HomeNote: Supporting
Situated Messaging in the Home

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ABSTRACT

In this paper we describe a field trial designed to investigate the potential of remote, situated messaging within the home. Five households used our "HomeNote" device for approximately a month. The results show a diversity of types of communication which highlight the role of messaging both to a household and to a place. It also shows the ways in which these kinds of messages enable subtle ways of requesting action, expressing affection, and marking identity in a household – communication types which have received little attention in the research literature. These in turn point to new concepts for technology which we describe.

Categories and Subject Descriptors

H.4.3 [Information Systems Applications] Communications Applications; H5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous; H.5.2 [Information Interfaces and Presentation] User Interfaces - User-centered design; H.5.3 [Information Interfaces and Presentation] Group and Organization Interfaces - Asynchronous interaction.

General Terms: Design, Human Factors.

Keywords

Domestic communication, messaging, situated displays, SMS, field study, epigraphic, family life.

1. INTRODUCTION

In the last few years, the growth in HCI research related to the home rather than the office underscores the realization of the enormous potential for innovation in domestic information technology. Till now, to put it coarsely, domestic technologies have broadly fallen into two camps: time-saving technologies (dishwashers, vacuum cleaners, microwaves and the like), and time-spending technologies (televisions, cameras, stereos, and, increasingly, home computers) [4].

As information technology companies have sought opportunities in this space, they have had to adapt the role they think their own technologies might play. Information systems in the workplace have been broadly sold on the basis that they are time-saving. Yet those same technologies get offered to home consumers in support of the enrichment of home and family life. It is no wonder, therefore, that such companies have struggled to succeed in this setting.

Part of the problem is not simply this apparent contradiction between office and home technologies. Rather, it is that the meaning of time-saving and time-spending is more complex in the home than might appear at first glance. Consider the technologies used for home communication. These technologies (some "hi-tech" and some very "low-tech") obviously help individuals within homes manage their practical affairs. Speed, efficiency, timeliness are thus factors likely to make some technologies more successful than others. But, in the home, communication technologies are also used to bind people (such as families) together. The home, after all, is not merely a place people share, it is a place made special by the way people live in it. How they do this, and how they use communication tools as one set of devices to create this binding, cannot be effectively encompassed by notions of saving or spending time. Certainly home communication is sometimes about efficiency and sometimes about time consumption, but it is also about ideas and displays of appropriateness, thoughtfulness, and even tenderness.

What it is that families are trying to achieve, and how they use mundane communicational artifacts (such as paper notes, paper mail and whiteboards) to do so, is illustrated by numerous ethnographic studies [see 6 for a summary]. These have shown, for example, that the *placement* of these artifacts within the home can be critical. Thus the meaning of a paper note is dependent on its physical and social place in the domestic environment. For instance, a note placed on the refrigerator door (even where on the door it appears) has implications for who will see it and how it will be used [17]. In the home, people make decisions about where best to leave a message for others through an understanding of the normal ebb and flow of the household [19]. This can result

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in there being places that can be thought of as "coordination centers" where many important messages get left [3].

Yet this binding of location and human action has important subtleties. Many messages, such as those inscribed on paper notes or on kitchen whiteboards, have *at-a-glance* properties. That is, they can be seen for what they are: a bill, a personal note, and so on. In addition, they can take on a visual, static *persistence* when casually left in places around the home, places like refrigerator doors. These affordances mean that these messages come to have a *peripheral* role in people's awareness. Paradoxically, one could say that many messages are 'pushed' to people's attention in the home by essentially putting them *out of the way* [7].

Other messages can be deliberately placed not for anyone in particular but for anyone and everyone present in a room or area of the house. These messages are not put out of the way but are rather put in places to *broadcast* them. These messages are not all alike: some offer instructions and commands, 'please do this' or 'do that', some are merely there to express affection. Postcards placed on the mantelpiece are exemplars of this [7].

These examples show that, when it comes to messaging, something special is going on in home settings. There is what one might call a delicate knitting of moral and practical concerns. Home messaging entails linking place to the daily schedules and movements of occupants; this is linked to mutual understandings about these schedules, which in turn is tied into every home's idea of appropriateness, thoughtfulness and affection; to what one might call for want of sociological jargon, a certain *moral order*. It is on the basis of this local knowledge and this moral order that members of households leverage the affordances of particular messaging media.

It is interesting to contrast these situated messaging artifacts with the affordances of communication technologies designed for the office or the 'mobile world'. These technologies are often offered to people as tools for efficiency. Yet, at the same time, mobile phones offer what one might call 'placeless solutions'. The mobile phone, and indeed email are, if you like, person-to-person messaging systems rather than person-to-place ones. Thus if a call is made or an email sent, there is no knowing *where* the call or message will be received, only a guarantee of *who* will receive it. This is a significant issue because, as we have remarked, in the home *where* a message is sent can be vitally important. In addition to this, these technologies offer only a crude version of "push" without the delicacy we noted above. The mobile phone rings aloud when a call is received, demanding attention; an email arrives on the *Blackberry* provoking an instant response. These technologies are designed to foreground messaging, not to make it peripheral and available "at a glance". Another difference is that, because these office or mobile technologies are essentially person-to-person, this makes it difficult to broadcast to a family or place, another factor which would seem to undermine many of the kinds of messaging we see in the home.

