



Making epistemological trouble: Third-paradigm HCI as successor science

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ABSTRACT

Epistemological issues have long been debated by feminist philosophers aiming to answer the question, “what difference does it make to take gendered points of view seriously in the construction of knowledge?” Coming out of this history, a strand of work in feminist science studies has argued for the necessity of “successor science:” new forms of science based in standpoint epistemology, i.e. a recognition of the necessarily situated points of view of scientific knowledge-makers. In this paper, we argue that such a successor science has already come into being within the field of HCI, though it is perhaps not recognized as such by its practitioners.

In particular, we identify a cluster of research we term the ‘third paradigm.’ This cluster of research cuts across HCI research areas as typically organized by topic area. Instead, this research shares an underlying epistemological orientation closely aligned with standpoint epistemology, focused around an acknowledgment of the social, cultural, and physical situatedness of both users and analysts. Feminist philosophers of science argue that a logical outcome of standpoint epistemology is the need for science to reflexively grapple with the limitations of its own ways of knowing; we conclude such an outcome may also be in store for the third paradigm.

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1. Introduction

Feminists have long concerned themselves with rectifying the historical shortcomings of science by identifying instances of gender bias such as the identification of the male body as the default in medicine and tracing the consequences for scientific practice of altering those biases. One goal of this work has been ‘successor sciences,’ or new forms of scientific practice that systematically avoid the problems of gender bias embodied in many existing practices. But as these analyses have proceeded, many feminist analysts have concluded that gender bias exists not only in flawed execution of science but also in the ideals and mechanisms identified with the scientific method itself. Arising from these concerns is a need to conceptualize successor science not simply as an unbiased version of science-as-we-know-it but as involving a significant epistemological shift.

In this article, we will argue that the epistemological shift which feminist philosophers of science describe has come into being within the field of HCI, though it is not always recognized as such by its practitioners. In particular, we will argue that the scene of HCI in the last few years shows signs of epistemological

trouble. While the historical roots of our field generally lie in the familiar epistemological frameworks provided by human factors and the cognitive revolution, over the last 25 years a wide variety of critiques and approaches have emerged that fit poorly the models and methods emerging from these frameworks. These include participatory design, value-sensitive design, user experience design, ethnomethodology, embodied interaction, interaction analysis, and critical design. On the surface, these critiques have involved a disparate array of issues and approaches. Yet, we will argue that many of these approaches can be usefully seen as elements of a single epistemological framework, which treats interaction as a form of embodied meaning-making in which the artifact, its context, and its study are mutually defining and subject to multiple interpretations. For historical reasons, we will refer to this framework as “the third paradigm.”¹

We initially conceived of the third paradigm in 2006. Although that work has been until now unpublished, this articulation of the

¹ We originally used this term in a 2007 alt.chi paper, “The Three Paradigms of HCI,” on which this article is loosely based. It alluded to human factors and the cognitive revolution as the first and second paradigms, respectively. Although in subsequent work we came to the conclusion that this framing of the third paradigm in contrast to a speculative identification of prior two paradigms was problematic and a better term for the “third” paradigm would be “situated perspectives,” we found that in the broader community the original term has stuck, perhaps reinforced by Bødker’s articulation of a “Third Wave” of HCI (Bødker, 2006) which partially overlaps with the third paradigm.

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third paradigm appears to have resonated in the community. In this paper, we rework our original arguments about the third paradigm in order to better flesh out its philosophical groundings through the use of feminist philosophy of science. Looking at the third paradigm through the lens of feminism enables us to better understand the consequences and potential of the epistemological shift it embodies. Our core argument is that the third paradigm is making the kind of epistemological trouble that feminist philosophers of science advocate, and that recognition of this connection leads to the conclusion that epistemological trouble, far from being resolved by the establishment of the Third Paradigm, will and should remain healthily pervasive.

We will start by explaining what we mean by epistemological trouble and what it looks like in HCI.

2. Epistemological trouble

By ‘epistemological trouble,’ we refer to methodologies and approaches that fundamentally question the mainstream frameworks that define what counts as knowledge in a given field. This notion of epistemological trouble draws to some degree from Kuhn’s theory of the structure of scientific revolutions (Kuhn, 1970), which reframes our understanding of science from a gradual accumulation of facts to successive, overlapping paradigms which fundamentally re-frame ideas and alter the nature of what we take to be facts. Canonical examples of such paradigm shifts include the acceptance of continental drift by earth scientists and the shift from a mechanically elegant Newtonian physics to the messy relativistic physics.

Kuhn argues that paradigms can be characterized by a common understanding of the phenomenon under study, the kinds of questions useful to ask about the phenomenon, how we should structure answering those questions, and how the results should be interpreted. New paradigms do not disprove established paradigms; instead, they provide incommensurable ways of framing their science’s work. Most science is what Kuhn calls ‘normal science,’ in which questions that logically follow from an existing paradigm are raised and answered. As a paradigm is worked through, the number of anomalies that poorly fit the paradigm inevitably accumulate. This may lead to a crisis period accompanied by what we here refer to as epistemological trouble, in which fundamental questions are raised about what terms should mean, what kinds of questions are valid to pursue, and what procedures should be used to validate their answers. This period may lead to what Kuhn terms ‘revolutionary science:’ new approaches which call into question fundamental, long-held assumptions of the existing paradigm. Usually, alternative approaches will be short-lived, since it is difficult to demonstrate enough explanatory power to challenge a proven paradigm. Occasionally, a new paradigm will gain the momentum to become an established alternative.

