Electronic Furniture for the Curious Home:
Assessing Ludic Designs in the Field

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Abstract

In this paper, we describe field trials of three electronic furniture prototypes for the home. Each of the pieces was developed to explore different ways to encourage "ludic" engagement with the home, suggesting that computational technologies can meaningfully serve curiosity and exploration in domestic environments. The Drift Table shows slowly scrolling aerial photography controlled by the centre of gravity of the things on its surface. The History Tablecloth senses the locations of objects left upon it and creates a slowly growing "halo" around those left the longest. The Key Table, measures the force with which people put things upon it and tilts a picture frame to indicate their mood. Each of the pieces was loaned to different households for periods ranging from one to three months. Because they were designed to encourage users to appropriate them through their activities and interpretations, a hypothesis-testing paradigm was inappropriate for evaluating the success of the designs. We focused instead on gathering rich, multi-layered accounts of peoples' experience through ethnographic observations and documentary videos. As we had expected, allowing people to try the designs in the field not only exposed issues relevant for assessment, but was integral to the designs themselves: Although we conceived of, designed and implemented the pieces, it was the users who endowed them with meaning.

Introduction: Digital Devices in Domestic Settings

The home is increasingly a contested site for new applications of digital technology. Processors, memory, displays and networking are becoming physically smaller, technically more powerful, and financially less expensive, allowing them to be used in a growing range of domestic applications. To users, this promises to bring the power of "the digital revolution" to the home, allowing new efficiency in maintaining the household as well as new forms of entertainment and communication. To computer manufactures, software suppliers, and associated researchers, the home offers a massive new marketplace for their expertise. Whether a true response to human values, or a combination of technological push and marketing, it seems clear that computational devices will radically change existing product categories for the home and introduce a wide variety of new ones as well.

Field trials appear essential to the development of domestic technologies, because the values that characterise the home are different from those of the laboratory or studio. The neighbourhoods, architecture and décor of research and development establishments contrast strongly with those of the home, and attempting to assess new technologies in such settings may be misleading. This problem is only partially addressed by pursuing research in laboratories that are—or appear to be—homes themselves (e.g., Intille et al., 2005; Monk et al., 2004; Kidd et al., 1999). The domestic environment doesn't depend merely on the *appearance* of home, after all, but crucially on the situated *activities* that make the home. We sleep, bathe, cook food, care for children, store our clothes, keep pets, make love and clean our teeth at home. We do few of these things in the laboratory, studio, or home laboratory. But domestic technologies may be involved in, or affected by, any of the complex, multilayered activities of the home. To understand how people will live with, use and benefit from new domestic technologies, it seems axiomatic that they must be studied in actual domestic environments.

Deploying technology in the home can be difficult, however (c.f. Hindus, 1999). As many researchers have noted, access to the home can be difficult to negotiate. Even if access can be arranged, one may be unwelcome at odd hours of the day or in the home's more intimate spaces. The presence of researchers may alter people's behaviours. They may act as if they are entertaining guests, or seek to present themselves as they wish to be seen (although, paradoxically, people will sometimes reveal things to researchers they would not tell their friends). Knowing that a

prototype has been produced as part of a research project, people may try to help researchers by giving overly positive—or critical, for that matter—accounts of their experiences. These problems may be alleviated by running relatively extended trials to allow both the artefacts and the research process itself to become embedded in domestic routines, but this approach is itself challenging.

Field testing domestic technologies is made even more challenging by the changing goals of system evaluation. Human Computer Interaction (HCI) developed historically in the context of workplace computation, with an emphasis on optimising *utility* and *usability* (Nickerson & Landauer, 1997). For a given system, claims about these factors are often amenable to a hypothesis testing approach, usually using quantitative measures of, for instance, task performance, efficiency and error rates. In the field of Computer Supported Cooperative Work (CSCW) since the early 1990s (for a specimen early study, see Hughes, Randall and Shapiro, 1992), broader concerns have emerged for factors such as how new systems extend, disrupt or otherwise relate to existing work practices. Such factors may be more difficult to assess using hypothesis testing or quantitative data, but they are accessible to argumentation based on qualitative, observational data (for a general review and discussion of ethnographic research in this regard, see Crabtree 2003). With the emerging focus on technologies for everyday life, however, a wide range of further factors becomes relevant. McCarthy and Wright (2004) argue, for instance, that in addressing such technologies we need to extend our concern for *practice* to consider *experience,* integrating sensual, emotional, compositional and spatiotemporal components. Properly addressing these affairs is a significant challenge for any empirical method.

In the face of this challenge, it is tempting to fall back on well-known criteria of utility and usability as determining the value of domestic technologies. Indeed, most visions of future domestic systems (e.g. Truong et al., 2004; Dishman, 2004; Adrich, 2003; Harper, 2003; Sharpe & Stenton, 2002; Mynatt et al., 2001; Norman, 1998; Mozer, 1998) take utility and usability as paramount. Placing utility at the heart of the domestic experience may distort the values people pursue at home, however. It may be more appropriate to explore the value of designing for non-utilitarian experiences, even if this requires the development of new forms of assessment. This is the approach we take in this paper.

Ludic Engagement

We focus on developing domestic technologies that support *ludic* engagement in the home. The term 'ludic' comes from Huizinga's (1950) *homo ludens*, or people as playful creatures. From this perspective, we are characterised not just by our thinking or achievements, but by our playfulness: our curiosity, our love of diversion, our explorations, inventiveness and wonder. Consider two examples. In the first, a friend is late arriving for a social engagement and, when she seems cagey about the reason, you make a flippant remark about interrupting her secret life. Someone suggests she is an international film-star living incognito. Others embellish the story, until she herself begins to act the part. In the second, you aren't looking at anything in particular, but you notice the afternoon light on a nearby building. A bird lands in a tree and you have a moment of delight as you see how it twists in the air to make a turn. Watching an airplane skimming the clouds, you speculate about how many people live in the sky at any given point in time. You wonder if it will rain. These sorts of engagements—open, responsive, led by pleasure rather than utility—are defining and valuable facets of our humanity, as worthy of respect as planning, logic or study.

The concept of ludic engagement covers a wide range of exploratory, self-motivated activities. We avoid defining strict boundaries around the notion since it is meant to suggest an orientation rather than define a methodology. Nevertheless, let us offer a few pointers. First, ludic engagement tends not to be concerned with outcome. We do not play to achieve a goal, but rather because the process itself is inherently rewarding. This does not mean that play is unproductive: on the contrary, play can be valuable in helping people to explore new relations, to reflect about activities and values, and to bring to awareness new goals and perspectives. In part this is because play often involves fluid reassignments of meaning, both to things and to situations. Exercising the ability to decouple things and events from their usual meanings is important to a range of cognitive abilities, and is one of the reasons that psychologists such as Vygotsky (1978) see play as crucial to development. Moreover, the meanings we play with may be emotional ones. Here play offers the additional benefit that intimate topics may be explored without the vulnerability that comes with commitment. As Bateson (1972, p. 180) puts it: "The playful nip denotes the bite, but it does not denote what would be denoted by the bite."

Play, in this sense, is not the same as entertainment or games. Entertainment tends to depend on "content" to be consumed in a structure or narrative determined by an

author, while ludic engagement is open-ended and exploratory. Games tend to rely on externally defined rules, whereas rules used in play tend to be self-defined and fluid, a product of ludic engagement rather than a prerequisite. Games tend to be competitive, whereas play is self-rewarding (Kaprow, 1972/2003). Games tend to offer an escape from our everyday lives, while the material for ludic engagement is often precisely those everyday settings, situations and events that surround us. These are the resources for ludic engagement, and when we exaggerate them, pretend they are something else, or simply explore them in new ways out of curiosity, the new experiences and understandings that result are available immediately.

Designing for Homo Ludens: The Weight Furniture

Can technologies be designed to support ludic engagement? One thing seems clear from the discussion above: *systems designed to support play should not offer a predefined experience for consumption*. Even designs meant to embody unusual or extreme values will not support ludic experience if people merely acquiesce to the narrative implied by the design. Instead, ludic designs must somehow encourage people to create and explore for themselves. Rather than thinking of technologies serving as tools to fulfil a clear set of purposes, or as providing a set of experiences, no matter how unusual, designs to support ludic engagement must offer situations and resources that people can appropriate themselves, flexibly and provisionally, through their actions and interpretations.

We designed and built three prototypes to explore how to support this sort of ludic engagement as part of a long-term research collaboration on interleaving digital and physical experiences. Each took the form of a load-sensing table, based on the convergence of Cultural Probes returns (Gaver et al., 2004) and related design proposals, ethnographic data stressing the importance of surfaces in the home (Crabtree et al., 2003), and the development of load-tracking algorithms (Schmidt et al., 2002). One of the appeals of using load sensors was that they are a form of *shy sensing* for the home, in which accuracy and completeness are sacrificed in favour of protecting against privacy intrusions. This relies on the idea that if systems sense and represent partial information, they may spur people to supplement this with their own interpretations and perceptions, allowing an accurate representation of situations to be distributed between technology and users.

