From Garments to Gardens: Negotiating Material Relationships Online and 'By Hand'

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ABSTRACT
From home improvement to scrapbooking, leisure activities performed "by hand" increasingly involve digital tools. In turn, software and devices to support handwork are proliferating. We use data from an observational field study of gardening and knitting to examine relationships to information technology. Handwork experiences of patience, effort, sensation, and cleverness can shift with the introduction of new tools. Our participants' attachment to these experiences made them sensitive to the potential consequences of introducing new tools. Digital tools were sometimes rejected and other times woven into handwork activities. In response, we propose three metaphors for handwork practice —extending, interjecting, and segmenting—as a resource for moving beyond the binary opposition of digital and physical practices.

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Handwork, craft, knitting, gardening, design theory.

ACM Classification Keywords
K.4.0 Computers in Society: general. H.4.3 Communications Applications: Bulletin boards; electronic mail; information browsers.

INTRODUCTION

You can't hammer a nail over the Internet

—*Economist Alan Blinder, Princeton Affairs,* quoted in [6]

Over the last decade, information technologies (IT) designed to engage leisure handwork pastimes such as gardening, cooking, and textile crafts, have proliferated. A host of online communication tools help promote in-person gatherings[1] through social networking tools, discussion forums, and blogs. While these online resources extend pre-digital means of disseminating craft knowledge, such practices cannot be achieved solely online. Just like hammering a nail, muscular effort and dexterity are still unavoidable elements of making objects by hand. These new technologies prompt us to ask: *How and why do people integrate IT into leisure handwork activities?*

This paper explores the interplay between digital and hand tools in leisure handwork to examine the incorporation of new tools and materials. It describes an in-depth, observational study of two handwork groups: knitters and gardeners. We compared these activities (instead of, say, cooking and car repair) because both are extremely common leisure pastimes that require long term commitment to a single project or goal, have significant participation in online support forums, yet produce very different kinds of activities.

Studies of contemporary leisure handwork have examined both instructional [31] and creative [33] online activity. However, these studies often treat newer digital tools separately from traditional "hand tools." This paper combines the two in order to inform and inspire the design of computational tools that are sensitive to the diverse material practices of handwork.

Fig 1. Community gardener cuts flowers as a gift.

BACKGROUND
At its simplest, "handwork" refers to manual manipulation of material objects by hands or hand-driven tools [6]. Historically, craft scholarship has treated handwork as a product of an individual's reflective consciousness and manual dexterity [1]. The processes of handwork often seem richly *embodied*, bridging mind and senses through effortful physical manipulation [6]. Handwork processes often feel

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[1] Several craft & DIY social networking sites (e.g., Instructables.com, Ravelry.com) launched between 2005 and 2007, as did the social gardening site MyFolia.com.

pleasurably tangible, stimulating multiple senses at once. Manual production involves accepting uncertainty and the 'thrill of avoiding failure' [6, 24] – unlike the predictable replication of "idealized" [24] forms desired by industrial production. The outcomes of handwork rely upon bodily skill [29]: trained senses, informed judgment, manual dexterity. Beginners and experts differ noticeably. Finally, handwork demands attention. With no mechanically automated processes, projects require consistent human care to make progress. Thus, despite its name, "handwork" almost always requires the full use of the human body.

Leisure handwork touches on questions of embodiment that have lately preoccupied human-computer interaction research, such as *thinking through doing, performance*, *visibility of collaborative tools, risks and uncertainty in physical co-presence,* and *thickness of practice* [14]. As an everyday hobby, leisure handwork also focuses attention the pleasures of hard work under the right circumstances (e.g., cooking, [10]). While a popular object of online discussion [16], handwork can also challenge our assumptions about what digital technologies should do [20].

Studies of handwork and digital technology

Studies of contemporary handwork have largely pursued three themes. First, many scholars have explored the relationship of human skill and effort to automation. Proponents of "traditional" handwork often focus on survival and popularity in the face of new technologies [12, 16, 20, 33]. Handwork often appears as an example of cultural heritage: the durability of shared memories in material objects. For example, the public exhibition of traditionally patterned African-American quilts can turn the quilts into sites of nostalgia, celebration, and defiance [28]. Emphasis on handwork's survival can take a moral tone, praising individual "makers" and "how people consume and interpret the handmade" [17]. While some argue that the conduct of skilled handwork exists in opposition to information work [6, 29], others celebrate the social and economic opportunities provided by the introduction of new communication technologies to otherwise isolated groups [17, 21].

Second, a small but rich literature explores the use of digital tools for sharing instructions, illustrations, and handwork-related messages. Online groups share expertise, exchanged feedback, and form a respected audience in which people present themselves as skilled, creative artisans [12, 32]. Wood et al. [34] explored the creation of online video resources for "bridging the gap" between novice and expert craft practitioners. Others address motivations for online craft activity [16]. These studies largely emphasize how participation in online groups recreates and extends interactions present in pre-digital counterparts.

