

Deploying Research Technology in the Home

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ABSTRACT

Deploying research technology in real homes is an important way of uncovering new possibilities for design. We reflect upon the deployment of a simple technological arrangement which might be construed of as a ‘breaching experiment’ that reveals significant challenges for technology deployment in the home. Of particular issue is the extent to which research deployments resonate with existing infrastructure and disrupt ordinary processes of domestication; the degree of ownership household members exercise over research prototypes and how this constrains domestication; and the nature of research practice and the limits this places on our understanding of domestication.

Author Keywords

Ethnomethodology, home technology, challenges to deployment.

ACM Classification Keywords

H.5.3 Group and Organization Interfaces: *Computer-supported cooperative work.*

INTRODUCTION

The home is a key area of technological research at the present moment in time and it has attracted considerable attention from technology researchers as a site of great potential. While a good deal of work in the area has centred upon ‘living laboratories’ (e.g., Georgia Tech’s Aware Home, Philips’ HomeLab, MIT’s PlaceLab, etc.), researchers have also sought to explore the possibilities for design by deploying novel technological arrangements in real homes [e.g., 11, 14, 24].

The act of placing an alien object in the home not only uncovers how household members might encounter and appropriate technology in the future. It also brings the ways in which members *ordinarily* orient to and reason about technology in the home into view. Household members are experts at managing the introduction of new technology in the home – we do it all the time – and research deployments

inevitably run up against *familiar expectations* whether they intend to or not (see also [1]). Research deployments in real homes therefore have something of the character of ‘breaching experiments’ about them in that they make tacit and taken for granted expectations visible [3]. Our aim here is to investigate the breach and examine what is made visible in the collision of research trajectories and ordinary expectations in order that we might understand more of the domestication process [18] and what it means for design. In particular we seek to do this in a fashion that will prompt active and constructive debate about the nature of research deployments, thereby enhancing sensitivity in the CSCW community to the important issues that may confront deployment teams across a range of domains.

The breach on this occasion was caused by deployment of the Video Window [12]. The designers of the Video Window sought to explore ‘ludic’ [9] possibilities for design in the home. We suspend such concerns and attend instead to how household members encountered and made sense of the deployment. We offer an alternate interpretation then [25], one rooted in ethnomethodological analysis of members’ orientation to and reasoning about the deployment. We are particularly interested in how member’s orientation to a research deployment *compares and contrasts* with their orientation to ordinary installations of technology in the home. The distinction brings significant problems of deployment to light.

When we speak of domestication it is worth pointing out that we are particularly concerned with the ethnomethodological orientation outlined by the late Harvey Sacks [23], here articulated with regard to the telephone:

Here’s an object introduced into a world ... Now what happens is ... a culture secretes itself onto it in its well-shaped ways ... What we’re studying, then, is making [technology] a reasonable part of the house ... That’s a funny kind of thing, in which each new object becomes the occasion for seeing again what we can see anywhere ... This technical apparatus is, then, being made at home with the rest of our world. And that’s a thing that’s routinely being done, and it’s the source for the failures of technocratic dreams that if only we introduced some fantastic new ... machine the world will be transformed. Where what happens is that the object is made at home in the world that has whatever organization it already has.

The contrast between the deployment of research technology and ordinary installations invokes a “world that

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has whatever organization it already has” *independent of research technology*. An already organized world which underpins members’ expectations of and reasoning about technology and provides for its incorporation into domestic life. The contrast between research deployments and ordinary installations is evident in household members’ orientations to and reasoning about the Video Window and it impacts upon broader efforts to understand new possibilities for design through deployment.

In order to elaborate the salience of our findings to design we exploit a design framework for understanding home-oriented research [21]. The framework is adopted from the work of the architectural historian Stewart Brand [2], which is concerned to explain the evolution of buildings, including the home. This explanatory framework is referred to as the “Six S’s” (Table 1).

SITE (Fixed)	This is the geographical setting, location, and the legally defined lot, whose boundaries and context outlast generations of ephemeral buildings.
STRUCTURE (30-300 yrs)	The foundation and load-bearing elements are perilous and expensive to change, so people don't. These <i>are</i> the building. Structural life ranges from 30 to 300 years
SKIN (20-30 yrs)	Exterior surfaces may now change every 20 years or so, to keep up with fashion, technology, or for repair.
SERVICES (20-30yrs)	These are the working guts of a building: communications wiring, electrical wiring, and plumbing. Buildings are demolished early if their outdated systems are too embedded to replace easily.
SPACE PLAN (3-30yrs)	The interior layout – where walls, ceilings, floors, and doors go. Turbulent spaces can change every 3 years or so; exceptionally quiet homes might wait 20-30 years.
STUFF (Continual)	Chairs, desks, phones, pictures, kitchen appliances, lamps, hairbrushes; all the things that twitch around daily to monthly. Furniture is called <i>mobilia</i> in Italian for good reason.

