Postcolonial Computing:
A Lens on Design and Development

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ABSTRACT

As our technologies travel to new cultural contexts and our designs and methods engage new constituencies, both our design and analytical practices face significant challenges. We offer postcolonial computing as an analytical orientation to better understand these challenges. This analytic orientation inspires four key shifts in our approach to HCI4D efforts: generative models of culture, development as a historical program, uneven economic relations, and cultural epistemologies. Then, through reconsideration of the practices of engagement, articulation and translation in other contexts, we offer designers and researchers ways of understanding use and design practice to respond to global connectivity and movement.

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INTRODUCTION

Technology travels. It moves around the world in projects of design and development. Design practice, similarly, spans continents, both in large-scale processes of transnational production and in the smaller, local practices by which technologies are understood and put to use in different settings. In recent years, HCI has become especially interested in opportunities surrounding cross-cultural design practice, with a special focus on HCI design for "the developing world" (HCI4D). Research in HCI4D has struggled with a range of complex problems – technological cultures, digital divides, multiple stakeholders, economic disparities, and more.

In this paper, we examine a series of concerns that are latent within much research conducted under the umbrella of HCI4D. We take as our starting point a move from "development" discourse to postcolonial discourse – that is, a discourse centered on the questions of power, authority, legitimacy, participation, and intelligibility in the contexts of cultural encounter, particularly in the context of contemporary globalization. Our first goal is to outline the alternative perspective on HCI4D that we can gain by looking to the lessons from related disciplines, most particularly Science and Technology Studies (STS) and postcolonial studies; we do this with four cases drawn from the revealing fringes of design-related fieldwork and history. Our second goal is to show how we might reconfigure design-oriented cultural encounters in this light.

We label this shift in perspective with the term "postcolonial computing."

What is "Postcolonial" Computing?
Formulating the term, we take inspiration from the articulation of new visions for HCI in programs such as "mobile computing," "service-oriented computing," "urban computing," and "ubiquitous computing." These areas, however, mark application areas and new forms of technology. Postcolonial computing is not a new domain or design space, but an alternative sensibility to the process of design and analysis. It asserts a series of questions and concerns inspired by the conditions of postcoloniality but relevant to any design project – most particularly those in HCI4D contexts, but in other contexts too.

When we speak of a "postcolonial" approach, we are not simply focused on the historical conditions of nations and regions that were once colonies. Postcolonial studies began with such investigations, but rapidly came to understand that its topic was actually the historical transformation of conditions of cultural encounter. Colonial relationships may have dissolved, and yet the history of global dynamics of power, wealth, economic strength, and political influence shape contemporary cultural encounters. For example, lower cost labor and mineral extraction in Asia and Africa tacitly undergirds the development of cheaper, faster, and smaller computers used and sold globally. Colonial tropes characterizing certain people as in need of enlightenment,

civilization, and development still persist today. These postcolonial conditions affect China and Sweden as much as they do India, Britain, Australia, or Kenya. We all live in a world shaped by colonial histories; we all find ourselves in postcolonial conditions.

Postcolonial theory has most powerfully demonstrated the ways projects we engage in for "others" often tell us more about ourselves. Postcolonial computing, then, is not a project of making better design for "other" cultures or places. It is a project of understanding how all design research and practice is culturally located and power laden, even if considered fairly general. This specificity is not a problem to be solved, but a reality that should be central to design practice – seeing the ways that design is culturally specific should allow us to broaden the conversation about what other practices can count as good design.

Postcolonial computing is a shift in perspective motivated by the challenges and problems of transferring of technological knowledge, particularly in ICT4D and the HCI questions it inspires.

THORNY ISSUES IN ICT4D
ICT4D designers face challenges transporting both design conventions and processes of HCI across cultures. HCI's visual conventions have proven not to be universal – systems effective in the US may fail utterly in Japan or South Africa. For example, design aesthetics vary wildly from place to place [21] and taken-for-granted symbolic literacies, such as recognizing an image representing a GUI button, are strange in less computer-saturated cultures [23]. The *processes* of designing and deploying HCI4D across cultures have proven challenging as well. Researchers designing for resource-poor but socially interconnected contexts have proposed shifting from user-centered design to "communitization" or community-centric design (e.g. [24]). Community engagement has become important in requirements elicitation and co-design (e.g. [8,24,28]), as well as making deployments sustainable [5]. The very different social, cultural, infrastructural, and economic situations of HCI4D have required researchers to substantially adapt HCI methods and practices.

