Intelligent Artefacts at Home in the 21st Century

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INTRODUCTION

For us, the term agency is a label to define that property of an artefact that gives it a place in some train of human action. Now, from this view, an artefact might be given agency by dint of being hit with another object held by a person. Thus the mechanics of movement could be a label for an agency of sorts. This view has no interest to us. Our view on agency assumes that the word is used to describe a sequence of acts that make manifest not just an action, a hitting of an object, but a thought, an idea, a moral purpose; in other words, a human action with particular kind of intention.

Now this sense of the term agency is one that opens up all sorts of conceptions and possibilities; it also opens up all sorts of conceptual confusions. As to the first: conceptions and possibilities. It leads one to imagine that objects with certain kinds of agency could be 'tools of the mind'. This, in crude summary, is the credo of distributed cognition and it various acolytes. As to the second: confusions. It seems to us that this claim –vis, how an object with agency is acting out an intentionality- has to be rigorously circumscribed. To say that a calculator is a tool of the mind, for example, is acceptable. But beyond this? The trouble is that in itself this claim seems too modest: after all, it tells us nothing that one would not ordinarily know insofar as one might pick up such a tool to help one solve a piece of arithmetic, say. Indeed one would expect a school kid of age 5 to know this. To say that somehow a device (say a calculator, again) 'extends the mind' leads one to want to say something more, though, and here confusion can slip in. Consider some of the things that one might want to say which claimed 'more'. One might want to say, for example, that an artifact, the calculator, has intelligence in itself. Another might be to say that an amalgam of things and a human mind are intelligent as a whole. The first of these statements few would aver to, one would imagine, even the most strident advocate of distributed cognition; the second most might accept at first glance, thinking it reasonable. But it is not, on our view. Let us explain.

In this view, intelligence is a quality or a quantity of the things in question. It is this (whatever this might be) that produces an outcome. Accordingly, this view might lead one to suggest that 'more things' in 'the right amalgam' might produce a 'righter', 'bigger', 'more intelligent' outcome. As it happens, this is more or less what Ed Hutchins claimed in his curious

book, Cognition in the Wild (1995). There he argues that the ways a mix of artefacts gets used as an assembly to allow large boats to be navigated in tight harbours makes the captain of the boat (or more particularly the pilot of the same) intelligent; here 'intelligence' is like a calculation. The problem we have with this is that this is not how one uses the term intelligent. That an amalgam of persons and machines might allow the person to achieve something intelligently is a claim that is reasonable. But to claim that the things and the person make intelligence is, in our view, wrong.

This seems merely semantic, but it is consequential, we would argue. Consider: one might say a pilot who fails to get his or her boat in to harbor fails because one of his or her tools fails. But this is not the same as saying that the pilot is unintelligent. Nor is it the same as saying that the tools (any individual one or them as a whole) are unintelligent. All it is saying is that the pilot failed in their job for a known reason – a tool or a set of tools didn't work. Of course, a situation where a tool fails might lead one to condemn that tool so that thereafter it is not used or, if it is, only circumspectly. Condemnation is important, it hardly needs saying. But at no point would one be saying when one condemns a tool one was doing so because 'it' was unintelligent or even because it was part of an 'intelligent system'. Its condemnation has to do with the fact it did not do what it was (is) supposed to. By contrast, when would it be that one would say of a pilot that he or she was unintelligent? Not when the tools let them down, we have seen. But one would say so in the following sorts of situation: when a pilot failed to take notice of the fact that a tool was not working, and did not devise word arounds or some other form of ameliorating action (like choosing not to go to that harbor). In this sense, a pilot's intelligence is held to account not for the actions of artefacts, whatever their agency, but because of his or her actions. In this view, intelligence is not a quality in a thing or a set of processes; nor is it a quality of agency. It's a question of moral culpability for persons. The term intelligence is, then, a moral term. Following Wittgenstein, we take the term to describe or label normative judgments: judgements about whether something has been done well, badly, thoughtfully or negligently. The term implies too that some one is accountable for the behaviour in question and for the arrangements of artefacts that allowed or enabled that behaviour. Intelligence is thus never an abstract concept - a label for an abstract thing nor a term applicable to empirical objects other than human - it is a term only applicable for human doings.

Now, what has this got to do with agency? How did we get here, only a page or two from the outset of this chapter? We are discussing this now since we think that misappropriating what agency might mean, and relatedly, the concept of intelligence, as bound up with the analytic purchase of the term agency, can lead to distraction and muddle in the ultimate tool we have at hand: namely language. Thus, when we say muddle and distraction, we don't mean that we say this as our view; we are not saying this as if it were our opinion; ours simply a view amongst many. We are saying this in reference to how it is that when

one stretches the limits and properties of language one can, sometimes, get wayward. Language is a tool of sorts but has to be used appropriately, we are saying; it is very easy, indeed, a chronic feature of words that they can be used in ways that misleads. And this is what we think is happening in the word agency gets used, most especially when it is used in connection with the word intelligence. When agency is used as label to indicate something about the relationship between human 'doings' and the 'things that people use', it seems to us that muddles occur and what is meant, ordinarily, gets confused.

Does this matter? Well, not because one wants to honour language; but only because one wants traction and direction on one's own thoughts. There are number of ways that one can lose such traction and direction. The most important one, at least the one we want to focus on in framing our chapter, is through making the workings of the mind (or at least perceptions as to what the workings of the mind might be), come to be far too important in the analysis of the relationship between things and people. We want to suggest that this is consequential for psychology (cognitive or otherwise), sociology, archeology and design, to name but a few disciplines. It seems to us that when distracted by having the 'mind' as the focus, disciplines that ought to be concerned with other matters start looking at methods for circumscribing the functioning of the brain. For archeologists, this means that artefacts they retrieve in the mud become indicators of the physiological state of mind of ancient man for example; for contemporary cognitive scientists, human action in everyday contexts becomes a measure of how the brain processes information.

