The boundaries between 'the digital' and our everyday physical world are dissolving as we develop more physical ways of interacting with computing. This forum presents some of the topics discussed in the colorful multidisciplinary field of tangible and embodied interaction.

Eva Hornecker, Editor

Habituated Objects

Everyday Tangibles That Foster the Independent Living of an Elderly Woman

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I recently visited an 82-year-old woman, Maria, the mother of a good friend whom I have known over the years. This visit got me thinking about tangible and embodied interaction in a different way: from the perspective of the everyday objects that inhabit and augment our lives and how they support independence and agency as we age. Maria is partially sighted and still getting used to living with an artificial hip she had implanted about a year ago. Still, she seems to navigate her fairly cluttered home with remarkable ease. And, like many of us, she wants to maintain her independence and control her own destiny for as long as she can. Many discussions about supporting independent living for the elderly begin with monitoring, and yet the concepts of monitoring and independence are rather uneasy bedfellows. I began to contemplate just how she lives with and fosters her own independence through all of her things and what we might learn from that for designing for the emerging Internet of Things.

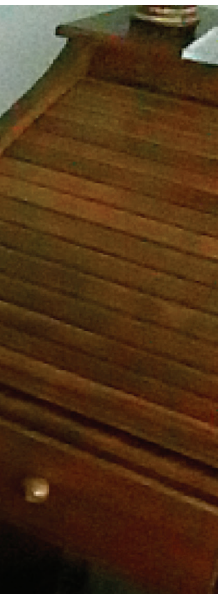
Maria has many objects, devices, and technologies she has adopted and adapted to support her living, and these in turn shape how she lives. I call these things *habituated objects* because she has incorporated them into her routines and her home, and they have in turn played a role in shaping how she lives in her home. I asked her what she thought were her most important and favorite objects. It's a diverse and interesting list: magnifying glasses, shoes, tea-bag squeezer, big-screen TV, computer, key-on-a-string, free bus pass, sturdy shoes, and so on.

These important things might give a little insight into tangible and embodied interaction design, not from the perspective of the young and healthy visiting museums and collaborating in workplaces, but from the perspective of one older woman in her actual aging body with all of its specific capabilities and time-worn habits in the home she has adapted to suit her living for the past 15 years.

Maria grew up during World War II in the U.K. and knows what it was like to live on rations. She doesn't like to waste anything. There is a paper bag on the kitchen counter that I would be tempted to throw out, but is there in case she buys bananas—they keep better in a paper bag like that. There

- Figure 1. (a) The kettle, tea, and tea-bag squeezer by the bed are all used for the habitual morning tea in bed. (b) The marmite jar that holds two portions of milk is taken upstairs at night in preparation for the morning tea in bed.
- Figure 2. Magnifying glasses are placed in strategic locations around the house. (a) The magnifying glass with built-in light is placed on a small table near where the bus timetables are kept. (b) A large magnifying glass kept in the kitchen for reading labels. (c) A magnifying glass placed near the couch.
- Figure 3. A key on a string by the windowsill is let down to welcome visitors.
- Figure 4. The computer monitor is often switched off and covered when not in use.

1b



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is a small Marmite jar next to the kettle. I would recycle that one, but she tells me it's the perfect size for about two servings of milk. She fills it each night and takes it upstairs for her morning tea in bed, the first cup, and then the second. She makes the second cup by using her tea-bag squeezer to get all of the remaining flavor out of one tea bag. It's a quirky little device that she enjoys for its utility and its clever little manual grab, squeeze, and release mechanism. There is a kettle by the bed as well as in the kitchen, so she can make her morning cups of tea in bed and listen to the radio without coming downstairs to the kitchen (Figure 1). It is a nice, relaxing way to start the day, tea in bed every morning. Learning about the objects in her home provides insight into her values and common routines.

