Casablanca:
Designing Social Communication Devices for the Home

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ABSTRACT

The Casablanca project explored how media space concepts could be incorporated into households and family life. This effort included prototypes built for the researchers' own home use, field studies of households, and consumer testing of design concepts. A number of previously unreported consumer preferences and concerns were uncovered and incorporated into several original prototypes, most notably ScanBoard and the Intentional Presence Lamp. Casablanca also resulted in conclusions about designing household social communication devices.

Keywords

Computer-mediated communication, CMC, domestic technologies, residential technologies, media spaces, audio spaces, shared whiteboards, awareness, ambient displays, internet appliances, design guidelines, aesthetics, consumers, homes, computer-human interaction.

INTRODUCTION

Computing technology is becoming pervasive in people's everyday lives. Yet telephony, a century-old technology, remains the primary means of communication between households. How will computing affect existing household communications, and what new forms of communication devices will genuinely be desired by consumers?

These questions were addressed by the Casablanca project, an effort inspired by media space work in general [2], our own work on workplace audio systems [15], and the notion of bringing media spaces into homes and home lives.

Casablanca investigated communication and technology in the home with a multidisciplinary team over a multi-year effort. We started by creating prototypes for our own homes that were based on existing media space motifs of synchronous interaction, multiple modalities and varying levels of media richness. We next performed in-depth field studies of communication and technology, leading to the

identification of unmet consumer needs. These needs inspired the development of product concepts that were presented to consumers. Informed by this exploratory market research, we designed and prototyped several of the more intriguing concepts. We concluded by formulating design principles for social communication technologies.

Prior to Casablanca, there has been little published work on designing technologies for home use, especially for social, or *phatic,* communication, defined by Schneider as "a type of speech in which the ties of union are created [and maintained] by a mere exchange of words" [14]. This research therefore contributes in several ways. The design guidelines and home-related study findings are one contribution. The prototype designs are another contribution. Furthermore, this work includes the first reported consumer reactions to media spaces with awareness and shared presence. Overall, this work is a significant advance in applying media spaces to homes.

The paper begins by addressing related work in awareness and home technologies, followed by descriptions of the first round of prototypes. Then findings from two studies of consumers, technology, homes and communication are presented. Next, design concepts are described together with the results from consumer testing of these concepts. Two prototypes influenced by the testing are shown and explained, and the paper concludes with design principles.

RELATED WORK

Casablanca was strongly influenced by prior work in computer-mediated communication, particularly in the areas of awareness and audio-related media spaces, and prior work in designing technologies for homes.

The topic of awareness is closely related to this work, although most awareness work has focused on workgroup and workplace concerns. Workgroup awareness has predominately been implemented using utilitarian screen-based representations, such as in Kuzuoka and Greenberg [11]. Dahley, Wisneski & Ishii [3] extended awareness to ambience and graceful representations in a work cubicle setting; our work similarly addressed aesthetics but in home settings.

The importance of design in awareness representations for homes was emphasized by Strong and Gaver [16], who created beautiful objects that could also convey awareness

information. Our approach differs in our emphasis on consumer evaluation of awareness-related concepts.

Media spaces are another topic relevant to Casablanca. Audio spaces, that is, audio communication systems for groups, were a particular source of inspiration. The Somewire work looked at design issues and workplace influence of a high-quality, audio-only group communication system [1, 15]. The Casablanca project adapted audio spaces to home situations to see how the workplace findings applied there.

In addition to augmenting the prior work in mediated communications, Casablanca adds to the small body of work in designing home technologies. Within the CHI community, specific research and design efforts for the home are sparse. Much of this work has been centered on the workplace aspects of homes [7, 13]. The HomeNet study by Kraut, et al., has measured social and family use of home computers [10], but has not addressed innovation and design. Social science methods have been incorporated into industrial research on homes, notably Mateas, et al.'s "garage ethnography" [12]. Casablanca is distinguished in that it applied CSCW and CHI techniques to the home.

Recently, the home domain has attracted more interest. In [5], Hindus argues for the importance of homes in technology research, and indeed, laboratories are building real or simulated homes to conduct such research [8, 9]. The latter two efforts assume extensive technological enhancements, whereas Casablanca augmented existing technologies in households.