In this paper, we argue that such a period of crisis is currently taking place in HCI. To identify the signs of this crisis, we draw on Agre’s theory of generative metaphors in technical practice (Agre, 1997). Agre argues that technical fields tend to be structured around particular metaphors which suggest questions that are interesting to ask and methods for arriving at answers to them. So, for example, the dominant metaphor of the cognitive revolution in HCI is that human minds are like information processors, and that interaction can be modeled as information exchange between humans and computers. This metaphor suggests research questions such as ‘how does information get in,’ ‘what transformations does it undergo,’ ‘how does it go out again,’ ‘how can it be communicated efficiently’ and so forth. It also suggests methods for finding answers to those questions, for example that by modeling human mental activity using computational code and validating

these models by comparing computational and human input and output.

In HCI, this metaphor is famously laid out in Card et al. (1983), which starts from the premise that human information processing is deeply analogous to computational signal processing, and that the primary interaction task is enabling communication between the machine and the person. Operations performed by one in pursuit of a goal affect the state of the other. By modeling the state of the person as well as of the computer, we can predict and optimize the relationship. One power of this approach comes from the fact that the information-processing model holds within the computer, between the computer and the person, and within the person. Since the model is one of rational actors, operations can be measured in terms of the accomplishment of goals. Therefore, designs can be systematically evaluated against one another. Experiments in human–computer interaction that take a task, such as “notification” or “awareness,” and test two or more designs against one another follow in this tradition at least implicitly by postulating an underlying psychological state for the user that can be modeled and optimized. The effectiveness of the metaphor of computers and humans as coupled information processors in generating research questions and answers is reflected in its longevity; Day (2000) claims it is still primarily guiding information science research today.

In Agre’s model, while such a generative metaphor by no means strictly dictates what is done in a field, it does bring certain phenomena into the center of investigation while marginalizing others. In HCI, for example, it has been relatively straightforward to analyze and design for rational activity, but it has been more difficult to address emotional and embodied experiences. Such ‘margins’ of the field tend to appear at first as unimportant cases or as future work, to be pursued once the more central cases have been resolved. Through ordinary technical practice, Agre argues, technical fields push on their underlying metaphors. Eventually, the metaphors’ usefulness is exhausted, leading to recurring patterns of trouble, including the proliferation of marginal cases which fail to be assimilated to the central metaphor. In Agre’s model, ‘crisis,’ in Kuhn’s terms, would be characterized by phenomena which once were at the margin coming to the center of attention, and in doing so suggesting the need for new metaphors that drive new research questions, methods, and validation procedures. In order to characterize the current crisis, then, we describe some of the contemporary strands of research in which formerly marginal phenomena are becoming central, suggesting limits to the information-processing metaphor and the need to develop alternatives to it.

First, current work in ubiquitous and pervasive computing brings the dynamic use context of computing into central focus. Some methods of dealing with the importance of this context follow directly from the information-processing metaphor, notably attempts to identify and optimize information flow between mobile and ubiquitous devices and their context. These approaches model use context as yet another source of information that can be formalized and transmitted to machines. But approaches to ubi-comp derived from disciplines such as ethnography, design, and the arts are based on the idea that use context is, in the end, fundamentally unspecifiable and must be dealt with by other means (e.g. Dourish, 2004). Pervasive gaming, for example, takes changing context as a central focus for investigation (e.g. Benford et al., 2003), while seamfulness (Chalmers and Galani, 2004) pays design attention to the ways in which the connection between context and technology breaks down.

A related set of issues arises out of workplace studies, which focus on the social situation of interaction. These perspectives have often been hard to reconcile with CHI, leading to their parallel exploration in CSCW and PD. In particular, the centrality of social,

situated actions in explaining the meaning of interaction is at odds with an information-theoretic, formalized view of social interaction (Bannon, 1995; Suchman, 1987).

A third set of issues arises out of the domain of non-task-oriented computing, such as ambient interfaces and experience-centered design (Wright and McCarthy, 2010). These approaches tend to be bad fits to the requirement arising out of information-processing approaches that problems be formalized in terms of tasks, goals and efficiency – precisely what non-task-oriented approaches are intended to question. It is difficult, for example, to apply usability studies to ambient interfaces, since standard evaluation techniques are ‘task-focused’ in the sense of asking users to pay attention to and evaluate the interface, precisely what the system is devised to avoid. Alternative methods are difficult to conceive and raise possibly incommensurate values.

