The Art of Interaction

What HCI Can Learn from Interactive Art

Synthesis Lectures on Human-Centered Informatics

Editor

John M. Carroll, Penn State University

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The Art of Interaction: What HCI Can Learn from Interactive Art Ernest Edmonds

www.morganclaypool.com

ISBN: 9781608458981 Paperback ISBN: 9781608458998 eBook ISBN: 9781681732855 Hardcover

DOI: 10.2200/S00825ED1V01Y201802HCI039

A Publication in the Morgan & Claypool Publishers series SYNTHESIS LECTURES ON HUMAN-CENTERED INFORMATICS #39 Series Editor: John M. Carroll, Penn State University

Series ISSN 1946-7680 Print 1946-7699 Electronic

The Art of Interaction

What HCI Can Learn from Interactive Art

Ernest Edmonds De Montfort University

SYNTHESIS LECTURES ON HUMAN-CENTERED INFORMATICS #39



ABSTRACT

What can Human-Computer Interaction (HCI) learn from art? How can the HCI research agenda be advanced by looking at art research? How can we improve creativity support and the amplification of that important human capability? This book aims to answer these questions. Interactive art has become a common part of life as a result of the many ways in which the computer and the Internet have facilitated it. HCI is as important to interactive art as mixing the colours of paint are to painting. This book reviews recent work that looks at these issues through art research. In interactive digital art, the artist is concerned with how the artwork behaves, how the audience interacts with it, and, ultimately, how participants experience art as well as their degree of engagement. The values of art are deeply human and increasingly relevant to HCI as its focus moves from product design towards social benefits and the support of human creativity. The book examines these issues and brings together a collection of research results from art practice that illuminates this significant new and expanding area. In particular, this work points towards a much-needed critical language that can be used to describe, compare and frame research in HCI support for creativity.

KEYWORDS

human-computer interaction, interactive art, practice-based research, experience, engagement

To Emma (in memoriam)

and Robert, Meroë, Emma, Catriona, Lulu, and Eric.

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Acknowledgements

This book originated from a keynote talk given to the Create10 conference held in Edinburgh in 2010: "The art of interaction", *Proceedings of Create10*, Edinburgh 2010. https://ewic.bcs.org/content/ConWebDoc/36532. (The original presentation can be viewed at https://www.youtube.com/watch?v=-W5MzJY_QU4.) Thanks are expressed to the organisers of the conference and Michael Smyth, in particular, for inviting me.

The book also draws on my chapter "Interactive art", in Candy, L. and Edmonds, E. A. (2011). *Interacting: Art, Research and the Creative Practitioner*. Libri Press, Oxford, pp. 18–32.

I am very grateful to my students and collaborators whose work I have explicitly drawn on: Stephen Bell, Zafer Bilda, Andrew Bluff, Matthew Connell, Stroud Cornock, Gina Czarnecki, Brigid Costello, Mark Fell, Francesca Franco, Andrew Johnston, Lizzie Muller, and Mike Quantrill. I am equally grateful to the many other students and collaborators with whom I have worked over the years, all of whom have helped me understand interactive art, HCI, and the relationship between the two. For many stimulating conversations that have informed my thinking, I am indebted to Margaret Boden, Gerhard Fischer, John Gero, Tom Hewett, Ben Shneiderman, and the many members of the art and HCI communities who have encouraged and influenced me.

I am grateful for the thoughtful suggestions made by the reviewers of my first draft of this book. Finally, I would like to thank Linda Candy for her advice and suggestions about the text and, above all, for the unfailing support that she has offered over many years.

CHAPTER 1

Introduction

Interactive art has become a common part of life as a result of the many ways in which the computer and the Internet have facilitated it. Human-Computer Interaction (HCI) is as important to interactive art making as the colours of paint are to painting. It is not that HCI and art share goals. It is just that much of the knowledge of HCI and its methods can contribute to interactive art making. This means that artists have been taking a very serious interest in HCI, including as part of their research activities. They have discovered some interesting things that can contribute to HCI. In learning from art, it is important to take the relevant value systems into account and, as art is deeply human, I will come at HCI from a very human perspective. I will not be discussing how to design products that will do well in the market. I will show how art can help HCI in its endeavour to enrich life and expand our understanding of human experience of interaction. This book reviews recent work in the area of art research and proposes contributions that these make to HCI.



Figure 1.1: *Shaping Space*, Ernest Edmonds. Site Gallery Sheffield 2012. Photo by Robert Edmonds, 2012.

