

Nourishing the Ground for Sustainable HCI: Considerations from Ecologically Engaged Art

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ABSTRACT

Sustainable HCI is now a recognized area of human-computer interaction drawing from a variety of disciplinary approaches, including the arts. How might HCI researchers working on sustainability productively understand the discourses and practices of ecologically engaged art as a means of enriching their own activities? We argue that an understanding of both the history of ecologically engaged art, *and* the art-historical and critical discourses surrounding it, provide a fruitful entry-point into a more critically aware sustainable HCI. We illustrate this through a consideration of frameworks from the arts, looking specifically at how these frameworks act more as generative devices than prescriptive recipes. Taking artistic influences seriously will require a concomitant rethinking of sustainable HCI standpoints – a potentially useful exercise for HCI research in general.

Author Keywords

Design, Art, Sustainable HCI, Reflective HCI

ACM Classification Keywords

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

Sustainability in and through design have become critical topics in HCI [e.g. 1,4,10,13,15,16,17,25,26,31,32,40] promising necessary change for both our natural environment and designed systems. This work is roughly categorized as building systems that are 1) ‘more green’, and/or 2) improve ‘green behavior’ [25,32]. Underlying these categories, however, is a call for more radical change [44] to the principles and practices of HCI.

As McDonough and Braungart have argued, end-of-pipe solutions such as reduce, reuse, and recycle, must be

coupled with a fundamental rethinking of design to achieve a sustainable society [28]. Nurturing a change towards maintainable, accountable, and respectful relationships with the environment requires questioning and re-imagining how we perceive and understand society, and our role in it as consumers and makers of things. Consequently, what we need in HCI is to question and re-imagine our design of and interaction with interactive systems.

One tactic for examining fundamentals within a field is to look outside the field—a practice HCI has embarked on in the past and one encouraged by the perspective of reflective HCI [35]. In particular, many within HCI are looking to the arts for enhancing, or in some cases transforming, our traditionally science-dominated practice [e.g. 5,8,14,19,24, 27,34]. We extend this effort by focusing on ‘environmentally engaged art.’ For decades, practitioners and scholars of this area have grappled with environmental policy, actions, and conditions via methods that are concomitantly activist and aesthetic. As sustainable HCI engages with such issues, this related experience offers a valuable resource.

We will draw out how scholars make sense of ecologically engaged art – how it is organized, contextualized, and interpreted – as a point of reference and comparison for sustainable HCI in particular and HCI in general. Through this examination, researchers and practitioners of both HCI and the arts can discover new perspectives on the practices and premises that ground their work. In the following sections, we provide a background on ecologically engaged art, explore the discourse around such work, delineate possible points of connection to sustainable HCI, and reflect on the implications for HCI as a field.

OVERVIEW OF ECOLOGICALLY ENGAGED ART

Looking to ecologically engaged art for inspiration and understanding requires an overview of this domain. This area encompasses eco-art, land art, reclamation art, and environmental art – each term reflecting a multitude of practices, strategies, political valences and disciplinary approaches [see 20]. One important implication of this diversity is that ecologically engaged art *cannot* be defined by a particular medium or way of working. Rather, it is best

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CHI 2009, April 4–9, 2009, Boston, Massachusetts, USA.
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understood as being constituted by a set of common themes, which are explored through a myriad of materials and practices. For this paper, we rely on three examples to draw out characteristic themes of ecologically engaged art.

Robert Smithson's *Spiral Jetty* (1970) intervenes into the environment on a large scale, extending a massive 15' wide, 1500' long, spiral form made of rock, mud, and salt, from the shoreline into the Great Salt Lake. *Spiral Jetty* is a sculpture constructed from the earth. The work is not meant as a comment on particular issues of the environment *per se*; rather, it references Smithson's interest in the temporal: the ways in which the environment changes over time, both due to the "natural" and the "human". For Smithson, these practices were part of his interrogation of the hermetic space of the gallery and the underlying ideology that erects a barrier between nature and culture. Smithson's art then can be understood as an exemplar of a broad theme in environmentally engaged art: *the negation of the artificial division between culture and nature and an exploration of the possibilities that exist once we see the two as fundamentally interrelated.*

The work of Joseph Beuys also questions the artificial distinction between culture and nature through his "Social Sculpture" whereby art and life are inextricably intertwined and "everybody is an artist". Beuys' projects exemplify a second theme of *engaging the political as art practice*. As a founding member of the German Green Party and twice candidate for European parliament, Beuys embodied his activism in his life and work. His projects challenged prevailing ideologies of consumerism and industrialized society, such as in his American lecture series cum performance *Energy Plan for the Western Man* (1974) where he suggested and developed with the audience the potentialities of creative, artistic means of resistance and responses to the growing energy crisis. One of Beuys' final pieces, *7000 Oaks* (1982-1987) integrated artistic practice with the mechanisms of community involvement by engaging local citizens to plant a variety of trees (7000 of them) around the city. This work demonstrated not only how individuals could affect change but also opened up conversations about new ways to think about city planning.

