Spyn: Augmenting the Creative and Communicative Potential of Craft

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ABSTRACT

We present data collected from a field study of 12 needle-crafters introduced to Spyn—mobile phone software that associates digital records (audio/visual media, text, and geographic data) with locations on fabric. We observed leisure needle-crafters use Spyn to create one or more handmade garments over two to four weeks and then give those garments to friends, partners, and family members. Using Spyn, creators left behind digital and physical traces that heightened recipients' appreciation for the gift and enabled a diverse set of meanings to emerge. Digital engagements with Spyn became a means for unraveling the value of the gift: recipients used digital information associated with the physical objects to interpret the story behind the objects and their creators. We discuss the nature of this relationship between digital and physical material and its implications for craft.

Author Keywords

Craft, process, gift exchange, material, creativity, design process, storytelling, tangibility, knitting, crochet

ACM Classification Keywords

H.5.2. [Information Interfaces]: User Interfaces—input devices and strategies; interaction styles; user-centered design.

General Terms

Design

INTRODUCTION

The production and exchange of handmade objects shapes, and sometimes even defines, our relationships with others. Handmade objects demonstrate personal skill, express appreciation, and become opportunities for reciprocation. While a diversity of scholars (e.g.,15,31]) have studied the activities and relationships that constitute everyday creative acts, the ways people incorporate physical creative work and digital information work is less understood. Apart from sharing craft knowledge (e.g.,[2,28]), the study of physical creative practice (e.g.,[15]) is often distinct from the study of digital information exchange around craft (e.g.,[14]).

Figure 1. The current Spyn system runs on Android 1.5 G1 phones; vision recognition correlates recorded media with locations on fabric. Image courtesy of James Jordan.

Here we turn our attention the ways people use digital tools to associate information with the creative process and products of physical handwork, specifically the popular handcrafts of knitting and crochet. We present findings from a study of people's engagements with Spyn—mobile phone software that associates digital records of the creative process (captured through audio/visual media, text, and geographic data) with physical locations on handmade fabric. We investigate how digital augmentation impacts the creation, transfer, interpretation, and continued use of everyday personal handcraft.

BACKGROUND

The process of creating a handmade object requires a human investment of time, physical effort, and care [9, 19]. Through traces of physical handwork, a handmade object reveals aspects of its creator's technical journey [1]. Through color, material, and form, a handmade object hints at the creator's expertise, knowledge, and taste [19]. Through its historicity, a handmade object connects with cultural tradition and learned technique [9].

Despite its seemingly non-technological orientation [1], handcraft often relies on tooling. A growing number of people extend the tools associated with craft by integrating skilled, creative handwork with new technology (e.g.,[12]). Ravelry.com, for instance, has emerged as an important social networking site for sharing and managing craft knowledge around needlecraft activity. "Ravelers" use the site to share tips, resources, inspirations, and arrange "yarn swaps" or "Knit Alongs" (events where several individuals follow the same pattern). Needle-crafters also create and

listen to craft podcasts, review and post to personal blogs, and connect with one another using social networking sites or email. While these activities support aspects of craft practice, they largely occur before or after handwork, not during the practice itself, remaining distinct from the physical activity of craft. In order to better understand the relationship between physical and digital creative practices, we introduced crafters to Spyn, a system that incorporates digital information with the craft process. By deploying Spyn, we explore the porous boundaries between digital and physical engagements around craft practice.

Gift-Giving

Handmade objects seem to have a special quality that prompts their role in gift exchange. Some scholars of handcraft practice have suggested gift giving is a core motivation [4,15]. Blood's [4] survey of leisure handcraft activity suggested that the idea of giving away craft products helped individuals maintain an interest in the activity and avert inactivity. When a person freely gives away a handmade object the person is not simply transferring utility. Rather, the person also gives his or her extended self [2].

Gift giving is a universal practice by which people constitute and maintain social relations. Taken broadly, a gift is a possession voluntarily transferred to someone or something. As an expression of affection, a gift can help create and maintain social ties [4]. As a marker of tradition, a gift can both create and fulfill a social obligation [18]. As a rhetorical device, a gift may obligate future exchange [2, 18]. Thus a gift is both a coercive and cohesive gesture that helps us frame our interactions with the social world.

Within HCI literatures, gift-giving rituals have been studied in the context of mediated interactions. Taylor and Harper's [27] study of teenagers' text-messaging behaviors suggested text messaging follows familiar patterns of gift exchange. Others argue that the transfer of digital files, as a form of online gift giving, is affected more by the difficulties and dangers of sharing than by its monetary cost [26]. According to [26], this research "is in its infancy." Even less is known about the integration of physical and digital forms of exchange.

In our work, we study the creation and exchange of handmade objects as a way to explore the communicative and creative interactions people have with digital and physical material. When a person gives a handmade object, the object may not simply be valued for its utility; it may also communicate affection and care, or demonstrate unique expertise. Thus, by studying the digital augmentation of handmade goods we can investigate the ways digital augmentation affects the recipient's relationships with the craft practitioner as well as with the process and products of creative work.

RELATED RESEARCH

Our work adds to a growing body of HCI research that considers the materials, activities and relationships around creative activity [3,14, 28].

Memory and Storytelling Technologies

Memory technologies have been designed to capture, store, and provide access to personal information. This work presents interesting albeit difficult challenges for the curation of vast amounts of data and the protection of privacy (see [30] for a helpful discussion). Our design of Spyn was inspired by ubiquitous computing technologies (e.g.,[16,32,34]) that combine paper transcripts with information technology. ButterflyNet [34] and Books with Voices [16] enable the collection, retrieval and exchange of task-specific information in order to support scientists and professionals in mobile settings, whereas MEMENTO [32] augments the creative activity of scrapbooking. We build on this work by designing mobile technology that allows for the collection and sharing of social activity around craft and gift exchange. Recent HCI research has explored the use [20] and creation [21] of memory objects and their implications for the design of life-logging technologies. This work has emphasized the potential of annotation technologies that augment meaningful physical objects and the contexts in which they are used. We directly extend this work to the domains of leisure crafts and gift exchange.