We need to make it clear that there is nothing wrong with looking for these matters in themselves: they are perfectly legitimate tasks. But it is a concern when this distracts from what might be more insightful concerns. At its worse, it can lead science to discern what can only be described as truisms: that electronic calculators are tools of the mind is one such claim, for example (though as it happens this is not one that has been made, as far as one knows, but it suffices to illustrate the species of claim we have in mind). At best it leads away from a concern with discerning what is pertinent to understanding the contexts in question. Thus, to get a perspicacious understanding of how ship's pilots do their job, one would do well to put aside concern with how the brain works and look instead at the social and cultural systems that have produced pilots, ships, harbours and navies. One should look at the institutional histories of these 'social institutions'; at the social processes that is the training of pilots and so on; in sum, one should focus on doings and not mental operations. Of course, this is what makes Hutchin's book so curious: he says that one should look at doings to understand the mind at work and thus his book leads one away from cognitive sciences as practiced before that book's publication. But what we are saying is that one ought to take that book more seriously that Hutchins does himself and abandon a concern with mental categories and cognitive

machinery altogether. Don't worry about the mind at all, we are saying, just focus on the doings if you really want to get to grips with pilots.

Now, our concern in this chapter are not doings in the past or even in the present but is, as it were, doings in the future. We want to present our view on how to understand artefacts and doings, linked by the term agency, by presenting our view on certain sort of technology design. In particular, we want to explain and account for a number of our own technologies that might go in to what is called, in contemporary parlance, a smart home, and claim that these designs reflect an attempt to ensure that those artefacts let humans be smart, thoughtful and intelligent by making sure that accountability, culpability, the moral responsibility for action, remains in the person's hands and is not merged, through conceptual confusion, with the 'agency of artefacts'. It is achieved too by eschewing all concerns with categories of the mind or with notions of distributed cognition and relateldy, how artefacts might be agents in this. Enabling human agency in the home of the future is our concern, certainly, but we want to show that how we get to our designs is through being strict about what we mean by agency, and nested concepts like intelligence in the design processes.

Now, it has to be said that, whatever our pride or vanity, the quality of our designs is not at issue here - they might be good or they might be bad. Our goal is this chapter is to try and expound the philosophical position that has led to their design so as to credit the relevance of that position. Others, better versed in the nomenclature of, say, ordinary language philosophy, might be able to better argue the critical view on the concept of agency and the concept of intelligence (e.g, Button et al, 2005); we have to argue with the devices we build. They will have to act as agents of sorts, though whether the reader will let them so behave is another matter.

OUR DOMAIN OF INQUIRY: AN ARCHEOLOGY OF THE FUTURE

We choose the case of smart homes and devices within them for the very simple reason that interactive systems computing research has become, recently, very heavily weighted towards the idea of a smart home. There are now several ongoing, prolific and high profile research programmes in this domain, including Georgia Tech's "Aware Home", MIT's "Place Lab", Samsung's "Smart Home Project" to name but a few. The goal of much this research has been, to put it crudely, exploring ways of using computing to make homes more 'intelligent'. What has been meant by the use of these claims in the various academic papers that have been produced, and in the marketing material that often gets associated with the projects, is not always clear, though as we shall see, it is bound up with pragmatics. Leaving aside the technical merits of the ubiquitous and pervasive computing that has resulted from such projects, in practice the most obvious social or human benefits (still more hypothetical than real, alas) have been for those one can say have constraints on their ability to effectively conduct

themselves intelligently. We are thinking here, most expressly though not unkindly, of the handicapped, the aged, the sick and so on. With the smart homes that have been built, disbursement of medicine can be monitored and managed; accidents that might befall old people can be observed and medical intervention summoned if necessary. In this way, what was before merely a set of walls and enclosed spaces has become, in these smart homes, an infrastructure with what some have called a 'technological intelligence': the ability, of the machines therein, to monitor, look and act at appropriate moments.

Leaving aside, for the moment, what one might think of this particular view of 'intelligence' and its agents, achieving these benefits requires a specific type of networked-smart home experience, replete with sensors, monitors and cameras of various kinds. Unfortunately, for home dwellers without the particular needs of the aged or sick, both the complexity of these technologies combined with their unfamiliarity demands a very high level of perceived benefit before they become appealing. Indeed, if the history of research into this area attests to anything, it is the narrowness of the appeal of smart homes to a wider population (Abowd, et al., 2003; Aldrich, 2003; Edwards & Grinter, 2001).

Nevertheless, this is not of concern to us here. As we say, we have a different view on what smart homes might be which does not pertain to the question of which segment of society they are built for. For us the goal of 'smart home research' is not to design technologies for specific and unusual needs through the implementation of networked technical infrastructures. Rather, we start from an altogether different assumption: we think of the home is already and always has been a place where people can be smart, smart not in terms of technology, but in terms of how people conduct their lives. Our view is that the smartness or, if you prefer, the intelligence in the home is to be found not in the artefacts nor in the structures that the artefacts are part of; it is to be found in the human endeavours with those artefacts. Recognizing this, our approach to the invention and design of devices for the home is to design them so as to augment and support the uniquely human art of home making. The intelligence we seek to enable is not in the devices then, it is in the artful ways those devices are leveraged by the occupants. This way of thinking, as we will show, results in technological concepts which are quite different from those typically found in smart homes which often seem to be based on blurrings of the term intelligence with agency; a blurring of the moral culpability of human action with the concept of mental functioning supported by embodied artefacts. Hence our agitation at the outset for trying to conceptually define what agency might mean. In our world, our research world in computer human interaction, agency and the smart home often mean intelligence in the artifact, agency as a synonym for distributed cognition (for a parallel argument, see Tolmie, et al., 2002).

We wish to present our own view not by reporting all the designs we have worked on, but by exploring a particular theme that highlights how we see human intelligence at play. More especially, we focus on what might seem to be the most

obviously unintelligent and mundane aspect of homes: namely, surfaces such as fridge doors, notice boards, kitchen walls and even the surfaces provided by bowls. We explore how these surfaces are transformed from being merely the materials that constitute a house into resources for the organisation and enrichment of home life but without having to impose some categorisations of agency and intelligence. Having understood this, we then elaborate on the ways in which we have extended the power of these surfaces as instruments, through the use of computing, again without any conceptual baggage.