1.1 Approach

To move on from this preoccupation with factors such as efficiency and time-saving and consider the richness of communication practices in the home, we have adopted two broad-based strategies. First, just as we learned to study the use of old technologies in the workplace to better design future office technologies [18], we have chosen to carefully look at the affordances provided by established domestic technologies in order to design for future solutions in the home. Second, we have begun deploying prototype devices in real households to learn how they might be used *in situ*. This provides a basis for what we hope will be a long-term relationship with these households, offering them something of value in return for allowing us to pry, inevitably, into their private worlds.

With reference to the second of these strategies, we decided to start with a prototype device based on *TxtBoard,* a situated messaging device that used the SMS protocol to let members of households broadcast messages home [14]. This device was expressly designed for simplicity with many of the paper-like functions we wanted to replicate. In addition, an early trial of TxtBoard with one household provoked some of the kinds of home communication we have discussed. We thus sought to combine TxtBoard's minimal set of functions with properties that might leverage new benefits. Specifically, given that so many of the messaging tools in the home involve inscribing in one way or another, we decided to use a tablet device that supported stylus markings, or scribble, in addition to SMS. The resulting device we call *HomeNote*.

With HomeNote we hoped to address four concerns:

- To continue on and deepen the work on TxtBoard, exploring the unique affordances and potential value of person-to-place as against person-to-person messaging technologies in the home;

- To develop and iterate on HomeNote as a particular design solution, aiming to support not only remote situated messaging, but local scribble;

- To use HomeNote as a kind of "Trojan horse" to allow us to develop our understanding of home communication and its relationship to the affordances of different kinds of communicational artifacts;

- And to use all of the above to explore possibilities for new and different concepts based on our understanding of the moral order of communication in households.

Given these concerns, HomeNote served in several respects as a *technology probe* [9]. Attention was given to the *in situ* use of the technology, and specifically to its impact on family communication and the lessons that could be drawn from this for future design. Extending this notion of a probe somewhat, though, was our hope to use the messaging system as a means to better understand the social organization of the home and sorts of communications that interleave with such patternings—to learn something of the home's moral as well as social character, as it were. In this sense HomeNote was used as a means to access the lived routines of the home in ways that are not always or easily available through interviews and observations alone; hence the term Trojan horse.

In what follows, then, we will report our findings with reference to each of these goals through a description of our field study of *HomeNote*. We will end not only with some implications for new concepts, but also an in-depth discussion of domestic communication.

2. RELATED RESEARCH
Of obvious relevance to place-based communication is the topic of situated displays which is fast becoming a research area in its

own right [15]. Most of this work concerns the use of situated displays in public, educational or work environments. Of most relevance here is the use of situated displays to support person-to-place messaging on office doors and walls such as HERMES [2], Smart Doorplate [21], or RoomWizard [16]. Other work has investigated the use of remote place-to-place messaging on situated displays, such as SPAM [1]. Such research tends to emphasize the practical benefits of supporting, for example, coordination and collaboration amongst co-workers.

Turning to the home environment, there are a number of studies and projects in which situated displays and other kinds of artifacts have been used to enhance and support awareness for families. For the most part, the emphasis has been on supporting connectedness *between* geographically distributed family homes, allowing for the exchange of images, notes, and written messages. The interLiving Project's messageProbe [9] and various prototypes that emerged from the Casablanca project [8] are illustrative of this trend. The messageProbe, for example, was designed and deployed as a probe by Hutchinson and her colleagues in order to explore both the synchronous and asynchronous sharing of written messages between households. Reliant on local area networks and using an interface based on a bulletin board, the probe was biased, strongly, towards messaging of a certain kind, namely messaging from one *place* to another—place-to-place messaging. This work and other similar projects have not then focused on the possibilities of person-to-place messaging that, as we have mentioned and shall go on to detail, HomeNote was designed to investigate.

Other related projects have focused on the display of more abstract, ambient kinds of information to support shared awareness between households using such things as digital picture frames [13], potted plants [10] and sculptures [20]. With regard to the support of communication *within* a household, there have been a number of ethnographic studies of the use of existing artifacts such as the use of paper notes, paper mail and notes on fridge doors, much of it already mentioned. Related to this, there have been a variety of ideas involving embodying or conveying messages within and through everyday household objects such as bowls, physical mailboxes, tables and doors [e.g., 11, 22]. However, with regard to research either between or within homes, only occasionally has it entailed actually building and deploying devices.

With respect to the materials to be presented, two past examples stand out from the broad array of work on distributed and awareness displays and should be seen in several ways to be precursors to HomeNote. One, a prototype called ASTRA [12] is similar to HomeNote in so far as it was designed to receive phone-based messages and present them on a display situated in the home. Unlike HomeNote, however, ASTRA was designed to support and possibly encourage mixed-media messaging. The motivations for ASTRA thus differed, as our efforts were concerned with examining what might be thought of as the specific *genre of communication* afforded by HomeNote [5]—namely textual person-to-place communication—and the ways in which families orient themselves around it.