Storytelling technologies have focused the augmentation of creative play (e.g.,[24]) and the representation and exploration of personal histories (e.g.,[25]). The storytelling enabled by Spyn can be distinguished from other narrativized presentations of self in that it physically connects the narrator's story with the creative artifact.

Craftwork and HCI

A central theme in HCI research has been the study of people's social and informational uses of online resources. This work has recently expanded to include the study of online activity around creative handwork. Blogs [3], how-to resources [28], and diverse distribution channels [28] impact the ways creativity is conceived of and enacted by individuals and the communities they help sustain. Researchers have also designed tools for offline sites of craft activity that merge craft with electronics to promote educational engagement [7]. Others view HCI [33] and Interaction Design [17] as crafts—allowing us to suspend "the distinction between tools and materials" [33].

Much of e-textiles research (e.g.,[4,7]) involves building interactive fabrics and open-source, easy-to-program toolkits (e.g., LilyPad, Arduino) for the invention of new wearable computational garments. Using workshops and classroom activities, e-textiles researchers have employed interventionist strategies to study everyday design. Though this research shares an interest at the intersection of craft and computation, it has distinctly different goals than Spyn. First, it is often directed toward increasing engineering engagement rather than supporting the social activity surrounding creative handwork. Second, it rethinks the materials and practices of craft rather than digitally augmenting the craft process. Lastly, it explores new aesthetic interactions (e.g.,[4]) rather than studying the convergence of contemporary online and offline craft

practices. Our work contributes to e-textiles research by broadening the investigation of digital-material engagements involved in craft activity.

SPYN

Spyn is a design study that explores how technology can support the social relationships that people have around hand-crafted artifacts and with the people for whom they are made. Over the past two years, Spyn has developed from a design sketch, into a series of prototypes [22,23], and now a mobile phone application.
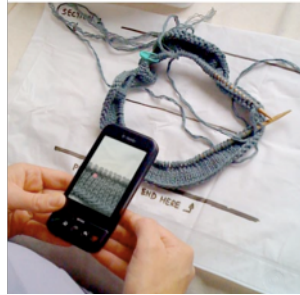

Figure 2. Gina using scanning guide to pin her knit.

Iterative Design Process

As detailed in our previous work [22], we began our design process by conducting fieldwork in four knitting circles in the Bay Area. Based on the data we collected, we distilled five design principles for Spyn. 1) *Portability*: knitters craft in diverse locations; technology should capture the places and times of craft activity. 2) *Process and Invested Time*: knitters enjoyed the process of handwork as much as its product; technology should keep track of progress and make the process visible. 3) *Occasions and Opportunities:* knitters were motivated by a variety of social and cultural phenomena; technology should celebrate those motivations by supporting digital media capture. 4) *Annotation*: knitters annotated their projects on note cards, notebooks and websites; technology should support note taking. 5) *Tactility*: knitters enjoyed the rhythm created by hands, needles and soft materials; technology should remain lightweight, and preserve the existing aesthetic of knitters' tools and materials.

The Spyn prototypes [22,23] were designed to capture contextual information around craftwork by enabling knitters to record digital information (geographic location, timestamp, yarn yardage, digital media) and associate it to locations on fabric. The connection between the fabric and digital records was achieved by correlating the position of the yarn (tracked by a rotary encoder) with locations on fabric (marked by patterns of infrared IR, invisible to the naked eye).

From our previous fieldwork, we learned several lessons that informed the current design. First, we established that knitters began their exploration of Spyn after using the system for several days. We therefore decided to extend the study period to allow knitters to begin multiple projects on their own. Second, we found that—despite its relatively compact size—the entire system (basket, cameras, rotary encoder and Ultra Mobile PC) was still too bulky for people to comfortably carry to different locations. In response, we redesigned the software for mobile phones. Third, we found that IR ink was impractical for long-term deployment; the ink solvent was non-permanent, and the preparation of ink posed significant demands on the

researcher's time. Thus, we replaced the IR ink with a vision technique for reading stitches on the garment. The row count produced by our vision algorithm (a more useful cue for knit work) also eliminated the use of the rotary encoder to track yardage.

Finally, we added new functionality to Spyn that allowed participants to 1) *delete and edit* each Spyn entry (called a *memory*), 2) *create and customize multiple projects* (by changing the title, background image, knit or crochet stitch), 3) *automatically associate row count* (along with the date and location) to each Spyn *memory* 4) *associate multiple media items* to each Spyn *memory* (short text, long text, photograph, video, and audio) (see Fig. 3c), 5) *distinguish between projects* (or project parts) using 1cm diameter buttons with unique barcodes, and 6) *easily switch between projects* (or project parts) by scanning the barcode buttons attached to fabric.

Current System

The current software has four main functions: *Pin*, *View*, *Find*, and *Map* (see Fig. 3a). *Pin* associates information with a location on the fabric. *View* displays pinned *memories* over an image of the garment; each pin links to the content associated with that *memory*. *Find* allows the user to switch projects (using the barcode buttons–see Fig. 5) and retrieve *memories* associated with that project. *Map* displays pinned *memories* on a map; each pin links to the content associated with that *memory*.