In this section, we describe each of the prototypes in turn. In the following section, we discuss the methodological approach we took to field trials of the pieces and the results of the trials themselves. We conclude by discussing our assessment of the prototypes and the lessons we learned for ludic design, before reflecting on our approach to field trials more generally.

The Drift Table

The Drift Table is a coffee table with a small viewport showing a slowly changing aerial view of the British landscape (Gaver et al., 2004b; Figure 1). Shifting weights on the table changes its apparent height, direction and speed. With about a terabyte of photography of England and Wales available for viewing, we conceived of the Drift Table as an open-ended resource that might be used to explore the countryside, travel to a friend's house, explore questions about geography, or simply watch the world go by.

To control the apparent motion and height of the Drift Table, users place weights upon its surface. The horizontal velocity is based on the difference in weights measured by load sensors under the tabletop's four corners, while apparent height is based on total weight. When weights are changed on the table, velocity and depth

Figure 1: The Drift Table

gradually approach their new target values, creating the impression that the table has inertia, so that users' actions are slow to influence its otherwise autonomous drifting motion.

The Drift Table's image moves slowly (equivalent to about 50kph top speed), and the view is set to be close to the ground (about 500m at most). It is easy to get lost while moving over the landscape. Accordingly, we included three features to help orientation. First, a small text display on the side of the table shows the name of the place nearest to its virtual location, allowing people to track their approximate whereabouts from memory or by checking a map. Second, a very small reset button changes the view to the table's default starting point (set to be directly over the user's home), allowing people to start new journeys and to reorient themselves in case they get lost. Finally, an electronic compass is used to align the aerial photography with the table's actual orientation, allowing people to map the table's apparent direction of travel to their understanding of the locations of landmarks.

We designed the Drift Table to be compact and aesthetically simple, incorporating all the technology within the relatively small (70 x 70 cm) table itself (Figure 2). To avoid the appearance of a computer monitor mounted in a table, we mounted the LCD display about five centimetres beneath a relatively small aperture (the 'viewport') cut into the table surface, and mounted a Fresnel lens in front of it. This allows viewers to
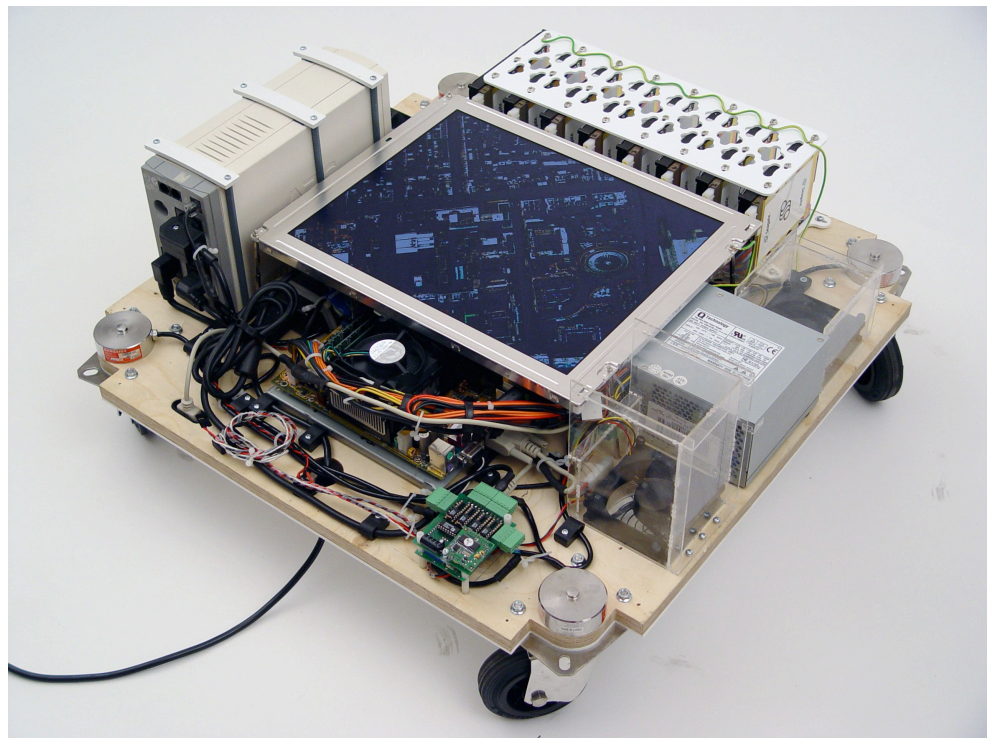

Figure 2: The Drift Table's technology.

Figure 3: The viewport.

obtain new views as they move from side to side, like looking through a window, while ensuring that the edge of the screen is never visible (Figure 3). We also paid a great deal of attention to keeping the Table as quiet as possible, for instance by using underpowered, low-noise fans. This was important both to de-emphasise the technical aspects of the Table and to avoid annoying people in their homes.

The Drift Table offers a massive *resource for exploration* without implying what it is for. In fact, it was purposefully designed to make an obvious application—reaching some distant location quickly—difficult to achieve. Travelling from place to place can take hours, and no interface is provided for travelling more quickly or for jumping to distant locations. We made this design choice deliberately, to downplay a particularly obvious potential use for the table in the hopes that people would find other uses (see Sengers & Gaver, 2006). By refraining from increasing the table's affordance for goal-directed travel, we hoped to make it more likely that people would take advantage of its affordance for random drifting, sightseeing, getting lost, etc.

The History Tablecloth

The History Tablecloth is a flexible plastic substrate screen-printed with electroluminescent material to form a grid of lace-like elements (Gaver et al., 2006;

Figure 4: The History Tablecloth

Figure 4). When objects are left on the table, load sensors under the table legs are used to calculate their position, and cells are lit to form a halo that grows slowly over a period of hours. When objects are removed, the corresponding halo is designed to disappear over a period of about 30 seconds. The History Tablecloth makes visible the movement (or lack thereof) of objects in the home, but leaves interpretation of that situation to the people who encounter the Tablecloth. Some might feel that it is a prompt to tidy up more often, others might become reluctant to move objects on the table lest they disrupt a particularly pretty pattern of lights. The piece is intended to create an ambiguity of relationship (Gaver et al., 2003) for people to resolve themselves.

The system is equipped with only two control points for users. The first, a large red "panic button" mounted on the front of the computer housing, allowed people to reset the system if its internal representation started to diverge from the reality of weights on the table, e.g. because of erroneous readings or missed placements or removals of weight. The second was a simple power switch mounted on the back of the housing, arranged to allow people to reboot the computer and automatically restart the Tablecloth software in case of more serious problems.

The History Tablecloth system is reasonably straightforward, and with tuning, the prototype worked well in our studio. But even in this relatively controlled

environment, the system tended to diverge from its intended behaviour over time. Like any detection technology, the History Tablecloth gave rise to a pattern of hits, misses, false alarms and so forth. The object-tracking algorithm was reliable when used carefully, but in casual use was liable to being misled. The end result was that, over time, the system's representation (and the Tablecloth's display) of objects would become increasingly inaccurate. We became aware of these problems while developing the History Tablecloth in the studio and managed to reduce them significantly over several iterations of the software, and tuning of the electronics. We hoped that a similar process of on-site tuning would help us minimize them in the field as well. Nonetheless, we realised that some problems would remain—this was one of the motivations for including the reset and reboot switches on the prototype device.

In sum, the History Tablecloth was designed to highlight the length of time objects were left upon it, using an aesthetic appropriate for domestic environments. Yet it does not suggest the implications of leaving things on surfaces. This might depend on what those objects are, and the History Tablecloth itself does not have access to that information. It is a form of *deictic interface* that points to important features of a situation rather than creating or representing them itself. People might construe it as demanding tidiness, or as a reward for clutter. The interpretation would be theirs.

The Key Table

The Key Table, an occasional table with an associated picture frame, was the simplest of the three prototypes (Figure 5). It was designed to provide a place for people to leave the things they carry with them when out of the house—keys, mobile phone, etc.—and we expected it to be placed near the entrance to the home. Like the other two tables, the Key Table contains a load sensor mounted under the top surface, but unlike the other tables it is used to measure the duration of oscillation caused by a new load, a good indication of impact force. When objects are put on the Key Table, this measurement is wirelessly transmitted to the picture frame, which tilts accordingly. The picture frame holds a given tilt angle for 40 minutes before slowly returning to vertical. If a new signal is received before this time, the picture tilts to the opposite side to distinguish the new angle from the old.

The Key Table was designed to be a simple kind of emotional interface (Norman, 2004; Picard, 1997) that would get a sense of people's frame of mind from the way

Figure 5: The Key Table

they put their things on it. Much as a slammed door may indicate a temperamental upset, the Key Table embodies the notion that the way people treat their things may indicate their mood. According to this concept, the picture frame would serve as a sort of emotional barometer for others.

