Why Research-oriented Design Isn't Design-oriented Research

Human-Computer Interaction (HCI) is the discipline concerned with the design, evaluation, and implementation of interactive computing systems. Typically, HCI researchers do not primarily study existing technologies, styles of interaction, or interface solutions. On the contrary, one of the core activities in contemporary HCI is to design new technologies—prototypes—that act as vehicles through which the researchers' ideas for novel and alternative solutions materialize and take on concrete shape.

Despite this situation, there is very little discussion in the field on HCI as design discipline and what the role of design is as an activity in the research process. This paper is specifically about the element of design as currently manifest in HCI research. We dig deeper into HCI as a design discipline by suggesting, analyzing, and discussing what appears to be two competing traditions in the relationship between design and research; that of *design-oriented research* and *research-oriented design*.

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INTRODUCTION

Human-Computer Interaction (HCI) is the research discipline concerned with the design, evaluation, and implementation of interactive computing systems—and in particular the phenomena that surround human use and experience of such technology. HCI grew out of the part of computer science and computer graphics that had to deal with what was generally regarded among programmers to be the most rickety of computer interfaces; the computer to human interface. It established itself as a research discipline during the late 1970s and early 1980s

As HCI has evolved, several disciplines have come to give their contribution to the field, each with different emphases and traditions. The pioneers of HCI, in computer science and computer graphics, brought with them application design and an engineering tradition. Quite early, parts of cognitive psychology showed interest in the new field and stressed the application of theories of cognitive processes when designing the user interface. The influence from cognitive science also brought a science attitude and a tradition of empirically studying human behavior to HCI. During the 1990s, sociology and anthropology gained methodological grounds in the field, establishing a culture of user-centered design and an increasing interest in broadening the scope of HCI to not only consider the meeting between human and computer but also to reveal the larger interactions that take place between technology, work, groups, and organizations. More recently, industrial design has come to influence the field [3], which again has contributed to a broadening of HCI's focus where user experience, virtual and physical form, and design methodology are now high fashion. Contemporary HCI is hence interdisciplinary to its nature. Today, its typical conferences and journals encapsulate such diverse areas as two- and three-dimensional interaction, interaction with and use of mobile devices, embedded systems, ubiquitous computing, virtual worlds, group interfaces, tangible interaction, social interaction, and augmented reality.

Is HCI a Design Discipline?

What one realizes when digging into contemporary HCI research is that it is very much *a field oriented towards design*, in the sense that most projects end up bringing forth new interactive systems. HCI research today is hence not directed to the study of existing technologies, styles of interaction, or interface solutions. On the contrary, one of the core activities in contemporary HCI is to design *new* technologies—*prototypes*—through which a researcher's ideas for novel and alternative solutions materialize and take on concrete shape. These new technologies may try to answer directly to experienced problems revealed in for instance a user-centered field study, but they can also be the result of pure innovation on the part of the researchers that are involved in the process.

This *design-orientation* is vivid in the field to such an extent that it makes more sense to regard HCI as a *design discipline* rather than as a more traditional academic research discipline.

Paper Overview

This paper is about the element of design as currently manifest in HCI research. The main argument which will be made is that there seems to be a major difference—or rather, two different *traditions* or *cultures*—in the way both researchers and practitioners in HCI seem to relate to design, but that this difference is not currently fully acknowledged in the field.

First, it will be discussed how and why the element of design as such has been made implicit in HCI conduct both theoretically and methodologically. Second, it will be shown and discussed how overlooking design as a key element of HCI might limit the way in which the field understands and deals with itself. By shedding light on design in HCI, we suggest and argue for a distinction between what appears to be two partly different kinds of traditions or cultures taking place within HCI—namely between the traditions of *design-oriented research* and that of *research-oriented design*—but which at the moment are often seen and treated as one.

DESIGN AND RESEARCH

'Design' is one of those terms that are intrinsically difficult to define, as it can denote many different things to different people: including design as a profession, as an activity, and—when design is used as a noun—as an artifact. Attempts to define design hence typically become too broad or too narrow. The definition used in this paper is inclusive rather than exclusive, and it emphasizes *design as a process in which something is created*—working out the form of something new, creating something which was not previously there [3, 7].