Finally, Natalie Jeremijenko's projects can be understood as exemplifying a third theme: *investigating the potentials for public engagement with environmental matters by re-imagining the relationships between technology, the environment, and the public*. In her most recent project, *Environmental Health Clinic* (2007-), she invites the public to visit a custom-built "clinic" with their environmental problems. Instead of providing ready-made prescriptions, Jeremijenko works with the "patients" to understand local and global issues that underpin their problem, while also providing specific interventions that potentially address the issue. Thus Jeremijenko does not erase the wider structural issues leading to environmental health issues, nor does she

negate the possibilities of individual and group action or the space for technological responses.

These themes are not mutually exclusive and ecologically engaged art often includes all three with variations in prominence. In addition, these themes and their examples indicate a number of shared qualities that further characterize ecologically engaged art. First, these examples foreground longitudinal work, with time measured on the scale of years and decades, highlighting the formal and conceptual position of temporality. Second, these projects exist outside the controlled space of the lab or gallery and within the messy and unpredictable space of "nature", variously defined. Third, science and technology are not erased in a Luddite move or heralded as a panacea, but rather are seen as practices for interrogation and change. Fourth, the works fundamentally involve the community on the continuum from the dialogic to the activist. Finally, the works are often deeply connected to the identity and history of the artist (or artists) themselves.

These themes and qualities, constitutive of ecological art as a whole, differ markedly from how one might characterize core HCI work in general and by extension the direction of many current sustainable HCI projects. Sustainable HCI work intervenes in the environment, but the direction of work is commonly either in making technology more green (e.g. such as using less power or using recyclable materials) or in using technology to make people's behavior more green (e.g. monitoring and visualizing energy usage) [25]. Although these projects certainly improve the sustainability of technology use and design, they do not tend to call into question the artificial division between nature and culture. Nor do such projects overtly engage in the political aspects of sustainability, the environment, and the role of technology. Some sustainable HCI projects do re-imagine relationships between the public and the environment by promoting alternate behaviors, but they tend to avoid explicitly exposing how technology might perpetuate current realities and its potential role in imagining new, perhaps radical, realities.

This shared focus but substantial differences in approach suggests that ecologically engaged art stands to offer new insights for sustainable HCI. However, if these practices are dramatically divergent from our own in HCI, how are we to make sense of them? If sustainable HCI work does not tend to address the interrelationships between nature and culture, if it does not typically engage the political head on, if it does not tend to design for reflection on the underpinnings of existing reality and the role of technology in perpetuating or challenging this, then it is not enough to simply suggest that these are things we should try. What is needed is an appreciation for how to approach *and* assess projects that take on such qualities. In the following sections, we look at how members of the art community analyze, contextualize, and attribute value to ecologically engaged art practices.

ATTENDING TO THE DISCOURSES OF ECO-ARTS

In this section, we explore arts discourse around ecologically engaged art and then reflect on intersections with sustainable HCI. ‘Discourse’ is a common term used in the arts to describe the ongoing construction of arguments concerning ideas. To this end, we first examined a wide range of art practices and corresponding critiques. We identified two frameworks relevant to re-imagining our design of and interaction with interactive systems. The first, from art historian and cultural theorist Malcolm Miles, proposes a scheme of categorizing environmental art. The second, from art historian Grant Kester, identifies essential components of dialogic art and activism.

We describe the organized ideas as ‘frameworks’ to be taken as generative themes and organizing questions as opposed to prescriptive directions or definitive classifications. The primary role of frameworks in this sense is not to uncover a ground truth about some phenomenon but to spark conversation about the organic development of a body of work. As such, the value or utility of the framework is in articulating a point of view that can be debated or engaged with, that opens up discussion and prompts new ways of thinking.

Miles’ Four Categories of Eco-Art

Art historian and cultural theorist Malcolm Miles has proposed a four-part categorization scheme of “art which responds implicitly to the natural world, or explicitly to environmental agendas.” [29] The categories are:

1. Art that represents the natural world.
2. Art that enters a discourse of the natural world and its apprehension.
3. Cultural production that tests methods of environmental salvage or contributes to sustainable forms of living.
4. Dialogic inter-action at the cusp of art and activism.

This framework is simultaneously thorough and succinct: it covers a broad range of work in direct language. This is not to imply that it is simplistic. It affords a sophisticated and productive discrimination among kinds of environmentally engaged art and provides the grounds for identifying important courses of inquiry for new perspectives in HCI.