Table 1. Rates of change across the fabric of the home.

The Six S’s framework suggests that change occurs at very different rates across the different componential layers that make up a building. It is of salience to design as it begs the question as to *where new technology resides in the home and what order of change technology therefore demands?* It speaks of a host of ordinary expectations oriented to by household members when installing new technology that impact upon research efforts to understand the potential for computing in this space [21].

DEPLOYING RESEARCH TECHNOLOGY IN THE HOME

The Video Window is one of a series of investigations of technologies designed to support ludic rather than utilitarian pursuits in the home [9]. Rather than designing solutions to perceived problems in the home, or supporting common household tasks, ludic technologies seek to explore possibilities for curiosity, wonderment, and play [10]. The Video Window [12] is one such exploration. It is a very simple technology and it is this, rather than its ludic character, that appeals to us about it for if even the simplest of arrangements is problematic in the real world, what then of the more complex arrangements we might envisage?

The Video Window consists of two basic parts: a ‘bullet cam’ mounted on a pole for outside the home and a 43cm flat screen monitor in a custom made wooden frame for inside (Figure 1). Both devices drew from mains power and were intended to be left on continuously.



Figure 1. The video window: a camera on a pole and a bespoke monitor.

‘Julia’ and ‘Ron’, a middle-aged couple who live in a large Victorian house with a view of the seaside, agreed to host the deployment. Ron is a high school teacher and Julia works as an administrator at a local university. The house is situated in a seaside town in the south of England with good views of the sea from the upstairs windows and balcony on one side of the house. The Video Window was installed in July 2006 and remained there until September 2006.

We did not select Julia and Ron as users and offer no account of why they were selected. We did not conduct the field trial, did not gather the data, and do not intend to offer an account of all that happened during the deployment. Furthermore, we are methodologically ‘indifferent’ [16] to the aims of the research and suspend concern with its *ad hoc* nature. We therefore offer no insight into its ludic character or the potential to further develop such technologies. Instead we adopt the ethnomethodological position of treating the deployment as a ‘perspicuous setting’ [8, 3], which will enable us to inspect the collision between household members’ ordinary expectations of the installation of technology in the home and the expectations that inhabit the deployment of research technology. The fact that this is a ludic technology and that we are looking at a single deployment for us is neither here nor there, a) because as ethnomethodologists it is a methodological feature of our research that we work with single instances [22], and b) because it is the way in which research, whatever its persuasion, rubs up against ordinary life that interests us. We are not interested in the ludic characteristics or the idiosyncrasies of the deployment then, but rather in the ways in which the *act of deployment* reflects the *ordinary concerns* ‘at work’ during the research exercise.

It is in the ‘rub’ between research and ordinary life that we see some kind of collision to be inevitable. We recognize

that ordinary installations and research deployments are very different beasts. Nevertheless, we take it that by examining the act of deploying a research technology in the home we may come to see what those differences might fundamentally consist of. In the first instance, we note that research deployments are designed for a wide range of exploratory purposes, and are usually intended to open up possible futures, rather than meet current needs. In this respect research deployments exhibit some of the qualities of the original breaching experiments conducted by Harold Garfinkel [7], which were explicitly designed to “make trouble”.

This is not how we normally think of design interventions and although some designers do set out to do this [17], we are not suggesting that making trouble is a common goal. Nonetheless, a certain degree of trouble is *inevitable* because research deployments 1) do not comply with ordinary methods of installation and 2) therefore disrupt ordinary orientations to and expectations of installation, even where the notion of ‘doing research’ is invoked. Thus, while the intent of research deployments is very different to Garfinkel’s experiments, the end result is much the same. This opens up the possibility for us to re-examine ethnographic data gathered by others and to explore some of the ordinary orientations that household members have to technology in the home. Accordingly we offer a series of *analytic reflections* based on the video, interview, email, and diary data others have made available to us.

ANALYTIC REFLECTIONS ON THE VIDEO WINDOW

Given the display-like nature of the Video Window it might seem that when such an arrangement of technology is put into a real home it would be primarily oriented to as part of what Brand describes as the ‘Stuff’ of the home. This is *not* to say it will readily become ‘unremarkable’ [26], but it is reasonable to think that it would be oriented to as a non-static part of the home’s contents like other Stuff in the home, such as TVs, stereos, desktop and laptop computers, etc. However, one of the most interesting aspects of deploying the Video Window in the wild is the extent to which orientations on all sides of the endeavour – i.e., the respective orientations of research team and household members to the deployment - *disrupted* the sense in which the Video Window could be seen and treated as Stuff.