Of course we realised that the ability to capture emotions in this way would be crude at best. Designing the Key Table's narrative to be somewhat implausible was intentional, however. On the one hand, we designed the piece as a critical comment on the agenda of emotional computing, which appears overly optimistic about machine recognition of complex emotions. This level of interpretation for the piece was aimed at the research community, not the piece's users. For them, the point in creating an implausible narrative was to subvert the authority of the system's narrative as an invitation for them to build their own interpretations.

The table and frame were both constructed of MDF laminated with yellow Formica. We chose the same material for both pieces to indicate their association, and a bright colour to highlight the fact that the Key Table was an experimental system. This was motivated by the nature of the narrative we intended for the piece. A portrait of a dog ("Terrence") photographed by the partner of one of the team members was mounted in the frame soon after it was finished. We all liked the picture and had no reason to

think another would be better, so it effectively became part of the piece. This seemingly minor detail turned out to be more significant than we expected.

In sum, the Key Table was designed to respond to the force with which people placed things upon it, and was intended to suggest an *exaggerated narrative* that could be disbelieved. The notion behind it was intended to be recognisable and superficially plausible, but ultimately open to question.

Assessing Ludic Designs in the Field

If, as we have suggested, it is desirable to assess any domestic technology in the field as an essential part of its development, it must be even more so for technologies meant to promote ludic engagement. Ludic engagement involves exploratory, curiosity-driven, self-motivated and defined activities that are, by definition, difficult to predict in advance. Put another way, if we design systems without saying what they are for, or what they mean, then the designs are not really complete until people try them and answer these questions through their own activities and interpretations.

The open-ended nature of ludic designs poses a fundamental challenge for the hypothesis-testing approach that underlies most evaluations, however, because there are few hypotheses to test. For instance, how would we recognise successful experiences with the Drift Table? Is it more successful if volunteers use it to travel to far-away places, or if they only travel in the vicinity of their own homes? What if they merely leave it to drift randomly, glancing at it occasionally to see what sort of landscape they are over? What if they interpret the view as diagnostic of their current spiritual state? Insofar as the Drift Table was designed to promote self-directed, exploratory activity, there is no *a priori* reason to privilege any of these engagements over the others. Perhaps the only clear sign of "failure" would be a complete lack of engagement with the piece (though that may not imply that more engagement is better than less). Simply checking for any form of engagement appears an impoverished form of evaluation, however. It appears necessary to move beyond simple notions of 'success' or 'failure' in assessing the designs, and instead focus on capturing a rich description of the encounters people have with the prototypes, addressing their activities, experiences and interpretations from a variety of perspectives. In developing such an account, we may well develop a perception of whether the pieces worked or not, but this will be multi-layered and situated to particular points of view.

Given that the pieces were intended to support multiple forms of engagement and to be appreciated at a number of different levels, they could succeed and fail in many different ways simultaneously, and we could not even anticipate all the dimensions in which they would be experienced. Thus, for us, assessing the prototypes was not just a matter of deciding "Were they successful?", but more fundamentally an attempt to answer the question "What happened?".

Many methods of empirical investigation and evaluation *of their essence* narrow down one's scope for addressing these issues. For example, one conducts controlled studies precisely to isolate a manageably small number of factors (so-called 'dependent variables') and see how they might be affected by externally determined alterations to the setting (so-called 'independent variables'). It is of the essence of such studies that their organisation is not of the participants' (subjects') own making and that their scope is focussed and not open-ended. We have no argument against such methods. They are entirely appropriate for pursuing certain kinds of research questions, specifically ones where there is good reason that exerting experimental control will make the phenomenon of interest more perspicuous and not destroy it. In our case, matters are very different. We want to *find out* what the phenomena of interest are and we are concerned in hearing a variety of voices giving answers back. We have designed technologies that are intended to be open so to employ or adapt methods which are concerned to achieve 'experimental closure' does not seem appropriate. It would also be inappropriate to pursue evaluation methods that involve 'experimental simulacra' in field evaluative settings (pre- and post-testing, formally defined prior evaluation criteria, and so forth).

In this project, then, we approached our assessment in two distinct ways. First, we made detailed ethnographic observations of two of the three systems in use, over time, in volunteers' homes. Second, we hired filmmakers to serve as *cultural commentators* by producing short documentaries of each of the pieces. We argue that these approaches allow us to approach an open form of assessment in a way that is nonetheless rigourous and publicly inspectable. Our purpose was three-fold. First, we were interested in understanding how the volunteers lived with the prototypes over time. Second, we hoped our experience with ludic designs would help us understand how to make their evaluation more systematic but in a flexible fashion that did not require us specifying a priori what the criteria for assessment would be. Finally, these approaches were themselves the objects of our research, as we sought to understand

better how they would allow us to assess ludic designs both individually and in relationship to one another.

Ethnography

In two of our three cases, we were able to conduct an extensive program of empirical observation of the artefacts we had developed in situ in selected homes. For each case, our research strategy favours a detailed examination of a small number of homes through an extended period rather than point studies over a much smaller timescale. By concentrating on a small number of deployments we were able to witness how use and appreciation of our artefacts varied over time, how such affairs relate to the rhythms of domestic life, many of which extend beyond the daily (e.g. seasonal feast days and their preparation), amongst many other issues.

Although we focused on a small number of homes, the number of individuals who encountered our designs was quite large. For example, though deployed in a single home, over the four month trial period more than 20 people encountered the History Tablecloth. This enables us to sample both a range of casual experiences of the designs and examine the householders' encounters with them in especial depth.

In common with much field research with a concern for studying a setting in depth, our methods favour ethnographic observation. This tradition of research emphasises detailed 'thick' description of people's activities rather than methods of hypothesis testing or premature theory development or application. Ethnographic research seems especially appropriate given our concern to examine artefacts that are intentionally open to appropriation in the manner we have described. As such methods have become an established contribution in many areas of HCI and CSCW where technologies are studied in real world settings, we do not give more details here but refer to Crabtree (2003) for more methodological details and example studies.

Cultural Commentators

To complement the ethnographic observations we conducted, we also commissioned documentary films of the pieces in the volunteer's homes. This was conceived as an example of using *cultural commentators* as a resource for assessing new designs. By "cultural commentators", we have in mind people who routinely describe, explain and

critique cultural events (including products and situations as well as happenings), such as broadcast journalists, poets and detectives. Employing cultural commentators in field studies has several potential advantages. By definition, cultural commentators have experience in identifying the salient aspects of events, suggesting their implications, and linking them with other contemporary or historical ones. Because they are purposefully chosen from fields outside of HCI, they are likely to bring different points of view to a study, potentially treating issues such as aesthetics or emotional impact that may be overlooked by scientific observers. Bringing such interpretations into a field study may usefully broaden the scope of assessment. Moreover, if they are recruited as semi-independent observers, their views may be relatively free of bias not only about the success of a system but even about its fundamentally important aspects. Finally, the different presentation styles they use may provide resources for questioning assumptions or simply viewing work in new and compelling ways.

For this project, we hired two independent filmmakers as independent subcontractors to produce short documentary videos of the prototypes in the volunteer households. The first, who made videos of the Drift and Key tables, had worked for a number of years as a cameraman for television news in the US, specialising in war reporting from areas such as Afghanistan and Bosnia. The second, who made a video of the History Tablecloth, was a designer who had used video for user-studies and to document designs in India and the UK; at the time of this study she was also a student in the Master's course associated with the design team's department.

We tried to give the filmmakers minimal information about the prototypes they were to film or the broader intentions of the project. This made the filmmakers uncomfortable, but we wanted to ensure that their interpretations would depend on what the volunteers told them and on what they perceived themselves. It became apparent that we were more successful in withholding information from the first filmmaker than the second, however, who clearly picked up some idea of our research intentions through exposure on the course (though the design team had never discussed this project with them). In both cases, we had to answer questions that would have pragmatic consequences for their process, for instance about the location and size of the prototypes, so neither filmmaker was entirely uninformed when starting their filming. It should also be noted that we paid the filmmakers for their work. It is impossible to say whether this biased the results, but none of the resulting videos were overtly critical, despite our having stressed that we wanted their

independent assessment, positive or negative. As we will describe, however, one of the videos was profoundly surprising. This supports the view that we succeeded in offering the filmmakers—and the volunteers—a great deal of freedom in the ways they approached the prototypes.

It was not our intention to promote cultural commentators as final judges of systems tested in the field, but instead to add new interpretations to a mixture that also includes ethnographic observations as well as the informal comments of the designers and volunteers. This reflects our underlying assumption that *in situ* trials of the prototypes would not be a matter of hypothesis testing or lead to simple conclusions of success or failure, but instead would be aimed at revealing the complex, multi-layered experiences people had with the pieces. Capturing a rich account of these experiences from multiple perspectives would be useful in itself. In addition, we hoped that it would help us better understand the dimensions along which such experiences might be assessed. Finally, combining cultural commentaries and ethnographic observations would allow us to compare and contrast the understandings afforded by each method more generally.

In the following sections, then, we weave together the accounts suggested by our ethnographic observations, the documentary films and our more informal impressions to describe how the volunteers lived with and perceived the three prototypes. In the discussion, we reflect on the contributions of each approach within this project and more generally on the possibilities for using cultural commentators as a resource for evaluation.