This process of giving form to something calls for a certain level of participation and commitment on behalf of the people that are involved in the design process. This metaphorically resembles the way carpenters in a direct way must be involved with the materials of carpentry; its physical tools, techniques, and materials. Without this direct involvement, something new cannot be brought into being, whether a baker, a software engineer, or an industrial designer. To design is hence about getting oneself involved in a conscious aim to create and give form to previously nonexistent artifacts, i.e. to make things work in the real world [1, 3, 5, 7].

What is Research?

'Research'—here used in a similar open fashion as a common name for all kinds of academic research activities—is yet another of those terms intrinsically difficult to define. A wide variety of activities take place at a typical research university, all of which operate under the name of research or science. Few—if any—theoretical and methodological foundations are shared across all institutional borders. It is even so that within a university, proponents of one discipline might not even recognize another discipline as scientific. So, rather than to define science and research in terms of use of specific methodological techniques, it makes more sense to concentrate on what it is both research and science in its most basic form tries to achieve: *to produce knowledge and to seek the truth*.

A BASIC DISTINCTION OF THE ROLE OF DESIGN IN HUMAN-COMPUTER INTERACTION

Design, as defined above, is an activity which seems to be involved in many different kinds of conducts, including HCI. In relation to HCI as research, as an academic discipline, design appears to be a quite special kind of activity difficult to compare to other available scientific methods and techniques. In this section, we will try to more specifically address design and its role in HCI by pointing out what we see as two different kinds of conducts in HCI. We will argue that there is a difference between *design-oriented research* and *research-oriented design* when it comes to the role, aim, and scope of *design*. And likewise, we argue, so is the role that *research* plays in these different conducts.

To briefly introduce these two notions, one can see design-oriented research—where research is the area and design the means—as a conduct which seeks to produce new knowledge by involving design activities in the research process. Here, design is used to drive and propel research.

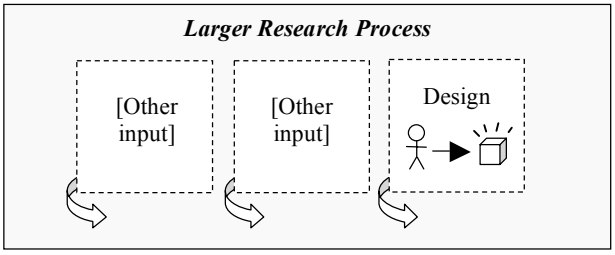


Figure 1: *Design-oriented Research*, i.e. research driven by design

In research-oriented design however—where design is the area and research the means—the creation of products, and in that process answering to the problems and real-world obstacles that are faced in that process, is the primary objective [3]. Here, research is used to drive and propel design.

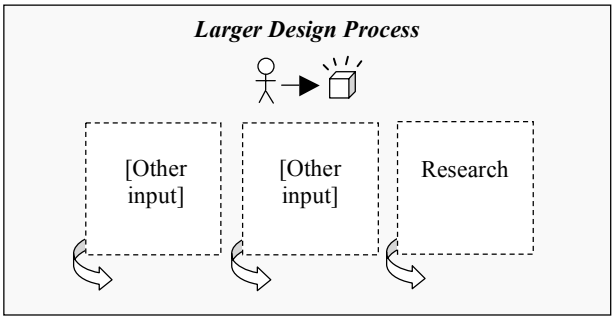


Figure 2: *Research-oriented Design*, or design that is driven by research

A first source of misconception with regard to these two concepts could be that one fails to recognize that design-oriented research and research-oriented design are in fact *both* conducts in which the researchers and/or designers as a part of what they do are involved in actual design activities themselves—the bringing forth of a new artifact. Studying designers at work (i.e. doing design studies as a by-stander) is hence something which is captured by *neither* of these two terms and an area of concern not treated here.