Example Projects

In this section, we present three examples of environmentally engaged projects and use Miles’ categories to analyze them, drawing out themes for HCI. We focus on the first three categories, reserving the fourth for the following section. Rather than choosing canonical or iconic examples of environmentally engaged art, we have chosen recent projects with an obvious intersection with HCI: they all use computational media to represent the natural world or engage environmental agendas.

The first example project, Brooke Singers’ *Superfund 365*¹ (2007), examines superfund sites through information visualization. Each day of a single year, a different superfund site is visualized to show the primary toxic make-up of the site (rendered as a flower-like geometric shape, with each day’s visualization being as unique as its toxic makeup) alongside demographic and historical information. As users explore the site, they can compare the toxicity of different sites. Over time and with extended interaction, trends concerning where the sites are located become apparent and raise questions concerning the relationship between environmental conditions, social status and justice.

The second example, *Mori*² (1999), by Ken Goldberg, Randall Packer, Gregory Kuhn, and Wojciech Matusik, consists of 3 parts: an embedded sensor in a natural environment, a gallery installation and a web interface. Both the installation and the web interface present in an installation real-time seismic data collected from a probe in the Earth. Aurally, the data produces a soundscape of the earth moving. Visually, the amplified sound reverberates a fabric structure within the installation, and the web interface presents the seismic data on a screen in a manner reminiscent of a heartbeat monitor or EKG.

Finally, in *7000 Oaks and Counting*³ (2007), Tiffany Holmes situates a screen-based visualization of energy expenditure in the lobby of the National Supercomputing Center. The visualization depicts the number of trees needed to offset the building’s carbon footprint (referencing Beuys’ *7000 Oaks*). Specifically, data is expressed through circular and swirl-like patterns, images of nature (often trees), and screens of textual information discriminated by color and typographic hierarchy.

From the perspective of a product-led or technological analysis, the three projects might appear very similar in that they all represent scientific environmental data in compelling aesthetic forms, primarily to a lay audience. In addition, all three works embody the ecologically engaged art theme of investigating public engagement with environmental matters through technology. However, by approaching the projects with Miles’s categories, important distinctions arise. These distinctions reframe the works in a manner novel to HCI and present a transformative potential for changing how we consider the design of and interaction with interactive systems in the context of sustainable HCI.

Miles’ first category—works that represent the natural world—can be used to frame *Superfund 365*. Key to this project is the use of computational information visualization to graphically depict environmental data of

¹ <http://superfund365.org/>

² <http://memento.ieor.berkeley.edu/>

³ <http://www.tiffanyholmes.com/>

either existing conditions or potential future ecological consequences. The critical aspect of this work, then, is what data is selected for visualization and the form of this representation. Unlike classical forms of representation such as an artist's rendering of pastoral landscapes, the graphical abstractions of *Superfund 365* are authorially selected data, procedurally rendered by software.

Mori exemplifies Miles's second category: work that enters into a discourse of the natural world and our apprehension (i.e., perception and understanding) of it. What distinguishes this from the first category (representing the natural world) is its emphasis on the interpretive quality of the representation, and how that interpretation prompts us as an audience to reconsider our belief concerning what nature is, and how those beliefs are shaped by the ways nature is depicted. That is, *Mori*, explicitly and reflexively calls into question how we perceive and understand the natural world and how this perception and understanding is technologically mediated. In choosing to represent seismic data in a manner echoing an EKG stream and doubling the aural signal into physical motion that literally animates the environment, the artists explicitly reference and engage discourses of Earth as a living being.

As an example of Miles's third category - testing methods of environmental salvage or contributing to sustainable forms of living - *7000 Oaks and Counting* visualizes power usage with the intention of motivating sustainable behavior. The thrust of this work, and related projects, is to raise awareness and ideally change behavior. Therefore an important question about this work is what kinds of behaviors are targeted, who defines these behaviors and what forces impact these behaviors. Reflection is also prompted regarding what key factors of the installation and its context, such as visual form, interaction, or discourse, might play into (or thwart) such a change.

The final category in Miles's framework is dialogic work. Whereas the second and third categories of Miles's framework address discourse and behavior change, the dialogic category suggests that the discussion and transformation is open ended. In *7000 Oaks and Counting*, for example, the participant's assessment of the piece and corresponding behavior change are scripted - the participant is supposed to identify his or her electricity consumption with the carbon footprint of the whole and subsequently opt for a smaller footprint. In contrast, in a dialogic approach, the expectation is for engagement that is not completely pre-determined. We will discuss the dialogic category in its own section, as we believe it is substantially different from Miles's categories 1-3, with potentially more radical implications, therefore requiring extended attention.