Below we wish to address the nature and consequences of this disruption and key issues that emerge from the placement of even a simple arrangement of research technology in a real world setting. The disruption was evident in a distinct number of ways, including:

1. The way in which technologies are positioned in the home and how this impacts upon domestication.
2. The way in which ownership of the technology is addressed and effects domestication.
3. The way in which research activities and practices shape understanding of domestication.

All three of these areas highlight key ways in which the ‘research’ nature of technological intervention in a real home frames, shapes, and permeates deployment and places significant challenges on how research into this class of system may be understood and managed. We consider each in turn below.

1. Installing the video window

The first and most obvious issue to be addressed when placing any technology in the home is *where to put it?* Situating technology in the home involves a range of practices whereby users and their expectations are ‘prepped’ for the installation of the technology. As well as describing something of the technology to the inhabitants this also involves deciding where to site the technology within the physical fabric of the home, the activities of actually installing the technology, and handing the technology over for use:

Finding a Place for the Stuff

When people purchase technology for their homes they usually do so with some understanding of *what the technology is for* and have some idea of *where they are going to put it*. Even if the location has not been decided when the ‘box’ comes in the door, household members routinely assume that it is, to some large extent and within the physical constraints of their homes, *for them* to make the decisions about its placement. The capacity of inhabitants to have control over such decisions is one of the defining characteristics of Stuff for Brand. However, the technical arrangement of the Video Window - an internal display linked to an external camera - meant that decisions about placement also involved the research team.

A pre-installation visit took place prior to the actual installation during which members of the research team – ‘Phil’ and ‘Terry’ - considered where the external camera might be positioned. Given Julia and Ron’s fondness for the sea view, Phil and Terry initially considered putting it on the roof of the house, but after crawling around the attic space they felt it would be better to place it upon a pole. The upstairs balcony was eventually chosen as the best location for the pole as it easily enabled the research team to run cables downstairs to the internal display.

Discussions of where the screen component of the installation was to be placed then began. These involved Phil, Terry and Julia, plus ‘Dave’ and ‘Natalie’ (also members of the research team). During pre-installation Phil wanted the monitor window to be placed so that it was oriented in the same direction as the camera and Julia had already prepared the wall where the monitor was to have been mounted by removing a cork board containing a plethora of postcards, photos, and notices. However, during the actual installation Phil came to feel that there might be problems with this:

Dave: [Julia], can Phil just have a word about where they’re going to put it? The screen?

Julia: Oh yeah.

Phil: So to mount it on the wall – which is, I know what we discussed, we really have to put this mounting bracket in, which means putting four big screws in the wall. And we thought ...

Julia: Yeah, it can go on the shelf.

Phil: It might be less destructive. Either on that shelf or the one up there.

Julia starts to clear items off the shelf.

While there is nothing particularly unusual in this interchange it does illustrate the extent to which the householders were prepared to let *the research team take the lead* regarding placement and to *relinquish control* over placement of the device. The original rationale for where to put the display is naturally set aside for practical considerations, without the slightest hesitation on Julia's part. What is interesting about the interchange above, and her conduct throughout the installation, is the extent to which Julia is prepared to just let the team 'get on with it' rather than to provide an authoritative degree of direction or decision-making herself. If the Video Window was, as is the usual case with the Stuff of the home, something Julia and Ron had gone out and purchased, it is hard to imagine them being so passive about the issue of placement.

In this deployment then, and we can see no good argument against the typicality of *householders' orientation* to deployment, there is a sense in which the orientation of household members is very much towards the endeavour as something that is being 'done to them' - albeit willingly - rather than them 'having it done'. As it is being done to them they can happily relinquish control. If they were having it done themselves they would expect to have *first say* about placement. However, it is clearly the case in this kind of exercise that the understanding of it being about 'doing research' provides a ready account for why setting aside such concerns might be an appropriate thing for household members to do.

Spanning the Layers

Household members orientation to deployment as something that is done by others - whether 'for them' or 'to them' - highlights one of the ways in which there is a tension between research deployments and their 'fit' with the home environment. As simple as it is, the Video Window nevertheless requires and exhibits strong dependant links to other components residing in different layers of the home environment. Televisions are one item of Stuff that exhibit similar properties, with aerials situated like the pole the camera is mounted on in the Skin and tied to the Structure of the building, with cables delivering a signal through the Service layer, and with the TV set delivering that service as part of the Stuff of the home.

