Undesigning Technology:
Considering the Negation of Design by Design

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ABSTRACT

Motivated by substantive concerns with the limitations and negative effects of technology, this paper inquires into the negation of technology as an explicit and intentional aspect of design research within HCI. Building on theory from areas including philosophy and design theory, this paper articulates a theoretical framework for conceptualizing the intentional negation of technology (i.e., the *undesign* of technology), ranging from the inhibition of particular uses of technology to the total erasure or foreclosure of technology. The framework is then expanded upon to articulate additional areas of undesigning, including self-inhibition, exclusion, removal, replacement, restoration, and safeguarding. In conclusion a scheme is offered for addressing questions concerning the disciplinary scope of undesign in the context of HCI, along with suggestions for ways that undesigning may be more strongly incorporated within HCI research.

Author Keywords

Design theory; design; undesign; sustainability

ACM Classification Keywords

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

General Terms

Theory

INTRODUCTION

This paper motivates and develops the question: To what extent and in what ways should the intentional negation of technology be an acknowledged and legitimate area of design research activity within HCI? While design researchers and practitioners often understood design to involve the intentional creation or introduction of some material or immaterial thing (product, image, service, value, etc.), the intentional destruction or removal of some thing may also be considered a possible or even necessary component of design. Within the HCI community, design

typically implies the creation or introduction of some digital artifact; rarely does it entail the explicit and intentional destruction, removal, or inhibition of an existing technology or the foreclosure of a potential future technology. This is particularly the case if such activity is undertaken without constructing or deploying a digital or "interactive" technology.

While of theoretical interest, our question concerning the intentional negation of technology is primarily motivated here by substantive concerns within and outside of our field. Within HCI we have witnessed a broadening of concerns spanning a diverse range of social, environmental, and moral issues including climate change and e-waste pollution [e.g., 3], busyness and overwork [e.g., 33], cultural difference and design for "developing" contexts [e.g.,30,48], politics and community-based design [e.g.,12,14], and human values, morality, and the good life [e.g.,17,21]. At the same time, within our community questions and concerns have been raised regarding the limitations and negative effects of well-intended technological interventions, including those that explicitly aim to address urgent social and environmental issues. Prior works have highlighted concerns such as the non-neutrality of technology [17], the harmful material effects of technology on environmental health [3], the extent to which HCI is capable of addressing, rather than contributing to, unsustainability [11,49], and the importance of considering implications to *not* design technology [2]. Critiques of technology from outside of HCI are far too numerous and diverse to outline here; but consider, for example, Winner [54] and the philosophical works of Borgmann [e.g.,7] and to a lesser extent Ihde [e.g.,29], both discussed recently within HCI by Fallman [17].

Indeed there is an apparent rift between researchers and others that describe, explain, and argue the limitations and problems with technology, on the one hand, and those whose primary concern is *designing* technology affirmatively. This gives way to a distinct issue for design in the context of HCI: What are the range and scope of activities that researchers have available when the implication *is* to *not* design technology[1]; or, to go one

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[1] Baumer and Silberman have recently highlighted the importance of considering the "implications *not* to design technology" [2].

crucial step further, when the implication is to *undesign*[2] technology?

In this paper I will aim to translate and move criticisms and concerns over the limitations and negative effects of technology more firmly into the realm of *design action*.[3] This move aims to give design research in the context of HCI greater agency to directly address such concerns (as well as to help identify limits to this agency). Here I do not focus on a specific concern that motivates undesigning, such as environmental sustainability [e.g.,3] or busyness [e.g.,33], but rather my aim is more generally to provide a framework for addressing a full range of concerns with limitations and negative effects of technology. My basic argument is that HCI research has both a capacity and responsibility to engage more strongly with *undesigning* technology, that is, with negating technology *by design*. However, it is not clear in what ways and to what extent these types of work should fall within the disciplinary scope of HCI. As a step toward both clarifying and addressing these questions, I will propose a theoretical framework for conceptualizing the intentional negation of technology, i.e., the undesigning of technology.

In what follows I first review related approaches upon which this work builds. Following this, I articulate a framework for conceptualizing the intentional negation of technology in terms of its scope and scale. I then expand on this framework to specify several additional areas of undesigning. This is followed by a summary and discussion of prior work that offers specific strategies for undesigning. In light of these discussions, I return to the questions posed here in the conclusion.

RELATED APPROACHES

In this section I briefly review two areas of work to which this paper directly builds upon and is indebted. The first is a specific design approach articulated by Tony Fry called elimination design. The second is design research in the context of HCI and interaction design.