A second prototype, TxtBoard [14], has, as we have noted, close ties with HomeNote. In detail, TxtBoard consisted of an 8-inch touchscreen display connected to a dedicated mobile phone via Bluetooth hidden within the casing of the device. SMS messages

sent to the phone were displayed, the touchscreen allowing users to navigate through or delete messages. Its use was studied in a single household in London where it was found that person-to-place messaging certainly had a benefit, allowing members of the family in question to make requests to the whole family or to share information about their location. The research also showed that the device succeeded in part through extending the already existing ecology of communication practice, including the use of such things as mobile phones, email and paper-based messaging. The results were, nevertheless, modest, with no design iterations reported and the trial limited to only one family. Moreover, the device was only deployed for a short time. Thus, there was no insight into any potential evolution of its usage.

This research was designed then to give more careful consideration to a particular genre of communication and, in doing so, extend the work TxtBoard began. Not only did we hope to build on the preliminary results obtained using TxtBoard, we also hoped to explore how a device that also enables scribble input might support new kinds of home messaging. In addition, we speculated that this new class of device might find its place in some kinds of homes but not others; an issue we wanted to investigate by deploying the prototype device into a number of different households.

3. STUDY

3.1 The HomeNote Device

The *HomeNote* prototype was essentially a Toshiba Portégé Tablet PC encased in a wall-mountable frame containing GPRS and SIM cards. This provided each HomeNote with a unique phone number which was used to receive and display text messages sent via mobile phones (in this version users could not send messages out through the device). Local scribbling was also supported using the tablet's stylus input. In total, five prototypes were built and deployed.
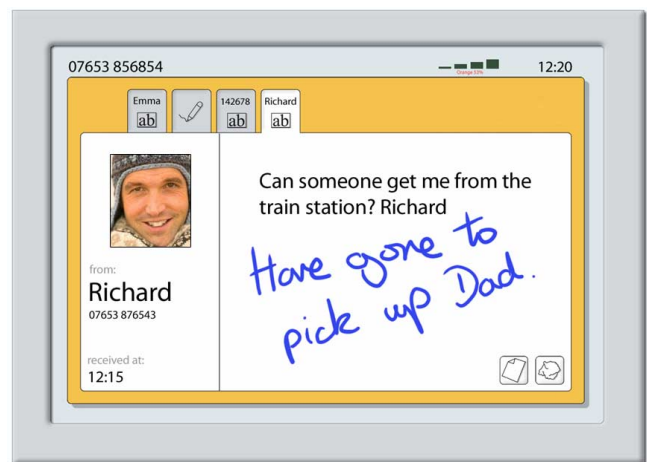

Figure 1. The HomeNote interface showing a text message overlaid with a scribbled note.

Figure 1 shows the design of the HomeNote user interface, modeled on TxtBoard. In the main area, individual messages were displayed (one at a time). These could be either text messages received from mobile phones, a locally scribbled note, or scribbled annotations on top of text messages. Tabs across the top allowed users to switch between messages - the type of message

is denoted as either scribble (pen icon) or text ("ab" icon). Two icons in the bottom right allowed new scribble messages to be created or existing messages to be deleted. New messages, whether remotely sent or locally scribbled, would replace previous messages.

The panel on the left shows information regarding the person who sent the text message including their phone number, the time the message was received and, if the user had been pre-registered, their name and photo. The top of the display showed the phone number for the device, the signal strength for GSM coverage, and the current time.

Software to capture any interaction with the device was also installed for later analysis. The logged data included screenshots of any messages sent and scribbles made along with data about when these events occurred and, in the case of text messages, who sent the message.

3.2 Households

Five households were selected to take part in the trial. Attempting to find a balance in the trade-offs between large- and small-scale field studies, the number was limited to five because we felt this would allow us to capture a degree of variability among families whilst still permitting the in-depth examination of the collected materials. Two basic criteria were used in selecting households. We chose families made up of parents and children (particularly teenaged), making for busy and complex domestic schedules; and families in which at least three members of the family used text messaging.

Four households were selected in the Cambridge area and one in London. The first, *Household A,* consisted of a single mother with a professional full time job and four teenagers. All members of the family owned mobile phones, though the teenagers texted more than the mother. *Household B* was made up by a professional working couple with five girls aged between 1 and 13 years. Both parents and the two eldest girls owned mobile phones, the girls texting each other when in credit and both parents very occasionally doing the same. *Household C* was made up of a working couple whose children had left home but who lived nearby. The house was also made busy by the presence of a lodger. All members of this family and the lodger used text, email, IM and other forms of messaging widely. *Household D* also consisted of a working couple, but the children in this case, girls of 17 and 21, lived at home. Texting was central to their lives as it was with the father, though the mother did not use SMS at all. The last household, *Household E* was made up of one parent with full time work, the other with part-time employment, with three children of 17, 13 and 8, the youngest of whom did not have a mobile phone.

3.3 Method

Our plan was to deploy HomeNote in each household for approximately a month which was sufficiently long, we hoped, that households could familiarize themselves with the device and fit it into their communication practices.

