Beyond Hybrids: Metaphors and Margins in Design

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ABSTRACT
This paper offers a critical reflection on the term "hybrid"— a term describing the merging of distinct and often contradictory entities. We trace how the term has been taken up in HCI's programs of design research to explore *resolutions* between two disparate entities, typically human and machine or the digital and analog. Drawing from programs of feminist technoscience, we suggest an alternative metaphor for designing coproductions. This approach emphasizes the contradictory and collective work of smoothly integrating social categories. We show how designing coproductions begins by locating places where categories break down—where humans are like machines or where the digital can be experienced physically—and uses design to draw out and reflect upon the ever-changing relationship with digital and non-digital domains.

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Hybrids; Hybrid craft; Coproduction; STS;

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INTRODUCTION
As interaction design continues to make sense of changing relationships between the digital and analog or the human and nonhuman, the field's core concept of "interaction" [11,30,34] becomes increasingly troubled. Recognition of this turbulence has sparked a range of alternative metaphors for the human-machine interface, each extending and reworking the merger of human and machine, including "integration" [11], "configuration," "intra-action," [2,34] and, perhaps most enticingly the "hybrid." The term hybrid tends to describe an object or practice that fuses two social categories, such as the "real" and "virtual" or "digital" and "physical." Within HCI, the term has buttressed efforts to develop new programs of research like "hybrid craft," which emphasize the merging of digital-material or human-

machine and give way to rich design explorations (e.g., [5,10,25,31,35,36,38]).

But like any metaphor, the hybrid makes some relationships between categories seem more evident or "natural" than others. In this paper, we examine those resulting relationships in design research using the domain of "hybrid craft." We show how hybrid metaphors suggest *purifications* that reinforce a separation between two categories, even while trying to fuse them [22]. We further show how in hybrid form, a product or practice *stabilizes* existing categories, often concealing the processes, histories, and negotiations that came to constitute those categories in the first place. And in attending to hybridity—which combines two *dichotomous* categories and not more—designers may narrow their scope of inquiry, neglecting a wider range of social, organizational, or political forms. Together these features of the hybrid—purifying, stabilizing, and dichotomous—shape what ideas remain core to design insight and action, and what ideas get pushed to the margins.

By tracing and expanding the hybrid metaphor, we make two key contributions to design research. First, we contribute a reflection on how the term "hybrid" has been taken up in design research, focusing on what it tends to emphasize and overlook. Second, we offer the alternative metaphor of "coproductions" to design research and illustrate what it could make present for the human-machine and digital-physical relationship.

WHAT IS A HYBRID?
A hybrid describes the coming together of distinct and often contradictory entities, whether it refers to the offspring of different species (like a mule) or a mixture of heterogeneous entities. Implicitly, because of its roots in biological reproduction, it refers to a dual. There are only two distinct categories that join to create a hybrid and the hybrid is of a different kind than the categories from which it emerged. In HCI to date, the term has been used to describe practices and products that bring together historically separated actors, tools or materials, with one of those actors being a computer or computationally driven system. Hybrids have addressed reconfigurations of humans and machines in varied contexts from machine learning [23] to work-place collaboration [21]. In this paper, we also use the term "hybridity" to describe the condition of a practice or product as being hybrid.

Hybrid Craft: Hybridity at Work in Interaction Design
Several design researchers have adopted the term hybrid in the context of digital fabrication tools and environments (e.g. [9,10,13,20,31,32,36,38]) to emphasize the blending of analog and digital modes of work as a way to combine the best aspects of digital and physical production processes. These projects include "tool-kits" composed of physical and digital parts [14] and manufacturing tools and infrastructures that explore the physicality of electronic media [5,33]. Often termed "hybrid craft," this work appeals to hybridity as a way to combine the best aspects of digital and physical production processes. For instance, in developing a hand-held CNC milling device called FreeD, Zoran et al. seek a mode of work that combines digital fabrication and craft traditions: "minimizing fabrication risk by using a small degree of digital control and automation while allowing authentic engagement with raw material to achieve unique results" [38]. Buechley and Perner-Wilson focus on the epistemic dimensions of material experience and "explore how different physical materials, tools, and processes can lead to different ways of thinking about, understanding, and constructing electronics" [5]. Golsteijn et al. seek pathways for including personal digital media (e.g. audio files, digital photos) in the production of "cherished" mementos [14]. Whether the work addresses an abundance and underutilization of particular media or differing dimensions of experience offered by particular techniques, each project suggests new hybrid design territories by selectively combing aspects of digital and analog modes of production that are seen to be beneficial within the design context. In this sense, the hybrid product or practice offers a *resolution* to conflicts between the categories from which it emerges.