Elimination design

Foundational to this work is the notion of elimination design, a design approach first developed by Tony Fry and partners of the EcoDesign foundation in the 90s, and which has recently been elaborated on by Fry in his writings on

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[2] Undesigning, as I name and elaborate on it here, builds upon and is indebted to Tony Fry's notion of elimination design, a design approach aimed at identifying and eliminating the unsustainable [23].

[3] To be clear, I will set my scope here on *research* practice concerned with design in the context of HCI, rather than HCI-oriented professional design practice. The relationship between design research practice and professional practice is, to be sure, a crucial one, yet one which this paper must largely set aside.

"design futuring" and "redirective practice" [23]. Elimination design essentially aims to identify and eliminate the unsustainable, ranging from "gas-guzzling vehicles" to building products containing toxins. The key question Fry poses is: "on the basis of a clearly identified overall contribution to extending unsustainability, what exactly should be eliminated." (p. 72).

In this paper, I will build upon Fry's notion of elimination design and expand on it in two ways. First, I will extend the range of concerns for elimination design beyond "environmental sustainability" to include, for example, specific concerns with the negative social impacts of technology. Second I will articulate a more general notion of elimination that extends over a wider spectrum of intended negating effects, ranging from inhibiting uses of technology to complete erasure of technology. I will do this by articulating a framework for conceptualizing intentional technology negation that allows for a more precise way of discussing the negation of technology by design.

Design research and HCI

The confluence of Design and HCI has been well discussed and documented in a number of prior works [e.g., 18,19,56,57]. Notable works that address the disciplinary role of design within the context of HCI include Fallman's distinction between the "knowledge-generating Design-oriented Research" and the "artifact-generating conduct of Research-oriented Design" [18,19]; and Zimmerman, Forlizzi, Stolterman and Evenson's treatments of research through design [56,57], which emphasize the process and products of making as legitimate forms of HCI research. Another important strand of design research is found among the works of Gaver et al. [e.g.,26,27], which has opened up a space for addressing notions of curiosity, ambiguity, and reflection—important concerns of "third wave" HCI [6]. Other works such as Blevis and Stolterman [3,4], Dourish [14], and Friedman and Nathan [21,22], have variously emphasized addressing design at broader scales. A more thorough treatment of design research within HCI must unfortunately be omitted here.

Despite the connotations it may evoke, undesign, as I will present the notion here, is not intended to displace prior design research and design-oriented work in HCI. This paper instead situates itself within this diverse body of work. Throughout this paper I will in fact point to ways that undesigning is already evident among designerly HCI work in certain ways (but less so in others). I will also suggest ways that undesigning may be more strongly incorporated within and discussed in relation to these works.

THEORETICAL FOUNDATIONS: WHAT DESIGNS DO

In this section I review several areas of theory that variously focus on aspects of design, technology and agency. These concepts will serve to both clear a space for the intentional negation of technology as distinguished from the effects of technology more generally, as well as offer

important insights into a range of scales at which to conceptualize the intentional negation of technology.

Consider first philosopher of technology Don Ihde's theory of "micro-perception" [29]. Ihde describes human uses of technology in terms of a structure of amplification/reduction in human perception. Ihde analyzes technologies including scientific instruments such as telescopes, revealing that these technologies amplify the user's visual perception of celestial bodies while at the same time reducing perception of the surrounding context. Ihde goes on to suggest that forms of perceptual reduction associated with new technologies are often overlooked in favor of what is amplified:

> [T]he fascination [with new technology] attaches to magnification, amplification, enhancement. But, contrarily, there can be a kind of forgetfulness that equally attaches to the reduction. What is *revealed* is what excites; what is concealed may be forgotten. Here lies one secret for technological trajectories with respect to development. There are *latent telics* that occur through inventions. (p. 78)

Building on and paralleling Ihde's analysis of the technological mediation of perception, philosopher of technology Peter-Paul Verbeek has described the ways that technology mediates human action in terms of a structure of invitation/inhibition [51]. Verbeek draws on the concepts of delegation and inscription described by Latour [31,32] and Akrich [1]. According to these concepts, designers delegate functions or responsibilities to artifacts by inscribing them with desired programs of action. For example, a speed bump is inscribed (designed) to inhibit fast driving and invite driving slowly. In Verbeek's terms, artifacts invite certain actions while inhibiting others or even rendering them impossible [51, p. 171.