SUBSTANCE IN DESIGN

We are, the reader might be surprised to learn, not the first to focus on such prosaic properties of home settings as fridge doors, walls, surfaces and bowls. Nor are we the first to explore the potential of digitally augmenting them. Attention has been given to picture frames, for example (Kim et al. 2004), digital pin-boards (Laerhoven, et al. 2003), and much else beside (e.g., Bonanni, et al. 2005; Ju, et al., 2001; Petersen, et al., 2005). What makes our research different though, and this does relate to our concern with what intelligence might be, is how the use of any particular artifact is subject to a larger regime of behaviours: in our view, to understand where a picture frame is located, for example, is to understand the moral order of the home where the location of a picture tells one something about how the occupants of that home want to communicate their intelligence'. They place some pictures 'here' because they are thus on show to visitors for instance, they place other pictures 'here' because they are in a more private place. Function, purpose, role, use, are bound up with the ecology of place, then, which is as much as physical system as a social and moral one. This harkens back to Norman in the *Psychology of Everyday Things*, who noted how placement of information in particular places can act as a memory aide (1988) but adds to that a sensitivity to the delicate arrangements of meaning that direct, control, guide, and provide a framework for understanding the intelligence behind the physical. And here what we mean by intelligence is how the artefacts in question owe their existence, location and function to what some one has judged to be 'right for the home'. In each of the following examples of technology concepts we shall and explain how we have sought to design devices that allow people to make these decisions as they see fit, so as to allow them to act intelligently.

FRIDGE SURFACES AND AUGMENTED REFRIGERATOR MAGNETS

The first example we would like to turn to emerges from our field studies of fridge surfaces in family homes. As most readers will know from their own experience, one of the notable properties of fridges is their relatively large display surfaces (although this can and does vary between houses and indeed between countries). Indeed, if fridges are oriented in certain ways, households can find they have two and sometimes three large surfaces available: the front and whichever sides are accessible. This expanse of space can be put to good effect in some simple but nevertheless useful, and in our view intelligent, ways.

Figure 1. Haphazard display of photos, artwork and invitations.

Figure 2. Working area to left plus "family history" displayed on fridge door.

For example, a fridge's different physical regions can be assigned to particular uses and even allocated to particular people. For example, the lower regions of family fridges are often taken over by items belonging to children, while higher up, it is common to find 'working' areas containing shopping and to-do lists, and other organising items for 'Mum'. Scattered across these zones, more often than not, are memorabilia (Fig. 1).

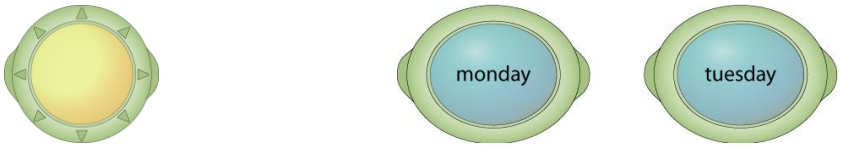
In some cases, the divisions between the different regions can be more formal. One side of the fridge might be given to a household's organisational items, the front to family photos, and the lower areas to children's things (Fig. 2.). Such organisation has the advantage of making it clear whether items are associated with specific activities or belong to particular household members. Spatial patterning can also be used to signify the change in status of items: a party invitation moved from a fridge's working area to its family display area can signify that the action has been taken to accept the invitation, for instance. Regardless of the particular arrangements, the salient point is that fridge surfaces lend themselves to having an array of heterogeneous items attached. The fridge's form—the height of its surfaces and its separated sides—helps in offering a simple way to categorise materials. All of these arrangements, enabled by the fridge's form, are controlled by those in a house.

Of course, it could be that any surface in the home would afford the same utility; but part of our approach is an understanding of what about the particular site of a surface gives it properties specifically relevant for the human endeavour in point. As we have mentioned, our own research and others have noted that where a display surface is situated in the home is key to understanding what is displayed, as well as when, how and to what ends. The same holds true for fridges. In nearly all homes, fridges are in the kitchen and thus seeing fridge surfaces is an almost unavoidable consequence of ordinary life—when preparing meals, making drinks, snacking and so on. Indeed, in most homes the established moral order, if you will, gives household members the right to be in the kitchen, use the fridge and to consequently view the contents attached to the fridge, whether they want to or not. The fridge provides a surface which is not only 'public', but also inexorably interleaved with the rhythms of the home.

What we see then is that fridge doors and sides become interactive surfaces of a particular sort, holding some materials, but not others; affording a particular range of interactions that weave into ordinary routines. In short, the physical form of fridges and the way in which use of that form is embedded into a home's social organisation set it apart from other surfaces. Surfaces on fridges become, in our terms, intelligent surfaces not in what they do, but in the way they are used. Our claim is not merely that, in the home, various surfaces are 'interaction and display points'—this much is obvious. This discussion of fridge doors and sides is intended to show that what makes homes intelligent is how surfaces (amongst other things) are used to display material in particular ways. The intelligence, in our way of looking at things, is in deciding where things are put, how those things are put, when and with what intended effect. Fridges may be dumb, but the way artifacts are attached to them is not.

With this in mind, we have considered ways that we might assist this intelligence with digital means. Rather than substituting fridge doors with digital alternatives, we have been exploring ways of letting fridge doors (and sides) do more for the user. We have begun by focusing on a distinctive properties of fridges that enabled the intersection of where, how, what and when: namely, that most fridge doors are magnetic. Magnets allow all manner of items to be attached to fridges; things can be attached anywhere with little to no thought and their movement and removal is made trivial. This enables a fluidity to fridges as a display—things can be easily moved into, around and between the different regions and no prescribed arrangement is enforced. The design concepts we have derived from this seek to augment this magnetic property to further enhances the fridge surface's useful functions.

In the first instance, we have conceived of reminding magnets. Somewhat perversely, sometimes things left as reminders on fridge doors get forgotten about. Although fridges are good places to put reminders, they are not necessarily perfect places. Our reminding magnets are a lightweight solution for drawing attention to items in unobtrusive ways. In one version of the concept, moving the magnet causes it to glow for some period of time thereafter, drawing people's attention to items that are newly attached or newly rearranged (Fig. 3a). In another version (Fig. 3b), magnets that glow on specified days can be attached to items which need to draw attention to themselves on those days such as appointments and party invitations.



