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The Confluence of Interaction Design & Design: from Disciplinary to Transdisciplinary Perspectives

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Abstract

In keeping with the conference theme of rigour and the authors' interest in sustainability and interaction design, we describe the confluence of *design-oriented notions of interaction design* and *HCI-oriented notions of interaction design* in terms of understanding the present and making choices about possible futures. We comment on the variety of research modes in this confluence and then take up the issue of how disciplinarity, multidisciplinarity, and interdisciplinarity operate and fail to operate as boundary crossing mechanisms for these research modes. As a complement and extension to disciplinary, multidisciplinary, and interdisciplinary practices, we take up the notion of *transdisciplinarity* and describe how it informs the possibility of values-rich free boundary crossing between research modes in the service of real world issues, while still preserving rigour.

Keywords

Transdisciplinarity; Interaction Design; Design Research; Sustainability; Disciplinarity; Multidisciplinarity; Interdisciplinarity.

This paper arises out of our interest in Sustainable Interaction Design (SID) (Blevis, 2006;2007)—an interest which exists in our treatment and expertise in the now well-established confluence of *human-computer interaction* (HCI) on the one hand and *design* as it owes to traditional design disciplines like architecture, industrial design, product design, visual design, and communications on the other. This confluence holds tremendous promise to create benefit which might not accrue from a single-disciplinary approach, as well as requiring certain cautions due to the overloading in meaning of certain terms and varied fundamental goals between the two disciplines.

One of our assumptions is that the growing interest in the confluence of these disciplinary traditions has led to (sometimes simplistic) misunderstandings of what it means and can mean to bring the two together. We also believe that there is a need for an in-depth examination of the intellectual foundation underlying such an idea. One primary goal of this paper is therefore to expose and disambiguate the apparent similarities and differences between the two disciplines—HCI and design. This goal is very much in keeping with the conference theme of *rigour*.

The service of this goal requires reference to, and explanation of, notions that reach beyond the realm of singleton and even combinatory disciplinary perspectives—beyond notions of disciplinarity, multidisciplinarity, and interdisciplinarity to notions of transdisciplinarity—a requirement that is

addressed in what follows. Even though our exercise is conceptual and theoretical, we see our effort as mainly an attempt to develop an intellectual foundation for design research *practice* since it is oftentimes implicated in academic contexts as what is “allowed” and what “counts” as acceptable and rigorous methods. It is also important to question the validity of such metrics of acceptability and rigour in terms of actual positive effects on understandings and actions that are vital to life. Our hope is that our efforts will lead to further developments of a design research understanding that is based on the realities and nature of design and its essential, intrinsic connection to sustainability.

Research modes at the confluence of design and HCI: Design Criticism & Critical Design, Needs and Requirements & Needs Satisfaction

The question of what is and what is not *design research*—both research in the service of design and research about design—dogs anyone whose research touches on aspects of design and any single disciplinary-bound context, as is common in academics if not in practice. We will argue that design is *not* a single disciplinary pursuit in its nature. Others have argued all corners of this debate, including Cross (2001), Fallman (2003), Nelson & Stolterman (2003), Rust (2007), Zimmerman, Forlizzi, & Evenson (2007), and others. We focus in this section on the specific case of interaction design as it owes to design traditions on the one hand and HCI traditions of computing, social, cognitive, and behavioral sciences on the other.

The concepts which need to be elaborated first are (i) **design-oriented notions of interaction design**—by which we mean HCI informed by the theory and practice of design, and (ii) **HCI-oriented notions of interaction design**—by which we mean design informed by the theory and practice of HCI. We use the term **design criticism** to mean reflection and critique as a means of understanding existing design effects. We use the term **critical design** to mean actions—including acts of elimination—that lead to new design effects. From the perspective of sustainability, *design criticism concerns understanding present ways of being* as effects on future ways of being, while *critical design concerns creating choices for alternative future ways of being*.