The Video Window spans several different layers then. The display component is locatable in the Stuff of the home, but the camera component appears, like a TV aerial, to sit within the Skin and Structure, and the wiring between the two in the Service layer. Thus it can already be seen that the

Video Window straddles several of the layers in Brand's model without comfortably sitting in any single one. Like a great many new technologies for the home, the Video Window is not solely located in the Stuff of the home. Rather, it is *distributed across several layers* that extend beyond those traditionally considered by technology researchers in this domain [21].

Reasoning about the Technology as Stuff

The ability of household members to reason about the Video Window as Stuff was also problematic, largely because it was a research technology and not a piece of Stuff that one would ordinarily, in ordinary ways, install and use within the home. This is manifest in such things as how household members seek to understand 'what the technology is for' whether the research mandates it or not, how they expect it to behave, and what they expect it to do. Here, for example, is an extract from an email sent by Julia to a member of the research team:

Alec, the camera has swung round so it points more easterly over the gardens (and down a bit I think), rather than straight down to the sea. Does this matter? I had the idea the angle was specially chosen but perhaps not.

It was not until some time after the initial installation that Julia came to understand something of what the Video Window should and shouldn't do at a technical level and also what its purpose was: it's "just for fun, something to enjoy" being a common account Julia gave to houseguests. Clearly, to invite a technology into your home *without any certainty as to what it is and how it might behave* is somewhat unusual.

This is not, of course, necessarily a problem in relation to the objective of developing technologies that are provocative. However, there are *not so many ways in which the home might accommodate such technology*. Something might be purchased as a 'curio' or 'gadget' and get handled in a similar fashion. However, the license for being able to deploy and situate technology in such a way is provided by the way in which it is generally accounted for as 'to do with research'. This stands in clear contrast to the ways in which people ordinarily reason about Stuff in their homes and even puts caveats in place that inhibit ordinary reasoning.

What's Seen in the Breach

Having set aside interest in the ludic character of the research we think that several generic issues are raised by the act of installing research technology in a real home. The arrangement of the technology as a set of components that span the different layers in Brand's model means that the Video Window (like many other research deployments) does not reside in an obvious site within the home. It is not Stuff, or Service, or Structure or Skin. Rather, and as simple as it is, it requires specialist installation and spans several of the componential layers that make up the home environment. Furthermore, and insofar as elements of it may be treated as Stuff, its very existence as a *device of*

research as opposed to an ordinary household product means that the Video Window challenges the ordinary ways in which new Stuff is situated in the home environment, is made sense of and accounted for by household members, and is thus *incorporated by them into the home*. This is further illustrated when we consider issues of ownership.

2. Owning the Video Window

Issues of ownership are about more than who possesses the technology. They also relate to issues of responsibility and who must maintain and fix things. These issues are a strong feature of Brand's model. In his discussion of the different layers that compose buildings he suggests that the *shedding of responsibility for change by inhabitants* largely occurs at the levels of Site, Structure, and Skin. Within the outer three levels one begins to witness less active involvement on the part of household members, whereas the responsibility for change at the level of the Space-Plan and Stuff of the home falls almost exclusively to them.

Whilst the Video Window as a technological arrangement does not sit comfortably in the Stuff of the home, the display itself has some degree of resonance at that level. Nevertheless, ownership of, and responsibility for this kind of Stuff within the home can be and clearly is *set aside* by household members. What seems to provoke this 'setting aside' is the orientation the inhabitants have to the installation of the Video Window as a research exercise. When a new technology is put into someone's home as part of a research project the householders will happily accommodate the presence of the technology in the context of a 'test' or a 'trial', but they do not understand the technology in such circumstances *to be their own*.

They have not gone out and chosen and bought it. There is no manufacturer manual and no informal network of support from others with similar appliances. Someone else who is presumed to know everything necessary about it has brought it into their home and if it breaks there are important ways in which it is 'not their problem'. This orientation became particularly pronounced when it came to keeping the technology going. Who maintained the technology and how it was fixed became a primary issue of ownership and responsibility for the Video Window, which impacts directly upon engagement and what, therefore, we might learn of the potential of new technologies in the home through deployment.

Who Maintains the Stuff?

In their capacity as household members Julia and Ron oriented to maintenance of the Video window quite differently from how they might if it was a commercial product they had purchased. They did not approach the need for maintenance in the routine ways one might tackle a problem by contacting a service engineer when things went wrong. Nor did they treat the research team as service engineers. For instance, whenever Julia contacted the research team she apologized for "bothering" them. Why

would you be 'bothering' a service engineer when it's their job to come and fix it?

Julia, however, is clearly concerned about this when interacting with the team:

It's just annoying 'cause I mean, you know, you have to ring somebody up. I feel I'm annoying you lot and then you have to come round, so I have to be there, so - I mean, you know, it's a bit of a pain.