Drawing on the field of rhetoric, design theorist Richard Buchanan has similarly argued that all technology is inscribed with persuasive arguments: "instead of simply making an object or a thing, [a designer] is actually creating a persuasive argument that comes to life whenever a user considers or uses a product as a means to some end" [10, p. 95]. Drawing on Buchanan among other areas of design discourse, Johan Redström [39] has discussed the recent research area of "persuasive design" associated primarily with "captology" and the work of B.J. Fogg [20]. Redström suggests that all design in fact persuades in the sense that it is done with the intention to alter people's behaviors and attitudes. The key aspect highlighted by Redström and Fogg is the relationship between the designer's intentions and the ways that an artifact mediates or alters people and their behaviors, thoughts, and attitudes. To this we may add that technology can also *dissuade* certain behaviors and attitudes, which is in fact an intended outcome of many persuasive technologies aligned with captology.

Taking a "macro-level" perspective, social theorists such as Giddens [28] and Bourdieu [9] have theorized human agency as shaped by social structures and institutions in ways that both constrain and enable human action. While this work tends to downplay the role of materiality and artifacts as well as the intentionality of designers, it nonetheless is concerned with technology understood more broadly in terms of material and immaterial structures such as social institutions. Recent work in sociology has drawn on such theory but with a stronger focus on materiality (and design), notably in the work of Elizabeth Shove [45].

Various theoretical concepts from areas of economics and innovation theory are also germane to our discussion, notably the concepts of "creative destruction" and "disruptive technologies". The former was originally used in Marxist economic theory but more recently has been employed to describe the ways in which radical innovations introduce new economic value by effectively destroying prior established value [e.g.,42]. The notion of disruptive technologies captures a similar idea, emphasizing that the introduction of new technologies displace old ones [e.g.,8]. A classic example of a disruptive technology is the automobile, which displaced the horse and carriage.

Elimination design as described by Fry is based on a principle that captures important aspects of "creative destruction", namely that "Creating anything always requires the destruction of something else, so make sure what you create is worth what you destroy." ([50], with reference to [23]). Echoing Ihde's discussion of perceptual reduction, Fry argues that the destructive aspects of design are all too often overlooked:

> The very way design is reduced and presented in relation to bringing goods into being fails to grasp design's ambiguity as an agent of both creation and destruction… what designers do is destroy value at the same time as they create it (a new style product is launched as the 'the latest' thus rendering previous versions 'dated'). This means that while it is acknowledged that artefacts can prompt the creation of other objects (such as system elements and accessories) and deliver experiences (for example, pleasure and the use of new skills) what they may equally destroy (knowledge, the use of a service, a craft practice, and so forth) is mostly overlooked. [23, p. 192].

The notion that design both creates and destroys may also be found among writings on ontological designing [23,24,53,55], which have proposed theories of design claiming that "we design our world, while our world acts back on us and designs us" [53, p. 1].

To summarize, then, our review of a diverse set of theories and theoretical concepts related to technology and design collectively point to ways that technology negates, in various ways and at various levels of analysis. Technologies can be understood to both amplify and reduce human perception, invite and inhibit human action, persuade and dissuade people to alter their behaviors and attitudes, constrain and enable action within social structures and institutions, and create and destroy material and immaterial aspects of reality, including value, practices,

entire industries and particular material things. Further, our discussion highlights ways that the negating aspects of technology are often overlooked or neglected. With these ideas in mind, I now turn to discuss the intentional negation of technology.

UNDESIGNING: TOWARDS A THEORY OF THE INTENTIONAL NEGATION OF TECHNOLOGY

The theoretical perspectives outlined in the previous section draw attention to ways in which design both creates and destroys, enables and constrains, persuades and dissuades, inhibits and invites, and amplifies and reduces. According to these ways of theorizing design and technology, in some sense all design may also be considered *undesign*. However, our discussion also raises the distinction between intended and unintended effects of technology—intentionality being the key to distinguishing undesigning from technology negation more generally. Here I will use the term *(un)design* to refer to a notion of design which emphasizes that all design variously negates as well as creates, both intentionally and unintentionally.

Here, however, my focus is on the *intentional and explicit* negation of technology. As such, I will use the term *undesigning* to refer to the intentional negation of that which design brings into existence. The emphasis on intentionality brings technology negation explicitly into the realm of design action. Notions of human agency and intention are at the very core of design as a human activity. For example, in their influential book *The Design Way*, authors Nelson and Stolterman discuss intentionality and purpose as integral to design as a form of inquiry and action. Nelson and Stolterman write: "Design is the ability to imagine that-which-does-not-yet-exist, to make it appear in concrete form as a new, purposeful addition to the real world." [36, p. 10]. While representing a very different understanding of and approach to design, the centrality of intentionality and purpose may also be found in Simon's oft-cited notion of design as devising "courses of action aimed at changing existing situations into preferred ones" [46, p. 130].

