

Artful Systems in the Home

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ABSTRACT

In this paper we introduce the idea of *organizing systems*. Through a number of examples from an ongoing ethnographic study of family life, we suggest that organizing systems come about through the artful design and use of informational artifacts in the home, such as calendars, paper notes, to-do lists, etc. These systems are not only seen to organize household routines and schedules, but also, crucially, to shape the social relations between family members. Drawing attention to the material properties of informational artifacts and how assemblies of these artifacts come to make up organizing systems, we discuss some general implications for designing information technology for the home. Most importantly, we suggest that technologies must be designed to accommodate the rich and diverse ways in which people organize their homes, providing them with the resources to artfully construct their own systems rather than enforcing ones that are removed from their own experiences.

Author Keywords

Mothers' work, home life, domestic life, ethnography, information devices, ubiquitous computing.

ACM Classification Keywords

H5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

TECHNOLOGY IN DOMESTIC LIFE

Domestic life encompasses myriad activities that can incorporate the use of information technology. For example, there are activities associated with leisure and entertainment, such as TV viewing, gaming, photography, internet usage, listening to and playing music, etc., all of which have become increasingly popular topics of research in HCI and its related fields [5, 15, 25, 32].

There has also been considerable research into “smart home” technology, with several groups building structures, such as the Aware Home at Georgia Tech and the MavHome at University of Texas [for a more comprehensive overview, see 1]. This research has been concerned with, amongst other things, ‘home control’, e.g., ambient

lighting, temperature regulation, plant watering [30], the use and interaction of sensors [19], the security of those sensors [8], and networking amongst household appliances [7]. One group whose stated aim is to “digitally engineer domestic life” have developed prototypes of an array of unusual items specific to the home, such as a “house memory”, which is programmed to “react” to residents, and a “smart pillow” that can read you bedtime stories [26]. While intriguing, this focus on technology, and on very specific forms of technology, has tended to render the inhabitants of a household less visible, and the work those inhabitants do practically invisible [3]. Indeed, one might conclude from surveying the above that ambiently lit, temperature controlled, sensor aware, networked household appliances which are protected from intruders are matters of pre-eminent concern in domestic life.

This paper is an effort to detail the common and lived experiences of the home that are somehow obscured by such technological imaginings and the arguably disproportionate attention given to leisure and entertainment. Focus is given to a collection of activities that have received little attention in the CHI literature, but without question make up a sizeable proportion of what constitutes home life: namely, those to do with the organization of information tied to a family's management and childcare. By information, we refer here to the miscellany of to-dos, bills, invitations, appointments, school correspondence, schoolwork, etc. that must be routinely handled, arranged and dealt with in the smooth running of a family home. With this focus, we recognize that the scope of our research is oriented towards one sort of domestic arrangement, the family. While well aware of the many and varied arrangements that comprise domestic life, our decision here has been to attend to a limited collection of home-based activities and consider the associated practices at a fine level of granularity, in the tradition of the broader work studies corpus [see 6, 18, 21].

Contributions to area

Attending to information and its place in domestic routines, the presented materials build on the significant works of Crabtree and his colleagues [10, 11], as well as a small but growing body of research examining the role of technology in home life [e.g., 16, 17, 33]. We aim to make four contributions to this research and to the broader interests of the CHI community.

The most modest of these contributions is to further explicate the everyday ways in which household matters are organized. We provide a number of examples from an ongo-

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ing field study of how such forms of order are sustained in practical ways. In our analysis we consider the material qualities of informational artifacts in and around the home and how these qualities lend themselves to or *afford* [see 24, 29] particular uses. Thought is also given to how these artifacts can come to make up “systems” for organizing home life, what we call *organizing systems*. An emphasis is placed on the *artful* ways in which people continually design, arrange and integrate artifacts as this is seen to figure heavily in the (re)configuration of organizing systems [27, 31].

A second and more theoretical contribution centers on the dual character of organizing systems. On the one hand, these systems can be seen as organizing because they arrange a household’s chores and activities, and delegate them to particular household members. In doing so, they determine where information is kept in a home and the movement of information between physical locations and people [see 11]. On the other hand, these systems serve to be organizing in a more subtle fashion by shaping the social relations between a household’s members. As we shall see in the presented materials, organizing systems necessarily demand that informational artifacts afford *action* by specific family members (and not others) and that, in turn, these actions produce a pattern or order to family life.

The third contribution made in this paper hinges on this last point. Drawing on our data, we suggest that the reconfiguration of artifacts and their use in organizing systems give rise to and sustain a particular type of family order, one in which mothers tend to be the central players managing and coordinating home life. The practical business of keeping track of family schedules, running household errands, taking children to and from school, and so on are shown to rely on organizing systems. These systems, in turn, are seen to depend on the informational artifacts that are typically designed and maintained by mothers. Household calendars, pin-boards, kitchen tables, etc. are thus enlisted into the common routines of organizing a home and, importantly, the ways in which they are created and used maintain a mother’s central role in family life. Our contribution, here, is in part to reveal just how mothers continually design and fine-tune a complex, interrelated and heterogeneous set of informational artifacts to organize home life, and how this serves to cement a social order.