(a) (b)

Figure 3. Magnets that glow when moved from one place on the fridge to another, drawing attention to attached item(s): (a) glows for 24 hours once moved, (b) glow on the labelled days.

A second concept builds upon the practice of putting important and frequently used items like shopping lists and school term dates in specific places on fridge doors. The fridge-glance concept is designed to overcome the problem of accessing this material when away from home; for example, when shopping or making calendar arrangements. Incorporating an in-built camera, the concept allows items placed within a purpose-built magnetic frame to be remotely viewed via a camera-phone or Internet browser. The frame is meant as a visual cue, a mnemonic, demarking an area where items can be casually placed to be remotely accessed. In this way, the design takes into account the informal, offhand use of fridge surfaces, but remains sensitive to the importance of particular attached materials.

A third concept, talking magnets, is intended to help 'annotate' the materials placed on fridges. Annotations might be useful when additional information about an item might need to be quickly and easily conveyed, to dynamically label a magnet (changing the status of items affixed to a fridge, for example). Differences in design might reflect differences in purpose: one might make it clear who a message is from (Fig. 4a) and another merely provides the message itself where identity might not matter (Fig. 4b).

At the moment, these are initial concepts, attempts to explore how we might augment what people do with particular surfaces, though even as we write prototypes are on display in our 'lab'. As is the way with technology, however, building ones tat don't break or look too cumbersome to make appealing is not always easy to do. Nevertheless, our ideas consist of using digital means to give greater conspicuousness to reminders, making remote access possible and allowing 'digital' annotation. We are not, at this stage, certain that these are all or even the best ways one might achieve the enhancements we have in mind. But in initial paper prototyping exercises, the overall response to these concepts has been largely positive, with five different households interviewed having their own particular favourites. Of relevance to the general theme of surface ecologies has been the reaction to the straightforwardness of the designs. Households were struck by the inherent simplicity of what they initially thought to be yet more 'technology' for the home. They responded positively to the idea that they might be able to operate the magnets almost without thought. This provoked a sense that the magnets would compliment the ways a fridge, as a surface, is used. As the mother in one household put it: "The most important thing is that they're easy to do, that you don't have to turn them on. You can use them on your way to the sink to do the dishes or something."

(a) (b)

Figure 4. Magnets that allow items on fridge surfaces to be annotated: (a) indicates who created it and (b) allows voice recordings.

SITUATED MESSAGING IN THE HOME: HOMENOTE

Turning from refrigerator surfaces, our second example relates to another kind of messaging, though this time going beyond the boundaries of the paraphernalia found on fridges. We are thinking here of how certain "low tech" artefacts, such as paper notes and Post-It notes, whiteboards, corkboards, and paper calendars are used for within-home communication, for messages between members of a house when they are at home. These particular forms of messaging, some of which appear on fridge doors but elsewhere as well, are strikingly non-computational. These mundane artifacts also have some distinct properties. As we have already described with refrigerator surfaces, the placement of these artifacts within the home, both physically and socially, is critical to their use. A note placed on the refrigerator door (and even where on the door it appears) has implications for who will see it and how it will be used. Further, people make particular decisions about where best to leave a note for someone else, there often being places in the home or "communication centres" where important messages are left [refs]. Additionally, it is in the nature of these artifacts that, because they are inscriptions on paper, or on other display surfaces such as a whiteboard, they have a visual, static persistence or "epigraphic" quality to them. There are two implications of this. First, they attract attention to themselves in the periphery and as a consequence of everyday activity. For example, notes are placed in such a way that the right people will "come across" them when they are needed and in the course of their routine activities. Thus, they are "pushed" to people's attention in often subtle ways. Second, because they are visually displayed in this way, depending on where such notes are placed, they can be accessible to anyone present in a particular room or area of the house. Thus they are, in a sense, publicly "broadcasting" to no one in particular, but to anyone present.

Contrasting this with remote communication technologies, we can see at once that many of these are "placeless" rather than situated technologies. The mobile phone and email, in particular, are "person-to-person" rather than "person-to-place"

technologies. In other words, if I send an email, I have no real assurance where my message will be received, only who will see it: it may be that it will be read at work, at home, or even on the road. If I call someone on their mobile phone, I have no real certainty about where and under what circumstances that call will be received. Remote communication technologies also differ in that they rarely push themselves to attention as a backdrop to other activities. They are more often foregrounded activities demanding attention, such the ring of the telephone, or they may require the user to make a deliberate decision to check for email or voice messages. Thus, they are often "pull" rather than "push" methods of communication. A final difference is that because remote messaging is often dynamic, transient, and hidden from view (such as voice messages or email), they do not naturally lend themselves to broadcasting to more than one person, or indeed to a household.

Our development of a prototype technology called HomeNote was motivated by the proposition that the unique affordances provided by paper-based messaging in the home, combined with the ability to remotely create them, would generate some compelling new design possibilities. More specifically, in building HomeNote, we wanted to explore the unique affordances and potential value of person-to-place as against person-to-person messaging technologies in the home. But we also wanted to deploy HomeNote into real households as a kind of "Trojan horse" to allow us to deepen our understanding of home communication. This in turn we hoped would allow us to explore possibilities for new and different concepts based on our understanding of the communication needs of households.

This led us to develop a technology called HomeNote. As a starting point, we based HomeNote on TxtBoard, a situated messaging device that used the SMS protocol to let members of households broadcast messages home (O'Hara, et al., 2005). This device was expressly designed for simplicity with many of paper-like functions and an early trial of TxtBoard with one household provoked some of the kinds of home communication we have discussed. We thus sought to combine TxtBoard's minimal set of functions with properties that might leverage new benefits. Specifically, given that so many of the messaging tools in the home involve inscribing in one way or another, we wanted to build a prototype that supported stylus markings, or scribble, in addition to SMS.