A third area of literature follows the contestation of "originality" and "creativity" as valued qualities in handmade objects. Pre-industrial handwork groups often shared patterns, colors, and techniques [18]. Modern notions of personal authorship and unique creative identities devalued such collective aesthetics [1]. After the advent of the Internet, research has studied the struggle of both online [12, 16, 33] and co-located [13] handwork groups to evaluate personal skill when myriads of handwork patterns, examples, and tutorials are widely available online.

In terms of methods, however, these studies share one characteristic: they study online handwork social groups and co-located handwork social groups separately (e.g. [12]). There has been little attention thus far to the integration of IT into handwork-centered groups.

TWO STUDIES OF HANDWORK

We performed an in-depth, observational study of knitting circles and gardening groups for three central reasons. First, these two forms of handwork share several features that help us explore handwork and embodied action: both are sites of sensory interaction that cannot fully take place online. They rely on manual skill and dexterity that affect quality and aesthetic detail; and they both require learning to manipulate a diverse set of materials and hand tools. Second, the knitting circle and the community garden have very different characteristic activities that shed light on how people integrate a range of materials and tools. Third, each activity has begun to involve digital information technologies (social networking sites, discussion forms, email) in the coordination of their work. As we will see, these qualities let us consider how people work out relationships to IT through embodied interactions with material.

Method

Forty-six participants (13 gardeners; 33 knitters) were recruited through emails to knitting and gardening mailing lists, posts on Ravelry.com (a social networking site for knitting), and in-person recruitment at knitting circles and gardens. By sampling from handworkers who use online tools, we aimed to ensure we observed online activity, in-person social interaction, and the use of traditional hand tools. There were almost equal numbers of men and women among the gardeners, though all but three knitters were female. Participants ranged in age from early 20s to mid 80s, though most were in their 30s. They varied widely in expertise and orientation: from an award-winning dahlia grower to a "newbie" knitter still struggling with a basic sockinette stitch. They were largely middle income, and most had college degrees. Occupations included software engineer, orchid grower, retired state employee, comic book illustrator, teacher, and nurse.

Our approach to fieldwork drew from interpretive design strategies, such as generative scenarios [3]. During interviews, both knitters and gardeners were asked to imagine integrating an experimental technology into their handwork practice. In this way, we hoped to prompt reconsideration of taken-for-granted technologies (such as automatic irrigation, or digital cameras) by confronting participants with actual experimental technologies currently in development. Thirteen of the knitting interviews were conducted in context of initial field trials with Spyn [27], an experimental tool for annotating knitted objects with data about their creation. The garden interviews included a pre-scripted

verbal presentation of two technology scenarios ready aloud by the interviewer. The first concerned a familiar technological situation: installing an automated watering system in their garden plot. The second was deliberately provocative: a speculative proposal for a "gardening robot" (based on current robotics agendas for agriculture [15]) that could perfectly perform monotonous physical chores, such as weeding. Introducing an experimental object (Spyn) and provocative gardening scenarios was intended to promote reflection on the implications of new digital tools for existing notions of effort, skill, and learning.

Interviews lasted approximately one to two hours and took place in a variety of locations: 29 at knitting locations (cafes or homes), four over instant messenger with remote participants (in Holland, Britain, Canada, and the Northeast United States), five at "Hillside Garden,"[2] eight at six other gardens, and one with a park volunteer in his park. Three of the interviews were with group coordinators or other group leaders. Our interview questions focused on the activities, and tools supporting established knitting and gardening practices. We also asked about the motivations for handwork activity, the discovery and use of online resources, and participation in social activities around handwork.

Interviews were complemented by participant observation over three months at monthly park workdays, four knitting circles, and other garden and knitting group events, including textual analysis of a year of park mailing list messages.

Relevant interviews and fieldwork were reviewed and transcribed by the authors; the authors met frequently to discuss the material and draw out relevant themes. The themes were iteratively revisited and revised based on discussions. The notes and transcripts were then organized and recoded based on these themes and emergent theoretical frames.

MAKING HANDWORK MEANINGFUL

Participants' projects, such as making sweaters or caring for a rosebush, often required continuing human effort and attention over months and years. In the moment, tasks such as tatting lace or plant pruning plants often required careful placement of hands and delicacy of touch. For this reason, many participants saw handwork as a healthy complement to office work, like physical exercise or meditation.

Korelle (gardener): As much as I love the city, there are some times when I need to get out, or I want a little retreat in the woods or you know something like that. And I think having a garden really helps.

Knitters also described their rhythmic motion as "therapeutic" and "meditative." For three knitters, knitting was a "direct replacement" for smoking. "*It slows me down*," Rebecca explained. But working with plants and fibers, as we expected, resulted in different patterns of engagement over time.