The last of our four contributions is related to the design of information technologies for the home. The work we present points towards a design program that should provide people with opportunities to creatively devise their own uses of and relations between technological artifacts. Technologies in this sense should be designed as *resources* for people to organize their own everyday arrangements; they should not attempt to institute organizing systems in themselves. In a similar way to the argument expressed by Suchman [31], this position takes into account the artful ways in which people design and integrate their own systems.

In designing technology for the home, the importance of this artfulness is twofold. For one, we suggest that home-based technologies should be built so that they can be integrated into the varied and idiosyncratic ways in which people organize home life. Rather than insist on rigid or pre-determined operation, technologies should allow for the artfulness that seems to be an almost intrinsic feature of how people configure the artifacts they use and the relations between them. A second and more fundamental suggestion is that designers of information technologies should be sensitive to how material artifacts play a part in ‘producing’ the home’s social order. Technological artifacts should be designed so they can be integrated with everyday routines and, critically, so that they provide new opportunities that do not restrict how people come to order their home lives. It is our belief that this relies on a sensitivity to the role of *artful systems* in the home—how they come about, how they are afforded in the use of artifacts, what motivates their use, what social orderings they sustain, etc. The content of this paper is a step towards addressing these issues.

EXAMPLES FROM THE FIELD

The materials presented in this paper are taken from an on-going project examining mothers’ work. The project itself draws on a body of work that is concerned with the centrality of mothers in household work and childcare [9, 22, 23], something that remains more or less unacknowledged in information systems research, including, as far as we know, HCI and CSCW (with [4] and [28] as exceptions). We tread carefully in orienting this research, intending not to suggest that mothers are uniformly the primary caregivers and supervisors of households, but rather to recognize that, despite the ever-changing patterns of work and family structures, mothers, by and large, continue to play the primary role in organizing and managing family tasks and activities [9, 23].

Adopting an ethnographic orientation, the project has thus far involved several in-depth interviews with eight mothers (over 20 hrs) and extended periods of observation in and around these mothers’ homes. To consider how the organization of home life is done in practice, we have chosen to pay particular attention to the use of informational artifacts in the participating households. Drawing on a broad but established tradition in the social sciences and particularly anthropology [e.g., 13, 20], we examine the practices surrounding these artifacts as a means of revealing how the home’s social order is brought about. The concern for the artifact and its role in home life is also seen as a way to link the results of the ethnographic enterprise back to design.

In the following, we present several examples taken from sessions with a number of the participating mothers, sessions that we feel capture some common features of artifact use throughout the homes involved. These data are then used to outline some broader findings that are, in turn, used to lay out a number of design implications. We conclude the paper with some thoughts on the implications our research has for HCI and the design of home-based information devices.

The School Pickup

Turning to our first example, the following excerpt illustrates how the relatively mundane activity of waiting at the school gates can incorporate the movement of information and, in particular, its flow through one parent into the home.

- [Emma ushers her only child, Sophie, from the school gates]
- Emma:** Come on trouble.
- Sophie:** I'm a bloody reserve...
- Emma:** Excuse me?
- Sophie:** I'm a reserve for the swimming thing
- Emma:** Oh, that's good
- Sophie:** I'm not going! I don't want...
- Emma:** That's not too bad, a reserve.
- Sophie:** Yeah, there's somebody [inaudible]
- Emma:** Well, at least you get to take part.
- Sophie:** Only one kid from our class has got in.
- Emma:** Really... [Addressing researcher:] Typical school letter [reads through it]. When is it, 17th of June?
- Sophie:** Tomorrow.
- Emma:** Tomorrow?
- Sophie:** ... and we've got to be at school at 8.30
- Emma:** What? Tomorrow?
- Sophie:** yeah
- Emma:** ... [reads from paper] Early start, leave school at 8.30. Errgh! Well, you'll have to talk to dad. Alright, let's get out of here.

Back at home, having returned from the school run, Emma places the letter about the gala on her sideboard. This is the place she temporarily puts paperwork that is awaiting action. As she makes herself a cup of tea, she returns twice to the sideboard to read over the letter. Following the second reading, she retrieves a diary from a filing cabinet kept in the living room and steps out on the balcony to talk to her husband, Simon (who is back, early, from his job as a window cleaner). Simon's talk is inaudible but Emma's side of the conversation speaks for itself:

You've got Jim at 9 o'clock... yeah, I know it's a pain in the arse, ... yeah, but I don't need to go anywhere tomorrow! [Returning to the living room, she again picks up and looks at the correspondence about the gala]. Hmm, ridiculous, 8.30 start!

Later Emma reveals it was Simon's diary she had with her when talking to him on the balcony. She explains what it was she was doing:

I knew Simon was taking her to school but I couldn't remember what time his first job was but luckily he can do tomorrow. So he's going to take her at 8.30. Then basically come back have a cup of tea and then go back out again, cause his job at 9 is right opposite the school, so he's going to have to go back and forth [laughs].