In this section my goal will be to articulate a theoretical framework for discussing what the intentional negation of technology is and general forms in which it may be enacted. I begin by presenting a framework for conceptualizing technology negation and then expand on the framework to describe several additional areas of undesigning. As a conceptual point of departure, consider an inversion of Nelson and Stolterman's notion of design that emphasizes design as destruction rather than creation: design as the ability to imagine *the absence* of that-which-exists, to make it *disappear* in concrete form, as a new, purposeful *subtraction* of the real world.

Coming to terms with "technology"

Prior to discussing the negation of technology, it will be useful to obtain a firmer grasp on the ambiguity of the term "technology". When the term technology is used in the context of HCI, the assumption often seems to be that we are talking about some sort of "high-technology" such as digital or information technology (as distinct from more traditional technologies such as books, pots, and furniture). Further, in the context of HCI the term technology typically appears in reference only to material artifacts (as distinct from the making or using of artifacts, or even immaterial things such as laws or symbols). Taking a cue from this implicit convention, I will use the term *interactive technology* as shorthand for "the technology that HCI as a field is primarily concerned with". Interactive technology, then, typically entails some type of electronic, digital, computational, or information technology, and with a focus on the materiality of these technologies, i.e., technologies as artifacts. I will allow the unqualified term *technology* to retain its broader, more inclusive usages, which include notions of technology as not only high-tech artifacts themselves but also the making and using of all artifacts, and within practical, social and intellectual contexts (see Mitcham [35, p. 230-231]). However, in the context of this paper the unqualified term technology will also in most cases be used with the more specific notion of interactive technology in mind.

A spectrum of technology negation

What exactly might it mean to undesign something? In order to more precisely discuss the negation of technology by design I propose a framework for conceptualizing technology negation in terms of scope and scale. This framework can be understood as a spectrum, which ranges from the inhibition of particular uses of technology, to the broader displacement of technology, to the total erasure of an existing technology or foreclosure of an emerging one. I will briefly elaborate on each of these positions along this spectrum of technology negation using a number of examples. In this paper I describe each in terms of *intentional* negation of technology (rather than more generally in terms of negating effects independent of human intentionality).

Inhibition refers to design that aims to hinder or prevent the use of technology in particular ways and contexts. For example, designers can aim to inhibit driving with speed bumps and speed limit laws, or inhibit excessive electricity consumption by displaying the financial or environmental costs of consumption. Inhibition as I use it here does not exclusively focus on the inhibition of action in the way Verbeek uses the term, as discussed previously [51]. The relevant unit for inhibiting technology is individual-level "interactions", by which I mean to include notions of uses, behaviors, perceptions, etc. Inhibition is often considered in design, and there is in fact already a substantial area of HCI concerned with explicit and intentional inhibition, namely "persuasive technology" [e.g., 20].

Displacement refers to design that aims to more substantially hinder or prevent the use of technology by

removing technology, perhaps literally, from its typical or currently occupied position. For example, designers can aim to displace the practice of watching television by encouraging dwellers to move their television sets from certain areas of the home or remove them from the home altogether. Displacing goes beyond inhibiting by aiming to more substantially negate routine or common interaction with technology, but without completely negating its existence and potential for use. The relevant unit for displacing technology is a practice, understood as a regular or routine way of doing things.

Erasure refers to design that aims to completely eliminate a technology from existence. At least in theory, we can consider designing for complete erasure of a technology. To what extent this is possible in a free society is a matter of debate, although there are noteworthy examples of societies relinquishing technologies. A well-documented example is the eventual and sustained rejection of the gun in favor of the sword by Samurai military culture in 17th and 18th century Japan—during which time Japan continued to enjoy cultural and economic prosperity [38]. The relevant unit for erasing technology is the material existence of a technology (within a broader social or societal context, such as the home or an entire culture), and its concomitant uses, practices and other inter-related aspects of the world. *Foreclosure* [4] is similar to erasure but rather than targeting an existing technology the target is a technology that has not yet fully emerged into existence. Some well-known examples of technologies that have been targeted for foreclosure and/or erasure include products made with toxic substances, nuclear power plants, genetically modified foods, and, of course, the mechanized loom (a frequent target of "machine breaking" by 19th century Luddites).

Elaborating types of technology negation
In this section I will expand on this framework to articulate several additional, more specific areas of intentional action that are each concerned with the intentional negation of technology—understood in terms of inhibiting, displacing, erasing, and foreclosing. My claim is that while each area is aimed at negating design they may nonetheless be considered within the boundaries of design activity, at least according to sufficiently broad notions of design [e.g.,36,46]. The list of areas presented here is by no means intended as an exhaustive description of the space of undesigning. My goal is rather to articulate a range of areas of undesign activity that I claim may be less considered or even overlooked, particularly with respect to the (un)design of interactive technology, as well as to demonstrate how the 4-part framework can be employed to further articulate areas of technology negation.