EARLY PROTOTYPES AND PERSONAL EXPERIENCES

Given the scant literature on home technologies, the Casablanca team engaged in an experiential study of home settings; we experimented upon ourselves by building three early prototypes and deploying them in our homes. These systems incorporated multiple modalities and varying levels of media richness: CommuteBoard used handwritten notes and continuous audio-based activity sensing, NeighborNet relied on activity sensing at a few discrete levels with the option of a video connection, and KitchenNet provided users with connection options from none to telephonic to video.

All users had ISDN connections[1], and experienced varying degrees of success in deployment and use over the month-long trial. Each household member was then interviewed by Casablanca's social science consultant.

The most successful system, CommuteBoard, is described below, along with the learnings from these experiences.

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[1] ISDN was the only widely available alternative to dialup connections at the time. ISDN provided bandwidth of 64-128KB.

CommuteBoard: Handwriting and Audio Sensing

The two CommuteBoard users often shared rides to work. Their morning routine involved placing a quick phone call to specify a departure time, and a later call to give a "5 minute warning" that the driver was departing. CommuteBoard replaced these early-morning phone calls with quick handwritten messages on a shared whiteboard. The whiteboard was supplemented by an activity sensor that visually showed the general noise level at the remote location. This audio-based activity sensor indicated whether the remote household was awake, yet was unobtrusive. The CommuteBoard ran on Apple Macintosh Powerbook 540 laptop computers with Wacom graphics tablets for pen input. The system software was based on Apple's Media Conference application.

Figure 1 shows the CommuteBoard screen for one morning. The colored graph at the top is the activity detector display and the window at the bottom is the shared whiteboard. The message content refers to the connection having dropped temporarily, and to a habit of listening to the radio in the morning.
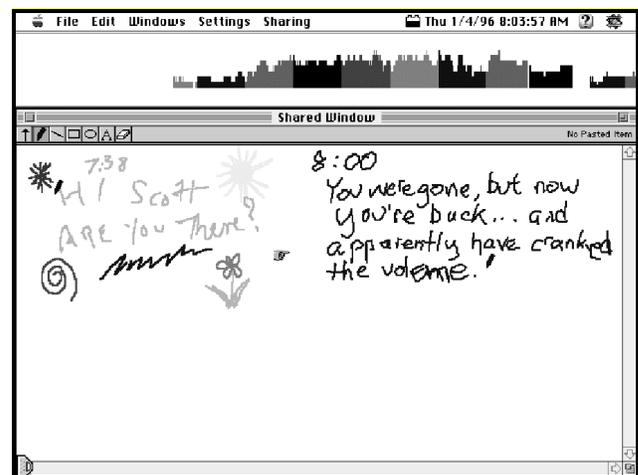

Figure 1. Example of CommuteBoard display in use.
(See color plate on page 554.)

Learning from the Early Prototypes

Our experiences with CommuteBoard were quite positive. CommuteBoard messages were ephemeral; timers started the system at 6:00 a.m. with a blank whiteboard. This ephemeralness, combined with the colored digital ink, engendered a playfulness and informality that users enjoyed. CommuteBoard was useful as well as fun—its users negotiated ride sharing arrangements during the trial without the intrusiveness of multiple phone calls.

One weakness of CommuteBoard was that the activity monitor was not particularly informative, though it did indicate that the connection was working. Also, users adopted a convention of manually time-stamping each message, which would be better supported by an automated system that registered the time and sender of each message.

Legibility of handwriting and limited writing space were also issues to be addressed in future designs.

The other two prototypes, NeighborNet and KitchenNet, suffered from the complexity and poor performance of video over ISDN.

Our conclusions are as follows:

- Simple, ephemeral and expressive interactions, e.g., handwritten notes, are surprisingly effective in homes.

- Prototypes in homes require a higher level of finish than in offices, due to the importance of appearance in homes along with safety and convenience concerns.

- Video and audio are attractive to users, but require higher speeds and reliability than we could achieve.

In short, these early experiences challenged our implicit assumption that synchronicity and media richness would be indispensable in homes, although users valued both the semi-synchronous nature of CommuteBoard interactions and the multimodality of all our prototypes.

We combined these experiences with findings from consumer studies, described in the following section, before proceeding to further rounds of prototyping.

CONSUMERS, HOMES AND COMMUNICATIONS

In addition to home prototypes, Casablanca explored domestic environments using ethnographic-inspired methods, or lightweight ethnography, that entail field workers spending time within real-world settings. We conducted an initial pilot study of consumers and then participated in an extensive cross-project study, both of which are summarized below.