There are several key points that we wish to draw attention to from these field notes. First, it is notable that Emma is confronted with an organizational matter when out on the school run. Whilst her daughter Sophie is busied with expressing her disappointment at being a reserve for a swimming gala, Emma attempts to get to grips with the practical arrangements. She moves between reading the letter she has

just been handed and coaxing the details from Sophie directly. At once, there is the impression that Emma is attempting to work out the logistics of where, when and how she will get her daughter to the gala, an unexpected appointment that she is none too happy about.

Once home, it is noteworthy that Emma puts the correspondence about the gala in a place she has established for things that require action. Her solution relies on tasks and chores having some embodied form, taking shape in scraps of paper, printed letters, and so on. It also makes use of the location of her sideboard—located, conspicuously, in the main living space and in full view when either sitting in or passing through the room. Over the course of the afternoon, the gala letter's location serves as a physical point of reference for Emma. She returns to the sideboard and the letter several times, attempting to absorb its content and figure out how the logistics for this seemingly simple event can be arranged. Emma interleaves various other chores and activities with this contemplation. She seems to have to mull over the specifics for an extended period, and it is only after some time that she confronts Simon with his diary. Of interest is that it is Emma who takes responsibility for making the arrangements and she who enlists her husband's diary. Emma has the assumed role of managing and coordinating Sophie's movements, even when they encroach on Simon's work schedule.

The point we wish to emphasize here is how the swimming gala letter, given to Emma, precipitates a chain of events centered on integrating and arranging the relevant information into the household's existing organizing systems. As such, the capture and integration of information is part of a larger, ongoing, sequence, the specifics of which are coordinated and marshaled by one central figure: Emma. Of particular importance is Emma's use of actual material artifacts in this coordinating and marshalling. The printed letter, the sideboard and her husband's diary are all enlisted into the unfolding sequence of events and enable, in part, the organizing systems to work successfully.

The Family Chart

This role of coordinating family and household activities is further illustrated in our next example. Rebecca is a mother of three girls, aged nine, six and three. To arrange and keep track of her daughters' as well as her husband's various activities she uses a home-made calendar, or what she calls her "family chart" (Fig. 1).

The chart, heavily annotated with the family's comings and goings, is hung prominently on the side of the refrigerator for all to see. Rebecca describes her own regular use of it:

I generally look [at the chart] at the beginning of the week. So just to remember like when there are tea dates, when I'm going out for dinner, have I got babysitting, and that kind of stuff. But I do look at it every morning. I do religiously come down, put the kettle on, have my shower, come back, look at it while I'm making the tea, and then go up back to bed with tea. And that's what I do every morning, that is my routine.



Figure 1. Rebecca's family chart.

It is the way in which Rebecca describes the routine nature of the morning ritual with her chart that is immediately striking in this excerpt. The chart's fixed place in her morning schedule signifies how it is she who takes on the role of overseeing the family's agenda in its entirety: to know who is doing what at any given point in the day. The very ordinary, everyday quality of the described ritual, performed in and amongst shower taking and tea drinking, establishes this work as a taken for granted feature of what Rebecca does.

Of course Rebecca does not operate alone in this household coordination; the arrangements and scheduling can involve collaboration between multiple family members. Encouraged by Rebecca, various family members have adopted the practice of inscribing their planned activities onto the chart (dependant on their ability to write). In the following Rebecca discusses her husband John's contribution:

- Interviewer:** Does John refer to it [the chart]?
- Rebecca:** He does. He does now yeah, occasionally he'll go through the year putting in when he's going fishing and when he's going to Belfast and when...
- Interviewer:** Really, where's that? Has he put it ahead of time?
- Rebecca:** Yes he does. He occasionally gets crossed out... [both laugh]
- Interviewer:** Who does he get crossed out by? [both laugh]
- Rebecca:** By me if I find something better to do.

Although from the text it appears as though Rebecca may be somewhat Draconian in her methods, what is evident is that she has enlisted practical ways for her and her family to get on with family business. Her occasional crossings out of John's fishing trips or trips home to Belfast are not simply authoritarian measures (in actual fact she is enthusiastic about his fishing), but rather reveal a system of hierarchy based on balancing individual needs within the larger context of the family's activities as a whole.

From the above, we can see that the chart becomes a material representation of the socially constituted order of the

home—who does what and what activities take precedence over others. Central to this practice is Rebecca's accepted role as overseer. Moreover, Rebecca acts not only as coordinator and overarching arbiter of the chart's content, she also has a vested interest in its efficacy as a family resource. A primary concern for her is how well it integrates into the organizing systems the family has in place and, in particular, how well it conveys the necessary information to her family as well as herself.

To consider this in more detail, let us turn to Rebecca's response when asked how she conveys the day's schedule to her family:

I think [breakfast] is more a rush, and I think you're trying to get the kids breakfast and get out the door. And actually when we're all sat in the car and you're in a very enclosed space for, you know, ten minutes and nobody's going anywhere and actually you've got their attention – I'm like 'remember, Anna, you're going to Chloe's for tea tonight', or 'remember I've got to go pick up Chloe', and you know, 'Flora you're doing this' or 'Caroline Oswald is picking you up tonight and I'll see you at Britannia.' So then they actually know – because I think it's important for them to know.