When hybrids seek resolution, researchers must emphasize how the initial categories from which the hybrid stems differ or oppose one another, a process we refer to as *purification* (following Leahu et al. [22]). Some hybrid craft research (e.g. [9,31]) purifies categories of human and machine by drawing from theorists like Tim Ingold [18], Malcolm McCullough [24], and Richard Sennett who foreground the role of the human hand within authentic craft experience. In a related move, other work focuses on "traditional craft" for design inspiration, pointing specifically to Arts and Crafts movement concerns of deskilling associated with mass production [5,20,38]. As a result, things like style, expressiveness, and creativity belong exclusively to the category of "human" and things like automation belong to the realm of "the machine." Purifying categories allows them to appear as stable or given—as though they have always existed as such. Thus, it becomes difficult to see how humans are already hybrid; how our actions could be understood as programmed; or how machines might express style. These ideas may seem nominally strange to some, but we have found them incredibly useful for probing new pathways of inquiry and insight [7–9,27].While we can certainly find differences in, say hand-craft and mass-production, situating design as a resolution or improved

combination to those differences has the effect of amplifying and reaffirming them, suggesting that it is the role of the hybrid to break them down. Thus, the hybrid-as-resolution works in two ways—suggesting a fusion between categories while reinforcing the idea that those categories are fundamentally different.

We do not wish to condemn hybrids, only to show that this category suggests particular approaches within a much wider design space. Existing hybrid work has demonstrated important developments for inquiry and expression such as tools that support a diverse range of experiences (e.g. [10,31]). Some hybrids reveal blindspots in contemporary technology design by countering narratives of ecology as separate from technoculture [39] or of fabrication as means to achieve perfect accuracy and replication [9,37]. Others support the inclusion of a broader set of makers in STEM activities as well as the so-called Maker Movement [5,33]. And still others reveal parallel cultural and technological breakdowns in our understandings of colonialist histories [28]. But there are other ways to explore the intersection of digital and analog [12] or human and machine [3,26] such as the processes Farooq and Grudin recently termed human-computer *integration* [11]. To articulate these broader design territories and treatments, and to address calls for sympoiesis [11], we turn to perspectives from feminist technoscience.

HYBRIDITY IN FEMINIST TECHNOSCIENCE
Science and technologies studies (STS) Scholar Bruno Latour, perhaps most famous for introducing a notion of hybridity within technology studies, examines the confluence of various phenomena as "hybrids"—a category that he argues breaks open dualistic conceptions of nature and society. Latour calls for interrogating the conditions that allow for certain purifications and hybridizations [20:11], the ways certain categories dissolve into one another while others stand alone as axiomatic. Complementing Latour's early writing on the hybrid, feminist technoscience scholar Donna Haraway most recently proposes "sympoiesis," a concept of making-with that invites designers to recognize a multiplicity of social relationships beyond the human or individual. "Who and whatever we are, we need to make-with— become-with, compose-with—the earth-bound," she explains [17:102]. In her focus on a collective making-with, as opposed to an individual acting upon, Haraway emphasizes *coproductions* (after [6]), processes of mutual shaping in which boundaries or differences between categories are questioned and explored, not resolved. Where hybrid often references a noun, coproductions takes the form of a verb, a contingent process of tying categories together—it cannot exist independently of the categories it joins and vice versa. Furthermore, where hybridity marks the merging of distinct categories in processes of resolution, coproductions draw out breakdowns or perforations between categories to give rise to multiple possible outcomes. Thus, coproductions retreat from hybrid dualisms that stabilize singularized contrasts (digital-physical, human-machine, or natural-

artificial) to draw attention to the tensions within. One might say that coproductions investigate generative potentials of the "-" to a greater degree than the individual categories it holds together.

