Designing Interactions

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Designing Interactions

Design is the conception and planning of the artificial.

Richard Buchanan, 1995

What Is Design?

Dilbert cartoons about design

- *Top* Process
- *Bottom* Intellectual property

Cartoons by Scott Adams, courtesy of United Media

IN THE FOREWORD, Gillian Crampton Smith summarized the design of interactions as being about shaping our everyday lives through digital artifacts—for work, play, and entertainment. Her essay gives us a very good understanding of the special attributes of interaction design when we compare it to other design disciplines, and if we are already fluent in our understanding and appreciation of design. However, it assumes that we know the answer to the question, What is design?

If you ask a designer for a definition of design, you are often answered with a smirk, a joke, or a change of subject, as design is notoriously difficult to define, and designers are much more at ease learning and knowing by doing than they are explaining. In 1995 the British Design Council put out a little book called "Definitions of Design," which was arrived at by asking fifty people—designers, children, and others—to give their personal definitions. The result was surprisingly uninformative, but entertaining. Here are four examples:

I believe design is an intention, purpose, plan: and that good design is therefore by inference, where such plan has been well conceived, well executed, and of benefit to someone.
Milner Gray, Designer

Design is all around us—either we control it—or it controls us.
Wally Olins, Chairman Wolff Olins

Design is the difference between doing it, and doing it right.
Mark Fisher MP, Co-chairman, All-Party Group on Design

With art—if you like, you can be really weird. But in design you have to think about what other people will like.
Ghisli, age 10

These quotes, like an impressionist painting, give you a sense of what is meant when you look from a distance, but they are not satisfying as definitions. This vagueness remains an accepted fact of life for design. If you visit the current Web site of the British Design Council,[1] the rhetorical question, What is design? is posed, and the answer given is, "Design is everywhere—and that's why looking for a definition may not help you grasp what it is."

The most satisfying definitive description of design that I have encountered is the statement by Charles Eames in conversation with Madame Amic. Here are the questions and answers from that conversation that seem particularly relevant to designing interactions:

Q. What is your definition of "Design?"
A. A plan for arranging elements in such a way as to best accomplish a particular purpose.

Q. Is design an expression of art (an art form)?
A. The design is an expression of the purpose. It may (if it is good enough) later be judged as art.

Q. Is design a craft for industrial purposes?
A. No—but design may be a solution to some industrial problems.

Q. What are the boundaries of design?
A. What are the boundaries of problems?

■ Charles and Ray Eames with a model of the exhibition "Mathematica," 1960

Q. Does the creation of design admit constraint?
A. Design depends largely on constraints.

Q. What constraints?
A. The sum of all constraints. Here is one of the few effective keys to the design problem—the ability of the designer to recognize as many of the constraints as possible—his willingness and enthusiasm for working within these constraints—the constraints of price, of size, of strength, balance, of surface, of time etc.; each problem has its own peculiar list.

