

Sustainably Unpersuaded: How Persuasion Narrows Our Vision of Sustainability

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ABSTRACT

In this paper we provide a critical analysis of persuasive sustainability research from 2009-2011. Drawing on critical sociological theory of modernism, we argue that persuasion is based on a limited framing of sustainability, human behavior, and their interrelationship. This makes supporting sustainability easier, but leads to characteristic patterns of breakdown. We then detail problems that emerge from this narrowing of vision, such as how the framing of sustainability as the optimization of a simple metrics places technologies incorrectly as objective arbiters over complex issues of sustainability. We conclude by suggesting alternative approaches to move beyond these problems.

Author Keywords

Persuasive sustainability; sustainable HCI; reflective HCI; critical reflection; modernism

ACM Classification Keywords

H.5.m.[Information interfaces and presentation (e.g., HCI)]: Miscellaneous;

INTRODUCTION

Environmental sustainability is a popular topic in HCI research, and one that is frequently addressed through persuasion. 86 papers contain the terms "environmental" and "sustainability" in CHI 2009-2011; of these, 38, or almost half, also include the term "persuasive." DiSalvo et al. found a similar emphasis; persuasive sustainability comprised 45% of their sustainable HCI corpus [11]. Froehlich et al. found that 56 of 139 sustainable HCI papers were in the related genre of eco-feedback [21].Given the prevalence of persuasive approaches in sustainable HCI, it is worthwhile to consider the nature of this area and how it may be shaping sustainable HCI as a research enterprise. Here, we offer a critical analysis of persuasive sustainability from 2009-2011, addressing three key questions: (1) How is persuasion being framed within sustainable HCI? (2) How is persuasive sustainability shaping how we conceive of and address sustainability in HCI? and (3) How should we approach sustainability in the future?

To answer these questions, we integrate empirical, theoretical, and critical methodologies. First, we ground our discussion in an analysis of the persuasive sustainability literature, identifying themes such as the framing of sustainability as reducing resource consumption and a focus on measuring and reporting information about individuals' activities. Second, we use sociological theory on modernism to develop a theoretical lens that helps us understand how persuasive sustainability is conceptualized. Our key argument is that persuasive sustainability works by narrowing its focus to a limited framing of sustainability, human behavior, and their interrelationship. While this may help make the problem of sustainability manageable as an engineering enterprise, it also makes designs susceptible to breakdown. We then identify key problems that result from this narrowing of vision. For example, we articulate how the framing of sustainability as optimization of a simple metric places technologies incorrectly as objective arbiters over more complex issues of sustainability.

Many issues we highlight have been noted in prior works which inform and motivate this argument [2,9,10, 11,13,21,27,44,46,54,55,58]. Here we synthesize these issues and explain how they fit together conceptually, offering a comprehensive treatment of persuasive sustainability and its problems. *Our aim is not to argue that persuasive sustainability is inherently bad.* Rather, our goal is to explain how it is organized as a modernist enterprise and understand the consequences for sustainable HCI research. Through our argument, we also draw attention to strengths of persuasive sustainability and suggest ways to improve it.

WHAT IS PERSUASIVE SUSTAINABILITY?

Persuasive sustainability has its roots in the application of Fogg's framework for "computers as persuasive technologies" [16,17] to the topic of environmental sustainability. Fogg draws on psychological theories of persuasion, defining persuasion as "an attempt to shape, reinforce, or change behaviors, feelings, or thoughts about an issue, object, or action" [16, p. 225], and going on to argue that "behavior change is a more compelling metric than attitude change"

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[16, p. 230]. According to Fogg, persuasive technologies are explicitly designed "to change attitudes or behaviors or both (without using coercion or deception)" [17, p. 15].

In their 2010 analysis of sustainable HCI, DiSalvo et al. [11] describe the emerging genre of persuasive sustainability. Roughly half of the literature surveyed by DiSalvo et al. derives its orientation from Fogg in that they are broadly aligned with the goal of "design[ing] systems that attempt to convince users to behave in a more sustainable way" (p. 1977). DiSalvo et al. characterize this large cluster of work as drawing primarily from the disciplines of psychology/communication and to a lesser extent design, providing information about user behavior related to sustainability, defining "sustainability" largely in terms of resource conservation, and defining success in terms of changing users' behavior in ways predetermined by designers.