So, how can we think about tangible and embodied interaction design for older people living in their homes? I'd like to begin by drawing upon some existing research. Eva Hornecker and Jacob Buur have identified some fundamental qualities of tangible and embodied interaction: First, the material and manipulable qualities of objects themselves (tangible manipulation); second, that interaction occurs by bodies moving in real space (spatial interaction); third, that how objects are configured in space affects and directs emerging social interaction (embodied facilitation); and fourth, that by combining material and digital qualities we can embrace new forms of expressiveness and legibility (expressive representation) [1]. We see in particular a spatial interaction strategy at work in Maria's home with her everyday habituated objects. Another strand of research has considered how agency develops in the relations between people and their technologies over time. Lucy Suchman [2] and Bruno Latour [3] have demonstrated how objects and social relations are mutually developed. Our houses, offices, coffee pots, guns, and other objects materialize the relations between us. We inhabit and use these places and objects, and they in turn shape our interactions, our capacities for action, and our agency. Suchman and Brigitte Jordan [4] and Pelle Ehn [5], taking a participatory design perspective, have articulated how design continues in use as people figure out ways of using, adapting, and appropriating technologies to their own purposes. And Toni Robertson [6] makes a fundamental point that our actual, as opposed to idealized, bodies engage and make meaning of the world. Maria is 82 years old, has born five children, is partially sighted, has older bones and joints and a replacement hip, and has values shaped by life experiences. If we look at a problem from her perspective in her body, we see that problem quite differently [7].

In considering the design of technologies for the elderly, then, we might consider the qualities of objects themselves, how elderly people configure them to suit their bodily needs and interests, and the ways in which these objects become habituated into life, places, and social relations over time. If we understand how these habituated objects increase the elderly person's agency and independence, we might better understand how to design new Internet of Things technologies that will become habituated and support independence.

When you first get to Maria's small townhouse, there are a few obvious clues that she has adapted the environment to her body, essentially to enable her to live independently. There are a couple of big, wide, sturdy portable steps leading up to the front door so that it is less of a rise to climb into the doorway with a delicate hip. The couch is propped up on some flowerpot-like stands to raise the height of the seat, making it slightly easier for her to sit down. There is a rail in the bath to help her stand up; she proudly explains that in order to get the height right she stood up in the bath so the handyman could see exactly where he needed to put it. Installing adaptations to the home is very much an embodied practice. These tangible objects that adapt the environment begin as manipulables, but once installed they take their place as fairly permanent fixtures of the environment, shaping it to suit the body that inhabits it.

Less obvious but very important are the sets of objects placed strategically around the house. Here we see a spatial interaction strategy at work. There are several large, sturdy magnifying glasses, either on stands with lights or with large handles (Figure 2). She shows me one in the kitchen that is good for reading labels. One is on a stand with a light incorporated next to where she keeps her bus timetables. There is one near where she sits by the TV and one upstairs by the bed. It is in part a planned strategy, but these objects are also simply left where they are used. Over time they develop their places. Maria has also invested in a high-tech portable digital magnifier that she keeps in her handbag. This is useful for looking in hard-to-reach places, and then taking and displaying a magnified image. She has used it in the supermarket to look at labels in high places without pulling things down from the shelf, and for looking under the

couch to see what kind of screw head she needed for her screwdriver, so she could fix the couch. Although this portable magnifier complements the others, it does not replace them. Each one of them is located just where it is needed for the task at hand in that location.

Similarly, there are four fixed landline phones in the house. It is a relatively small house, and the distance between the phones is small—less than 8 meters from the kitchen phone to the living room phone, or to the upstairs bedroom or downstairs hallway phones—but when walking doesn't come so easily, it is very handy to have them where they are needed. She says, "It's surprising how often the phone goes when I am in the kitchen. So if I am stirring a sauce or something, I can carry on doing it." There's one in the living room next to the couch where she watches TV, one upstairs next to the bed, and one downstairs by the front door that she says is useful if she's phoning for a taxi and waiting to see if it's coming and wanting to call them back. She wouldn't want to have to go upstairs just to call. And she adds, "If someone came and I looked through the chain and thought they were suspicious, I could dash in there and call the police."

Again, with the phones, there is a spatial interaction strategy at work. And this strategy is preferred over the alternative strategy of one mobile phone. Maria does have a mobile with big buttons that she can wear around her neck. Her children bought it for her, but she never wears it. She prefers her phones arranged in space, rather than wearing one all the time, in part because mobile phone plans are expensive and because she doesn't want it constantly hanging on her. She uses her mobile for one specific purpose: to call taxis when she is out. She has programmed the local car-service numbers into it. The mobile phone is used solely to meet her transportation needs when she is away from home.

