Research Methods for Human–Computer Interaction

Human–Computer Interaction (HCI) draws on the fields of computer science, psychology, cognitive science, and organisational and social sciences in order to understand how people use and experience interactive technology. Until now, researchers have been forced to return to the individual subjects to learn about research methods and how to adapt them to the particular challenges of HCI. This is the first book to provide a single resource through which a range of commonly used research methods in HCI are introduced. Chapters are authored by internationally leading HCI researchers who use examples from their own work to illustrate how the methods apply in an HCI context. Each chapter also contains key references to help researchers find out more about each method as it has been used in HCI. Topics covered include experimental design, use of eyetracking, qualitative research methods, cognitive modelling, how to develop new methodologies and writing up your research.

PAUL CAIRNS is Senior Lecturer in Human–Computer Interaction in the Department of Computer Science at the University of York.

ANNA L. COX is Lecturer in Human–Computer Interaction at the UCL Interaction Centre, University College London.
Research Methods for Human–Computer Interaction

Edited by
Paul Cairns and Anna L. Cox
To our girls and boys
# Contents

List of figures ........................................... viii  
List of tables .......................................... xi  
List of contributors ................................. xiii  
Preface .................................................. xv

1 Controlled experiments .............................. 1  
   Ann Blandford, Anna L. Cox and Paul Cairns

2 Questionnaires, in-depth interviews and focus groups 17  
   Anne Adams and Anna L. Cox

3 Eyetracking in HCI .................................. 35  
   Natalie Webb and Tony Renshaw

4 Cognitive modelling in HCI research ............... 70  
   Anna L. Cox and David Peebles

5 Formal analysis of interactive systems: opportunities and weaknesses 88  
   Michael Harrison, José Creissac Campos and Karsten Loer

6 Using statistics in usability research .............. 112  
   Paul Cairns and Anna L. Cox

7 A qualitative approach to HCI research .......... 138  
   Anne Adams, Peter Lunt and Paul Cairns

8 Methodological development ....................... 158  
   Ann Blandford and Thomas Green

9 Theoretical analysis and theory creation ........ 175  
   Alan Dix

10 Write now! ......................................... 196  
   Harold Thimbleby

11 Applying old research methods to new problems 212  
   Paul Cairns and Anna L. Cox

References ............................................. 221  
Index .................................................. 237
Figures

