

CHAPTER 1: INTRODUCTION

The term *interaction design* is now more commonly heard than ever before yet our current understanding of the field is incomplete. The aim of interaction design is to create and shape computationally interactive systems and artifacts for human use. Despite the term's growing popularity, our knowledge of the making of computational systems and artifacts is limited since our current understanding of interaction design is not sufficiently guiding research and education in the field. The simple reason for this is that current theories of interaction design have overlooked or ignored issues of *design* and the *designer* in conceptualizing the term. As a consequence, interaction design and especially interaction design research is under-defined. This minimizes our ability to understand how best to create interactive systems.

Interaction design is both a nascent field and an interdisciplinary one, and the field and research communities have yet to develop a mature research program. Having emerged from different disciplines, progress in the study of interaction design has been slowed by the disciplinary boundaries and differences in the epistemic cultures of design, science, and social sciences. Human-computer interaction (HCI) is particularly important in this regard, as it has had a great impact on theorizing interaction design. HCI has roots in psychology, computing science, and engineering, and these perspectives have dominated the study of

interactive systems and artifacts. HCI is commonly viewed as the study of interaction between people and computers, whereas interaction design can be seen as the practice of creating interactive computational artifacts for people. There is significant and beneficial overlap with the concerns of both HCI and interaction design. The influence of HCI has positively shaped interaction design in ways that other design disciplines may benefit, e.g. user-centered design. However I will later discuss how it has also eclipsed and obscured distinct interaction design contributions. Additionally, past design research traditions have the potential to contribute to theorizing interaction design, yet to date these traditions have had little influence on conceptualizing the field. It can be argued that while issues of interaction continually need to be debated and discussed, the picture will always be incomplete without a greater understanding of the role of design and designers in interaction design and by extension HCI.

The importance of contributing to a fuller understanding of interaction design is that this eventually leads to better design of computational artifacts and systems. The role that theory plays in a design discipline is that of a normative theory that informs new routines of practice, creativity and the fostering of environments that lead to beneficial design outcomes. Ideally, a design theory both informs human actions in design and articulates human values in design. In the context of interaction design, a theory helps to answer the questions of how we design, how we might design better, and what can we learn in the design of computational artifacts and systems?

This thesis will address these questions by way of a pragmatic inquiry of interaction design. Central to this approach is the framing of interaction design as a pragmatic experience, instances of which take the form of design inquiries. The underlying pragmatism shifts interaction design from a user-centric formulation to a designer-centric

formulation. The measure of the thesis will be the degree to which the theory provides a fuller account of interaction design and the knowledge it generates, creates a better understanding of interaction design's relationship to complementary fields like HCI, and constructively guides interaction design research and education.

The remainder of this chapter will introduce and describe the study. I will begin by discussing current (mis)formulations of interaction design that ultimately do not serve the discipline as theoretical positions. I then examine the role of theory in interaction design to help establish criteria to follow in the rest of the thesis. I conclude the chapter by providing an overview of the study, its research and disciplinary context, and a roadmap for the dissertation.

1.1 The visionary and status quo versions of interaction design

This thesis asserts that interaction design is currently an under-defined concept, a fact obscured by current views of the field (Sharp et al., 2006 , Kaptelinin et al., 2006 , Cooper et al., 2007). The result is an undervaluation of interaction design research that results in less published results and impact on interaction studies discourse. Some may well argue the contrary, however there is evident fragmentation and gaps in understanding interaction design with respect to teaching as well as research. In my own experience, as an educator and researcher in interaction design, I have found that the missing clarity is a pressing issue. One problem is the lack of conceptual coherency in the current understandings of interaction design. Earlier I noted the influence of human-computer interaction on theorizing interaction design and as we will see, HCI plays a prominent role in understanding interaction design. Another assumption of this thesis is that HCI and interaction design are distinct and in fact can be mutually beneficial - each addresses

different facets of the making and testing of interactive systems, as well as the study of the phenomenon of interaction.

Current views see interaction design as integral to and therefore part of HCI (Preece et al., 2002 , Kaptelinin et al., 2006), or conversely that interaction design is an entirely new field that subsumes HCI (Pirhonen, 2004 , Harrison et al., 2007). In both cases the argument currently fails to present a clear epistemological ground between interaction design and related fields, which would be more productive with respect to research and education. In effect, either HCI or interaction design is ascribed an overwhelming diversity of concepts and approaches. This creates confusion as a result of epistemological conflicts, i.e. tensions between ways of knowing. As a result, the conflicting range of rationales overwhelms students and practitioners such that mastery of the discipline is reduced to a selection of skills and methods with no conceptual anchors to explain their meaning and applicability.

In my own academic department, the School of Interactive Arts and Technology at Simon Fraser University, we have a broad-based design and computation major in our undergraduate program. Faculty often engage in discussion (and experimentation) as to what constitutes foundational knowledge and skills that are typically represented in the first and second year undergraduate courses. In our particular case, such courses range from graphic design, to spatial geometry, to object oriented programming. Students may learn diverse techniques from design critiques to statistical analysis, as well as disconnected concepts from human visual processing to cultural aesthetics. While as a faculty we make our compromises and settle on skills and narrow topics to develop further in more senior courses, there is the strong sense that students lack an overall conceptual grasp for connecting or relating the diverse skills and concepts.

1.1.1 The visionary view of interaction design

One view of interaction design that I label as *visionary* contends that the current disciplinary model of HCI is too narrow to address the challenges of ubiquitous applications and situations. It is visionary in that it looks forward to a complete reformulation of HCI and interaction design. For example, Pirhonen et al (Pirhonen, 2004) argue that HCI principles are a good starting point but are ultimately inadequate: “These [HCI] principles can even be used during the first steps in the creation of a new product concept or interaction concept, but their scope is limited to the current paradigm of HCI. New technologies and the growing awareness of their uses and of user needs require new types of paradigm, capable of integrating traditional empirical and analytic approaches as well as approaches that are novel though applicable to advanced artifacts in a human world” (Pirhonen, 2004, p.3). The authors argue for the subsumption of HCI within interaction design as the new approach to interaction: “Modern interaction research must do more than simply extend human-computer interaction...The prospect of ambient, ubiquitous and proactive computing and associated advances in services and service production necessitate the consideration of wider perspectives within interaction design” (Pirhonen, 2004, p.4).