Experience with the Drift Table

We loaned the Drift Table to S, J, and W, who share an apartment in central London. S, the owner, was selected to try this prototype on the basis of his responses to the earlier Cultural Probes study we had run as part of the project. S is a musician who usually works in the flat during the day, evenings and nights being spent at another flat he shares with his girlfriend D. J and W, conversely, often return to the apartment during the evenings, after spending days away at work. With both sets of flatmates entertaining a steady stream of guests and collaborators, the table was used in this household by a number of people in a variety of circumstances. This household had use of the table for six weeks. We explained the table as we set it up in S's flat and gave him a manual explaining its operation, but avoided suggesting how he might use

it.

We organise our observations around seven headings:

- Table activities
- Collective use of the table
- Working the weights
- Accommodating the table within domestic and working routines
- Appreciating the table aesthetically
- S's interpretation and articulation
- The filmmakers' views.

Table Activities

We observed the flatmates engage with the table in a variety of ways. S described a number of his activities as 'sightseeing', and would steer the table to well-known locations that he expected to be noticeable from the air (e.g. Stonehenge, landmarks around London). The motivations for these trips were quite varied. We observed the flatmates arrange to visit places they had heard about in news reports. S would commonly navigate to places associated with his friends or colleagues. Several journeys were arranged to places of personal historical significance such as former homes or popular meeting places.

The flatmates often used the Drift Table to explore places about which they were interested, finding details that could be deployed in interaction with friends, relatives and colleagues. The table was not a source of definitive information of the sort that a factual source of geographic data might provide. Rather, its use was occasioned by curiosity about what places might look like from the air or where they were in relation to other locations, or what might be encountered along the way, and so forth. Interestingly, these activities often involved journeys which took significant time (i.e. several hours) and required considerable expertise at navigating the table. Moreover, they showed a degree of purposiveness that might not have been expected. The flatmates did not (only) use the Drift Table to wander around, but also to reach certain places. We will return to this issue in the Discussion.

Collective Use of the Table

Interaction with the table was a socially-oriented affair. S often found things on the table that he could talk about with others and engaged in trips provoked by what

others said and did. The scale of the table and the fact that physical objects are used to control it made many features of its operation readily intelligible to onlookers. Moreover, the table was often used collectively. J and W commonly formulated trips and set them in motion together, reporting to each other on the progress of a long trip if the other was away overnight. Regular times evolved when J and W would gather around the table, often with guests who were offered the chance to see their homes from the air.

Working the Weights

During S's tenure of the Drift Table, initial complaints were made about the table moving too slowly in response to light weights. Over time, however, members of the household learned to artfully select objects from the domestic environment so that a variety of navigational effects could be achieved. One of the implications of this was that the Drift Table tended not used as an "ordinary" table with the incidental added feature of responsiveness to the weight of objects as they pass across the surfaces of the home. While the table was responsive to moderate weights casually left behind as part of other domestic activities, we did not observe the table being used predominantly this way. Rather, a set of somewhat heavier weights was selected, a course embarked upon, and whatever else needed to be put on the table as part of transient domestic or working activities took its place amongst items which were there for navigational reasons.

It is important to appreciate that, although the table was controlled functionally by moving weights, this was embedded within practices of reasoning about trip purpose (where 'let's just wander and see what happens' is still a kind of purpose), current location, and desired trajectory. Such reasoning was supported by much more than just the view through the table's viewport and involved more than just shifting weights. Sometimes it was enough for people to look at the view on the tabletop to see where they were or what progress had been made. But more commonly, gaining a fix on the view required checking the location display, finding the location in an atlas, and, through this, reasoning about the nature or significance of the image visible on the table in light of the purpose of the trip. Once all this had been done, the re-deployment of weights might be considered.

The video documentary captures several of these activities clearly. For instance, as S

demonstrates the table in an early scene, he pulls out a small bucket of rocks from behind the table to show how to make it go quickly. Neither he nor the filmmaking team comment on this, but the scene usually elicits chuckles from unfamiliar audiences. Similarly, in one scene he is shown checking the view on the table, referring to a roadmap, and then adjusting the weights. Again, the audience often laughs. Both scenes are presented as incidental backdrops to S's spoken narrative on the video, but they serve as vivid representations of the expert, if unusual, behaviours that built up around the table.

Accommodating the Table within Domestic and Working Routines

S, J, W, and their visitors accommodated the table to their domestic life in a variety of ways. J and W would quite commonly organise their activities on the table as part of an evening's domestic life. If they were going to the cinema, for example, the table might be set on course before going out and then its location checked on return. Similarly, the table might be set to drift overnight with curiosity as to where it might have got to when the flatmates woke up. S identified 'post-pub, pre-bed table-time' as a characteristic routine for the household, one which, he claimed, provided a significant alternative to television viewing during this domestic leisure time slot.

S also folded interaction with the table into his working day. The table was placed next to S's computer-based music set-up (see Figure 6). This enabled him to glance across at the image on the tabletop from time to time without interrupting his work. More extensive checking on the table's progress could take place as and when a break in S's work occurred. While the table was drifting all the time, it did not require attention all the time. The slow speed and simple interactivity of the table allowed engagement with it to be easily accommodated into the other domestic and working activities that occupied S and his flatmates.

Appreciating the Table Aesthetically

The table was often an object of and for appreciation. That is, people routinely said whether they liked or didn't like it, compared it to other things they liked or didn't like, and discussed the reasons for their judgments. The table could be appreciated on a variety of grounds—as a piece of technology design, as a designed-through domestic artefact, or as an interactive experience. Matters to do with appreciating the table as technology or as a designed artefact commonly occupied people in their early

Figure 6: The Drift Table in S's home

encounters with the table. For some, these initial encounters were decisive. D, for example, was unconvinced by S's attempts to engage her with the table and took it as a mere demonstration of technical possibility. Those who did engage with the table commonly expressed concerns about the speed with which the image moved and the restricted interaction offered by the table. This inability to go quickly to places turned out to be a decisive feature in J's appreciation of the table, his interest being exhausted at the end of the six weeks he had access to it. S and W, however, used the table persistently throughout the period. For these individuals, criticisms like J's came to be reappraised as constitutive aesthetic features of the table. Initial objections about the speed of movement (various shades of slow) and the uniformity of navigation control (various shiftings of weight) came to be seen as just that: initial objections that disappeared as they acquired an overall sense of the table's aesthetic identity that included an appreciation for its restricted interactive character.

S: "Initially, I thought fantastic, another hi-tech toy in town. Then I became annoyed after the first day by the porthole. I couldn't show it to people as it is too small. I found myself straining to see to the edge. But that's worn off now. I thought about having a switch for double speed. Now that's worn off too. You should take a look around on the way like on a train journey. One should accept it and use it as it is. Another thing I thought was that it would be great to have a keypad so as to type in a

coordinate. Then I thought no, it's for drifting around. I like it for what it does. It's extremely sophisticated but without the arsing about. It has one use. It drifts. I like that under-statedness about it. After a couple of days I was about to get bored with it because of its weaknesses but now those are strengths. From shiny new object, to where's the buttons, to this is what it does."

S's On-camera Account

The trajectory of appreciation that S experienced in living with the Drift Table forms a major part of his narrative in the documentary we commissioned. Filmed about 2 weeks after the table was installed, without the research team present, the two-minute video appears like a clip that might be shown on a popular technology show or as a news feature. In the video, S describes his experience with the table and his changing attitude towards it. His statements are well thought-out, if not rehearsed. Some take the form of "sound-bites" that convey information concisely and vividly (e.g. the Drift Table as "like a hot-air balloon that you travel in from the comfort of your own front room"), while others are more elaborate, suggesting considerable reflection both about his experience with the Drift Table and how to articulate it.

The occasion of being videoed seems to encourage S to produce a definitive story of his engagement with the Drift Table. His concern appears to be with communicating in a way that will be interesting to the filmmakers and to the implicit viewers. He evidently enjoys being the focus of a documentary, often smiling or telling small jokes as he talks, and seems intent to convince the audience of the appeal of the piece. This gives his description an air of being self-directed and genuine, while at the same time it is articulate and reflective. The result both reinforces the findings of the ethnography and presents a strong interpretative account as a resource for considering the Drift Table in situ. If the ethnography provides details of the lived experience with the table, the video occasions S's articulated conclusions about it.

The Filmmakers' Views

Most of the Drift Table video focuses on S's account, but there is also a short scene in which the presenter explicitly presents his own opinion of the piece:

> "So what do I think of the Drift Table? Well when I first heard about it I thought it might be a gimmick or some kind of techno-experiment. But for me it's an art installation that functions very well as a piece of furniture too. Now would I want one? Yep."

The presenter's description of the Drift Table as "an art installation" is not one we would have chosen had we managed the production of the video as an expression of our views. Instead it reveals how this semi-independent, popularising commentator viewed the piece, and may indicate how a wider public would see it as well.

