Experimental Human–Computer Interaction

Experiments that require the use of human participants are time consuming and costly: it is important to get the process right the first time. Planning and preparation are key to success. This practical book takes the human–computer interaction researcher through the complete experimental process – from identifying a research question, to designing and conducting an experiment, to analyzing and reporting the results.

The advice offered in this book draws on the author's 20 years of experience in conducting experiments. In describing general concepts of experimental design and analysis, she refers to worked examples that address the real practicalities and problems of conducting an experiment, such as managing participants, obtaining ethical approval, preempting criticism, choosing a statistical method, and dealing with unexpected events.

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Experimental Human–Computer Interaction

A Practical Guide with Visual Examples

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To my father

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Preface

Some years ago, I presented a retrospective of the graph drawing (and related) experiments I had conducted since 1995 to an audience of information visualisation researchers, describing the process I went through in defining a new experimental research area and learning to run human–computer interaction experiments. This was an honest and reflective seminar in which I highlighted the mistakes I had made, the good and bad decisions, and how my knowledge of experimental design had increased and improved with every experiment. At the end of my presentation, a member of the audience asked, "So, Helen, what is the 'Black Art'? What is it that you have learned about running experiments that we should all know?"

This started me thinking about how much expertise is embodied in experience and seldom communicated apart from in a master/apprentice model. PhD supervisors can advise students on how to formulate and conduct experiments, psychology and HCI research texts can be read, and other experiments in the research literature can be copied, but the actual step-by-step process of designing and running an experiment is rarely written down and communicated widely. Although I believe that one can never understand the process of conducting experiments without experiencing the process oneself, I also believe that experiences can (and should) be shared and that advice resulting from others' experiences can always be useful.

This, therefore, is my "Black Art" book. Based on my own experimental experiences, it aims to introduce researchers to the process of defining and running formal human–computer interaction experiments. It is a practical book, taking the reader through the entire process from the initial research idea, through experimental design and procedure and data analysis, and, finally, to reporting.

The material in this book is based on my own experiences, rather than on any textbook material (apart from a few basic common concepts) or other research

available in the literature. It is therefore unique in that all examples are primary sources: I was personally involved in some way in all 21 of the experiments described here. Taking this approach allowed me to discuss the challenges and complexities of putting together these experiments, including the successes, mistakes, and failures. Such behind-the-scenes insight is seldom presented in secondary-source research publications. Most of these experiments have been published elsewhere, but some have not – they are included as a means of illustrating the experimental concepts and processes that I have adopted in my journey of learning how to conduct effective experiments.

As a consequence, the examples naturally relate to my own research area: information visualisation, and, in particular, the representation of relational information using graphs. However, the experimental principles illustrated by these examples are widely applicable to other HCI areas, including (but not limited to) mobile and multimodal devices, collaborative systems, games technology, and interface design.

Some advice offered here may seem trivial (e.g., clearly define a research question, ensure that there are no interruptions to the experiments, make sure that the software is robust, verify that data are being collected and stored correctly). Such seemingly trite advice is included here simply because I have suffered by NOT doing these things and then paid for it later (typically by having to throw away hard-fought-for data).

This book does not claim to be the only or final word on the topic of experimental design or statistical analysis – indeed, there are several other fine books in this area, most notably, Field and Hole's *How to Design and Report Experiments* (2003), Cairns and Cox's *Research Methods for Human–Computer Interaction* (2008), and Hinton's *Statistics Explained: A Guide for Social Science Students* (2nd ed.) (2004). As with any endeavour, advice from a wide range of other sources is recommended.

This book aims to be useful to anyone who wants to enter the exciting world of experimentation in HCI, and, in particular, PhD students, early career researchers, and industrial research scientists. It will also be useful as a text for an advanced undergraduate or taught postgraduate course in experimental HCI.