In this paper, we build on this prior analysis by critically examining persuasive sustainability papers published since that review. First, we searched the ACM Digital Library for peer-reviewed HCI conference publications from 2009 through July 2011 for the term "sustainability", excluding work not specifically related to environmental sustainability. The conferences searched were CHI, CSCW, DIS, TEI, ACE, Ubicomp, OzCHI, and Persuasive. Second, we searched within the initial results for work in which the authors describe their primary goal in terms of changing users' behavior to make it more sustainable (rather than, for example, changing local cultures or stimulating debate). 36 papers met the final selection criteria. As in [11], not all the papers self-identify as "persuasive". In 22 out of the 36 papers, the authors explicitly identify the work using the term "persuasive" in the keywords, title, or body of the paper, or use the persuasive literature as theoretical grounding. The remaining 14 "implicit" papers in our sample did not explicitly describe themselves as persuasive but still aimed for behavior change. We found both sets of papers shared similarities in the way the framed and approached the problem of sustainability; differences are noted where relevant.

While the following analysis is based on these 36 papers that we have labeled as "persuasive", it is important to note that certain papers are much more strongly focused on persuading behavior change than others. Some papers, while explicitly focused on persuading people to alter their behaviors, additionally engage with design issues and goals that may be considered as falling outside of a more pure "persuasive approach—including engaging with concerns such as privacy [32], aesthetic [e.g. 34], and curiosity [5]. As such, our designation of each of these papers as a "persuasive" paper should be considered with this caveat in mind.

Sustainability as resource management

The papers in our review covered a range of systems including in-situ ambient displays using pervasive sensor technology [e.g. 31,36], ambient computer widgets [33,34], social network applications for sharing environmental data [18], persuasive games [23] and interactive visual displays [38]. According to Fogg's notion of persuasion, professional or researcher designers are depicted as being ultimately responsible for deciding what constitutes desirable behavior change and how this is to be accomplished. We found that our corpus was largely aligned with this perspective, with only 3 papers reporting participatory design, 2 of which are from the same research group [8,41,52]. There is a remarkable unanimity among the papers with respect to the types of environmental issues addressed and the ways in which they are framed. Like [21], we found energy consumption to be the most commonly identified issue, a topic which was addressed in half of the papers reviewed (18/36) [e.g. 18,23]. Of the remaining papers, half (9) involve other forms of resource consumption, including water [e.g. 31,36], printing paper [59], and gasoline [39]. The remaining papers deal with making green transportation choices [20], improving indoor air quality [e.g. 32], reducing CO2 emissions [e.g. 51], or are not tied to any one specific, easily demarcated topic [e.g. 8]. Except for [20], all papers that mention a specific area aim to improve 1-3 well-defined metrics. Most of the papers follow a fairly standard presentation of a brief justification (a paragraph or a sentence) of why the identified issue is significant in terms of global environmental concerns, followed by an argument framing the designed technology as a possible solution.

Indirectly changing individuals' behavior

The systems presented in this corpus are overwhelmingly designed to intervene at an individual level [e.g. 18,19,20,22,33,34,39], with some aimed at individual behavior defined as occurring in a community context such as in a family [e.g. 5,23,38,51] or company [e.g. 30,40]. All the papers mention changing individual behavior in some form, although some papers discuss how behavior change using softer, less direct, terms such as "motivate" [35], "encourage" [42], "educate" [33], "promote" [31], or "influence" [40]. Some papers focus on relatively specific behaviors like using less water in the shower [e.g.38], but most focus on more general behavior change. This was particularly true for the 18 papers focusing on energy conservation in the home, which generally did not clearly define targeted behaviors. In the majority (though certainly not all) of these papers, users are given no specific direction on how to decrease their resource consumption or how much decrease is enough.

Sensing and reporting information

Of the 29 papers we reviewed that reported full system designs, 23 automatically sensed the result of user activity, often in real-time. Sensing electricity consumption was the most common area of focus [e.g. 18,19,26,33,34,40,43]; other areas included water usage [e.g. 31] gasoline and CO2 emissions from driving [39], and printing [e.g. 59]. A few papers do not directly sense user behavior, e.g. a computer game to educate users about resource consumption [23], a design framework for persuasive services [60].

All but 1 of the sensing systems feed the sensed data back to users. This feedback is, for the most part, provided in real-time to aid conscious decision-making [e.g. 31,32,33,34,36,39]. A few papers also describe influencing behavior without conscious awareness, including feedback through subliminal information [25], influencing "unconscious behaviors" [53] and influencing behaviors by making them easier [60]. In other words, some systems aim to provide information for reflective decision-making, while others aim to deliver information to produce behavioral effect without conscious decision-making.