Implications for HCI

Miles' categorization scheme is valuable because it calls into relief important differences in environmentally

engaged art. More specifically, it facilitates identifying the objectives intended by a particular project and the factors by which those objectives are pursued, which in turn suggest relevant questions to ask of individual work and set realistic expectations to hold the work against. This then enables a judgment of each project on its own terms. For example, to ask whether *Superfund 365* or *Mori* changed the behavior of users assigns inappropriate intentions and expectations to the works.

This is not unlike a traditional approach to understanding work within HCI: objectives and expectations are identified and the work is assessed against these. However, the expectations identified from environmentally engaged art in general, and Miles's articulation of this work in particular, shifts the perspective in subtle but substantial ways. In particular, the framework's categorization of projects highlights three important challenges to dominant HCI practices: when assessment happens (and therefore what is assessed), the use of behavior change as a defining metric of success, and adopting dialogic sensibilities into design.

When Assessment Happens

A standard HCI-led approach to the projects discussed above might concern itself primarily with whether or not the user of the visualization could decipher the visual graphics. Could the user 'decode' the spiral representation in *Superfund 365*, for example, as readily as if the information had been presented in a list format? Would the user recognize in *Mori* the heartbeat metaphor and be able to 'read' the seismic data? Would the trees in *7000 Oaks and Counting* communicate the carbon load to building occupants, and could a discernable change in electricity consumption be measured as an effect? These questions revolve primarily around the point of interaction between user and system, and whether this interaction meets a predefined metric of success (e.g. decoding the right meaning or changing behavior in a measurable, quantifiable manner).

Although these questions may be important for understanding these pieces, a critique from an arts perspective leads with different questions. What is more essential in representational ecologically engaged art are the critical questions about what data is available to represent, what data is selected and what is overlooked, how this data is expressed algorithmically, and how all of these choices have been informed. For work that enters into discourse of the natural world and our apprehension of it, the critical questions revolve around the choice of discourse the project calls upon. The subsequent questions ask how the work advances and/or contests such histories, assumptions and belief systems. These projects question what it means to represent nature or the environment. For example, whereas the natural world used to conjure up images of land, sea, sky, and species, the nature represented in many of these projects is pollution. The basic concept of 'nature' is called

into question. Whereas in HCI, assessment of a project typically begins at implementation, from an arts perspective assessment begins at conception.

What it means to ‘measure’ behavior change

Work that falls into Miles’s third category of salvage and sustainability also requires examination at the conceptual level and therefore is assessed in terms of representations chosen and discourses supported. Yet as this work orients toward behavior change, the point and process of interaction is also important. Thus, this category shares a similar orientation with HCI and its science-informed perspective: the notion of assessing behavior change as a measure of project’s success is a familiar method within HCI. Yet, again, an arts perspective shifts this focus.

Holmes’s project could easily measure electricity usage of building inhabitants pre- and post-installation, search for a significant effect, and argue for a degree of causality. Although Holmes may propose to do this, it is not a strategy born from an arts perspective. Instead of searching for direct causality or strong correlation, we might rather ask how an individual’s behavior is called into question and accounted for and how people make sense of this experience. Does the piece spark debate and reflection about one’s own behaviors and that of others? The work in this category is measured by the potential or idea of behavior change – as opposed to the prediction or enactment of behavior change. This shift does not lend itself to the same kind of measurement we are used to performing in HCI.

Overall, assessment of projects from the Miles framework does not revolve around whether or not the projects ‘work’ but about what the projects set out to do—and whether this is interesting and valuable in the current context. Does the work provide a unique perspective or uncover something previously hidden? Does it authentically engage with—and perhaps challenge - its social, political and cultural context?

Realizing the dialogic

Miles’ final category describes work that is dialogic, yet our review of computational eco-art work turned up fewer compelling examples to illustrate this type of practice. However, as sustainable HCI projects often work with a variety of diverse communities and stakeholders, these projects seem primed for a dialogic approach where different and contrasting perspectives intermingle. At the same time, the idea of the dialogic from Miles’ perspective explores a different shift in the kind of interaction we are used to studying in HCI – namely a dialogue between the artist/designer and the participant. In an eco-art perspective, the technology is often treated as a means for engaging another topic as opposed to the technology being the sole focus. To explore the dialogic and its implications for sustainable HCI, we turn to our second framework.

Kester’s Dialogic Aesthetics

Our second framework on ‘dialogic aesthetics’ is not a categorization scheme like Miles but more of a dialogue itself in that we begin with the articulation of dialogic arts from one scholar, Grant Kester, and advance this concept with responses or different perspectives from other scholars in this area. We use this discussion as a backdrop for posing considerations from a dialogic arts perspective on an example computational project from HCI. We end with implications of this discourse for sustainable HCI.