The initial study comprised 16 in-depth home interviews, conducted with subjects recruited from the periphery of the San Francisco Bay Area. These home visits placed special emphasis on where and how technology was used, particularly communication technology. In addition, two families were revisited for lengthier observations, leading to "day in the life of" portraits of the families and how technology fit into their daily routine.

In a subsequent study that involved Casablanca along with other projects, researchers conducted over 35 home visits in six American cities. The study made use of techniques for conducting qualitative in-home interviews and observation, along with subsequent quantitative and demographic analyses, that were developed by Ireland and Johnson [4]. The three-hour home tours and interviews probed consumers' use of technology and their attitudes towards those technologies. The home visits were videotaped, providing an insightful view of households.

From these two studies, a number of important themes emerged that reflect concerns unique to households and family life. These themes include the following:

- **Households are displays.** Households are stages upon which household members imprint their identities, as shown by the considerable effort put into decorating and personalizing most homes.

- **Households are sanctuaries.** The home is a private place where people take refuge from the pressures of work and where they can rest or play without scrutiny.

- **Family life is the household priority.** In homes, people are concerned first and foremost with other household members, followed by family members outside of the household and then, less importantly, friends and other relationships such as those of shared interest groups.

- **Women are the household communicators.** Women maintain communication with friends and family, as shown in this quote from a couple in Los Angeles:

  > Janet- *Probably the person I talk with the most is my mom… at least once a week, usually more than that. …I actually have two friends that are equally dear to me… and I probably talk to Sharon every day.*

  > Jeff- *…I think it's different between men and women; I have like four or five really good friends I talk to once a month.*

- **The telephone is not good enough.** Talking in person was preferred; it allowed for more personal interactions and spending time together, as in the following quote:

  > Eloise- *I would like more to be able to see her [mother], even though she's only 10 minutes away… I call her every day at 9:30 on my break.*

  > Interviewer- *So if you could really see her and monitor her…?*

  > Eloise- *Yes, yes,… you could just walk around doing your daily work and if you want to switch to where you could see her… You could just look up there to see that she's all right.*

These findings substantiated how unique homes are as a design domain and emphasized to us the importance of paying attention to appearance, family life and adult women when designing communication devices for homes. Futhermore, the findings confirmed our initial focus on innovative household communication as a worthwhile research topic. These findings influenced the subsequent Casablanca design efforts, as described in the next section.

CONCEPTS AND CONSUMERS' REACTIONS

The home study findings gave Casablanca a wealth of new knowledge in addition to the lessons from the early prototypes, and inspired the team to take a fresh approach to designing home communication technology.

We put aside our previous media space experience, and explored the space of designs for new domestic communication devices through brainstorming and design exercises that produced dozens of scenarios and product concepts. Many of the concepts involved continuous low-

bandwidth communications between households. The concepts included a variety of communication modes: voice, visual images, handwriting, touch and movement.

We narrowed the many concepts down to a representative handful that most directly addressed themes highlighted by the field studies. We then solicited reactions from potential users before engaging in the next round of prototyping. The concepts and the consumer market research studies are described in the following sections.

Awareness-Related Concepts

The home studies showed that people desire more kinds of connections to family and close friends. We therefore developed two awareness-related concepts, InTouch and PresenceLight, and presented them to consumers with the following descriptions:

IN TOUCH: Small tokens you carry or wear to keep "in touch" with a friend or relative. If you touch your token, your friend will receive the touch through their token – it might glow, become warm or vibrate.

PRESENCE LIGHT: A pair of linked decorative objects that come in a variety of styles. The objects show activity from a remote location. If one light senses nearby sounds or movement it tells the other light in the other house to turn on. More activity makes the light brighter.

RoomLink, an Audio Space-Related Concept

We knew from our earlier prototyping that high-quality audio connections were not practical for consumers due to bandwidth constraints. Nonetheless, we wanted to ascertain the appeal of an audio space for consumers, given how effective audio spaces had been for workgroups [1] and the home study finding of the limits of telephony. The RoomLink concept statement appeared as follows:
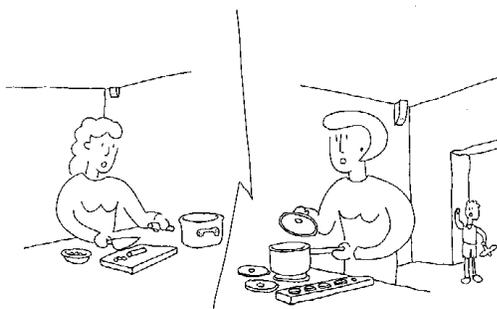
ROOMLINK: An "always on" connection that links two rooms in separate households using only high quality audio. You can hear everything that happens at the other location. Room Link doesn't tie up your phone line and has better quality audio than a speakerphone