Knitting does not require a specific time commitment: projects progressed intermittently or in long or short stretches, as the knitter desired. Like idly puttering (or pottering) [30] in homes, periods of knitting were often *residual* —time leftover from other tasks and often unplanned [36]. Knitting often takes place while attention is elsewhere —at meetings or while watching television. It is not tied to a specific place: people knit at home, while waiting for transit, en route, or in organized "knitting circles" that provide support and companionship while knitters worked on individual projects. Knitting, in this way, differs from other types of handwork (e.g., pottery or wood working) in what sociologist Eviatar Zerubavel calls *temporal flexibility* [36]. For Rebecca, a librarian, knitting during boring work meetings reinforces an unstructured, uncalculated sense of time. "*I can take a year or two or a week or two depending*."

Gardening is far less flexible. Rooted in particular places and yearly cycles, it exhibits what Zerubavel calls *temporal symmetry* [36]. Gardeners cannot rush their harvests; they follow the seasons and the times of plant germination. After following directions for preparing soil, sowing seeds and watering, gardeners wait for visible results – sometimes over weeks and months. And unlike textiles, gardens could not be left untended for long. Summertime garden visits could last more than an hour — so gardeners, unlike knitters, had to free time from work or family responsibilities.

Through observing, manipulating, and reacting to handwork materials, participants developed long term relationships with the people and things around them. Knitting and gardening, of course, rely on different materials: plants and soil make different demands on humans than yarn and needles. So it is unsurprising that knitting and gardening follow markedly different spatial and temporal patterns. However, we found striking similarities in how knitters and gardeners explained why they did what they did.

Sensory sensitivity

Gardeners often mentioned the importance of putting their "*hands in the soil,*" sometimes even lowering their face to the ground to smell it.

Dana (gardener): My college degree is that I was a biology major […]. And when I worked, I worked in research labs, so I did experiments. <pauses> So I like doing experiments, and I like trying things. And in a way, my garden, I do a little bit of experimenting. You know, I observe what happens, what, you know <pauses> I just observe.

Noticing and interpreting changes in her plants was important to Dana's sense of accomplishment. The knowledge she sought was particular and situational—attending to the plants that grew well in her plot, or patch of land. Both knitters and gardeners described learning through "*experimentation*" and "*trial and error*." Building knowledge was intimately tied to working with the conditions at hand.

The pleasures of handwork were often described in sensual and emotional terms: the "impressive" giant dahlias grown by Gerald; Ellie's "yummy" sock yarn; Korelle, who was

[2] This and all following names of individuals and locations are pseudonyms.

Fig 2. Knitting a washrag and baby sweater, two participants found difficult stitches require concentration.

"nuts for purple vegetables!" One gardener linked gardening to *feeling*, not thinking. She preferred not to plan her summer garden too far in advance of the growing season, explaining that gardening should be "*visceral, physical, intuitive*." For another knitter, the pursuit of sensorial novelty was almost acquisitive: "*You want to taste, try, touch the newest colors, mixes*." In this way, participants described their relationship to handwork in terms of "urges" or "hankerings" – bodily needs satisfied by physical action. Thus, as Karl, a longtime gardener, said, "*a virtual garden will do nothing for you.*"

Virtuous effort

In many cases, however, participants felt that the difficulty and the effort required to produce anything "by hand" demonstrated honesty and responsibility.

Maple (knitter): It is an honest way to live, it is tangible. You can't lie with yarn. And you can't shortcut.

For Maple, manual labor itself produced virtue. Maple's motto was: "*Honest effort in, honest sweater out*." The honesty of the maker, she felt, was proven by the imperfections (and beauties) of the sweater, which revealed that it was made without mechanical shortcuts.

Gardeners' constant need to weed, water, mitigate pests, and prune was similarly described in moral terms. Iris, a graduate student, felt "*very guilty*" when school kept her away from her plot, shares with a less active older couple: "*I feel it's a moral responsibility to tend your garden*." Mark, a garden coordinator, condemned neglectful garden members: "*There's a concept of a 'flako,' and to me that's the worst thing you can be. When you commit to something, you do it*." Mark and Iris, like others, treated community gardening as a voluntary commitment both to fellow gardeners and to the plants themselves.

Cleverness

Learning to produce something by hand can be seen as a type of "special" knowledge or talent—"*the 'wow, clever me' aspect of the crafting thing*" as one knitter described. "*I doubt I would feel as clever if it on[l]y took 10 minutes*," another knitter explained.

Janus: In some ways I feel knitting is almost a secret society in that it is often only knitters who understand the work that has gone into producing something.

For Janus, part of gaining cleverness was learning how to read expertise from completed objects. It may be impossible, as Maple said, to "lie with yarn," but learning to decode the language of stitches and needles also took work.

Community gardeners similarly admired – or criticized – style and skill. With gardens packed into small urban lots, they worked near each other. As Iris said:

There's this kind of approach to gardening as a like reflection of you, like a profile. […] Is it an artistic, creative endeavor? Is it a production line?

Longtime garden members like Iris could even deduce patterns of gifting or teaching between gardeners by observing the movements of a specific variety of flower, or a certain brand of plant trellis, from one plot to another.