2.1 Two types of Likert scale
3.1 1965 eyetracker
3.2 A remote eyetracker
3.3 Visual angle of the eye
3.4 An example scanpath
3.5 Eye movements when looking at ‘Unexpected visitor’
3.6 Bright pupil method
3.7 Position of corneal reflections
3.8 The transition matrix for a scanpath
3.9 The convex hull of a scanpath
3.10 An example gaze trail
3.11 An example heat map
3.12 Example web page showing Areas of Interest
3.13 Heat maps on the Starbucks homepage
3.14 Example of graph design style 1
3.15 Example of graph design style 2
4.1 A CPM-GOMS model of a micro-strategy
4.2 The modular structure of ACT-R 6.0
4.3 Function and parametric graphs used in Peebles and Cheng (2003)
4.4 Mean response times for experimental participants and ACT-R models
4.5 Screenshots showing an experimental participant’s eye movement data and the ACT-R model’s visual attention scanpath
5.1 Integration of verification in development
5.2 Plant process
5.3 Plant model
5.4 Control screen layout
5.5 Initial specification of control screen behaviour
5.6 A hand-held control device (modified version of the ‘Pucketizer’ device in Nilsson et al. (2000))
<table>
<thead>
<tr>
<th>List of figures</th>
<th>ix</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.7 Model of device positions</td>
<td>98</td>
</tr>
<tr>
<td>5.8 Comparison of behaviours for a goal: ‘Produce substance C’</td>
<td>100</td>
</tr>
<tr>
<td>5.9 Modified (deterministic) specification of control screen behaviour (cf. Figure 5.5)</td>
<td>101</td>
</tr>
<tr>
<td>5.10 Simple observer automata</td>
<td>102</td>
</tr>
<tr>
<td>5.11 The dispatcher process</td>
<td>105</td>
</tr>
<tr>
<td>5.12 The sensor process</td>
<td>106</td>
</tr>
<tr>
<td>5.13 The passenger process</td>
<td>106</td>
</tr>
<tr>
<td>5.14 The observer process</td>
<td>108</td>
</tr>
<tr>
<td>5.15 Property specification patterns (Dwyer et al., 1999)</td>
<td>109</td>
</tr>
<tr>
<td>5.16 Usability perspective of property editor (req2tl)</td>
<td>110</td>
</tr>
<tr>
<td>6.1 A normal distribution</td>
<td>115</td>
</tr>
<tr>
<td>6.2 Bar charts of example questions 2–5</td>
<td>118</td>
</tr>
<tr>
<td>6.3 A scatterplot of the data in Table 6.1</td>
<td>119</td>
</tr>
<tr>
<td>6.4 Histograms of the task times for each type of interface</td>
<td>129</td>
</tr>
<tr>
<td>7.1 Graphical representation of a process effect chain</td>
<td>143</td>
</tr>
<tr>
<td>7.2 Perceived/actual memory contradictions</td>
<td>150</td>
</tr>
<tr>
<td>7.3 User behaviours produced by perceptions of physical security levels</td>
<td>151</td>
</tr>
<tr>
<td>8.1 A screenshot of the OSMosis editor</td>
<td>169</td>
</tr>
<tr>
<td>8.2 A screenshot of Cassata, showing a complete system description</td>
<td>171</td>
</tr>
<tr>
<td>9.1 Uses of multiple classification (from Dix, Beale and Wood, 2000)</td>
<td>184</td>
</tr>
<tr>
<td>9.2 Network of influences of number of items shown on screen</td>
<td>185</td>
</tr>
</tbody>
</table>
### Tables

1.1 Example Latin square with four different tasks  
   **page 8**

1.2 Organising tests for comparing two interfaces with two different tasks  
   8

1.3 The design of the experiment showing two factors and six conditions  
   12

1.4 Predicted time (in seconds) for each task condition based on the GOMS model  
   12

2.1 Mean correlation coefficients between automaticity, memorability and frequency of password usage  
   28

3.1 Example areas of research suitable for using eyetracking  
   43

3.2 Example eyetracking metrics in different areas of research interest  
   48

3.3 Results from metrics of timing and accuracy, participant assessment and eyetracking (Asterisked metrics indicate they were significant to \( p < 0.05 \) (two-tailed))  
   60

6.1 Example task completion times and numbers of wrong clicks  
   113

6.2 Example questionnaire data  
   117

6.3 Summary statistics of questionnaire data  
   117

6.4 Number of users preferring given designs  
   121

6.5 Predicted time (in seconds) for each task condition based on the GOMS model  
   128

6.6 Mean time taken (and standard deviations) to complete each task for all combinations of input modes. Time is shown in seconds  
   128

7.1 Example of a category broken down into properties and dimensions  
   141
Contributors

DR ANNE ADAMS
Lecturer in Practice Centred Education and Development
The Institute of Educational Technology, Open University

PROF. ANN BLANDFORD
Professor of Human–Computer Interaction
UCL Interaction Centre, University College London

DR PAUL CAIRNS
Senior Lecturer in Human–Computer Interaction
Department of Computer Science, University of York

DR ANNA L. COX
Lecturer in Human–Computer Interaction
UCL Interaction Centre, University College London

DR JOSÉ CREISSAC CAMPOS
Lecturer in Informatics
Department of Informatics, School of Engineering, University of Minho

PROF. ALAN DIX
Professor of Computing
Computing Department, Lancaster University

PROF. THOMAS GREEN
Emeritus Professor
School of Computing, University of Leeds

PROF. MICHAEL HARRISON
Professor of Informatics
Informatics Research Institute, University of Newcastle upon Tyne