2 1. INTRODUCTION

In interactive digital art, the artist is concerned with how the artwork behaves, how the audience interacts with it and, ultimately, in participants' experiences and their degree of engagement. In this book, I examine these issues and bring together a collection of research results and art practice experiences that help to illuminate this significant new and expanding area. In particular, I suggest that this work points towards a much-needed critical language that can be used both to describe, compare, and discuss interactive systems art and to frame research in HCI, particularly in relation to support for creativity.

This book is, in essence, a lecture. It is written as such and so covers basic background material, some of which most readers will know. However different readers will know different parts of that background. For some, the historical context sections might readily be skipped, depending on the reader's knowledge. As with all good lectures, the intention is not just to impart information, not even primarily to impart information. The intention is to stimulate thinking about creativity and the future of HCI and to encourage further reading and exploration. At times my text is informal and I do not shy away from expressing opinion that, as yet, I cannot back up with hard evidence. Stimulating questions in the reader's mind is as important in this lecture as providing answers. The biggest question that I pose is: How best can HCI researchers learn from interactive art?

Digital art is increasingly interactive. Some of it is built on notions that come from computer games and much of it is intended to engage the audience in some form of interactive experience that is a key element in the aesthetics of the art.

This book reviews recent work that looks at the design of interactive systems in the art context. The concerns in HCI of experience design and understanding user engagement are especially relevant ones. We are not so much concerned with task analysis, error prevention, or task completion times as with issues such as pleasure, play, and long-term engagement.

In interactive digital art, the artist is concerned with how the artwork behaves, how the audience interacts with it (and possibly with one another through it) and, ultimately, in participant experience and their degree of engagement. In one sense, these issues have always been part of the artist's world but in the case of interactive art they have become both more explicit and more prominent within the full canon of concern.

Whilst HCI in its various forms can offer results that at times help the artist, the concerns in interactive art go beyond traditional HCI. Hence, we need to focus on issues that are in part new to, or emerging in, HCI research.

As is well known to HCI practitioners, we do not have a simple cookbook of recipes for interaction and experience design. Rather, we have methods that involve

research and evaluation with users as part of the design process. The implications of this point for art practice are, in themselves, interesting. The art-making process needs to accommodate some form of audience research within what has often been a secret and private activity.

This book looks at these issues and brings together a collection of research results and art practice experiences that together help to illuminate this significant new and expanding area. I provide a set of case studies in interactive art research to help guide the reader on that further journey. I also include an extended description of my own journey. On the way I cover a little history, both of HCI and of art. I hope that HCI people might find an expanded way of looking at art—and learn from it—and also that artists might see a new way of looking at HCI.

A Little HCI History

2.1 THE NAME HCI ITSELF

Human-Computer Interaction (HCI) is a relatively new field that is always changing. Even its name has gone through many transformations. Of course the advocates of each new name wish to imply some shift of focus or scope for the subject, as indeed has happened.

When I first worked in the field it was known as Man-Machine Interface, or a branch of Ergonomics or Human Factors (terms which still survive). Naturally, it turned out that the machines that mattered most to us were computers, so we started to talk about the Man-Computer Interface. Eventually, even the ground-breaking *International Journal of Man Machine Studies* (IJMMS, 2017) had to admit not only that we were concerned with computers but that the climate of opinion no longer accepted "man" as a generic term for all human beings. The journal moved with the times and changed its name to the *International Journal of Human-Computer Studies*.

Having moved on to using the phrase Human-Computer Interface, we then saw that it was not the object, the interface, that was the main concern but it was actually the process of interaction. The name of the field then moved to Human-Computer Interaction or, in the case of the important society the Association for Computing Machinery (ACM), Computer-Human Interaction. The ACM term removed a risk of ambiguity that some people were worried about. The subject is not concerned with computers that are human like (human computers) but about interaction between humans and computers.

The next move was based on the recognition that a really key element of the area was "design". Within the design community it is well recognised that many aspects transfer across domains, whilst others are quite specific. In our case, for example, interaction brings specific design concerns. So we now have a large body of work that goes under the heading of Interaction Design. Obviously, this does not cover all of HCI as it excludes, for example, studies of interaction behaviour that do not have direct design application. However, it is generally seen as another variant name in the field of HCI.

Just as once we moved from "interface" to "interaction", people have come to understand that the "experience" of interaction is often the key issue that we need to

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consider. Just think of Steve Jobs and the innovations he brought to the market at Apple (Isaacson, 2011). The result is another shift, this time to Experience Design. Some people will argue that designing experiences is not quite what is being done and that terms like Design for Experience or Experience-Centered Design capture it more accurately. In any case, Interaction Design is important in this book and will figure as such.