Patience

At Hillside Garden, Mahon's chayote squash vine is flourishing in an explosion of leafy green. But Mahon is unhappy. It has produced no fruit for two years. He considers uprooting it, but decides to give the plant a "reprieve" for a year. As his fellow Hillside gardener Dana said, "Wasting one year on a tomato crop is not a bad thing."

Like Mahon and Dana, gardeners thought in terms of months and years. Korelle, for example, typically received seed catalogues in January, ordered by March, and planted in May. Knitting also demanded patience, but of a different sort: sustained dedication to a single task. Following a complicated shawl pattern demanded full attention. Unlike gardeners, knitters did not wait – they kept busy. As Rebecca said: "*It's not unusual for me to knit a whole sweater and take it apart, or to knit something really slowly*."

Handwork as resistance

Karl (gardener): There's not a lot of room for technology in the garden, and that's what makes it beautiful… It's like you just follow the simple laws of nature and let the insects do the work. It's like they're your employees, you know. I just think the garden should be a place where you can get away from technology.

Karl's comment illustrates a widespread, though not universal, framing of handwork in opposition to industrial technology. Knitters and gardeners often described their work as an act of resistance – to "speedy technology," "factory farms," or a "throw away culture." They often associated qualities they disliked, such as dependency, disconnection, and emotional emptiness, with IT.

Although they sought information online, participants actively discouraged the perception of "dependency" on digital information. "*It's not like […] I have to look at Ravelry or else I don't know how to do something*," said another knitter. "*It's just a helpful little thing.*"

Julia (knitter): I mean if the shit hit the fan—excuse my language—where would we be? If I didn't have an iPhone, could I make it around the city? Probably not... And it scares me sometimes. So things like gardening and knitting bring me a little bit back to earth, you know? Teaches you to appreciate how lazy we've become.

In contrast to the positive language of "effort" used to describe manual labor, Julia suggests that her phone makes her not just "lazy" but somehow adrift. She needs to be connected "back to earth." Notably, she introduces this complaint by imagining a world without her iPhone. The iPhone becomes a marker of dependence and vulnerability, something countered by growing food or making one's own clothes.

Similarly, Iris used images of disconnection in conjunction with an imagined introduction of digital technology. Standing amidst her bean plants, she rejected both the idea of installing automatic irrigation, and the speculative scenario of the "magic" gardening robot that could weed her plants for her. *"I don't want to be cut free,"* she said. *"I might want to be informed, but I want to have an engaged relationship."*

Common engineering heuristics recommend "designing out" dirty, difficult, or dangerous manual work [25]. But rather than happy liberation from dirty and boring labor, being "cut free" from watering and weeding implied to Iris an unwelcome separation from a desired relationship. To be "informed," however, might be acceptable. Iris' varying visions of being "informed," "engaged," and "cut free" suggests the complicated relationship between notions of disconnection, dependence, and human control implicated in deciding to automate versus searching online. To be "engaged" is to commit to the material details of making objects oneself – whether bean plants or alpaca yarn.

Some saw the importance in the knitting circle and the community garden in reinstating the "humanity" of face-to-face communication (as opposed to computer-mediated-communication). Yali, a knitter, described knitting circles as "real life," and online interactions as insufficient to let people "laugh out loud and be heard." Yali was not alone in feeling the importance of "being heard." Faced with the possibility of a "weeding robot" that could reduce the amount of time people spent in the garden, Gerald linked anxieties about computer-mediated communication to mechanical automation:

You don't have to have any emotion in an email, or in an Evite, or texting – they don't know if you're pissed off or whatever. When you actually speak to people, it's different. So one… I don't see how [robots] would work in this garden and two, I would vote against anything robotic here.

Earlier, Gerald had praised the garden's email list – which he said made the garden "work." Yet with the introduction of the magic garden robot scenario, the reliance on email begins to trouble him. These common scenarios of technology introduction or disappearance often spurred reconsideration of previously taken-for-granted digital technologies. Reconsidering accepted technologies often led participants to a discussion of loss: of Julia's navigational skill, or Gerald's feeling of emotional connection. These losses are rendered as a disconnection from the traditional social and material relationships produced in handwork. In turn, participation in knitting circles or community gardens becomes a way to reinstate lost skills and emotions.

Karl's metaphorical exile of "technology" to *outside* the garden, or Yali's placement of "real life" *within* the knitting circle suggests at the very least ambivalence about the compatibility of some familiar online activities within handwork activities. If designers of computational tools for handwork wish to honor the priorities of handworkers like Karl, Yali, Julia, and Gerald, the positioning of handwork as resistance to certain forms of "technology" seems to present a dilemma. Yet, as we will see in the next section, participants routinely interwove digital technologies (such as email lists and websites) into handwork projects.