For each area, the specific types of intervention and areas of

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4 I thank Paul Dourish for helping bring this term to my attention.

design expertise that are drawn upon (e.g., interaction design, communication design, product design) have been left largely unspecified. In the section following this one, I will review several such strategies and approaches that have been articulated in prior work. In this section, I will continue with the focus of the previous section on articulating more general areas of technology negation in terms of intended negating effects.

Self-inhibition and Self-inhibiting Options
Self-inhibition refers to the design of attributes of a technology that inhibit use of that technology in various ways. Self-inhibition is more specific than general inhibition in that it directs attention toward the design of technologies intended to inhibit *their own* interactions. Self-inhibition covers the design of a wide range of attributes. First, consider the ways that a design may self-inhibit by means of physical affordances [37] (which may be understood also in terms of the concepts of inhibition/invitation [51], amplification/reduction [29], and inscription [1,31,32] discussed previously). To elaborate on the way affordances can self-inhibit, I will draw on a well-known design exemplar from the HCI literature, the Drift Table [26]. The Drift table is an electronic coffee table that displays a slow-moving map of aerial photography and is controlled by placing objects on the table. Sengers and Gaver (one of the designers of the artifact) describe the design of the Drift Table as follows:

> In order to block the obvious interpretation of being for a task, the Drift Table was designed explicitly to not support task-oriented use as a travel device. For example, there is no way to type in coordinates to go to a particular point. The only way users can move across the landscape is to place objects on the surface of the coffee table; the table 'drifts' in the direction of their weight, at a purposefully low rate. The view can be reset (typically to the table's own physical location), but this requires pressing a small and unobtrusive button, designed to emphasize that resetting the view is not a primary feature of the device. [44, p. 103]

The decision to omit expected features (the ability to specify coordinates) and to limit or minimize other features (the rate at which the table "drifts", and the size and placement of the reset button) can be understood as attributes intended to self-inhibit. Moreover, self-inhibition is in this case intentionally employed in order to invite and enable forms of engagement that would otherwise be difficult or impossible to mediate, namely what the designers refer to as ludic engagement, or "activities motivated by curiosity, exploration, and reflection rather than externally defined tasks" [26. p. 885]. Indeed, designers do this all the time, whether or not they can or do articulate it in terms of concepts like affordances or the material mediation of action. While almost any design can be understood to have self-inhibiting attributes, the Drift Table is particularly relevant to our concern with undesigning because, as a design research artifact, it

explicitly draws attention to enabling self-inhibiting attributes that are often overlooked in the design of technology. A related idea is Tatar et al.'s "zensign", the notion that the features of a technology that are omitted are just as important as those that are included [47].

There is a special case of self-inhibition that I will further draw attention to, which I refer to as *self-inhibiting options*. Self-inhibiting options refers to the design of self-inhibiting user-specified settings or other choices that individual users can freely select in order to later inhibit uses or even prevent them altogether. The critical form of interaction to consider in the design of self-inhibiting options is what we might refer to as configuration modes of use. Configuration is distinguished from normal or routine use in that an individual can (re)configure how an artifact functions, how it is interacted with, and, consequently, how it is normally and routinely used (by altering the way it mediates). Familiar types of configurations considered in interaction design include menu options or product settings. However, there are other important configuration modes that are more easily overlooked because they are less clearly demarcated by specific aspects of an interface, such as where an item like a laptop computer is stored or used, how a television set is positioned in relation to seating arrangements, and the acquisition or de-acquisition of certain service options (such as different data plan options for mobile phones).

While designers often intentionally design for user configuration, there is apparently less explicit consideration given to the design of configuration options that encourage or allow individuals to reflectively and explicitly self-inhibit their own use. Consider an issue raised recently by Phoebe Sengers based on her reflections on the slower pace of life experienced during her fieldwork with a subsistence fishing community:

> [We] might think not about how technology can give us access to more choices, but about how we can design technologies that help us create constraints on our choices. Technologies might help to reduce the burden of choice for us by automatically excluding things we wish to keep out of our current field of vision… Or, as Ben Fullerton recently argued in *interactions*, perhaps technology should support not only connectivity but also solitude" ([43 p. 47] referencing [25]).