The fact that the research team paid for the video introduces complexity to its interpretation, however. For instance, while the presenter enjoyed the Drift Table, the filmmaker was less enthusiastic. It is telling that he decided not to include his own views in the finished video. Knowing this, or simply that the documentary was paid for, may encourage viewers to take a suspicious attitude towards the filmmakers' expressed attitudes. Thus the video can be seen as suggesting several overlapping accounts: S's trajectory of appreciation from initial excitement, through disillusionment with the table's limitations, to a new appreciation based on understanding; the presenter's account of having been won over to this "art installation" despite initial scepticism; and a more cynical version in which continued scepticism is masked by financial relations.

Experience with the History Tablecloth

We loaned the History Tablecloth to G and B, a male/female couple living in an apartment in the east end of London. Their living space was part of the second floor of a converted factory that offered one large open space with a separate bathroom. The main space (some 100 square meters) contained recognizably separate relaxing, cooking, working, storage and sleeping areas. It occupied the width of the building and so had light from both sides. The couple typically both worked from home though were often called out to appointments during the working day. We sited the History tablecloth in their dining room (replacing the existing table), so that it could have access to power and oriented it so the computer housing at one end would cause minimal disruption (see Figure 7).

The Tablecloth was described to G and B as minimally as possible. They were told that it would respond to objects placed on the table by lighting up and that the research team was interested in what it is like having such an artefact in their home. No specific details were given about how the table and cloth work. The panic (reset) button was pointed out by comparison with similar on existing computing technology with which G and B are familiar but no particular occasion under which it should be

used was highlighted.

We organise our observations around six headings:

- Domestic objects and their detection
- Interpreting the light
- Accommodating the table and illuminating domestic activities
- Appreciating the tablecloth aesthetically
- Interpretation in the documentary

Domestic Objects and Their Detection

It was clear to G and B immediately that the Tablecloth illuminated where a notable domestic object was placed. But within their first day of living with the table, it became apparent that some objects would consistently pass undetected, very light ones, a pencil, for example. Some objects were detected in a surprising and engaging fashion. A lightweight wine glass was missed on its initial placement but became illuminated once wine was poured in. A laptop might be placed first edge on with just two feet in contact and then the remaining feet placed shortly thereafter; sometimes only the first contact points were detected. Pushing or leaning direct on the table might also lead to the detection of an object as occasionally did walking heavily by

Figure 7: The History Tablecloth in G and B's home

the table on the old floorboards. There could be considerable uncertainty in what to expect of the response of the table to various events around it.

One should not get the impression from this that the Tablecloth's patterns of illumination were effectively random. A typical scene was one in which some objects were clearly encircled by light, some had been missed, and some light patches were close to but not exactly where the object had been placed. Equally, as the patterns spread over time, more and more objects on the table would come to be illuminated from below whether they had been detected or not. This made for an overall relationship between objects and light which was noticeably non-random. As such, and this is a point we will return to, G and B *preferred* the incomplete but noticeable coincidence of the light pattern with the layout of objects over alternative relationships. This, to them, was more subtle and intriguing, as were the occasionally enigmatic behaviours of the table in response to objects being placed and removed.

Interpreting the Light

An important factor in G and B's engagement with the History Tablecloth were the interpretations they offered of how the piece worked, what its 'states' were, its operational trajectory, and how one might intervene in this or work with it. Indeed, the table's behaviour became a talking point between G and B and their callers. G and B developed a *local knowledge* of the table's behaviour (its occasionally anomalous detections, its changes in sensitivity over time) complete with ways of interpreting things which occurred, both expected and unexpected. Very commonly, this knowledge and interpretations of phenomena were compared with other views. G (to a caller, J): "It's interesting you're trying to give sense to it and you do it in a different way from me. You said it was confused. I just think it is doing its thing".

Noticing phenomena worthy of interpretation in the table's behaviour, offering and discussing interpretations, looking out for things in the future, and so forth were valuable activities for G and B in their appreciation of the Tablecloth and not obstructions to its use and enjoyment. Indeed, the Tablecloth seemed to offer a quite open ended set of things to observe even with four months of co-habitation. A number of phenomena occurred with requisite rarity to keep G and B's interest piqued. Occasionally, they would observe lights pulsing on and off. Once, all the cells lit up at one end around objects placed there and, when those objects were removed, a pattern of light cascaded to the other end of the table rather than gently fade at the spot. This

unique occurrence "kept us talking for days".

Accommodating the Table and Illuminating Domestic Activities

In the case of the History Tablecloth, such moments of interpretation and wonder are not problematic for folding the artefact into customary domestic activities. Whether it lit up or not, there was still a table there with all its usual capabilities. Finding the Tablecloth's behaviour intriguing and worthy of interpretation was thus quite a natural affair to accommodate into the ordinary domestic activities the table was used for: working, preparing food, eating, temporary storage.

More than that, G and B found some of these activities to be engagingly 'illuminated' (all senses intended) by the History Tablecloth. For example, a common routine for them just before guests arrived for dinner involved "resetting the table" (G's joke), and then discussing the pattern that unfolded over the course of the meal with guests. The documentary also captured G and B reflecting on the changing patterns of lights as a visualisation of their table use. B: "The other day when I was working I put my stuff on there—it was evening time as well—by the end, I'd covered most of this half of the table. But then, that was really interesting because suddenly that side of the table looked very lonely." G draws an analogy between the History Tablecloth and the wooden table it temporarily replaced: "With a wooden table, its got like a patina on it already of age and the grain of the wood and et cetera. That's not a thing that you associate with manufactured things. This however, is very similar in that it develops its own patina".

In sum, some connections with everyday routines were illuminated by the tablecloth. Some other activities came into existence where the playful opportunities of the table were more to the fore, for example, predicting whether a particular object would or would not be detected. In all this, that the Tablecloth's behaviour was commonly a matter for interpretation did not disrupt its use, but rather provided engaging opportunities for new activities or enrichments of existing routines.

Appreciating the Tablecloth Aesthetically

Sited as it was next to a large (old) factory window on the kitchen side of B and G's living space, the cells of the cloth did not appear brightly lit during daylight hours. But as it grew dark, the glow from the History Tablecloth became noticeable (Figure
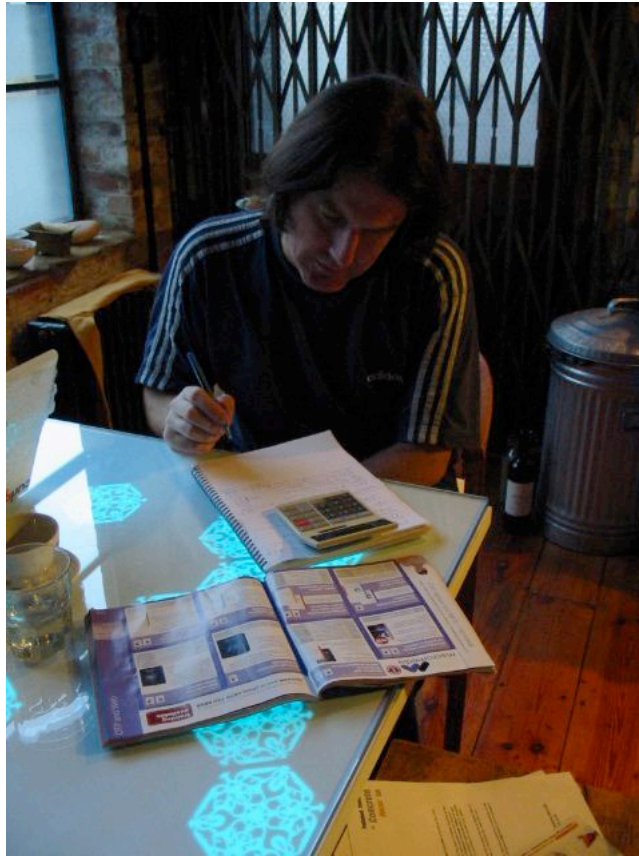
Figure 8: The History Tablecloth in the evening

8). G: "It's like an electric doily. At night it really comes into its own". B expresses similar sentiments in the documentary: "Sometimes when I wake up in the night and go to the bathroom, I turn around and it's beautiful, it's all lit up and it's really lovely because it lights your path". A number of B and G's friends, who were sceptical when they first heard of 'an electronic tablecloth' became fascinated when the table was seen first hand and in the good viewing conditions of an autumn evening. B: "It was quite spectacular when A was sitting here and the light came out from her. She said 'it likes me'. It looks great when it's dark". Particular patterns might be found appealing even if the table was unresponsive. G: "I like this pattern, it was yesterday's dinner". Clearly then the Tablecloth had a visual aesthetic which was found appealing.

However, the Tablecloth had an *interactional* and *interpretative* aspect to its aesthetics too. That G can preserve a 'stuck' pattern until the next reset is a feature of the (intended and unintended) interactional behaviour and capability of the Tablecloth. Instances in which the table looks "lonely" or is just "doing its thing" reveal an interpretative aesthetics at play. In many respects, there is not so very much you can do with the Tablecloth: move objects around, press reset. But, as we also observed with the Drift Table, this minimal interactive repertoire can come to be

strongly appreciated. As one does not have to continually attend to the artefact and make selections from a rich set of actions to engage with it, there is little to learn and little to disrupt ongoing domestic routines. In the quote from G next, he combines remarks about the sometimes anomalous behaviour of the Tablecloth, its interactivity and his appreciation of it in an integrated aesthetic appraisal.