These distinctions are sketched in **Figure 1** as a way of characterizing the intellectual space in which *design* and *HCI*, *reflection* and *action* interact from the perspective of sustainability. In the view of design-oriented notions of interaction design, design criticism may be commonly characterized as engagement with the implications of present ways of being for future ways of being (quadrant A) whereas critical design may be characterized as engagement with choices of possible future ways of being (quadrant B). In the view of HCI-oriented notions of interaction design, design criticism may be commonly characterized as engagement with present needs (quadrant C) whereas critical design may be characterized as engagement with the satisfaction of needs (quadrant D). Whether the focus is on futures or needs, both design criticism and critical design are essential to effectiveness for HCI and design. In Blevis (2006), we argue that

“Time being what it is, critical design takes place in the absence of complete understandings of present ways of being. Thus, design criticism and critical design are mutually dependent, ongoing, and co-evolving acts. Design without design criticism is unlikely to create critical design and criticism without critical design is unlikely to create design criticism. Design criticism is strategic. Critical design is tactical.”

Interestingly, the often-accepted standard definition of sustainability—which is clearly fundamental to our distinctions between the implications of the present and the choice among futures—emphasizes this dialectic between needs and futures illustrated in **Figure 1**—that is the definition of sustainability as “*development that meets the needs of the present without compromising the ability of future generations to meet their needs*” (W.C.E.D., 1987). Fry (2008) has noted that this notion of *sustainable development* might be less effective from the perspective of sustainability than would be a notion of *development of sustainment*—the former emphasizes sustainability as a constraint on development as usual while the latter emphasizes sustainable behaviours and futures as the goal of development. This nuanced, uncommon, and yet vital distinction which owes to design philosophy and which would otherwise be lost is an example of why the support of research in the confluence of HCI and design must encompass all of the research activities characterized in **Figure 1**, rather than privilege only those activities which fit neatly into a values-neutral conception of science.

In **Figure 1**, the question of what is or is not specifically a research activity is avoided. We claim that all of the activities in the diagram are **design research** activities—either or both in the sense of activities that inform design practice or that inform understandings of design. This is not without contention. For example, in a design school where one of the authors once taught, students were strongly discouraged from regarding survey research or focus groups as legitimate forms of design research, since research relying on self-report was regarded as something of an *anathema* by many of the faculty. In still other contexts, we have encountered people who believe that survey research endows understandings with meaning that is positively distinguished from other research in both its rigour and credibility. We think such sentiments are to be avoided and that design most often occurs in the context of so much complexity, that more techniques of understanding are better than fewer as a means of triangulation. Löwgren & Stolterman (2004) provide an enumeration and critical perspective on various methods.

Such matters are also taken up by Zimmerman, Forlizzi & Evenson (2007) as an issue of the recognition of design research within the HCI research community, and Fallman (2003) has contributed similar accounts to that community. Also, we hypothesize that arguments about what is or is not research often focus on a dialectic between any two of the quadrants in **Figure 1**, when in fact the arguments are better understood as a *quadra-lectic* about the understanding as research of all four quadrants. Few people work only within a single quadrant, and few people work within all of them. Furthermore, the matter of which activities fit within which of the quadrants is very much an open matter of discussion, not intended to be strictly specified by the diagram.

Another way to think of the quadrants of **Figure 1** which is perhaps more accessible and probably just orthogonal is to think of each quadrant in terms

of characteristic activities and orientations. Thus, when people focus on quadrant A, they may be acting as **collectors** who are primarily oriented towards *ultimate particular exemplars*—a notion due to Nelson & Stolterman (2004), when on quadrant B, they may be acting as **sketchers** who are primarily oriented towards meaning and form, when on quadrant C, they may be acting as **gatherers** who are primarily data oriented, and when on quadrant D, they may be acting as **builders** who are primarily function oriented. Other orthogonal descriptions of these quadrants are possible—for example, **criticism** (A), **communications** (B), **empiricism** (C), and **prototype engineering** (D). We believe that all are necessary elements of design research, and that anyone doing design research could be helped by **Figure 1** as a *means of reflection on the role and actions involved*.

Disciplinary, Interdisciplinarity, & Multidisciplinarity

The different modes of research described in section 2 contribute to disciplinary parochialism which is the failure to recognize as research contributions that which is outside of one's own discipline or understanding of research. Many have tried to support interdisciplinary or multidisciplinary perspectives as a means of overcoming the effective limitations of disciplinary parochialism.

We would characterize the distinctions between interdisciplinarity, multidisciplinary, and disciplinary in the following ways:

- (i) **disciplinarity**—is an approach to a particular problem space using a single collection of methods within a single domain of expertise;
- (ii) **multidisciplinarity**—is an approach to a particular problem space using coordinated outputs from distinct collections of methods that owe to respective distinct domains of expertise;
- (iii) **interdisciplinarity**—is an approach to a particular problem space using integrated outputs from combined collections of methods that owe to combined domains of expertise.