Pinning Memories

In order to "pin" a *memory* (Spyn entry) to fabric, a person captures or selects a photograph of the garment and then touches the screen at the location he or she would like to add the information (see Fig. 3b). This opens the "Create Memory" screen (see Fig. 3c) where the person creates a title (short text), description (long text) and/or media items (still image, video, audio). Once created, the *memory* is automatically associated with the location on fabric (knit or crochet row and x-location), geographic location (when available), and timestamp. The computer vision algorithm that automatically associates locations on fabric with digital information uses simple edge detection to count rows on the sockinette stitch (a basic knitting stitch). Each creator was instructed to capture images about six inches from the garment; they were also provided a "scanning guide" (see Fig. 2) for accurately gauging that distance. We adjusted the row count for other stitches and yarns. If the knit was too large to fit under the viewfinder at six inches from the garment, the user took multiple images of the fabric. Each image was analyzed separately and the combined in the viewfinder.

STUDY: RESEARCH METHOD & PARTICPANTS

We are interested in the ways people integrate Spyn with their existing practices of craftwork and gift exchange. The scale of the current work differs from our previous work [23] both in terms of the duration and the number of people involved in the craft process. While in prior work [23] we focused on creator's use of Spyn over short trial periods,

Figure 3. Screenshots of Kyla's Spyn project (left to right) (a) Spyn home screen, (b) pinning garment, (c) creating a new Spyn *memory*, and (d) viewing the Spyn *memory*.

our current study involves both the creator and recipient of a craft object, further investigating the creator-recipient relationship over two-to-four weeks. Specifically, we study the following questions:

- What types of information do people capture with Spyn when creating a gift for someone else?
- How does using Spyn affect the creator's craft activity? How does it impact the creator's thought process while making?
- How do recipients of the craft object respond to the digital information associated with the object? How does it affect the recipient's understanding of the craft process? How does it affect the recipient's relationship to the creator?

Participants

Twenty-four participants were recruited for the study: 12 creators and 12 recipients. Since one creator was unable to complete her project due to time constraints, we were only able to interview and observe 11 creator-recipient pairs. Creators were recruited from several sources, including community-based craft events, craft social networking websites and through referrals from local contacts. Recipients were recruited based on their availability and their relationship to the creator, rather than their familiarity with needlecraft. We made this decision based on lessons from our previous fieldwork [23] where accessing recipients proved difficult. Although this limited the creator's selection of a recipient, we were able to meet with each person who received a Spyn gift (N=11). Participants had no previous exposure to the Spyn system or affiliation with the researchers before beginning this work.

Creators were all female and active in the knitting or crochet crafts. They ranged in age (early 20s to late 50s), nationality (US, Argentina, and Russia), number of years knitting or crocheting (16 years on average), and comfort level with various technologies (see Fig. 4). Their occupations also exemplified this technical diversity: professions ranged from web-master ("I'm pretty tech savvy") to stay-at-home mother and nurse practitioner ("For a non-technical person, I did okay!"). Recipients were coworkers (N=3), friends (N=2), family members (N=2), and a romantic partner (N=1) of the creator. Seven recipients were female and four recipients were male.

Study Design

Our study was designed to intervene in the existing practices of needle-crafters (cf. [13]) in order to understand the role of annotation technology in the process of craftwork and gift exchange. Although we asked creators to complete one craft project, five participants chose to create two or more projects. This independent activity indicates a desire to use Spyn that was not directly prompted by our study protocol.

We tried to give our participants as much flexibility as possible to determine the creative and temporal constraints of the craft project. In order to compare aspects of the craft process across subjects, we asked creators to use Spyn for *at least* two weeks, and to log their activity in a journal every day (whether or not they used Spyn). Paper diaries [6] were used to gain more insight into the creators' experiences with Spyn when we were not present and provoke reflection on their use of Spyn. Questions included: "How comfortable were you using Spyn today?" and "How do you think the recipient of your craftwork will interpret these memories?" The diaries effectively provided us with data surrounding the two-to-four week creation process, such as how their understanding of the system changed over time. We conducted a *situational analysis* [8] of field notes, interview transcripts and diary entries. We then iteratively developed a set of (non-mutually exclusive) categories for the content of the Spyn *memories*.

Figure 4. Participants during the gift exchange in *Phase 4*.

The study was composed of five phases and took place over seven weeks.

***Phase 1**: Introduction to study.* We spoke with creators by email (N=4), phone (N=5) or face-to-face conversation (N=3), asking them to use Spyn for at least two weeks to make a gift for someone else—a recipient with whom we could also speak with in-person. Creators intending to use unusual stitches were instructed to bring us sample swatches or inform us of their pattern choice before *Phase 2* so that we could optimize the vision software.

***Phase 2**: Introduction to Spyn.* We met with each creator individually for 1-2 hour(s) in a quiet location of the creator's choosing: the creator's home (N=5), the researcher's home (N=3), the creator's workplace (N=2), or a nearby café (N=2). Creators were introduced to the Spyn functionality and received an Android G1 phone and a Spyn "kit" containing support materials (see Fig. 5). Introduction to the software involved asking creators to complete four "practice" tasks using two existing Spyn projects supplied by the researcher (a long scarf and a short scarf). The tasks included "pinning" the Spyn projects, and viewing and editing the Spyn entries. We also conducted semi-structured interviews during this initial phase in order to better understand how creators talked about their past experiences knitting for others and communicating with others about their knitting.

***Phase 3**: Creators use Spyn on their own (for two or more weeks).* We offered creators technical support by email, by phone, and in face-to-face meetings. Support ranged from replacing a lost battery charger to helping participants learn how to "tile" scans of their garment. During this period we also created and maintained an online how-to website which was kept up-to-date with answers to creators' questions.

***Phase 4**: Gift exchange.* Each meeting consisted of a 2–to-4 hour meeting with the creator and recipient in a quiet location of the their choosing: a café (N=5), the creator's home (N=4), the creator's workplace (N=2), or the recipient's home (N=1). We first conducted a semi-structured interview with the creator; we then observed the creator present the Spyn project to recipient. Next we gave participants pencil and paper survey questions, and interviewed both the creator and recipient based on the gift exchange and the survey answers. Survey questions included: "If you were going to create another project with Spyn, what would you create?" and "Do you think that the Spyn project changed how you feel about this craft? Please explain." Sessions were videotaped and later transcribed.