G: "I like it that it takes time to fade when it does. If it faded instantly, it'd look far too abrupt, not gentle or abstract enough. I like it that sometimes it gets stuck and then you can see how things were. I'd be very self-conscious at the table if it always followed me and reacted to me. It adds interest to what you are doing, which would not happen if things moved randomly. It's reacting but it's doing so in a way that gives it a life of its own. That makes it like an artwork. For a tablecloth that's pretty good going. As I don't have control over this, I can just enjoy it".

Interpretation in the Documentary

In contrast with the Drift Table documentary, the History Tablecloth documentary includes a narrative voiceover and music added after the on-site filming. This reflects the filmmaker's interpretation of the piece and our research agenda more strongly than the apparently spontaneous reaction of the filmmaking team in the Drift Table documentary. Like the presenter's description of the Drift Table as an "art installation" in the previous documentary, the narrative in this film does not reflect the research team's view of their agenda, but the filmmaker's perspective of the work. Because the filmmaker was relatively close to the design team's community, the narrative appears more indicative of the issues other interaction designers might perceive than of how the piece might be received more generally.

The body of the video shows scenes of G and B using the table or talking to the camera while discussing their experience with the piece. Their descriptions—several of which appear in the preceding sections—do not take the form of S's definitive account of the Drift Table. Instead, they offer a variety of different reactions to the piece. Some of these create a narrative of changing appreciation similar to that expressed by S. For instance, the documentary filmmakers, who had accompanied the researchers to record the deployment, interviewed G and B soon after the table was installed. G was quite positive, but B expressed hesitations. Initially these did not focus on the tablecloth itself so much as the process: "You know, G's been waiting for this table for a very long time, so… it's just sort of like, I don't know, it's quite

strange. I've had to kind of fit into that." Later, her doubts focused on the piece: "I think what I don't like about the table is that its got a big hard drive thing that sits with it. So, actually it seems like you're sitting with a kind of computer rather than you're sitting with a table." Over the course of her experience with the table, though, many of these doubts seemed to subside, and she later acknowledged the piece's suitability for their lifestyle: "The table's trying to fit in with people and their lives rather than people having to fit in with the table. That's a very different thing. I think that that requires someone to understand how you live your life." The documentary complements our ethnographic observations by showing samples of G and B's reactions over time.

Experience with the Key Table

The household we loaned the Key Table to consisted of a single mother, H, living in a semi-detached house in the North of London with her two teenaged children L and S and a friend of her son's, N. We loaned the Key Table to H's household for about 6 weeks. For a variety of logistical and pragmatic reasons, we decided against making ethnographic observations of the Key Table in H's home. Instead, most of our understanding of the household's experience comes from the video documentary we commissioned, supplemented with informal observations and conversations with the household when dropping off and picking up the table. While offering less detailed information about the behaviours that emerged over time, the documentary nonetheless offers ample material to comment on dimensions of the household's experience similar to those discussed for the other pieces.

We organise our discussion around five headings:
- Situating the table
- Re-interpreting the table
- Accommodating the table and invented activities
- The table as a site for domestic rituals
- The filmmaker's role

Situating the Table

Upon delivering the table, we suggested putting it in the hallway just inside the front door. H felt that the space was too narrow, however, and opted to have the table just inside the entrance to the living room with the picture frame hanging over it (Figure

9). The hallway is a transient space, the living room one where people are more likely to spend time engaging with a piece of interactive furniture. The original proposal for the Key Table suggested it would be engaged with largely when entering or leaving the home. The video, in contrast, shows several instances of people considering the table from various seats around the living room, or engaging with it while others look on. This is not to suggest that the Key Table was sited in an inappropriate space, but to point out that it was an unexpected one that may well have had consequences for its use.

Re-interpreting the Table

During the deployment, the Key Table was also situated conceptually. As the design team unpacked the piece, the filmmaking team recorded the process and asked one of the team members, and later the first author, to describe the system. Thus the first descriptions the household heard of the Key Table were crafted for the documentary, not for them. Neither description framed the Key Table as sensing and displaying mood. As with the Drift Table and History Tablecloth, the members of the household were left to develop their own interpretations of the piece.

Soon after the Table was working, the filmmaker asked the members what they

Figure 9: The Key Table in H's household

thought. The result is captured in the documentary. Within three remarks, the participants agree that the key element of the piece is the dog, that he is a kind of watch-dog looking at what is left on the table, that the project is about giving inanimate objects a personality, and that the role of the viewer is to be considered in this process. In this short exchange, then, and prompted by the filmmaker, the household reaches significant consensus about how the Key Table is to be understood.

Accommodating the Table and Invented Activities

In a later visit to the household, the filmmakers found that H referred to the piece as 'Terrence the Table'. The interpretation developed during the deployment is still the preferred one, and serves to structure the household's engagement with the piece. H: "My interaction with the piece has become more personal. It's not a table with a picture and a frame, it's now Terrence the Table who has a personality." Building on this metaphorical interpretation, she goes on to describe how she plays with the table as she might a pet. Evidence for this is found in the ways that the members of the household adorned the table and frame over the time it was in their possession. A scarf was hung over the frame to hang down on either side. A strip of clear plastic film was spread over the lower edge of the frame, trapping several small balls on the narrow lip between the frame and the inset picture so that they would roll back and forth as the picture tilted. A cat toy was attached by a string to the surface of the table, which H explained was to allow her cats to play with the Terrence. These adjustments were made piecemeal, and became an important part of how H related to the table. H: "Rather than switch on the TV sometimes I have five minutes with Terrence and sit and imagine what I could be doing." As she says later in the video: "I've actually started to think of myself as the artist."

Appreciating the Table Aesthetically

H's interactions with the Key Table revolved around periodically inventing "games" for the piece. They also involved the way she articulated her relationship with the table as being similar to her relationship with other members of the household. Both these trends culminate in the final scene of the documentary (Figure 10). The family and filmmakers look on as H enters the room, carrying a bottle of champagne, a glass, and a party hat. Amidst suppressed laughter, she puts the hat on the picture frame, pours a glass of wine and toasts him to "welcome you into the family." The family and filmmaker join in, speculating in about sibling rivalry before agreeing that

Terrence fits in well with the family.

The documentary captures a striking portrait of the strange relationship that H seems to have formed with the table. It is amply clear, however, in this and the preceding exchanges that H does not mean for her statements or her actions to be taken literally. After toasting the table with champagne, she doubles over with laughter. She smiles as she talks of treating the table as an equal to her cats or her children. Occasionally she steps out of the role she has taken on, for example to explain that she sees herself as an artist, and enjoys doing "strange things" with the table.

H's aesthetic appreciation of the Key Table does not focus on its appearance, then, or its limited interactional repertoire. Instead, she appreciates the opportunity the piece provides to take an unusual stance to an electronic device, and moreover to play with that role through invention and exaggeration. For H and her household, doing "strange things to an inanimate object" is the purpose of the Key Table, and the source of its aesthetic appeal.

The Filmmaker's Role

From the beginning, the filmmaker played a much more significant role in this trial than the others. Throughout, the process of making the documentary film appears to have made H's pretence more articulate, more public, and more exaggerated that it

Figure 10: H welcomes Terrence to the household

would have been otherwise. It is apparent that H and the filmmakers are colluding to produce the narrative of the documentary. The filmmaker helps to maintain and propel the fiction of Terrence as a member of the household by asking questions (e.g. "Are you getting any sibling rivalry?") from within this frame of reference, rather than from a more distanced one. In the video, the filmmaker and presenter laugh along with the other members of the household, enjoying their role in the fantasy. When the filmmaker delivered the final result, he appeared simultaneously enthusiastic and embarrassed, aware that the documentary was not what we expected and offering to re-edit it if we did not like the results (we did not take this offer up). It seems clear that both the household and the filmmakers felt that they were transgressing the bounds of the research, that they were, in a sense, playing a joke on the research team.

After an initial dismay, however, we realised that this was a surprisingly successful result. H's engagement with the table is not only in the same spirit as Bateson's observation mentioned earlier: "The playful nip denotes the bite, but it does not denote what would be denoted by the bite" (Bateson, 1972, p. 180), but captures his recognition of "a more complex form of play; the game which is constructed not upon the premise 'This is play' but rather around the question 'Is this play?'" (Bateson, 1972, p. 182). The Key Table may not have been interpreted as indicating people's moods, but it seems to have succeeded at promoting the kind of ludic engagement that is the more fundamental subject of our research.