Q. Does design obey laws?
A. Aren't constraints enough?[2]

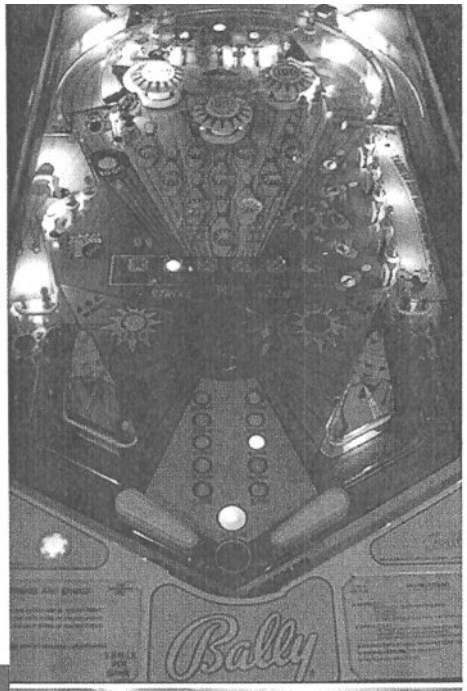
Core Skills of Design

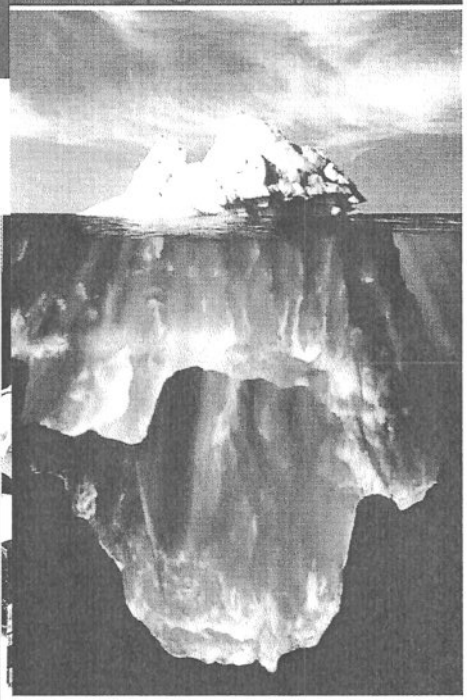
CHARLES EAMES WAS right about constraints; they are key to understanding design. Scientific disciplines rely on the ability of the practitioner to become expert in a narrow field, learning how to focus by excluding extraneous information and thus learning more and more about less and less. Here are five core skills of design:[3]

1 To synthesize a solution from all of the relevant constraints, understanding everything that will make a difference to the result
2 To frame, or reframe, the problem and objective
3 To create and envision alternatives
4 To select from those alternatives, knowing intuitively how to choose the best approach
5 To visualize and prototype the intended solution

I describe a process that includes this list at the end of the chapter. The five skills can be applied in the listed order, but the process is iterative rather than linear and does not necessarily follow a sequence. The most productive approach is often apparently unstructured, where members of the design team may suddenly dive into a prototype, renew some research activity, look

Good design comes from the successful synthesis of a solution that recognizes all the relevant constraints, and the nature of the constraints defines the difference between design disciplines.





- Pinball machine
- The mind is like an iceberg

at people afresh, reexamine some of the constraints, or create new alternative concepts. The process does not look like a linear system diagram, nor even a revolving wheel of iterations, but is more like playing with a pinball machine, where one bounces rapidly in unexpected directions.

Tacit knowledge

Design thinking harnesses tacit knowledge rather than the explicit knowledge of logically expressed thoughts. Designers operate at a level of complexity in the synthesis of constraints where it is more effective to learn by doing, allowing the subconscious mind to inform intuitions that guide actions.

Perhaps the mind is like an iceberg, with just a small proportion of the overall amount protruding above the water, into consciousness. If we operate above the water line, we only have a small volume to use, but if we allow ourselves to use the whole submerged mass, we have a lot more to work with.

If a problem has a large number of constraints, the conscious mind starts to get confused, but the subconscious mind has a much larger capacity.[4] Designers have the ability and the training to harness the tacit knowledge of the unconscious mind, rather than being limited to working with explicit knowledge. This makes them good at synthesizing complex problems with large numbers of constraints; it also makes them bad at explaining or defining what they are doing or thinking. They will describe process and results because they are not consciously aware of their own rationale.

This is the reason that design education relies on a project-based approach of "learning by doing." The normal academic structure of learning is based on the conscious mind. You learn by understanding, with information that can be explained, elucidated and justified. A PhD is earned by contributing to the body of knowledge, by which we mean explicit knowledge. Designers learn by an atelier process, working on projects; the teacher advises on process as the designs are developed and criticizes the result, but neither teachers nor students are asked to explain the reasoning. When a problem is complex, with lots of constrains, it is much easier to recognize a good solution than to explain it.

These are typical evaluation criteria for a student design project:

