

Print This Paper, Kill A Tree: Environmental Sustainability as a Research Topic for Human-Computer Interaction

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ABSTRACT

Many HCI researchers have recently begun to examine the opportunities to use ICTs to promote environmental sustainability and ecological consciousness on the part of technology users. This paper examines the limits upon this work as currently construed. In particular, it argues that the political and cultural contexts of environmental practice must be part of an effective solution. Research on ecological politics and the political economy of environmentalism suggest some new directions for the relationship between sustainability and HCI.

Author Keywords

Environmental sustainability, environmental justice, political ecology, environmentalism, scale, social networks.

ACM Classification Keywords

H5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

INTRODUCTION

In parallel with a growing political and social consciousness around topics of global climate change and environmental sustainability, research in Human-Computer Interaction has lately turned to environmental topics. In part, this reflects the observation that, as information technology becomes an increasingly common aspect of daily experience, it provides a platform for reflection and intervention that may have positive social benefits. This observation has driven research in the use of information technology to promote personal health and wellness [e.g. 13, 25], as well, more broadly, as what some have termed “persuasive technologies” [18]; the interest in HCI research and sustainability is founded on the premise that global or environmental health and wellness might also be a site for

similar technological interventions. Over the last year or two, a range of studies have been published that connect questions of environmental sustainability and ecological responsibility to different aspects of the technology research program in Human-Computer Interaction and Ubiquitous Computing. These have included: studies of the owners of “green homes,” conducted with an eye to understanding the problems and opportunities surrounding forms of technological living [55]; studies of the use of mobile phones as environmental sensors, mobilizing “citizen scientists” in projects of pollution monitoring [37]; explorations of tools that might help people understand the impacts of their purchase decisions [51], transit decisions [19, 31], or domestic energy use [40]; investigations of the role that sustainability might play in design practice itself [6, 22]; and a range of workshops, panels and discussions about how issues of sustainability might be given a greater focus within HCI research agendas.

In this paper, I want to explore some of the issues at work in this research. In particular, my goal is to place the concern with environmental sustainability within the contexts (social, historical, cultural, political, and economic) in which it arises, and to examine how these might influence an emerging research agenda for sustainability as a topic of concern for HCI.

This paper is motivated by the conviction that, in order to assess the potential and effectiveness of HCI interventions in environmental practice, it is necessary to inquire into the contexts in which those practices arise, and to recognize the potential contradictions between the goals of our interventions and the forces that shape their deployment. In particular, this paper will argue, first, that an engagement with environmental questions which presumes *a priori* a sphere of environmental affairs distinct from other aspects of social life may fail to recognize the conditions of its own emergence; and, second and consequently, a form of engagement which fails to acknowledge questions of political ecology [42], environmental justice [14], and citizenship and governance [2], may be crucially limited.

Three related considerations will be explored in turn. The first is the way that, for a variety of reasons, HCI has often transformed the problems of sustainability into the cost-benefit trade-offs of rational actor economics, promoting

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sustainability as a matter of personal morality rather than industrial regulation or political mobilization. Both the environment and the market here are taken as natural facts, which has important consequences for the ways in which technological solutions are imagined. The second concerns the social and political consequences of what Pepper [38] has referred to as “ecotopianism,” and in particular the broader considerations around environmental sustainability as a totalizing discourse. The third is the way that these problems limit technological opportunities by focusing too narrowly on the forms of engagement that might be attempted; in particular, I will explore the issue of scale as a means to gain a different sort of purchase on the problems of information technology and environmental activism.

I offer this critique not to dismiss HCI’s concern with environmental sustainability, but instead precisely because the problems are important ones and HCI’s potential contribution is particularly significant. However, HCI’s traditional design focus offers just one of a number of potential avenues for engagement.

In his discussion of international development programs, Ferguson [17] examines development as an “anti-politics machine.” What he means by this is that the discourse of development systematically forecloses an examination of the political contexts within which the development engagement takes place – the reasons for income disparity, the conditions of inward investment, the nature of democratic processes, the history of colonial relations, the effects of globalization, etc. Ferguson argues that the effectiveness of development projects are fundamentally constrained by the fact that the development discourse does not allow one to examine the conditions under which it arises. A similar argument could be made about design discourse, in which commitments to technological determinism and technosocial progress leave little room for the political and historical. The first part of this paper illustrates the problem by identifying a set of factors that contextualize HCI’s interest in environmental issues but which are left out of the equation; the second part of the paper presents a potential alternative in which the political becomes the locus of design practice.

NATURAL FACTS AND SOCIAL FACTS

An economic metaphor – that is, a metaphor of value and exchange – lies at the heart of many attempts to use information technology for environmental sustainability. Economics pervades these systems not in terms of financial incentives, but rather in terms of the fundamental idea behind economic analysis – large scale effects produced by the individual decision-making processes of rational actors making choices under scarcity.

The starting point for this discussion is an appraisal of how both problems and solutions in the domain of sustainability are framed, and therefore how information technology is positioned as a means towards effective action. My particular focus of attention is the way in which both “the

market” and “nature” are construed as natural facts rather than as social ones.

The Market as Natural Fact

The market – that is, the applicability of market models and economic exchange – enters into environmental rhetoric in a range of ways, both explicitly and implicitly. The ease with which it arises as a source of solutions reflects a prevailing cultural attitude towards market exchange that frames the market as a naturally occurring phenomenon rather than a motivated social product. Perhaps the most telling way this happens is in the framing of sustainability as an issue of personal choice for rational actors – an instance of an economic rationality of costs and benefits.