Hardware and connectivity have also produced instructive case studies of technological failure in international encounters. Take, for example, the simple matter of a lightbulb that traveled from Europe to Africa [2]. The lightbulb's European designers tightly integrated its components, hiding the technology in order to user-proof it. When the lightbulb required adaptation to reach power sources far away from the room to be lit, the bulb proved impossible to hack or adapt. The notion of a hermetically sealed, all-in-one, "plug-and-play" design – seemingly perfectly adapted to an environment without an extensive technological infrastructure – turned out, in fact, to render it useless in the face of local contingencies. Many such well-intentioned efforts to "migrate" technologies from industrialized contexts to other parts of the world have

founded either on infrastructural differences or on social, cultural, political, or economic assumptions that do not hold. Such failures of technology transfer led to the rise of the "Appropriate Technology" (AT) movement in the 1970s and 1980s [31]. AT focused on fitness for purpose, arguing that smaller technologies that accounted for local needs, infrastructures, skills, and materials would be more effective than large-scale engineering efforts. These principles, of course, are also central to user-centered design, and so the emergence of HCI4D as a user-centered design perspective on cross-cultural development is an unsurprising development.

Some have sought to predict and understand these problems of translating HCI knowledge by drawing on taxonomic models of culture where members of cultural groups are characterized by traits and averages (e.g. [19]). This model has been used to explain conflict in organizations, communication dynamics, and even choices in website design. However, the assumption that individuals have a single cultural background is problematic, especially in the face of contemporary patterns of globalization and transnationalisms. These models, as Marsden argues [24], are also of limited help in design because they describe average tendencies but provide little insight into any particular person's cultural experience.

If these models are misleading, then what can we turn to as a resource for research and design practice? We argue that STS and postcolonial studies provide understandings of cultural entanglement and colonial discourses that help us better understand complex issues of intercultural engagement around technology design in HCI4D. In the following section, we illustrate this through explorations of four connected cases: first, the rhetoric of cultural differences; second, the problematic rhetoric and practice of "development"; third, the globalized pattern of economic relations within which these efforts are embedded; and fourth, cultural conceptions of knowledge. We then turn to implications for design practices and methodologies arising from this analytical turn.

CASE STUDIES
The following cases are drawn from our fieldwork and from histories of technological travel. These are stories of connection: of researcher to culturally different users, of rural Indians to transnational NGOs, of Brazilian engineers to Apple, and of aboriginal Australians to California. We examine these mundane experiences in globalized technology design through the lens of postcolonial computing.

Reassessing "Culture" Difference
We begin with a case drawn on a research project conducted by one of us as part of a corporate internship.

The design brief given by the large multinational corporation hosting my summer internship was clear: the company was developing a sensor network for the elderly

so that they could remain independent in their homes as they aged, and wanted to examine the opportunities for releasing this product in international markets. The target groups were the BRIC countries (Brazil, Russia, India, and China), united by their economic status on a global measurement scale rather than by any cultural similarities. With little money available for travel, I trekked out into the mid-sized American town and its suburbs to conduct my research. There, among immigrant populations, I was told, I would find examples of these different national cultures, and could find out from there how their culture conceived of issues of health and aging.

This design brief may sound familiar to many readers, as may the conflicts that followed in the ensuing research. The researcher encountered families that called themselves "American" in some contexts and "foreign" in others. These families' practices bridged communities between their US locality and international networks, employing a variety of technical and social resources for what they were, what they valued, and what they did. Such language disconnected with the design brief, wherein culture was taxonomized, reified, and employed as a static denomination to distinguish between user groups and communities. This view of culture is quite common as a way of classifying people, activities, and settings – "Latin" versus "Asian" cultures, for instance – in terms of systematic difference between groups. This sense of culture taxonomized people along lines that might be figured as geographical, in the sense of regions or nation states, or collective, as in subcultures, diasporas, or organizations. These taxonomic views invoke the idea of two bounded spaces: "here" and "there," where "there" is other, apart, and disconnected, stably distanced from "here." They invoke "other-ness" and, tacitly, a universal "self" who can observe and mark the difference. Even within the "here"-ness of the American town that was the researcher's field site, the researcher was promised to encounter an "other" "out there" – someone with a different, disconnected, and static method of categorizing and making sense of the world.