However, the strong view of interaction design does little to address the issue of fragmentation, in fact it exacerbates it. Pirhonen et al argue that interaction design is multidisciplinary in nature and includes collaboration amongst engineers, designers, social scientists and humanists. Pedagogically, Pirhonen and his colleagues acknowledge the unlikelihood that such skills and knowledge could be integrated and found in a single individual: “it is hardly possible to be a highest-level engineer, designer, and psychologist at the same time” (Pirhonen, 2004, p.3). The authors stress skills of interdisciplinary

understanding, communication, and explicit goal-setting are necessary in order to overcome the challenges of the different disciplines working together. The authors make no claim for interaction design to be conceptually coherent or epistemologically grounded, and offer no promises of a practice nor a curriculum in which an understanding of an intellectual foundation would be integral to the necessary acquisition of skills and methods. Pirhonen and his co-authors argue: “it is unrealistic for such a collection of disciplines and expertise to be reflected in a unified field. Hence, future interaction studies will be characterised by the diversity of applicable skills and methods between which practitioners have to choose” (Pirhonen, 2004, p.4).

1.1.2 The status-quo view of interaction design

John Carroll (Carroll, 2003), argues that HCI provides an overarching conceptual umbrella to a multi-disciplinary science. The field of HCI emerged as an application domain of cognitive science that integrated and extended systems thinking from human factors. The field of HCI first sought to apply cognitive science theory to software development. Drawing on this scientific foundation, HCI became a discipline in its own right, and broadened its focus to include scientific theories and methods on the use of technologies. Carroll suggests that HCI within the context of a multi-disciplinary science eventually incorporated relevant aspects of other traditions like the social sciences (Carroll, 2003, p.2). As such, subsequent influences of anthropology and sociology forged a scientific foundation in HCI that had become quite rich and as Carroll states: “HCI encompassed nearly all of social and behavioural sciences” (Carroll, 2003, p.5). The grounding of HCI in cognitive science, a natural science, formed the foundation upon which social sciences added diversity to the field and yet did not fundamentally alter the epistemological grounding of HCI in the natural sciences: “The tremendous range of

empirical methods and scientific concepts in routine use in HCI has been a source of strength as the field grew to address new problems and issues encompassing new technologies and new applications” (Carroll, 2003, p.5). Hence, in Carroll’s depiction, what I refer to as the *status-quo view* of interaction design, HCI is an ongoing emergent field that sufficiently grows in diversity to adapt to the changes of ubiquitous applications and situations in computing. However interaction design is weakly defined in this formulation since it is ultimately subsumed within a strong scientific realism orientation that lies at the foundations of HCI. Scientific realism, in short holds that knowledge is of independent phenomena that are discoverable, and justifiable by our observation of the phenomena. In practical terms, this means the discovery of observable facts verified by empirical and rational (i.e. scientific) methods.

This view of interaction design described by Carroll is a multi-disciplinary balancing act in which the epistemological traditions of science form ballast, stabilising the diverse approaches. Yet what are the limits to the degree of diversity that one epistemological viewpoint can hold? Carroll states that this very issue currently challenges HCI. As he phrases it, there is an “ironic downside” in which inclusiveness leads to fragmentation: “there are too many theories, too many methods, too many application domains, too many systems” (Carroll, 2003, p.6). Indeed, the challenge of there being such a range of diverse concepts and approaches can lead to some researchers isolating themselves in narrower niches, ignoring other aspects of activity and knowledge in the field. Understandably, Carroll sees such factional decamping as undermining the multidisciplinary science core of HCI. In addition, balancing the tensions of depth and breadth challenges HCI practitioners, especially students. The *status-quo* view holds that HCI is diverse yet sufficiently coherent. However, echoing my concerns previously stated

that students in my academic department lack the conceptual understanding to relate different skills, methods, and theories together, Carroll plaintively states that practitioners need to “understand the intellectual foundations of HCI, not merely how to manipulate the tools and methods constructed on those foundations” (Carroll, 2003, p.6). He continues to underscore the current challenge as he sees it: “Ironically, because HCI practice has diversified so rapidly and has incorporated so many new professionals, average expertise among practitioners has never been lower” (Carroll, 2003, p.6).

Interaction design within the *status quo* view is either synonymous with HCI or is an applied component of HCI. I’ve labelled it *status quo* since this conceptualization is the commonly held view among diverse and current theorists of interaction design, some of whom I will explore in depth in the following chapter. From an opposite perspective, in what I referred to as the *visionary* view, interaction design is seen as the next “wave” or “generation” of HCI. In other words, the tables are turned and HCI is present within this understanding but subsumed by a notion of interaction design.

In short, both formulations of interaction design suffer from a fragmented and superficial understanding of what is involved in designing interactive technologies. Researchers cope by pursuing depth, thereby foregoing a more holistic understanding of the field, and creating a sense of *progress* that masks the need for more resolved conceptualizations. Practitioners and students fail to acquire a coherency of knowledge and practice. Instead, they pragmatically skim the surface of the discipline, pursuing skills and methods separate from the intellectual traditions that provide the rationale for the skills and methods. Carroll sees the need “to continually synthesize a coherent methodological framework” (Carroll, 2003, p.7) as the way past the fragmentation. Methodology remains an integral aspect of the problem, yet the circumstance of methodological disarray (i.e., ‘too

many methods') is more symptomatic than causal. The critical issue is a matter of epistemological coherency or lack thereof, i.e. how we can agree that what we know is knowledge. Pirhonen and his colleagues do not rank conceptual unity high on the list of issues to resolve for interaction design yet they offer that the ongoing "solving of concrete interaction problems...effectively provides a unifying tacit discourse" (Pirhonen, 2004). In many respects this is what constitutes the traditional design approach to research, the building up of understandings case-by-case through exemplars. This represents the "long road" to discovery that risks no discoveries at all. As part of this thesis, I advocate a shorter route by way of a philosophical-theoretical approach that grounds interaction design in a clear and distinct epistemological orientation with the aims of greater coherence, and the demystifying of interaction design actions and interaction designers.