As concern and awareness of environmental issues grows as a global political issue, a common response is, “what can I do?” Frequently, this is inspired by a sudden realization of the environmental consequences of everyday actions – choices people make in transportation, disposal of waste materials, etc. The developing environmental consciousness manifests itself as guilt and then a call-to-arms over everyday practice, and then, often, in confusion over the right thing to do. Environmental impact, after all, is difficult to assess. The well-worn debate about the relative environmental impact of paper or plastic shopping bags is a classic example; while we know that reusable cloth bags are the most environmentally responsible option, the very fact that no consensus exists over whether plastic or paper bags are more environmentally appropriate is telling.

Accordingly, a typical approach to the application of information technologies to environmental topics focuses on these kinds of assessments. Various prototype systems have been created to help people monitor and understand the environmental impacts of their decisions – especially actions in the home [e.g. 40], transportation options [e.g. 19], and consumption choices [e.g. 51]. The idea here is that, better informed about environmental considerations, people are able to make more effective choices to meet their concerns. The logic at work here is the logic of neoclassical economics, in which large scale phenomena can be reduced to the aggregated effects of decisions made by rational actors acting in the light of informed self-interest. Here, then, the logic of the market is invoked, almost implicitly, as an appropriate framing for ecological rationality. Markets are designed as mechanisms to yield collective benefits from individual selfishness and self-interest [35]. Market models so dominate our daily experience that they appear as natural mechanisms, despite the apparent contradictions of shared ecological fate and aggregated self-interest.

There are three issues to be raised here. The first is the problem of motivation through a focus on personal moral choice; the second is the invisibility of the political discourse behind this approach; and the third is the attribution of responsibility.

My first point is one that I borrow from Phoebe Sengers, who remarked at a panel at CHI 2008 on the problems of framing environmental concerns purely in terms of personal moral choice, particularly moral choice over patterns of consumption. While there is much to appreciate in any effort to make more explicit the political consequences of consumption – a form of ethical shopping, perhaps – several problems attend this particular framing of the questions of sustainability. These include: the indeterminacy of individual impacts (as in the case of disposable bags, but also many others, including, for instance, hybrid cars); the downgrading of political participation to everyday consumption (in which one operates merely through a limited series of choices offered by the market); the linkage of morality to economic means (so that sustainability is a choice available only to those who can afford it, while those who cannot are morally stigmatized); and the difficulty of motivating behavioral change through negative sanction (as in systems that operate largely through exposing moral lapses.)

The second, related consideration is the invisibility of the political discourse behind the approach of framing sustainability in market terms. As many commentators have observed, the cultural conditions of late capitalism make this kind of market logic almost inescapable. Lukacs uses the term “reification” to refer to the process where, under capitalism, the logic of commodity and market extends itself into every sphere of life in such a way as to seem natural rather than a human product [26]; Muller [35] has detailed the entwining of market models with our ideas of rationality and reason since the Enlightenment. The primacy of the market as a model of “natural” regulation is perhaps particularly true in the context of neoliberal political ideology associated with the administrations of people like Augusto Pinochet in Chile, Ronald Reagan in the United States, Margaret Thatcher in the United Kingdom, and John Howard in Australia [21].

Neoliberalism places economic prosperity ahead of other political goals (such as equality or social justice), arguing that, in the presence of an unfettered market as a regulative regime, these other issues will be outcomes of market forces that ensure “the greatest good for the greatest number of people.” By this logic, competition and market forces are the only trustworthy means of regulation and management of government function. Consequently, the agenda of neoliberal governments has been to privatize nationalized industries and public services, open up government services to competition, devolve state functions to non-governmental agencies, and reduce regulations and constraints on private industry, and dismantle barriers to international trade. Once associated particularly with the political right, the neoliberal agenda has, arguably, come to dominate political discourse as parties of the left have moved to a more central position, placing economic wellbeing and “business-friendly” policies at the top of their agendas.

More specifically here, the ideological framework of neoliberalism pervades other forms of cultural discourse including that around environmental management. Just as neoliberal government policy attacks problems of pollution and sustainability by creating markets for trading pollution rights and carbon offsets, market economics is invoked, explicitly or implicitly, as a generic model for social phenomena. McCarthy and Prudham [29] note that:

“Free-market” environmentalism, once an oxymoron, has proliferated since the Reagan-Thatcher years, in forms such as tradable emission permits, transferable fishing quotas, user fees for public goods, and aspects of utility privatization. (279)

In the cultural logic of neoliberalism, markets appear as natural objects rather than social constructions. It is in this context, then, that the typical design response is to frame sustainability in terms of *informed choice* – on the part of individual consumers operating in the unremarked context of a market economy. By corollary, discharging the commitment to neoliberal argumentation opens up other design options, below.

This in turn leads to the third consideration here, which is the way that, by focusing particularly on *individual* patterns of consumption, this particular formulation of the problem erases or obscures the responsibilities and actions of other social entities, most notably corporations and states. When environmental action is framed in terms of individual acts of consumption in an unfettered market, questions of state regulation and of corporate responsibility are written out of the picture. Regulation is inherently framed as a restriction on market forces, while corporate responsibility is reduced to return on shareholder investment. Government action is not a part of the picture. It is interesting to imagine, for instance, a persuasive technology designed not to estimate the carbon footprint of my actions in the grocery store, but those of my actions in the voting booth, or those of the parliamentary and legislative records of my elected representatives. In such an application, a system of choice amongst alternatives is retained, but without the model of the market as a means of connecting “supply” to “demand.”