In addition, as Julia's remark also begins to make visible, whilst householders will routinely arrange to be in when service engineers come to undertake a repair, there is an important distinction here: the Video Window is not *their* equipment so - and this is where matters of direct ownership cut in - the drain on the householders' time is oriented to as a kind of *favour* to the research team. Furthermore, it is quite apparent that the research team also have this orientation to ownership and maintenance of the equipment. At the end of the initial installation, before parting for example, Natalie says to Ron:

No but seriously you are free to say - you're very free to say "look it's not working, we're not enjoying it, take it out".

Who could accountably say that upon installing in someone's home a technology they have just purchased? It only makes sense if it is understandable to all concerned that it is a thing that has been taken in by the participants as a *favour* and that can be given back at any moment. This is not even like a leasing situation where a product might fail but it is presumed that if it does it will be replaced by something exactly the same or similar.

Fixing the Stuff

In some cases one might imagine that the householders themselves could engage in occasional repairs, especially if they did not demand any special competence. Yet the assumption on the part of household members that it was not their job to fix the technology further underscores the extent to which they were not orienting to it *as owners of it in any way*. Ron is actually quite explicit on this point:

I mean if it was mine and I kept getting the no signal thing I suppose I might get a bit frustrated and worried about that. But I knew, as I said, that it was a kind of improvised set up and actually not mine, you know, not my responsibility to fix it, so I didn't mind that.

It is the bane of service engineers working lives that many people, when something breaks, *do* have a go at fixing it, often with aggravating consequences. It is not an idle matter that so many devices specify 'no user-serviceable parts' and that evidence of 'tampering' invalidates most warranties. If Ron or Julia in any way saw the Video Window as something they had responsibility for they might well have been moved to try and sort out the problems with the camera angle. Instead they saw it as not being for them to touch. This once again displays the sense the deployment has for them as something that is being done to them rather than something in which they should get *actively involved*.

What's Seen in the Breach

Again, above and beyond the ludic character of the design, several generic issues arise that revolve around what we might call the '*anthropological strangeness*' of research deployments: in contrast to an ordinary installation, maintenance is not the responsibility of household members and neither do they exercise ownership over it. Thus, the act of deployment makes the technology stand outside the ordinary ways in which Stuff is accommodated within people's homes and clearly impacts upon the ways in which inhabitants of the home experience and are involved in the elaboration of new technological possibilities.

3. The Stuff as Part of a Research Endeavour

The fact that the Video Window has been deployed as part of a research endeavour, owned by members of the research team, directly impacts upon the degree to which it can become part and parcel of the home environment. This does not mean that nothing useful can be learnt from research deployments. It does raise a real dilemma as to the extent to which one can understand deployment to be research into *how the technology will be oriented to and treated as an integral part of the home* though where and when research is concerned with such practical matters.

That a 'job of research' is being done is unquestionable and nowhere more manifest than in the record-making practices of the research team. Such practices are, of course, ordinary features of the business of doing research. There were numerous occasions during the deployment where the need to produce a 'research record' was taken for granted and seen as an appropriate part of what the deployment was actually 'all about' from the point of view of household members. The attempt to embed the technology in the home and to document its embedded character as part of a research endeavour is done through further anthropologically strange behaviours, however.

For example, and in addition to those issues already addressed above, one Saturday evening whilst the Video Window was in their home, Julia and Ron had a party. This was seen to be a good opportunity to gather additional impressions of the Video Window from their guests so one of the research team attended the party and sat close to the window, answering questions and collecting feedback. In the context of a research project this is a reasonable enough way to proceed and Julia and Ron were happy to have him there. However, one might pose the question: would you have your plumber along to your party to *see that and how* the new heating system was being appreciated?

In the case of the Video Window, it is not only the researchers who were involved in documentary activities. As is common practice with such installations the householders were also encouraged to keep a diary. Julia proved to be fairly religious in keeping this up-to-date but was critical of Ron for not doing so. Ron's response to this was telling in a number of respects:

When you live with something like this and it's here all the time, what I like is the routineness of it - I like to see the trees move, I like to see the vegetation - you know, the kind of things that I'd otherwise be standing at the kitchen window watching. Or you know, watching from upstairs. But I mean, that's the sort of satisfaction of it for me. Which is not erm - I mean it is worth recording but you'd only record it once, you know what I mean, it doesn't, it isn't something that changes day by day.

Of course one might comment again upon how unusual it would be for a plumber, having just installed a heating system, to ask the members of the household to keep a record of what happens with it. However, this cuts a bit deeper than that. This is also about what an appropriate report might look like. What *would* you tell the plumber if he asked you how things were going with your installation?