Rebecca's description illustrates how her morning ritual, where she absorbs the day's events, feeds into her system for conveying information to the family. In the car—where there is no getting away—the tasks, activities, play dates, etc., inscribed in handwritten markings on the chart, are translated into a verbal listing of where people will be, who they will be with, and so on. Rebecca stands in for the chart, conveying the day's schedule and also renegotiating anything unforeseen. Her reeling off of the children's activities brings us back to the items listed on her chart, interweaving one child's schedule with another's, timetabling the day with reference to the chart's structure and order.

This process reveals how Rebecca has had to contemplate the most effective way of conveying the chart's content. In contrast to breakfast, the ten-minute school run is seen to be the best time to ensure the family's attention. What's particularly remarkable about this example, however, is how Rebecca's system for conveying information is fashioned in and through the family's practical routines. The system is afforded through the car, because it provides an enclosed space, and it arises and is sustained through the family's routines and particularly through Rebecca's matter of fact engagement in them. For Rebecca there is no time out from these systems and their enactment because they are the very business of parenting.

A Petal-board and Kitchen Table

Moving on, we find further evidence that the organization of family and household matters can be far from straightforward or obvious. The distribution and coordination of action and responsibility undertaken by mothers can become more complex when factors such as children's well-being and a husband's sense of aesthetic come into play.

In our next example, Olivia has placed what, for lack of a better term, we refer to as a “petal-board” in a room that is by the family entrance to the house, where the family keeps their shoes, coats, schoolbags, etc. The board is in the shape of a flower with five surrounding petals, labeled Monday to Friday, and with the centre of the flower labeled ‘Sat/Sun’ (Fig. 2).

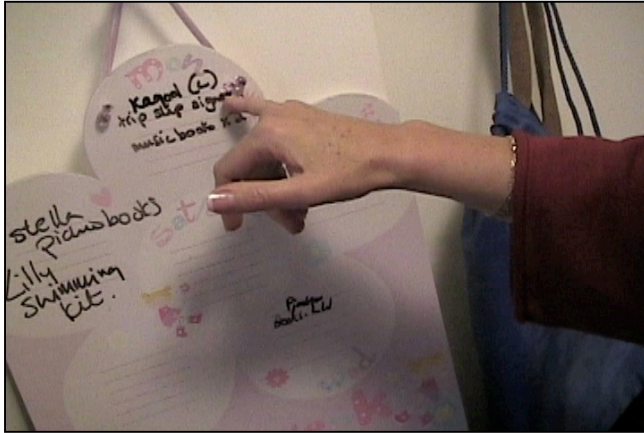


Figure 2. Olivia’s petal-board.

On one of the days we visit, the petals for Monday and Friday have been written on by Olivia, while Wednesday’s entry has been inscribed by Laura, her 8 year old daughter. For Monday, the entry reads “Kagoul (L), trip slip signed, music books x 2.” Olivia’s explanation of these items provides us with an insight into how the petal board is used:

This was for this Monday, just gone. Because that was Laura who went on a trip on Monday and so I needed that [points to the “trip slip” inscription] for that day and they both do music on a Monday. And Laura’s Kagoul I knew was at home and it was supposed to be at school and that’s why... [moves onto new topic].

Olivia’s explanation reveals how the petal-board is enlisted to manage and convey the work and routines that make up family life. The list stands as a three part embodied reminder of 1. the Kagoul (a type of raincoat) Laura, (L), must have for a school trip; 2. the “trip slip” that needs to be completed, giving permission for Laura to go on the trip; and 3. the music lessons the two daughters attend on Mondays.

Elaborating further, Olivia reveals that the petal-board has a secondary function:

This should be for the children. That was the theory. I did it to try and encourage Laura not to forget everything on a regular basis.

Olivia’s use of the word “theory” suggests an underlying motivation to her system. Her explanation denotes a moral undertone suggesting her aim is to design more than a simple aide-memoire for Laura. Her artfully devised solution seeks to instill a sense of responsibility in her daughter, and lessen the reliance she has on her mother. For Olivia then, the petal-board amounts to more than a simple organiza-

tional system. Rather, it provides a practical method to foster a self-reliance and independence in Laura.

During our visit, Olivia goes into some detail describing how she has chosen to situate the petal-board where she has. After careful consideration, she has placed the petal-board next to the door in the entry hall where her daughters can view it as they enter and exit the house, but in an unobtrusive spot so as to not be unsightly for other visitors. This forethought and attention to detail gives a sense of Olivia’s interest in the system she has created, as does her continual assessment of its effectiveness. The quote below describes one of her various strategies to improve upon it:

It needs updating otherwise people get tired of looking at it cause it looks the same... What happened was we used it a lot, Laura wrote all over it illegibly, but she could read it and then it kind of got ignored because it was the same things every week. So I kind of wiped it clean and started again and I think wiping it clean’s a better thing.