Learning from Ludic Designs

The field trials of the weight furniture provided a rich set of observations and accounts of the volunteers' engagement with the systems we built. The purpose of such trials, of course, was to come to a view about the relative success of the individual designs we studied. Beyond this, however, we sought to understand better how to design artefacts that could promote playful, exploratory engagements within the home. Finally, we were concerned to explore and extend approaches to assessment that do not centre on notions of task performance or hypothesis testing. In this concluding section, we discuss each of these topics in turn.

Weighing Up the Prototypes

Through the ethnographic observations and documentary films, we sought to the describe volunteers' activities and articulate their orientations to the furniture in their own terms rather than applying predefined theoretical categories of our own. This is reflected by differences in the topics we discuss for each of the pieces. Nonetheless, as the field trials progressed, we saw commonalities in the kinds of issues that were important in understanding how people lived with the weight furniture. We discuss these here under four categories: activities, accommodation, operation and interaction, and appreciation. We suggest these may be more generally applicable to assessing the success of ludic designs.

Activities

In each of the cases we have presented, participants were able to create and sustain recognisable activities in relationship to our designs. The Drift Table could be used for 'sightseeing' or investigating sites that had been mentioned in the news. The History Tablecloth might be specifically reset at the beginning of a meal-time to illuminate the meal. The Key Table came to be embedded in an extended domestic ritual venerating the dog Terrence in his tilted frame. All of these activities, no matter how fanciful, are clearly occasioned by the introduction of the artefacts into the homes we studied. The activities are recognisable, indeed are sometimes nameable by participants (e.g. 'sightseeing', 'visiting'). In most cases, they relate to or are folded into activities that participants might commonly engage in their domestic environment (e.g. meals, as part of entertaining guests, or as an accompaniment to work). However, our prototypes have given such activities further features that incite curiosity and add to the topical repertoire people have in conversation either accompanying engagement with the artefact or in report of it. In short, in each case, we have witnessed a variety of activities coming into existence around and in response to the introduction of the designs.

Accommodation

The activities we have seen emerge around our designs do not seem to cause massive disruptions to daily routines or require existing domestic activities to be completely reconstituted. This is not to say that engagement with the prototypes is a completely non-problematic affair. The point is that such efforts are not 'mission critical' for the acceptable organisation of the home. To put it another way, our artefacts can be

accommodated. It is possible that it is precisely their open-ended nature that makes them readily possible to accommodate. The artefact too can be adjusted in its significance, in how it is being appropriated, so as to find a place in the home, as we saw for instance with the Key Table. By 'accommodation', then, we wish to suggest this mutual adjustment of existing domestic activities and routines to new technology, on the one hand, and of technology to the domestic, on the other. Along the way of course, new activities or new features of existing activities may come into existence as we have observed. It is also worth noting that all of our prototypes offer the everyday affordances of (different kinds of) tables. That they have this already existing identity also facilitates their accommodation. Their identity as tables suggests already known or anticipated places for them (in a kitchen/dining area, before a sofa) and, besides, if all else failed, they could still be used as tables. In contrast, an artefact designed to fulfil a single purpose in a radical new format may be playing a high-stakes accommodation game: if domestic routines cannot be easily adapted around it to make it work fully as intended and if its identity is fairly inflexible, then it might not be worth the effort.

Operation and Interaction

Interaction with each of our designs is, in some respects, a very simple affair. Indeed, under one description, there is very little you can do with them but move weight around (and perhaps occasionally reset things). However, there are an indefinitely large number of things around the home that have weight, all varying in interesting and idiosyncratic ways, and variably relating to different activities that one might perform on a table surface. In the case of the Drift Table and the History Tablecloth, there was some art in the selection of objects for making the artefacts work within whatever activity participants had conceived for them. This might require concern for the object's footprint, the shape of one's gestures placing the object on the table, or features relating to the object's customary use in the home and trajectory from one location to another. We would suggest that this meeting of simplicity (of interaction method: place weight) with richness (what weight? exactly where? when?) also contributes to participants' ability to accommodate our designs in the home and create and sustain activities with and around them. By slowing responsiveness in the Drift Table and the History Tablecloth, we have also encouraged forms of engagement with our designs that find a place in parallel with or at the junctures of other ongoing domestic activities.

The dual simplicity/richness and the pacing of interaction made for a form of engagement that our participants have found intriguing. In the Drift Table, this is further underwritten by the richness of the visual content available in the enormous corpus of aerial photography embedded in the artefact. In ways that were not entirely expected or intended, the sometimes enigmatic operation of the History Tablecloth also heightens intrigue and curiosity. Why is it working in that way? Is it stuck? Or is that the wrong way to think of its behaviour? If I do this will it do that? Remember the time when X happened? And so forth. That the History Tablecloth seems capable of a variety of behaviours, many predictable but a satisfying number not, from such meagre means as placing weighty objects and lighting up was something which engaged our volunteers throughout their time living with the artefact. We believe the curiosity that the prototypes have aroused, and the form of engagement they incite, further motivate their sustained use and exploration in the homes we have studied.

The Key Table was, from this point of view, notably less rich from an interactional point of view than the other two pieces. Putting something on it caused a picture frame to tilt. This interaction did not reveal significant new content as in the Drift Table, nor was the subsequent behaviour as intriguingly complex as the History Table. As our field study showed, intrigue and curiosity came less from the inherent properties of the table itself, and more from its ability to serve as a canvas upon which the volunteers could project their own narrative. They filled out the piece, as it were, both physically by dressing it in various ways, and conceptually by their choice to playfully 'canine-omorphise' it in their talk about it.

Appreciation

Our studies have shown how the Drift Table, History Tablecloth and Key Table can come to be objects of appreciation. That is, they are not merely used in the activities that people create or adapt for them, they are appreciated for what they are and for what they do. In all cases, the simplicity of one's basic interaction with the artefact and its response has been appreciated. "It does what it does." While participants often express initial dissatisfaction with the lack of more complex interactive functions, this often wears off. Not always though. The Drift Table was not so loved by folk who saw the artefact as pointless or who soon tired of its restrictions. We cannot boast (who can?) that all of our participants appreciated our artefacts and developed attachments towards them. However, in each case, there was at least one householder who did become so attached, indeed, to the point of being saddened when we had to

reclaim the artefact at the end of the loan. Notably, for each of these participants, the use of our design had become richly embedded in activities and appreciated *aesthetically* not just for its look (though that was the case most strongly with the History Tablecloth) but for its interactional and operational features.

Another source of appreciation came from the ability of the designs to be used towards ends of the volunteer's own invention. Perhaps because its interactional features were so sparse, the Key Table provided a particularly clear example of this. H and her household managed to create a rich experience around the Key Table by using it as a spur for a sort of game, in which they imagined it was an animatronic pet and played with the implications. This was not the narrative we intended them to read into the piece but the resulting behaviour was much what we had hoped for: the household did not just accept the narrative, but exaggerated, laughed at, and played with it. They appreciated it, not just for what it did, but for how they could use it as an occasion for play.

Understanding Ludic Engagement

The field trials allowed us to gauge the success of the particular prototypes, and to find commonalities in their experiences that may provide the basis for future evaluations of similar systems. In addition to this, our observations and the accounts of the cultural commentators helped further our understanding of ludic engagement more generally. In this section, we discuss some of the issues that arose in these studies that taught us new ways to think about the ludic.

Playful purposes

The prototypes were designed to encourage playful exploration rather than utilitarian task performance, yet we repeatedly saw people pursuing goals in their activities with the prototypes. This does not fundamentally contradict the ludic design agenda, however. The goals and purposes that people followed were not *inherent* to the device's design in the sense that without them no meaningful experience could be had. Instead, they were invented as a way of structuring activities with the table, in an *autonomous*, *provisional* and *ad hoc* way. Just as a child might play "Mommy and Daddy" with their dolls for a time before switching to "School", so the volunteers might take the Drift Table to look at neighbourhood homes before setting off to explore the coastline. The provisional, idiosyncratic nature of the goals set by

volunteers are not contradictory to play but a manifestation of people's curiosity and desire to explore. The simple interactional nature of the weight furniture encourages this open-endedness in formulating and pursuing playful purposes.

Sociality

The prototypes were designed with individual users in mind, but the field-studies made it apparent that their deployment and use were notably social affairs. The prototypes and their behaviours became conversational objects within the households and among the householders and their guests. In addition, many of the activities with the prototypes—for instance, the plotting of journeys with the Drift Table, dinner parties on the History Tablecloth, and the ritual welcome of the Key Table—were themselves primarily social in nature. Our different assessment methods were variably sensitive to this point. The documentaries, being based on individual interviews, may have deemphasised collective use. However, the social organisation of conduct is a central topic for ethnographic research so it is not surprising that our observational studies emphasised and were able to document and give substance to this topic. The point is that although people often did engage with the prototypes on their own, a great deal of their use was collective (including later reports of solo journeys): It is important to remember and design for the fact that people often play together.

Time out

Activities with the prototypes were commonly interwoven with the day-to-day routines of the household. As we have discussed, this allowed the prototypes to be easily accommodated within the home. It also suggests that play should not be seen as an activity to be focused upon instead of work, but rather a form of engagement that may fluidly punctuate ongoing work activities. The slow and persistent interactivity offered by the prototypes seemed to support this form of play. Rather than needing to abandon routine activities as one might do in starting a computer game or watching a movie, these prototypes afforded more flexible and fluid switches of attention and engagement, allowing continuity between utilitarian and ludic engagement in the home.