On our first visit to these households, HomeNote was installed, and a brief tutorial was given on how to use it. Households chose where to place the device themselves (using a stand rather than attaching the device to the wall so it could be moved if desired). In all but one, HomeNote was placed in a conspicuous location in the kitchen (see Figure 2). Household E chose to put the device next to the television reasoning that this would be where HomeNote would be most likely to be seen.

Interviews were scheduled at approximately one week intervals. The day prior to each interview, logged data and screen shots recording its intervening use were downloaded and printed. We then used the chronological print-out as a discussion point with the participants, taking notes about each of the messages created since the previous visit. For each message we asked a series of questions to find out for whom each message was intended, for what purpose and with what effect. If appropriate, we also asked how that message would have been accomplished without HomeNote. In addition, for text messages, we asked where they had been they sent from, and for scribble messages we asked who created them (this is recorded automatically for text messages). For annotations on top of existing messages, we established who had made them, why and with what effect.

Figure 2. HomeNote in the kitchen.

In the final interview, a series of additional questions were asked, reviewing the features and aspects of HomeNote they liked and disliked, as well as establishing opinions about future possibilities. We explored, too, how subsequent iterations of HomeNote might be linked to other applications such as a home calendar, and how these various possibilities would affect the ways in which the families conducted their lives. All of the interviews were audiotaped for later review and transcription.

4. RESULTS AND DISCUSSION

Despite our intention that each household use HomeNote for a month, in fact this varied. Only Households B and E kept the device for four weeks. Household A kept their device only for two weeks and then was glad for us to take it back (the reasons for which we will explain). Household D used the device for only three weeks, as they were on holiday for a week. Household C enjoyed using it so much they kept theirs for eight months.

There was also considerable difference in the frequency with which different households used HomeNote (see Figure 3), though all households used it more for scribble messages than texts. In terms of daily frequency of both scribble and text, this ranged from an average of 1.4 (for Household D) to 3.6 (for Household B) messages per day. These are not large volumes, especially if one contrasts them with, say, the frequency of office

email. But, as we shall see, frequency bears little relation to its value for households. By looking more closely at its use, we saw that all households recognized the utility of person-to-place messaging. However, its value depended very much on the nature of each household, as we will discuss.
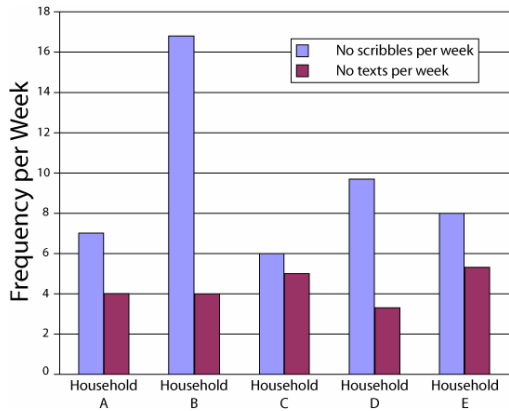

Figure 3. Frequency of use per household.

4.1 Seven Kinds of Messaging

More telling than numbers are the messages that these families created for each other, and more particularly, the reasons behind them. Relying mainly on our notes and the screen shot printouts, messages which were similar in nature to others in terms of the function they performed were clustered together and a description of these different message types was gradually generated. In addition to the notes, it was sometimes necessary to go back and review the audiotapes to check on details. Input for this taxonomy also came from the previous TxtBoard study. Here we fully expected that some of the same categories would apply. While there is some overlap with the findings from that study (in fact three of the categories are the same), we found more diversity in the types of messages from these households mainly as a function of the ability to scribble.

In the descriptions that follow, we are not claiming a comprehensive or complete description of home messaging but rather aim to explore the particular messaging practices made visible by HomeNote. The goal here is to describe the key characteristics of the different phenomena we observed, using this to deepen our understanding of these families as well as to point to future technologies we might build.

4.1.1 Calls for Action

One class of messaging was easy to recognize and was one that also emerged in the Txtboard research. It was also a common type of message making up 23% of the total corpus. This had to do with eliciting action from others, what we refer to as "calls for action". HomeNote was often the channel through which more than one person could be asked to take some action. This was sometimes done remotely through texting, and other times achieved through a locally scribbled note.

Here we saw that, in many examples, the ability to remotely create place-based messages in the home was used to valuable effect. Figure 4a shows an example of messaging 'anyone in the home'. In this case, the daughter in Household D wanted two television shows tape-recorded. In this case, *where* the message was re-

ceived was important, not *who* received it - anyone could tape record the programs, as long as they were at home.
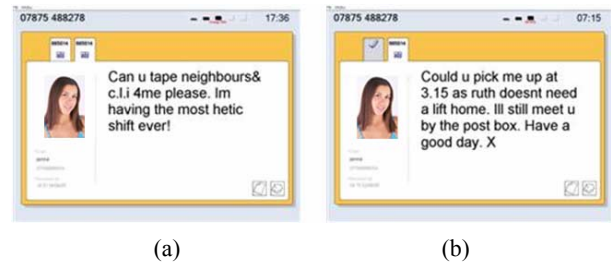

(a)   (b)

Figure 4. Examples of "calls for action". (The images have been changed to preserve anonymity.)