As a means of overcoming the potential effects of disciplinary parochialism, interdisciplinarity and multidisciplinary have both promises and issues of their own. For example, Rogers, Scaife & Rizzo (2005) critically distinguish interdisciplinarity from multidisciplinary as follows:

“There is a widespread view that interdisciplinary research is a good thing. By ‘interdisciplinarity’ is usually meant something like: the emergence of insight and understanding of a problem domain through the integration or derivation of different concepts, methods and epistemologies from different disciplines in a novel way. However, it is also widely believed that ‘true’ interdisciplinarity is very difficult to achieve and, more often than not, remains an elusive goal. In practice, many self-styled interdisciplinary enterprises actually work at the level of being multidisciplinary (or pluridisciplinary): where a group of researchers from different disciplines cooperate by working together on the same problem towards a common goal, but continue to do so using theories, tools, and methods from their own discipline, and occasionally using the

output from each other's work. They remain, however, essentially within the boundaries of their own disciplines both in terms of their working practices and with respect to the outcomes of the work."

Rust (2007) provides a positive approach in his descriptions of how artists and designers may act as provocateurs in interdisciplinary collaborations. This role requires acceptance of a proposition about what ought to be considered to be valid research:

"It is proposed that there can be valid research whose contribution to knowledge cannot be stated fully or precisely by the researcher. This is particularly relevant to research by creative artists, but it also has implications for interdisciplinary or multidisciplinary research that might result in contributions in different domains and where not all participants can 'own' the conclusions unless their partners are prepared to acknowledge the importance of the developmental contributions."

Critical to Rust's discourse is the notion that mutual recognition is a requirement of successful interdisciplinary or multidisciplinary research. Rust's proposition may also be related to the need to recognize the role of designers in *problem setting* as a complement rather than force set in opposition to the understanding of design as *problem solving* common in the computing sciences. The importance of recognizing as research the manner and tacit knowledge in which understanding the world as it is contributes to understanding the world as we want it to become is also well stated by Dourish (2005):

"What matters is not simply what those implications (for design needs and requirements) are; what matters is why and how they were arrived at, and what kinds of intellectual (and moral and political) commitments they embody, and what kinds of models they reflect."

The importance of tacit knowledge and recognition also is taken up by those who put forward notions of **transdisciplinarity**—a complementary notion to notions of disciplinarity, multidisciplinary, and interdisciplinarity that we describe in all that follows.

Transdisciplinarity

As a complement to interdisciplinarity, multidisciplinary, and disciplinarity, we define a fourth notion—that of transdisciplinarity—as follows:

- (iv) **transdisciplinarity**—is an approach which focuses neither on collections of methods nor domains of expertise, but rather focuses on a broader goal, *transcending* disciplinarity and using collections of methods and their associated domains of expertise on an as needed basis as required by the pursuit of this target broader goal.

A scholar or practitioner can be transdisciplinary in terms of broad perspective and still be either disciplinary, multidisciplinary, or interdisciplinary in terms of approaches to more specific sub-problem spaces. These categories of approach are not necessarily mutually exclusive.

The present day **foundations of transdisciplinarity** are in our account Nicolescu's *Manifesto of Transdisciplinarity* (2002) which refers to his

participation in an earlier accord of the Convento da Arrábida (1994) and Max-Neef's *Foundations of transdisciplinarity* (2005). The notion of *transdisciplinarity* enjoys a present day renaissance, having first appeared thirty to forty years ago in writings by Jantsch (1972), Kuhn (1962), and others according to Nicolescu. Nicolescu and Max-Neef's account of transdisciplinarity calls for a radical, values-rich interpretation of what it means to *transcend* disciplinarity. A number of books and anthologies have appeared recently which attempt to distinguish transdisciplinarity from more familiar notions of *disciplinarity*, *multidisciplinarity*, and *interdisciplinarity*. We classify these as follows:

Case studies & Perspectives

Some of these sources describe case studies and individual perspectives on the nature and definition of transdisciplinarity, including Hadorn et al.'s edited volume, (2008) *Handbook of Transdisciplinary Research*, Klein et al's edited volume (2001) *Transdisciplinarity: Joint Problem Solving among Science, Technology, and Society*, and Somerville & Rapport's edited volume (2000) *Transdisciplinarity: reCreating Integrated Knowledge*.