A fourth set of issues arise out of the marginalization of emotion in classic cognitive work. A wide range of approaches to emotion, notably those of Picard (1997) and Norman (2004), has been inspired by recent cognitive psychology, which argues that emotion plays a central role in cognition and models emotional exchange as a type of information flow. But other approaches to affective computing reject the equation of emotion with information and focus instead on the interpretation and co-construction of emotion in action in ways analogous to situated-action approaches in workplace studies (e.g. Boehner et al., 2005).

These difficulties have not only raised new topics and questions; they also suggest alternative metrics and methods for design and evaluation that can be difficult to reconcile with established standards within HCI. Their clash with some of the central assumptions and understandings of HCI as constituted so far has led to a variety of fates. Some approaches, such as affective computing, have found ways to back-fit new phenomena under study to the information-processing metaphor. Some, such as ethnographic approaches, have been amalgamated to HCI in an uneasy marriage. Some, such as ethnomethodological concerns about the centrality of practices outside those formalized in HCI, have been heard but not fully worked through, spawning alternative fields such as CSCW outside of the mainstream represented by CHI, and, inevitably, some have failed to find a home.

A principal argument in this paper is that the apparent proliferation of alternatives to mainstream frameworks of HCI can be conceptually unified when viewed through the lens of feminist philosophy of science. That is, these research approaches can be understood as part of a nascent paradigm that puts these issues in the center rather than the periphery of investigation. Our aim in doing so is, first, to enable these research approaches to better cross-inform each other by demonstrating their conceptual compatibility, and, second, by articulating their implicit commitments as part of a ‘third paradigm’ to better understand and further develop the philosophical position they embody. In particular, we will use feminist philosophy of science to suggest that this new paradigm will not replicate the epistemological assurances and methodological unity that we normally associate with scientific paradigms.

3. The third paradigm

We begin our exploration of the third paradigm by recognizing that embodied interaction is a key underlying theme. Embodiment, of course, also plays a role in other approaches to interaction. In human factors, attention is paid to such factors as the fit of a mouse to the human hand or how easily particular font sizes may be read. Cognitively based work in HCI lays out physical constraints that usefully inform interface design such as the speed at which humans are able to react. Embodiment in the third paradigm is based

on a different stance: drawing on phenomenology, it takes as central that the way in which we come to understand the world, ourselves, and interaction derives crucially from our location in a physical and social world as embodied actors.

Embodiment in this sense substantially changes what we take as central to interaction. Klemmer et al. (2006), for example, in a review of the literature on embodiment, highlight five central implications an embodied stance has for how we think about and design interfaces. When thinking is conceptualized as achieved not only abstractly but through doing things in the world, gestures, manipulation and physical prototyping become central to interface design. Attention to embodiment suggests that GUI interfaces overemphasize seeing, hearing, and motor control of our hands; instead, design can also support other senses and physical abilities such as action-centered skills and motor memory. Embodiment refocuses attention from the single-user/single-computer paradigm that has recently dominated HCI towards collaboration and communication through physically shared objects. It highlights the importance of risk as a positive aspect of embodied practice; there is no undo button in the real world. Finally, it reminds us that, while historically we have tended to design for aspects of activity that are easily automated, real-world practice is complex and rich, interleaving physical activity and awareness with abstract thoughts, rituals, and social interaction in ways that defy a purely informational approach.

Many in HCI have been introduced to aspects of embodiment through Dourish’s *Where the Action Is* (Dourish, 2001), which argues for embodied interaction as a theme uniting tangible interaction with ethnographic and ethnomethodological approaches. Dourish emphasizes that embodied interaction does not involve primarily a shift in what we build but a more fundamental shift in how we understand interaction: “Embodiment is not a property of systems, technologies, or artifacts; it is a property of interaction. . . In contrast to Cartesian approaches that separate mind from body and thought from action, embodied interaction emphasizes their duality” (p. 189). This conceptual shift in turn changes the landscape of appropriate choices in design and evaluation.

In this section, we will demonstrate that a perspective drawing on embodied interaction unites not only tangible interaction and ethnomethodological approaches but a wide range of existing approaches poorly fitting the information-processing metaphor. In doing so, we will explicate how this perspective is not simply a different topic for standard HCI methods, nor only a different understanding of what is salient about interaction. Rather, this perspective is grounded in substantially altered epistemological commitments and therefore systematically leads to changed research questions, methodologies, and forms of design and evaluation. These epistemological commitments, we will argue, are shared with feminist philosophy of science. Our argument is not that researchers in HCI are explicitly drawing on feminist philosophy (although some are (e.g. Bardzell, 2010)); rather, we will show how the commitment to embodied interaction which underlies the third paradigm leads organically to a perspective on science similar to that envisioned by feminist philosophers. We start by articulating this perspective.

3.1. Successor science

One of the primary goals of feminist philosophy towards science has been famously described by Harding (1986) as the establishment of ‘successor science’ – new, i.e. successive, forms of science which would avoid the systematic gender, class, and racial bias which sociologists, anthropologists, and historians of science have identified in current scientific practices. As Harding argues, successor science became substantially more difficult to conceptualize as feminist philosophers of science realized that

such bias is not simply the result of error or poor practice but is directly tied to the values and norms of the scientific method, as commonly construed.