The rhetoric of individual moral choice exemplifies a broader cultural discourse in which questions of social justice and responsibility are transformed into matters of individual action. In her study of the formulation of ecological questions in “lifestyle” television programming, Lewis [24: 227] notes:

A central feature of the neoliberal focus on self-regulation involves the displacement of questions of social responsibility away from government and corporations onto individuals and their lifestyle ‘choices’, reflecting a growing ‘ethicalization of existence’ [43: 263-4]. The center of political life has shifted, then, towards the private sphere with citizenship increasingly seen as being ‘produced by

personal acts and values,' a shift that Berlant [4: 5] sees as '[d]ownsizing citizenship to a mode of voluntarism'

In short, then, framing sustainability solely in terms of personal moral choice in a marketplace of consumption options may obscure the broader political and regulatory questions that attend significant change. Behavior change on the level of the individual is a fine thing, and indeed it is quite reasonable and appropriate to adopt a model of "ethical shopping" in which the political and moral dimensions of everyday consumption become clear. Clearly, consumer behavior in the marketplace is an appropriate site for technological intervention; however, the danger of naturalizing market models, and hence of obscuring the ideological commitments that lie behind them, is that they may begin to seem to be the only mechanisms at our disposal, offered to the exclusion of other forms or sources of change. The relevance of these ideological commitments is that they foreclose potentially important areas of design investigation.

Nature as a Social Fact

Contemporary social conditions discursively render the market as a natural fact rather than a social one, as I suggested above. However, the market is certainly not the only object to be naturalized in this manner. Most relevant for this discussion, the very idea of "nature" and "the environment" are themselves the result of similar processes.

Cronon [15] documents the history of the western conception of Wilderness. In the US during period of westward expansion, wilderness is seen as a threat to human existence. It betokens the kinds of arid, unforgiving and hostile environment that settlers might experience in their movement west, something that must be conquered (and so also a source of opportunity.) It is not for nothing, he argues, that it is the wilderness where Christ struggles with the Devil, or into which Adam and Eve are cast. By the late nineteenth century, though, a new notion of wilderness emerged – not a threat but a comfort, not something to be overcome but something to be cherished, a place not of danger but of rejuvenation. The US national park movement reflects a change in the understanding of what wilderness might be, what it might be worth, and why. Cronon examines aspects of this ideological framing of wilderness (including the gender issues associated with the image of the rugged masculinity involved in taming "virgin" nature, the problems of habitation by indigenous peoples, and the issues of the supernatural associated with the encounter with wilderness), but his central concern is the way that the ideological construction of wilderness obscures the role of human action:

By imagining that our true home is in the wilderness, we forgive ourselves the homes we actually inhabit. In its flight from history, in its siren song of escape, in its reproduction of the dangerous dualism that sets human beings outside of nature—in all of these ways, wilderness poses a serious threat to responsible

environmentalism at the end of the twentieth century. [15: 81].

The context of this discussion is the strategic essentialism at work in the creation of the environmental movement – a process by which such disparate groups of people as farmers, naturalists, hunters, botanists, mountaineers, fishermen, surfers, foresters, and others are enrolled into a single movement through the discursive creation of "the environment" as an object of mutual concern. As Macnaughten and Urry [27] detail in their book "Contested Natures," there is no single "nature" that lies simply and unproblematically outside the realm of human affairs; rather, any kind of separation between the "natural" world and its implied other (the human world? the social world? the unnatural world? the artificial world?) is itself a human creation, depending upon social interests, cultural dispositions, historical trajectories, and local perspectives. We see this particularly in the disparities between the ecological perspectives of the countries of the "global North" and of the "global South" [45]. One's position on the exploitation of rainforest timber differs greatly with perspective; ecological concerns are rarely uppermost for those for whom it represents the sole available economic resource [52]. In general, the natural world, its classification and cataloging, is enmeshed in any number of debates at various scales [8, 39]. As Raymond Williams [54: 68] has commented, "the idea of nature contains, though often unnoticed, an extraordinary amount of human history."

A reconsideration of the social processes and contests at work in definitions of nature and the environment suggest, again, an alternative role for information technologies. When information technologies present themselves as lenses through which the natural world can be encountered and understood, they are also, inherently, incorporated into the processes by which particular definitions of nature are developed. Again, as with the discussion earlier of market models, this observation has two particular consequences, suggesting, first, that it is important to recognize the social processes within which persuasive technologies are embedded, and, second, that new opportunities might present themselves for technologies that embrace this aspect of their use. When I present an alternative account of ICTs and environmental sustainability, below, I will return to this argument. First, though, I will turn my attention to the consequences of the "ecotopian" arguments that support much contemporary technological intervention.

THE PROBLEMS OF ECOTOPIANISM

The second major theme here concerns the implications of utopian thinking in sustainability movements in general, but specifically with reference to the opportunities around information technologies.

Pepper [38] explores the tensions and contradictions implicit in radical environmental arguments – what he terms "ecotopianism," as exemplified by the writings of

people such as Sale [44] or Bookchin [7]. He argues that attempts at environmental “transgressive utopianism” (that is, a form of utopianism aimed at effecting social change) face a series of obstacles inherent in their own discourse. While Pepper does not suggest that all ecological activism embraces a radical ecotopian position, it is useful to look at these extreme cases to identify a series of issues that do manifest themselves, to one degree or another, in other forms of environmental debate – including, here, arguments about the opportunities for technological intervention. I will outline Pepper’s argument first, and then discuss the technological considerations.