The promise of generalizability along familiar scales such as the nation-state has made Hall's [17] and Hofstede's [19] frameworks popular in organizational behavior and social informatics. The taxonomic view, however, suffers from a range of problems. Studies have found such dimensions analytically weak in explaining conflicts [10] and differences in technology use [12], while HCI researchers have argued that cultural "averages" are of limited use for design [24]. More problematically, the taxonomic view of culture is both historically and ontologically suspect. Cultural categories are frequently rooted in geographical separation, but technologically enabled interactions, such as internet communities, mobile technologies, and remote collaboration, call into question where one cultural zone ends and the next one begins. These technologies of communication and mobility circulate cultural concepts

globally ([3,22]) as a condition of contemporary (and not-so-contemporary) living. At what scale should we see culture – the nation, the region, the city, the town? With respect to the "Asian", "European" and "Latino" families encountered in this fieldwork, where does the "home culture" end and the "American culture" start?

A more productive analytical position here, we argue, a "generative" view of culture arising from contemporary anthropology and postcolonial studies. Here, culture is a lens through which people collectively encounter the world – a system of interpretive signification through which the world inter-subjectively meaningful. From this view, an individual may participate in many cultures – cultures of ethnicity, nationhood, profession, class, gender, kinship, and history – each of which, with its logics and narratives, frames the experience of everyday life. Rather than classifying people on various cultural dimensions, a generative view of culture suggests we ask how the technological objects and knowledge practices of everyday life become meaningful contingently and dynamically as social activity unfolds. In this sense, culture shapes experience but is in turn reproduced and *generated* through everyday interaction.

Indeed, taking culture as something that is dynamic, collectively produced, and enacted in everyday encounters problematizes taxonomic models that see culture as acquired and internal to the individual – "software for the mind" shared by people of the same nation [19]. This shift of perspective is especially important in the context of HCI, as understanding transformations effected in part by technology design requires an understanding of cultural *change* as much as cultural *stabilities*. Hofstede's popular framework, after all, provides a snapshot of traits at a single point in time. It has little to say, then, about the norm-shifting of technologies, social movements, or even everyday reconfigurations of practice around technology, media, artifacts or experience. Yet it is precisely those changing cultural practices that designers aspire to support and in which they wish to intervene when they introduce a system into a setting. For example, HCI4D projects might use technology to make microlending more efficient, accountable, and far reaching (e.g. [26]). Such interventions begin in conversation with existing practices, but also reconfigure local power relations within villages and households [16]. These reconfigurations can shift the interpretive frames of diverse aspects of everyday life, including technology, financial practice, commercial activity, and gender relations. Understanding how technology design is adopted, learned, and used, then, requires a dynamic model of culture.

We do not present this case to suggest that studies of diasporic communities can substitute for studies of cultures in a pure or home context. Rather, the diaspora case illuminates the fluidity of cultural, regional, and transnational boundaries, as well as the variability of the what "home culture" can mean in daily life. People relate

variably to a range of local and international networks, producing their cultural identities through a variety of signifying practices [20]. If it seems that Indonesians, say, share common frames in how they intersubjectively interpret the world, it is a phenomenon in need of explanation. The same may not be true of all nations.

Consistent with these dynamic processes by which cultural identities and practice are formed, the generative view of culture suggested by the postcolonial perspective allows designers to recognize their work not as designing appropriately for static, nationally-bound cultures, but instead as interventions both in conversation with *and* transformative of existing cultural practices.

The Problem of Development
Our second case is drawn from an initial ethnographic engagement that forms part of a larger, ongoing project.

D-Design, an Indian design consultancy, had been commissioned by health care NGO HealthWorks to complete a home placement study of prototype household water filters. The client was a reputable non-governmental organization focused on development. HealthWorks sought to develop a commercial market for water filters among Indians living in poverty as a means of curbing water-borne illness. The imagined study recruit, according to the lead designer, was "fairly poor," getting "water from the dirty river," often ill from water-borne illness, and without a filter.

D-Design's team drove hundreds of kilometers from village to village searching for participants for the study but found few people who matched the client's image of poverty. What the design researchers found instead were villages where people seemed relatively happy or even proud of their water. Few complained about water-related illness, though many complained about health problems from over-fluoridated water from wells – a problem that the prototype water filters would not remedy and HealthWorks chose not to pursue. "Where is the poverty?!" cried one of the designers at a team debriefing following village visits, throwing his hands up before dramatically throwing his head onto the table. Failing to find the imagined targets of development in the field, the team loosened their image of the ideal participant, finding people who were curious enough about the filter and met loosened income requirements.

By seeing this case through the analytical lens of postcolonial computing, several issues in contemporary development are foregrounded: the discourse of global, technical solutions to problems; the alignment of development projects with the interests of commercial actors in industrialized countries; the directionality of product and monetary flows in development programs; and disempowerment through consumer-oriented development. Development here encompasses a range of programs for financial and technological assistance set up between "advanced" and "developing" countries, or among more complex financial arrangements between governments, NGOs, philanthropists, corporations, and supranational institutions such as the World Bank.