Kester uses “dialogic” or “littoral” (meaning ‘by the shore’ or ‘in-between’) to describe work that extends beyond ecological concerns to include any art employed by local communities as a vehicle for conversation and change [21, 22]. As an example, he compares *House* (1993) by Rachel Whiteread with *West Meets East* (1992) by Loraine Leeson, both projects installed in London’s East End at roughly the same time. *House*, a cement cast of the inside of an entire Victorian house at its original location, is identified as an example of avant-garde art, where the shock of defamiliarization prompts looking at the area and its structures anew. The focus, then, is on the physical object (the house) and the vision of the creator (Whiteread). This is contrasted with *West Meets East* where Leeson collaborated with teenage Bengali girls to design 16ft x 12ft photomurals of their experience living between cultures. The focus here is not so much on the billboards, but on the way in which communication between, across, and within disparate communities transpires.

Kester argues that analysis of dialogic art requires attending to three vital points that distinguish it from past art movements [22]. First, dialogic or littoral art is by definition interdisciplinary and thus requires heterogeneous approaches, both in the realization of the project as well as in its analysis. Second, these works function on “multiple registers of meaning,” in the sense that the artwork can mean different things at different times and in different places. Time and place are critical components; the local community defines the piece. Third, the artwork is indeterminate, not necessarily in the way it unfolds or exists as an object, but rather in its dialogic interpretation.

Kester’s articulation of the dialogic is not without precedent within art discourse, nor is it without controversy. Contemporary debates on this issue often cite Nicolas Bourriaud, a French curator and author of *Relational Aesthetics*, a book that discusses works that focus on the development of relationships [9]. A characteristic project for Bourriaud is Rirkrit Tiravanija’s *Untitled (Free)* (1992) where a gallery storeroom becomes a kitchen for Tiravanija to cook Thai food for patrons. Conversation, and the everyday exchange between people over a meal, becomes the art. This is a different kind of dialogue than that invoked by Kester, suggesting the need for unpacking broad terms such as ‘dialogue’, ‘conversation’, and ‘relational’.

This need for precision speaks to the critique by Claire Bishop [11] in her review of both Kester's and Bourriaud's work. Bishop argues that analysis does not stop at whether or not a work involves relations. Rather, analysis should question the type of relation that is provoked by a particular artwork. Bishop asks: who is drawn into the relationship (or the dialogue) and who is excluded? Who is privileged in the dialogue in terms of voice? Does the relationship or dialogue draw out potentially productive differences or does it try to smooth them over with assumed consensus? In this sense Bishop draws from the political theories of Ernst Laclau and Chantal Mouffe who describe *agonistic democracy* as an explicit means of encouraging debate and preventing the foreclosure of accord or unity within a disparate community [23,30]. In terms of discourse, agonistic democracy would not be based on coming to agreement, but rather on enabling and provoking the proliferation of views that would enable alternative and repressed voices to be heard⁴. This should be contrasted with the model that Kester suggests in his book, which privileges consensus as a means forward.

Kester's treatment of the dialogic and the corresponding critiques raise the following kinds of questions for work within HCI that aims toward this level of exchange: What types of discussion (agonistic, consensus, somewhere in between) do we want to encourage? How do disparate communities engage in dialogue? How might we determine the efficacy of our design or relate it to questions of assessment? And how might we begin to understand better what "communication" actually means, and how it is related to the technological objects we develop? How these questions are answered dictates the projects we choose to pursue and the eventual pursuit.

Example Project: Neighborhood Networks

We can now turn to a computational example of ecologically engaged work and consider how the dialogic aesthetics discourse could advance our development and understanding of this project. *Neighborhood Networks*, led by author DiSalvo, uses robotics and sensing technologies with urban communities for identity expression, advocacy, and activism, specifically in relation to the local environment [11]. Central to the project are a series of workshops in which participants work together with researchers (designers, roboticists, and cognitive psychologists), to simultaneously learn about and explore robotics and environmental sensors while also using these technologies to discover, engage with, and articulate issues in the neighborhood. The participants then lead a design process to develop prototypes of robotic devices that might intercede in or mitigate local environmental issues. For

example, participants have developed prototypes of robotic devices that monitor and express air-quality conditions caused by idling diesel trucks. These devices often take the form of kinetic sculptures or ambient displays. A defining characteristic of these workshops is that participants present the concepts and their motivating ideas to community members and local officials for further consideration. It is this spirit and practice of exchange that makes the *Neighborhood Networks* project appropriate for a discussion of dialogical practices. Although the project does not take the familiar form of supporting sustainability through tactics such as reduce, reuse, recycle, it does use technology to prompt a deeper awareness of local environmental conditions and attempts to support citizen-led interventions to improve the quality of the environment.