There is a tension between being in command of your environment through technology and being at the mercy of that same technology. For my partially sighted friend, it would be possible to wear both a mobile phone and a magnifier on her person and avoid a spatial interaction strategy altogether. But this would likely entail more time hunched over technology on her person and less time moving between the various stations in her house, free of items hanging from her. Product convergence can offer great benefits by packing everything into a smartphone, but it also diminishes the environment and reduces movement about the house. Maria could arguably move about the house searching for her mobile phone, but then she would be in service of her technology. She would also spend more time figuring out passwords, updating operating systems, and configuring an unfamiliar technology. Such practices are confounding and often result in failure. The spatial interaction strategy in this case offers a gentle agency and a fitness for purpose to suit the task and the aging body; she moves about her own house doing what she likes to do and simpler technology is right where she needs it, fostering her own agency.

Beyond the home and out in the world, Maria identifies two items that really foster independence: her free senior citizen bus pass—her eyesight no longer permits driving—and three pairs of sturdy shoes for different times of the year. But I will devote my attention to how she manages the boundary between the home and the outside world. Of course there are doors and windows to see out of and to keep the weather and the people out, or to let them in. There is a programmable light for the front window so that it looks like there is activity in the house to deter would-be burglars. She likes to be able to adjust the program every now and then. The chain on the door with phone nearby also helps with security. But there is also some more artful appropriation at work. On the windowsill of each level, there is a key on a long string that she can lower down to visitors so they can let themselves in (Figure 3). Some sort of electronic door system might be possible, but the key on a string is simple and quite social—like passing down a gift to a trusted friend, or like Rapunzel in the fairy tale letting down her long hair so that the prince can climb up it. She can look out the window and see who is there, rather than relying on a voice over an intercom. It is one tangible strategy for managing the boundary that works in this case. And she made it herself. The key on the top floor has a longer string to reach down two levels.

Less obvious but very important are the sets of objects placed strategically around the house. Here we see a spatial interaction strategy at work.

To engage with the world from her home without leaving it, Maria identifies some important devices: a large-screen computer, large-screen TV, and a special "boom box" for playing local news. Local community groups read out stories from the local newspaper that are recorded on memory sticks. These memory sticks are then posted through the mail and arrive in the characteristic Partially Sighted Society yellow and black envelopes. Maria looks forward to getting these packages in the mail and can tell me about all of the community groups that record the news stories. There is something pleasing about the tangibility of the memory stick and this little box, especially because it is designed with tactility in mind to be easy for a partially sighted person to put the memory stick into the port and make it play.

The large-screen computer is used for email and surfing the Web for information and e-shopping. When walking is tiring, e-shopping is very handy—Maria finds that a short walk to the local shop for a few groceries is quite enough exercise. But the computer is only on two or three times a week. Again, it is apparent that as a convergent device, this can meet some needs but not all of them. She switches it off when she isn't using it, and it sits under a dust cover (Figure 4). New applications like Skype take longer to learn. Often the devil is in the configuring. Her children haven't been able to convince her to persist with Skype, nor has she developed the habit of checking it, so she uses the phone to keep in touch and arrange outings with family and friends. For family overseas, however, the phone is awkward to manage across the time zones. She goes for a long time without talking to some of her children due to their busy schedules and the time-zone differences. It strikes me that a spatial interaction strategy might work better for communicating with her relatives overseas than an application on a general-purpose personal computer. Perhaps short messages could be left on technologically augmented kettles or teapots. Or a boiling kettle in her home could make a gentle boiling sound in her children's homes to let them know she is up and about. Such strategies might facilitate communication and connectedness across time zones, eliminating the need to set aside half an hour to call at an awkward time of day. Design strategies that mesh with the use practices of her other habituated objects might proactively support staying in touch, socialization, and the fostering of agency. And such strategies might be more effective than camera- and sensor-based monitoring that reports to a centralized service provider.

Whether within the home, at the boundary, or out in the world, my elderly friend identified a number of habituated objects, important items that she has adapted to her living. Many of them were intimately related to the specificities of her aging body (magnifying glasses, key-on-a-string, talking newspaper, shoes, bus pass) and managing mobility in and around her home. Others support her comfort, habits, and routines (kettle, talking newspaper, electric blanket). As she has appropriated these objects to her living needs, they have gradually found their places, and she has developed habits of use that support her independence and agency, connecting her to friends and services that she needs. In seeking to design to support the agency of the elderly, it is worth taking time to understand the ways in which objects and technologies have been successfully adopted and habituated in an elderly person's life, and why some technologies fail to become habituated. Therein lie clues to successful design strategies for new Internet of Things technologies that support the agency of older people.

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ENDNOTES:

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