Interpretative flexibility

The prototypes we built were intended to refrain from offering strong narratives or

interpretations. Nonetheless, their structures and constraints clearly embody general notions on the part of the designers about what the prototypes were and how they might be used. The Drift Table was meant for wandering over the countryside. The History Tablecloth was meant to highlight the time objects were left on domestic surfaces. The Key Table was meant to indicate people's emotional state. These stories, however, were never reflected exactly by users' engagement with the pieces. S and his household took long journeys with the Drift Table to reach specific destinations. B and G enjoyed the unpredictable reactivity of the History Tablecloth. H and her family built up exaggerated rituals around "Terrence the Table".

This suggests rethinking the role of designers' narratives in developing ludic designs. From this perspective, designer's narratives, like interface metaphors, are useful and perhaps crucial in guiding the development of interactive structures and constraints. It may not be necessary or even desirable, however, to communicate these narratives clearly to users. Instead, narratives may serve a useful function in development by ensuring a consistent and coherent experience, but refraining from making it explicit in final designs may free users to make their own interpretations. From this point of view, good design might sometimes be better served by making narrative metaphors obscure yet suggestive rather than transparent.

Lessons for Field Evaluation

Integral to designing for ludic engagement is the avoidance of privileging particular use activities in order to encourage multiple activities and interpretations. While there may be a design story behind each artefact, appropriation in use may turn out rather differently, and this is to be welcomed. As we have discussed, however, this makes assessment of ludic designs difficult from a traditional HCI perspective. Any evaluative criterion one might want to specify in advance would seem to depend on an anticipation of how something would be used but it is precisely this that ludic design attempts to resist. A sceptic might ask, then: in the absence of prediction, wouldn't any assessment of success or otherwise be arbitrary?

Dimensions for Assessment

Our explorations of the Drift Table, the History Tablecloth and the Key Table in people's homes, however, suggest that a general set of dimensions may be useful in assessing ludic designs: (1) **Activities**. Does the designed artefact serve as an arena

for multiple activities? Do recognisable, characteristic activities come into existence in response to the introduction of the artefact where the artefact is systematically used as part of them? (2) **Accommodation**. Can the artefact be accommodated within the setting? Does the artefact show the requisite flexibility for its coexistence with indigenous activities? (3) **Operation and interaction.** Does the artefact have a method of interaction and a means of operation which intrigue people and incite exploration and/or speculation as to how it works or what it can do? Through this, does the artefact have the right kind of interactive and operational flexibility to sustain multiple activities? (4) **Appreciation.** Does the artefact come to be appreciated? Do those who engage with it become attached to it and value it aesthetically?

Having conducted our studies we do not believe these are empty questions which would allow arbitrary answers. On the contrary, these questions can be pursued as rigourously and critically as any evaluation exercise based on more traditional methods. Naturally, our dimensions and the specimen questions we give above involve multiple aspects and criteria and, in any new context, will be starting points for further specification and study. Our point is that one does not *require* a functional orientation to design and a hypothetico-deductive empirical method to enter into such affairs and address them vigourously. One can pursue design for ludic engagement along with relevant empirical and interpretative methods (in our case, ethnography and critical commentary) and still have a communicable sense of whether the work is successful or not.

Cultural Commentaries

The documentary videos we commissioned were intended to supplement the account given by the ethnographic observations. The videos do not do the job of ethnography. Their relatively short format and the simple narratives they present lack the thick and detailed descriptions of the ethnography, in part reflecting the relatively short exposure the filmmakers had with the volunteers. Nonetheless, our experience with the videos both as a means for assessment and as presentational tools suggest that they usefully complement the ethnographic studies in several ways.

First, the process of filmmaking seems to occasion focused reflection and articulation on the part of the volunteers. We saw this in all the videos in the combination of sound-bites and longer descriptions offered about the various pieces. S describes his changing attitudes towards the Drift Table from excitement to frustration to

appreciation. B describes her initial feeling of being imposed upon by the History Tablecloth and her later aesthetic and conceptual appreciation. H steps back from playing with the Key Table to articulate her feeling of being a co-creator of the piece. It is not that such articulations did not come up in the ethnographic studies: they did. The filmmaking process seemed to encourage participants to treat their pronouncements as particularly definitive, however. The videos capture an authoritative account of the participant's experience that can be returned to over time. These accounts take the form of activities demonstrated on-camera as well as verbal descriptions. S shows how he places (unusual) weights on the Drift Table and checks a road map to aid navigation. G and B demonstrate how they set the table for dinner and the patterns that appear on the History Tablecloth. Most dramatically, H dramatises her engagement with the Key Table, dressing it in a scarf and a hat, and ultimately toasting it with champagne. Through these re-enactments, the volunteers give a different sort of account, but one which summarises their experiences just as their verbal ones do.

The documentaries also serve to draw out the interpretations of the filmmakers about the prototypes. These may be articulated, as when the presenter describes his desire for the Drift Table despite sceptical expectations, or via the questions used to structure the Key Table video. They may also be more implicit, for instance in the interactions the filmmaker has with H and her household, encouraging them in their game around "Terrence the Table". They also come through the framing and editing of the film, the material that is included, and the genre of the film that is produced. The differences between the Drift and Key Table videos are suggestive here: produced by the same team, the first takes the form of a standard feature clip, while the second is much more participative and playful, perhaps reflecting the filmmakers' greater familiarity with the nature of the designs as well as differences in the pieces and volunteers. In any case, these interpretations may work at several levels. Even though they may not do the job of cultural positioning that we might expect from, say, an art critic or historian, as presentations by members of a community of practice concerned with communicating to a general audience, the videos embody orientations towards the designs that go beyond the volunteers' immediate experience to suggest how they may be understood more generally. In addition, they work to reveal new accounts of the pieces—in the case of the Drift Table, as many as three—to be compared and contrasted with those of the volunteers.

Finally, the video documentaries complement the ethnographies as a presentational

medium for describing what happened during the field trials to interested audiences. In this they have a summary immediacy that can be difficult to achieve using ethnographic descriptions. Watching the videos, we see the prototypes in the volunteers' homes, we witness the volunteers using them in various ways, and hear them as they describe their experiences. At the same time, the videos are not just presentations of our findings. Because they are semi-independent, they show or describe events in ways we might not choose. S puts a bucket of rocks on the Drift Table. G jokes about the History Tablecloth crashing. H refers to the Key Table as "Terrence" and offers it champagne. Moreover, as we have described, the videos can be seen as offering multiple accounts: those of the volunteers, those of the filmmakers, and those the audience are anticipated as having. These accounts may supplement those offered by the ethnographies in helping people understand how people experienced the weight furniture in the field. This is not a matter of undercutting the validity of the ethnographic observations: as we have discussed, these are far richer and more detailed than the documentaries. But multiple accounts may help reveal how the prototypes may be understood culturally, beyond the particular experiences we witnessed. Moreover, the combination of the video's immediacy with multiple explicit and implicit accounts may encourage viewers to make their own interpretation of events, allowing audiences to conceptually appropriate the research itself much as the volunteers appropriated our designs.

Learning from the Ludic: Revisiting 'Ordinary' Technology

Through pursuing a ludic design agenda we have built and explored a number of artefacts which are intended to be open in how they can be appropriated and used by people in domestic settings. Through ethnographic research, we have documented how people conduct activities using them and around them in a playful fashion, how such activities are multiple and varied, how artefacts are accommodated to the home and features of domestic life are accommodated to them, how simple forms of interaction can come to have a requisite complexity in engendering curiosity, and how people can become attached to artefacts and aesthetically engaged by them. Our work with cultural commentaries enforces these points and further shows how people (not just the designers and the volunteers into whose hands designs fall) give varied senses to our artefacts in ways that we did not anticipate.

While our specific focus has been on artefacts designed with playful intent, these points have broader resonances. In work in Science and Technology Studies,

researchers very commonly document similar findings in studies of technologies one might consider to be more a little more 'ordinary' or utilitarian than our ludic designs. For example, Bijker, Pinch and Hughes (1987) document the large set of design alternatives that existed for the bicycle before the diamond frame chain driven design became dominant. These alternatives are mapped onto the extremely variable accounts people had historically of their advantages, disadvantages and associations with different social groups (for other examples, see Pinch & Trocco, 2002; Schwartz Cowan, 1985). It is not within the scope of this paper to review properly historical and sociological work in this area, nor is our intention to endorse uncritically the studies we have cited. Our point is to suggest that our orientation to technology should not be thought as only offering insight to marginal forms of experimental innovation. In principle, any technology can be seen in the flux of varied interpretations and use activities, some in line with designer expectation, some not. What is particular about 'ludic design' is that we have taken the first steps in outlining a design practice that is based on such perspectives, not antipathetic to or merely tolerant of them.

Acknowledgements

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