1.1.3 The shadows of user-centrism

In addition to fragmentation, a second problem in the current confusion with interaction design and its relationship to HCI is missed opportunities in the research of interactive systems and artifacts. In particular, a design perspective on interaction research is invaluable if we are to understand how to successfully design interactive technologies. The ubiquity of interactive technology makes interaction design and HCI especially holistic, what Daniel Fallman (Fallman, 2003, p.231) states as "the act of trying to unfold a coherent whole." Unfortunately, interaction design is seen to lack validity in research methods and validation. The role of interaction design in the very processes of research is under-explored and perhaps even ignored, subject to measures of empirical and quantitative research methods in HCI that overwhelmingly focus on users. To underscore this point, many interaction design researchers find themselves caught between the fact that it is unrewarding to conform one's research to an HCI model and yet there is uncertainty as to

what constitutes a design research model. For example, by way of a personal anecdote, a paper I submitted to a major international HCI conference was rejected due in part to reviewers considering it a ‘design paper’. In HCI reviewer parlance this means the paper lacked a quantifiable contribution, focused too much on design process, and its relevance to the HCI research community was not clear. I made some minor adjustments to the paper and in earnest submitted it to an international conference on designing interactive systems, a conference known for its sympathetic view of interaction design research. It too was rejected and in this instance, reviewers commented that the paper was too focused on HCI issues, lacked sufficient details on the design process, and did not contribute clearly to the design community. I do not recount this example to bemoan the fact the paper was not accepted or that the reviewers were incorrect. My point is that there is lack of clarity in regard to what constitutes interaction design research and what its relevance is to HCI.

Carroll remarks how in the early years when HCI was focused as an application domain of cognitive science, “there was a sense that there was wide tacit agreement as to the overarching research paradigm. And a lot got done” (Carroll, 2003, p.3). Pirhonen and his colleagues describe a wildly diverse group of specialists jointly engaged in the practice of interaction design including “education, sociology, philosophy, art, design, marketing, gerontology, demography and culture research” (Pirhonen, 2004, p.4). While not offering clues as to how to address research quality across the disciplines, Pirhonen et al do offer suggestions for practice. They argue for reshaping the organization of work and knowledge. Adding to their emphasis on interdisciplinary skills of breadth and communication, Pirhonen et al cite the design industries as having established “distinct practices and organization” in which creative thought is “central and intrinsic” (Pirhonen, 2004, p.4). Steve Harrison, Deborah Tater, and Phoebe Sengers (Harrison et al., 2007) suggest a third

paradigm of HCI that is phenomenology and design oriented, and equally catholic in respect to inclusion of diverse perspectives as Pirhonen et al's view of interaction design. In regard to research quality, Harrison and his colleagues see within their third paradigm a need for multiple interpretations that provide a rich description rather than a "single, objective" description (Harrison et al., 2007, p.8).

Harrison et al argue that the multiplicity approach of design research faces the challenge of being measured by the "gold standard" of behavioural sciences. This "gold standard" is central to what Harrison et al describe as the second paradigm of HCI, similar to the earlier described *visionary* view. For example, Harrison et al discuss the difficulties in the review process for submitted papers to the major international technical conference for HCI (similar to my own experience cited earlier), the Associated Computer Machinery (ACM) Conference on Human Factors and Computing known as CHI. Two main hurdles exist within the interaction research community: "(1) the legitimacy of only certain kinds of measures of success, (2) limited understanding of validity of methods outside a limited canon..." (Harrison et al., 2007, p.11). As such, an epistemological hold is in place that ignores the different strategies for claiming knowledge and ultimately, in their view, thwarts future development of a more diverse field. Design is overlooked in making a contribution since it is perceived to lack the exacting rigour of sanctioned methods. Fallman (Fallman, 2003, p.231) wryly comments in a mocking paraphrase, "Then we designed the prototype. Ugh...it took forever! Anyway, here are the results of our meticulous evaluation!" The point being that design is dismissed as opaque – a mysterious black box – and thus having no real research value, "concealed" according to Fallman (Fallman, 2003, p.231).

Yet what is the interaction design experience and how does interaction design contribute to research? In this respect we have at best only partial answers or in certain cases explicit polemics intended to open space for discussion and future engagement from which processes and a research paradigm may emerge. Harrison et al's arguments can be seen in this light. Their argument for a multiplicity of knowledge claims within a new paradigm of HCI is more a call to action than a research direction. Fallman (Fallman, 2003) makes the critical point that the question of how to address interaction design and research is unavoidable, for no other reason than the fact that no research contributions would have been claimed from studying interactive systems and artifacts if such items were not made actual by design. Fallman aptly observes within HCI the false notions that the design artifact either occurs by sheer chance or that a direct causality can be found between for example, fieldwork data and the design artifact (Fallman, 2003).

By way of review, I have been discussing two problems related to the lack of understanding of the field of interaction design and its relationship to HCI. The first problem is the lack of epistemological coherency that occurs because interaction design is overshadowed by HCI (the *status quo* view of interaction design) or because interaction design surpasses HCI (the *visionary* view of interaction design). Both cases fail to avoid fragmentation and to create a deep understanding between practice, knowledge, and education. The second problem is the missed opportunities in the research of interactive systems and artifacts. Interaction design is seen as lacking in research methods and validation. Further, the phenomenon of design and the role of the designer in interaction research are under-explored, subject to measures of empirical and quantitative research methods in HCI.