Based on this set of concerns, some examples to consider include self-inhibiting options that allow technology to be configured to be "put aside" or "put away", such as a television designed with cabinet doors that invite "closing" it, or a mobile phone that comes with a factory pre-set "I'm home" button for filtering calls and emails. We can also consider designing self-inhibiting options that allow technology to be configured to "not allow", such as a monthly mobile phone contract that gives the option to relinquish certain distracting types of functionality like video. Another example to consider is the control features that many televisions currently have which allow parents to restrict their children from viewing certain programming.

Replacement and Restoration
Replacement refers to design that aims to undesign a technology by replacing it with some other technology. Examples of replacing technology include replacing an older refrigerator with an improved model, replacing analog film cameras with digital cameras, and replacing landlines with mobile phones. Replacement is most naturally conceptualized in terms of functional or use-value replacement. However, replacement can also be understood in terms of replacing the symbolic function or social role of something. For example, a Valentine's Day card can be replaced with an affectionate embrace and kind word. The symbolic status associated with an expensive car or article of clothing could also be targeted for replacement. One specific strategy for replacement is *replacing a product with a service*. For example, car-sharing services may aim to replace a product with a service, which may lead to the displacement of personal ownership of vehicles. Later this strategy will be described as "disowning" [50].

A special case of replacement is *restoration*. Restoration refers to replacement by means of (re)introducing a displaced or foreclosed technology. Examples of restoration include restoring person-heating technologies and practices such as the use of blankets and clothing to keep warm indoors (and undesigning space heating technologies and practices), restoring bicycles and light-rail systems (and undesigning automobiles and buses), and restoring the home garden and farmers' market (and undesigning industrial processed food). Restoring can range from reintroducing a displaced technology "as it was" to substantially redesigning and remaking a displaced technology (e.g., the use of modern materials and ergonomics in modern day fountain pens, bicycles, and hand tools).

Removal and Exclusion
Removal refers to design that aims to literally remove a technology from a context it currently or typically occupies. Technology removal can be understood as a contextual erasure of technology, i.e., a restricted form of erasure that is neither universal nor necessarily permanent. Examples of technology removal include removing the television from certain areas of the home in order to alter social dynamics, removing a fast food restaurant to encourage healthier eating in a community, or removing a nuclear power plant to remove the possibility of nuclear disaster.

Exclusion refers to design that aims to prevent or substantially hinder the use or occupation of a technology within a given context. Technology exclusion can be understood as a contextual foreclosure of a technology, i.e., a restricted form of foreclosure that is neither universal nor necessarily permanent. An example of excluding technology is designing a café without Wi-Fi or power outlets in order to prevent or hinder patrons from using

laptop computers and Internet-enabled technologies such as email and social networking sites. This may be done (and in fact sometimes is done) in order to encourage "face to face" interactions and a more "lively" social atmosphere.

Safeguarding

Safeguarding refers to design that identifies and demarcates contexts in which to exclude or foreclose technology. Safeguarding names design activity that is broader than excluding, yet less drastic than the ultimate case of complete foreclosure. An example of safeguarding would be identifying a population or area of practice that would *not* benefit from designerly intervention or would be harmed by certain types of intervention, and taking steps to enact or advocate for the exclusion or foreclosure of such interventions. Such advocacy can range from the design of public policies and services to communication campaigns.

STRATEGIES FOR UNDESIGNING

Throughout our discussions in the previous section, the specific type of design intervention (e.g., website, product interface, image, service, etc.) and area of design expertise drawn on (e.g., product design, graphic design, interaction design, etc.) was left largely unspecified. In this section I summarize several approaches or strategies that help address *how* designers can go about undesigning in practice. First, I present a set of approaches for elimination design outlined by Tony Fry. This is immediately followed by another set of approaches for elimination design presented by Cameron Tonkinwise. Finally, I outline several relevant approaches that have been discussed within HCI.

Approaches to elimination design

As discussed previously, elimination design is concerned with identifying and eliminating the unsustainable [23]. Although Fry emphasizes that "design for elimination cannot be based on a nice, neat checklist" (p. 76), he nonetheless offers some general approaches to guide elimination design. One of these is *dematerialization and rematerialization*. An example Fry gives for dematerialization is the potential for digital documents to eliminate the need for printing paper (c.f. [41]). On the other hand, rematerialization involves "the substitution of human labour for machines in a smart way" [23, p. 79]. An example would be restoring the push mower to displace the gas-powered mower. Another approach offered by Fry is *product multipurposing*, which directs attention toward the large amount of "waste" associated with the design of "single function technologies" such as toilets that use potable water and kitchen sinks that waste grey-water.