A traditional HCI perspective would highlight the output of the *Neighborhood Networks* workshops, such as the design of devices for the ambient displays of pollution. Although there exists a long history of work in HCI that also focuses on the process of designing technology – for example participatory design practice – the emphasis and validation of the process tends to remain on the finished product. Systems would be evaluated in terms of how well they accurately monitor activities, how easily residents can use the system, and how use of the system changes resident behavior or attitudes. Examining *Neighborhood Networks* from the perspective of dialogic practices, however, changes our focus and how we perceive and understand our role as designers and HCI researchers. Specifically, a frame of dialogic practice focuses attention on the character of the exchanges that occur. That is, what is of concern and held for judgment are the ways in which the exchanges model and aesthetically mediate new social and power relations amongst the participants. In the case of the *Neighborhood Networks* project then, we might critically ask whether, and if so how, were the prior categories and identities (and thereby power-relations) of “researchers”, “designers”, and “community-members” transformed or reinforced?

We could also extend Bishop's proposition of agonism in art to ask if *Neighborhood Networks* enables contestational exchange between community members and local officials. That is, rather than developing a community technology program for the purpose of consensus building, does *Neighborhood Networks* invoke debate that might suggest a new form of community-driven critical design for HCI?

With this emphasis on the character of exchange, technological devices and systems take on new roles. They are not end goals themselves, but means for supporting and shaping the exchange between participants and researchers, agents in the process of fomenting dialogue. This requires a shift to understanding technologies as discursive props rather than as instrumental devices. That is, the artifact or system is evaluated based upon its capability for fostering new social and power relations amongst participants.

⁴This strategy is often a component of various avant-garde artistic practices as well.

Implications for HCI

The idea of ‘dialogue’ as a model for technology design and aesthetics is not a new concept for HCI. Early UI metaphors were based on establishing a conversation, in terms of a give and take, between the user and the computer (screen) [33]. This give and take was certainly intended more along the lines of consensus (i.e., user model = system model) than disruption or agonism as espoused by Bishop, Laclau, and Mouffe. More recently, however, interest in hermeneutics and pragmatic philosophy in technology design draws upon a stance of open dialogue where user models may rework system models or system models may enable multiple user models [34]. As another example, McCarthy and Wright [27] recently explored implications for technology design from Mikhail Bakhtin’s philosophy of dialogics whereby the meaning of a text or artwork is not closed simply because the artifact appears fixed. The idea of dialogic aesthetics therefore is not necessarily new to HCI or sustainable HCI, but the implications of this kind of practice are still being explored. Through applying the dialogic aesthetics lens to *Neighborhood Networks*, we can identify three distinct impacts for HCI: 1) the production of new working relations, 2) the frustration of closure, and 3) a renewed focus on documentation.

New Working Relations

One effect of designing to support a dialogic aesthetic is the configuration of new working relationships between the researcher and participants. In perhaps the most common design relationships, the designer relates to users as either servant or king [14], responding to user needs or determining user wants. In participatory design, the designer takes on the role of advocate for other participants in the process. In citizen science projects, an increasingly popular model within sustainable HCI [18], the designer typically relates to participants in a similar fashion as in scientific laboratories, e.g., as lead researcher to lab assistants. From a dialogic aesthetics position, the designer is the conduit between the participants and cultural discourses and social practices. This conduit is enacted by way of the methods and materials produced, but it is the exchange—described above as the ‘character of the exchange’—that is to be evaluated. This requires a rethinking of the role of design and research for HCI. Similar challenges in developing appropriate working relations for new modes of production have been raised by Suchman in her discussion of the relationship between anthropologists and technology designers [36] and recently elaborated within the HCI community by Dourish [12].

A Frustration of Closure

Another effect of designing to support a dialogic aesthetic is the frustration of closure or completion of the project. When designing in support of a dialogic aesthetic the primary role of the researchers is not to produce a final product. Rather, it is to produce processes and material

mechanisms that enable productive and meaningful exchange with and between individuals and groups. As the processes and material mechanisms are not the final outcome, but a means to achieve one, the projects may remain speculative, challenging HCI assessment methods.

Role of Documentation

Documentation in a dialogic aesthetic is both the evidence providing proof of a project completed and the means to present the project to others in the future. This is not simply a problem for the researcher, but requires the collaboration of all of the parties involved. The problem of documentation is threefold: what is to be documented, how it is to be documented, and by whom? We have yet to formulate an answer, and most likely, the answer will only emerge from ongoing work in this area. However, one promising perspective is to look towards the field of visual anthropology for some initial thoughts, where the issues of participation in visual documentation and interpretation of events has been a central theme for the past twenty-plus years.