DR KARSTEN LOER
Department of Strategic Development, Germanischer Lloyd AG, Germany
List of contributors

PROF. PETER LUNT
Professor of Media and Communications
School of Social Sciences and Law, Brunel University

DR DAVID PEEBLES
Senior Lecturer in Cognitive Psychology
Department of Behavioural Sciences, University of Huddersfield

DR TONY RENSHAW
Research Fellow
School of Computing, Leeds Metropolitan University

PROF. HAROLD THIMBLEBY
Professor of Computer Science
Department of Computer Science, University of Wales, Swansea

NATALIE WEBB
Freelance Usability Consultant
London, UK
Preface

Why write this book?

Human–Computer Interaction (HCI) is a clearly multidisciplinary subject. It has historically grown out of both computer science and psychology but in addressing the full complexity of how people use computers it has also grown to encompass social sciences, organisational theories, cognitive ergonomics and even philosophy. These areas all have their own traditions for how to make a useful contribution to knowledge. This means that researchers coming into HCI, be they MSc students, PhD students or even established academics from another area, are rarely aware of the full range of methods that can be used to provide a useful contribution to HCI knowledge. Moreover, it is through awareness of the range of research methods that good researchers realise that a narrow approach to HCI may not be most appropriate in providing a substantial contribution to the area.

The purpose of this book is to describe and demonstrate research methods used in HCI so that new researchers in this area are aware of the possible sorts of research that can be done. In addition, through demonstrating how such research has been done, the book will provide a starting reference for a researcher who is intending to use a particular method. This book will not therefore tell you everything you need to know about a particular method, but it will tell you where you can find out more. Its main aim is to help you to be sure that you have chosen the right method(s) for your particular research project.

Who is this book for?

Our audience is any student (BSc, MSc or PhD) doing a research project in HCI and who needs to know about research methods, that is, methods for producing sound, valid research knowledge. We know that students have very good ideas for research but often do not know how to perform the research in a way that is useful and valid to other researchers. This is not because these students are stupid, but because HCI research is hard. HCI researchers generally come from a single background (psychology, computer science, information science, etc.) and although they are often expert in the research methods used in their own discipline, they are sometimes ignorant of the methods used in another complementary discipline. For example, a computer science student would approach a supervisor to develop a new design for an interface. Whilst the idea can be interesting and
useful, they do not necessarily appreciate how they are to evaluate whether their
design really does deliver promised improvements. Or conversely, students in
psychology sometimes consider it sufficient to merely find out how users behave
with a particular interface rather than to think about how the interface could be
designed to be better.

We hope that a single resource for anyone planning a research project in HCI
will be valuable both to the individuals and to their supervisors, and also to HCI
research generally.

What is in each chapter?

As the purpose of the book is to describe and demonstrate research methods, in
each chapter we will describe what the method is and how to apply it, how it
works and what the expected outcomes are. Each chapter shows how the method
has been applied by describing a published piece of research that has employed
the method and then highlight the strengths and weaknesses of using the method
in the example. We will also point you to other examples that you could look up
and tell you where to find out more information about the method itself.

The book is roughly in three parts. The first part is about methods for gathering
data, the second for analysing that data and the third for methods that encourage
HCI researchers to take a wider perspective on their work.

The first part is made up of three chapters about studying users in order to gather
data about what they do, what they think and how they feel. The first chapter is
therefore on controlled experiments and describes how to design and run them
to evaluate HCI designs, principles and user behaviours. The chapter covers the
types of numerical data you can expect to collect and tells you how to go about
observing and recording the behaviour of the participants. The second chapter
tells you about asking questions, specifically about designing questionnaires,
conducting different types of interviews (structured and unstructured) and how
to run focus groups. Again the chapter will cover the type of data you can expect
to collect from each of these techniques.