Pepper’s Four Tensions

Pepper identifies four primary tensions in ecotopian arguments.

The first problem is that ecotopian arguments argue for social change leading towards an alternative ecological future which is itself imagined to be stable and rigid – and hence inherently repressive. The contradictions between a position that argues simultaneously for revolutionary change and stable and fixed social structure are particularly tense when the outcome being promoted is visualized as a return to “the imagined past of society-nature harmony.” Pepper cites David Harvey’s [20] critique of ecotopianism, contrasting a utopian idealism with a position that focuses on transforming material forces within existing society. They argue is that transformations of current social arrangements need to be seen in terms of their transgressive potential rather than becoming the new *status quo*.

The second problem is the inherent contradiction between, on the one hand, ecotopianism’s commitment to diversity (both biodiversity in the large and ecological diversity in the small) and, on the other hand, its invocation of universal values to be applied to society. Given that human needs inevitably vary, ecotopianism inherently postulates strict social control while at the same time espousing diversity and democracy as aspects of social life.

Drawing on this, the third problem that Pepper outlines is the tension between modernism and postmodernism in which ecotopianism finds itself. From postmodernism, ecotopian draws a rejection of grand narratives of social life, focusing instead on the pluralistic, local, provisional and polyvocal nature of ecological realities. At the same time, however, ecotopianism subscribes to exactly the sorts of grand narratives that postmodernism critiques. Perhaps the most significant of these is the central place that ecotopianism accords to a broad technoscientific agenda – both in the authority of sciences such as botany and earth systems science to analyze and understand the environment, and the transformative potential of new technology to change both the environment and our place within it.

The final problem for ecotopian rhetorics is the tension between the operation of society at different scales. On the one hand, ecotopianism talks in terms of localisms – small,

self-supporting and self-regulating communities adapted to local conditions – while at the same time, it depends on regulation at the national and international levels in order to function effectively. Evocations of scale in ecotopian arguments – in particular, the suggestion that the natural world effectively defines the scales of environmental action – is often formulated as a critique of national or international agendas, and yet action at this scale is as critical to ecological utopianism as local or regional action.

Although Pepper’s critique is directed towards a radical ecotopianism, these issues are often implicit within more mainstream arguments. Further, Pepper does not suggest that these problems are insurmountable, and he examines a range of positions on each of them. However, in general, he draws attention to the ways that the contradictions and tensions inherent in radical and transformative ecological positions may become obstacles to achieving exactly the kinds of social and political change that they advocate.

Technological Considerations

Pepper’s account of the tensions of ecotopianism is not specifically oriented towards HCI applications; neither does the radical ecotopian position he critiques underwrite the HCI research agenda in environmentalism. Nonetheless, the issues he discusses do manifest themselves to one degree or another in much of this research, and Pepper’s analysis carries implications for contemporary developments in information technology. Let me briefly take them in turn.

First, the dilemma between transformation and stasis, and in particular the repressive nature of stasis, manifests itself most particularly in the role that technology frequently plays in regulation and governance [1, 9, 46]. Technologies designed to monitor and record actions, particularly with respect to their environmental consequences, are clearly also a natural path for various forms of surveillance and regulation. Within HCI, we are most immediately concerned with “personal” technologies, but we need to think also of these systems as being tools not just for individuals but also for corporations and for states. It is not simply that states might make use of such systems to monitor and regulate personal activities; more broadly, what I want to draw attention to is the ways in which patterns of access to and control over information are mechanisms through which states and individuals connect [2]. So, for example, movements towards the use of mobile and personal technologies in support of “citizen science” movements [e.g. 37] are predicated too upon particular notions of citizenship. Not all states share a common perspective on the “informed” citizen.

Second, the tension between diversity and universality arises in the relatively uniform commitments to particular kinds of “users” in many persuasive technologies. This observation has been made before in other areas of HCI and ubiquitous computing design [e.g. 53, 56] but, as sustainability arguments intersect with arguments about how people are positioned with respect to technological

infrastructures [e.g. 30], with the power-geometries of place and movement [32] and an interest in the different patterns of technology adoption and use in different parts of the world [e.g. 37].

Third, the tension between modern and postmodern accounts of contemporary life is one within which these kinds of technologies are thoroughly implicated. Current efforts in HCI and related practices arises from a commitment to technological progress in environmental responsibility and awareness, whether that be in the form of mobile devices to help people understand the environmental consequences of purchase decisions [51] or technological reconfigurations of domestic technology for green living [55]. As Pepper observes, arguments about technoscientific progress sit uncomfortably with postmodern critiques of totalizing narratives to which transformative ecological arguments are also implicitly or explicitly committed. Again, the tension here lies in the commitment to representation and equivocality which is at the heart of HCI's program, and particularly in its concern to represent and champion "the user" [12], while at the same time advocating for the progressive nature of technological agendas.

Pepper's fourth dilemma – that of scale – might, at first glance, seem the least relevant for current HCI efforts, being rooted as it is primarily in the problems of ecological transformation and environmental governance. However, questions of scale may offer a new and different way of thinking about HCI and environmental practice, one that responds to the sorts of critique offered here, mainly by thinking of the opportunity to reconsider information technologies as technologies of scale-making. At this point, then, we can begin to adopt a more constructive perspective on new opportunities for technological design. To do so, we need to elaborate the issues of scale in more detail.

