stevenson) provided numerous useful suggestions on the first reading of the book as a whole. Final preparation of this book was performed when Ritter was on a gratefully received sabbatical from Penn State, and with kind help from colleagues at TU/Chemnitz and Tufts, which hosted him. Finally, thanks to our families and friends who supported us in this endeavor. In particular, we would like to thank Josef Krems and Pat Langley for advice and comments, and Nicole, Colleen, Robert, Paul, and David. Finally, Alles in ordnung!

Frank E. Ritter and Josef Nerb, for the editors  
2 June 2006