Sustainability & Transdisciplinarity

Somerville & Rapport's anthology is part of a series on sustainable development, and the issue of sustainability & transdisciplinarity is taken up as a distinguished topic in Hadorn, et al.'s journal paper (2006) *Implications of transdisciplinarity for sustainability research*, and Pohl's (2005) *Transdisciplinary collaboration in environmental research*. Pohl's treatment in particular describes observed individual disciplinary-focused impediments of attitude towards collaborative transdisciplinary research.

Other sources

A reasonably comprehensive reading list on transdisciplinarity by Cremer appears at: <http://web3.woodbury.edu/faculty/dcremer/readings.htm>. Older sources frequently referenced in discussions of origins of the term and notions of transdisciplinarity are Jantsch's article (1972) *Towards Interdisciplinarity and transdisciplinarity in education and innovation*, and Kuhn's (1962) *The Structure of Scientific Revolutions*.

Some part of Nicolescu's (2002) and Max-Neef's (2005) accounts includes the need to distinguish between **strong** and **weak transdisciplinarity**, and these accounts in turn require distinctions between classical notions of logics which include the law of the **excluded middle** and logics of the **included middle**—known as intuitionistic or mathematical constructivist logics. A good source for understanding the possible semantics of logical systems is Martin-Löf's (1996) *On The Meanings Of The Logical Constants And The Justifications Of The Logical Laws* which is a transcript of lectures Martin-Löf gave in 1983. To understand Max-Neef's (2005) account of strong and weak transdisciplinarity, it is helpful to review Martin-Löf's account of the cognitive and perceptual nature of intuitionistic logics:

*“There is absolutely no question of a judgement being evident in itself, independently of us and our cognitive activity. That would be just as absurd as to speak of a judgement as being known, not by somebody, you or me, but in itself. To be evident is to be evident to somebody, as inevitably as to be known is to be known by somebody. That is what Brouwer meant by saying, in *Consciousness, Philosophy, and Mathematics*, that there are no nonexperienced truths, a basic intuitionistic tenet. This has been puzzling, because it has been understood as referring to the truth of a proposition, and clearly there are true propositions whose truth has not been experienced, that is, propositions which can be shown to be true in the future, although they have not been proved to be true now. But what Brouwer means here is not that. He does not speak about propositions and truth: he speaks about judgements and evidence, although he uses the term truth instead of the term evidence. And what he says is then perfectly right: there is no evident judgement whose evidence has not been experienced, and experience it is what you do when you understand, comprehend, grasp, or see it. There is no evidence outside our actual or possible experience of it.” (Martin-Löf, 1996: p.14).*

Weak & Strong Transdisciplinarity

Max-Neef (2005) defines **weak transdisciplinarity** as actions which are defined to include all four of the following levels:

- (i) **empirical level**—what exists (i.e. mathematics, physics, chemistry, ...)
- (ii) **pragmatic level**—what we are capable of doing (i.e. architecture, engineering, agriculture, ...)
- (iii) **normative level**—what we want to do (viz. planning, design, politics, law)
- (iv) **value level**—what we must do (viz. values, ethics, philosophy)

In defining weak transdisciplinarity, Max-Neef (2005) refers to the familiar laws of classical logic, namely (i) **identity**—everything that is, is, (ii) **conjunction**—nothing can both be and not be, and (iii) **excluded middle**—everything either is, or is not. According to Max-Neef who takes his inspiration from Nicolescu, **strong transdisciplinarity** requires that in addition to actions that encompass all four of the levels above, three additional principles are needed, namely (i) **alternative levels of reality**—the idea that something that is evident in one context may not be evident in another, (ii) **included middle**—the idea that owes to intuitionism that there is at least one state between or which subsumes the states of knowing that something is or that something is not, and (iii) **complexity**—the idea that the opposites of these first two principles—the notions of a single reducible and objective reality and a simplistic two-state linear logic—are the antithesis of any path towards addressing the hard issues of our times.