Although the papers all allude to behavior change as their general goal, many seemed to focus more on increasing "awareness," describing their systems using language such as "motivating teenagers towards energy awareness" [23], "mak[ing] the public become aware of the connection between their everyday activities and global climate change" [33], or "increas[ing] awareness of electricity consumption in everyday life" [30]. As also found in [11], in many cases the causal relationship between awareness and behavior seems only loosely articulated, suggesting that increasing an individuals' awareness of energy consumption (e.g., how much she is consuming or how much other individuals are consuming) can or will lead to conservation behavior [e.g, 40,43]. A few papers use an explicit causal model in which information leads to motivation leads to behavior change [e.g. 26].

Evaluating behavior change

So, does persuasive sustainability lead to intended changes in behavior? Of the 36 papers in our corpus, almost half (17) have no user evaluation. Of these, 12 *cannot* evaluate, e.g. because they explore a design methodology or are in the early stages of design. [1] evaluates using performance tests; the other 4 that do not evaluate impact on users are implicit, designerly papers. Of the 19 papers that do report on a system evaluation, 5 discuss preliminary evaluations, mostly usability studies that do not address behavioral change. The remaining 14 report on field studies that look at use in situ. One study has 52 participants [34], 2 have 14, and the rest have 10 or fewer participants. Twelve of the 14 studies report some kind of behavior change, although in at least two cases this is only for a small subset of participants [20,33]. In some cases, metric changes are reported without any discussion of what behavioral changes might have led to them; in others, behavioral changes are claimed but without any statistically significant effect on the intended metric. Generally speaking, when behavioral changes are claimed, anecdotal evidence of behavior changes is related, but it is difficult to determine what behaviors changed or by how much.

Little evidence for long-term behavioral change is offered in any of the papers we reviewed. The typical duration of a field study is 3-4 weeks, which is likely not long enough to go beyond novelty effects. Some studies argue for a potential longer-term effect based on the fact that the metrics had stabilized before the end of the study [e.g. 31]. Only 2 of the studies are longer than one month; 1 is 5 weeks [36]; and 1 is a 3 month study [5]. This is the only study that could truly be considered long-term; the authors state that behavioral changes took place, but what changes, how frequent or effective they were, and how many participants had them was unclear.

Summary

Persuasive sustainability papers are by no means homogeneous in their approach. For example, some papers aim for a scientific approach in which the goal is explicitly to control variables and optimize particular metrics [e.g. 23], while others take a more designerly orientation, in which system design and evaluation proceed in an open-ended, exploratory fashion [e.g. 5]. Nevertheless, our analysis described in this section identifies properties that are overwhelmingly shared across persuasive sustainability papers of all orientations. Persuasive sustainability aims to change behavior related to sustainability, generally understood as reducing individual resource consumption; the nature of the expected behavioral change is often unspecified. Persuasive sustainability systems generally aim to do so by raising individuals' awareness of the consequences of their activity. In order to do so, these systems typically sense and measure human activity, especially as related to resource usage. The method of persuasion is to provide information, usually about the sensed usage of resources. The type of behavior to be changed, and the metric by which that change is measured, are chosen in a top-down fashion, rather than in a bottom-up, participatory or user-centered fashion. Evaluation tends to be short-term and with small groups, and there is limited evidence of lasting behavioral impact.

A CRITICAL LENS ON PERSUASIVE SUSTAINABILITY

Unsurprisingly given the potential for broad impact of the persuasive sustainability approach, it has been subject to various criticisms. Such criticisms include overly focusing on incremental over systemic change [2,11,13,45,54,55,58] and individual consumption [11,13,28,42]. A main contribution of this paper is to build on these previous works and demonstrate how issues with persuasive sustainability are not isolated problems but rather are necessary consequences of the problem framing of persuasive sustainability. Dourish [13] and Strengers [55] have similarly traced a variety of these problems to an underlying liberal assumption of a rational, economically calculating actor. We complement their analyses by arguing that persuasive sustainability systems can be usefully understood as an example of *modernist* technology design, which have been argued to have particular modes of breakdown. Based on these critiques, we will demonstrate how these theoretically-expected modes of breakdown appear empirically in the literature.

What is modernism?

By "modernism" we refer to a broad cultural movement that rose to prominence in the 20th century. It avows that people can and should change the world for the better by analyzing present conditions and improving them through

scientific and technical knowledge. Modernism rejects the idea that tradition should be the guide for action and seeks instead to rethink and optimize our life conditions through rational planning. Modernism aims to improve life through technical means; it is associated with the idea of "progress" and embraces scientific perspectives as the grounds for new definitions of value.