The discourse of global, technical solutions to problems of development is critical to understanding why HealthWorks chose not to pursue the problem of over-fluoridation identified through early stage design research. This may seem to fly in the face of user-centered design, which prescribes designing around target users' needs. The project, instead, is a solution in search of users – users found through great expenditure of time and energy. HealthWorks' reluctance to change course stems from the wide availability of low-cost bacterial filtering technology designed for wealthier markets. HealthWorks, by their own description, adapts existing technologies in rich countries so they work in poor ones. Designing a fluoride filter would require a longer design and research cycle for a less universal-seeming problem. By contrast to the NGO's design-centered efforts, local Indian activists have been mobilizing for a public-sector, political and infrastructural solution to the fluoride problem. Ferguson's analysis of NGOs and development in Lesotho [13] suggest that HealthWorks' global framing is characteristic of development more broadly; development regimes in recent decades, he argues, have systematically avoided confronting the actions of large-scale actors such as governments and corporations as causes of the socio-economic conditions they seek to remedy, instead seeking behavioral, educational, and market-based solutions at the local level. Some see NGO's focus on the local as an advantage, keeping NGOs far from the taint of the politics [15] of governments that have been painted as corrupt. This NGO avoidance of politics, Ferguson argues, depoliticize poverty by covering the sometimes highly political causes of poverty: "By uncompromisingly reducing poverty to a technical problem, and by promising technical solutions to the sufferings of powerless and oppressed people, the hegemonic problematic of 'development' is the principle means through which the question of poverty is de-politicized in the world today" [13:256]. In Lesotho, Ferguson's example, World Bank reports recommended agricultural technology as a remedy for farmers who had lost their arable land to Dutch settlers. These approaches fail to discern the importance of political causes and political solutions to problems of poverty, leaving many failed development projects in their wake.

This leads to a second critique: development regimes have historically been aligned with the interests of politically powerful commercial and capital market actors. HealthWorks is well known as an early advocate of public-private partnerships in the development and distribution of health products. In its project with D-Design, HealthWorks sought not only to develop a usable, useful water filter but also to develop distribution networks to retail the filter through rural and slum businesses. In aligning diverse

actors to enable the distribution of water filters, HealthWorks' interests are aligned with corporations like Pepsi who have similarly developed retail channels among India's poor. These alignments can take diverse forms at different times and places. In opening developing economies to Western investment as a loan condition, World Bank policies destabilized many economies by exposing them to speculation or predatory corporate interest. In some cases, these interests have not run parallel to those of stable state development. In his study of extractive industries in Africa, Ferguson [14] notes that while opening African nations up to Western investment in the 1990s had been proposed as a way of incorporating African nations into the global economy and providing them with the resources to grow both economic and civic infrastructure, foreign investment actually fared best in countries that were anti-democratic or even in a state of civil war. Highly-technologized mineral extraction industries reaped profits by avoiding African nations with strong unions and democratic traditions as they would impede extraction operations. The potential consequences of bringing resources and people in line with the interests of powerful capital and commercial actors is rarely recognized and analyzed in ICT4D literatures.

Third, the flow of technologies from HealthWorks, an American NGO, to development targets around the world parallels the structural flows of goods and money in colonial relations. The economic ties are quite complex. HealthWorks partners with private entities, sometimes local distributors or manufacturers and at other times multinational consumer goods corporations, to develop and distribute health products. As a prominent, well-funded NGO with connections to powerful actors, however, HealthWorks exerts considerable strategic control over the shape of projects and deployments by channeling money in ways that funders in highly industrialized countries find compelling. These flows, Escobar argues [11], of capital and strategic control characterize development more broadly. Escobar analyzes the history of development efforts in the second half of the twentieth century, observing that development typically follows patterns based broadly on colonial histories. The economics of colonialism were frequently based on the movement of raw materials from colonies to colonial centers, and the movement of finished products in the opposite direction. The movements of goods in development relationships are often much the same.

Fourth, HealthWorks' local, individually-focused strategy attempts to build a market of consumers – a strategy that some argue is inherently disempowering. Escobar argues that development programs have historically pursued progress by figuring people as consumers of technology designed and manufactured elsewhere. These technologies historically have included laptops made in Taiwan [6], fertilizers engineered in the US [16], or even water filters. In Escobar's analysis, the rhetoric and practice of

development positions emerging nations as essentially powerless and unable to "develop" without intervention. The provision of goods and services then positions these nations as consumers of Western technologies and services. The kinds of infrastructure investments that are often associated with development efforts ensure "lock-in" to the goods and services provided by Western corporations. This was an explicit goal of the US Marshall Plan for aid to Western Europe after the Second World War, which sought to rebuild the economies of European nations in order to ensure a ready market for American products [30]. The Marshall Plan set the context for further development programs, which share both the ideological commitment and the practical consequence of creating new markets and new consumers. These framings do not necessarily effect disempowerment, but they make uneven relations of economic dependency possible. These problems complicate HCI4D projects that seek to help integrate people into markets, whether as producers or consumers, as a means of empowerment.