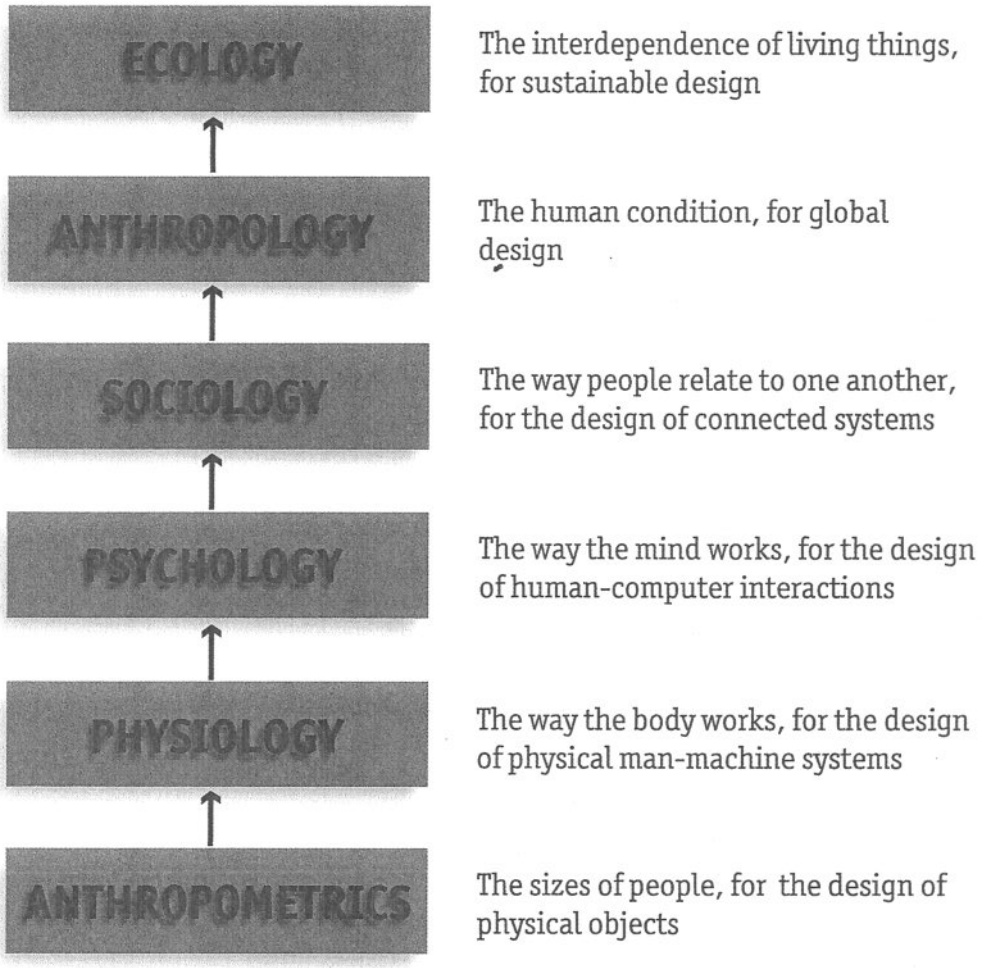
1 Creativity/innovation
2 Aesthetics/quality
3 Human factors/values
4 Performance/technology
5 Completeness/presentation

Design disciplines

The nature of the constraints defines the design discipline. If you ask why people choose to be product designers, graphic designers, or architects, the answer will be less about their abilities and talent than about the kinds of constraints that they like to work with. Did they like everyday things, two-dimensional images and typography, or the built environment? Once you have been through a long educational process of projects and moved on to expand your experience in practice, it becomes more and more natural and normal for you to collect and understand the appropriate constraints for your design problem. Product designers know about how people relate to physical objects and how to manipulate metals and plastics. Graphic designers learn about how we see images and understand information and how to manipulate marks on paper. Architects become expert in the way we relate to space and learn how to develop structures for people to inhabit.

Designers are both enabled and controlled by the constraints that they learn about and come to understand; they are fluent with their tacit knowledge, in their own media, and in the contexts that they are familiar with and understand. This makes it difficult to develop a new design discipline in response to new kinds of constraints, but design problems are changing all the time. In the introduction I told the story of my own experience facing the complexities of designing a laptop computer and how this triggered my effort to start a new design discipline that we ended up calling "interaction design."

I think it is worth looking at the need for this new discipline as a step on a hierarchy, which forms a continuing trend of increasing complexity.



This hierarchy shows the increasing complexity of the relevant constraints, if you consider each type of design problem from the point of view of the user. The hierarchy is based on the type of human factors that is relevant to the design context in each level of complexity, starting with the simplest at the bottom.

A Hierarchy of Complexity

When I graduated from college as an industrial designer in 1965, I expected to spend my life designing mass-produced objects to be manufactured in metals and plastics. Thinking about what people want from an object was a predominant consideration for the design, but there was an assumption that the most complex aspect would be to think about the subjective and qualitative values that would help the designer to create an appropriate aesthetic, so most of the research into what people wanted was aimed at discovering those subtle values that could inform an intuitive design process. The overall complexity came from synthesizing this understanding with all of the functional attributes of the design, such as performance, assembly, manufacturing, price, distribution, marketing and so on. These constraints demanded collaboration between experts in all of the fields that make up a multidisciplinary team, but with the roles clearly understood, individuals could operate successfully in separate disciplines, as long as they were willing to work together, even though failures were often encountered in companies when communications between discipline based departments were not strong enough. Designers were expected to be fluent with anthropometrics, as that was needed for the design of objects.