THE POLITICS OF SCALE

The fourth of Pepper's tensions is that between the kinds of local efforts which ecotopian agendas promote and the large scales at which ecological impacts emerge and at which environmental regulation is managed; this is the dilemma of "think globally, act locally." Indeed, one of the complexities of ecological regulation is that much of it extends beyond the nation-state to supra-national organizations such as the United Nations, the World Trade Organization, and other entities that lie beyond the reach of representative democracy within individual nations [34, 37].

McCarthy [28] uses the example of California's regulation of MTBE to illustrate this. The articles of the North American Free Trade Agreement (NAFTA) contain provisions to protect corporations from the expropriation of their foreign investments, should, for example, the objects of those investments be nationalized by the foreign state. While such protections are relatively uncontroversial, NAFTA is unusual in including within its expropriation

provisions not only direct investments but also the profits that might reasonably be expected to flow from foreign investment and international trade. It was under these provisions that the state of California found itself subject to a \$970m claim in 1999. Earlier in the decade, scientists had documented the widespread pollution of groundwater with methyl tertiary butyl ether (MTBE), a gasoline additive and suspected carcinogen. California passed legislation to phase out the use of MTBE in gasoline by 2002, spurring other states to do likewise. Consequently, California was sued under NAFTA provisions by Methanex, a Canadian manufacturer of methanol, on the basis of the expropriation of expected profits in consequence of the ban.

In 2005, a tribunal established by NAFTA dismissed the claim. However, what is interesting is the general set of circumstances that warrant such an action, and what they say about the scales of ecological governance. The provisions of NAFTA and similar agreements turn these kinds of disputes from disputes between nations to disputes between states and corporate actors. Methanex itself could bring a complaint against California, rather than petitioning Canada to do so on its behalf. Further, given that the provisions are designed to protect investors, they are one-sided; no right is granted to California (or to citizens or NGOs) to bring suit against Methanex or other corporations. Settled by tribunals rather than in national courts, these complaints also need not follow the rule of the law of any particular country. Playing out on a different scale, beyond the level of the nation-state, these arrangements potentially confound the processes by which individuals and nations might expect to introduce elective environmental protections. McCarthy notes that, while the provisions of NAFTA in this area were somewhat unusual for the time, NAFTA is widely seen as a model to emulate for similar, regional free trade agreements.

However, if the politics of scale constitute a problem for ecological action, they may also turn out to offer a new site for solutions. Recent work in mobile and ubiquitous computing has suggested a transformation in our understandings of spatial practice through the ways in which we can inhabit and act in the world [11]. Arguably, it is in terms of question of scale that these transformations are most significant. In "Modernity at Large," Appadurai [3] argues for the imagination as the primary site of globalization, referring to the way that transnational movements of goods, media, ideas, people, and capital alter the scale and the stage upon which we think of ourselves and our associations. Similarly, communication technologies are implicated in reimaginings of the scales upon which we act and at which we are connected [33]. What this suggests, then, is that one alternative role for information technologies might be to help connect people at the scales at which environmental action and engagement can be effective.

DESIGNING TECHNOLOGIES OF SCALE-MAKING

The primary focus of this paper has been the discursive structures within which research on HCI, persuasive technologies, and environmental sustainability is embedded. Its primary concern, then, is critical engagement rather than design [16]. However, drawing upon the arguments just presented, I want to show that this critique can be supportive of alternative models for technological intervention.

Identity Politics and Strategic Essentialism

Postcolonial scholar Gayatri Spivak [49] coined the term “strategic essentialism” to refer to the ways in which subordinate or marginalized social groups may temporarily put aside local differences in order to forge a sense of collective identity through which they band together in political movements. Post-war resistance movements to colonial rule often relied on just such mechanisms by which particular forms of ethnicity or nation-hood were used to align disparate groups towards common goals. The only way it made sense, for example, for the many cultural, religious, and linguistic groups of contemporary India to come together as “Indian” was in the context of their common colonization by the British. Spivak’s observation is that, while such terms as “indigenous” peoples or similar labels result in problematic and unstable groupings that erase significant differences and distinctions [50], nonetheless these acts of identity formation support important political ends. While terms such as “Indian,” “African”, or “Native American” may be manufactured and homogenizing, they nonetheless do important work.

As Proctor [41] demonstrates, strategic essentialism lies at the heart of the creation of the environmental movement. “Environmentalism” is a political force resulting from the forging of an alliance between groups with concerns as diverse as open access, biodiversity, air and water pollution, surfing, animal husbandry, agricultural efficiency, bioengineering, and rock climbing. “The environment” emerges as a concept shaped by the union of common interests, even though these interests might be mobilized in quite different ways and for quite different reasons. As Spivak would note, the inherent heterogeneity of the group is made subservient to strategic goals. Arguably, one of the reasons that clashes of perspectives over environmentalism (e.g. between Western activists and native Amazonians over sustainability and economic survival in the rainforest [52]) are troubling is because they threaten the alliances from which these political movements are formed.

As noted above, when we talk of persuasion as a consideration for information technologies, we are frequently concerned with how behavior modification can be induced by intervening in moments of local decision-making and by providing people with new rewards and new motivations for desirable behaviors [18]. However, if we think about environmental sustainability from a political perspective, and particularly bearing in mind the important role of strategic essentialism, then a different application

area presents itself. From this perspective, what we might want to persuade people of is the ways in which their interests are aligned with those of others. As is demonstrated by sociological research into the formation of social movements, this process of alignment, by which one can start to find one’s own interests as being congruent with those of others, is a critical first step in political mobilization [48].