There is a wide array of literature describing the nature and characteristics of modern societies. Here, we draw on an influential understanding of modern society arising from the work of Weber [57] and popularized by Ritzer [48]. This work emphasizes 4 values central to modernist approaches: (1) *calculability*, or framing human endeavors with respect to values that can be numerically computed or measured; (2) *predictability*, or being able to ascertain beforehand the precise outcome of actions or decisions; (3) *efficiency*, or accomplishing goals through the least use of resources; and (4) top-down (technological) *control*, or achieving desired outcomes by controlling what might otherwise be unruly or unknown situations. Technology plays a central role in modernist approaches as a method for improving the human condition. Modernist approaches to technology tend to be predicated on *quantifying* aspects of human life, focus on improving the *efficiency* of everyday processes, intend to have *predictable* effects, and in order to do so necessarily aim to increase *control* over the vagaries of those processes. Modernist approaches tend to be oriented around three axioms: (1) trust in technoscientific reasoning and top-down, expert knowledge as a way to organize our lives; (2) orientation around means-end thinking, maximizing efficiency, and exerting control as ground principles to optimize everyday processes; and (3) trust that formal, rational methods capture essentially everything that matters about a given situation.

Persuasive sustainability as a modernist enterprise

We previously described contemporary persuasive sustainability systems as technologies that sense, interpret, and respond to human activity by providing information intended to change the behavior of individual consumers according to a metric selected in a top-down fashion, usually defined as reducing resource consumption. In this definition, we recognize several of the attributes of modernism. These technologies embody trust that through scientific and technical intervention, we can solve the problem of sustainability. The use of sensing to automatically track and report on human behavior reflects trust that calculable, formal measures can capture the essential aspects of sustainability. The intended change of behavior is an example of attempting to control vagaries in order to lead to a predicted and desired outcome. The top-down selection of a metric reflects an emphasis on expert knowledge as the driving force in finding solutions.

These attributes of modernism are not only reflected in the overall orientation of persuasive sustainability, they deeply inform specifics in system design. We aim to give a feel for modernist aspects of design through a fictional design anchored in design decisions made in the literature (this strategy is similar to [47]). Consider a mobile phone app that uses GPS traces to determine the user's mode of transportation, e.g., whether the user is driving a car, walking, biking, or riding a bus [20]. The system can also use the proximity of other Bluetooth-enabled devices to determine, when driving, whether or not the user is carpooling. The system then allows the user to view miles traveled and tons of CO2 emitted, aggregated in a variety of ways, such as by week, month, or year, or by transportation type [43]. The system also aggregates data across all users to indicate whether a given user is above, near, or below average transportation-related carbon emissions, optionally scoped by such means as geographic region or social network [18]. This social comparison is presented via a "thermometer" display, which reminds the user of the global warming s/he is causing or preventing [36]. If the user is above the norm, the app provides tailored daily tips to reduce transit emissions, such as recommending public transit options or suggesting carpooling buddies [26].

In this concept, we see many modernist traits. The system is designed around the improvement of efficiency, where efficiency is specifically defined in terms of emission of CO2 as a result of transportation. The system's proscriptions are based in scientific authority embodied in the carbon-counting and sensing algorithms and the personalized suggestions that interpret their consequences. The GPS trace and transportation mode detection not only make emissions calculable, these features also make it predictable; the system can tell the user just how much carbon she will cut by taking a different mode of transportation. Furthermore, by choosing a different mode of transportation, the user can control her emissions, thereby optimizing her behavior.

In practice, persuasive sustainability papers vary in how and to what degree they embody a modernist orientation. For example, while some papers focus in evaluation on tracking and optimizing a single metric in ways consonant with modernism, others engage in more open-ended evaluations which aim to uncover unexpected and unanticipated uses, and therefore do not fit as neatly into a modernist frame [e.g. 21,5]. Nevertheless, our analysis of the common traits of the persuasive sustainability literature suggests that the rhetorical frame that drives problem statements and solutions in the research area as a whole is strongly modernist.

Indeed, there is much that is laudable about modernism as a frame for technology design. For example, by structuring "sustainability" as the more manageable problem of "resource minimization", persuasive sustainability provides an actionable framework for developing novel solutions, rather than becoming paralyzed because the problem seems so complex. For users who want to reduce their resource consumption but are unsure of how to do so, the real-time measurement and judgment provided by persuasive sustain-

ability systems can usefully inform their decisions. The use of expert data, rather than individuals' preferences, to drive decisions about metrics to aim for and the behavior that should result may increase confidence that we are building systems that will really make a difference in global problems of sustainability. The problem is that modernist technologies are susceptible to breakdown. In the next section, we describe this breakdown and explain how it manifests itself in contemporary persuasive sustainability.