Anthropometrics—the sizes of people

For the design of physical objects

The constraints are complex enough to demand the core skills of design, but the problems are well understood and have been evolving slowly since industrial design emerged as a new discipline in response to the Industrial Revolution. Designers have to understand basic human factors, but it is reasonable to expect that anthropometrics, or the sizes of people, are the most relevant. Thanks to the human factors work at the office of Henry Dreyfuss, anthropometric information for the designer is easy to find, by referring to the book *The Measure of Man*,[5] or the reference cards in *Humanscale*,[6] which present the salient dimensions of people of different statures, gender, age, and ethnic background.

Physiology—the way the body works

FOR THE DESIGN OF PHYSICAL MAN-MACHINE SYSTEMS

The next level of complexity comes when you need to consider actions as well as objects. If the design context includes what the person is doing as well as the things that they are using, the constraints need to include the way the human body works, or physiology, as well as the sizes of people. When you are designing a chair for work, you must consider the danger that long periods of sitting may cause back strain, which demands that you understand the structure of the human spine and the muscles that support it; this is not a constraint when you are designing a casual couch or a bar stool. When you are designing a racing bicycle, you need to know about the way the frame can be fitted to the body to yield the maximum power. When you are designing a keyboard for long hours of typing, you need to understand about tactile feedback for the keystrokes, and repetitive stress for the carpal tunnels.

Once we delve into the specifics of an active context like this, the designer may find that the issues are too complicated to understand and act on intuitively; this is when the partnership between designer and a human factors specialist, in these examples a physiologist, becomes essential. The basic complexity of design constraints still demands subconscious synthesis as well as collaboration between everyone in the multidisciplinary team, but a special connection is needed between designer and physiologist, to allow them to be innovative in the human aspect of the solution.

Cognitive psychology—the way the mind works

FOR THE DESIGN OF HUMAN-COMPUTER INTERACTIONS

Enter the chip! Electronics started with computers, gradually invaded everyday things and places, and are now almost everywhere. This is where we pick up on my stories of designing the laptop and the digital watch, as it is more and more difficult for the designer to understand intuitively about people and what they need and want, as the context is no longer just physical and biomechanical.

When you are concerned about the constraints that will matter to people when you are designing computers and things that are enhanced by electronic behaviors, you need a much more rigorous understanding of the way the mind works. When the design context includes machine intelligence as well as human intelligence, the design team will benefit from the expertise of a cognitive psychologist and will also need designers who are skilled at designing interactions. At this point in the hierarchy, we have arrived at the contents covered in the first five chapters.

Sociology—the way people relate to each other

FOR THE DESIGN OF CONNECTED SYSTEMS

Connecting everything together caused the next leap in complexity, when the Internet made connectivity a part of many design problems and solutions. Communications technologies like telephones and broadcast media have been with us for long enough to settle down and become familiar, but the sudden explosion of the Internet added the potential of connectivity to objects and services. Sociologists can help members of a design team understand the implications of this and to operate in the more abstract realm of designing services, where you are affected more by relationships among people as well as between users and objects or interfaces. Although services have been around for a long time, the sudden expansion of technology enabled services—and hence service design as a discipline—is still very new. We can see this by the freshness of the ideas expressed in chapter 6, "Services."

The addition of the expertise of sociologists to a design team is especially important when the nature of the constraints is systemic. When we are designing connected systems of products, services, and spaces, which are used in real time, the brain of any designer who tries to absorb all of the constraints is likely to explode. We are better equipped to face the complexity as an interdisciplinary team, with a collective consciousness, and the ability to create designs as a group or team rather than as individuals.

Forget your ego, and leave your discipline behind. Let's do this together!

Cultural anthropology—the human condition

FOR GLOBAL DESIGN

Any designer who has developed a product for a global market has had to face the complexities that come from cultural variations. Some people eat with chopsticks and others with cutlery. And colors have strong symbolic meanings that are specific to particular societies. Cultural anthropologists can help people in a development organization understand the nature of cultural differences, which probably will not be intuitively obvious to them without some direct experience of the variations. There are also variations of culture within a single market, as different groups of people have unique anthropological characteristics, based on their occupation, background, or interests.