Besides her ongoing commitment to the petal-board, what this excerpt indicates is Olivia’s overall say in the family’s organizing systems. Even though the board has been designed to be instructive for Laura, it is Olivia who has the last word on the board’s content. Key here though, is that the wiping clean and starting again are done for the very practical reasons of clearing the illegible handwriting and reinstating the board as a something not to be ignored. Olivia’s authority is exercised so that the device can function properly; it is necessarily implicated in the use of the artifact to successfully convey information.

In a similar way, Olivia relies on the inherent properties of the kitchen table to assemble another system. In one of our visits with Olivia, she recounts the arrangements behind a school trip scheduled for her younger daughter. Her description presents the necessary arrangements as logistically complicated, involving an array of instructions listed in a letter sent home by the school that are too detailed to be accommodated on the petal-board. Explaining her preparations for the trip, she tells of her use of the kitchen table as an alternative:

My other system is doing everything the night before, so I got it all ready last night and went through it in my mind and I looked at the thing [the letter relating to school trip] and put – on the [kitchen] table I put a note of what I was to remember.

of her various methods of organizing children’s and household matters as systems, whilst the phrase “and went through it in my mind” alludes to the forethought that can be required in such organizational arrangements.

What this example demonstrates is the manner in which one household system can lead into and co-exist with another; for detailed arrangements, we see that the petal-board is simply not adequate, and that the “note-on-kitchen-table” system must be invoked instead. Olivia’s reference to her “other system” suggests that she has instituted a range of systems to handle the organization of information and these co-exist for different purposes.

Interestingly, the kitchen table is also used as part of a different system Olivia has devised. When dealing with the miscellany of documents and paperwork associated with her household's management, Olivia has instituted a practice of laying out the various items that demand attention across the kitchen table. As an item is dealt with, she takes it off the table and puts it in a pile elsewhere, signifying that it has been resolved. When particular items need thought or the relations between them need to be carefully arranged, Olivia finds herself walking around table, circling her paperwork as it were, in an attempt to get to grips with the task she faces and ultimately clear the decks, so to speak.

This variety of functions that Olivia's kitchen table serves (besides the obvious as a place to eat) is interesting because it illustrates how the table's inherent properties can shape its use as an information 'artifact'. In the first example, the table functions as a temporary and shared display for family members, a location where critical reminders can be placed that need to be seen in the morning. In this incarnation, its important attribute is that it is centrally located and likely to be used for breakfast. In the second example, it is used as a setting to lay out and interrelate an array of documents—the physical space provided affords the spreading out the documents and facilitates their sorting out and management. Of course, the table has myriad other functions in family life: an offloading point for schoolbags, a place to do homework, etc. The point, though, remains the same in each case: it is the material properties of the table and its placement in the home, both physically and socially, that afford its use.

Recipe Books' Multiple Functions

Our next example considers a book Charlotte keeps that contains what she refers to as 'critical phone numbers'. The book, placed on a shelf in the kitchen, originally began life as a record of their youngest child's first two years. Because Charlotte works outside the home, as a teacher, this was a book kept by the baby sitter, or nanny, to keep Charlotte up-to-date with her youngest child's routine, schedule and significant occurrences. In describing the book, Charlotte, like Rebecca, expresses a sense of 'maternal overseeing' that she does remotely with the help of the book:

When our nanny first started, this was like Dotty's... she would just write in the times of her feeds and nappy changes, but she's grown out of that now. But we had a similar system when the boys were little and it was nice for me just to know when they're small babies what was going on.

From Charlotte's description of the book, we get a feel for the evolving nature of family life as well as the mechanisms devised to accommodate them. Because Dotty has grown out of needing a record of nappy changes and feeds being conveyed, the book is no longer needed for its original purpose. Interestingly, however, the book under discussion is still serving several purposes:

The reason it's still in existence is because in the back there's like critical phone numbers for everybody so they're like my mobile, doctor's, Colin's work, the schools. Actually that's defunct cause she's moved to Frankfurt [points to name in book], quite a few of these things are defunct, (pause) so this could be re-jigged really, this system [pause]... except the other thing is it's got all our nanny holiday dates.

There are several points to be examined here. The fact that Charlotte refers to this as a system that is defunct and could be re-jigged, shows that she sees it as something *she* has constructed, which can be improved upon. After a moment's pause, during which she apparently conducts an ad-hoc evaluation, the book is deemed worthy because it is still serving some function other than simply being Dotty's baby book. Thus, even though it has been deemed more or less 'defunct' in terms of acting as a repository for critical phone numbers, it is, on final reflection, still serving a 'useful' purpose as a written reminder of the nanny's holiday dates. Similar to Olivia's petal board, there's an ongoing assessment of how well the system works. And in keeping with other household systems, this evaluation happens in an informal manner, as she runs across it, in the course of looking for something else.