HomeNote itself was constructed from off-the-shelf technology: it was a tablet computer encased in a wall-mountable frame containing GPRS and SIM cards. This provided each device with a unique phone number to receive and display text messages from mobile phones. Because it was a tablet computer, HomeNote also supported locally scribbled notes, or scribble annotations on top of text messages. Users could also switch between messages using the tabs along the top of the screen, create and delete new messages, and see at a glance who sent a text message from the information down the left side of the panel (Fig. 5). (See Sellen et al., 2005 for more detail.)Whereas our studies of fridge magnets were paper-based

prototypes, Homenote was built and tested. In total, we built five prototype devices and deployed them in local households for a period of a month or more.

We found that HomeNote did extend the ways messaging practices were undertaken, and not simply by combining remote delivery with local display in ways that prior surface technologies like Post-It notes could not. It also encouraged new forms of messaging. That is to say, Homenote did not just stretch the intelligent use of particular kind of surface, it helped create new ones.

For example, in supported remotely-created situated messaging, HomeNote demonstrated value for all households using it, allowing them to communicate in new ways. Thus, teenage children could send messages home to reassure all the family of their whereabouts, and husbands and wives could text home to say that they were on the train and due home at a particular time. These kinds of messages were not only functional, they were also ways of having a presence in the family, and expressing affection for other family members.

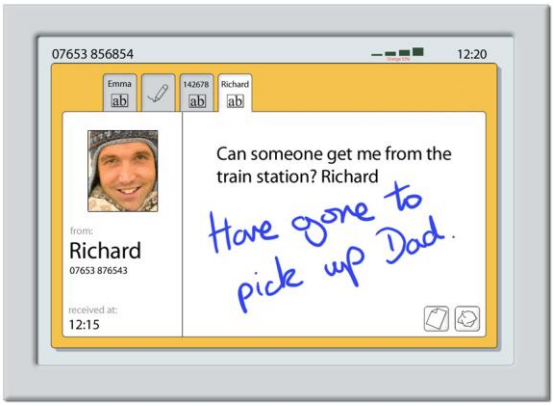


Figure 5. The HomeNote interface showing a text message overlaid with a scribbled note.

Aside from messages of awareness and reassurance, we also found many messages were, in effect, "calls for action" sent remotely to the household. Here we saw that the ability to remotely create place-based messages in the home was also used to valuable effect. HomeNote allowed calls for action to be finessed in new ways. For instance, in one household, one of the daughters would use HomeNote to request a lift home from her shift at the hospital. Here the fact that this message was posted in the background of ongoing domestic activity, broadcasting but not specifying either parent, meant that such requests were viewed as less demanding than might have been done via the telephone. According to this daughter, and indeed her family, the peripheral awareness afforded by HomeNote messages enabled an expressly polite kind of request to be made.

HomeNote was used frequently to broadcast what we came to call 'social touch' messages to the family. These were "I'm thinking of you" notes sent generally to a whole household, or addressed to one person in recognition of the fact that others would see it. These would sometimes take the form of scribbled notes, but other times would be sent remotely as text messages. For example, the father in one household regularly sent messages the night before to HomeNote to say "good morning" to his whole family, or from work to say "welcome home" when he could not be there in person. Thus, the creation of notes remotely, with many of the paper-like qualities we have described, offered a new set of affordances for households.

In addition to demonstrating the value of remote messaging, we also found that, because HomeNote supported local scribblings created in the kitchen, it took on the role of a whiteboard, being the place for jotting down reminders, important telephone numbers, shopping lists, phone messages and so on. More interesting, however, was how HomeNote highlighted new kinds of messaging not previously recognized in the literature on communication (Sarvas, et al., 2005). For example, we found frequent use of the device for messages that looked like social touch messages, but in fact were more about broadcasting the identity of the creator of the message, rather than directed at anyone else. Many of the 'good morning' messages scribbled by younger members of households, for instance, were signed with a flourish—as if these declarations and ornate signatures were intended to put that person's 'stamp' in the kitchen. Scribbles in which children announced they were off to bed or had finished exams were also of this nature, drawing attention to themselves without any particular purpose. We found that it was not just children seeking a visible space for their expression; the father who regularly sent 'good mornings' to his children complained when his messages were occluded under others or were scrawled on by children. In short, we came to the conclusion that these kinds of messages were playful, sometimes tender ways, of seeking affection, or of drawing attention to their creator. They were, if you like, a form of saying 'don't forget me'.

In summary, this (relatively simple) prototype and its deployment underlined the ways in which the kind of communication that goes on in families is bound to place: to the sensitive—intelligent in our language—selection of particular places to put messages. But in addition, the introduction of the device encouraged a sensitivity to new forms of communication, where "placeness" was linked to affect. Family members appreciated it when others expressed a thought for them. They appreciated it all the more when these thoughts were displayed it in a public place: the kitchen. Similarly people felt a tenderness (even a sympathy!) for those who simply messaged, in effect, 'think of me'. In other words, what we enabled with Homenote was intelligence of a kind, albeit sometimes sentimental. Smart homes should be as sensitive to this as they are to reminding, planning and other more functional types of tasks. After all, intelligence is not merely a matter of practicality, it is also a matter of affection.

SUPPORTING FAMILY AWARENESS: THE WHEREABOUTS CLOCK

Our next example leads directly on from our work around situated messaging in the home. Our studies of HomeNote made us realise that there was a place that could allow a variety of forms of expression, ranging from the tender through to the functional. But amongst these messages it became clear that some, a particular kind, had a special value that needed protection for itself. This was not because these messages were notably valuable or rich, rather that their value derived from being seen at a glance in the place in which they were relevant.

In particular, the messages in question were related to the whereabouts of the sender. Here it turns out that where someone is is not something that lets them express something in particular, it is a statement of fact that in itself expresses meaning. Thus the fact that someone is stuck on a train might mean that the person in question is lamenting the chaos of the traffic system, but what it also means, and this is more salient to those in the home, is that that person is likely to be late. This is of importance to the recipient of this information, important given where they are. It might mean that they might adjust their plans for eating, for example, or it might mean that they avoid worrying about the due arrival of their spouse or offspring. The whereabouts of people turns out to be a useful piece of information in the home for those doing particular things in the home.