It is easy to object to the definition of these two terms given above on one level, because they appear to express more or less the same thing. This argument would have it that if research is used to propel a new design (research-oriented design) that particular design simultaneously propels further research (design-oriented research) and so on. Hence, design and research seem to fuel each other ad infinitum. Because of this, design-oriented research and research-oriented design are not dichotomies or even two separable conducts at all but rather two intertwined processes in support of each other. Or at least— which is another slightly more defensive objection—they might be seen as two conducts but they are often overlapping, and within a single project there may be people that see one's current project as a research project and those that think of it first and foremost as a design project.

While these are compelling arguments, one should however realize that this distinction—although presented as two separate conducts—forms a continuum along which it becomes possible to pin-point many current HCI projects. Talking about

them as two different conducts or traditions rather than as a continuum has rhetorical value however, in that a dichotomy is clear, easy to understand, provocative, and at least indirectly proposes that one has to make a choice. Presenting design-oriented research and research-oriented design as separate traditions is thus in some sense a reaction against the 'anything-goes' tendency in contemporary HCI.

But more importantly, this paper tries to look at the role of design in HCI on a level deeper than that (without aiming at offering a complete understanding of these issues, obviously). We will suggest what appear to be some inherent differences in perspective and tradition between the two conducts of design and research, which seem to render the idea of such trouble-free exchange between research and design problematic at a deeper level. This will also lead us to propose that the center of the continuum, i.e. in between design-oriented research and research-oriented design, is not a good or optimal position.

Yet another stumbling block for understanding these two terms, and an important one as well, is of course built into the way one chooses to define and think about research as well as design. If we take research for instance, the development of new theories, methods, techniques, research papers and even single lines of thought could be encompassed by a far-reaching definition of design—as they are also artifacts and products. So, according to this view, all research is design. On the other hand, designers make use of as well as produce a lot of new knowledge when they are involved in what Schön [9] describes as the dialogue with the design situation. Hence, it seems that if researchers are designers, then designers are researchers. Or are they?

There are at least three things to say in relation to this argument. First, we simplify this discussion in this paper by restricting ourselves to talking about design in the context of HCI as the activity of bringing forth artifacts such as sketches, mock-ups, prototypes, and other computational artifacts of some kind. Second, it is important to understand that this paper is not about whether or not it is a good thing to have trained industrial designers taking part in a HCI project. It probably is, but it is not the topic of this paper—what we do here is instead to look at the role of *design* in HCI, as a specific kind of *activity* that can be carried out by trained designers as well as by other people.

Third, a more fundamental problem with this line of reasoning that this work also attempts to tackle is that while it is correct on one level—that the designer and the researcher indeed both need to use and produce new knowledge and that they are both involved in a process where things take on concrete forms (along with bakers, philosophers, stay at home dads, pirates, just about anyone really)—it becomes a too broad and inclusive definition for our purposes up to the point where it looses meaning. Everything becomes design and everything becomes research too, at the same time. Design and research becomes intertwined; the same thing.

We argue that when looking into the issue of the role of design as a process in research, from a methodological and philosophical standpoint, one must dig deeper into some of the fundamental ideas of research as well as design to understand *that* they, *why* they, and *how* they differ. The main disparity between research and design from this perspective is hence not primarily that design only produces artifacts and research only produces knowledge, but rather that *designers and researchers are part of two different traditions or cultures*. At this slightly deeper level, we find that embodied within these two cultures there appear to be some quite incommensurable basic starting points and beliefs. In the following sections, we will look at some of these.

DESIGN-ORIENTED RESEARCH

Design-oriented research, what could be seen as the praxis and profession of many academic researchers in HCI, must ultimately have truth, the revealing of new knowledge of some sort, as its main objective. This is especially the case if this knowledge is of a kind that would not have been attainable if design—the bringing forth of an artifact (e.g. a research prototype)—had not been a vital part of the research process.