INTEGRATING INFORMATION TECHNOLOGY

Discussions of activities that entwine both digital tools and human bodies often fall back on an understood shorthand terminology of "digital" or "virtual" versus "physical" or "in-person" actions. The handwork groups studied accomplished their activities both in-person and online, and through software and hand-tools. We have addressed the defining of handwork in opposition to varying types of "technology." Participants understood that distinction as meaningful while still relying on digital tools.

Working with materials

The integration of screen-based digital information into tasks requiring full attention and two hands was a prominent feature of handwork experience (see Fig 1). Participants usually engaged with certain websites or applications *purposefully*, often to accomplish bounded tasks and interventions with material.

Learning how

Iris (gardener): It is very precise. Information is very important in gardening. It's not hazy. I mean, you gotta know – you have to plant this week.

Iris and other gardeners wanted detailed knowledge of the local garden environment: weather patterns, soil conditions, even typical pest infestations. But few gardeners in this study regularly visited gardening websites. One garden kept a few faded, ragged paper print-outs of "how to" web pages in their greenhouse. Nor did we see any obvious computer equipment in gardens. Instead, specific projects – such as growing tobacco or okra – prompted initial online information searches. Later, gardeners might return to a website to cope with a specific problem, such as a failing rosebush. Some occasionally visited the blog of a local gardening journalist.

The problem was that instructions online might not match local soil and weather conditions. Instead, gardeners in the variable climates of the Bay Area (fog, sun, and mixture)

adapted instructions by closely observing plants and reasoning about what they saw. Most gardeners tried to solve their problems through observation, with only rare appeals to help from senior members of their garden.

Several knitters, on the other hand, performed online searches alongside handwork. Executing intricate patterns and unfamiliar stitches pulled them back multiple times an hour to a given online reference – occasionally staring at the screen in between concentrating on their hands. Expert knitters make hundreds of stitches per hour. Replicating knitting patterns can mean counting every single stitch. Depending on the pattern, a second's loss of attention could lead to a calculation mistake undermining days of work. These different temporal and spatial patterns of online instruction use occurred in the context of the material relationships participants had with the objects they made.

Documenting sensory interactions

For many, verbally describing color, pattern alterations, and garment fit was difficult. Knitters often resorted to associative metaphors such as "scrumptious" or "luscious" yarns. Gardeners might praise a flower as "intense," or criticize a tomato that "tastes like nothing." Photographs often served to document and convey these tangible attributes. Several knitters used annotated digital images to manage large collections of yarns, and information about unfinished work and pattern alterations. All the gardeners preserved seeds in bundles of paper seed packets, sometimes brought with them to their gardens to share. Illustrated with images of mature plants (often photographs) and pre-printed with cultivation instructions, the commercially produced paper packets performed much the same function as knitters' annotated digital images.

Working with people

As contemporary handworkers, knitters and gardeners used digital means to produce and maintain lasting relationships with other people (as suggested by previous studies, e.g. [13,23]). But the two groups had some differences.

Creating and crossing group boundaries

When Ellie "got a hankering" to knit, she recalls, she looked online for a "Chicks with Sticks" meeting. Without a specific desire for education or friendship, she just wanted to talk about knitting. Eventually, she got a part-time position at a knitting store. While working, she laughingly tells a patron whose daughter, a "fourth-generation knitter," was returning from college: "She's going to be putting in a couple hours here because she needs to get in touch with the yarn!"

"Getting in touch with the yarn" means more than doing some shopping. It also entails participating in a local group of knitters. In working at the shop, coordinating with groups on Ravelry.com, and continuing attendance at a knitting circle, Ellie developed object- and technique-focused relationships with an evolving group of knitters. Handwork was thus "object-oriented": conversation revolved around techniques and aesthetic choices, and participants described other people largely through reference to the type of objects they made and how they produced them. She did not treat this "community" as a tightly-knit, well-bounded entity. Rather, people moved in and out of Ellie's daily life, online and offline, as she and they pursued engaged relationships with the yarn.

For many gardeners, the sight of a tidy and well-tended garden was the "community" they desired:

Mark (garden coordinator): You don't ever have to see [other gardeners]. If gnomes or leprechauns are doing the work in the middle of the night, we don't care.

Mark sends gardeners with weedy, dried-out plots a warning email and a letter. If two weeks pass without visible improvements, Mark expels them from the community garden. This happens once or twice a year. Most participants felt they did not permanently "own" their plots; they described themselves as temporarily "renting."

So the word "community garden," as geographer and community garden coordinator Mary Beth Pudup writes [23], may be less accurate than "organized gardening projects." For many community gardeners, membership did not imply communal values. Many participants reported only rarely talking in-person to fellow garden members. Dana, for example, spends ten or more hours each week in the summertime at Hillside, but rarely speaks to fellow gardeners. Korelle, uncomfortable at quarrelsome in-person meetings, prefers email discussions for decision-making. Mary, during her interview, was still upset about a recent fight that had split the garden into two camps. And Iris knew the names of only three of the more than 30 other garden members.