However, perhaps more interesting is *why* Charlotte would transform her daughter's baby record into a phone list; why not use a new notebook? The answer emerges when Charlotte mentions that this system of transforming baby records has a historical precedent, and describes her older son's baby notes, recorded in a book from 1995 (Fig. 3a/b),

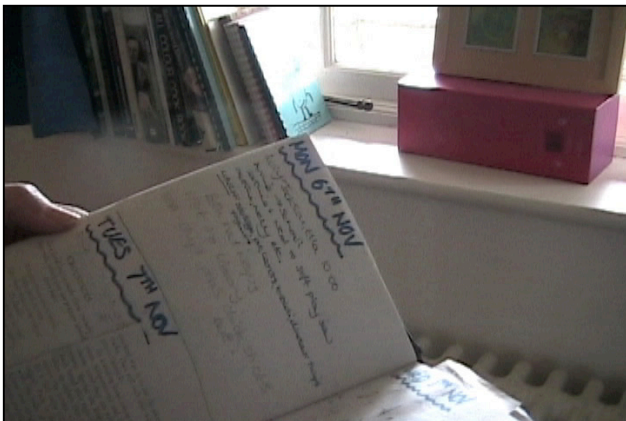


Figure 3a. A page from Charlotte's son's baby book

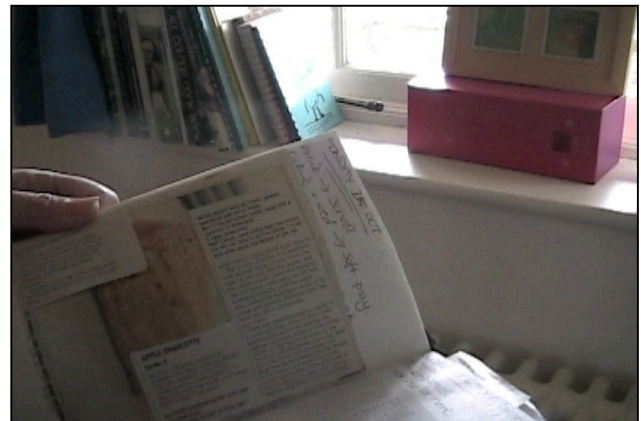


Figure 3b. A page from the baby book with recipe.

which have been similarly co-opted:

It has a kind of sentimental value... And I can't bear to throw it away but you know, it's silly to keep, so I've kind of made it into my recipe book where I stick in recipes and stuff. So I can see some of it but some of it's just boring and repetitive and (flips through book) there are lots of useful pages in the back so...

Here we see how Charlotte has devised an artful, albeit unusual, solution that reconciles sentimentality and a certain degree of functional utility that she finds necessary in her household. The statement “And I can't bear to throw it away, but it's silly to keep,” nicely captures the conflicting dichotomy between the two. Because the book relates to a period of her son's life that will not happen again, it has personal and sentimental value, yet the book has no immediate purpose other than acting as a memoir of that time. By turning the baby record into a recipe book, she has managed to reconfigure the book into a functioning artifact that has a justified place on the kitchen shelf, thus allowing her to retain something of sentimental value. Illuminatingly, it is Charlotte's satisfaction with her creation that is important here. Her sense of pride in being able to combine the two is evident, both in the way she displays the baby record/recipe book and in the fact that she continued the tradition with her daughter's baby record, although in a somewhat different form. Arguably, this particular configuration is not an obvious one, nor necessarily well-suited to anyone else, but it is this sort of bespoke artfulness that is a key characteristic of organizing systems in the domestic environment.

BROADER FINDINGS

Heterogeneous organizing systems

The results from our ongoing fieldwork confirm much of what Crabtree et al. have reported in their extensive studies of the information artifacts tied to a household's organization [11]. We have seen, for example, how Emma keeps her pending items on her living room sideboard or how Charlotte keeps a book with her critical phone numbers on a kitchen shelf, and in so doing make up what Crabtree et al. refer to as a home's *ecological habitat* of information artifacts—the arrangement of communication media throughout a home. The way in which Olivia arranges her paperwork on the kitchen table illustrates the use of *activity centers*, the established places in the home where the actual work involved in using these artifacts is done. The shared use of Olivia's petal-board and Rebecca's chart pinned to the refrigerator also point towards the use of *coordinate displays*—places where communication media are located to support collaboration.

Our own findings build on these points, and have similarly significant implications for the design of interactive technologies for the home. The presented examples suggest that a home's ecological habitats, activity centers and coordinate displays are all incorporated into broader *organizing systems*—systems in which heterogeneous collections of artifacts are enrolled to capture, integrate and arrange, and convey information. Our first example, with Emma, illus-

trates this well, where a letter she is given at the school gates finds its way into the family's system for arranging pending to-dos and is then translated into a scheduled journey in and amongst the family's routines.

The organizing systems are often ingeniously devised to overcome the limitations of particular artifacts or stand in as alternatives for other systems in their entirety. Olivia's note-on-kitchen-table, for instance, offers an alternative to the petal-board when the arrangements to consider are too detailed. Likewise, a system another mother, Sarah, uses to record to-dos on her answer-machine replaces the use of paper-based lists in inopportune moments, when pen and paper are not to hand. Sarah makes use of the hands-free attachment on her mobile phone whilst driving on the school run to record reminders for herself so that she can later integrate her fleeting thoughts into artifacts like her diary or calendar.