As a crucial example, claims of science to universal objectivity have been repeatedly deconstructed to show how ‘universal’ claims actually embody specific gendered, class, or racial agendas. This perspective is formalized in the notion of “standpoint epistemology,” i.e. the idea that all knowledge arises from and is related to specific social, cultural, and historical circumstances – a particular point of view. In standpoint epistemology, subjugated standpoints – those of people oppressed due to gender, race, or other forms of systematic bias – are thought to potentially be more insightful than those of people who are systematically privileged.² The result is that *all* universal knowledge claims become suspect, since totalizing claims would imply taking one person’s point of view as more valuable or more central than others’, and therefore sidelining those in less powerful positions.

It may seem impossible to engage in scientific practice without such universal knowledge claims. But guidelines for what such a successor science could look like are provided in a remarkable and highly influential essay by feminist philosopher of science Haraway, in which she develops a conception of feminist objectivity termed ‘situated knowledges’ (Haraway, 1988). Its core idea is to rethink objectivity for successor science by changing the metaphor of vision which underlies it.

Traditional notions of scientific objectivity are based on a metaphor of transparent vision: truth consists of mental representations that are directly tied to and validated by natural reality. Colloquially speaking, we can think of automatically generated visual images such as electron microscope scans or astronomical images which present themselves as direct access to true reality, independent of any one person’s point of view – what Haraway terms the “god’s-eye view.” At the same time, however, such images are complex constructions. So, for example, electron scans reveal objects that are smaller than could possibly be visible with light, while images from outer space generally lie outside the visible spectrum. Each image is therefore not a direct view of reality; rather, each is based on methods of mapping sensed data into a visual range we can see. Understanding the ‘truth’ of these images requires knowing not only what you can see in them, but also the mechanisms through which they are produced.

Based on this insight, Haraway moves from a model of science as transparent access to natural reality, to a model of ‘situated knowledges’ coming from particular points of view and generated through particular mechanisms. Appreciating the nature of the varying truths these positions and mechanisms generate requires knowing where they come from and how. Fully general, true-for-all-time knowledge is not possible, since no one person represents the ‘correct’ view or even a single view. Yet, because of Haraway’s emphasis on the mechanisms by which knowledge is created, her model does not devolve into an anyone’s-opinion-counts-the-same dissolution of science. Instead, an awareness of how knowledge is grounded in standpoints and mechanisms enables the establishment of discussions between different ways of knowing. From this perspective, people and institutions cannot simply say “it’s how things look to us;” instead, they can and must be held accountable for the sorts of mechanisms they rely on and the forms of knowledge they create. In addition (and following the feminist agenda), it is important to recognize power disparities in knowledge and to make sure minority voices are heard.

² Philosophically, this perspective has its roots in Hegel’s highly influential master-slave dialectic, which argues that ‘slaves’ who are engaged in the minutiae of labor have a better understanding of the exigencies of reality than the ‘masters’ who give them their orders (Hegel, 1977).

3.2. The third paradigm as successor science

Central to feminist philosophy of science, then, are critiques of the placeless, bodiless god’s-eye view central to traditional notions of truth in science. Instead, feminist philosophers see both knowers and knowees as essentially socially, culturally, and historically located, and argue that taking this idea seriously has deep implications for how we understand what it means to know. We see this idea reflected in the phenomenological viewpoint which is central to the third paradigm, in which all action, interaction, and knowledge is seen as embodied in situated human actors. From this perspective, it is possible to articulate the third paradigm as a specific form of successor science. Here we describe how this commitment to knowledge a standpoint epistemology plays out in the intellectual commitments of the third paradigm. The goal here is not to identify what the third paradigm *should* be, but to describe what it already appears to be.

3.2.1. The situated construction of meaning

The third paradigm sees meaning and meaning construction as a central focus. Following from the standpoint of embodied interaction, it sees meaning as constructed on the fly, often collaboratively, by people in specific contexts and situations. Because of this, interaction itself is an essential element in meaning construction. Meaning derives from information, of course, but is also irreducibly connected to the viewpoints, interactions, histories, and local resources available to those making sense of the interface and therefore to some extent beyond the reach of formalization. This notion is at the heart of *Plans and Situated Actions* (Suchman, 1987) and has been constitutive of CSCW; in other areas we see, for example, research on the value of ambiguity (Gaver et al., 2003). This focus on the situation in which meaning arises directly connects to Haraway’s identification of the knower’s standpoint as being necessary to make sense of knowledge claims.

3.2.2. Putting users in their place

If meaning is irreducibly local, then knowledge is strongly situated as well: people’s understanding of the world, themselves, and interaction is strongly informed by their varying physical, historical, social, and cultural situations. Following from standpoint epistemology, the move to embodiment entails recognizing a plurality of perspectives and appreciating the value of accommodating those differences rather than reducing them to a single perspective. Designing interaction moves from attempting to establish one correct understanding and set of metrics to studying the local, situated practices of users, taking into account but not adjudicating the varying and perhaps conflicting perspectives of users (Sengers and Gaver, 2006). Aoki and Woodruff, for example, argue for the value of CMC systems accommodating multiple understandings of what is happening in a relationship (Aoki and Woodruff, 2005).