Ecology—the interdependence of living things

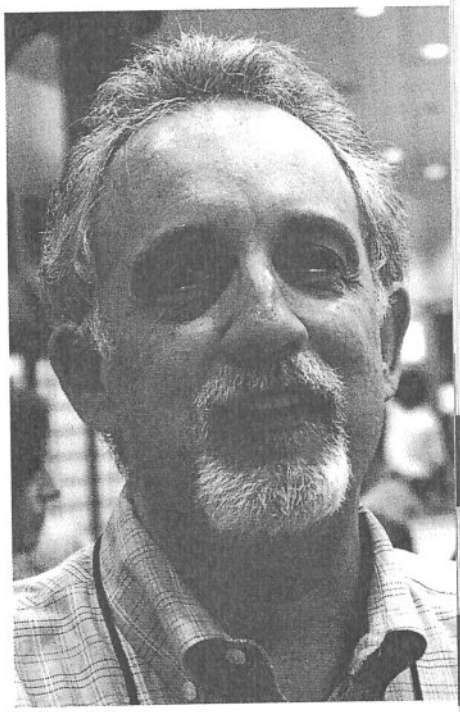
FOR SUSTAINABLE DESIGN

At the top of the hierarchy is ecology, where designers need to understand the issues that will affect the environmental condition of our planet as well as the interconnected social and economic systems that we need to sustain. At first thought, sustainable design seems to be in direct opposition to the nature of the consumer society that industrial designers and interaction designers strive to enhance, and is thus a challenging subject for designers to come to grips with. Organizations and processes are emerging that allow the design team to understand and analyze the implications of their designs on sustainability, including the use of materials, energy, and the full lifecycle from "cradle to cradle."[7] This knowledge is still immature, making design for a sustainable planet an intuitive rather than exact science so far. The designer can intuitively synthesize a complex set of requirements, but the right information has to be there to draw on. Sustainability is still at the level of complexity where the science is not yet well established.

Why a Design Discipline?

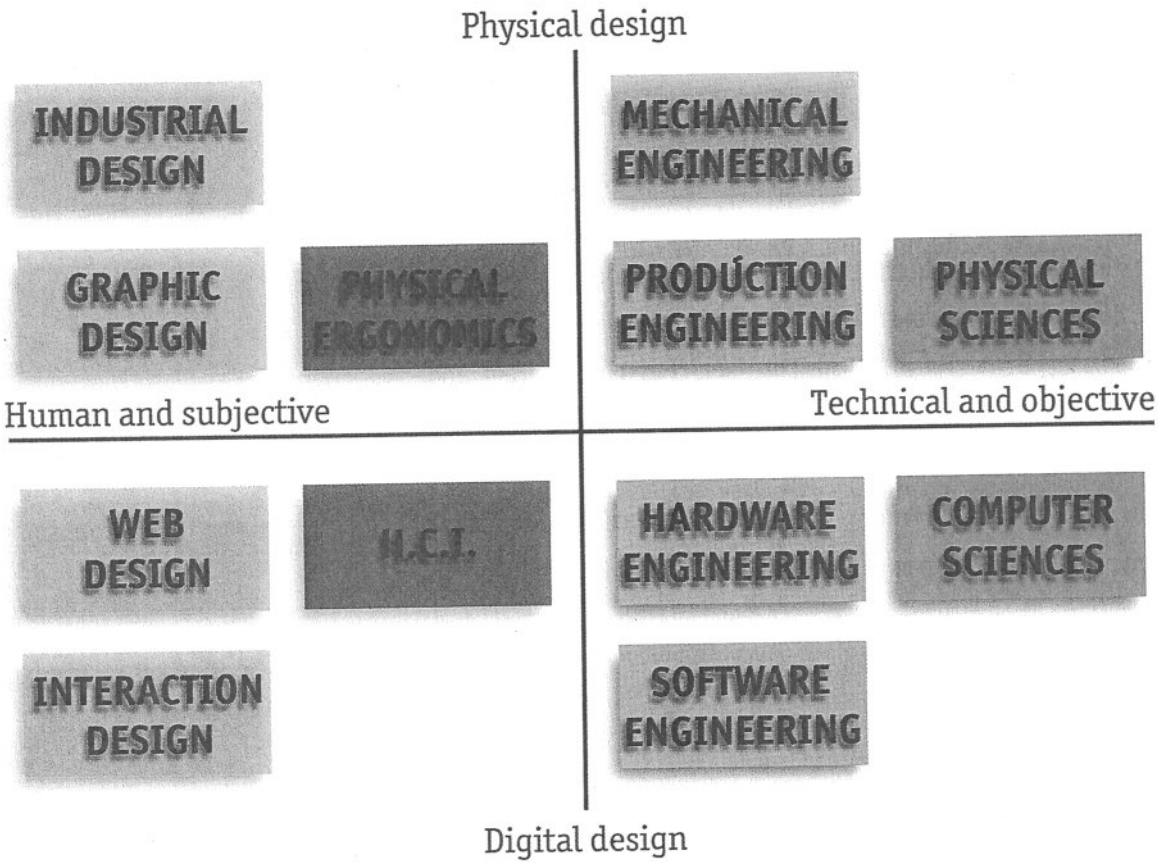
When you go to design a house, you talk to an architect first, not an engineer. Why is this? Because the criteria for what makes a good building fall substantially outside the domain of what engineering deals with. You want the bedrooms where it will be quiet so people can sleep, and you want the dining room to be near the kitchen. The fact that the kitchen and dining room should be proximate to each other emerges from knowing first that the purpose of the kitchen is to prepare food and the dining room to consume it, and second that rooms with related purposes ought to be closely related in space. This is not a fact, nor a technical item of knowledge, but a piece of design wisdom.