Most likely, unless things were seriously wrong, you'd say something along the lines of "Oh, pretty well." The ordinarily *unremarkable* details of when your boiler came on, how hot it got, and so on are ordinarily taken to be *unworthy* of report by household members even though they may attend to them on a daily basis. Nevertheless, under the auspices of 'research' Julia and Ron are expected to suspend this ordinary orientation to reporting. It may appear that Julia complies with the expectation. However, if members ordinarily ignore the unremarkable details of technology use in the home, this begs the question of *what* is actually being reported?

While we could consult the diaries to find out, the situation is best illuminated by Ron when questioned by a field worker about when he does talk about the Video Window:

Dave: Do you find yourself talking about it much with Julia?

Ron: Erm, we talk about it. We talk about it to other people.

While doing it in different ways - one through the production of a research document and the other in ordinary conversation - both Julia and Ron are engaged in formulating accounts that render an alien technology ordinarily *remarkable to other people*, researchers included. Thus, participants come to speak of its exceptional qualities. But what of the ordinarily unremarkable details that actually characterize day-to-day use - where are they to be found in the research record?

Self-reporting practices render the unremarkable ways in which technology is actually domesticated or 'made at home' opaque. What is offered are ordinarily remarkable accounts rather than the unremarkable details that accompany its being taken for granted and embed it in the household routine [3, 24]. This, then, brings us back to the dilemma: how are we to understand the deployment of technology in the home to be research *into how technology is oriented to and treated as an integral part of the home*, when research is focused on eliciting the remarkable rather than the mundane qualities of the technology and its use?

BEYOND THE VIDEO WINDOW

So what are we saying here, what do our analytic reflections mean for CSCW, and what can designers take-away from them? First, we should make it clear that we are not saying anything about the Video Window beyond that it has provided us with an occasion to reflect upon how deploying a research technology in a real home compares and contrasts with the ordinary expectations that accompany the installation of technology. Whatever else the Video Window sought to explore or achieve, it has enabled us to see how even a simple arrangement of technology can breach ordinary expectations of where technology resides in the home, who owns it, who maintains it, and how user experience of it is accounted for. These findings illuminate key dimensions of the deployment exercise to consider when conducting technology research in real domestic environments. Naturally, the ways in which they manifest themselves will vary from case to case.

We are not saying either that *all* researchers necessarily approach home deployments in the same way as those involved with the Video Window. On the contrary, we recognize that there is a wide range of reasons and goals involved in deployment. In some cases the work of deployment is far more intensely negotiated with the householders [e.g., 19], for example, and in other cases interventions are quite specific and distinct [e.g., 15]. Nor do we suggest that *all* householders will necessarily have the same kinds of experiences of research deployments as Julia and Ron: the experience will very much depend on the research and nature of technological intervention. We are saying that a host of ordinary expectations and concerns will accompany deployment, whether they are recognized by researchers or not. Clearly we think that recognition *and explication* of the ordinary expectations and reasoning that accompanies the incorporation of technology into the home is important to continued development.

What we do suggest about Julia and Ron's experience is this: that their expectations are social through and through. That they exhibit what *any* competent member of the home knows about the organization of technology installation: that they exercise control over placement within the physical constraints of the home, that they own it, and that they have various rights and obligations in relation to the technology's maintenance. The deployment of research technology in the home violates what anyone ordinarily knows about technology installation. Fundamentally, deployment is something that is done to members, not for them, and it raises serious problems as to the extent to which research deployments can be oriented to and treated as an integral part of the home.

The situation raises serious issues for design. We have elected to use the Six S's framework adopted by design researchers [21] to articulate these. This framework provides a view on the different physical characteristics of houses in which technology is embedded and how they

come to be oriented to as *changeable*. Design is all about change and introducing even a simple technology like the Video Window obviously instantiates change at some level. What we have found here is that when this occurs under the auspices of research the kinds of practical orientation and layers of change proposed by the Six S's framework are not so evidently aligned with the research effort.

In the spirit of 'informing design', not in details of system requirements but in terms of domain knowledge and a sensitivity to real world settings and users [5, 20], we wish to reflect upon the nature of these *misalignments* and consider their implications for undertaking future deployments within domestic environments. It might be useful to consider our experiences in terms of the alignment between the technology as Stuff and the layers suggested by the Six S's framework; the ways in which deployment aligns with ordinary processes of domestication; and consideration of how the anthropological strangeness which is inherent to the deployment exercise might be managed.

Is it Stuff?

Our reflections on the deployment of the Video window make it visible that even simple arrangements of technology may span several of the componential layers the home environment is made up of. In this respect two interrelated issues arise:

1. The relationship of future and emerging technology to the existing infrastructure of the home.
2. The relationship of those technologies to different rates of change across the various component layers.