Uneven Economic Relations

No design practice takes place outside of a series of economic conditions that make it possible. In the case that follows, uneven economic relations, with consequences for legal and cultural power, shape what counts as legitimate design practice.

As Brazil sought to develop its economy during the 1970s and 1980s, its government provided incentives to companies that designed and manufactured products within Brazil as a means of eliminating poverty and encouraging indigenous innovation. Unitron, a Brazilian company, responded by reverse engineering, designing, and manufacturing a Mac compatible machine called "Mac de periferia" (Mac of the Periphery). Though Apple had no intellectual property protection for the Macintosh in Brazil, the American corporation was able to pressure government and other economic actors within Brazil to reframe Unitron's activities, once seen as nationalist and anti-colonial, as immoral piracy. In exerting political pressure through its economic strength, Apple was able to reshape notions of authorship to exclude reverse engineering and modification, realigning Brazilian notions of intellectual authorship with American notions that privilege the originator over maintainers and modifiers of code and hardware architecture [9]. These economically motivated legal actions shaped definitions of what counts as legitimate design work, innovation, and creativity – concepts often taken for granted in HCI research.

Notably, in this case, Unitron's design process had value beyond the technology that it produced, or in this case reproduced. The very process of creating the Mac of the periphery was meaningful as a claim of indigenous technological capability in reverse engineering, as a symbol of local manufacture, and as a way of signaling national independence. This suggests that as design methods travel

transnationally, we consider not only how requirements are gathered or how artifacts are produced, but also by whom, in what economic relationship, and with what cultural meanings. In contrast to HCI culture, which commonly values creativity and the production of the new [34], Unitron represented the value of reconfigured economic and technological relations in Brazil during the 1970s – relations then reshaped by more powerful economic actors within the global industrial system.

The cultural meanings of design practices are also evident in the adoption of open source technologies in Peru. In the early 2000s, the Peruvian government and open source activists began arguing for free software (FS) over proprietary software for official uses. Activists first argued that FS reduced dependence on transnational corporations and later argued that FS ensured public control over information access [7]. Peruvian open source at the time became not only an appropriation and translation of software design methods of knowledge and software production that originated in the West, but also a response to contemporary conditions surrounding intellectual property and the international economics [9,27]. It was not only the usability, learnability, or even fun of such technologies that shaped their adoption and diffusion. Technologies' cultural meanings in particular social and historical circumstances, not only among users but among others [29], that shaped their uptake.

These cases suggest that the uneven flows and exchanges of capital that surround the uptake of information technologies have implications for HCI interests such as design method, software adoption, usefulness, usability.

Knowledge and Voice
A Skype call, in February 2009, connects ten researchers and collaborators across the world. The context for the call is a project, funded by the Australian government, investigating the use of Internet conferencing technologies to allow indigenous Australian knowledge authorities to teach university classes about their culture and language from their homelands. Participants in the call are connected from California, Darwin, Melbourne, and a number of sites in the traditional homelands of the Yolngu people in Northeast Arhemland. In reference to a recent lecture in which one of the indigenous participants had discussed a story – the Turtle dreaming – one of the researchers, H, suggests to the knowledge authority, D, that perhaps an interesting class would consist of a discussion of this story amongst indigenous participants. H asks, "Does your brother still live next door? Perhaps you and he could talk about it together on camera." D is open to this, but immediately reluctant. The Yolngu observe a brother/sister avoidance relationship, but there is another problem. Speaking of her current location, she says, "These are our mari's [classificatory grandmother's] lands. We don't have the authority to tell the Turtle dreaming here. We could do it if we went back up to [home settlement]. Ah,

but we don't get good 3G service there. We'd have to use the satellite phone; and the delay on that [for videoconferencing] is always a problem."

Our traditional design methods are centrally concerned with the problem of making knowledge portable. Knowledge about usage problems and settings must be moved from the context in which it arises (the users' everyday world) to the design site; knowledge about design opportunities must be moved from the design site to the development process; knowledge about the design must somehow be moved among those participating in the creation of the technology.