In some ways, this resembles the way natural scientists may only be able to test a theory by first designing the tools or instruments with which to study a proposed phenomena [3, 4, 6]. At times, the design of a new instrument also gives rise to new, wholly unexpected discoveries. But it is important to realize that design-oriented research in HCI also differs from natural science in several respects, not least in that the developed artifacts are typically placed in the life-world where they become used by people [1, 2].

People have a tendency to use artifacts in ways which were not intended and are not controlled by the designer. Mixing artifacts with people also brings the phenomenon of 'now' into play. This is to say that while natural scientists develop instruments to be used in a lab setting, consciously abstracting away much of the gore of the real world, the design-oriented HCI researcher's instruments become used by real people—which inevitably carry with them meanings, presumptions, cultural and societal values and beliefs, and so on. Hence, in this respect design-oriented HCI research is more of a social sciences discipline—relating to work in ethnography, phenomenology, and sociology—than it is related to the natural sciences. Design-oriented HCI research hence inevitably means dealing with issues of people, which entails also dealing with issues of organization, culture, and society; i.e. dealing with the 'now', the volitions, structures of power, structures of gender, meanings, assumptions, presumptions, beliefs, and worldviews, with which a natural scientist usually does not deal. Studying an artifact to gain some new knowledge is hence as much a question of understanding people, context, and 'now'—i.e. looking into and trying to grasp the complex interplay between people, technologies, and society and how this 'now' changes when a new artifact is introduced—as it is to develop and study technology.

In design-oriented research, the knowledge that comes from studying the designed artifact in use or from the process of bringing the product into being should be seen as the main contribution—the 'result'—while the artifact that has been developed becomes more of a means than an end.

Typically, this implies that the artifact that is developed does not need to encompass all services, functions, and level of completeness that a final 'product' would need to embrace. The design-oriented researcher hence works with sketches and prototypes of different kinds, depending on what aspects are investigated. Hence, sometimes a brick could be used to sketch a mobile phone; a piece of paper may be used as a screen; and a wholly faked interface may be controlled not by an application but by an experimenter hiding behind a curtain. This implies that the artifact takes on a philosophically interesting role as a kind of middle ground between a thought experiment and a real thing. Many of the sketches and prototypes that researchers develop are too anything but convincing products. They may be wholly or partly fake; if implemented, they may be unstable and lack some expected functionality; as well as they in the area of HCI are often, to put it mildly, modestly aesthetically pleasing. Notwithstanding, they need to be neither of these, as they are not products per se—they are means to get at knowledge. This is possible because in design-oriented research, it is the knowledge that comes from studying user behavior and user experience that

one is after, not the artifact itself. And in this conduct, it is from the knowledge that is generated that one may commence on building new artifacts, even products, not from the sketch or the prototype in itself. This knowledge should, ideally, be if not universal at least general enough to say something about a range of phenomena.

One should also stress that design-oriented research typically includes what Schön [8, 9] talks about as 'problem setting' as an important part, i.e. the possibility of exploring possibilities outside of current paradigms; whether these are paradigm of style, technology, or economical boundaries. Design-oriented research hence strives to question the initially recognized limitations of a problem description. It is able to do this because the guarantor of the design effort—its 'client' in design language—is the research project in which it is situated, it is not a paying third party, nor in fact even one's end users.

RESEARCH-ORIENTED DESIGN

In contrast, research-oriented design is a term that is believed to better illustrate the relationship that consultants, applied researchers, and designers from industry typically hold in relation to design in HCI.

In Research-oriented design, the artifact is the product or primary outcome; it is regarded as the 'result' of their efforts. Obviously—which is an expected critique to this distinction—this conduct also generates knowledge of various kinds. The argument is neither that this conduct would not generate knowledge; it is rather that it is not what is emphasized and that the difference in purpose of the design activity generates different kind of knowledge. This knowledge is not universal or generalizable to a broad range of phenomena. Rather, this knowledge is particular to its character.

In research-oriented design, the artifact also takes on a much clearer and explicit role in what the designers stress as their contribution. Another sign of research-oriented design is the level of completeness and styling of the resulting artifact. Here, the artifacts often come in the shape of final 'products', rather than as sketches and prototypes.