As discussed above, many of these problems are not unknown to researchers in the fields of HCI and interaction design. The perceived criticality of the issues varies, different strategies are invoked, and partial answers are given. For example, Carroll sees greater methodological coherency as a way to address fragmentation, yet I've identified the issues as epistemological in nature of which methodology is a key element but not at the root level. While Pirhonen and his colleagues do not see epistemological issues as critical, to some degree this is true of Harrison et al as well. Pirhonen sees the case-by-case descriptions of real design problems as a gradual unifying process, yet we can bootstrap the discussion by generating a theoretical view of interaction design. Lastly, some researchers offer strategic polemics launched with the intention of creating space for new discussions and the emergence of methods and research paradigms in interaction design but not a theory. I argue we need now to begin the process of developing a theory to support interaction design.

1.2 Role of theory in interaction design

The preceding discussion shows the absence of a theory for interaction design. I will later discuss how design discourse, including emerging discussions on interaction design, has typically resisted the type of abstractions and formulizations that constitute theories. The limit of this approach is that the lack of theory generated from within interaction design leaves the field vulnerable to theorizing from other theoretical and disciplinary viewpoints like HCI or limits discussion to polemics. Further, trying to understand interaction design through design examples alone is too challenging and runs the risk of defining symptomatic views rather than explaining underlying relationships and processes.

In the following chapter I will discuss Victor Kaptelinin and Bonnie Nardi's *Acting with Technology* (Kaptelinin et al., 2006). These authors provide a good example of theory

that aims to be descriptive, explanatory, and generative. Kaptelinin and Nardi discuss activity theory as a basis for revisionary critique of HCI. They see in activity theory the descriptive capacity to provide a new set of key concepts and definitions, and the explanatory capacity to redefine relationships and processes within HCI. At the heart of the revisions that stem from activity theory is an epistemological critique of how the field defines the user, a concept central to HCI theory. Activity theory advocates a post-cognitive construction of the user over the traditional cognition-based formulations. As part of the shift toward a post-cognitive view for HCI, researchers and theorists see a greater role for invention and creativity in the making of interactive systems (Nardi, 1996 , Dourish, 2001). In this light, Kaptelinin and Nardi claim that activity theory also plays a generative role through its direct applicability to both HCI problems and further invention in a theoretical sense by contributing to the ongoing conceptual development of HCI. The authors draw on Ben Shneiderman's notion that generative theories (Shneiderman, 2002) facilitate creativity, invention, and discovery.

John McCarthy and Peter Wright in *Technology as Experience* (McCarthy and Wright, 2004) offer another revision of HCI theory by explaining our relationship to technology through experience. Similar to the approach of this thesis, the authors draw on the pragmatist ideas of Dewey in addition to the novelist Mikhail Bakhtin. McCarthy and Wright re-theorize the notion of user experience to include the emotional, intellectual, and sensual aspects of interactions with technology, arguing in the pragmatist sense that we live with technology rather than simply use it. From a pragmatist viewpoint, theory is by definition generative, in that it is seen as a systematic inquiry for imagining a possible future. For a pragmatist, theorizing is a necessary and practical consequence of living or approaching one's life such that theory changes one's world rather than represent it.

McCarthy and Wright discuss how Dewey criticized scientific theory as retrospective, concerned with describing and explaining the world as it is, rather than prospective, which is concerned with how the world might become. The authors argue that their generative view is “valued not so much for whether it provides a true or false representation of the world as for whether it helps us think through relationships between for example, people, technology, and design” (McCarthy and Wright, 2004, p.19).

Generative theory that supports creativity and discovery, as well as a prospective orientation which is aimed at shaping future outcomes, are both critical to any theory for interaction design. The reason is that interaction design is primarily concerned with the creation and development of interactive systems. Additionally, interaction design by nature has a future orientation since the goal is to understand what prospective design actions and outcomes will beneficially shape our environment. As such, the discoveries are both different in nature from intellectually-reasoned discovery and are reliant on the generative dynamics of design.

Participatory design (PD) is a good example of a generative theory or at least a well-elaborated set of generative strategies. Participatory design emerged from socio-technical concerns regarding the design and use of information systems in organizations (Ehn, 1989 , Schuler and Namioka, 1993 , Greenbaum and Kyng, 1991). In *Work-Oriented Design of Computer Artifacts* (Ehn, 1989), Pelle Ehn theorizes on the aim of participatory design to base design on embodied knowledge, mutual learning, and participation. The basis of Ehn’s notion of participation is a shared understanding of the design needs between designers and skilled workers. In order to create something new, designers must bridge the different languages, tacit knowledge, and past experiences that lie between them and stakeholders. Ehn phrased this as “the dialectics of tradition and transcendence – that is

what design is all about” (Ehn, 1989, p.7). Participatory design offers a set of theoretical tools for the practice of design and for the generation of design actions and outcomes. Participatory design stands out for the degree to which it is a relatively coherent and effective theory for design practice. Ehn in particular provides a theoretical context for PD based in Heidegger, Wittgenstein and Marx that offers a rationale and basis for further elaboration on techniques and principles incorporated into information systems design. The principles afford an articulation of techniques and goals for participatory design that mobilize the theory into a form serviceable in design practice. PD focuses on the relationship between designers and end-users, devoting a large degree of its efforts on articulating how designers interact with end-users. It does not revise core concepts in how design occurs or could be defined; rather it critiques scientific approaches to the user by offering a design perspective of the user. It falls short of offering a mode of validation or self-reflection that ultimately is the mechanism to critique and evolve theories. As a consequence, it articulates little about how to communicate research outcomes of PD and how PD interacts with other disciplines. Yet it is a powerful precursor to thinking in interaction design. I will show how PD serves as a critical theoretical antecedent for the theory I propose for interaction design.