***Phase 5**: Final survey.* In order to further investigate the recipients' reflection on the gift, we sent them a final survey by email 3-to-7 days after the *Phase 4* meeting.

FINDINGS

On average, creators used Spyn for 3 weeks; one person (Fay) used Spyn for 14 days and one person (Carrie) used Spyn for 28 days. All participants took the Spyn projects quite seriously—creators spent significant time creating

Figure 5. The Spyn "Kit". The kit contained support materials for the Spyn software and a journal for documenting daily activity with Spyn. Support materials included barcode "buttons" (for switching projects), a scanning guide (for gauging the viewfinder's distance from the garment), and instructions for using Spyn.

and managing their Spyn entries, and recipients were appreciative of the creators' efforts. Two participants continued to email the researchers (un-prompted) about their craft experiences after the end of the study. For some, the act of making and receiving their Spyn projects was highly emotional, as evidenced by the two creators and two recipients who shed tears just before or during the gift exchange sessions. For others, the projects became a way for recipients to learn about the lives of some they love.

During the course of the three-week study, participants dealt with professional deadlines, moving homes, romantic stresses, and childcare. Despite pressing life events, all but one participant finished at least one Spyn project. In total, 11 creators completed one project, five of whom started one or more additional project(s).

In the following sections we first discuss the content and form of the Spyn *memories*. We then describe the ways that creators and recipients attributed meaning to the *process* of craft, the *creator-recipient relationship* and the craft *product* while using Spyn.
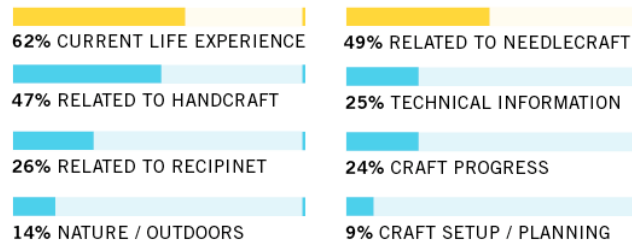
What types of Spyn *memories* did creators make?

Overall, Spyn *memories* varied considerably in sentiment and style (see Table 1). Creators recorded and saved a total of 161 individual Spyn *memories* (15 *memories* per creator on average), the majority of which (62%) described the creators' subjective experiences at the time of capture or earlier that day. For example, in a *memory* for her friend, Qwara, Erin described her surroundings while knitting in her garden:

> [Spyn video] *I'm enjoying the weather, and enjoying the blue of my princess tree. And I'm thinking, gosh, it's a good time to be alive. [...] And I'm thinking, gosh, I bet this is what <Qwara> feels when she's in Mariposa.*

Erin's video excerpt gave her recipient access to what her life was like while knitting. Unlike an instant message or a status update, the communication was asynchronous and the content was intended to last. It was also typical of 14% of Spyn *memories* that discussed the outdoors or pleasures of nature, and 26% of Spyn *memories* that detailed events or situations related to the recipient.

Table 1: Content of Spyn *Memories*

62% CURRENT LIFE EXPERIENCE	49% RELATED TO NEEDLECRAFT
47% RELATED TO HANDCRAFT	25% TECHNICAL INFORMATION
26% RELATED TO RECIPINET	24% CRAFT PROGRESS
14% NATURE / OUTDOORS	9% CRAFT SETUP / PLANNING

A variety of phenomena prompted creators' thoughts of the recipient, including everyday objects (lottery tickets "*made me think of [Ursula]*"), a lunch conversation with a friend (the Spyn scarf "*sparked my conversation*" about the recipient), and even a bad day: "*[I'm] having a crappy monday but i know as soon as i see you, all that crappiness will disappear*," Irene wrote in a *memory* pinned to her boyfriend's scarf.

Before using Spyn, all creators discussed thinking of a recipient before ("*usually right at the beginning and that's it*") or after their craftwork. But while using Spyn, creators communicated directly to the recipient, even in the recipient's absence, as evidenced by the third (34%) of *memories* that addressed recipients directly. Gina (creator) shyly summarized this sense in a final interview: "*I felt like I was talking to <my recipient>. Is that weird?*" Three participants frequently used the term *"talking"* to refer to their interactions with Spyn: "*What was fun was definitely **talking** to the person while making the project for them [...] Why you made the project, and what made you think of that person while you were doing it.*"

In addition to "talking" to their recipients with Spyn, creators recorded needlecraft-related subject matter in roughly half of all *memories* (49%): 24% attempted to keep track of craft progress ("*I'm a little over halfway done.*"), 11% related to yarn color or choices ("*these are the fibers and colors I'm using*"), and 9% concerned craft setup or planning (" *[...] different designs of hats. Making my lists and perhaps I'll show you them tomorrow.*"). Two creators described having "*trouble having the emotive journey*" while crafting with Spyn. Carrie and Laura both used Spyn to keep track of her progress by creating a Spyn entry each time they finished a section of they garments. Carrie described being most "*excited*" by Spyn's automatic row count—"*because sometimes counting rows can be a pain in the ass. Like when you're creating a scarf and you're on row 500, counting is like—[crinkled face].*" Her recipient, Owen, noted accordingly, "*yours is the quest, it's not the journey.*" Carrie was interested in documenting her progress, but not in recording the social context surrounding her craft.