3.2.3. Putting interfaces in their place

One result of taking situated embodiment as crucial is a renewed emphasis on the importance of place. This aspect reflects literally the notion from standpoint epistemology that all actors see the world from a particular location. For example, McCullough’s *Digital Ground* (McCullough, 2004) analyzes the significance of ubiquitous technologies being designed for specific locations, times, social situations, and surrounding systems. ‘Putting interfaces in their place’ is grounded in the recognition that the specifics of particular contexts greatly define the meaning and nature of an interaction. Since all possibilities cannot be designed for, one strategy is to design an interface with respect to its intended embodied location. By designing the interface to fit into its intended physical and social setting, the device or system does not have to model every contingency but instead can rely on properties of the environment to support

or constrain interaction (Leahu et al., 2008a,b). Other strategies include location awareness or situation awareness, for example cell phones knowing if they are in a movie theater or if their owner is in the middle of non-phone conversation.

3.2.4. *Putting researchers in their place*

If users' knowledge is situated, so is that of the researchers studying them. Compared to the cognitive revolution, the range of disciplines and perspectives constituting the third paradigm is remarkably catholic, ranging from the arts to sociology to policy. The goal does not appear to be to establish one of these disciplines as the gold standard. Indeed, one characteristic of the third paradigm is a preference for multiple interpretations that give a rich sense of the site of interaction over a single, objective description of it (Sengers and Gaver, 2006). This is the aspect of the third paradigm that most directly embodies standpoint epistemology – the notion that science does not have a single, objective viewpoint but may encompass a wide variety of viewpoints, even ones that may conflict.

3.2.5. *Explicit focus on values in design*

Given the variety of potentially valid viewpoints underlying the third paradigm, evaluation of what makes a system a success can no longer be rooted *a priori* in measures said to be universally valid. This aligns with standpoint epistemology's insistence on recognizing the cultural and social contingency of perspectives that claim to have universal validity. If we cannot come up with a universal metric for a good system, then we must ask questions about what it means for a system to be 'good' in a particular context – a question that quickly brings us to issues of values. Value-based approaches to HCI such as participatory design and value-sensitive design have come into use to establish new criteria of success – and therefore of decision-making – in system design and evaluation (Friedman, 1997). All call for some form of explication and explicit negotiation of standards of success. Instead of being marginalized as a confounding factor, the context of design is seen as central, leading to questions such as "Who is making the design decision?", "Who is paying for it?", "What is this saying about the user?" and so on. Likewise, in esthetic evaluation of interfaces, "elegance" is no longer exclusively premiated; it is just as likely that "appropriate" or "appropriable" are central esthetic requirements. Finally, critically-oriented approaches such as critical design and reflective design aim not to establish particular values but to highlight the need for critical interrogation of the values promoted within each design project.

3.2.6. *The centrality of context*

Historically, HCI has tended to see context primarily as "those non-technological factors that affect the use of the technology." Under the third paradigm, researchers tend to ask not only "how does context give our design meaning?" but also "how does our design accommodate the context?" This latter question includes what researchers do *not* put into their design, their restraint, or "zensign." It also encompasses the possibility that the technological system is reported not because, taken alone, it is particularly unique or attractive, but because of how it fits into the particulars of a complex situation (e.g. Gaver et al., 2010). A consequence of this is that context is a central component not only to the problem (if any) but also to design and evaluation (Forlizzi, 2009). This emphasis on the importance of context reflects feminist theorists' critique of the notion of universal truths and emphasis on particular situations.

3.2.7. *The necessity, but inadequacy, of theory*

The third paradigm includes emphasis on theory as a resource for making sense of what is happening at the site of interaction.

Nevertheless, because context is seen as an equally essential ingredient for knowledge-making, the third paradigm follows feminist critiques of abstract knowledge by recognizing that theory in the abstract has necessary limitations. In contrast to approaches arising from the laboratory behavioral sciences, which often see theory as primary and design and evaluation as ways of instantiating, testing, and developing theories, third-paradigm approaches tend to focus on theory more as heuristics to be drawn on, with full understanding emerging from the combination of theoretical lenses and what happens practically at the scene of action – what Gaver calls "humble theory" (Gaver, 2006). So ethnographic and particularly ethnomethodological approaches, for example, tend to eschew *a priori* categories of interest in favor of discovering what emerges from interaction (Emerson et al., 1995). Similarly, cultural probes are purposefully constructed to avoid asking direct questions which would limit discovery to what is suggested by researchers' theoretical interests (Gaver et al., 2004; Boehner et al., 2007).