Another powerful theory in design is Donald Schön’s reflective practice (Schön, 1983 , Schön, 1987). Reflective practice is well established as a critical crucible for conceptualizing fields of design. Schön sought to dispel the notion of designers and other professionals as implementers of received theoretical wisdom from elsewhere. Schooled in Dewey’s pragmatist inquiry (Dewey, 1938), Schön challenged the dualism of practice and theory and saw knowledge in doing, or as he phrased it, reflection in action (echoing Dewey’s dictum, learning by doing). His emphasis on the irreducible relationship between

action and knowing evolved into a hierarchy of knowing that leads from immediate actions to informed understandings of practice as a whole, i.e. reflection in action, reflection on action, reflection on practice (Schön, 1983). The formalization of the dynamic interaction of design and the forms of knowledge that are enacted by a designer actively designing are among Schön's most significant contributions. He shone a bright light in the "black box" of design in such a way that his theory continues to hold up to the scrutiny of the lived experience of designers. Schön reconstructed the design process from the failings of reductive and prescriptive design methods which were based on logic and the cognitive science of the early 1970s (Bayazit, 2004). The relevance at hand is that Schön's reflective practice offers a model for interaction design that is informed by pragmatism and avoids the logical abstractions and analytical empiricism of past approaches and HCI informed theories. The strength of what Schön offers is an applicable set of concrete formalizations and formal techniques grounded in the interactional and practice-based characteristics of design. Reflective practice offers a broad set of mechanisms for self-reflection on the field that has deeply influenced education in professional domains (Schön, 1987). Similar to PD, reflective practice serves as a starting point for the theory proposed in this thesis.

We can gather from the preceding discussion that an ideal theory for interaction design will describe critical concepts, principles and definitions, and provide an explanation of the relationships, actions, actors and processes within interaction design. In addition, an interaction design theory will facilitate the generation of new forms of practice, creativity, and discoveries with a prospective orientation grounded in the practice of making. A generative theory leads to an understanding of future possibilities or inventions in interaction design and guides us in determining the value of each possibility.

A positive consequence to interaction design's relationship with HCI is that HCI offers a clear counterpart that must be matched theoretically otherwise interaction design will continue to be eclipsed since it is under theorized. The strength of HCI theory is that it has theoretical depth. Underlying HCI is an epistemological grounding in scientific realism and phenomenon of study such that there is agreement on core concepts yet these concepts are open to revisions and subject to vigorous and critical debate that grows the field intellectually. This strength in focus and epistemology creates coherence around principles that in turn allow for flexibility and experimentation with methods of research, validation, and the means to verify claims. Further, HCI has mobilized a theoretical understanding through communication and flexibility of methods. In many respects, interaction design needs to match this standard in its own theory-making.

Given this, together with our discussion of related theories the following criteria can be used to establish the role of theory in interaction design:

- 1) Provide epistemological orientation: an underlying philosophical grounding that is appropriate to design that will guide the development of core concepts and defining principles;
- 2) Establish coherent principles to guide the development of research methods, design methods, and evaluation methods. This creates flexibility and experimentation in methods avoiding prescriptive approaches of the past;
- 3) Provide standards of validation that provide a means to credibly communicate and verify claims;
- 4) Mobilize the theoretical ideas and actions in a way that is accessible in practice and open to revision through practice.

1.3 Overview of the study

Contrary to the *visionary* and *status quo* formulations of interaction design discussed above (see 1.1 The visionary and status quo versions of interaction design), I claim that interaction design can be articulated as a coherent theory with a distinct epistemological foundation from HCI. I argue also that John Dewey's (1859-1952) philosophical pragmatism serves as a good and productive starting point for an epistemological framing of interaction design. I will show how pragmatism is relevant to interaction design and how the field can be seen as grounded in the pragmatist inquiries of traditions in design like participatory design, design ethnography, and criticism. The aim of the thesis is to develop a pragmatic theory for interaction design that describes critical concepts, principles and definitions, provides an explanation of the relationships, actions, actors and processes within interaction design, and articulates strategies for proving trustworthiness in the knowledge generated. Directly outside of the theory, I will explore how a revised interaction design bridges activities and outcomes with HCI, and how the theory points to practical directions in research and education.

In this section I explain how the structure of the argument is guided by several propositions. The resulting theory is further detailed and illustrated through analysis of two interaction design inquiries.

1.3.1 Propositions

I aim to develop a new understanding of interaction design in a theory built upon five propositions. I briefly discuss the propositions in order to provide an overview of the study and to provide initial orientation for the reader:

The first proposition is that current descriptions of interaction design are inadequate and there is a need for theorizing of interaction design in order to better value its role in the research and creation of interactive systems.

I stated earlier how the term interaction design is growing in use and yet there is little agreement on what it means. My aim is not to settle the “dispute” by providing the most definitive answer; rather my goal is to firstly understand how interaction design is currently understood and then to prospectively use theory to offer a more beneficial conceptualization of the field. Computing is increasingly more ubiquitous, relevant, and complex. It has moved past the narrow confines of experts to impact and influence everyday experiences. Hence, in addition to current interaction study approaches, new approaches are required to tackle the issues of design and computing in their fullness. The value of the theory proposed in this study is that it provides clear descriptions of key concepts and fundamental distinctions. It also aims to guide interaction design practice and to facilitate creativity, invention and discovery (Shneiderman, 2002). A proactive and pragmatist stance to theory is an effective way to construct a view of interaction design that measures its value in both research and practice.

The second proposition is that an epistemological home for interaction design lies in pragmatism. In pragmatists’ terms, design is lived; it is an experience that it is bound up in ongoing interactions between the designer inquirer, matters of the inquiry, the environment, and stakeholders.

Pragmatism, in particular Dewey's pragmatism, elucidates the intellectual coherency of interaction design and reveals how the field contributes to knowing in the world. I will show how pragmatism weaves through design's intellectual history in ways relevant to a theory of interaction design. This approach provides an explicitly pragmatic explanation and description of design that substantiates knowledge creation inside and outside of the field. Pragmatism is concerned with the *here and now*, yet it continually asks what is the value of an understanding in terms of action and what future multiple possibilities can it uncover? To state the obvious, which is often overlooked, future experience is irreducible, which leaves little room for absolute knowing. And so in terms of design, multiple possible outcomes must be constantly negotiated and interpreted. Taking a view that design traditions are rooted in pragmatist philosophy leads to the third proposition.