However, unlike the knitting groups, the gardening groups also used digital tools to expand the sphere of their influence outside the boundaries of personal projects. For the coordinator of Corona Gardens, two small community spaces in a neighborhood notorious for violence and poverty, the purpose of the garden blog and email list is not just to communicate with garden members. They all live on the same block, and see each other in-person frequently. Another purpose is to share uplifting "good news" about the garden and the neighborhood with outsiders – to rally support for the garden and local civic activism outside of their small group of neighbor-gardeners. The blog thus serves not as a way to facilitate individual relationships to the garden but rather as collective action directed at political and economic change in the garden's vicinity.

Similarly, only half of the 108 messages to the park volunteer mailing list in 2009 concerned group activities. The rest almost exclusively asked for participation in neighborhood urban planning— from "town hall" meetings on the renovation of a local hospital to soliciting volunteers for a meeting with the mayor about urban green space concerns.

Knitting and gardening groups used similar tools to find and maintain membership in handwork groups. However, the groups generally used those tools to pursue different types of membership. Membership in knitting groups was

"object-oriented," with conversations revolving around personal techniques and aesthetics, as well as the organization of temporally coordinated individual activities. Membership in gardening groups was "place-oriented," revolving around enforcing plant upkeep responsibilities and inviting collective commitment to the surrounding neighborhoods.

Coordinating activities

For almost every community garden studied, as well as the park volunteers, garden upkeep was coordinated mainly through email. Like Mark, many gardeners cared more about managing chore schedules and shared garden supplies than teaching techniques or building friendships.

Gerald: Before email, how did this garden work? We didn't use to see each other, but now, with email, we talk to each other fairly regularly.

For Gerald, email "talk" easily replaced in-person conversation. What it often meant to have a garden "work" also seemed place-oriented: to have fertilizer purchased, common areas cleaned, and vandalism repaired. It was not friendship or even liking.

Email contact was important because many garden members had very different routines. Retirees and students came when they chose, often during weekdays; working people and families on weekends. Emails shared news, scheduled chores, reported task completion, or helped make urgent decisions. Gardeners feared – often from experience at other gardens – that without active recruitment to group "work days" their gardens would turn into weed-filled empty lots. For example, the park mailing list had a membership of 65 – but only about five people regularly showed up for the monthly park gardening days.

While knitters coordinate joint activities less frequently, several used online networking sites (Ravelry.com in particular) to arrange specific events. *Yarn Swaps* (yarn exchanges) and *Knit-Alongs* (in which a group of knitters follow the same pattern at the same time) were common prompts for online interaction. Knitters posted messages Ravelry.com forums to recruit other knitters to try out and evaluate new or altered patterns. Online groups organized participation in mass events ("Stitches West 2010") or themed projects ("10 Shawls in 2010"). Digital tools thus helped to initiate and coordinate communal activities at the same time, if not the same place.

Documenting and sharing work

Both knitters and gardeners used digital media to record their progress and distribute their artifacts to others. As we discussed earlier, for those who could interpret them, effortful artifacts such as textiles and plants acted as entry tickets to the "secret society" of expertise. For both knitters and gardeners, photography was one way to find more people to appreciate their skill.

For some knitters, sharing their work online seemed prompted by feelings of cleverness. Thus posting documentation took place at varying intervals of time —"*in fits and spurts*" based on events within the project:

Louise (knitter): I finish a project and I remember to take a picture and I remember to put it up.

Many, like Louise, valued their participation in websites such as Ravelry, but visited the sites only at critical moments during the project. Personal blogs and online forums provided knitters and gardeners with resources to "*showcase"* their ongoing handwork activities. Members of Ravelry.com used online means to echo traditional knitting circle interactions. They posted "*before and after*" photos of completed projects; asked and gave advice about choosing patterns, techniques, or yarns; and kept track of ongoing, finished or disregarded projects.

As such, digital photographs allowed knitters to "keep" sweaters they had already given as gifts, and gardeners to preserve ephemeral flowers. Those photographs then served as "calling cards" showcasing aesthetic taste and handwork skill — as with one gardener, whose first email to an author included multiple unasked-for plant photographs. Evocative images also cemented bonds with relatives and friends. Gerald emailed photographs of his prized dahlias "almost weekly" to family who lived far away. He had promised flowers to his niece for her wedding bouquet, and wanted her to see them grow. Visually rich digital imagery conveyed the multisensory pleasures of handwork (texture, pattern, color), while making unique, ephemeral, or bulky goods more portable and durable.

DESIGNING FOR HANDWORK TEXTURES

As discussed earlier in this paper, studies of handwork often conceptually and methodologically separate "digital" activities and groups from "physical" ones. While this scholarly separation does seem to echo participants' presentation of handwork as separate from "technology," it presents a dilemma for the design of new kinds of digital handwork tools. On the one hand, participants' stated beliefs suggest resistance to new digital or machine tools. On the other hand, we witnessed extensive integration of both hand-tools and software to establish and sustain a feeling of connection with other people and the material objects of their handwork practice. The integration of online and offline tools supports the physical, emotional and social relationships that make handwork meaningful. These relationships unfold through embodied commitments to handwork.