Creators' affinities for certain audio/visual media formats also differed. Among all *memories*, 98% contained text, 60% contained still images, 20% contained audio clips, 20% contained no audio/visual media (only text), and 17% contained video clips. Two creators, Gina and Irene, discussed feeling uncomfortable recording audio messages

("*I don't like the sound of my voice so I deleted it*") but comfortable recording text and images, whereas Laura, a novelist, was surprised to find she recorded mostly audio. Creators discussed using the video to capture multiple images in a scene ("*to just kind of scan a whole area*" of a garden) or to show more than they could or should express in words ("*you don't want to type out too much on the keyboard*"). While three creators reported favoring video ("*I felt like the video was [...] killing two birds with one stone*"), two creators felt their video was "too shaky" or unpolished, and multiple images would suffice.

Spyn and the Craft Process

As we have seen, individual Spyn *memories* revealed a variety of personal moments while crafting. Yet, taken together and "pinned" to a single garment, the *memories* composed narratives of the creator's activity. This content ranged from technical accounts of craft progress to poignant illustrations of the creator's social context.

Frogging as Storytelling

Tearing out stitches—often referred to as "frogging"—became a form of storytelling for participants. While using Spyn, five creators captured their experiences running out of yarn and making mistakes, and two creators ripped out all or half their projects, subsequently documenting their efforts with Spyn.

> Hannah [Spyn audio]: *Today [...] you picked up the shirt with those crazy neon colors. And I decided that the hat that I made for you was not bright enough. So I came home and I ripped it half apart and I added this crazy strip of yellow.*

Hannah recorded this story after shopping for clothing with her recipient, Tara. Based on Tara's newfound interest in yellow, Hannah undid half of her Spyn hat and incorporated yellow stripes—integrating Tara's tastes as well as saving herself from running out of hot-pink yarn. Tara responded with tears of joy: "*The fact that she undid half of it based on a shirt we saw that I liked made me appreciate the work even more.*" For Tara, the effortful labors of handwork were enhanced by the stories Hannah captured and "pinned" to the fabric with Spyn.

Revealing Process

While using Spyn, aspects of the craft process were revealed for both creators and recipients. By collecting tidbits of her craft activity, Erin explained, "*I actually appreciate the [craft] process more.*" Four recipients spoke of Spyn exposing them to the creator's thoughts throughout the craft process ("*It's like getting a peek into [Deborah's] crafting world*"). Jane composed a "little story" of the one-shouldered-vest she was making for her recipient, Victor:

> It was like the "making of," you know? Like when I watch a DVD, I always want to know how they made the sets and costume... I don't know why I like that. Just that it's more-it makes it more meaningful and maybe people will understand me better.

Jane seemed to use Spyn to allow Victor to understand her better, in addition to her creative process. And Victor did: *"[I] honestly think that I feel more connected with Jane because of the way that she personalized the messages she left me on the Spyn,"* he reported after receiving the gift.

Spyn and the Creator-Recipient Relationship
While using Spyn, both creators and recipients discussed enhanced feelings of closeness. This intimacy seemed to be the result of the personal content recorded with Spyn and participants' shared involvement in the creative process.

> Erin [Spyn video]: *And so I'm sitting here [...] thinking about you and how much you've meant to me in my life. You've been such a guiding force, such a balance, you've fought for me, and I've been able to talk to you about so many things. So I wanted this to be special.*

In this except from a Spyn video, Erin contemplates the positive affects her friend Qwara (recipient) had on her life. Once Erin completed the turban, she reflected on her craft process: *"it felt like I was giving her part of me."* Qwara mirrored this sentiment when she received the finished turban: *"I know my friend's heart,"* and later, *"My spirit was part of the project."* Other participants similarly discussed playing increased roles in the craft process—as one creator noted: *"I think he'll feel like it's part of my personality attached to his scarf."* Spyn seemed to enable not only the recipient's understanding of the creator, but also both people's sense of being part of the object's making.

Signifying Intimacy
As creators "attached" small pieces of themselves to their recipients' garments, they used the Spyn fabric to express feelings of intimacy—reinforcing aspects of the creator-recipient relationship.

> Tara (recipient): *It made me realize how much [Hannah] cares about me. It's not that I didn't know she liked me, but I didn't know her connection to me was as deep as what I feel for her.*

For creators and recipients who knew one another well before crafting, the experience of intimacy was more nuanced.

> Amy (creator)*: Using Spyn definitely adds a different character to the process. The actual physical act of knitting is the same, but the thought process is quite different.*

Amy's "thought process" involved ruminating about her relationship with Mark (recipient), her partner of 10 years. During the time Amy used Spyn, Mark was living in another city and communicated with her remotely by email, by phone, and by sending her flowers at work.

> Mark (recipient)*: Taking a set of memories that I wasn't present for and tying them to a physical object — that's something that's novel. Because I get lots of electronic memories, all the time, and I get physical objects, but the physical objects I get, generally, they don't have memories connected to them that I'm not present for.*

Looking at Amy's handmade scarf through Spyn, Mark seemed to gain a new perspective on Amy's experiences while crafting his scarf. The intimacy enabled by these connected memories was echoed in final surveys wherein creators explained that the next project they would create would be for someone they were emotionally close to (N=4) or physically far from (N=2)—so that they could share the project with someone they did not see everyday *"but would like to."* For Mark, his Spyn scarf was laden with important fragments of Amy's everyday life in San Francisco, a few hundred miles away.

Spyn and the Craft Product
Spyn's digital augmentation had visible effects on participants' relationships to their craft objects.

> Erin: *[Spyn is] sort of like taking baby pictures of your baby [...] it's like your baby you're working on.*

Erin found parallels between photographing her Spyn knit and photographing her daughter as a child. Her close and constant connection to the knit was heightened by her diligent documentation of project, often planning *memories* beforehand and chronicling the growth of the garment.

By contrast, Jane's project was mostly improvised each night when she sat down to crochet. She used still photos to integrate a "subliminal message" into her crochet project.