Chapter 3 covers a very different way of gathering data through the use of
eyetracking. This brings its own particular problems, such as relating what the
eye is doing to what you need to know about an interface. This chapter therefore
aims to lay the foundations for knowing when to do eyetracking, how to do it and
what you can sensibly expect to gain from such a study.

The second part of the book consists of four chapters addressing analysis tech-
niques that can be used to understand user behaviour, perhaps using data gathered
through the methods in the previous three chapters. In Chapter 4, we discuss the
advances that cognitive modelling has made in the area of HCI and demonstrate
how this method can be used to test, confirm and support data collected by other
methods. Chapter 5 focuses on formal methods such as statecharts as a different
sort of model for interactive systems. Instead of modelling the user like cognitive
models, these models consider the system and the context for the system. They
can then be reasoned about to ensure that they function as they should. This is particularly important in safety critical systems, like air traffic control or medical monitors, where the cost of failure is never acceptable.

Chapter 6 introduces the use of statistics to analyse quantitative data. This chapter is naturally closely linked to Chapter 1 on controlled experiments and we use the same example in both chapters. However, questionnaires and even interviews can produce quantitative data that statistics summarise and analyse in greater depth. In contrast, Chapter 7 takes a more qualitative look at data arising from questionnaires and interviews in order to develop grounded theories of how users think, their attitudes and what influences their thoughts and attitudes. This chapter therefore uses the same examples as Chapter 2.

The third part is not what you might find in a typical book about research methods but nonetheless covers important aspects of doing good HCI research. One particular feature of HCI, unlike other disciplines, is that HCI can influence the design and development of the systems that it studies. The usual way of providing designers and developers with the results of research is through methodologies that embody the research findings in some way. However, it is no trivial matter to develop a new methodology. In Chapter 8, we tackle the development of methodologies and the important step of validating the methodology. Without making use of case studies with which to validate new methodologies, we do not have the evidence to be confident that the methodology will really be able to deliver what it claims it can. Even then, developing a methodology is best considered as a long-term project. This does not mean that there cannot be many valuable smaller-scale projects that can contribute to methodology development, but rather that the planning of such projects needs to be done with care and with a view to the bigger picture.

Chapter 9 addresses one of the most important ideas in any research, the theoretical basis for the work. Theory in HCI is very hard to define and so this chapter explores different ways of understanding theory in HCI research. It is perhaps odd to call it a method, but at the same time without theory it is very hard to say exactly what a piece of research is contributing. Theories enable us to generalise our findings to other situations and can then provide us with a focus for our future research and give us something to think and argue about and test.

All research ultimately needs to be communicated to the wider research community if it is to be valuable. This process of writing up work is usually considered at the end of the project. However, in Chapter 10 we make the case that writing is actually a valuable research method that should be begun at the same time as the project. The process of writing helps us to clarify our thoughts not only about what needs to be done, but also about what our results mean.

As already mentioned, HCI is a multidisciplinary area that has been growing to encompass more and more areas of research that were once thought to be distinct. We expect that this is likely to continue in the future as those individual research areas offer us more insights into the interactions between people and computer systems. It is likely therefore that more areas of research will contribute to HCI
research and bring with them their own preferred research methods. In the final chapter, Chapter 11, we discuss how the existing methods can still be used to analyse a new area of research, namely user experience, but also how we have found from our own work that there are clearly limitations to the methods. This does not mean the methods are useless, but rather that there is an opportunity to develop new methods that will fill the gap and continue to produce sound, valuable and valid HCI knowledge in these new and challenging areas.

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We would like to thank all of the authors of this book for agreeing to join us in this enterprise. Though we planned the book, we have been surprised and rewarded by the freshness and enthusiasm that the other authors have brought to their chapters. We have also appreciated the mutual support they have provided to us and each other.

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In the end though, this book is our responsibility. We hope you enjoy reading it and, as a result, enjoy even more doing successful research. If not, do let us know because there is always more to learn in HCI.

Paul Cairns and Anna L. Cox