Drawing on this STS scholarship, designers have recently shown that such categories (like "human" or "machine") are in continual flux: shifting based on how they perform values and conditions central to design [30]. Purifying categories like human and machine, and stabilizing such purifications through the metaphor of the hybrid takes constant work. By choosing different metaphors, designers can disrupt those purifications, allowing new possibilities to come through. While other metaphors, such as Barad's concept of "intra-action" [2,23] and Haraway's "cyborg" [16] or "string figures" [17], are also useful tools for calling out the margins of hybridity, we focus here on "coproductions" due to its rhetorical simplicity while emphasizing mutual construction (an emphasis shared by these other metaphors).

CRAFT COPRODUCTIONS

To concretize what designing from a perspective of coproductions might look like and the potentials it holds for expanding design, we present three proposals for craft coproduction. Each example draws from existing themes in hybrid-craft such as the expression of personal style with computational tools or digital-physical fabrication processes. But each also seeks to provoke a richer and more complex set of relationships with technology: reaching beyond the hybrid metaphor and its withstanding dualisms, stabilizations and purifications to suggest possibilities for recognizing other kinds of action and participation obscured by functionalist programs traditionally examined in HCI.

Hand of the Wind

Our first design proposal considers coproductions through their intermixing of purified categories. For instance, the human hand often stands as a counterpoint to the machine in hybrid craft research. As such, new technologies are designed to make room for the hand within processes that are typically automated. Zoran and colleagues [38], for example, link the hand with style and evaluate their tool in relation to how users are able to express their personal style. We begin this proposal by attempting to disrupt the idea that style belongs to the human hand, and thus, imagine what other forces could be capable of expressing a "personal" style.

Beginning from a search for examples of the "hand" or style of a natural force, we envisioned what a computer numeric control (CNC) machine might look like if it were driven by wind and how the wind could produce unique signatures or styles within the objects it produces. We imagine creating a mechanical loom that would move yarn along the weft of fabric at slow a constant speed, such that it would take a week to produce a region of fabric. As it wove, the machine would let out thread in accordance with wind speed. The result would be a woven fabric with regions of variable tensions, with sagging loops of thread representing regions of high wind, and correctly tensioned regions representing areas of little or no wind. Human makers, interested in the production of different textures, might move the machine to different regions, from windy urban corridors to mountain passes, in order to produce fabrics with different styles that represented each place, not the human per se.

In this example, coproductions tie together categories of human, machine, and environment. At this basic level, it breaks open the hybrid focus on duals by drawing together a triad: humans, winds, and machinery. It begins by identifying similarities in those categories and by framing each of them as having "hands." The textures and "style" of the object produced does not belong to any single actor, but a confluence of the three. As such, the project seeks a flatter relationship or a making-with multiple categories where the human is not necessarily in control. Rather, the form produced is a coproduction of multiple creative and agential forces.

Blooming Imagery

In a second design proposal, we emphasize the collective nature of coproductions that contrast with projects of hybrid craft, which typically describe spheres of activity constituted by individual human actors. Golsteijn and Frohlich, for instance, characterize overcoming the gap that exists between digital media and physical components through new forms of user composition, allowing individuals to arrange physical building blocks associated with digital imagery [15]. This mapping of physical and digital elements works within conventionally conceived classifications of 'human' and 'machine', ontological separations that conceal a vast set of actors and social forms (families, communities, publics) with potential contributions to the design process.

This sensibility shifts with the introduction of coproductions, which suggest a wider variety of design influences, such as the many heterogeneous micro-actors (water, proteins, minerals) that compose the bodies of humans, plants, and animals. When we integrate making and biological processes, aligning making with agriculture, gardening, and farming, we can imagine a project like Blooming Imagery, a machine for animating flowerbeds. Some species of flowers, like sunflowers and poppies, change their orientations or open and close at semi-predictable time windows. With this in mind, we conceive of a CAD interface where one can design flower-based imagery and animations by positioning flower species in a grid, as though each flower were a pixel. A robotic arm could "print" the pattern by planting seeds in individual pots and watering the seeds over time. Captured by day-long timelapse, the image would bloom into and out of form, looking more or less like the original plan based on the natural formations of the flowers and the weather patterns. With each flower in its own pot, a human maker could rearrange pots to bring particular features into and out of focus, or dynamically update the computer based "pattern." This example engages a wider set of actors

(flowers, soil, sunlight) within a largely unchanged CNC manufacturing process, highlighting that designers have not to completely reinvent the wheel in the process of engaging alternative metaphors. Instead, they simply reconsider the role of the machine within a broader collective of agential forces, a move that some might describe as post-anthropocentric.