Given this integration, "digital" and "physical" may not be the most salient conceptual and methodological framework for studying handwork. Indeed, recent work by STS scholars such as Jean-François Blanchette [4] has problematized distinctions between the *material* and *immaterial*, arguing that *digital material*—from the application interface to the network stack—is structured by a host of functional constraints. Following this analytic perspective, we found that analyzing the "digital" in isolation from the "physical" does not adequately describe the significance people find in handwork, and thus can unnecessarily limit the scope of design explora-

tion. We propose *studying handwork activities as unified pursuits that exhibit textures of tool use*.

The concept of *texture* has recently been offered in multiple disciplines as a metaphor for the processes and products of design and creative practice. Media scholar Erica Robles and interaction designer Michael Wiberg [26] recently proposed the term *texture* as a way to describe the connection between traditional architectural materials and digital interfaces for interaction design, as well as surface and compositional form. They define texture as "the feel, appearance, or consistency of a surface"—that which allows us to experience an environment as a "meaningful whole." A texture, then, is the unified effect of combining different materials.

Anthropologist Tim Ingold describes the experienced world as an ever-changing texture [11]. Making, for Ingold, "is a practice of weaving." The notion of a finished object is much less important than the "textility" or "tactile and sensuous knowledge" with which artists and makers improvise reactions to the changing world. Ingold's emphasis on making as a process of embodied knowledge unfolding through improvisational actions resonates strongly with our observations of knitters and gardeners. We extend this design metaphor to describe handwork as a "meaningful whole" for participants. Its importance emerges from a series of interactions with different kinds of groups, spaces, materials, and tools.

Drawing on our fieldwork, we describe some characteristically patterned engagements with the materials of handwork that produce knitting and gardening as distinctively textured activities.

Extending

One of the most visible patterns of engagement is that of extension, in which direct, embodied handwork interactions occur as the handworkers attend to other stimuli, such as having a friend read a book aloud to a knitting circle or watching television while knitting. These *extensions* of knitting mediated knitters' everyday interactions with needles and yarn. By contrast, gardeners in this study did not tend to accompany planting, weeding, and watering with additional sensory interactions. Some gardeners listened to gardening advice radio shows in their homes, but none brought music players, televisions or reading material to the garden itself; few brought friends or cell phones. For many, even imagining installing a computer screen in the garden was unacceptable. The absence or presence of extending behaviors follows the differences we found between the rhythms of knitting and gardening activities: gardening required its own demarcated spaces and times, while knitting was more flexible.

Designing for extension

Controlling the extension of sensory activities was critical to our participants' sense of engagement. As such, it presents new opportunities for creative combinations – or isolation. Tools to engage these extensions might consider the role of ritual in handwork processes. Many gardeners, like Karl, insisted upon the garden as a space removed from mass media, whereas many knitters took pleasure in knitting during their favorite television shows. Extension also suggests possibilities for improvisational creativity. Accompanying media (like podcasts) suggest new projects and techniques at the moment in which handworkers are already engaged in creative labor. Experimental tools, such as Spyn [27], enable knitters to layer puzzles or stories onto handwork while knitting. The experience of gardeners suggests a challenge to designers: how might devices and services engage with handworkers according to their own rhythms? How might "just in time" creative prompts enable new meaningful ways of the hand?

Interjecting

Gerald gardens with his partner, Daniel. When Daniel sees the first spring bud, he immediately calls Gerald on his mobile phone. "It's a bud, it's a bud," exclaims Gerald, imitating Daniel's excited phone calls. "It's like a baby's coming."

Immediate needs for information or coordination prompt brief switches from one activity (such as watering plants) to another (such as talking to a friend on the phone). Carried in pockets or bags, digital phones and cameras were routinely taken to the garden. Used briefly, they were not rejected by gardeners as alien "technology." When Daniel called Gerald, or when Louise snapped a picture to document a knitting project, they *interjected* a tool into an activity – then withdrew it. *Interjection* involves the brief use of an external tool (sometimes a camera or mobile phone, other times a website, book, or magazine) during handwork activity. *Interjection* also takes place when an email message, tweet, or conversation briefly focuses attention on handwork; and then the handworker returns to non-handwork activities. Here it is the bounded, momentary character of the activity that matters. Unlike extension, interjection is experienced as a departure from one activity to focus on another.

Designing for interjection

New tools might enable a range of purposeful interjections into handwork activity**.** For example, how else might Gerald learn about the new buds in the garden besides getting a phone call from Daniel? Interjections could involve not only getting information but also fulfilling participants' desires to connect with a recipient or keep someone informed of their progress. The Botanicalls DIY soil moisture sensor[3] is a customizable kit that helps home gardeners remember to water their plants by sending Twitter messages when the soil is dry. Botanicalls digitally *interjects* brief plant reminders into non-gardening places and times. It does not automate watering; instead, it recalls potentially neglectful, inexpert gardeners back to their plants. New tools for beginners as well as experts might produce brief yet satisfying connections with people and material that help keep handworkers connected to the objects of their craft – even when the objects are far away.