Building on Fry's work on elimination design, Cameron Tonkinwise has described 4 strategies that draw on the design disciplines of product design, built environment design (e.g., urban design, interior design, architecture), service design, and communication design [50]. The first strategy is "developing a product that renders existing products redundant." Tonkinwise refers to this strategy as

displacing, although to prevent confusion I will refer to this strategy as *product displacement*. The second strategy is to *restructure* the built environment. For example, bicycle lanes can help inhibit or exclude driving and displace automobiles by promoting cycling. The third strategy is to *disown*: to develop "a service system that promotes shared use of products, eliminating the need for individual or household ownership of those products." Car-share and tool-share services are examples of disowning. The final strategy is vilify/celebrate, which involves using communication design to market the negative qualities of a product or promote lifestyles that do not require a product.

Undesigning with interactive and digital technology

Next I highlight several strands of research from within HCI that are especially relevant to undesigning.

Persuasive design

While persuasive design [20] was highlighted earlier, I once again draw attention to it because of its clear relevance as a cluster of strategies for undesigning. By employing intentional persuasion (c.f. Redstrom [39]), designers can, and in fact do, use technology to persuade (or dissuade) at various scales, ranging from inhibition to foreclosure.

Critical design & Projection

Critical design is an approach that also has strong relevance to undesigning. Dunne and Raby describe critical design as "design that asks carefully crafted questions and makes us think" and directly contrast it with design in the commercial realm that is focused on solving problems and findings answers [16, p. 58]. Critical design is noteworthy in the way that it may call attention to issues and concerns over interactive technology by employing interactive technology, such as bringing into question the effects of electromagnetic radiation by designing provocative electromagnetic devices (see [16]). More generally, DiSalvo uses critical design work by Dunne, Raby and Singh to demonstrate how design may be employed to project potential future consequences of technology to stimulate discussion and debate [13, p. 52-55]. DiSalvo refers to this as the design tactic of projection. Critical design and projection are perhaps most clearly related to the areas of safeguarding and foreclosing.

Photography and digital imagery

Photography, as a mode of designing and making, is also relevant to undesigning. Tonkinwise, in his discussion of vilify/celebrate as a strategy for elimination design, reminds us that "the profession and discipline of visual communication has a proud history of subversion, recasting commercial or political visual promotions in new contexts that reveal the concealed truth of about what is being promoted." [50]. Eli Blevis has recently drawn attention to the potential role of digital photography as a mode of design and design research within HCI [5]. To demonstrate the role that photography can, and has, played as a mode of designerly action, Blevis cites Lewis Hine's photographs of child laborers in the early 20th century as leading to the enactment of child labor laws in the U.S. I draw attention to

this area here because it suggests ways that digital technology may variously be employed to undesign technology (including its use in persuasive design and critical design).

Implications not to design

Recently Baumer and Silberman have highlighted the importance of considering implications to *not* design technology [2]. They propose three questions that may be used to identify instances where technological intervention may not appropriate: (1) "Could the technology be replaced by an equally viable low-tech or non-technological approach to the situation?" (p. 2271) (2) "Does a technological intervention result in more trouble or harm than the situation it's meant to address?" (p. 2272) (3) "Does a technology solve a computationally tractable transformation of a problem rather than the problem itself?" (p. 2272).

These questions and the approach suggested by Baumer and Silberman are clearly aligned with undesigning (and are particularly suggestive of the areas of foreclosure and exclusion, as well as restoration). An obvious yet important way that implications to not design may be incorporated into HCI research is with respect to the "implications for design" resulting from fieldwork and user studies (c.f. Dourish [15]). For example, based on their studies of productivity tools, Leshed and Sengers caution designers against the design of productivity tools that are too immersive [33]. Related to this discussion, Satchell and Dourish argue that there is overlooked value in studying not only uses but also *non-uses* of technology in order to inform design [40]. The articulation of implications to not design or to undesign, whether based on user studies or otherwise, represent an important route to engaging with undesign.

EMERGENT ISSUES AND OPPORTUNITIES

Having more precisely articulated what undesign is, in what specific ways technology may be negated, and how in practice this may be achieved, I now turn these ideas back onto the questions outlined in the introduction. To reiterate, the two key questions posed were: (1) To what extent and in what ways should undesigning technology be an acknowledged and legitimate area of design research activity within HCI?, and (2) what are the range of activities that HCI has available when there is a strong argument for *undesigning* technology?

Certainly, this paper, or any single paper, cannot possibly hope to definitively resolve these questions. Indeed, questions of this scope can only be determined on an ongoing basis by discussion within the community and by actually conducting research (e.g., running studies, designing technologies, publishing results). However, this paper has taken an important step toward clarifying and addressing these questions. With respect to the second question, thus far I have outlined a range of potential activities upon which HCI may draw. In conclusion I

further offer a scheme of dividing the space of undesigning into areas that can further help clarify the issues at hand. Each category moves increasingly further away from the notion of design as the concrete making of a novel interactive technology. For each of these four areas, I will review relevant areas of undesign covered thus far.