ROM+RAM

Our final design proposal explores coproductions by focusing attention to histories that have been obscured by processes of stabilization. As we have argued, much hybrid craft research has sought to offer a resolution to fundamental differences between sensory rich processes of working by hand and the thinner experiences of working with computation or electronics. A look into histories of technology development reveals moments in which such practices existed but were delegitimized by the need to maintain differences between, say, technical processes and manual work.

In this third design proposal, we focus on the age-old weaving techniques that were engaged in early core memory production—both read-only memory (ROM) and random access memory (RAM). Throughout the first two decades of the Cold War, magnetic-core memory was the principle mechanism with which computers stored and retrieved information. Across the 1960s and 70s, NASA engineers nicknamed this hardware "LOL memory" for the "little old ladies" who vigilantly wove wires around electromagnetic ferrite cores by hand. Craftwork became hardware manufacturing, and hardware manufacturing became craftwork.

In an effort to reflect on the sociotechnical factors that led woven core memory to be outmoded and its history to be effectively erased, we point to a project performing this labor in the present day, a venture that is ongoing at the time of authorship (makingcorememory.com). This performance surfaces the practices and people of the past for recognition, perhaps prompting reflection on cultures of electronics in a similar fashion as Buechley and Perner-Wilson's work [5]. In this respect, a metaphor of coproduction does not produce something wholly different from hybrid, but calls attention to the processional nature and dynamism that we associate with materially-embedded labor.

METAPHORS AND MARGINS

While we have so far focused on hybrids and the different imaginative tools coproductions engender, with this reflection we aim to do something more: offering new tools for raising our response-abilities [17] within the various interdisciplinary threads of interaction design. By suggesting the alternative (and equally partial) metaphor of coproductions, we highlight territories residing at the margins of hybridity that foreground different concerns alongside their limitations. As Phil Agre has said of artificial intelligence programs, "The point is not simply to discover the right set of metaphors but to encourage a critical awareness of the role of metaphors in research" [1:24].

With the continual intertwining of nature and artifice questions concerning the role of digital technology in previously non-digital domains not only prove critical to theorizing the human-machine interface, but also offer a means of designing otherwise—in locations and moments of collective work that address a wider arrangement of humans and technology. Focusing on craft, we have seen how the alternative metaphor of coproductions may animate new possibilities for design like considering environments as makers, collective (human and nonhuman) experiences, ephemeral forms, and resituated histories. So doing, we join broader calls to diversify hybrid territories (e.g. [11,19,23,29,34]), acknowledging how all formulations give way to wider sets of actors and arrangements. What is being "tinkered" with in these alternative formulations is not just stuff, but also selves, relationships, collectives and cultures.

Our work has thus surfaced new horizons for contending with hybrid metaphors in design. But coproductions, much like hybridity, also present limitations. For instance, our proposed craft coproductions may seem to live in a gallery or exhibit floor. They do not contain strong narratives of users or utility and they are not framed as solutions to problems or ways to address limitations of a particular medium because limitations and tensions are precisely what they present for exploration (much like [4]). While such tools may struggle to find a place in the present beyond art or exhibition contexts their resistance to what designers might think of as natural, useful, or everyday allows them to function as a counter-point from which to reflect on design habits, norms, and the ever-changing relationships between culture, technologies, and environments. As artful projects, they prioritize reflection and inquiry (by designers and audiences) over use and personal expression. The strength of coproductions as a metaphor is its ability to expand and sensitize designers to a different set of phenomena in the world. These sensitivities could ultimately lead to more traditionally "useful" designs that suggest compelling alternative interactions in a vibrant world of people and things.

While some of our design proposals may remain out of reach, our proposals steer questions around technology and invention in new directions that extend the margins of design. If taken as a compliment to hybrid-as-resolutions, coproductions speak to design territories obscured or left out by the hybrid. They muddy its purified categories; broaden its objects of study; and treat its resulting design projects less as inert and passive things. Coproductions point to the always-interconnected arrangements of various entities, be they human, nonhuman, or technology. These contrasting positions can create productive dissonance, prompting designers to rethink established norms in design. Such inflections highlight the generative capacity of metaphor: reorganizing design's traditional sites and proclivities to honor the porous, troubled, and indeterminate nature of social categories.

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