DISCUSSION

We have argued thus far that frameworks from arts discourse can operate as resources to provoke new perspectives. In this section we consider how the frameworks together suggest alternatives in the design and assessment of sustainable HCI specifically, and more generally for HCI as a field.

Design and Assessment Alternatives

Sustainable HCI systems informed by ideas from Miles and/or Kester become epistemological exercises, using technology to examine how climate change and environmental flux are constructed by and intertwined with social, cultural, and political processes. The designed technical systems take on new roles and expectations. They are not easily defined as an information visualization tool, for example, that can be directly and accurately read, or as a mobile application, for example, that can monitor and remind people how to behave in a certain sustainable way. Although such systems might be useful and valuable in promoting sustainability, such systems are designed for solving problems—and are therefore evaluated in terms of how well they tackle the problem. In contrast to solving problems, if we follow the paths of Miles and Kester our emphasis will be on using technology to reveal, explore and articulate *the conditions of a problem*, as a step towards, but not the final step of, finding a solution. Inherent in such analysis is a sensitive awareness of the role that technology plays in perpetuating problematic cultural patterns as well as its potential to foster new cultural realities.

As arts discourse can inspire different types of systems, so too will it inspire different types of assessment. The frameworks call attention to the boundaries of existing

forms of assessment in HCI, and challenge us to create new forms of assessment appropriate for sustainable HCI projects and the alternate objectives they espouse. In Miles's framework, for example, the first two categories concerned with representation are assessed even before someone engages with the system. Furthermore, many of the systems that an arts discourse might identify as successfully disrupting reified perspectives or practices would 'fail' by traditional technical standards. Some systems, such as those described in *Neighborhood Networks*, may never result in a 'user study', yet a fruitful assessment of speculative systems can still take place. As yet another challenge, authentic realization of systems could require years, even decades, a timeframe untenable for a typical HCI study (even a so-called longitudinal one). Finally, tractable metrics such as behavior change give way to discussions about how a system affects the 'character of an exchange' or how it might challenge power dynamics, for example. From an arts perspective, assessment is reframed in terms of when it takes place, what it aims to accomplish, how it is conducted and by whom, and what is valued as an interesting result. There is a tendency to value openness to new dialogues, disagreements, perspectives, and possibilities rather than to fix the nature and calculate and control the impact of a system.

Alternatives for the Field

We have demonstrated how arts discourse, and two particular frameworks by way of example, may influence design and assessment of sustainable HCI projects. We will now turn to considering how arts discourse can provide a useful resource to the field of HCI at a meta-level in terms of how we define ourselves as a field. As a 'meta' level, the field of HCI has been present throughout this paper thus far. To call for alternatives in design and assessment is to some extent touch on changes at a more fundamental level. However, the history of HCI, and indeed of any field, is also laden with examples of borrowing from fields outside its border in an instrumental fashion where new methods are imported but existing methodologies remain intact [8,12,35]. What must be articulated then is how arts discourse can enter the HCI community in a profound way.

Thus far, we have described arts discourse against the foil of science, namely a science-led practice of HCI. In doing so, we've created a dichotomy of 'art does it this way' and 'science does it this way'. One response to this depiction may be to argue that this is how things should stay: artists and humanists have one way of knowing and scientists have another. In fact, during our analysis of ecological arts discourse, we questioned the relevance of this paper for the premier HCI conference. Yet this opinion presumes a unified 'CHI audience', and even if we are guilty ourselves of drawing a homogenous straw man of science-dominated HCI, we believe there are many factions within HCI who will share an affinity, if not familiarity, with the arts.

We would also argue that exhibiting contrasting, and perhaps competing, perspectives and methods from an arts discourse, exposure to alternate ways of knowing is at the minimum a valuable exercise for factions within HCI. Time and again, HCI has demonstrated how looking outside has enriched its core. Knowledge and awareness of not only arts practice but also arts discourse may prove to be as groundbreaking a resource as philosophy has been in transforming many tenets of the field, such as when Winograd and Flores looked to Maturana and Heidegger [39]. Examples from arts practice, such as the impact of the situationists [24], in the realm of urban computing and publicly sited systems also suggest the potential value of learning from the scholarship in the arts theory and criticism.

Awareness of alternate points of view is important for any field, yet a bolder position would call for revolutionizing the sciences of HCI. As the progression of sustainable HCI projects continues, what will likely become apparent is that mainstay HCI practices are not equipped for addressing the kinds of issues that will arise such as the inherently political nature of committed environmentalism and the need to reconsider familiar discourses of technology and progress. This is related to a claim put forth by many within the HCI community that we have pursued 'usability studies' at the expense of questioning usefulness [37]. Is it enough to ask if a product or system is "carbon-neutral?" Should we instead be asking how does this project or system shift us away from prior and existing destructive environmental policies, actions, and conditions?