To sum up, the third paradigm contains a variety of perspectives and approaches which focus on interaction and its study as phenomenologically situated. The goal for interaction is to support situated action and meaning-making in specific contexts, and the questions that arise revolve around how to complement formalized, computational representations and actions with the rich, complex, and messy situations at hand around them. Because of its emphasis on multiple perspectives, the third paradigm does not espouse a single, correct set of methods or approaches to answer these questions. It adopts multiple theories or stances and considers them non-exclusively.

3.3. *What is the third paradigm?*

We note that the description we have offered of the third paradigm thus far occupies an uneasy ontological position. For one thing, we have not given a complete list of areas or approaches which clearly fall under the third paradigm, which may lead the reader to wonder what is intended to be thought of as a third-paradigm approach and what is not. A second, related issue is that it is unclear whether the attributes of the third paradigm previously laid out are intended purely as descriptive or normative, i.e. whether we are describing an existing trend or proposing rules for a new one which will delineate what those claiming to adhere to this paradigm must do.

These two issues require us to be clearer about the nature of the theoretical contribution we are providing. The reason we do not provide a laundry list of areas is that many relevant areas of HCI such as affective or ubiquitous computing are defined by subject topic rather than the mode of approaching that subject. We would argue, in contrast, that the primary characteristic of the third paradigm is a fundamental epistemological shift, which raises questions about the categories of knowledge production which have until recently been dominant in HCI, a shift we will describe in more detail below. Thus, topical areas such as experience design or affective computing involve some approaches which can be understood as third paradigm, and others that cannot, depending on the stance to their subject.

In this context, then, our goal, on the one hand, is to provide a set of lenses to the research community which can help researchers see the commonalities between what appear superficially to be a wide range of projects and approaches. At the same time, through articulating implicit commitments that appear to underlie those approaches, we aim not simply to describe what is happening but also to provide footholds for further research in the same vein. The theory therefore calls into being what it describes.

Indeed, since our original identification of the third paradigm, a substantial amount of new work in its vein has appeared, some of which explicitly calls itself out as third paradigm (e.g. Ylirisku

et al., 2009). Particularly relevant to our discussion here is the developing critical discourse that directly treats epistemological issues related to the core intellectual commitments of the third paradigm, including Bardzell's analysis of how to grapple with the "philosophical incompatibilities" (p. 2357) between mainstream HCI and critical theory (Bardzell, 2009), Irani et al.'s exploration, drawing on postcolonial theory, of taking the cultural context of researchers and researched seriously in the constitution of HCI methods (Irani et al., 2010), and Bardzell's discussion of design and research directions for HCI that draw on feminist theory (Bardzell, 2010). Next, we will explore the epistemological shift inherent in the third paradigm in more detail, by showing how it complements and extends the epistemological commitments of feminist theory.

3.4. Epistemological trouble-making in the third paradigm

Feminist philosophers argue that standpoint epistemology leads to substantially changed epistemological commitments. Within HCI, we can see the difference that standpoint epistemology makes in many of the qualities of feminist HCI identified by Bardzell (2010):

- The quality of pluralism involves a shift from universal knowledge claims to multiple, particular knowledge claims, including a shift in central object of study from the 'typical' user to including marginal users.
- The quality of participation involves a shift from a distant, God's-eye view on the subjects under study to active participation with those under study in the construction of knowledge.
- The quality of advocacy challenges HCI researchers to move from positions of apparent neutrality with respect to what they study to politically informed advocacy and engagement.
- The quality of ecology moves the scene of knowledge creation from controlled, artificial situations to holistic, complex contexts.
- The quality of self-disclosure echoes Haraway's articulation of situated knowledges by suggesting a shift from hidden to exposed mechanisms for generating conclusions about users.

In Bardzell's argument, the only quality that does not have an immediately obvious epistemological dimension is embodiment, which Bardzell articulates as a call to study embodied aspects of users. Articulating the third paradigm as grounded in embodiment as a phenomenological viewpoint from which knowledge is made, and as thereby performing Haraway's injunction to see knowledge as situated in particular positions and mechanisms, allows us to see the epistemological consequences of this quality of feminism as well.

For one thing, if we understand knowledge as arising from particular positions in the world, this suggests a value to recognizing and articulating subjective forms of knowledge. For example, the HCI research world has been challenged recently to better understand and address design practices as a form of knowledge production (e.g. Wolf et al., 2006), in which the stance taken by the designer plays a key role to shape the products of design (Boehner et al., 2007). Similarly, epistemological trouble has arisen with the incorporation of ethnography into HCI, which, as Dourish has argued (Dourish, 2006), has a similar emphasis on the analytic stance of the individual ethnographer in the construction of understanding. While from the viewpoint of traditional HCI research, such approaches may appear simply anecdotal, situated knowledges suggest that all knowledge should be understood as having subjective aspects, and that this does not invalidate knowledge claims nor put us in a situation of your-word-against-mine. Rather, it becomes key to better articulate how those subjective understand-

ings were arrived at. For example, McCarthy and Wright demonstrate how to use detailed, personal reactions to using a particular website to develop new design considerations that take into account users' personal experience (McCarthy and Wright, 2004).