Calls for action also varied in the extent to which they were finessed. In some examples, the messages could be straightforward demands related to activities around the home (e.g., a scribbled note demanding "Put grey bin out"). Other times, HomeNote was used to request action more politely and indirectly. In Figure 4b, the same daughter asked for a lift home from her shift at the hospital. Here the fact that this message was posted in the background of ongoing domestic activity, broadcasting but not specifying either parent, meant that such requests were viewed as less demanding than might have been done via the telephone. According to this daughter, and indeed her family, the peripheral awareness afforded by HomeNote messages enabled an expressly polite kind of request to be made.

That being said, such calls for action often led to a sender's desire to know whether such a message had been seen. All households also commented that they wanted the ability to seamlessly respond through HomeNote, and in doing so, not just to say "yes", "no" or "OK", but to say *who* was making the response.

4.1.2 Awareness & Reassurance

If calls to action were messages related to practical action, this next category had more to do with thoughtfulness. These messages had to do with sharing awareness of each other's activities, and again was a common kind of message (occurring 17% of the time), also evidenced in [14]. By remotely sending text messages or leaving scribbled notes, teens and older children used HomeNote to reassure parents about where they were or where they were going (Figure 5a) and adults, meanwhile, communicated to each about when they would arrive home (Figure 5b). More generally, messages of this sort entailed sharing knowledge about the state of domestic affairs. Sometimes this kind of broadcasting had an added quality of being 'in the moment'. In one case, the father of Household B took one of his daughters to play in her football tournament. He used HomeNote to text home a series of updates on their daughter's progress ("in the final", "penalties", "extra time") which were viewed by the family in the kitchen as they were having lunch.



(a)   (b)

Figure 5. Examples of "shared awareness and reassurance".

In supporting this kind of activity, HomeNote again offered up a new and different possibility from existing technologies: broadcasting home from the mobile phone. However, one of the problems of broadcasting is sometimes knowing who one is broadcasting to, and thus in some households, particularly those in which schedules were changeable, there was again a feeling that being able to reply from HomeNote would be beneficial, since it would allow occupants of the home to indicate *who* had seen a message.

4.1.3 Social Touch

Another use of HomeNote was to send messages to say, in effect, "I'm thinking of you". Interestingly, this was the most popular use of HomeNote (and observed with Txtboard), constituting 29% of the messages we analyzed. Figure 6 shows two examples of this. In Figure 6a, the mother in Household A scribbled a note to wish three of her children good luck in their exams before she left for work in the morning; and in Figure 6b, the father of Household B sent a text the night before, from home, to say good morning to his family in the kitchen. This kind of message, along with "welcome home" messages to his family sent from work became a regular practice for him.

(a) (c)

(d) (b)
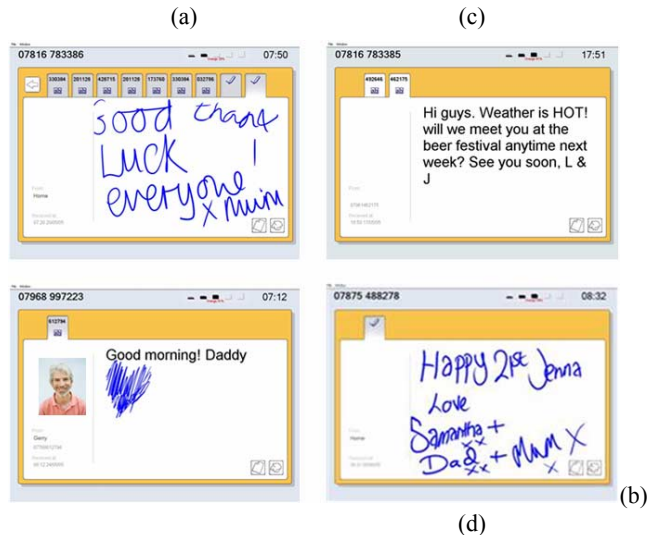
Figure 6. Examples of "social touch" messages. (The image has been changed to preserve anonymity.)

In addition to expressing affection from one to many people, HomeNote also allowed the expression of multiple people to one person, or even many to many. In Figure 6c, friends of the family texted a message to Household C to let them know they were thinking of them; in Figure 6d, all the family in Household D composed a "Happy Birthday" note to their daughter/sister. Thus HomeNote supported not only broadcasting to the family, but also the collaborative creation of such expressions of tenderness.

By dint of the fact that HomeNote was situated in the heart of the household and yet was, at the same time, part of the backdrop to family activity rather than a demanding focus, it seemed particularly well suited to creating these kinds of expressions. They were notes designed not to interrupt family life, but to display and communicate a social bond in more subtle ways.

While HomeNote's design lent itself well to sending or creating this kind of message, at the same time, those who received them often wanted to acknowledge it and express tenderness back. This is shown both by the "thanx" written by one daughter on her

mother's message in Figure 6a and by the heart drawn on her father's message by one of his daughters in Figure 6b. Again, the inability to support this kind of response to an SMS touch (as against local scribbled touches) was mentioned by many as something they would like to be able to do in future.