Yet another quite important difference between these conducts is that research-oriented design most often has problem solving within some area as a characterizing component, i.e. that this conduct is often carried out within a fixed and known paradigm. This is because in the world of research-oriented design, the designer's main guarantor, or customer, is typically a third party that puts up restrictions of different kinds and expects certain results (not to mention certain sales). While research-oriented design may relate to, seek influence in, and even contribute to research (i.e. the generation of knowledge) in different ways, it has the production of new artifacts as its main motivation and goal.

DISCUSSION

From the distinction between research-oriented design and design-oriented research, it is possible to regard most work carried out within HCI as having a position along a single continuum:

Design **Research**

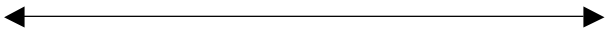
Research-oriented Design	*Design-oriented Research*
Real	True

While the continuum's left end, design practice's, main concern is to create and change, i.e. to make things work, it needs to be real. Design practice—or research-oriented design—must take into account all aspects of life that may interfere with the goals of creating and changing. It needs to deal with 'real' things such as commercial aspects, cost, time to market, sales figures, political interest, user preference, etc. Design-oriented research on the other hand, should by means of design seek to understand and explain *the truth*, which is not necessarily real.

A simple example may enlighten this very important difference in *perspective* of these two conducts. Computer keyboards have used the QWERTY layout ever since the days of the early typewriters, where the layout was designed to separate frequently used keys to prevent mechanical jams rather than to provide efficient user input of text. Research (which seeks the truth) shows that many other layout models for keyboards, such as the Dvorak layout, significantly increases typing speed. Alternative layout models for keyboards have done very badly in the market however, so designers of keyboards (which need to be real) keep the QWERTY layout. The main point here is that it is not negligence on the part of keyboard designers nor is it a matter of not knowing the facts that is the cause. Rather, the difference is one of fundamental *perspective*. While science seeks the truth (*alternative keyboard layouts provide more efficient input*), design needs to be involved with the real (*QWERTY keyboards are what sells*).

According to the basic continuum provided above and using it as a basic model for further exploring the relationship between science and design, it seems possible to further distinguish some characterizing aspects that differentiate the two conducts.

Design **Research**



Research-oriented Design	*Design-oriented Research*
Real	True
Judgment and intuition	Analysis and logic
Client	Academic peers

In a design project, research-oriented or not, decisions are often based on *intuition* and *judgment* [7] For instance, the form given to a specific element of a logotype is due to the designer's judgment in the specific situation—based on his or her competence, intuition, experience, taste, knowledge of the context and the client, and so on—in a very complex process where the designer moves back and forth between considering details (e.g. exact coloring, specific shapes, and font kerning) and considering larger wholes (e.g. flow of characters, the logotype's whole gestalt, and even very big issues like branding and corporate identity).

This is quite dissimilar from science, where decisions never should come out of the researcher's judgment, intuition, and taste [7]. Nonetheless, there are probably a lot of decisions taken in science every day that are partly or fully based on judgment, intuition, and taste, but in theory these cannot (by definition) be regarded as scientific.

Moreover, all kinds of design work can be characterized as an activity which is 'in service of' a client [7]. Academic research which has a similar 'client'—which is sometimes the case within medicine particularly—is typically quite controversial. Some would even argue that research cannot have a client in the same way as design has, as that would influence and limit the research process to such an extent that it would cease to be true and tend to drift into the real. Hence, the role of the 'guarantor', i.e. the body guaranteeing the quality and validity of the work, is typically quite different between design-oriented research and research-oriented design. Whereas the letter emphasizes the role of the client in this process, design-oriented research must lean on scientific peer reviewing for quality assessment.

Along this continuum, which clearly is a gross simplification of reality (as any other model), it is possible to come up with a number of other important differences between research-oriented design and design-oriented research based on the discussion above, but for the purposes of this paper the ones which have been discussed above provides a reasonable cause.

Why Is This Distinction Important?