Articulating the gap between what might transpire from an arts-based HCI versus a science-based HCI crashes together different worldviews and values. In doing so, we have suggested how the discipline of the arts and humanities may have insights and experiences that the sciences could learn from in order to approach ecological issues in a more holistic manner. However, this argument has not drawn out limitations, challenges, and critiques of the arts as a discipline. Further work in learning from the arts as a discipline should highlight its struggles as a field as well as its strengths. In particular, there are interesting challenges being pointed out in the arts community for advancing and valuing dialogic work that are also issues of discussion within HCI. Kester, for example, describes how dialogic work undermines the 'artist as outsider' and requires true participation in a local community. Ethics and responsibility, issues artists have tended to eschew, now require attention [38]. These are also an issue under consideration within the HCI community: what does it mean to be an 'outsider' in terms of evaluation and design? Can this guarantee some kind of neutrality or objectivity or is that an impossible stance to maintain? What this parallel demonstrates is that in moving forward with sustainable HCI, there are opportunities not only to learn *from* the arts but also to learn *with* the arts.

Our focus on the arts in this paper should not be construed as a belief that an “artistic turn” will solve all of the problems of sustainable HCI nor HCI in general. Indeed, artistic practice has, at best, a contentious relationship to questions of the instrumentality of technology. Thus our affinity with the arts in our own discourse should be seen rather as a means of considering a different practice that is also addressing similar questions of humans and the environment. A dialogue between the two groups, specifically in the areas of commonality, is a way of puzzling through these vexing questions together.

CONCLUSION

The HCI community has identified sustainability as a crucial issue now and for the future. Designers are called to consider greener alternatives for technology and to imagine ways in which technology can support more sustainable lifestyles. Scholars are called to understand the impact of current and future technology and lifestyles. Why do people make sustainable or unsustainable choices? How does technology support sustainable or unsustainable behavior? This questioning will lead to new designs and research that improve sustainable technology and lifestyles. At the same time, we see an opportunity within sustainable HCI work to use these new developments as a prompt for examining core HCI practices and perspectives. Why did our technologies and behaviors become ‘unsustainable’ in the first place? How might we re-imagine HCI so that there is no need to talk about ‘sustainable HCI’ but simply ‘HCI’?

To answer these questions, we looked to a field outside of HCI that was addressing similar issues to those that sustainable HCI proposes to take on, but from a different vantage point. In particular, we examined projects and practices from the field of ecologically engaged art. This work is characterized by three qualities that differentiate it substantially from mainstream HCI work: 1) questioning ontologies: what is nature? what is culture?, 2) embracing politics, and particularly contestational politics, and 3) using technology to re-imagine the relationships between technology, people and culture. As ecological artwork is qualitatively different from typical HCI work, we argue that we must first understand how ecological art work is valued on its own terms.

The discussion of arts discourse, specifically the examples of Miles and Kester, provides one foray into this endeavor – a bounded starting point for undertaking new kinds of research in sustainable HCI and HCI in general. These frameworks can provide those interested in sustainable HCI with a set of categories and themes for examining and extending their work from an arts perspective. This switch in perspective can lead to fundamentally different designs and assessments – in terms of when assessment happens, what ‘metrics’ are valuable indicators, how roles are altered, implications of open-ended work, and how the

‘content’ of a user study shifts from results-oriented to process-oriented.

The complexities of environmental issues necessitate such a shift in perspective. We must continue to question basic concepts such as our definition of what is natural and what is artificial, and acknowledge how these can both stagnate and change over time. We must accept that there are political ramifications of any intervention. We must not simply label technology as culprit or savior in an environmental crisis. Instead, we must consider structural, cultural, and technological reasons for current environmental issues and consider how technological response could provide one means of articulating alternative sustainable futures. Following such paths of reflection and questioning might lead to the promotion and adoption of new, and at times radical, arguments about how we could or should live— challenging what constitutes the ‘good life’ of progress and convenience for example. Alternative proposals of what to aspire to and what we need could suggest radically different technology designs. All of these charges require us to seriously consider new, transformative ways to think about and do HCI if we are to support and further an agenda of sustainability.

In this way, our arguments contribute to the ongoing work in HCI on epistemology and foundations, in particular work that looks to inspiration from the arts and humanities. Yet it is not enough to use practices and methods from the arts within our existing science-dominated perspective. Such an approach will certainly result in innovative new ideas and applications, but these will still be bounded and limited by existing values and perspectives. Radical transformation, such is required by the complexity of designing and understanding environmental issues, requires reimagining the ground on which we build our work.

ACKNOWLEDGMENTS

This work was supported in part by NSF grants IIS-0238132, IIS-0534445, IIS-0847293, and ISE-0741685 and support from Intel Corporation.

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