Even when these movements are seemingly simple – from the meeting room to the cubicle – a whole range of representations and artifacts are employed to achieve them. More significantly, we depend on an infrastructure of knowledge practices to achieve these movements – the practices that allow us to interpret the artifacts, to invest them with authority, to recognize the people who stand behind them, and so on. As the case of the Yolngu shows, knowledge sharing – what it means to know something, and what it means to be able to tell it – is hemmed in all around by a series of infrastructures, social, cultural, and technological, that must be brought into alignment.

Clearly, this affects any efforts in "knowledge management" by which diverse cultural understandings are to be harnessed to western techno-social practice (e.g. [4,35]). In recent work, Verran and colleagues have attempted to understand these questions specifically in the context of online practice and digital information, with the goal of developing an indigenous aboriginal approach to information management [35]. Indigenous knowledge, we would caution, is not to be naively contrasted with scientific here. Verran's project, and technologies more generally, occasion new hybrid forms (e.g. the hybrid chemical-humoral models of soil that Gupta notes in his studies of agricultural development in rural India [16]). The "knowledge" that flows around these design processes is not impersonal, abstract, or timeless. It emerges at particular moments, voiced by particular people, who speak with particular kinds of authority – cultural, technical, spiritual – and their right to speak is contingent on that authority. Srinivasan's [32] projects similarly attempt to create information systems with community-appropriate ways to categorize and organize information and artifacts. His work emphasizes the importance of specific community "voice" in contrast to the (implicitly unvoiced) notion of abstract authority in data repositories.

The cultural conditions of practices of knowing and telling become deeply relevant to HCI design methods because HCI methods themselves embody principles and models of knowledge sharing and knowledge representation.

INTERCULTURAL ENCOUNTERS IN DESIGN PRACTICE
As we have illustrated, the insights of postcolonial studies and STS speak at once to the highly local and contingent

practices that we see at work in different specific sites of technology design and use, while at the same time recognizing the ways that those localisms are conditioned and embedded within global and historical flows of material, people, capital, knowledge, and technology. The postcolonial computing lens focuses our attention, then, on the translations, dependencies, conditions, and histories that shape perceptions of technology and its opportunities. This change in approach inspired by postcolonial and STS work provoked us as designers to revisit our design toolkit with an eye towards international settings.

This reframing also invites us to reconsider design methods and design practice. Traditional design processes, in HCI as well as related disciplines, break down into a familiar range of steps and procedures, from the identification of potential user communities, the analysis of their activities, the formulation of design requirements, ideation and iteration, and so forth. We suggest an alternate formulation of design work – *engagement*, *articulation*, and *translation*. This formulation broadens notions of what counts as design work and suggests an alternate sensibility for evaluating such work.

By "engagement" we mean connecting with users or an application domain in order to understand relevant work or activity; since HCI design is primarily "user-centered," this is most commonly (although not always) a form of engagement with people and their material worlds. "Articulation" concerns how properties of this domain are formalized and transformed into a series of requirements for technological support. Finally, "translation" concerns how these requirements, possibly through a series of steps, are transformed from statements about a domain to statements about technology and eventually into specific pieces of technology designed to support the application domain.

By abstracting design methods into these aspects, we gain analytical purchase over HCI design practices. Our motivation for introducing these facets is to take traditional elements of the design process, such as requirements capture or workflow analysis, and place them in a context that makes clear relevance of issues of power, history, and epistemology. We will discuss each one in turn, and show the relevance of a postcolonial approach.

Engagement
Postcolonial computing points to the many ways histories, power relations, and epistemology tacitly underpin engagements in design, offering HCI researchers and practitioners new lines of inquiry. Design often involves transcultural encounters, between designers and users, designers and engineers, between corporate- and non-corporate actors, or even between differently located actors working collaboratively to design for themselves or for one another. In this view, observing users, eliciting requirements, and deploying technologies are only some of the sorts of encounters that can animate HCI research.

Engagements in design methods can take many forms, including design research, technology deployment, feedback, and maintenance. In usability testing, people serve as model users in a usability lab setting, directed by a usability researcher to test software in front of two-way mirror. The encounter within the laboratory walls is described as data, often observed by unseen others behind a one-way mirror or on video. Whether or not this form of engagement is scientific or objective is less interesting for our purposes than the way the engagement has been shaped by scientific roles and discourses, lending authority both between researcher and model user, and between researcher and consumer of the research findings. The authority of this method benefits from the ways scientific ways of knowing have been elevated above other forms of knowledge creation in some settings [1]. In other settings, however, the context in which usability studies work may not be present. For example, histories of exploitation by researchers or a distrust of disengaged observers make such methods untenable in some communities [4].