Our findings also reveal how a family's organizing systems are by no means static. The systems are continually being (re)designed to suit any actual case and to meet the ever changing needs of families as children age and relationships develop. Charlotte's multipurpose baby-record/recipe-book provides a nice illustration of this. By re-appropriating the artifact once its function as a baby-record has run its course, and transforming it into a volume for recipes, the organizing system thus becomes one of integrating and arranging handwritten notes and newspaper cuttings (detailing food ingredients and cooking instructions) with inscribed mementos of her children's past. Charlotte's reference to “lots of useful pages in the back” of the baby book/recipe book is a further example; the sense is that this book could be re-configured for yet another bit of domestic work, the repository of some other household system. The possibility conveys the ad-hoc nature of household systems (reminiscent of lists on backs of envelopes), and this opportunistic combining and reconfiguring are indicative of how they evolve over time.

Finally it is important to note the very personalized, idiosyncratic and bespoke nature of some of these organizing systems. Charlotte's baby record/recipe book is a case in point. Rebecca's family chart is another example; although less unusually configured than Charlotte's system, the fact that it is home-made when there are several commercial alternatives available is notable. Another mother, Mary, uses wooden bowls to categorize the family clutter in her kitchen, using the visibility of the topmost layer to establish which items have priority. These examples show that people go to some lengths to devise their own organizing systems and that the possible variations are near limitless. This also suggests that there are different underlying motivations at work in the home; arguably, the concepts of ‘efficiency’ and ‘optimization’ can have very different meanings in domestic environments.

The social organization of the home

Less immediately evident, but perhaps more critical in the presented work is how these organizing systems come to make up or occasion a home's social order. What we have seen, thus far, is that one person—typically a family's mother—enlists a variety of systems to organize a household's arrangements. Developing this line of reasoning, what we wish to suggest is that the work that mothers do to artfully construct these systems, and then maintain them, has consequences over and above the organization of a family's practical arrangements, so that the systems are not merely about the management of information. The systems lie at the heart of the fundamentals of home life, in so far as their routine and practical use occasions the social organization of the home.

Critically, this ordering is by no means something that is explicitly imposed. Rather, it is rendered visible through the ways in which the organizing systems are routinely and practically instituted. Olivia's petal-board stands as a particularly good example here because it shows how a system of organizing also works to instill a sense of responsibility in her daughter Lilly. In other words, the actual use of the petal-board institutes a system through which Lilly might begin to conform to the expected order of things.

It is the *doing* of systems such as these that can be seen to constitute the order that places the mother as central in organizing household information. A mother's participation in the ordinary household routines and, in particular, her immediate relations to the enlisted artifacts are what make her central. In short, it is because mothers do the school run, manage calendars, arrange notice boards, piece together multi-functional books, and so on, that they come to play a central role in designing and maintaining the organizing systems. Their centrality in household work is, in this regard, an unavoidable consequence of their part in getting on with everyday household matters.

What is crucial for design is that these organizing systems are afforded in and through the properties of the artifacts used. The very nature of the artifacts—their form, the way they are arranged, and their routine use—are what give shape to the systems and allow them to be sustained. The school bag provides an example, serving as an unsuspecting but ubiquitous resource for transporting information into the home. In discussing how she stays up-to-date with events at her children's schools, the description Zoe (mother of three) gives of her 5-year old son's schoolbag shows its communicative function, acting as an embodied method for transporting details about school-related events, projects, etc. in the form of notes or letters. Moreover, the schoolbag's contents can have a monitoring role, so that exercise books, homework diaries and artwork all provide an opportunity to coax the less obvious details of a day from a child. It is the fact that a young child's school bag is designed to contain specific material, that it is transported to and from school, and that it is packed and unpacked by the child's mother that afford its part in a system designed

to incorporate school-related information into the home and monitor progress at school. The organizing systems thus arise from and are part and parcel of a home's ordinary routines and through the use of specific artifacts in these routines.

DESIGN IMPLICATIONS

To a certain extent, the presented findings point towards a number of arguably predictable design implications. Broadly, our research indicates that technological infrastructures for the home should allow for the use of multiple, mobile and embedded, information devices that can be combined and interconnected in ad-hoc ways. Such a position harks back to the vision of ubiquitous computing originally articulated by Weiser in 1991 [34] and further developed by a host of research programs, worldwide (for an overview, see Dourish [12]).

For the purposes of brevity, we briefly list three implications that we believe add to the growing corpus of research surrounding ubiquitous computing:

Artfully combining heterogeneous devices – first, we suggest that our findings call for an infrastructure in which a heterogeneous collection of devices can be assembled to capture, integrate and arrange, or convey information, or do all three. Crucially, though, they must be able to be artfully combined so that people can design organizing systems that suit individual or family needs. Recognition should be given to the bespoke character of organizing systems and how they are often assembled for reasons that cannot be simply predicted or generalized.