NARROWING THE VISION

The possibilities and limitations of modernist approaches are cataloged in Scott's classic work *Seeing Like a State* [49] (similar critiques are embodied in [14] and [57]). As Scott argues, modernist solutions to problems are based on a "narrowing of vision" (p. 11) that "brings into sharp focus certain limited aspects of an otherwise far more complex and unwieldy reality. This very simplification, in turn, makes the phenomenon at the center of the field of vision more legible and hence more susceptible to careful measurement and calculation. Combined with similar observations, an overall, aggregate, synoptic view of a selective reality is achieved, making possible a high degree of schematic knowledge, control, and manipulation" (p. 11). While this narrowing of vision makes possible a wide range of technical solutions, those solutions tend to break down in the face of ecological issues outside of the 'selective reality' constructed through the problem framing.

In one example, Scott analyzes the development of scientific production forestry in late-18th century Germany. The goal of scientific forestry was to maximize how much saleable wood could be extracted from a given plot of land. This aim was achieved by analyzing and measuring forests solely in terms of the amount of saleable wood they contained, then controlling forests to maximize this measure. Species of wood that were not saleable were removed from the forest and replaced by saleable species, while animals, plants, and human practices such as foraging for firewood that might affect individual trees' health were removed from the forest.

The result, in the short term, was an improvement in the predictability and yield of the forest. But in the long term—over the lifecycle of the forest, about 80 years—the forests began to die off. The fundamental problem was that aspects that had been sidelined in the narrowing of vision underlying scientific forestry turned out to be key to the health of the forest. For example, the quality of the soil began to suffer with the loss of underbrush and plant and animal species; the monocultured forests planted only with saleable wood were prone to blowdowns and blights; and the peasants, whose subsistence practices of firewood gathering and hunting had been banned, both openly and covertly undermined the restrictions.

All designs have unintended consequences, but these cause greater problems for modernist designs because their success is often predicated on an assumption that all factors have been taken into account. They tend to be blind-sided by factors outside of what was formally modeled. Also, their reliance on expert knowledge and use of mechanisms of control means they tend to place technologies in a position of authority over user's lives. This control is authoritarian, imposed through a centralized scheme based on the conceiver's frame of reference, which will solve the problem only to the degree that it achieves compliance. The control is illusory, however, because it focuses only on those aspects of reality that are within view—those that are of interest to the modeler, rather than to the modelee.

A similar narrowing of vision is imminent in persuasive sustainability. Rather than tackling the complex problem of sustainability as a whole, most persuasive sustainability has chosen a small subset: individual consumer behaviors which have a fairly clear and direct impact on "sustainability" understood as a form of resource management. This narrowing of vision has a benefit in giving us a handle on an otherwise unmanageable problem. Just as scientific forestry made "keeping a healthy forest" approachable by framing it as a maximization problem over the number of saleable-wood trees, in persuasive models "sustainability" becomes framed as a minimization problem over the amount of a resources used by an individual or other metric chosen by the designer; the lens here is focused in particular on optimizing individual decisions in order to achieve that goal. Like scientific forestry, persuasive sustainability has the potential to achieve well-defined changes in those choices. Yet, also like scientific forestry, persuasive sustainability's long-term success is susceptible to being undermined by factors outside of what it aims to measure and control. In the next sections, we describe ways these problems manifest themselves in persuasive sustainability.

Defining sustainability too narrowly

A key attribute of modernist technologies is that they narrow their focus in order to be able to make measurable progress along known dimensions. In persuasive sustainability, we often see such a refocusing of the topic of "sustainability" leaving projects unable to deal, as others have argued, with the systemic nature of sustainability as a problem [2, 28,42,55]. First, the emphasis on sensing users' behavior means that these technologies limits their focus to aspects of sustainability that are clearly measurable, such as the amount of electricity that a person uses. Although the actions that a person takes are frequently measurable, the meaning of those actions and their causes often lie outside of the frame of persuasive sustainability. Problems come about, for example, when the technology's necessarily limited judgments are seen and presented to users as absolute values which reflect the true sustainability of their behavior, rather than as partial views of a much larger and more complex problems. The orientation of persuasive sustainability towards technology automatically evaluating human activity also results in a focus on aspects of sustainability that appear to be non-controversial. This leaves out many definitions of sustainability that HCI could address. It also

means that persuasive technologies are framed as objective arbiters of the truth, with sustainability tending to be portrayed as fixed, known, and stable. This is a where the authoritarianism which is endemic to modernist technology plays out; an expert decides what is or is not "sustainable" and embodies this view in a technology which will judge users' behavior along the expert's lines. As others have argued as well [2, 11, 13, 27, 28,44], this framing has difficulty dealing with varying local definitions of sustainability and tends to sideline the politics involved, for example, in who gets to use resources, for what, and why.