4.1.4 Broadcasting Identity

Another class of messages was announcements, often created by children, which seemed at first glance somewhat perplexing. Indeed these had not, to our knowledge, been written about before. They were also all the more curious in their frequency, making up 15% of the messages we examined. The messages in question often looked like social touch messages, but they tended to be more self-directed than directed at others. Many of the 'good morning' messages scribbled by younger members of households, for instance, were signed with a flourish—as if these declarations and ornate signatures were intended to put that person's "stamp" in the kitchen. Scribbles in which children announced they were off to bed or had finished exams (Figure 7a) were also of this nature, drawing attention to themselves without any particular purpose it seemed. And we found that it was not just children seeking a visible space for their expression. The father who regularly sent 'good mornings' to his children complained when his messages were occluded under others or were scrawled on by children. His complaints gave the impression that his expressions were being mocked if not ignored when this happened. He directed the children to 'leave his messages alone'.

In short, we came to the conclusion that these kinds of messages served no practical purpose nor were they vehicles for expressing affection. Rather, they were playful, sometimes tender ways, of *seeking* affection, or of drawing attention to their creator. They were, if you like, a form of saying 'don't forget me'. After reflection, we therefore chose the term *broadcasting identity* for these kinds of messages in order to indicate that HomeNote was being used to say something about the sender and their part in the household. For example, Figure 7b shows a scribble by the youngest child in Household E celebrating her place in the family.

(a) (b)

Figure 7. Examples of children "broadcasting identity".

The difference between this kind of practice and communication measured in terms of practical need is, of course, great. We ought not, however, be surprised that people in households want to draw attention to themselves. More surprising, perhaps, is that the ability to inscribe onto HomeNote—to draw, doodle, scribble and sign—came to be an effective way of doing so.

A question to be addressed is why HomeNote turned out to be a popular *place* for this, as there are of course many places in the home where scribbling can be done. As it turned out, in three of the households, HomeNote provided a place where such acts were acceptable; in the other two, doing so was spurned. One reason

for this had to do with ownership of space. For example, mothers in two of the households were particularly vigorous in their control over the family whiteboard or calendar. Though these were places for inscription, they were not places for children, nor even husbands, to inscribe. In other words, the manifestation of this kind of messaging was indicative of how households are not domains populated by people with equal rights. Moreover, it shows how the inequality of rights impacts upon access to and use of *places of expression*.

4.1.5 Reminders

If these preceding functions combine thoughtfulness with expressions of affection and identity, then the next type had more to do with thoughtlessness, but not as in a lack of kindness. This had to do with reminding the forgetful. While occurring only 9% of the time, some households, such as Household B, did this more frequently than others.

Such notes were almost exclusively scribble-based rather than sent as text messages - there were only one or two examples of the latter. The fact that nearly all were created locally suggests that they usually arose or came to mind as a result of being in the middle of family activities, many of them being created either first thing in the morning or before bed in the evening. Most of the households placed their devices near other family management tools such as calendars and whiteboards suggesting this is where these activities usually occurred anyway.

(a)   (b)

Figure 8. Examples of reminders for others and for self.

Likewise, displaying these reminders in the home was also important because they were often things that needed to be conveyed while in the home, or on entering or leaving it. In other words, it was important that they were inscribed and displayed in the home. Figure 8a shows a message from the father in Household E to his son reminding him not to forget his boots for a job on a building site on his way out the next morning. Interesting here is that Household E's father explained this message to be a reminder to the family of the son's first day at work, as well as a practical reminder directed to the son.

This exemplifies how, as with other kinds of messages, these reminders were often intended for broadcast. More explicit reminders were also addressed at the household in general; "leave the butter out of the fridge" or "leave the garage door open for the gardener" being examples. Many, however, were strictly for self reminding. Typically such messages were almost unintelligible to anyone else. For example, the mother in Household B frequently used HomeNote to remind herself of all the activities she needed to attend to. The scribble in Figure 8b is actually a list of four things she needed to remember to do, mainly about phone calls she had to make.

Both the fact that HomeNote was situated in the hub of the household, and supported quick local scribbling, made it an effective place to create and leave reminders. Many households also commented that HomeNote was more conspicuous than a whiteboard and therefore better supported attracting attention, suiting this reminding function.

However, two aspects of HomeNote's design undermined these features. First, notes could be easily and unwittingly deleted by other family members (usually children). Second, new notes created or received could obscure prior reminders. This could be consequential: after all, to remind, it is critical that a note persists and draws attention to itself.

4.1.6 Passing on Messages

Scribble notes were also used as a means of passing messages on to others, often as the result of a phone call (see Figure 9). These were therefore the equivalent of paper notes by the phone. There were not many examples of this, this type of message occurring only in 4% of cases. But here, we were told the ability to write on HomeNote meant that such notes could be created quickly and easily. Once written, the obligation to convey information to someone else was essentially discharged.
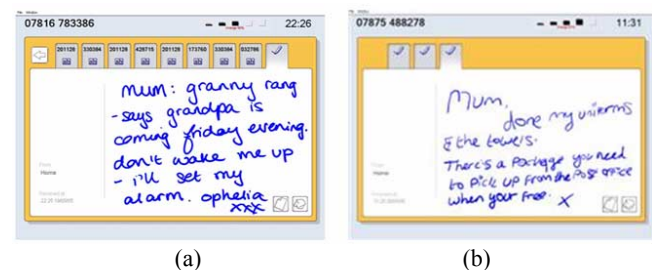

(a)   (b)

Figure 9. Scribble notes to pass on messages.