Arguably, we can find the foundations for such technologies in the current crop of so-called “social software” applications, of which Facebook is perhaps currently the most prominent. Social networking sites claim simply to articulate “social networks” that are already there, although the relationship between social networks as construed by these systems and the formal analytic concept deployed in sociology is at best tenuous, and they might better be thought of as sites for various forms of strategic engagement with others. Instead, then, we can approach social networking sites as technologies of affiliation, alignment, and identification, sites at which forms of collective identity are forged and enacted.

If social software works by, first, tying individuals and actions to groups and networks and, second, by providing a platform through which one acts as a member of a group (be that an institutional affiliation, an informal group, or simply an identifiable social type), then a similar approach can perhaps be harnessed in the domain of sustainability. This would suggest that, rather than using technology to provoke reflection on environmental impact of individual actions, we might use it instead to show how particular actions or concerns link one into a broader coalition of concerned citizens, social groups, and organizations. So, for instance, if we were to combine the sorts of monitoring technologies developed by Paulos et al. [37] or the kinds of scanning technologies explored by Bernheim-Brush et al. [5] with social networking accounts of the different interests associated with sustainability debates and movements, then we might have a system that could tell people, “the action you are about to take aligns you with X but against Y,” or, “the products that you are looking at have these different impacts on these different groups.” This process of frame bridging [48] not only allows for forms of reflection and behavior modification but also links the individual into a broader coalition of interests. What becomes visible is not so much the world, but its political alignments.

This is an attempt to think of information technologies as technologies of scale-making. By focusing not on connecting people *to* their actions and their consequences, but on connecting people *through* their actions and their consequences, we can approach persuasive technologies as ones whose intent is to persuade people of the effectiveness of collective action and of their own positions within those collectives. As an approach to the use of interactive technologies and environmentalism, it attempts to move from fostering environmental consumers to shaping

environmental movements. If we see the problem of environmental responsibility to be a problem of the ways in which people are linked together through their commitments, interests, and actions, this approach takes these connections as the primary focus of design attention.

CONCLUSION

Environmental sustainability is both an urgent problem and a massive one. HCI's engagement with questions of environmental action reflect a history of concern with the world in which information systems are deployed. However, I have argued here that the dominant approaches to research into environmental topics in HCI are inherently self-limiting because they restrict the scope of that engagement. In particular, by turning the problems of environmentalism into questions of personal moral choice and by turning environmental action into a redirection of consumption patterns, research in HCI for environmental sustainability has systematically ignored important areas for potential action. This is both a conceptual and a pragmatic critique; indeed, I scarcely believe it makes sense to separate the two. Lewin [23: 169] wrote that, "There is nothing as practical as a good theory," and so it is here. Effective engagement with environmental problems requires us to carefully and critically examine the conceptual foundations upon which our systems and our reasoning are based.

In particular, here, I have identified a series of problems. The first problem is the naturalization of market models as means of aggregating individual action for collective ends. As I have suggested, this naturalization of the market, an inherent aspect of enculturation in market capitalism, is certainly suggestive of important opportunities (particularly in making visible the political consequences of patterns of consumption) but comes at significant cost, obscuring important areas for engagement by placing the emphasis upon the actions of consumers rather than states and corporations, and most especially by adopting an approach to collective action that is premised upon competition rather than cooperation. The complicated entwinings of the environment and contemporary capitalism [36] require that we pay attention to the ways that problems and solutions are articulated. The second problem is the naturalization of the environment itself. This obscures the diversity of perspectives and positions that are elements in any definition of the natural world, and so in turn hides the social and political activity at work in negotiating those boundaries. When we turn the environment into something that "just is," then, first, we no longer see the negotiation of meaning as a site of important activity, and, second, we adopt a totalizing discourse that fails to accommodate the variability of local circumstance. The third problem – really a series of problems – concerns the tensions implicit in the kind of ecological utopianism that is necessary in order to articulate opportunities for change. Drawing on Pepper's [38] work, I have attempted to show how these apply in the case of HCI research. It is important to recognize that

Pepper's goal is not to show that ecological utopianism is inherently wrong-headed, nor is it to suggest that the tensions and dilemmas that he identifies are issues that must be resolved before progress can be made. Instead, the tensions that he notes are sites of active engagement and "productive friction" – they help to carve out the opportunity space within which any form of social action and engagement must be sited.

By analogy with Foucault's notion of "governmentality," Agrawal [2] discusses the production of environmental subjects under the label "environmentality," which "refers to the knowledges, politics, institutions, and subjectivities that come to be linked together with the emergence of the environment as a domain that requires regulation and protection" [2: 236]. In other words, our notions of ourselves as environmental subjects and agents is entwined with the production of the environment itself as a site of regulation and management. As with Foucault, there is a triple-meaning to the production of "environmental subjects" in Agrawal's analysis – first, the emergence of our own consciousness of ourselves as participants in environmental processes; second, the internalization of the ways we are subject to particular forms of governance and regulation; and third, the production of the topics of environmental discourse. Rather than taking nature and environmental consciousness as timeless and pre-given, Agrawal traces their emergence through specific encounters between the individual and the state.