We could go on, and these changes and transformations certainly will in the future. For this book, however, from now on I will use the term HCI in its most general sense to cover the range of work named in these many different ways: human computer interface, interaction design, experience design. etc.

2.2 FROM EASY-TO-USE TO USER EXPERIENCE

In 1947, writing about programming the EDVAC computer, Mauchly said "Any machine coding system should be judged quite largely from the point of view of how easy it is for the operator to obtain results" (Mauchly, 1973). Ease of use was a concern in computing from the very beginning. Of course, Mauchly's user was the "operator" or, as we would say today, the programmer. Quite a bit of HCI research has in the past been directed at the programmer and the design of programming languages, so he was hardly alone in adopting this focus.

The late Brian Shackel's paper "Ergonomics for a computer" was published in *Design* in 1959 and can be seen as the start of the serious consideration of research in HCI (Shackel, 1959). It brought our attention to the need to include human factors into computer science research.

The next important steps were very much concerned with the "interface" as was indicated in the early names mentioned above. Ivan Sutherland completed his Ph.D. in 1963 in which he presented Sketchpad and many of the founding ideas of interactive computer graphics that are still relevant today (Sutherland, 1963). Shortly afterwards, Doug Engelbart invented the mouse (Engelbart, 1967). Taken together these advances in the computer interface laid down the foundations of modern interactive computing.

An important conceptual moment for HCI was Alan Kay's idea of the Dyna-Book, a small tablet-like computer designed to be used by children (Kay, 1972). It was way beyond any engineering capability available at that time but provided a vision of the future. As Mike Richards put it, when reviewing the iPhone in 2008, "After a forty-year delay, Alan Kay's DynaBook might just have arrived" (Richards, 2008). Perhaps, really, the DynaBook has arrived in the form of the iPad, which, after all, was put on the shelf for a little while once Steve Jobs realised that a smaller version could be revolutionary: the iPhone (Isaacson, 2011: 468).



Figure 2.1: Alan Kay's sketch of DynaBook. Courtesy Alan Kay.

That Alan Kay's vision of a machine that would be easy, natural, for children to use can surely be seen in the iPhone and iPad. It is commonplace to see very young children, of two or even one, manipulating these machines by pointing and swiping. Progress towards this end was made much stronger by the foundation of Xerox PARC (the Xerox Palo Alto Research Center, now PARC) in 1970. This hothouse of computing development was driven by a general application led strategy—focused on the office—and by drawing in all that was innovative and promising, particularly, but not only, in the HCI area.

Also in 1970, Brian Shackel founded the HUSAT (Human Sciences and Advanced Technology) Research Institute at Loughborough University in the UK, which became a major center for HCI research (Shackel, 1992). Then, in 1976, SIGGRAPH held the UODIGS workshop on "User-oriented design of interactive graphics systems" (Treu, 1976). In the same year a conference on "Computing and People" was held in Leicester in the UK (Parkin, 1977). In 1978, the ACM Special Interest Group on Social and Behavioural Computing (SIGSOC) ran a panel at the ACM Conference on "People-oriented Systems: When and How?" So, a process that would lead to the first American conference on human-computer interaction in 1981, "The Joint Conference on Easier and More Productive Use of Computer Systems," had started, and SIGSOC was transformed into SIGCHI. Note that the main preoccupations at this time were mostly ease of use and the consequential benefit to productivity.

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Meanwhile, some people were dreaming about the magic of the DynaBook, of children "playing" with computers, and with the user's enjoyment. A famous critical event was the visit by Steve Jobs, and others from Apple, to Xerox PARC in 1979 (Isaacson, 2011: 96). They saw the prototype machines with bitmap displays, using a mouse and emulating the use of paper and printing on the screen. Jobs was not slow to say that this was the future and that Apple needed to produce it, albeit at a tiny fraction of the cost. This was the start of the commercial move towards DynaBook and the 1984 launch of the Apple Macintosh computer.

In the second CHI conference, held in 1982, Tom Malone presented a paper about designing enjoyable user interfaces.

"In this paper, I will discuss two questions: (1) Why are computer games so captivating? And (2) How can the features that make computer games captivating be used to make other interfaces interesting and enjoyable to use?" (Malone, 1982).

This might be seen as the start of the research effort to look at user engagement and enjoyment as significant research and design issues.