With regard to the first of these issues, we have seen that even a simple technological arrangement exhibits strong *dependant links* between different componential layers of the home environment. It encompasses not only Stuff (the monitor) but also the Skin and Structure of the building (to which the pole is mounted), and the Service layer (cables). The Video Window is not solely located in the Stuff of the home then, but is *distributed* across several layers.

Consequently, we need to take seriously how deployment resonates with existing infrastructure in the home [6]. More specifically, the distribution of new technological arrangements and dependant links between the componential layers they span need to be made *explicit* in order to ensure that deployment ties into existing infrastructure. This will involve exposing the various components that make up technological arrangements, making it visible where they *fit into* the different componential layers and how they *link together*.

This, in turn, brings a second set of considerations to the foreground, which revolve around the rates at which the layers of the home environment change. If technological innovation extends beyond Stuff to other componential layers, then presumptions of change come into serious question. We cannot, for example, assume that

implementing technological visions is a matter of developing new Stuff that may be imported piecemeal into existing infrastructure [6]. Rather, there is need for technology researchers to be sensitive to the different rates of change that the different componential layers evolve.

This is a key feature of the Six S's framework. While Stuff undergoes continual change, once we reach the Service layer and Skin then change occurs at a significantly different rate: 20-30 years. Change at these levels is physically more disruptive and taxing, hence its relatively infrequent occurrence. If deployment requires intervention at these levels it therefore makes the technology harder to domesticate as a natural part of the Stuff of the home. Furthermore, change at these levels may be a significant barrier to broad adoption and use; hence the importance of understanding *just how* future technical arrangements tie in with existing infrastructure.

So, beyond wholesale reconceptualisation of design for the home, we recommend that designers carefully consider how new technologies resonate with the home's infrastructure and map out implicated levels of change prior to installation. This will enable them to manage migration of the technology from the research lab into real homes on any particular occasion of deployment and to understand the particular challenges involved in making this move.

Disrupting Domestication

In addition to the ways in which new technological arrangements are distributed across different componential layers, their role as part of a research endeavour also creates a misalignment with the ordinary ways in which technology is made at home. Naturally, the practices of researchers are unlike those of the service engineers and professionals who enter the home to install and support technology purchased by inhabitants. While researchers no doubt realize this it is important that they appreciate that their orientation to inhabitants and the technologies at play impact upon the extent to which the technology *can* be made at home, and that they develop ways of managing the situation.

One of the significant preoccupations in the design of novel technologies for the home is to understand how effectively they might be incorporated into domestic settings such that the inhabitants *do* treat them just like all the other Stuff in their home. Our reflections on deployment of the Video Window have uncovered some important ways in which research makes installation, maintenance and ultimately ownership quite different from the ordinary Stuff of the home, however. Consequently, we think it necessary that technology researchers develop the role of the 'digital plumber' in home-oriented research. The purpose of this is to *enable household members to shape installation* and transform deployment from something that is being done to them into something that they are having done.

This is not incidental to research which is concerned to develop real world applications ludic or otherwise, but a

core feature: making installation into something that inhabitants are having done is key to understanding how the technology may actually be incorporated into domestic life. Even where the technology is not something members would or could have bought and placed in the home, creating a situation in which they can exercise control over its placement is essential to understanding the real world, real time potential of the technology. Similar attention also needs to be paid to ownership and maintenance – understanding key issues cannot be about household members 'doing favours'. Clearly, as the Video Window makes perspicuous, householder experience of the technology does not reside there, but rather, results in their not being as actively involved in the research as they might.

This is not, we note, a criticism of the researchers involved in the deployment of the Video Window, their maintenance practices (like their other research practices) are far from unusual. The point we are making is much more general and requires that technology researchers develop a keen sensitivity to the issues of installation and maintenance as these underpin ownership of the technology and are indeed constitutive of it. On this everything turns. As it stands, ownership resides in the hands of researchers (see [19] for a rare exception). This has the direct consequence that our understanding of how new technology is oriented to and treated as an integral part of the home is necessarily *limited*. Thus, we not only need to develop our awareness of just how deployments tie in with existing infrastructure, and understand the ramifications of this on any occasion of deployment, we also need to ensure that end-users can assume ownership of the technology, including ownership of the processes of installation and maintenance.

Managing Anthropological Strangeness

Deployment is done through a range of 'anthropologically strange' practices that revolve around installation, maintenance, ownership, *and* study. By this we mean that the deployment of technology for purposes of research differs radically from that of ordinary installations in the home, and that research deployments are encountered as an entirely different order of installation than those that householders ordinarily encounter and expect.