It is in this regard that I have suggested that one of Pepper's concerns – the consideration of scale – might actually be a useful point of departure for design engagement. Here we have an opportunity for a form of design intervention that takes seriously the political, cultural, institutional, and spatial aspects of environmental activism, not by resolving the question of scale but by adopting it as a site of productive engagement. In this, we can connect some of the problems of environmental action to other concerns with the production of scale through technological processes in human geography [10].

More generally, this work reflects an ongoing concern with the conceptual foundations of information technology and its uses. It is entirely appropriate that HCI's attention should broaden beyond the level of interaction between user and screen, to encompass the appropriation and meaning of digital media and the cultural and social processes by which it comes to be embedded in everyday life, and the emerging interest in questions of sustainability exemplifies the power and importance of this approach. However, it must be accompanied, too, by a broadening in the theoretical and conceptual approaches that we use and a similar broadening of the contexts that we take to impinge on this work. Political, social, cultural, economic, and historical contexts have critical roles to play, not only because they shape our experience with information technologies, but also, and even more, because information technologies in

contemporary life are sites at which these contexts are themselves developing.

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REFERENCES

1. Agar, J. 2003. *The Government Machine: A Revolutionary History of the Computer*. Cambridge, MA: MIT Press.
2. Agrawal, A. 2005. *Environmentality: Technologies of Government and the Making of Subjects*. Duke University Press.
3. Appadurai, A. 1996. *Modernity at Large: Cultural Dimensions of Globalization*. University of Minnesota Press.
4. Berlant, L.G. 1997. *The Queen of America Goes to Washington City: Essays on Sex and Citizenship*. Durham, NC: Duke University Press.
5. Bernheim-Brush, A.J., Combs-Turner, T., Smith, M., and Gupta, N. 2004. Scanning Objects in the Wild: Assessing an Object-Triggered Information System. *Proc. Intl Conf. Ubiquitous Computing UbiComp 2004* (Nottingham, England).
6. Blevins, E. 2007. Sustainable Interaction Design: Invention and Disposal, Renewal and Reuse. *Proc. ACM Conf. Human Factors in Computing Systems CHI 2007* (San Jose, CA), 503-512.
7. Bookchin, M. 1990. *Post Scarcism Anarchy*. Montreal, ON: Black Rose Books.
8. Bowker, G. 2000. Biodiversity Datadiversity. *Social Studies of Science*, 30(5), 643-683.
9. Bowker, G. and Star, S. 2000. *Sorting Things Out: Classification and its Consequences*. Cambridge, MA: MIT Press.
10. Brenner, N. 1998. Between Fixity and Motion: Accumulation, Territorial Organization and the Historical Geography of Spatial Scales. *Environment and Planning D: Society and Space*, 16, 459-481.
11. Brewer, J. and Dourish, P. 2008. Storied Spaces: Cultural Accounts of Mobility, Technology, and Environmental Knowing. *International Journal of Human-Computer Studies*, 66, 12, 963-976.
12. Cooper, G. and Bowers, J. 1995. Representing the User: Notes on the Disciplinary Rhetoric of HCI. In Thomas, P. (ed.), *The Social and Interactional Dimensions of Human-Computer Interfaces*. Cambridge University Press.
13. Consolvo, S., McDonald, D., Toscos, T., Chen, M., Froehlich, J., Harrison, B., Klasnja, P., LaMarca, A., LeGrand, L., Libby, R., Smith, I., and Landay, J. 2008. Activity Sensing in the Wild: A Field Trial of UbiFit Garden. *Proc. ACM Conf. Human Factors in Computing Systems CHI 2008* (Florence, Italy), 1797-1806.
14. Corburn, J. 2005. *Street Science: Community Knowledge and Environmental Health Justice*. MIT Press.
15. Cronon, W. 1995. *Uncommon Ground: Rethinking the Human Place in Nature*. Norton.
16. Dourish, P. 2006. Implications for Design. *Proc. ACM Conf. Human Factors in Computing Systems CHI 2006* (Montreal, Canada), 541-550.
17. Ferguson, J. 1994. *The Anti-Politics Machine: Development, Depoliticization, and Bureaucratic Power in Lesotho*. University of Minnesota Press.
18. Fogg, B.J. 2002. *Persuasive Technology: Using Computers to Change What We Think and Do*. Morgan Kaufman.
19. Froehlich, J., Dillahunt, T., Klasnja, P., Mankoff, J., Consolvo, S., Harrison, B., and Landay, J. 2009. UbiGreen: Investigating a Mobile Tool for Tracking and Supporting Green Transportation Habits. *Proc. ACM Conf. Human Factors in Computing Systems CHI 2009* (Boston, MA), 1043-1052.
20. Harvey, D. 2000. *Spaces of Hope*. Edinburgh University Press.
21. Harvey, D. 2005. *A Brief History of Neoliberalism*. Oxford University Press.
22. Huang, E. and Truong, K. 2008. Breaking the Disposable Technology Paradigm: Opportunities for Sustainable Interaction Design for Mobile Telephones. *Proc. ACM Conf. Human Factors in Computing Systems CHI 2008* (Florence, Italy), 323-332.
23. Lewin, K. 1952. *Field theory in social science: Selected theoretical papers by Kurt Lewin*. London: Tavistock.
24. Lewis, T. 2008. Transforming Citizens? Green Politics and Ethical Consumption on Lifestyle Television. *Continuum: Journal of Media and Cultural Studies*, 22(2), 227-240.
25. Lin, J., Mamykina, L., Lindtner, S., Delajoux, G., and Strub, H. 2006. Fish'n'Steps: Encouraging Physical Activity with an Interactive Computer Game. *Proc. Intl. Conf. Ubiquitous Computing UbiComp 2006* (Orange County, CA), 261-278.
26. Lukacs, G. 1967. Reification and the Consciousness of the Proletariat. In *History and Class Consciousness*. Merlin.