Another Western design method, Participatory Design (PD), draws authority from a very different set of discourses of labor relations and social justice. Developed primarily in Scandinavia but taken up more broadly, PD maintains roles for designers and users but calls for users to participate in the imagination and specification of work technologies. The modes of engagement, deliberation, and negotiation are drawn from Scandinavia's strong traditions of union involvement in workplace decision-making [36]. It is not that PD works because of an inherent superiority to other methods. It works (when it works) because it takes advantage of cultural logics and practices particular to the location in which it emerged. Researchers have long grappled with how to generalize and adapt PD to enable participation by non-organized workforces and have noted the particular challenges of reproducing PD engagements in different national and political cultures [25].

Drawing on Suchman's [33] account, we find it useful to think of design processes less as ways that designers can formulate needs and measure outcomes, and more as shaping and staging encounters between multiple parties. The essence of the process is the fact of different people coming together and meeting – holding a conversation rather than following a recipe. What this draws our attention to, then, is, first, the context of that encounter – its histories, its politics, those who are present and those who are not, the authorities and responsibilities with which different people speak – and, second, the bidirectionality of the exchange. It directs us to think about what people bring into the encounter and what they take away from it.

For instance, consider Hayden's [18] discussion of bioprospecting processes in Mexico, in which scientists from US and European pharmaceutical companies sought to identify the active ingredients in traditional remedies that could then be incorporated into new drugs. This encounter is framed by very different understandings of the kind of

knowledge being shared – one of tradition and spiritual practice and one of intellectual property licensing. The encounter breaks down not least in light of these different orientations, which similarly inflect any understanding of what is being "exchanged."

There are two consequences to reframing design methods from extractive processes, such as lessons learned, knowledge gained, or requirements identified, to mutual encounter and learning in which responsibilities between different parties are enacted. First, it suggests we acknowledge users as active participants and partners rather than as passive repositories of "lore" to be mined. People may bring different things to the table and may take different things away; indeed, they might have different understandings of what has been brought and taken. A focus on the encounter as a moment of mutual engagement gives us a very different way of thinking about what "requirements", say, are, and what the process of "capture" might entail. The second lesson is the recognition of an encounter as an intentional, motivated, and power-laden act (rather than as an inherent consequence of an impersonal process.) People are brought to the table; others are relegated to peripheral positions or excluded altogether. This is always and obviously the case, and indeed it is frequently desirable (some people speak up when others are out of the room); the point is to be conscious of it and to imagine alternatives.

Articulation

By articulation we mean the way we might see and frame a situation as designers. In much design practice, articulation includes the ontological work of designating targets of design, such as an individual or a community, and interpreting or inferring the targets' "needs, "wants," "desires," "opportunities," or "constraints." Articulation abstracts the experiences of engagement and reframes them in terms amenable to design practice. Articulations are culturally specific for both designers and their audiences.

The production of formal and informal representations is a key component of articulation, including personas that serve as stand-ins for imagined users, task flows that represent work processes in designed-for contexts, or research summaries that conclude with implications for design. These representations are normally produced to move around in the world – to flow from designers to implementers, to document decision-making processes, to serve as a baseline for later evaluation, and to be reused and repurposed in future design efforts. As our discussion of knowledge practices suggested, however, a postcolonial perspective might point to the highly situated nature of knowledge practices, with two implications for HCI4D.

First, HCI methods often see knowledge as something to be captured, rather than something to be performed or enacted as it is in other cultural settings. The photograph only captures something of the moment; the question of whether it captures the essence depends on what you think is important

about the moment. Second, by corollary, it these seemingly mobile representations are themselves highly localized, connected to specific practices of seeing and interpretation. Latour [23] calls such representations "immutable mobiles", but they are "immutable" only within delimited ranges of movement. Representations of people, activities and artifacts take on radically different meanings in different cultural contexts in ways that can often be quite problematic. Only in the context of a specific set of technical practices and assumptions does a workflow diagram capture what it means to carry out a task. Cross-cultural design efforts, then, must recognize how articulation in UCD functions to frame and interpret engagement drawing on traditions of representation that may not be commensurable with knowledge and design practice in other cultures. Processes of articulation come with ontological and epistemological commitments. Furthermore, perfect commensurability through translation is not possible. Postcolonial computing is not a matter of finding the right ethnographic informant or the true way of articulating users' ontologies. It is a matter of grappling, as did the designers of the aboriginal knowledge system discussed earlier [35], with how to design when the certainty of perfect intercultural translation is not possible.