Focusing too strongly on individuals and behaviors

Another way in which persuasion has narrowed the vision of sustainability is through its framing of "users" as individual, isolated consumers and bracketing of the complex social, cultural, and institutional contexts in which they live. A variety of critiques have demonstrated that when we expand our lens to understand the institutional, social, and cultural influences and constraints on individuals, persuasive solutions begin to fall apart [2,10,13,46,54,55]. One problem commonly identified [10,27,46,54,55] is that the focus on individuals and their responsibility to make wise choices with respect to sustainability neglects the ways in which social dynamics outside the system condition what is possible, e.g., who is actually able to make changes, or how this will change political relationships or social norms. Because of this, persuasive sustainability interventions tend to assume that individuals have a greater capacity for action than they actually do in practice. Dillahunt et al, for example, showed that even sustainably focused renters have relatively little control over their appliances, heating, and other major factors in their electricity use [9]. And when focusing on what the individual *is* capable of doing, persuasive sustainability tends to marginalize aspects of the design context that the individual cannot alter [9,10,55]. This means persuasive sustainability tends to neglect the need for change at other scales beyond the individual consumer, as argued by [11,13,28,42].

Assuming rational actors swayed by information

A remarkable difference between what we might expect from Fogg's [16] articulation of persuasive technology and its instantiation in persuasive sustainability systems is that most are not directly aimed at behavioral change but instead aim to provide information and raise awareness, in the hopes that this will lead in some way to altered behavior. This change in emphasis from Fogg's notion of changing behaviors and beliefs to focusing on providing information may be because the latter is easier to aim toward and evaluate, lends itself to HCI's existing strengths in information display, and may be a better fit to a user-centered design philosophy by avoiding to the appearance of aiming to control user behavior. But the emphasis on providing information as a driver for behavior change rests on a common modernist assumption that people are rational actors seeking to optimize activity based on what they know. Even if we focus exclusively on changing individual behavior, it is not clear that providing information is the best lever to do so. Approaches where humans are framed as using information to maximize the utility of their behavior have been critiqued for not taking account of cognitive limitations and the role of emotion in decision-making, and the role that habit plays in many of our everyday behaviors [29]. So, for example, [44] have argued that sustainability-related behavior is influenced as much or more strongly by material aspects of design as by explicitly provided information.

Too distant from lived use

A characteristic of modernist technologies is that they are designed from the perspective of an expert, orient towards his or her formal models, and tend to abstract away from the details on the ground. Because of this, they deal poorly with socio-cultural particularities. By not fully taking into account the nuance and complexities of everyday life, several researchers have argued that persuasive sustainability is prone to leaving out important concerns and values that undermine the long-term effectiveness of these interventions [9,21,44,54,55]. For example, Chetty et al [7] find that the complexity of household activity makes it difficult to save computing energy, and persuasive technology is therefore unlikely to speak to household dwellers' motivations. One particular kind of socio-cultural difference that modernist regimes have difficult handling is power differences; they tend to presume that the system applies to everyone, but that intended universality frequently masks the fact that systems are designed with one group in mind and may map poorly onto the experiences of others. In the case of persuasive sustainability, as [9] has shown, the primary target audience is white, middle- to upper-class, urban consumers who have a great deal of discretionary power and whose motivations map onto those of typical HCI researchers.

Trouble dealing with the dynamics of change over time

One consequence of the narrowing of vision on which modernist technologies rely is that their models tend to be rigid and deal poorly with changing circumstances over time. Persuasive sustainability systems tend to be oriented towards a specific change which users are intended to make. Once users have absorbed the "lessons" of the system, it is difficult to imagine what the value of the system will be [58]. In households that are given feedback about electrical usage, there tends to be an initial phase of exploration and alteration of habits, but in the longer run the feedback becomes uninteresting [55]. One response has been to break up behavior change into multiple stages and design interventions for each stage [26]. Even such approaches may fail to counteract the ways in which users' preferences and practices form a moving target shaped by external cultural forces. Strengers [55], for example, found that eco-feedback systems do lead to increased efficiency of existing practices, but do not work against the adoption of new, more resource-intensive practices.