> Jane (creator) [Spyn text]*: i am going to create a message for you word by word using the photos i attach.*

In the above excerpt, Jane chronicled her first "secret message"—a single photo depicting the word "WHERE'S" above a hand (see Fig. 6). On its own, the photo appears arbitrary and strange. Yet in the context of the description, it becomes a clue to a puzzle dispersed throughout the vest. Upon receiving the vest, Victor (recipient) unraveled the "secret message" by attending to each clue in turn. In doing so, he discovered three layers of Jane's craft project. First, he found the media items that depicted Jane sailing and lying on the beach—material that described her leisurely social setting while making the vest. Next, he stumbled on the puzzle of connected memories—a device that conveyed her creativity and inventive skill. Lastly, he encountered the garment's form—a physical structure that revealed Jane's investments of time and energy while crafting (especially legible to Victor, an avid needle-crafter himself). After some deliberation, Victor characterized this particular quality of Spyn:

> *It's almost another tool to kind of like enhance the creativity of it. It kind of almost turns it into **a 4D project** instead of, like, instead of just having an object, you have a timeline to go with it.*

Penney (recipient), had a similar reaction:

> *Penny (recipient): Rather than viewing the gift as a single object, I felt as if I was given **the present of captured time.***

Figure 6. Jane's "secret message"

Through Spyn, the craft product was not seen as a static record but as an account of time passing from which new stories, games, and meaning could emerge.

Captured Memories as Reflections of Self

Echoing the words of a participant in a previous study, the craft object "*felt more like **a time capsule***" to Kyla (creator). Kyla focused on sharing positive memories, and described her self-editing as "*not honest.*"

> Kyla (interview)*: I supposed I could be more honest with my sister about what's going on in my life...I guess I just wanted to look back at this scarf and look at the positives of this time.*

The information recorded with Spyn was not an automatically generated record of a life event; rather it was the creator's conscious construction of self-image. Channeling Goffman [11], Kyla' concern revealed an awareness of "self-presentation." Like Kyla, Hannah and Deborah discussed imagining how the recipient would perceive of them once receiving the Spyn gift; they therefore tried to carefully control the expressions *given* (intentionally) and *given off* (unintentionally) by Spyn.

The (un)discarded project

Irene created two projects: a scarf for her good friend Ursula and a scarf for Uri, her boyfriend of two months. When Irene and Uri broke up mid-way through the study, Irene understandably put down Uri's scarf—"*after a while I just stopped pinning to his.*" Not wanting to throw away her handwork, she quickly posted a message on Facebook in order give it to another friend. The Spyn project was no longer a part of that gift. Or was it? In a last interview, Irene described:

> So I go through all these memories and they're all sweet, like I'm cooking at his house, and I, you know, pinned one [memory] there, and I had lunch with Rebecca and she said she loved him – he's a keeper– and, you know, all these sweet memories, and then— bam! I'm stuck. I'm totally stuck.

While "sneak knitting" the scarf under her desk at work, Irene left a final Spyn message: "*can't seem to figure out what to do...*" For Irene this message had great symbolic weight, pointing at what was to come. In the end, she was still ambivalent as to what to do with the object: "*It'd probably be better if I gave it to someone I didn't know.*"

Whether capturing love, triumph, or despair, Spyn gave recipients glimpses at the social and psychological worlds surrounding the creator's craftwork. Using Spyn, creators "*attached*" themselves to garments, captured a recipient's "*spirit,*" and gave the "*present of captured time.*" Just as the craft process took place in different locations, on different days, and in different situations, Spyn enabled the craft object to retell the story of its making.

COMPARING SPYN WITH OTHER DITIGAL TOOLS

All creators already used at least some online resources to support social engagement around needlecraft activities. Personal blogs, Ravelry.com, and Etsy.com were mentioned

most often. During final interviews, participants were asked to compare the Spyn project with other forms of digital communication. For all creators Spyn was more "*about middle stages,*" whereas blog posts and Raverly.com were about "*the beginning and end.*" Kyla demonstrated this relationship by creating a post about her Spyn scarf on her knitting blog after giving the scarf to her sister. Carrie blurred the boundary between the "middle" and "end" stages of her project by using Spyn to document a Ravelry post that she created for her completed Spyn baby bib (Fig. 3d). The emergent integration of Revelry, blogging and Spyn materials suggests that each electronic medium was not mutually exclusive, but could be used in combination with others.

When asked to reflect on their use of Spyn, participants found email, blogging, and Twitter important points of comparison. Three creators contrasted Spyn to Twitter due to Spyn's mobility, its small text format, and its limitations on captured media (only one of each media item could be recorded per Spyn entry). For instance, Laura, an avid Twitter user and blogger, thought Spyn "*was more like Twitter for me than it was like blogging,*" yet noted some differences in our interview:

> That felt more intimate than Twitter does—Twitter feels more like what you would scream to your friends across the gym. While Spyn felt like what you would write if you still wrote letters to each other—like real letters not emails. Like when you write a card to someone when you're on vacation. You know, the old-fashioned 19th century letter.

Laura's remark suggests that creating Spyn content was more personal for her than writing twitter messages. Spyn *memories* were meant for a particular recipient rather than a broad audience. They were communicated calmly over prolonged periods of time rather than in short bursts. They were intended to endure rather than disappear over time. Using Spyn resembled writing an "old fashioned" letter—a private correspondence that gave the recipient access to the creator's experience while crafting.