The third proposition is that a revised interaction design productively draws on the intellectual histories of design. Arguments grounding interaction design in cognitive science and systems thinking have concealed the contribution of interaction design to interaction research and education. A clearer formulation of interaction design begins with grounding it in reflective practice, participatory design, design ethnography, and criticism.

It is truly surprising that few if any approaches locate interaction design in the traditions of design thinking. There is substantial value in this tack; above all it balances the intellectual attention on interaction from HCI with a complementary focus on design. The traditions of reflective practice, participatory design, design ethnography and criticism link to form a rich set of antecedents that help describe what interaction design is and might

become. For example, I will show how Ehn's (Ehn) understanding of participatory design shares with Schön's (Schön) reflective practice an inherent pragmatism that inquires at the level of descriptive action, disavows reliance on abstractions, and holds a dialogical view of design. To paraphrase Schön, interaction design is an explicit conversation between materials, end-users, and designers. I will show how the pragmatic inquiries of Ehn, and especially Schön, draw on Dewey's notion of *immediate empiricism* in which claims hold value or afford possibilities over time in the everyday and lived world. I will argue how criticism and design ethnography hold the potential to carry out the evaluation and shaping of the design claim, especially in understanding the ongoing and everyday existence of interactive artifacts and systems.

The fourth proposition is that a pragmatist view leads to the understanding of interaction design as experience and an interaction designer as an embodied inquirer that shapes the experience through experimentalism. Instances of interaction design experiences can be seen as inquiries in which judgment and interpretation are central actions.

Within a pragmatist view of interaction design we can describe designing as an *experience* (Dewey, 1934). We can see how an interaction designer's understanding of the experience of designing in the present is deeply informed by his or her own lived history with design. In addition, much of the skill in design is embodied and made evident through reflection; Schön referred to this as surprise on the part of designers whose prehension of change becomes reflection on an embodied difference in action (Schön, 1983). We can see that past experience, embodied reflection, and overall understanding of the experience of designing form an interaction designer's judgment. Professionally, judgment takes the form of a warrant on behalf of the designer, design team, or firm in relation to quality of the designing and design outcomes. In short, it *is* important *who* is designing. However,

judgment does not act alone. Rather it is subject to ongoing interpretation and feedback that helps negotiate the limits of that judgment. A commitment to explaining the designer inquirer's judgment and interpretation mediates the level of integrity and quality of the interaction design process.

The fifth proposition is that interaction design is guided by qualitative and interpretive orientations in validating new knowledge. The pluralism of pragmatism leads to the proposed theory promoting multiple strategies of validation that set out to be rigorous in interpretation and supportive of the practice of criticism, and inclusive of quantitative strategies where relevant.

It is important for interaction design to make its judgments and interpretations evident, communicable, and valid to others. This level of explicit reflection and agreed upon shared knowledge increases the interaction designer's capacity to make future design decisions. Reflection draws from the practice of interaction design, contributions that are important to the development of the field and to other fields. The trustworthiness and validity of findings in a revised understanding of interaction design is a qualitative question that is hinged upon interpretation and negotiation. Within this orientation, quantitative strategies can also support findings or guide research and practice. In parallel, a practice of criticism is a needed validation strategy that moves reflection on interaction design past specific inquiries and designers. Additionally, criticism mediates the values of interaction design inquires over time.

1.3.2 Interaction design inquiries

The propositions discussed above represent the theoretical framing of the research. I examine and illustrate the proposed theory in detail by using it to analyze two interaction design research projects. In both projects, I was the lead researcher working together with faculty researchers whose research foci included artificial intelligence, electro-acoustics, and games. In both instances the projects were complex and brought together multiple research agendas. My research interests and contributions were in the area of interaction design. With respect to this study, only aspects related to interaction design were analyzed. I hope to show how a first-person perspective is a critical and preferred stance in interaction design research given the dictates of pragmatism, the centrality of the interaction designer to the design experience, and the richness and credibility of the interaction design data.

The first of the cases is the research and design of an adaptive museum guide, known as ec(h)o. The interface for the prototype is a combined tangible user interface and audio display that utilized user modelling. The project is typical of an interaction design endeavour in that it is holistic in its approach and outcome. The aims of the project included the consideration of the museum setting as a significant aspect of the design process and outcome, the discovery of qualities of interaction that go beyond levels of efficiency in information delivery, and the testing of a dynamic approach to user modelling in support of a tangible interface. The project employed ethnography, participatory workshops, scenarios, prototyping, and mixed methods (quantitative and qualitative) for evaluation as part of its design process. Research focused on reflections on the design process (Wakkary, 2005 , Wakkary and Evernden, 2005), evaluation of the role of tangibility and play in user experience (Wakkary and Hatala, 2006 , Wakkary and Hatala, 2007), and evaluation of user modelling (Hatala and Wakkary, 2005 , Hatala et al., 2005).

The second case is a project known as *socio-ec(h)o*. The project comprised a prototype environment for group play whose goal was to explore the design of an ambient intelligent system, a method for composing group user models, and group interaction utilizing a game structure. Ambient intelligence (AmI) computing is the embedding of computer technologies and sensors in architectural environments that, combined with artificial intelligence and multi-modal displays, respond to and reason about human actions and behaviours within the environment. The main research goal from an interaction design perspective was to understand how to support groups of participants as they learn to manipulate an ambient intelligent space, as well as to understand and learn about designing ambient components of a responsive environment capable of providing this support. Similar to *ec(h)o*, the project employed as part of its design process ethnography, participatory workshops, scenarios, prototyping, and mixed methods (quantitative and qualitative) for evaluation, however with different emphasis on the importance of the each technique. Published research to date has focused on the technical platform (Wakkary 2005), interaction and gameplay (Wakkary et al, 2005; Wakkary et al 2007), group interaction (Wakkary et al 2008), audio display (Droumeva et al 2006; Droumeva et al 2007; Droumeva et al 2008), and the design of the audio display (Droumeva et al 2006; Droumeva et al 2007).