BLIND SPOTS: CONSEQUENCES FOR HCI

Having made the argument that common forms of persuasive sustainability are problematic, the question we now to

turn to is "So what?" Beyond just identifying methodological issues, what are the consequences for HCI research and practice?

Individual and simple acts limit how we imagine change

Although individual behavior change *may* be *one* means for instigating a sustainable society, it is not the only means. Turning off lights, unplugging unused appliances, and conserving water are all important. But focusing only on simple acts sidesteps more difficult lifestyle choices that may in fact be necessary to work toward a more sustainable society. Instead the common tactic is to tweak behaviors, with the goal of adjusting actions to be more in line with benchmarks of sustainability. It's notable how few persuasive sustainability projects attempt to eliminate behaviors entirely. Absent from this work are fundamental questions such as "What is to be sustained?" As others have argued [2,11,13,45,54,55,58], what we find instead is incremental change.

Granting undo authority and expertise to designers

In persuasive sustainability, designers are entrusted with the responsibility to decide what is or is not appropriate behavior. Indeed, in the process of designing any system, the designer configures dependencies and delegates responsibilities between people and objects. What is surprising in the persuasive sustainability literature is how little this is discussed. Instead of working toward equitable configurations of responsibility and accountability—e.g. as argued for by Suchman [56]—persuasive sustainability reinstates the authority of the designer and the technical object. The designer seems to be *de facto* more knowledgeable about sustainability than the users of persuasive sustainability systems. But little evidence is provided that either the designer is actually an expert or that the user is uninformed.

Constraining HCI

The primary consequence of the dominant framing of persuasive sustainability and its narrowed visions is that it constrains what sustainable HCI can imagine being and doing. The focus on individual behavior not only sets bounds for what might be imagined and designed, but it does this by granting privilege to the literatures of psychology and economics. Much of the persuasive research draws upon social-psychological research, but this is not the only literature that exists on either persuasion or shaping sustainment. Moreover, the emphasis on behavior change through artifacts and systems neglects other areas or possibilities for design [11, 13]. Given the prevalence of persuasive sustainability as a frame for sustainable HCI research, these issues may have a substantial impact on how a larger group of researchers conceives their work. The question we are faced with is how to reconsider persuasive sustainability in a more open manner.

MOVING FORWARD

Our intention with this analysis is to provide critical insight into issues around persuasive sustainability as currently pursued. But there *is* an important place for persuasion in sustainable HCI. We first consider how one might do persuasive sustainability without being unduly encumbered by a modernist approach. Next, we consider alternative approaches to sustainable HCI that are neither persuasive nor modernist and thereby may overcome some of the limitations of those two approaches.

Persuasion Redux

We provide here three specific suggestions as to how persuasive sustainability may be adapted to address some of its shortcomings, as well as examples of each.

Broaden our understanding of persuasion. Within design it is common to frame design in relation to rhetoric, as the art of persuasion [6]. Design is considered rhetorical because every product can be interpreted as an argument for how we should live in the world [6]. This notion of the rhetorical qualities of objects and systems is echoed in the fields of digital rhetoric and media studies. For example, [4] Bogost explores how video games provide unique opportunities to produce simulations that enact arguments. What is common across these approaches is the idea that persuasion is a *process* through which an audience is presented with perspectives that inform and shape their beliefs and actions. This is different from the common techniques of persuasive technology, which as Bogost notes are more akin to coercion than rhetoric [4]. These ideas from design, digital rhetoric and media studies can be used to shape alternative forms of persuasion in sustainable HCI. For example, drawing explicitly from these fields, Hirsch and Anderson [27] developed a game that allows varied stakeholders to explore issues and consequences of water allocation and usage. Through the design of the game a particular perspective is expressed and reinforced with the objective of persuading the stakeholders toward a specific course of action, but without dogmatism.

Include users in the design process. Rather than making technology designers arbiters of all things sustainable, there is an opportunity to more deeply involve users in the design of persuasive systems. We can draw both inspiration and techniques from existing work in HCI and design involving sensing systems and environmental technologies [12,37]. Davis [8] provides a strong argument for this approach, suggesting participatory design as a method for engaging community members in the design process for a persuasive system [see also 40,52]. Such approaches can maintain or increase the sense of agency that is a strength of persuasive sustainability while bringing systems closer to the definition of sustainability that users enact in daily life. More strongly considered users' values on the ground could lead to more acceptable, satisfying, effective designs. Considering the potential (arguably inevitable) imposition of values through persuasive design is a responsible practice. Kuznetsov and Paulos [37] and Hirsch and Anderson [27] provide exemplars of broadening participation in the design process.