Naturally, a concern for engagement and enjoyment points to the need to look hard at user experience. Kevin Biles' 1994 paper in *Computer Graphics*, "Notes on Experience Design", set the agenda:

"Technology, no matter what it is, isn't the entertainment. The integration of technology needs to be seamless in an attraction, always letting the story and the overall experience take the front seat" (Biles, 1994).

The HCI trend from "ease of use" to "user experience" is the human side of the trend described by Jonathan Grudin as "tool to partner" (Grudin, 2016). Much of Grudin's more detailed history can be interpreted in this human-oriented way, but, as I will show, there are trends that hardly focus on the computer side of HCI at all. In that respect, one particularly significant issue is embodiment. In the broad sense, this is concerned with understanding interaction in the physical and social context in which it takes place (Dourish, 2001). The concern for embodiment in art is sometimes very specifically about interaction that takes the body and movement fully into account, as in the case of dancers and performers. See the case that I discuss in Section 5.4.

In the next section, I will describe how recent developments have been bringing HCI closer to the human values found in art by concentrating on the support that can be offered to enhancing human creativity.

2.3 ON TO ENHANCING CREATIVITY

An interest in creativity began to flower in the Artificial Intelligence, Cognitive Science, and Design communities at the end of the 1980s. The "First International Conference on Computational and Cognitive Models of Creative Design" was held on a Great Barrier Reef island in 1989 and turned into a regular series (Gero and Maher, 1989). Margaret Boden (1991) published her book, *The Creative Mind: Myths and Mechanisms*, in 1991. The main thrust of this kind of work was in building and critiquing computational models of creative processes, but some designers and members of the HCI community also took a strong interest. They had a different focus, that of envisaging how computational systems might support and enhance human creativity.

This development seemed a natural extension to the HCI concerns for engagement and enjoyment. We were no longer locked into an HCI focus that emphasised work (the "easier and more productive use of computer systems" of the first CHI). Instead, interest was growing in entertainment, art, and pleasure. The values had changed. Of course, it turned out that a considerable amount of work involves creativity. Creativity in the Design domain was first to receive significant attention. It was found that the older emphasis on work was, in fact, on *routine* tasks: copy editing, for example, rather than writing a screen play.

In 1993, the first Creativity and Cognition conference was held at Loughborough University in the UK. This conference, and the many that followed, took a strong multidisciplinary approach in what was initially an exploration of a possible new area:

"...the cognitive modeling of creativity, the empirical study of the creative process and the theoretical reflection upon its characteristics are of concern to everyone involved whether artist, designer, philosopher, cognitive scientist, or computer scientist" (Edmonds, 1993).

By the 1996 meeting of this conference series (as it had become) the primary goal of supporting human creativity became clear:

"The design of creativity supporting computer systems is now firmly on the research agenda" (Candy and Edmonds, 1996).

Creativity had become an HCI research issue.

As mentioned above, Loughborough University, where the Creativity and Cognition conference series began, was an early and very strong HCI research center. Hence, the conference series developed in an HCI climate and by 1999 it had been adopted by ACM SIGCHI as a sponsored conference, which it remains today. Since then the range of conferences and publications in the area has expanded vastly. Fund-

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ing bodies have also taken an interest. In the late 1990s, the UK's Engineering and Physical Sciences Research Council added the topic of supporting creativity to its definition of interesting areas of HCI. In 2005, the U.S.'s National Science Foundation (NSF) sponsored a high-level workshop on Creativity Support Tools in Washington DC (Shneiderman et al., 2006).

The NSF workshop can be seen as a pivotal event in relation to HCI and creativity: "This U.S. National Science Foundation sponsored workshop brought together 25 research leaders and graduate students to share experiences, identify opportunities, and formulate research challenges. Two key outcomes emerged:

- 1. encouragement to evaluate creativity support tools through multidimensional in-depth longitudinal case studies; and
- 2. formulation of 12 principles for design of creativity support tools" (Shneiderman et al., 2006).

The evaluation outcome was to recommend that the way forward should focus on "multiple metrics and evaluation techniques based on long-term in-depth observations and interviews over weeks and months with individuals and groups." Twelve principles were identified that provide a valuable check list.

- 1. Support exploration.
- 2. Low threshold, high ceiling, and wide walls.
- 3. Support many paths and many styles.
- 4. Support collaboration.
- 5. Support open interchange.
- 6. Make it as simple as possible—and maybe even simpler.
- 7. Choose black boxes carefully.
- 8. Invent things that you would want to use yourself.
- 9. Balance user suggestions with observation and participatory processes.
- 10. Iterate, iterate—then iterate again.
- 11. Design for designers.
- 12. Evaluate your tools.