It is in light of this that we built a device called the Whereabouts Clock. This allows family members to observe the whereabouts of other relatives, using a coarse-grained representation. Figure 6 (left) shows a screenshot of this initial prototype with three broad location categories identified as “Home”, “Work” and “School”. The middle of the circle identifies when individuals are travelling between locations, or are in an unregistered location. Icons identify individual family members, these moving between categories to reflect changes in physical location. Our current implementation uses the identification of nearby cell towers to detect, at a loose approximation, where individuals are. Groupings of cell towers are mapped onto these high-level human interpretable categories. A SmartPhone client (Fig. 6 top right) scans for cell towers in proximity and sends updates via SMS to the situated surface when people cross over these mapped boundaries.

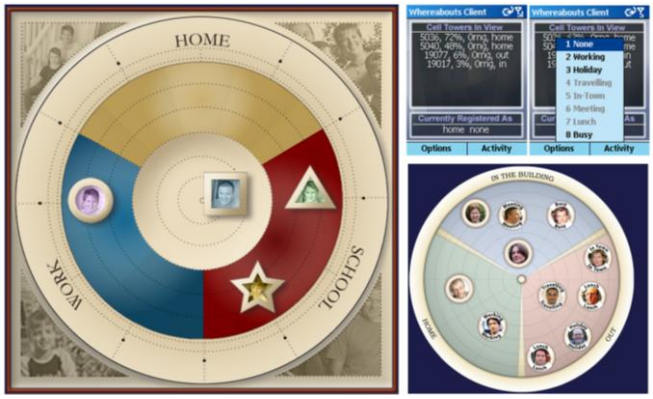


Figure 6: One particular design for the home version of the Whereabouts Clock (left), office version (bottom right) and SmartPhone client (top right).

We designed the Whereabouts Clock to offer the protection for whereabouts information we had in mind, a protection which reflected its rather particular importance. First, and perhaps most obviously, the surface is intended to be situated in the home rather than remotely accessible or mobile. Though this is obvious, it is worth noting because it makes it clear that the information that this surface displays is designed for recipients in a particular place. The display is also intended to be always on, continually available for people in the home (and specifically in the kitchen) to view. This is not because we think this information is so important that it is needed twenty-four hours a day, but because its persistent availability means that it is there, when it is needed, whenever it is needed. A surface such as the one on the Whereabouts Clock offers visual information persistently and does so through being at-a-glance. Hence people at home can engage with it in much the same way as they might glance at a table or fridge to see if mail needs to be attended to. But, in being separate from these other places where various types of information might be located, the utility of this information is made greater. In this case, seeing is the trick; seeing without effort. Location information is important, but only to the extent that it can be seen without effort. The Whereabouts Clock reflects this.

We have as yet to trial the Whereabouts Clock either in the office or in the home. Whatever its fate, the fact that it is a situated display may be important in addressing some of the concerns around privacy found in the literature on location tracking. With our device, only people located in a particular place can view location information. These people are in the home and are therefore subject to its constraints: determining who can see (by dint of access rights to the house), as well as when they might be able to see (by dint of when people ought to be in the house), and so on. The result of this is that, by design, sensitive information is only broadcast to other trusted family members. This is not to say there are no privacy concerns around such a surface. There may be instances when family members prefer to be selective in revealing their

location or activities to others. Teenagers, for example, may prefer not to have location information automatically pulled, but would rather push this information to their parents at select times to reassure them, or they may be happy for their parents to know they are in town but would rather not reveal their specific location in a bar or club. We have therefore deliberately selected a high level of granularity of the location information in question. In this sense, we have tried to attain a level of 'intelligence' that is appropriate for the home, given the nature of the need for the information, and the type of people who have access to it. Intelligence is as much about where you can find out about something as much as what it is you know.

MEDIA CONTAINMENT: THE PICTURE BOWL

The final example from our studies is of a seemingly persistent feature of family households which would not seem to have much to do with surfaces. After having our attention drawn to a series of bowls holding a collection of miscellany in a household we were studying, we became intrigued by the different ways people collect, store and manage clutter. The prevalence of clutter in family homes seemed to recommend it for study if only because of its near ubiquity. As we began to delve into this topic, we also began to see how surfaces of a kind might be leveraged to offer new ways of dealing with clutter. To get to this point in our thinking, though, requires us to take a look at what clutter might be.

Clutter is made up of a variety of things: things temporarily out of place, things with limited life spans, things with ambiguous sentimental value, things in transition and things that no one knows what to do with, to name a few. By its nature, clutter in family homes is particularly heterogeneous because it represents the detritus of all the various family members. In and amongst a family's clutter, one finds functional things like glue, rubber bands, tape, lumped with children's broken toys, old sentimental items that do not quite deserve a place on the mantle piece, and so forth. Similarly, there are coupons, batteries, and chequebooks sitting alongside what might be seen as the quintessential item of clutter, keys that belong to no obvious keyhole, but no-one dares throw out.

People deal with clutter in a variety of ways. They enlist bowls and drawers, dividers, tubs, plastic bags, and all sorts of categorization methods (or hardly any at all). How people in families choose to divide and store their clutter varies, as does the amount of effort expended, but what remains consistent is the use of artefacts that physically contain. The trouble with clutter, as we all know, is that it can spread out; bowls, drawers and the like keep it together, contained.

Although clutter is often treated in an off-hand way, what is evident is that where containers like bowls and drawers are situated in the home does matter. And this returns us to our concern with surfaces, to the idea that where things get put, what things, when and how, is a measure of the human intelligence in a home. Here, though, this intelligence relates to being tidy,

being, as it were, organised sufficiently that the home does not submerge under chaos. This is a kind of intelligence which is also (on the other hand) not so organising that it becomes a burden. One can be intelligently lazy after all.