To bring all of this back to the conference theme of **rigour**, what Nicolescu and Max-Neef propose is that **the rigour we need** can be achieved by an issues-driven transdisciplinary perspective that treats disciplinary perspectives as materials of values, ethics, and philosophically sound design and embraces

alternative levels of reality, intuitionism, and complexity. From this perspective, transdisciplinarity unifies alternative notions of science, logics, and rigour with a values-rich ethical imperative for a previously unsupported notion of research. **The rigour we have** in our universities and scholarship that owes to notions of disciplinarity—even interdisciplinarity and multidisciplinary—scaffolds a vision of knowledge and boundaries which run counter to solving the hard problems faced by humanity. Nicolescu argues:

“The rigor of transdisciplinarity is of the same nature as scientific rigor but the languages are different. One can even assert that the rigor of transdisciplinarity is a deepening of scientific rigor to the extent that it takes into account not only things, but their relations to other beings and things. Taking account of all of the givens present in a particular situation is a characteristic of this rigor. It is only in this way that rigor is truly a safeguard against all possible wrong turns.” (Nicolescu, 2002:p.120).

It is possible to understand Nicolescu and Max-Neef’s treatment as the rigorous mathematically constructivist semantics that underlie concepts like Nelson & Stolterman’s (2003) notion of design as a reflective practice (after Schön, 1986) that engages ultimate particular things, rather than general, averaged notions of things. A physicist by training, Nicolescu lays the foundations of transdisciplinarity in terms of the non-linearity of quantum physics as evidence of alternative levels of reality and intuitionistic logics of the included middle in place of classical ones. In doing so, we claim that Nicolescu’s account of *transdisciplinarity is a suitable underlying semantics for design criticism and critical design* as we have defined them in section 2.

The notion of *alternative realities*—however radical it might seem—may be just the notion required to provide rigour for design criticism within its ontological bounds. The constructivist notion of *included middle* may be just the notion required to provide rigour for critical design as a practice which takes place in the absence of complete understandings, preferring ultimate particulars to rules. The notion of *complexity* may be just the notion required to combat disciplinary parochialism and expose the opportunities for collaborations that focus on research actions in the service of larger critical goals of humanity and sustainability. It is possible that Nicolescu and Max-Neef’s notion of transdisciplinarity is the rigour that is needed to support such notions of design research.

What begins in Nicolescu’s account as rigour that owes to a re-thinking of the nature of science and its logical foundations, ends with a manifesto which serves as well for an ethics of design as it does for a definition of transdisciplinarity. As well as the Nicolescu’s text, the manifesto appears online at:

<http://nicol.club.fr/ciret/english/charten.htm> accessed 30.3.08

and while we won’t reproduce it entirely here, the preamble to the manifesto is enough to provide evidence of how Nicolescu’s rigour leads in his treatment to ethics suitable for design:

“Preamble

- *Whereas, the present proliferation of academic and non-academic disciplines is leading to an exponential increase of knowledge which makes a global view of the human being impossible;*
- *Whereas, only a form of intelligence capable of grasping the cosmic dimension of the present conflicts is able to confront the complexity of our world and the present challenge of the spiritual and material self-destruction of the human species;*
- *Whereas, life on earth is seriously threatened by the triumph of a techno-science that obeys only the terrible logic of (productivity for productivity's) sake;*
- *Whereas, the present rupture between increasingly quantitative knowledge and increasingly impoverished inner identity is leading to the rise of a new brand of obscurantism with incalculable social and personal consequences;*
- *Whereas, an historically unprecedented growth of knowledge is increasing the inequality between those who have and those who do not, thus engendering increasing inequality within and between the different nations of our planet;*
- *Whereas, at the same time, hope is the counterpart of all the aforementioned challenges, a hope that this extraordinary development of knowledge could eventually lead to an evolution not unlike the development of primates into human beings;*
- *Therefore, in consideration of all the above, the participants of the First World Congress of Transdisciplinarity (Convento da Arrábida, Portugal, November 2-7, 1994) have adopted the present Charter, which comprises the fundamental principles of the community of transdisciplinary researchers, and constitutes a personal moral commitment, without any legal or institutional constraint, on the part of everyone who signs this Charter.” (Nicolescu, 2005:pp.147-152).*

Transdisciplinarity and Interaction Design

It should be obvious at this point that we are making the case that a transdisciplinary understanding of research is suitable for design research. Design as a way for humans to approach and act in the world is based on a “broader goal” where methods are involved on an “as needed basis.” This is particularly true for design practice, but also for design research. Therefore, it is possible for design research to develop on its own needs and merits if more attention is paid to the notion of transdisciplinarity. We see this paper as an exploration in that direction.