That being said, members of two of the households suggested that it would be a useful feature if one could directly send such messages to the person in question. This would be especially valuable for important or urgent messages. In addition, they worried about important notes being covered up by newly created messages, obscuring the notes before the person concerned would see it. This function reflects the fact that homes are also transit environments, with people coming and going. Messaging in such settings can often mean sending messages to other people or places.

4.1.7 Information Store

Finally, HomeNote served as a useful place to jot down details such as lists, phone numbers, names and dates. These were not reminders, but better thought of as information held in a temporary repository, often resulting from a phone call. Again, these were infrequent, occurring in only 3% of cases. Figure 10a shows jottings by the father of Household E noting where a relative was staying in the local hospital. Figure 10b shows how the number of the local taxi company was left for the benefit of a visiting friend.

HomeNote worked well in this capacity because it supported quick access and the flexibility of scribble. In this way, the interaction with the device was akin to paper notes. Unlike paper, however, the information was inherently associated to a single location and, in part because of this, returned to with relative ease. The problem with HomeNote was again the ease with which im-

portant details could also be erased by others. Paper has the advantage of stubbornly persisting; these digital images did not.

(a)　　　　　　　　　　　(b)

Figure 10. Scribble notes for temporary information stores.

4.2 Finding a "Place" for HomeNote

Each of these messaging types can be thought of as part of the repertoire of exchange that members of these households used to achieve both practical ends *and* bind each other together. It is the particularities of both that reflected the character of each family. That is to say, our description of these types of messages and the examples we have provided are one way of understanding the data. Another is to look at how each household had a different tempo, balance and overall texture in the patterns of their communication as mirrored in HomeNote. These in turn determined whether HomeNote found a valuable place in each home. In this study, as we have already alluded to, HomeNote was rejected by Household A. As for the other households, it was accepted as fun by Households B and E, but held in very high regard by Households C and D.

One way of examining the differences between the households might be to look at the different composition of message types for each of them. Indeed, each showed a different pattern, as one might expect: Household A, with four teenagers, used it mainly for Awareness & Reassurance messages, whereas Household D used it mainly for Calls for Action. However, such statistics are not enough. Rather, these were only one input to understanding and painting a picture of each family. When we had examined all aspects of the data more thoroughly, we found that use of HomeNote was tied to: the roles and structure within each family, their willingness and tolerance of different forms of communication, and their use and control of other artifacts within the broader ecology of the home.

More specifically, the value of HomeNote had to do, in part, with how the structure of each family created a need or otherwise for broadcasting. For example, the mother in Household B with five younger children needed to know when her husband was coming home but did not need her children to know it. Since it was only of concern to her, person-to-person messaging often sufficed. In contrast, in Household D, with adult children, the very same piece of information about the husband (i.e. his arrival time home) was deliberately broadcast so that the whole household could know. But here, the father simply wanted to let his family know of his schedule. Nothing turned on sharing this information; it was simply an announcement, a call if you like, saying 'Think of me, I am thinking of you'.

Broadcasting was also of little value in Household A. Here, the mother was essentially the only one with a "need to know" about her teenage children. As a working mother with a busy social life, she was often, too, out of the house. For her, therefore, her mobile phone was the best way to message her children and for them to message her. HomeNote was seen as a toy and an unnecessary luxury. Not so, however, for Households C, D, and E where not only was the relative status of the adult members of the house more equal, but where other factors encouraged the use of broadcast messaging. Here in particular, the comings and goings of household members was subject to shiftwork, and limited by the sharing of cars, making messaging about people's whereabouts and polite requests for lifts more important. Household E, for instance, initially found HomeNote to be a useful medium for passing messages between parents and extended family members who regularly cared for the children. Their erratic working hours made HomeNote a viable place for both parents to leave awareness and call for action messages, and to have these passed on to the appropriate recipient via the children or other carers.

However these sorts of differences were only one set of concerns affecting the role of HomeNote. Differences in the culture and willingness of different families to message also had an impact. Indeed, Household E's firmly entrenched practices around text messaging between all but the youngest in the family, prior to their use of HomeNote, may have been one reason for their increasing indifference to a situated messaging device over the course of the study. Arguably, the family had already established a culture of person-to-person messaging that was well routinized and superceded HomeNote's functionality, at least in their eyes.

The culture of tolerance for situated messaging was more emphatic amongst the other households. Whereas Households C and D were populated by individuals who immersed each other in messages, in Household A the mother insisted messages only be created 'if there was a real need'. HomeNote encouraged the children to send 'thinking of you' notes which she frowned on as ephemera. It was no wonder she was pleased when we took it back.

These differences were also bound to, and manifest in, the kinds of spatial territories available for messaging in each house: some had few surfaces for inscription and display, others very many. In Household B surfaces such as the family whiteboard was strictly controlled and managed. At first, the children in this household began to appropriate HomeNote, but gradually their access and use of this too was discouraged. In Household D, however, access to HomeNote was more open, and even a lodger had rights to access, inscribe and doodle not just on HomeNote but on a range of surfaces and media.