It's possible to imagine a smart home automatically sorting and dealing with clutter in the ways we have described. The premise might be that a task that requires just a little bit of forethought and intelligence could be done away with and given, so to speak, to the building. From what we have seen it seems that such a solution would encounter all sorts of problems. It is evident, for instance, that the allocating of certain sorts of stuff to clutter bowls, drawers and so forth, is a thoughtful activity, where subtle judgements are made about stuff that may have no immediate place or certain 'home'. To be sure, some of it might eventually be given somewhere to go, but a lot of clutter sits in the bowls or drawers waiting until time and a little sentiment move it along, perhaps to another bowl or a drawer, or sometimes to the rubbish. Thus, however intelligent a smart home might be, it is in the very nature of clutter that a proportion of it can't be sorted out, that it remains ambiguous.

If this seems reasonable, it still remains some way from the design of technology. 'Some things don't have places to go: so what!', one can hear the smart home designer say. But this is to miss the point that an intelligent way of dealing with the uncategorisable is required in the home. Stuff like keys for unknown locks is one thing, but it seems to us that, at a time when members of homes increasingly carry all sorts of digital devices, the amount of digital clutter they bring home is increasing, too. We think smart home designers might ignore this clutter at their peril and, though they might prefer to ban it from their smart homes, a solution for dealing with what one might call digital clutter is required.

Currently, the established solution for handling the proliferation of digital media (e.g., digital photos, video, music, etc.) centres on the PC. The PC serves as a 'hub' to peripheral devices designed to capture and play digital media, devices such as still and video cameras, MP3 players, PDAs and, increasingly, mobile phones. There is, undoubtedly, much to recommend the PC as a destination for digital media. It offers a common interface to store, organize and manipulate digital media, and gives users the ability to perform a number of sophisticated editing procedures. Seen from our perspective on the use of bowls and drawers, the PC, however, does not present an easy, low effort method for dealing with digital media. Rather, it offers what one might say is too much, an unwieldy piece of intelligence that doesn't reflect the casual storage and loose organization that clutter deserves—even of the digital kind.

Take, for instance, the burgeoning use of media-enabled mobile phones. The content on these phones is not necessarily captured, stored, shared and occasionally cherished for its quality or to use in later editing. Instead, the quickly snapped photos or shared video are retained, temporarily or possibly for longer, primarily as a way of augmenting the lived experience of any moment in time (Harper et al, 2003; 2005). Accordingly dozens of images are taken during a day, most of which have

no value after they are shown. Some though, for a variety of reasons, may have value but this might not be clear at first nor something that the person who has taken the images wants to decide upon there and then. Instead, a common practice with mobile phone content is for users to keep the images on their device until they are forced to make a decision. Unfortunately, they are eventually confronted with the PC option, download them all and edit. Our point is that this is a step too far. And here is the rub: what would a reasoned alternative to the PC be? It seems to us that what is required, instead, is a solution that reflects how images on phones have clutter-like properties. They consist of a mixture of stuff, some that has no value and some that does. What is needed is a way of putting this stuff somewhere temporary. This is what we have being trying to devise.

Drawing on the ideas we have developed from our study of clutter, we have attempted to determine what physical properties enable the low-effort storage of clutter. By enabling comparisons, our position on surface ecologies has been instructive. For one, it has provoked the question as to why it is that bowls and drawers, as opposed to other places including the innumerable surfaces one finds in the home, afford the practices we have described above. Why are countertops, floors or stair landings not the sites for clutter? The answer is obvious, but we will restate it: stuff needs containing.

Second, the idea that there is an ecology of surfaces in the home made us recognise that where a bowl of clutter is affords something special: it's placed in a way which reflects where the clutter may be 'properly unpacked'. We find that bowls in entranceways to the home, for example, succeed in their rolls as containers for keys, cheque books and the like because that is where those things spue forth from pockets and raincoats. Again, we return to the moral order of the home, to when and where it is acceptable to do things like place and amass clutter. Bowls and drawers, placed in particular locations offer just enough to deal with clutter where it arises and shows itself. Situated as they are, in the right place and at the right time, bowls (and indeed other containing devices) allow for an intelligently low-effort method of maintaining order.

Our studies also made us reflect on the fact that bowls display at least some of their content. This means that what class of things might be placed into them is visible to everyone in a house. So, whilst bowls contain, they also reveal; passers-by, as it were, can see what they are for and leverage it for themselves. In these ways, the placement of bowls, the way they display clutter, makes the organisation of tidiness tractable. It may be a form of idleness that leads people to throw things in to a bowl, but it is an intelligent way of dealing with the problem (of clutter) in home settings.

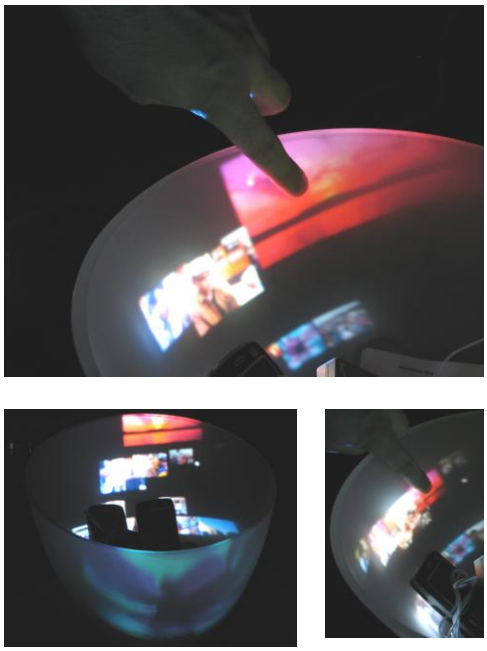


Figure 7. Current manifestation of *Picture Bowl*. Two data projectors project media thumbnails onto the opaque glass surface where media is visualized. We anticipate using Bluetooth and to identify individual devices and transfer content. We also intend to touch-enable the bowl, incorporating a flexible transparent capacitive overlay.

With these points in mind we have designed the Picture Bowl (Fig. 7), an augmented bowl that exploits how bowls 'work' and that further enables simple and lightweight actions for viewing and holding digital media. Still at its concept stage, we plan for our Picture Bowl to allow physical and electronic devices to be placed in it and when this happens for their content to be displayed in the form of thumbnails on the sides of the bowl. As more devices are added, existing content will be 'pushed' towards the bottom of the bowl. In this way, the Picture Bowl will provide a sense of sidedness and depth—in essence a place to contain. We also propose that content will be copied to the bowl by simultaneously holding a collection of thumbnails with one finger and removing the associated device, simulating a peeling-off like effect. We have in mind how this operation will offer a low effort solution to simply shedding content, for instance in an entranceway bowl as one rushes out the door with a digital camera. The possibility of this stands in stark contrast to the efforts needed to upload content to a PC and, in doing so, being immediately directed into an 'environment' where one must organize and edit media.