Pliable systems of organization – closely related to the first point, any infrastructure should allow devices to be combined or removed from an organizing system so that the overall function the system serves might be redesigned. The point here is that a system should be pliable in so far as its function can be altered over time, or that it might serve multiple functions, through the recombination of devices.

Integration with established organizing systems – third, our findings suggest that information devices introduced into a home should be able to integrate with a home's established systems. This includes paper-based systems. For example, thought could be given to how paper-based notes, letters, calendars, notebooks, etc. could be embedded with electronic tags (e.g. RFID) so they could be integrated with their electronic counterparts. Central to this point is that the architecture should allow all available devices to be enlisted and (re)combined to render the organizing systems pliable.

Designing for Organizing Systems

In what remains in this section, we wish to develop a final point that draws heavily on the notions of materiality and embodiment that have become central tenets in the ubiquitous computing movement [12]. More significantly, we aim to elucidate a point that we believe has fundamental implications for the design of information devices in the home.

At the end of the previous section we presented an argument that foregrounded the role organizing systems play in a family's social order. We suggested that the organizing systems instituted in a household play a part in constituting a home's social organization—its social order. Critical for design, the argument hinged on the fact that a household's organizing systems are afforded in and through the properties of the artifacts enlisted. The organizing systems are shaped by and indeed come about through the practical ways in which the artifacts are used.

This suggests that an information device should be designed around one of two principles. Either:

1. An information device should be so flexible that it can be incorporated into almost any organizing system a family has designed. The ubiquitous, pliable and free-form properties of paper-based artifacts stand as exemplary examples [see 29]; *or*
2. A device should be designed so that through its use it affords the 'doing' of a particular organizing system or set of systems. That is, whether a device is built to capture, integrate and arrange, or convey information, it should be designed so that the practical ways in which it can be used affords the system of organizing it is targeted at.

With respect to the second point, fridge doors are an example par-excellence. The practical ways in which fridges are used mean that the door (and what is attached to it) is, without need for prior specification, a shared space for displaying information to the family; the fridge door has inherent properties that afford organizing systems intended to convey information. Similarly, the kitchen table, with its material qualities and physical location, lends itself to being used as both a shared but temporary display and a place to work on multiple, paper-based documents [see 11].

Notably, the alternative to this, where prior specification is a prerequisite to the use of a device (such as the configuration of an application's privileges), misjudges the artful ways in which people incorporate artifacts into organizing systems and occasion an order in doing so. For instance, the need to configure the access rights to a PC situated in a living-room, *a priori*, is counterintuitive because the very location deems it to be public. In contrast, diaries or even mobile phones can stay personal, not by setting access or privilege rights but rather because they are kept in places that make them personal: in pockets, handbags, bedrooms, etc.

Finally, relating to this last point, information devices that are built for family homes, and for more than one family member, should take into account the fact that organizing systems are routinely designed with one person as a central organizer. Thus, the devices should afford, or at the very least not inhibit, the flow of information through a central figure, whether that be a mother or father. Like the school bag, hallway notice board, family chart, etc. a device's

properties should allow the centrality of one person to be an ordinary feature and possibly natural consequence of its use.

CONCLUSION

In this paper, we have drawn on a number of representative examples from our fieldwork to make a case for the design of information devices in family homes. The examples have illustrated how the systems used to organize a home are artfully designed using a multitude of artifacts. The examples have also served to reveal the ways in which mothers take on the primary role of designing these systems, initiating, sustaining and developing them in order to organize matters relating to home- and child-care.

Key to the presented findings is the part a family's organizing systems have in shaping the social organization of home life. The findings have been used to suggest that a home's social order is constituted, at least in part, through the practical accomplishment of its organizing systems. Moreover, it is suggested that these organizing systems are afforded in and through the artifacts that are enlisted. It is this latter point which is seen as a crucial issue for the design of interactive systems and especially information technologies for the home. From this, our contention has been that home-based information devices should be built with careful thought given to how their form and use (and more generally, their physical and social properties) might lend themselves to particular organizing systems and, in turn, what part these systems might have in constituting a home's social order.

Rather than present specific design suggestions or criteria, what this work has aimed to do is contribute to what has been referred to as the *play of possibilities* for design [2]. Through our work, we have sought to lay out a number of principles that might guide but not limit the design of home-based information devices. Generally, the implications of what has been presented outlines a vision of multiple and heterogeneous information technologies operating within the home, a vision that is closely aligned with the ubiquitous computing project. Importantly though, like Edwards and Grinter [14], our contention is that technologies of all persuasions will be gradually adopted in homes in a *piecemeal* fashion and that the work set out for the HCI community is to understand how people might artfully integrate them into existing, everyday practices [see 31].

With respect to this, our broad aim has been to consider how the established routines that comprise mothers' work might be augmented through technology. Specifically, it has been to consider how information devices might support the central role mothers typically play in organizing and managing everyday family life. What we remain sensitive to, however, is the possibility our presented argument has for addressing the division of work in the home: how devices might be designed to afford organizing systems that reallocate mothers' work to different family members or support the collaborative undertaking of this work.

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