Mitch Kapor, "A Software Design Manifesto" (1990)[8]



Mitch Kapor ■

DESIGNERS GET THE love because we control the part that people want. I feel privileged to be a designer, because people like what I do (if I do it well). I also feel a little embarrassed to accept the accolades and the appreciation, as I know that I rely on all the other people who contribute the information that makes the successful synthesis possible. Mitch Kapor is right that designing a dream house is the output of design wisdom rather than technical knowledge. You enjoy your favorite article of clothing because it seems to be designed just for you, and it makes you feel good to wear it. I have a relationship with my favorite objects based on their aesthetic qualities more than their utility or price/performance ratio.



The diagram shows four quadrants, with the horizontal axis dividing human and subjective qualities from those that are technical and objective, and the vertical axis separating physical design contexts from those in the digital realm. We can position the development disciplines in four columns: the design disciplines, human sciences, engineering disciplines, and technical sciences. We see the need for interaction design as a discipline that can create solutions with human and subjective qualities in a digital context.

Designers rely on all the other disciplines, in that everything else has to work before design has a chance. First you have to be able to afford it, whether it is a house, a car, or a piece of software. Then it must perform: the building withstands the wind and rain; the car takes you where you want to go; and the software is stable. It must be useful, sheltering us, transporting us, and achieving the goals of the program. It must be usable, with stairs of the right tread sizes, steering wheel of a familiar size, and software that we can understand. Only when all of these attributes are already satisfied, after much effort from all of the contributors from the various disciplines, will the question of delight become important. Design wisdom has the power to please, but only in a context where the demands of all of the constraints are obeyed.

It can all go horribly wrong, of course, because the risks of living in the subconscious are so high. Operating at a subjective level, it is difficult to tell whether we are synthesizing the right set of constraints or whether the information is accurate. Your architect may be so interested in the magnificent material for the kitchen counter that the wisdom of space is lost, a difficulty that makes it risky to commission the design of your dream house, rather than buying one that already exists. At least with a car you can take it for a test drive as well as read the consumer reports. Interaction design is so new that there is very little established wisdom so far, and the chances are still low that you will be able to find a solution that satisfies all of those functional constraints, let alone give you aesthetic pleasure.

Where Does Interaction Design Fit?

A NARROW DEFINITION of interaction design is: "The design of the subjective and qualitative aspects of everything that is both digital and interactive, creating designs that are useful, desirable, and accessible." The designer is working in the artificial context of bits, pixels, input devices, users' conceptual models, and organizing metaphors. This is the version of interaction design that I

practice—that I needed to learn in order to move up the hierarchy of complexity. This is a narrow version of interaction design, related to the experience and background of other design disciplines that deal in aesthetics and qualitative values, like industrial design, graphic design, and architecture. It is the equivalent of these disciplines in that the first concern of the designer is the values of the people who will use the design—the aesthetics, subjective and qualitative values, and human factors. The designer creates a solution to give pleasure and lasting satisfaction, and hence to fit the market, business, and social requirements.