A second consequence of taking situated knowledges as central to HCI is that detailed, rich descriptions of specific situations become particularly valuable as a knowledge product, as compared to generalized formalisms. Bardzell articulates a similar sensitivity as part of the quality of pluralism, which suggests that detailed understanding of specific users may be more valued than universal understanding. In the context of the third paradigm, we see how these issues are tied to considerations of embodiment. For example, *Plans and Situated Actions* (Suchman, 1987) argued that while abstract knowledge and formalisms are useful, they do not directly drive or explain our activity in the world. In order to better understand what people are doing, we need to track the situated contingencies and strategies people use to apply this abstract knowledge in real situations. Where historically HCI studies may not have paid attention to whether an office had books in it or that a computer sitting under a desk produced lots of heat when analyzing mouse performance, we now recognize that "externalities" are often central figures in the understanding of interaction. CSCW in particular has been an area where this concern for moving beyond formalism and paying attention to the details of concrete situations has been worked out.

A focus on situated, embodied forms of knowledge suggests as well an epistemological shift from analytic means such as statistical analysis, classification and corroboration, often under controlled conditions, to a focus on multiple, participatorily generated interpretations in concrete, real-world situations. This stance shares attributes with Bardzell's qualities of participation, and ecology, and suggests that the epistemological stance brought to this site will generally be hermeneutic, focusing on developing holistic, reflective understanding while staying open to the possibility of simultaneous, conflicting interpretation.

Recognition of the changed commitments of third-paradigm work from those historically dominant in HCI research can lead to real innovation, as practitioners draw their methodological conclusions (e.g. Gaver, 2007). But where the differences are poorly understood, troubles can emerge. Some troubles arise around applying criteria for validity that conflict with the core intellectual commitments of third-paradigm work, for example requiring ethnographic investigation to lead to universal statements of user needs (Dourish, 2006). Other troubles arise around attempts to build on third-paradigm work by eliminating those aspects of it which conflict with the information-processing metaphor, for example 'fixing' the dialogic nature of cultural probes by replacing open-ended interpretation with statistical methods (Boehner et al., 2007). Such issues suggest that there is a need across the research community to better articulate and reflect on the reasoning behind methodologies. In the final section, we will explore this in more detail.

4. Discussion

In our initial work on the subject, we proposed the third paradigm as a successor or alternative to other paradigms in HCI. Indeed, so far, our argument identified a period of epistemological trouble within HCI and the gradual emergence of a cluster of research whose underlying epistemology is related to feminist standpoint epistemology. Within a Kuhnian frame, this may appear as a period of crisis, possibly heralding a period of 'normal science' under a new paradigm – the third.

However, our view of the third paradigm through the lens of feminist philosophy of science substantially troubles that

conclusion. As Harding (Harding, 1986) famously argues, a successor science that takes feminist philosophy of science to its logical conclusion will not be oriented towards establishing a new, stable paradigm, but rather will develop a reflexive awareness of the limits of knowledge practices as part of scientific practice itself. This is because there will always be a necessary tension between developing a successor science which can establish new truths and the feminist project of questioning the validity of any universalizing knowledge practices. One might see this as inducing a permanent crisis state, in Kuhn's terms – as Harding puts it, “No ‘normal science’ for us!” (p. 648). In other words, epistemological trouble-making is *itself* a central form of feminist practice.

In considering the potential of the third paradigm to live up to this feminist vision, we must recognize that HCI operates within a pragmatic, industrial context that renders it more than a pure search after knowledge. HCI practitioners and theorists operate in a world involving engineers and engineering values such as efficiency and optimization. Industry depends on predictability and control. At this historical moment, as devices become omnipresent, engineers may be more open to new knowledge forms because they are faced with problems of a new culture. However, as ubiquitous computing practices become more codified and routine, so too may engineering practices harden. Thus, as the third paradigm is becoming recognized, it could diverge from Harding's vision.

What alternatives might we be able to imagine? We begin here with Agre's conception of critical technical practice, which has had a substantial impact on HCI (Dourish, 2001, 2004; Sengers and Gaver, 2006; Sengers et al., 2005). Following his theory of generative metaphors, Agre conceives of critical technical practice as continuously identifying and providing alternatives to the key metaphors which are driving technical work. “A critical technical practice would not model itself on what Kuhn called ‘normal science,’ much less on conventional engineering. Instead of seeking foundations it would embrace the impossibility of foundations, guiding itself by a continually unfolding awareness of its own workings as a historically specific practice” (p. 23). This notion of continuous reflexivity is remarkably consonant with Harding's call for a destabilizing feminist successor science, but it simultaneously raises the specter of an unproductive intellectual churn in which margins are simply brought to the center, codified, and then made marginal again.

Haraway's conceptualization of situated knowledges, with its emphasis on the articulation of mechanisms for the production of knowledge as a foundation for engagement between varying knowledge claims, may offer a way out. While Agre would argue that knowledge arising from different metaphors is more or less incommensurable, Haraway sees mutual engagement as possible as long as we are explicit about the standpoint from which a particular knowledge claim comes and the methodology which is used to generate it.