Undesigning interactive technology with interactive technology

In what ways can the design of interactive technology be employed to undesign interactive technology? Here I have drawn attention to one such area: the design of interactive technologies that self-inhibit. These types of self-inhibiting technologies appear to clearly fit within the scope of design in the context of HCI. Indeed, self-inhibition was shown to already present itself in certain ways in the design of interactive technologies. However, I have also drawn attention to an area of self-inhibition that is apparently less often considered, namely the design of self-inhibiting options. Considering the concepts of self-inhibition and self-inhibiting options may be particularly useful in conjunction with design approaches such as persuasive design [e.g.,20,39], critical design [16], and designing for reflection and multiple interpretations [e.g.,26,27,44].

Undesigning interactive technology without interactive technology

To what extent can HCI design without interactive technology? While this paper cannot hope to resolve this question, here I will suggest that there is value in considering areas of design that target interactive technology yet do not necessarily involve making or deploying interactive technology, at least not in traditional ways. Undesigning specific uses of interactive technology without introducing new interactive technologies may be a worthwhile and viable area to consider, such as removing technology, excluding technology, replacing technology and restoring technology. While such forms of design activity should almost certainly not occupy a central position within our field, considering them could open up new and overlooked spaces for design.

Argumentation as undesigning: Undesigning "without making" anything

To what extent can HCI (un)design without making novel or tangible artifacts? The areas of critical design and digital photography suggest ways of designing that place less emphasis on the introduction of a physical thing with a clear utilitarian function, and instead emphasize a form of design that is primarily concerned with argumentation and provocation. Another area to consider is "implications for design". As at least one step removed from the actual design and making of an artifact for "end users", such activity may be considered a form of design activity that does not involve making anything, and in fact may lead to the "unmaking" of technology. For example, approaching the interpretation of fieldwork data through the lens of undesigning could lead to implications to undesign by

removing, excluding or safeguarding. Whether or not such activity is firmly placed within the realm of design, there is apparent value in considering them to be among the range of options available to HCI. Indeed, having at least considered the "implications for undesign" (including implications to not design [2]) when interpreting fieldwork is arguably a responsible and valuable design-oriented research activity; if they are not considered, to what extent can we have confidence in the appropriateness of the implications to affirmatively design technology?

Inaction as design action

Finally, I raise the question: To what extent should inaction be considered as a viable form of design action? Consider, for example that Blevis has previously drawn attention to the negative material effects of technology disposal on the environment [3]. Baumer and Silberman have further called attention to a range of mobile applications that aim to encourage sustainable behaviors yet do not address the environmental problems associated with the proliferation of mobile computing devices [2]. To take this a step further, it could be argued that there is a relationship between the design of mobile applications and the proliferation of mobile devices. Given these concerns, the question may be raised: Is refraining from designing mobile phones an appropriate form of designerly action?

In contrast to the previous areas of consideration, here I raise the question of inaction as design action primarily as a provocation rather than as an issue of discerning disciplinary boundaries. What I am suggesting is that the notion of inaction as design action could be a useful construct for consideration of the limits of design action, and the appropriateness of such (in)action. The notion of design inaction, and undesigning more generally, may also prove to be useful for *creatively* exploring a design space. Brainstorming and other methods of "transcending fixation" are hallmarks of design practice [e.g.,34]. Exploring the ideas of inaction, erasure, exclusion and so on may in fact be useful within the design process as methods for arriving at new and creative design outcomes. In this way I am suggesting that undesigning may useful to design that is primarily concerned with creating rather than negating.

CONCLUSION

Based upon various concerns over the limitations and negative of effects technology, this paper has inquired into undesigning, understood as the intentional and explicit negation of technology. Building on a range of theoretical constructs, I have articulated a framework for conceptualizing the intentional negation of technology in terms of its scope and scale. This framework describes technology negation in terms of a spectrum ranging from inhibition, to displacement, to erasure and foreclosure. I then expanded on these areas to articulate several additional areas of undesigning, including self-inhibiting options, exclusion, removal, replacement, restoration, and safeguarding. As such, this paper offers a theoretical contribution to what might appropriately be termed (un)design theory. In closing, I would like to emphasize that it is my hope that the ideas presented here may be engaged with not only through intellectual discussion and the elaboration of theory, but also through the actual doing of (un)design research through design—a notion that takes a cue from HCI design research that emphasizes doing and making as valuable and valid forms of inquiry.

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