Given the discussion above, there seems to be at least three answers to the question of why this distinction is thought important enough to consider.

First, this distinction was originally made to provoke a discussion to take place within HCI as to what is the role and nature of design in the field. This discussion, suggested at CHI 2003 [3], had at that point been largely missing. After the publication of the original paper, a workshop at CHI 2004 was dedicated to these issues and another workshop is planned for INTERACT'05. Hence, in this respect the original purpose has been at least partially successful.

Second, while research-oriented design and design-oriented-research appear to be two different ways in which design shows up in HCI—and likewise, HCI shows up in design—they are rarely acknowledged as separate types of conduct within the field. The problem with this black boxing or anything-goes attitude is that these different conducts among other things also require quite different kinds of quality measures and success criteria. Not least is this obvious in the reviewing process for international conferences and journals. While design-oriented research projects needs to be valued according to the quality of the knowledge that has been generated, and success is when some new knowledge has indeed been created, research-oriented design projects need on the contrary be assessed according to some other scheme. Commercial success or at least such potential is clearly one alternative, but probably not enough. For help, HCI could turn to design to seek influence in how it assesses work, in fields like industrial design, architecture, possibly even art, literature, and the movie industry.

A straightforward way of dealing with these issues would be to regard design-oriented research and research-oriented design project as *different contributions categories*, with their reviewing systems. This process has already started with the introduction of submission categories such as "Design Cases" to many conferences. For these categories, success criteria may include commercial real-life (while not necessarily true) factors, such as increased sales, branding, good-will, and so on.

Third, one of the main arguments with this distinction, eventually, is that *the difference in tradition and basic perspective* between research and design must be recognized and made explicit, even if both will continue to take place under the cover of HCI. A contemporary problem in HCI is that academic researchers at times seem to be more interested in conducting research-oriented design than in design-oriented research. While design-oriented research should have the larger HCI community as its guarantor and peers—i.e. where the quality of work is judged by peer reviewing—it is easy that the guarantor of such an effort rather becomes the commercial organization that may provide one's funding, and one may find oneself working for, and not with, these organizations.

It is important to realize that what is suggested is not a general distinction of value—i.e. that we would suggest design-oriented research to be a 'better' or more 'elevated' conduct than research-oriented design. It is rather a suggestion to recognize these as *different kinds of conducts*—with different kinds of ingoing limitations, possibilities, scopes, intentions, motivations, and success criteria—that we find in contemporary HCI.

This is also why we argue that the center of the continuum between research-oriented design and design-oriented research is not an optimal position for most HCI projects. It is not so because it is vital that one is clear about what it is one wants to do; what kind of conduct one is involved in; what one's goals, limitations, and boundaries are; and with what and to whom it is one wishes to contribute. It might simply be too much to both do good design, with a happy client—answering to all the real-world challenges one will face—and good research, with happy peers, i.e. answering to being true over being real.

REFERENCES

1. Coyne, R. Designing Information Technology in the Postmodern Age, MIT Press, Cambridge, MA, 1995.
2. Ehn, P. Work-oriented Design of Computer Artifacts, Arbetslivscentrum, Falköping, Sweden, 1988.
3. Fallman, D. Design-oriented Human–Computer Interaction, Proc. Conference on Human Factors in Computing Systems, CHI 2003, ACM Press (2003), 225–232.
4. Ihde, D. Instrumental Realism, Indiana University Press Bloomington, IN, 1991.
5. Jones, J. C. Design Methods, Van Nostrand Reinhold, New York, NY, 1970.
6. Kuhn, T. S. The Structure of Scientific Revolutions, University of Chicago Press, Chicago, IL, 1962.
7. Nelson, H. & Stolterman, E. The Design Way: Intentional Change in an Unpredictable World, Educational Technology Publications, New Jersey, NY, 2003.
8. Schön, D. The Reflective Practitioner: How Professionals Think in Action, Basic Books, New York, NY, 1983.
9. Schön, D. Designing as Reflective Conversation with the Materials of a Design Situation. Knowledge-Based Systems, 5, (1992) 3–14.