To bring this full circle, the relation between this discussion of transdisciplinarity and notions of interaction design needs to be described. We do so with the following points:

Design Criticism

From (i) acts of collecting as we have ascribed to design-oriented notions of interaction design criticism to (ii) acts of gathering as we have ascribed to HCI-oriented notions of interaction design criticism, being transdisciplinary is a

likely means for taking a multi-dimensional view that accepts and admits to many levels of evidence in the task of understanding the implications of present ways of being for future ways of being. Such triangulation and recognition of alternative methods is the likely way to overcome the ontologically bound nature of our perceptions and understandings. Being transdisciplinary implies not only embracing many collecting and gathering techniques which would otherwise put design-oriented researchers and social sciences researchers at odds, but also that these techniques themselves are applied in a way that serves a broader societal goal and admits to alternative realities, the logic of included middle, and complexity.

Critical Design

From (i) acts of sketching as we have ascribed to design-oriented notions of interaction design criticism to (ii) acts of building as we have ascribed to HCI-oriented notions of interaction design criticism, being transdisciplinary is a likely means for ensuring that the choices we create for alternative future ways of being follow from sound values and ethics informed by design criticism.

Being Transdisciplinary

As an example of what it means to be transdisciplinary with respect to interaction design, consider that the preamble clause of Nicolescu's manifesto

"Whereas, life on earth is seriously threatened by the triumph of a techno-science that obeys only the terrible logic of (productivity for productivity's) sake; ..." (Nicolescu, 2002;p.147)

implies that particular interaction design practices need to be justified in terms of their effects on sustainment, rather than in terms of the ways in which they drive consumption. The transdisciplinary tools of doing so include envisioning alternative realities, acting constructively from what is at hand and what is imagined from the evidence of experience, and admitting to the complexity of what is involved in designing otherwise as an opportunity for opportunistically engaging disciplinary knowledge as a material of design rather than a guild to which the task of interaction design has been assigned.

Summary & Analysis

This paper starts by enumerating research modes in the confluence of design-oriented notions of interaction design and HCI-oriented notions of interaction design. It follows with a description of the triumvirate forms of disciplinarity, multidisciplinary, and interdisciplinarity. We quote from Rogers, Scaife & Rizzo's observation that what is often done in the name of interdisciplinarity is more rigorously understood as multidisciplinary. We also quote from Rust, who calls for recognition in interdisciplinary pursuits as a means of extending notions of rigour. We investigate Nicolescu and Max-Neef's account of transdisciplinarity and consider if it advances our understanding of collaborative behaviors and rigour in the context of interaction design. We think it does advance our understanding at the same time as being a work-in-progress, with some uncertainty about how exactly the transdisciplinary perspective can be made effective in terms of practice and appeal for

interaction designers. We conclude by referencing article 14 of Nicolescu’s manifesto, which affords the rigorous stance of Rogers, Scaife & Rizzo, the appeal for recognition and tolerance of Rust, and the openness that is at the heart of understanding the ontologically bound nature of design:

“Article 14 : Rigor, openness, and tolerance are the fundamental characteristics of the transdisciplinary attitude and vision. Rigor in argument, taking into account all existing data, is the best defense against possible distortions. Openness involves an acceptance of the unknown, the unexpected and the unforeseeable. Tolerance implies acknowledging the right to ideas and truths opposed to our own.” (Nicolescu, 2002: p.151).

Figures & Tables

Design-oriented notions of interaction design

(HCI informed by design theory and practices in general)

Design Criticism: Reflection & Critique (understanding present ways of being as effects on future ways of being)	(A) Present Implications for Futures Characteristic Activities Design Theory Reflection Design Philosophy Design Values Ontological Design Orthogonal Descriptions Criticism Collecting exemplars	(B) Possible Futures Characteristic Activities Observations Reflective Practice Insights Concept Systems Visual literacy Orthogonal Descriptions Communications Sketching	Critical Design: Action & Elimination (creating choices of alternative future ways of being)
	(C) Present Needs Characteristic Activities User Experience Studies Needs & Requirements Science & Design Value-Sensitive Design Activity Theory	(D) Satisfied Needs Characteristic Activities Prototypes Proofs of Concept Usability Studies Ubiquitous Computing	

Surveys & Focus Groups	
Orthogonal Descriptions Empiricism Gathering data	Orthogonal Descriptions Engineering Building

HCI-oriented notions of interaction design

(design informed by HCI theory and practices)

Figure 1. Disambiguating Design-oriented & HCI-oriented Notions of Interaction Design

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