We do not suggest that anthropological strangeness can be dispensed with – it is an unavoidable feature of *research*. Nevertheless, we need to be aware of the impact of research practice and manage its effects. In other words, a certain measure of reflection is required. In addition to the issues already treated above, this also applies to the ways in which we seek to account for deployment – our record-making practices - particularly self-reporting techniques, the result of which is the production of remarkable accounts which render the unremarkable ways in which the technology is ordinarily made at home *opaque*.

What is at issue here is not the use of diaries and other such devices, but a well-grounded understanding of how technology is 'made at home'. Rendering appropriation

visible is the point. Technologies that are thoroughly domesticated, such as the telephone, TV, even the home network, are embedded in unremarkable routines [4, 13, 27]. By eliciting the remarkable it is not only unclear how we might come to understand this achievement; it is also unclear how we might move beyond exploration to develop “unremarkable computing for unremarkable routines” [26].

Naturally a process of acculturation accompanies the introduction of any new technology. This is, indeed, remarkable for inhabitants of the home and is characterised by a host of practical concerns revolving around how to use it, when to use it, where to use it, who uses it, who doesn't, and so on. The issue, however, is how we move beyond opaque methods of account to account for acculturation *and* sustained use from an ordinary point of view; that is, from a point of view in which household members evidently make the technology into a reasonable part of domestic life which is hardly worthy of comment? However we address the question it minimally requires that we attend to and make visible the practical orientations, expectations, and reasoning that householders bring to bear on the deployment exercise and that we seek to understand how this compares and contrasts with design conceptions.

If it is evident that the deployment is something that is being done *to* household members rather than for them, that they have no control over placement of the technology, that they have no ownership of it, no interest in maintenance, that they really are doing you a favour, and are endlessly commenting on how remarkable the technology is, there is quite probably need to recalibrate those design conceptions. The suggestion, then, is not one that amounts to a specific way of doing deployment – a method as it were – but that we attend carefully to and elaborate a distinct set of *criteria* relevant to understanding the process of domestication and the potential of new technologies to be made at home.

CONCLUSION

The home is a site of increasing technological interest. Researchers have sought to explore possibilities for design in this space in various ways, ranging from the construction of lab houses through to the deployment of technology in real homes. We have focused here on the deployment of a very simple arrangement of technology as it begs questions of more complex arrangements envisaged by researchers in the field. Put another way, if the deployment of a simple arrangement of technology is problematic, then what of more complex arrangements?

The Problem

The problematic character of deployment is that installing research technology in real homes inevitably breaches the expectations that household members have about technology installation. Members ordinarily know and understand that the installation of technology in the home is something organized by them, for them. Accordingly, they expect to have practical ownership of the technology, to

exercise control over its placement, and have rights and obligations in the technology's maintenance. The deployment of research technology in the home violates the ordinary ways in which members reason about technology and incorporate it into everyday life. Fundamentally, the act of deploying research technology - rather than the technology *per se* - sits uncomfortably with members' ordinary orientations and expectations. In turn, this draws our ability to determine the actual and potential resonance of research technology with domestic life into question.

The Solution

Our reflections on deployment do not suggest that deployment is of no value or should be abandoned. They do suggest that there is a need for design teams – including those responsible for deployment and documenting technology use – to develop and exploit a sensitivity to the real world, real time character of technology installation in the home and to user expectations. This is not to say that researchers should become like service engineers: the job of work – research – still has to be done. The recommendation is one to develop research practice so that technology deployments resonate much more strongly with domestic life. Our reflections suggest that there are three main ways in which practice in this area may be further developed.

Mapping Technology Distribution

In order to effectively migrate technology from the research lab to the home it is necessary to map its distribution across the different componential layers articulated by the Six S's framework. This will enable designers to understand the infrastructural impact of deployment and the changes that are involved in moving the technology out into the real world. At a very practical level, this will enable researchers to understand what they need to do to put the technology in a particular home and provide resources for discussing actual placement with household members.

Digital Plumbing

There is a real need to move research beyond something that is done to household members towards something that much closely resembles something they are having done. Household members need to be able to exercise control over placement and in other ways come to own the technology for all practical purposes. The suggestion is that researchers develop the role of the digital plumber to enable members to actively shape installation and support ongoing maintenance. The aim is to move research beyond a practice that essentially relies on the doing of favours to one that sheds light on and responds to the demands that householders ordinarily expect to place on technology.

Monitoring Feedback

However the research is conducted, we suggest a set of criteria might be applied to monitor user feedback. These focus on ownership, control, maintenance, and the order of account elicited from and provided by householders. By

tracking these considerations, and by actively deciding how to deal with them as a feature of deployment, technology researchers may be in a better position to see the lines between what the inhabitants of the home view as being about the practice of research and where some of their *genuine orientations to the technology* might lie.

Developing these areas of practice may in turn improve our prospects of opening new possibilities for design in the home.

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