MessageBoard, a Note and Picture Sharing Concept

Building on the success of CommuteBoard and the desire for easy communication with family and friends, we designed MessageBoard, a concept for simple small-group messaging that we described to consumers as follows:

MESSAGE BOARD: This appliance allows people in different locations to share the same message board. Each person in the group has a flat screen about the size of a sheet of paper. Writing or drawing on the screen with a special pen makes "ink" appear. What anyone writes appears on their own screen, and is also sent to the screens of all the other members of their group within a minute or two. In addition, you can share snapshots, drawings, newspaper clippings, etc., simply by passing them through a slot on the bottom of the screen. There can be a separate shared board for each pair or group you are a part of – you can switch between groups with a press of a button.

Concept Testing, Participants and Methodology

Two rounds of exploratory focus groups were held in Sacramento, California, a medium-size city 100 miles from San Francisco. Our goal was to learn how the Casablanca product concepts would be received by consumers. What desires and concerns would emerge, and what features would be valued?

Based on the earlier finding of women as the primary household communicators, we chose adult women for the focus groups. The participants had household incomes above the regional median and were busy people who placed high value on communications. Both rounds included two groups, for a total of four groups. One group in each round was comprised of women aged 25 to 45 with children living at home, while the other group was comprised of women aged 40 to 55 with grown children who had left home. Concept descriptions and recruiting criteria were slightly revised between the two rounds.

Each group lasted for 2 hours and included about 10 women. Groups were videotaped and the tapes were transcribed. Casablanca's marketing consultant moderated the focus groups.

Participants were first asked a number of questions about their household communications, both real and ideal. The concept statements, one-page handouts on each product idea, were then presented. Each concept was accompanied by a cartoon-like sketch illustrating the concept in use, as exemplified in the RoomLink description shown above. The moderator read the product descriptions and answered questions while participants reviewed each handout. They then rated and provided feedback on each concept. Each group concluded with a discussion of the product concepts' value overall and in relation to target price ranges.

General Reactions

Consumers readily understood and appreciated the product concepts. They could imagine using them and did not consider them "high-tech" or computer-like. The women also had high expectations of new technologies in terms of performance, cost and utility. For example, they readily appreciated the sound quality improvement of RoomLink compared to the telephone.

More significantly, consumers articulated social needs that were not well met with existing communications technology, such as staying in touch with immediate family and keeping in touch with home while at work.

Reactions to the Product Concept Statements

The focus group participants had diverse points of view about the product concepts. InTouch in particular elicited a bimodal response. Those who liked it thought it was a fun and personal way to keep in touch with a loved one; the others perceived it as just another gadget or something the kids would lose. Some participants also felt that it could create an unwanted obligation to respond to its signals.

PresenceLight was the least preferred of the concepts. It elicited concerns about privacy, monitoring, and the low level of information conveyed: it was perceived as a surveillance device that threatened home privacy while being too imprecise to function as a monitoring device—it would not necessarily distinguish, for example, a pet from a person. While consumers were interested in receiving presence status about others, they were reluctant to send information about themselves continuously. They wanted to control the timing and type of interaction more closely.

In contrast, RoomLink generated widespread interest. It could be used hands-free, particularly while working in the kitchen, and other family members could easily take part in conversations. Suggestions included adding visuals and being able to move the system from room to room. Privacy and control issues were raised by some participants.

MessageBoard likewise had strong appeal, especially for women with children at home, who valued its potential for efficient and convenient coordination of ongoing group activities. The photo- and clipping-sharing feature was quite popular, engaging participants' imaginations in ways that handwriting and sketching did not. Participants requested that MessageBoard also be usable from vehicles.

Summary of Concept Testing Findings

In sum, consumers were interested in social communication devices with the following attributes:

- Fun to use, low in cost and simple to operate.
- Kept users in touch with loved ones or helped them monitor kids and elderly parents at home.
- Respected privacy and did not create new obligations.
- Offered multiple communication modes and enough information.