To support the 'glanceability' of content in bowls, we also envisage thumbnails being slid up the Picture Bowl's sides and 'attached' to its top edge by selecting on and moving a thumbnail with a finger. This could allow specific media to be left for passers-by to see, possibly offering a subtle, visual reminder for some action or event. To further support this, we want to exaggerate the stretching effect that results in moving a thumbnail from the tightly curved bottom of the bowl to its relatively flat sides: as a thumbnail is slid up the side we propose to increase its size and also its brightness.

Last, but not least, we imagine the bowl being portable so that it can be situated in places that fit the home in question. Ideally, a home might also have multiple augmented containers that could be situated to support different uses. This would allow, for instance, problems of privacy to be dealt with in a common sense fashion. People could place personal containers along with their content in private places like the bedroom and thus privacy would be managed through the social ordering of the home and not through the cumbersome and arcane use of passwords and access rights. A portable device would also allow media to be moved from one place to another. Thus content might be brought to an augmented tabletop where it could 'poured' onto the larger flat surface and organised, shared or deleted. This would further harness the properties of different surfaces, making the most of bowls for containing and the flat horizontal surfaces for activities such as sharing and organising.

CONCLUSION

And thus, in a roundabout way, we have come back to the beginning, to the idea of what intelligence might be as a concept driving a design orientation. Things do not have intelligence, in our view; things never will, we believe, because it is what people do with things that endows the human user of the things in question the ability to display their intelligence (see also Norman in press). For that only they, the human, the 'user' in our parlance, are culpable. Artefacts never can be morally responsible.

We have illustrated our arguments with concerns that have been deliberately mundane. We have wanted to avoid any muddles about complexity and function and form so as to focus on the conceptual issues at hand. Thus we have looked at 'surfaces in the home', for example, because they are places in which the 'intelligence of people' in the home is marshalled, displayed, leveraged and worked on. People use surfaces in intelligent ways to do various sorts of things. But surfaces are not artefacts of intelligence. It would add nothing to the understanding of them or to the process of designing new forms that might take to say of them that they did. Surfaces are merely surfaces.

Not all of the things we have explored are equally useful in the attainment of intelligent behaviour in the home, needless to say, nor do they achieve equal ends. The ways in which people use fridge surfaces does not reflect the fact that they orient to their daily tasks as if all were of equal importance or merit. Quite the contrary: what one sees on almost any fridge door is how some things matter more than others; how some things will matter tomorrow but not today; and how other things don't matter at all and yet are thoughtfully placed there for everyone to see. Sentiment is a form of thought too.

One could approach this diversity as a problem, one that computers could help solve. The smart home programme, as we see it, has been preoccupied with elaborate technologies to monitor human movement, the comings and goings of occupants, and

has sought to link this movement to various messaging systems, for example. According to this vision, the smart home will be able to check who is in the kitchen, say, and can alert that person to various messages to or to-do-items related to their being in that place.

Though this vision sounds appealing, to us it is misguided on two counts. First, and this is the weakest objection (though nonetheless a powerful one for that), we conject that this vision will be too difficult, both technologically, but also in terms of its usability. Replicating the complexity of the real world would make the system complex and vulnerable to error; it will almost certainly make it complex to use. We would expect the burden of entering in data in to the smart house to be far greater than the (unreliable) benefits that come out of it.

A stronger objection, from our view - and indeed the one we have wanted to emphasise as the leitmotif of this chapter - has to do with what one might call the balance between human and machine in this vision. This is to allude to a particular take on what intelligence might mean and imply. It seems to us, and we are strongly convinced of this, that the way people deploy their thoughtfulness at home is through steering a course between two opposites: being mechanical on the one hand and being relaxed, unplanned and almost chaotic, on the other.

To be more specific, it seems to us that what one learns from almost any ethnographic study of home settings is how things become sterile when they are routine. To send a good morning message to one's partner as they walk in to the kitchen each morning will soon become meaningless and irritating if done every day, mechanically. Tenderness between people in the home is suffocated by routine. Yet the opportunity for tenderness is squeezed by the practical requirements of living at home. There are always tasks to do and things to plan for. Though one might want to make everyday different, in practice there is a daily grind of 'housework'. This would suggest, then, that the solution is found in mixing the routine and the novel, the effortful and the relaxed in different ways. Accordingly, every person and every household is different in precisely the ways that each chooses a particular course between these opposing goals. Their choice makes each home unique. Our view is that we should design technology that allows people to make the decisions as they see fit, and to reflect what they value on any particular day. Thus it is up to individual members of a household to send a note to say they are thinking of someone else; it is up to that person to sort the digital clutter in their bowls. This is how they show their intelligence. They may do it badly, they may do it well, they may do it artfully or crudely; but this is what intelligence means. This is how we use the term; this is its correct meaning. No intelligence in the artifact for us.

This is not to say that we exclude the possibility that artefacts, in their design, cannot help people be intelligent; that they cannot, as it were, offload some of their work needed for intelligence. Certainly, we want to make some of the work easier for

people but not in the sense of 'letting the device do some of the thinking', nor in the sense of reducing the burden of choice but by making choices clearer to judge and easier to see both for those who make the choices and those who benefit from them. To be able to see at-a-glance that some one is still at work means that an individual can choose either to delay dinner or give the person still at work a call and urge them to hurry home, before it's too late. The technology here is not offering intelligence, it is only offering people in homes resources to act and think. It is this thinking, in the hearts and the minds of the occupants, that should make a home smart, not the technology used to build a home. This is our vision of the future. In this chapter we have wanted to offer this vision as a way of looking back to the past: in to what it might have been to be intelligent in homes that have long since vanished into dust and dirt, only to be conjured with the intelligent use of the archeological imagination.

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