Although all participants used information technology in their everyday lives, three creators discussed wanting to have little to do with mobile technologies. They enjoyed checking craft blogs and other online resources, but they saw little advantage to going mobile: "*I'd rather sit on the bus and craft than sit on the bus and look at Ravelry.*" Despite their stated disdain for the mobile phone, they saw advantages to using Spyn—"*I do think of Spyn as something different,*" Hannah noted. Hannah reflected this contrast in her first and last interviews: Ravelry "*forces me to **explain** what I'm doing*" and later, Spyn "*forced me to **think about** the person I was making it for.*" Blogs and online resources provided some scaffolding for Hannah to track her craft process, yet these digital resources were often separate from the recipient of the craft product.

Notions of immediacy, moving easily and seamlessly between physical and digital activities, also became

important when comparing posts on Ravelry or blogs with entries created in Spyn ("*it's much quicker with Spyn because I would [normally] have to upload it to Flickr.*")

> Laura (creator)*: It's really different if you're blogging or if you're on Ravelry and you finished the project and you're taking notes, because it's a conscious act that's separate from process. It's reflection. And reflection and process to me are two very different things.*

In this excerpt from an interview, Laura (creator) describes how her craft "process" and her "reflection" on that craft process were distinct activities that required different forms of digital engagement. While knitting with Spyn, she found that she was more interested in documenting her planning activities than her reflections, so much so that she only began knitting in *memory* 13 of 28. In these initial *memories,* Laura used Spyn to (unsuccessfully) "pin" her knitting needles and yarn. Her behavior suggests that future work should explore the integration of Spyn with existing tools for craft setup and planning (e.g., Ravelry).

Limitations

As craftwork is a highly varied activity, we were unable to support the range of media and content one could imagine associating to products of craft. Largely female and middle class, our small sample of needle-crafters allowed us to explore the affects of augmentation on a particular subset of leisure handwork practitioners. Further work in different cultural contexts, creative leisure activities, and creator-recipient relationships would greatly add to this work.

In practice, features of the software also limited creators. Three creators wanted to capture more information in each entry ("*when I was in my friend's garden – one photo wouldn't tell the story*") or create entries on the fly ("*have a memory and then stick it somewhere later*"). Fay and Laura mentioned wanting to capture "*planning notes, not attached to knitting, yet,*" as well as ways to more integrate and "*remix*" video and audio material. We plan to support more flexibility by developing mechanisms for collecting digital material—similar to a knitter's "stash" of yarn.

All participants reported some troubles recording location automatically (when GPS was unavailable), and recording the row count accurately. When problems arose creators either contacted the researcher or recorded the information manually. Independent solutions appeared prompted by a sense that participants should be able to figure it out for themselves ("*I'm a quick learner*") or the device should be able to figure it out ("*I want the machine to read my mind!*") Fay summed up these irritations succinctly: "*I got frustrated because I wanted it to be perfect.*" We are addressing these issues by continuing to improve robustness and usability.

DISCUSSION

As we have described, individual Spyn *memories* revealed a variety of personal moments while crafting. Yet, associated with a physical garment, these *memories* became more than discrete reminders of past experiences; they connected accounts of the crafter's subjective experiences at the time of

production with the products of craftwork. While our previous work [23] was primarily concerned with the creator's experience, our current study allowed us to study the process of gift exchange. We found that digital records associated with tangible materials enhanced even recipients' appreciation of the process and products of craftwork.

Anthropologist Alfred Gell [10] has described a theory of art in which art objects are indices into their creator's personhood (or internal mind). For example, the signature on a painting or the thumbprint on a ceramic bowl reveals the presence or intention of the creator, a quality that is preserved long after the creator's death. In this case, an index is that which allows someone to impute agency to other people and things.

Knitting too has a natural indexical property. Each stitch produced while creating a garment is sequentially recorded by the garment's structure, enabling facets of the creative process to be read from its final form. Bauhaus instructor Lazslo Moholy-Nagy has referred to this quality as *fracture*—a form's ability to show how it was produced [1]. Using Spyn, creators augmented the inherent *fracture* of a standard knit product—extending its indexical form.

The key feature that distinguishes Spyn from other physical or digital tools for craft is the hierarchical nature of the indices it produces. Through Spyn, creators introduce layers of meaning into the creative process. The first layer is the physical fracture, which reveals the technical craft. The second layer is the digital *memories* the fracture anchors, which reveal stories of the creative process. The third layer is the digital information (media items, text, row count, timestamp, and GPS location) the *memories* contain, which reveal the creator's life experiences, craft progress, reflections, and so on. Taken together, these indices not only communicate the technical skills of the creator, but also imbue the creative process with new meaning.

Based on our fieldwork, we suggest that the hierarchy of indices introduced by Spyn has the potential to reshape the creative process. Like Jane's "secret message" or Kyla's "time capsule," creators' projects extended communication around craft as well as augmented the physical handwork. The creative process was not just the tangible construction of form; it was also itself a form to be reinvented and shared. Spyn provided mechanisms for augmenting creative products with a hierarchy of indices—traces left by creators during the craft process that enabled a diverse set of meanings to emerge and to be shared with others.

CONCLUSION

By studying people's engagements with Spyn we investigated two important activities for HCI research: the act of *making*—involving creative play and significant investments of time and effort, and the act of *giving*—involving communication between the giver and recipient. Although the recipients in our study were not present while their gifts were being created, by enabling access to aspects of this creation process, Spyn prompted greater appreciation for both the creator's efforts and the craft process, more

generally. While using Spyn, participants viewed augmentation as a transformative process. They added new creative dimensions to handwork and visibility to aspects of the production process that were previously invisible.

Our findings suggest that technology should support not only the *creative* and *communicative* potential of the craft process but also the intimate nature of craft activity. We found that Spyn facilitated a prolonged, private correspondence between the creator and recipient, giving the recipient access to the creator's subjective experience while crafting. Like the transfer of physical objects, digital tools engender emotion, intimacy, and care. As digital technical practices merge with traditional physical handwork, designers have the opportunity to enrich the social cues related to processes of craft and creative redesign.