Move beyond the individual. Unsustainability arises from complex interactions among individuals, social groups,

corporations, organizations, governments, etc. Although, as noted above, persuasive sustainability has focused primarily on the individual, it could benefit by also considering community, political, and infrastructural engagement. Hirsh and Anderson's previously mentioned water game provides one example: rather than focusing on individual behaviors, it strives to enact change through policy reform [27]. As another example, rather than an app to calculate my carbon footprint, one can envision calculating the carbon footprint of a vote, of my elected representatives [13], of my stock portfolio, or of my national government or its military. These and other community-oriented approaches [2] provide examples for how sustainable HCI can grow beyond the modernist persuasive paradigm to engage with societal and cultural change.

Beyond Persuasion

The above suggestions, to varying degrees, still exhibit modernist tendencies. A carbon calculator for a vote still requires calculability, an expert perspective, etc. These suggestions are meant as ways of revising persuasive approaches to address some of the pitfalls of modernism. However, we also want to suggest alternatives approaches.

Shift from prescription to reflection. Most current work in sustainable HCI adopts a specific definition of sustainability, usually chosen by the technology designer, and attempts to persuade the user to take actions consistent with that definition—a definition that may not connect with users' actual lived experiences. Such systems need not be so prescriptive. For example, Strengers [55] describes how eco-feedback can provide people with material resources to talk about and socially negotiate their use. So, one way to approach the design of persuasive sustainability systems would be to frame them less as means of prescribing behavior and more as a kind of provocation or boundary object for eliciting issues of sustainability, drawing on the literature in open-ended reflection [24,50]. Recent work in the area of health technology suggests that such an open-ended system can lead users to considerations of what it actually means to be healthy and how health is defined [3]. A similar approach to sustainable HCI may encourage users to reflect on what it actually means to be sustainable in a way that makes sense in the context of their own lives.

Shift from behaviors to practices. As argued above, the narrowed vision of persuasive sustainability focuses on individual, specific behaviors, often in isolation. Such behaviors, though, are rarely isolated in actuality, but rather connect to larger, complex sets of social and cultural practices. For example, home heating is not simply a matter of energy consumption; though it does consume energy, it also creates a certain environment for the home dwellers and, at times, their guests [35]. In general, energy-consuming behaviors in the home seem rarely to be thought about primarily, if at all, in terms of the energy they consume [46]. Similarly, sustainability itself is rarely practiced in isolation but rather connects to a broad constellation of concerns [58]. These examples demonstrate approaches that, rather than focusing on specific, isolated behaviors, consider energy in the context of broader sociocultural practices.

CONCLUSION

In this paper we present a critical analysis of persuasive sustainability. We argue that persuasive sustainability can understood as a modernist technology that works by narrowing its vision to define sustainability as resource optimization pursued by individual rational actors conceptualized apart from the messy realities of everyday life. We identified key shortcomings of persuasive sustainability with regard to sustainability, and proposed a series of alternatives that might be useful in redirecting research.

The challenges we describe are not limited to persuasive sustainability. The narrowing of vision and subsequent problems manifested by a modernist approach potentially affect all sustainable HCI research that frames sustainability around values of efficiency, calculability, predictability, and control. Arguably, these problems are also present in persuasive health [47]. The challenges we present are therefore not limited to persuasion or sustainable HCI, but connect to broader issues in HCI research.

We have argued that persuasive sustainability follows a modernist agenda. But why is modernism so attractive to HCI? Modernism provides a seductive role for HCI: it proposes *technical* solutions to *social* problems. Ironically, a key aspect of our critique is that most persuasive sustainability research is *not* producing solutions. There is little evidence of efficacy, while the problem space has been so restrained that what we frequently witness is repetition rather than inventiveness. What is needed are new approaches to framing the issues and opportunities of sustainability—from which we might better be able to employ HCI to meet these challenges. The list of problems manifested by a modernist approach and blind spots, therefore, potentially have broader applicability throughout HCI, as themes for the analysis of existing research. Likewise, the alternative approaches we delineate may be applicable across domains of HCI as ways of discovering and pursuing new, more resilient, vectors of research.

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