Some readers may wonder why the cases are exclusively research-focused rather than practice-oriented, i.e. a professional and commercial project. Firstly, as a design researcher, my projects offered the richest set of data available to me but more importantly, design research projects provide the degree of exploration, reflection and documentation that best support the questions of this thesis with respect to education and research. A design research project explicitly engages methods of research and interactions with fields

like HCI for the purpose of research. My aim in this thesis is to describe and improve upon these interactions to further design research. Similarly, the projects make explicit and also document design practice, in part as an object of study and in part in keeping with the goal of transparency in the research process. These reflections and documentation provide valuable data for a case study researcher, particularly with respect to education. A significant point that is particular to interaction design and HCI research is that the research requires the design of a functioning prototype. In many respects, it can be said that a design practice is embedded within the practice of design research, notwithstanding the absent roles of the client and market.

1.4 Context for the study

I have discussed the broad outlines of HCI research as well as the historical progression from an application domain within cognitive science to human factors engineering to the inclusion of social sciences and other approaches (Carroll, 2003 , Grudin, 2005 , Cooper and Bowers, 1995 , Harrison et al., 2007). Given that there is confusion about interaction design within HCI research, while at the same time there is an acknowledgment of its relevancy, the aim of this study is to clarify interaction design and its role in relation to HCI. For the purpose of this study I will consider the larger context in which this relationship results in the labelling of the term interaction studies. The interaction studies term is a rubric to generously cover the various interrelated fields focused on human interaction with computational artifacts and systems. Within interaction studies we find interaction design and HCI. In Figure 1, these fields have been brought to the fore and highlighted since they are most relevant to this thesis. However, of equal prominence are Human Factors and Computer-Supported Cooperative Work (CSCW). Human Factors are concerned with human and systems performance, while the latter is

concerned with supporting technologies in collaborative work environments. Of a somewhat secondary order are fields that strongly relate, however they may have intellectual homes elsewhere, including Participatory Design, Industrial Design, Robotics, and Artificial Intelligence. The notion of interaction studies is not the focus of this study, and is presented here as an operational term and should be considered provisional, as such one could imagine many other fields within this schema.

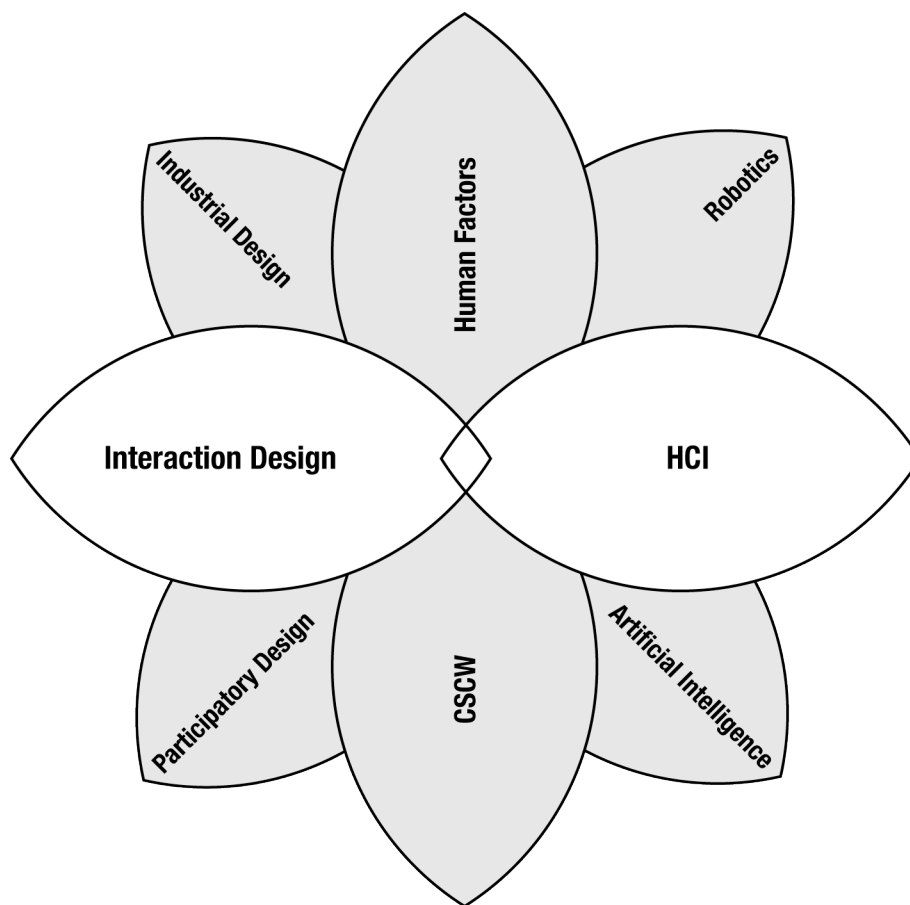


Figure 1 Schema for interaction studies, an operational rubric for interaction related research