ACKNOWLEDGMENTS

REFERENCES

1. Adamson, G. *Thinking Through Craft.* Berg, Oxford and New York. (2008)
2. Belk, R. Possessions and the Extended Self. In *The Journal of Consumer Research* 15, 2, 139-168. (1988)
3. Bean, J., Rosner, D. Learning from IKEA Hacking: "I'm Not One to Decoupage a Tabletop and Call It a Day". In *Proc. CHI 2009*, 419-422. (2009)
4. Berzowska, J. Electronic textiles: Wearable computers, reactive fashion, and soft computation. *Textile*, 3, 1 (2005), 2–19.
5. Blood, A. Non-Industrial Textile Production as Optimal Experience: Applicability of the Flow Theory to Clothing and Textiles Subject Matter. *Dissertation*. (2006)
6. Bolger, N., Davis, A., and Rafaeli, E. Diary methods: Capturing life as it is lived. *Annual Review of Psychology* 54, 579–616. (2003)
7. Buechley, L., Elumeze, N., and Eisenberg, M. Electronic/computational textiles and children's crafts. In Proceedings of *IDC '06*, 49-56. (2006)
8. Clarke, A. E. *Situational analysis: Grounded theory after the postmodern turn.* Sage, Thousand Oaks, CA, (2005)
9. Dormer, P. The language and practical philosophy of craft. In *The Culture of Craft*, P. Dormer (ed.). Manchester University Press, Manchester. (1997)
10. Gell, A. *Art and Agency.* Clarendon Press, Oxford (1998)
11. Goffman, E. *The Presentation of Self in Everyday Life.* Anchor, New York. (1959)
12. Green, P. *Home Crafts Get Wired*, New York Times, Sept. 10, (2009)
13. Hutchinson, H., Mackay, W., *et al.* Technology Probes: Inspiring Design for and with Families. In *Proc. of CHI 2003,* ACM Press, 17-24. (2003)
14. Johnson, J. S., Hawley, J. Technology's impact on creative traditions: Pieceful co-existence in quilting. *Clothing and Textiles Research Journal* 22, 1/2, 69-78. (2004)
15. Johnson, J. S. and Wilson, L. E. "'It Says You Really Care': Motivational Factors of Contemporary Female Handcrafters." *Clothing and Textiles Research Journal* 23, 2, 115-30. (2005)
16. Klemmer, S. R., *et al.* Books with voices: paper transcripts as a physical interface to oral histories. In Proceedings of CHI '03. ACM, New York, NY, 89-96. (2003)
17. Löwgren, J. Interaction Design Considered as Craft. In Eds. T. Erickson and D.W. McDonald, HCI Remixed. MIT Press, Cambridge, MA, 199-203. (2008)
18. Mauss, M. The Gift: The Form and Reason for Exchange in Archaic Societies. Routledge, London. (1997)
19. McCullough, M. *Abstracting Craft: The Practiced Digital Hand.* MIT Press, Boston, MA (1998)
20. Petrelli, D., Whittaker, S., and Brockmeier, J. AutoTopography: what can physical mementos tell us about digital memories? In Proc. of CHI '08. ACM Press, 53-62. (2008)
21. Petrelli, D., van den Hoven, E. Whittaker, S., & Brockmeier, J. (2009). Making history: intentional capture of future memories. In *Proc. of CHI '09*. ACM Press, New York, NY. (2009)
22. Rosner, D.K., Ryokai, K. Spyn: Augmenting Knitting to Support Storytelling and Reflection. In *Proc.* of *Ubicomp 200*8. 340-349. (2008)
23. Rosner, D.K., Ryokai, K. Reflections on Craft: Probing the Creative Process of Everyday Knitters. In *Proc. of Creativity & Cognition 2009*. 195-204. (2009)
24. Ryokai, K. and Cassell, J., Computer Support for Children's Collaborative Fantasy Play and Storytelling. In *Proceedings of CSCL 1999*. 510-517 (1999)
25. Shen, C., Lesh, N., and Vernier, F. Personal Digital Historian: Story Sharing Around the Table. ACM *Interactions*, 10, 2, 15–22.. (2003)
26. Skågeby,J. Analytical dimensions for online gift giving: 'other-oriented' contributions in virtual communities, International Journal of Web Based Communities, 3,1, 55-68. (2007)
27. Taylor, A. and Harper, R. "The Gift of the Gab: A Design Oriented Sociology of Young People's Use of Mobiles," J. Computer Supported Cooperative Work, 12, 3, 267–296. (2003)
28. Torrey, C., Churchill, E., and McDonald, D. Learning How: The Search for Craft Knowledge on the Internet. *Proc. CHI'09*, ACM Press. 1371-1381. (2009)
29. Turner-Rahman, G. 2008. Parallel Practices and the Dialectics of Open Creative Production. *Journal of Design History* 22, 4 371-386. (2008)
30. Van House, N & Churchill, E (2008) Technologies of memory: Key issues and critical perspectives, *Memory Studies*, 1, 3 295-310. (2008)
31. Wakkary, R., and Maestri, L. The resourcefulness of everyday design. In *Proceedings of ACM Creativity and Cognition*, ACM Press, 163–172. (2007)
32. West, D., Quigley, A., and Kay, J. MEMENTO: a digital-physical scrapbook for memory sharing. *Personal and Ubiquitous Computing*, 11, 4, 313-328. (2007)
33. Wroblewski, D. "The construction of human-computer interfaces considered as a craft." In John Karat (Ed.), Taking Software Design Seriously. Boston, Academic Press, 1-19. (1991)
34. Yeh, R. B., C. Liao, et al. ButterflyNet: A Mobile Capture and Access System for Field Biology Research. In *Proc. of CHI 2006*, ACM Press, 571–580. (2006)