Taken together, we find that HomeNote found its most valuable place in households where there was a high need to broadcast, a culture of messaging was encouraged, and where access to HomeNote was less controlled.

5. SUMMARY & DESIGN IMPLICATIONS

What this study shows is that person-to-place messaging (in terms of messaging-from-outside-the-home to broadcasting-within), has value. In particular, the ability to remotely broadcast messages of awareness and reassurance, calls for action and social touch were the kinds of messages that some households especially valued. Within these homes, these were uniquely supported by HomeNote and a function of its combination of remote messaging capability, its situated nature, and the way in which it displayed messages.

More specifically, we found that a broadcasting device is more likely to succeed if it is placed where all in a household will see

the content, but not where that content intrudes. A dedicated display in the kitchen is one such place, but sharing the TV screen in the living room is not. Partly this is a function of knowing, as a sender of a message, where that message will be displayed; partly it is knowing that the display screen will not be used for something else. Moreover, some kinds of messaging will succeed only if the content persists, is visible and is conspicuous. A reminder to do something will only remind if it can be seen at the right time. Thus reminders buried in PCs are often inappropriate. What is required instead are designs that enable messages to claim screen collateral, and to push themselves to awareness in the periphery, as HomeNote did. Taken together, the affordances of HomeNote are to a large extent "paper-like" in the way it presents information at-a-glance, in a fixed location, and with visual persistence. This research emphasizes how important these aspects of design can be for some kinds of technological systems.

All of this does not obviate the need to improve HomeNote, however. Indeed, we found that HomeNote would be better if it allowed people to respond to messages, and in particular to easily identify who was responding to any given message. It was also clear that more thought is needed as to how to make new messages more conspicuous, how to deal with important messages being occluded, and how to prevent the inadvertent deletion of important information.

Rather than simply iterating on this design, however, the results of this study also inspire new possibilities for situated technology in the home to support some of the kinds of communication we have elucidated. For example, HomeNote shows that if users are given the ability to inscribe, the resulting interactions point to a range of purposes and goals. Some of these are analogues to paper-based messaging forms, others combining paper and remote messaging in perhaps more interesting ways.

One possibility is suggested by the notes and scribbles "by the phone" as a means of passing on messages to others, or as a temporary holding place for information. Here we conceived of the idea of a "virtual notepad" allowing users to scribble instantly on a digital tablet on the spur of the moment and particularly when a phone call is received. On the basis of our findings, one suggestion is that such notes could be easily forwarded to other people or places from a simple paper-like interface. Just where the notes are sent to and how messages are displayed by the receiver, is, as our evidence makes clear, of paramount importance. Sometimes these messages may be sent person-to-person, but they may also be sent person-to-place, such as to a HomeNote device. Another possibility is to combine this scribble-and-send function with a scribble-and-file function for keeping and organizing the numbers, names, and details of information easily to hand. If successful, this may be a promising possibility for a pared-down tablet device in the home. We are currently completing a prototype of such a system.

Beyond this, though, our research has also uncovered forms of messaging or better, *forms of expression*, the salience of which we had not previously realized. These were messages that turned out to be instruments of emotional bonding in family life rather than some sort of concern for practical matters. In considering messages of "social touch", for example, one possibility here is to support richer forms of such messages for families, through not only the sending of text messages but also images from camera phones, as well as possibly visible representations of voice mes-

sages. This is akin to the idea of digital family "postcards". Social touch messages on HomeNote, with their visual persistence and situated nature, indeed had the character of postcards about them.

But as we have seen, messages of emotional bond were not solely for the expression of affection from one person to others. Sometimes they were demands *from* the sender for affection. HomeNote provided opportunities for such expression by offering a surface for their display that might have not otherwise been available. With HomeNote, children and even husbands found a place in which they could draw attention to themselves. HomeNote let them create graffiti to celebrate themselves. This suggests the idea of a messaging device in which all members of a home have rights to certain areas of a display where they can send messages about practical affairs or requests, the calls for actions and the reminders we have described. Because part of the screen belongs to them alone, their messages would not disappear under a collage of other people's messages, thus ensuring that their reminders would be seen and their calls for action noticed. But the device would also provide them with an inviolate space for them to *express themselves*. We have seen that, in some families, finding a place for expression turns out to be difficult. With this new device, an area of the kitchen would not be a mere place for notes, but a space for *epigraphs*.

6. CONCLUSION

In conclusion, we have shown that by paying attention to some of the affordances of mundane communication technologies in the home, we can begin to build new classes of devices that both support existing practices, and enable new ones. What we have found is that a particular sensitivity to building these devices emerges from a focus on both the practical arrangements of household communications and how these arrangements weave into the social features that make family homes distinctive.

In practical terms, we have shown that the deployment of working prototypes, such as HomeNote, offers a means of interrogating these qualities of the home, and of understanding the range and diversity of home communication, as well as the intricacies and subtitles of family life. As we begin to build this understanding, we hope to contribute to a body of research in which new possibilities for technologies begin to find their place within the home in more ways than one.

7. ACKNOWLEDGMENTS

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