We note that taking this point of view seriously clouds our description of the third paradigm. For example, we described one of the epistemological shifts underlying the third paradigm as moving from analytic, controlled forms of knowledge production to hermeneutic, interpretive ones. Looked at from the vantagepoint of Haraway's situated knowledges, however, the situation is more complex, since Haraway suggests that the problem is not the *nature* of the mechanism for generating knowledge but a recognition of its fundamentally situated character. This suggests that a feminist take on third-paradigm HCI would put both analytic and hermeneutic approaches into dialogue.

Leahu, Schwenk, and Sengers explored one way to do so, explicitly inspired by Haraway's work (Leahu et al., 2008a,b). In a design exploration of affective computing, they made maps of GSR readings (physiological signals tied to emotions) as participants walked around campus. While GSR readings are typically used as an objective measurement of a person's actual (rather than reported)

emotional state, in this design study they used the maps instead as a prompt to elicit participants' subjective descriptions of their emotions. The maps triggered rich self-reflection around emotion, in part because the GSR reading was able to be read ambiguously and strategically both as a genuine indicator of hidden emotion and as a meaningless physiological signal. This allowed conflicting viewpoints on emotion to co-exist and cross-inform each other, rather than establishing one single viewpoint – the GSR reading vs. the participants' claims – as the final adjudicator of the truth of emotion. Results from the study were used to drive conceptual designs of systems to support multi-perspectival, community-based reflection on emotions. This case study provides one way of thinking through how feminist arguments for opening a space for varying perspectives can be embodied in technology designs grounded in apparently objective sensor data – not by rejecting objectivity but by reframing it as in dialogue with subjective interpretation.

Another way to understand the implications of Haraway's perspective is through the lens of postcolonial computing, as described by Irani et al. (2010). In contrast with how ICT4D is typically understood – the developing world as the topic of study of IT designers – postcolonial computing reframes the discussion around the consequences of taking cultural difference and its political dimensions seriously in the framing of IT design practice. One implication of this approach is that the cultural specificity of methodologies becomes much clearer. As the authors argue, this does not lead to the systematic privileging of some methodologies over others. Just as laboratory studies of usability build on particular kinds of relationships between researchers and researched which may not make sense in contexts where they reproduce particular histories of cultural domination, so too does participatory design depend on notions of collective action which do not speak to all cultural contexts. Rather than determining which methodology is best, this suggests a need for continuing sensitivity to where methodologies come from and adaptations to make them locally meaningful.

5. Conclusion

The two examples just mentioned would normally be counted as in separate domains of HCI: one is ‘about’ affect, the other ‘about’ ICT4D. Yet viewing these through the lens of the third paradigm let us see that they take a similar approach to their disparate topics, and that they jointly build a conceptual argument for a reframing of technology design practice based on standpoint epistemology.

More generally, in this paper, we have argued for attention to feminist philosophy of science in understanding HCI practice. Such philosophy of science plays two major roles in this paper. First, given Agre's articulation of the need for reflexivity in technical practice, feminist philosophy of science has provided us a lens to become aware of how knowledge claims and forms are changing within HCI. In particular, we argue that a new epistemological framework is emerging across the landscape of HCI research which takes as central the phenomenological situatedness of users, designers, and researchers, a perspective closely tied to feminist notions of standpoint epistemology. Awareness of the links between feminist philosophy of science and third-paradigm epistemologies can therefore help push forward methodological discussion with the third paradigm, on the one hand, and help us explore concretely what successor science means, on the other.

Second, feminist philosophy of science, having worked out the implications of standpoint epistemology, suggests that, if the third paradigm takes its own epistemological commitments seriously, it will not lead to a stable paradigm with clearly defined methodologies and outcomes, but must remain aware of and questioning its

limits as a knowledge practice. This development suggests that we as a field need to engage in discussion of epistemological issues as a first-order part of technical practice, i.e. as regular research papers.

Specifically, taking situated knowledges seriously has two concrete implications for how we report HCI research. First, research papers should articulate to the extent possible the intellectual and political commitments that the authors bring to a particular project, in order to allow readers to better evaluate the knowledge which it generates. Second, since the mechanisms by which knowledge is produced are crucial for its evaluation, research papers should not only mention what methods were used but also articulate how and why methods are applied. Black-boxing methods – i.e. turning them into recipes that can be applied without understanding, sometimes articulated in HCI as improving their ease of use by practitioners in the field – is inappropriate, since we need to know how knowledge was generated in order to be able to weigh it. So, for example, making critical technical practice itself a mechanically reproducible method is probably ill-conceived.

One final point is key to the uptake of feminist philosophy of science within HCI. The theory of situated knowledges calls for special awareness of voices which are marginalized. On the surface, this appears aligned with user-centered design, which sees itself as championing the neglected user. Yet, as Cooper and Bowers (1995) argue, the stance of self-appointed advocate for users who are said not to be able to speak for themselves is a political move with its own problematics. Feminism suggests no easy answers to this difficulty, but emphasizes continuing awareness of its existence and systematic questioning of the ways in which users are represented in particular projects.

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