27. McCarthy, J. 2005. Scale, Sovereignty, and Strategy in Environmental Governance. *Antipode*, 37(4), 731-753.
28. Macnaughton, P. and Urry, J. 1998. *Contested Natures*. London: Sage.
29. McCarthy, J. and Prudham, S. 2004. Neoliberal Nature and the Nature of Neoliberalism. *Geoforum*, 35, 275-283.
30. Mainwaring, S., Chang, M., and Anderson, K. 2004. Infrastructures and their Discontents: Implications for Ubicomp. *Proc. Intl. Conf. Ubiquitous Computing (Nottingham, UK)*, 418-432.
31. Mankoff, J., Matthews, D., Fussell, S., and Johnson, M. 2007. Leveraging Social Networks to Motivate Individuals to Reduce their Ecological Footprints, *Proceedings of HICSS 2007*, 87-96.
32. Massey, D. 1993. Power-geometry and a Progressive Sense of Place. In Bird, Curtis, Putnam, Robertson and Tickner (eds), *Mapping the Futures: Local Cultures, Global Change*. London: Routledge.
33. Miller, D. and Slater, D. 2001. *The Internet: An Ethnographic Approach*. Berg.
34. Mol, A. 2002. Ecological Modernization and the Global Economy. *Global Environmental Politics*, 2(2), 92-115.
35. Muller, J. 2002. *The Mind and the Market: Capitalism and Western Thought*. New York: Anchor Books.
36. O'Connor, J. 1998. *Natural Causes: Essays in Ecological Marxism*. New York: Guilford Press.
37. Paulos, E, Honicky, R., and Hooker, B. 2008. Citizen Science: Enabling Participatory Urbanism. In Foth, M. (ed), *Urban Informatics: Community Integration and Implementation*.
38. Pepper, D. 2007. Tensions and Dilemmas in Ecotopianism. *Environmental Values*, 16, 289-312.
39. Philip, K. 2003. *Civilizing Natures: Race, Resources, and Modernity in Colonial South India*. Rutgers University Press.
40. Pierce, J., Odom, W., and Blevis, E. 2008. Energy Aware Dwelling: A Critical Survey of Interaction Design for Eco-Visualizations. *Proc. Australasian Conference on Computer-Human Interaction OZCHI '08 (Cairns, Queensland, Australia)*.
41. Proctor, J. 1998. The Social Construction of Nature: Relativist Accusations, Pragmatist and Critical Realist Responses. *Annals of the Association of American Geographers*, 88(3), 352-376.
42. Robbins, P. 2004. *Political Ecology*. Oxford: Blackwell.
43. Rose, N. 1989. *Governing the Soul: The Shaping of the Private Self*. London: Routledge.
44. Sale, K. 1995. *Dwellers in the Land: The Bioregional Vision*. San Francisco, CA: Sierra Club Books.
45. Saunders, L., Hanbury-Tenison, R., and Swingland, R. 2002. Social Capital from Carbon Property: Creating Equity for Indigenous Peoples. *Philosophical Transactions: Mathematical, Physical, and Engineering Sciences*. 360, 1763-1775.
46. Scott, J. 1998. *Seeing Like A State: How Certain Schemes to Improve the Human Condition have Failed*. New Haven, CT: Yale.
47. Sonnenfeld, D. and Mol, A. 2002. Globalization and the Transformation of Environmental Governance. *American Behavioral Scientist*, 45(0), 1318-1339.
48. Snow, D., Ruchford, B., Worden, S., and Benford, R. 1986. Frame Alignment Processes, Micromobilization, and Movement Participation. *American Sociological Review*, 51, 464-481.
49. Spivak, G. 1987. In *Other Worlds: Essays in Cultural Politics*. Taylor and Francis.
50. Stoler, A. 1989. Rethinking Colonial Categories: European Communities and the Boundaries of Rule. *Comparative Studies in Society and History*, 31(1), 134-161.
51. Tomlinson, B. 2010. *Greening through IT*. Cambridge, MA: MIT Press.
52. Tsing, A. 2004. *Friction: An Ethnography of Global Connection*. Princeton, NJ: Princeton University Press.
53. Williams, A., Robles, E., and Dourish, P. 2008. Urbanizing the City: Examining and Refining the Assumptions Behind Urban Informatics. In Foth (ed.), *Handbook of Research on Urban Informatics: The Practice and Promise of the Real-Time City*. Hershey, PA: Information Science Reference, IGI Global.
54. Williams, R. 1980. Ideas of Nature. *Problems in Materialism and Culture*, Williams (ed), 67-85.
55. Woodruff, A., Hasbrouck, J., and Augustin, S. 2008. A Bright Green Perspective on Sustainable Choices. *Proc. ACM Conf. Human Factors in Computing Systems CHI 2008 (Florence, Italy)*, 313-322.
56. Woolgar, S. 1991. Configuring the User: The Case of Usability Trials. In Law (ed), *A Sociology of Monsters: Essays on Power, Technology, and Domination*, 57-99. London: Routledge.