Design research also has its origins in rational and systems thinking schools of thought that are still prevalent in design research today. Early design research focused on applying logical and systematic approaches to methods for design that were inspired by operations and management research during World War II in which scientific principles

were applied to logistics and management (Cross, 2007 , Gedenryd, 1998 , Bayazit, 2004). Despite later disavowals from design method research pioneers Christopher Alexander and Chris Jones (Bayazit, 2004), design method has been a continuing focus in design research. Design method has shifted away from the abstraction of logic and systems to a more empirical based approach or what has been referred to as the “second generation” design methods (Rittel, 1972) brought about by the realization of the complexity of design as characterized by Horst Rittel and Melvin Webber’s description of *wicked problems* (Rittel and Webber, 1973). Interestingly, an avenue opened that intersected cognitive science and the study of *design thinking* (Lawson, 1997 , Rowe, 1987 , Cross et al., 1992) that incorporated analytical empirical methods such as *talk aloud* and *protocol analysis*. These methods were applied to designers as means of studying expert behaviour on the part of cognitive scientists, and designer thinking on the part of design researchers. Significant breaks with the rationalist approach to design research occurred periodically such as Alexander’s *pattern language* (Alexander et al., 1977), a design formalization grounded in a social evolutionary understanding of design, Victor Papanek’s *Design in the Real World* (Papanek, 1972) that advocated a holistic and ecological approach aimed at sustainability in design, and Schön’s *Reflective Practice* (Schön, 1983). Schön’s reconceptualization of design against the “technical rationality” that dominated professions like design offered paradigmatic change. While reflective practice is often held up as an exemplar for understanding design, its critical challenge to a rational understanding of design in favour of a pragmatic approach is generally overlooked.

Since this investigation crosses interaction studies and design it is helpful to situate interaction design in relation to other disciplines. Figure 2 is also a provisional mapping that positions interaction design between but overlapping with design and HCI. I’ve taken

the liberty of leaving design unspecified but one can consider the practices of industrial design, visual communications, engineering and so on within the circle of design. In addition, and equally general, art including performance, installation, sculpture, media art and so on are overlapping with design, interaction design and HCI. CSCW, given its attention to design of collaborative and cooperative work environments and ethnography, overlaps with HCI, design, and interaction design.

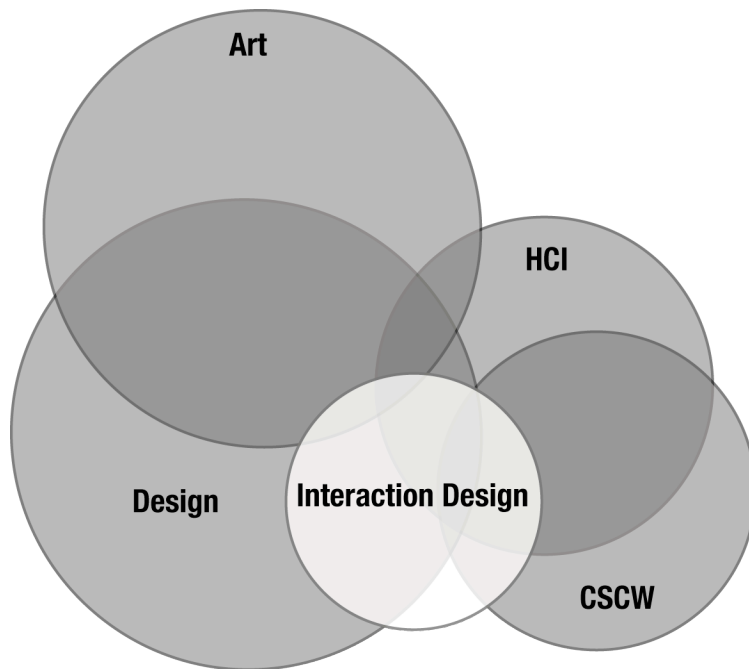


Figure 2 Situating interaction design in relation to other disciplinary fields

The main audience for this thesis is the interaction design researcher who may come to interaction design from either tradition of design or HCI. The study is also relevant to the HCI researcher who wants to better understand the role of design in HCI and the design researcher who is interested in the emergence of interaction design as a design phenomenon and may want to consider its impact on design as a whole or on other design disciplines. This thesis also offers a critique of current theory in interaction design and a focus on

revising theory based on interaction design research practice that is relevant to practitioners and students.

1.5 A roadmap of the thesis

In this introduction I have sketched the broad outlines of the dissertation and the issues it plans to tackle and why. I will in detail present the case for this revised understanding of interaction design in the chapters that follow. The plan for the remaining chapters is as follows.

Chapter 2 will review and address the current formulations of interaction design. The review groups the literature into HCI dominant views that tend to overshadow design, and interaction design views rooted in design discourse. Chapter 3 discusses the proposed theoretical framework for interaction design. The chapter establishes a philosophical basis for interaction design founded on Dewey's pragmatism. It firmly pivots the discussion of pragmatism and a basis for the theory on aspects of design's intellectual history. In particular the theory draws upon reflective practice, participatory design, design ethnography, and design criticism. Chapters 4 and 5 divide into two parts the analysis of the two interaction design research projects using the theory. The first project is the design of an ambient intelligent and adaptive museum guide known as ec(h)o; the second is an ambient intelligent physical game for multi-players known as socio-ec(h)o.

Chapter 4 begins with an analysis of the two projects in what is referred to as the inquiry layer that describes the designer inquirer, designer intentions, and rationales. The chapter continues with a detailed account of the actions of judgment and interpretation in ec(h)o in what is referred to as the actions layer. Chapter 5 is the second part of the project level analysis. It includes an analysis at the actions layer of socio-ec(h)o and concludes

with a holistic account and analysis of the entirety of each project at what is referred to as the experience layer.

Chapter 6 investigates the validation strategies in the theory and provides examples of how they are operationalized within the theory. Chapter 7 looks at the implications of the theory in relation to HCI, and interaction design research and education. A discussion of the theory in relation to the emerging interaction design theories and interpretive approaches in HCI sets out to critically examine the theory in a wider context. The chapter concludes with a discussion of the limits of the study and theory. Chapter 8 is the concluding chapter of the dissertation. In it I summarize how the theory offers a revision of interaction design that addresses the theoretical gaps in the field. In Appendices 1 and 2 are the lists of sources and abbreviations for data from the interaction design inquiries analyzed Chapters 4 and 5. Appendix 3 is the list of contents for the accompanying DVD that includes videos from the interaction design inquiries.