We can see these issues at work in the OLPC project. The project's motivating articulation of needs is made with respect to a very familiar, unilinear model of technological progress, one in which the problems of the developing world are framed as a series of absences, specifically of the furniture of Western life, viz., digital technology, and in particular, the *personal* computer. Implicit in this model are commitments to individual ownership; indeed, one of the critiques of OLPC has been that the devices might have been better conceived as owned by communities or family groups, and yet the specific design of the laptop – and in particular the small keys on the keyboard, or even its color and design – orient it specifically towards children rather than other family members. Articulated design needs and requirements, in this case individual control and ownership, reflect a series of often unquestioned ontological, political, and economic commitments that are integral to the design.

Translation

Finally, how might this postcolonial perspective illuminate "translation" in design methods: the transformation of requirements into statements about technology or technology itself? Translation has both a linguistic sense and a geometric sense. The linguistic sense of "translation" captures the transformation between different languages – representational schemes that are deeply culturally situated. At the same time, "translation" also has a geometric sense, where it refers to the movement of a figure from place to place. In the examples we are discussing, both are present concurrently. Although the very idea of design methods as portable prescriptions of practice is predicated on the assumption that translation preserves meaning, a focus on transformation and movement may allow us to be more attentive to the fact that such translations are intentional and

explicit acts whereby statements produced for one purpose are made amenable to new purposes and new actors. The translations, then, by which statements about domains and needs become statements about technology and solutions, must also be seen as purposeful, partial, and situated.

While HCI research has recognized the cultural specificity of design products, the processes and methods of design has largely been imagined as universal. Taking a broader view, we would argue that methods – the products of research communities, economic actors, and educational practices that span the globe – are always transnationally produced and dynamic. When an open source software (OSS) team or a proprietary design team meets in Silicon Valley, they are simultaneously negotiating their products and their methods in situ. The two are not easily separable. In the same way, Indian OSS teams or proprietary software designers are also engaging in the same talk and practice around their products and methods. As design methods move around in the world, they are subject to different interpretations and they become locally meaningful design in different ways.

Engagement, articulation, and translation are only three aspects of varied, highly situated practices of design. Yet examining these aspects through the lenses provided by STS and postcolonial studies exposes some tacit commitments and thus limitations of current approaches.

CONCLUSIONS

We have raised a number of issues relevant to information technology drawn from STS and postcolonial studies. We have argued that these considerations are particularly significant in the context of current migrations HCI into new settings, but they have been largely absent from the research literatures in this area. Yet we do not mean to suggest that design over "there" is fundamentally different than design "here." While the cultural traditions of UCD have often emerged out of Western traditions, those traditions themselves are contradictory and multiple. There is no single "here" of Western knowledge and design. Incommensurability might mark relations not only between different national cultures, but also organizational cultures, or even professional communities within an organization.

Our goal is not to criticize ongoing work in HCI4D and cross-cultural design, but rather to expand the conversation around cross-cultural technology development by placing it in a broader context. Understanding the processes of translation of design methods (both in the sense of movement and in the sense of transformation) is a means to this end. Similarly, it is important to avoid simple dualisms between developed and developing contexts, traditional and scientific knowledge practices, and so on. In his study of development efforts, Gupta shows that simple dualities of traditional and modern, developed and undeveloped, colonial and (historically) postcolonial do not hold [16]. Rather, we call for an investigation of how, out of the encounter between different forms of knowledge and practice, new hybrid forms design and technology are generated. Communication is

bidirectional here, and as the postcolonial perspective vividly demonstrates, the encounters here are not instantaneous and fleeting, but rather take place over years and decades.

We argue for attentiveness to the emergence of hybrid practices in information technology design, coupled with sensitivity to how uneven power relations are enacted in design practice. The goal, as we have outlined here, is not simply to bemoan the problems that arise when methods are assumed to move easily and stably from one setting to another, but rather to understand the diverse forms design practice and contextual reasons for that diversity. We have suggested that thinking about the design process in terms of engagements between different groups, the complexities of articulating perspectives, and the implications of translation between sites, provides a starting point for acknowledging and embracing heterogeneity in design, rather than attempting to control or eliminate it.

While we have been looking at design primarily in the context of HCI4D, concerns of power, mutual intelligibility, and how cultural forms are generated are also relevant to the intercultural encounters between designers and users in traditional corporate or academic contexts. Suchman [33] framed the work that she and her colleagues conducted at Xerox as the staging of encounters amongst various stakeholders, including engineers and workers. The lens of HCI4D defamiliarizes design so that we may understand its methods more deeply. Locating these commitments allows us to imagine what practices with alternate commitments might look like, and open new spaces for design [33].

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