There is another, much broader, view of interaction design: "The design of everything that is both digital and interactive." It includes the design of all the interactions that are enabled by digital technology, whether by computers, chips embedded in products or environments, services, or the Internet. This broad view of interaction design includes the work of human-computer interaction (HCI) professionals, computer scientists, software engineers, cognitive psychologists, sociologists, cultural anthropologists, and designers. It includes everyone who has the knowledge and tools that allow them to "create or contrive for a particular purpose or effect"[9] in this digital context, sometimes as an individual, but usually as part of an interdisciplinary team.

A narrow definition of interaction design is: "The design of the subjective and qualitative aspects of everything that is both digital and interactive."

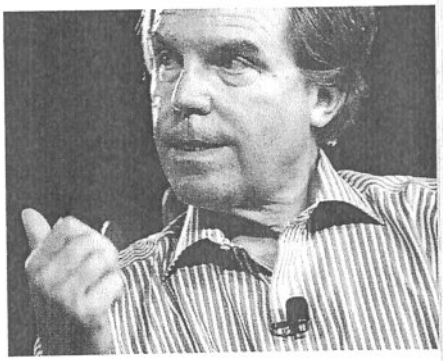
A broad definition of interaction design is: "The design of everything that is both digital and interactive."

It is natural for people outside the design and development disciplines to see this broad view, as they react to the resulting designs in terms of the experiences they have as users of interactive software, devices, and services. If they think about the design at all, they are likely to see the whole result, as they don't understand the individual roles of particular disciplines. This book is structured around this inclusive vision of what interaction design can be and has presented the thinking of many experts in the field from very varied backgrounds, chosen for their contributions rather than their closeness to my personal view of the discipline.

Is Interaction Design Here to Stay?

The decades ahead will be a period of comprehending biotech, mastering nature, and realizing extraterrestrial travel, with DNA computers, microrobots, and nanotechnologies the main characters on the technological stage. Computers as we know them today will (a) be boring, and (b) disappear into things that are first and foremost something else: smart nails, self-cleaning shirts, driverless cars, therapeutic Barbie dolls, intelligent doorknobs that let the Federal Express man in and Fido out, but not 10 other dogs back in. Computers will be a sweeping yet invisible part of our everyday lives: We'll live in them, wear them, even eat them. . . . Yes, we are now in a digital age, to whatever degree our culture, infrastructure, and economy (in that order) allow us.

Nicholas Negroponte, MIT Media Lab, 1998[10]



Nicholas Negroponte ■

We seem to be well on the way toward fulfilling these predictions that Nicholas Negroponte describes with such colorful images. Even if you doubt that we are already in a digital age, it is clear that we are marching relentlessly toward a condition where everything that can be digital will be digital.[11] What does this mean for interaction design?

In June of 2002 I was in London at the time of the display of work of the graduating master's students at the Royal College of Art, and I was looking at the projects from the interaction design department. I was impressed by the fact that most of them were both digital and physical; the students were designing smart

objects rather than computer-based software. I was moving from the work of one student to the next, looking in some detail at the individual designs. Suddenly I looked up at the whole room, and discovered to my surprise that I had drifted into the area occupied by the projects from the industrial design department, never noticing a difference in the nature of the work. Just as the interaction designers were designing smart objects, the industrial designers were designing objects that were smart, finding it natural to include electronically enabled behaviors. It made me wonder if this was evidence of the beginning of the end of interaction design as a separate discipline.

Practitioners in the technical design disciplines adopt new technologies earlier than their counterparts in the human disciplines, as is explained by David Liddle in chapter 4, "Adopting Technology." This would lead one to expect that a similar migration might have already happened in engineering. Computer science emerged first and gave rise to new disciplines for the design of hardware and software. Eventually every engineer expected to use electronics and software in the natural course of development, so engineering education included learning about circuits and programming languages. However, this did not mean that the new disciplines of hardware and software design merged back into the traditional engineering design disciplines, but rather that all aspects of engineering design make use of technology, and all engineering designers can operate to some extent in the digital realm. It seems likely that a parallel to this will exist in the human disciplines, with all designers thinking it natural to include digital solutions as aspects of their designs, accepting the constraints and opportunities offered by new technologies. At the same time there will continue to be interaction designers who have a more in-depth knowledge and expertise about designing interactions and remain the experts in the field. I think interaction design is here to stay.