[3] http://www.botanicalls.com/

Segmenting

Kyla had many worries. Among them was her alcohol consumption, for which she was getting weekly counseling. "It is a little war with myself about being perfect and not being good enough," she explained. "It's weird. I can kind of feel it physically in me. I can kind of feel it in this one [knitting] project. It's not going well. I don't know how to resolve that feeling." She decided to digitally document a sweater she had made and given to her son some time ago. Unlike her current knitting, this sweater was "perfect."

The metaphor of *segmenting* suggests that activities affecting the objects of handwork can take independent trajectories. Though Kyla's "perfect" sweater was long completed, she was able to repurpose digital documentation of its making to recapture a feeling of mastery – and then circulate it to her online audience. Documentation and production efforts, separated widely in space and time, created both handwork objects and human relationships. Recall Gerald's weekly email exchanges with his niece, as she plans her wedding and he sends her images of the flowers for her bouquet. Knitters often posted documentation of knitting projects to Ravelry.com long after they had been completed and given away as gifts. The notion of segmenting suggests that handwork activities need not be continuous – and that they take place within relationships of pride, love, and regret.

Designing for segmentation

We have discussed how the activities of documentation and knitting can *segment* time between different types of activities and materials. The LilyPad Arduino integrates computation into sewing projects [5] through a similar process of *segmentation*. Programming the LilyPad and hand attaching it to fabric *segment* time between laptop and textile. As with the gardeners who moved between group email lists and plant care, we can think of LilyPad users as dividing their time between different genres of activity: planning and writing code, designing textile patterns and stitching them, looking for instructions and documenting outcomes. Designing for segmentation can help object relationships develop in "fits and spurts" over space and time.

Handwork texturing as aesthetic experience

Extending, *interjecting*, and *segmenting* describe characteristic interwoven patterns of tool use that further develop Wright et al's [35] notion of aesthetic experience as "*an engagement of a concerned, feeling, self acting with and through materials and tools*." Within handwork, emotional and sensory engagements are critical to how people know, see, and act. The unfolding of handwork activity creates what McCarthy and Wright [19] might call the *tensions* and *cumulative patterns* of aesthetic experience. Textures are thus cumulative: they build up as handwork relationships temporally unfold. Textures can also be built upon *tension*, as we saw in Gerald's attachment to the email list that makes the garden efficiently "work," and his fear of losing the emotional connection of face-to-face contact. We can think of the texturing of handwork as the creation of aesthetic life experiences.

Treating handwork as a textured whole undermines the rationale for a methodological or conceptual binary opposition of digital and physical interactions within handwork. It can also prompt productive exploration of the possibilities for supporting the aesthetic experience of handworkers. Designers cannot assume constant use or consistent adoption of new technologies and tools. Handwork tool use, whether of software or hand tools, instead weaves into and between ongoing periods of non-use. How can we design tools that respond to the long cycles and rhythms of inactivity, contemplation, and anticipation? The interplay not just between different kinds of tool use, but also between modes of engagement and disengagement, and intensity and calm, become important resources for design.

CONCLUSION

As Malcolm McCullough has suggested,

We must look very closely at craft. As part of developing more engaging technology, as well as developing a more receptive attitude toward new opportunities raised by technology, we must understand what matters in traditional notions of practical, form-giving work" ([20]:19).

Participants described their handwork as part of an interpretive framework opposing manual aspects of handwork to technologies such as email and robotics. They valued the development of patience, cleverness, effort, and sensory sensitivity through sustained engagements with handmade objects, often in handwork groups. They frequently defined their values in contrast to negative characteristics associated with "technology" – in particular, notions of dependency, disconnection, and emotional absence.

Yet overall, knitting and gardening relied upon many different tools and interactions, digital tools among them. By tracing the relationships to IT and hand tools enacted during handwork, we witnessed the interweaving of digital technologies with traditional hand-manipulated tools to build and sustain these significant relationships. We propose three metaphors of *extension, interjecting,* and *segmenting* as part of a principled design agenda for handwork and other domestic leisure practices. Platforms such as the LilyPad Arduino exemplify how engagement with digital tools designed for handwork can change people's relationships to the materiality of the objects they make.

However, while handwork is an exciting area for design exploration and engagement, it presents some critical questions to designers. How might a professional gardener's pursuits differ from our subjects? What obstacles might a carpenter or car repair technician encounter while working with email? Engaging with additional types of handwork could suggest different textures of tool use that present new challenges. In following handwork from online to hands-on interactions with people and materials, we have tried to convey the importance of embodied practice to understanding what makes different types of handwork meaningful sites of group membership, affective attachment, and skill production.

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