PROTOTYPE SOCIAL COMMUNICATION DEVICES

Following on the conceptual design work and the consumer testing just described, Casablanca conducted a brief, intensive prototyping effort. Our goal was to instantiate what we had learned from the consumer concept testing together with the earlier experiential home prototypes and the lightweight ethnography studies.

We prototyped four devices. One prototype, the Intentional Presence Light, was a kind of awareness mechanism between households that was embodied in two distinctive devices. Another prototype, ScanBoard, enabled scanning-based messaging amongst groups of households. The remaining prototypes, not presented here, were a technical demonstration of the RoomLink audio space concept, and an audio variant of the InTouch awareness concept.

The Intentional Presence Lamp and ScanBoard prototypes are described in the following sections, along with observations from demonstrations to other researchers.

Intentional Presence Lamp (IPL)

This awareness prototype was based on the PresenceLight concept of a decorative object that provided friends or family with an indication of a user's presence. Based on the focus groups' feedback, the concept was changed into the *Intentional* Presence Lamp (IPL). No active sensing took place; a user's presence was communicated to others only if he or she explicitly activated the IPL device.

Two different prototypes, the Curtain and the Lampshade, were created to show that IPLs were not bound by physical appearance and that different devices were compatible.
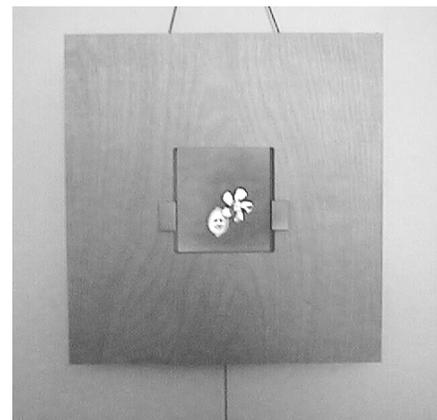
Curtain IPL

Figure 2. The Curtain intentional presence device.
(See color plate on page 554.)

The Curtain device was like a small window placed within a wooden picture frame on the wall. Users opened up the curtain by pulling apart wooden shutters over the display, thus indicating their presence. Users were represented by faces superimposed on images of objects. For example, in Figure 2, one user is shown as a flower, another as a lemon. These images floated around the display in a slow and

random motion. Users could pull the string hanging from the device to select from a range of objects to represent them locally and on remote devices.

Lampshade IPL

The Lampshade device had the form of a lamp, as shown in Figure 3, and served as an accent lamp as well as a communication device. When both users indicated their presence, the lampshade became a collaborative decoration. Users chose the appearance of their own lampshade by selecting a solid color for the upper region and a foreground image for the lower region of the shade. This foreground image was the user's representation in the upper region on the remote user's lamp.

Figure 3. The Lampshade intentional presence device. The local user has chosen to be represented by lemons, seen in the lower part of the lampshade, and the remote user has chosen chili peppers, seen in the upper part. Both users have intentionally indicated their presence.
(See color plate on page 554.)

These devices allowed users to indicate their availability for communication, and to control the appearance of the device to a limited extent.

ScanBoard

The ScanBoard prototype showed how the MessageBoard concept could be implemented with existing technology. ScanBoard's interface consisted of a digitizing scanner, a touchscreen, and a set of push buttons. In a product, these pieces would be integrated into a flat panel device to hang on a wall or affixed to a refrigerator.

With foam core and wallpaper, we simulated a ScanBoard hanging on a wall, as shown in Figure 4. On this fake wall, the bezel of a touchscreen monitor projected through an opening and below that sat a Logitech ScanMan scanner. Working push buttons were placed around the monitor. The buttons, monitor and scanner were connected by long cables to a hidden PC that controlled the ScanBoard in a Wizard of Oz manner. The UI was written in Macromedia Director.

Figure 4. The ScanBoard prototype.
(See color plate on page 554.)

ScanBoard implemented the following functions:

- Select a message board. Push buttons above the monitor corresponded to different boards.

- Post a message. Pieces of paper, e.g., handwritten notes, photos or newspaper clippings, that were put through the scanner were digitized and added to the currently selected board. A reduced-size thumbnail image then appeared on top of the collection of thumbnails that comprised the board's content.

Figure 5. Closeup of the ScanBoard screen in use.
(See color plate on page 554.)

- Examine a message. Quickly touching a thumbnail image on the touchscreen zoomed the image to full size. The message could be scrolled by dragging a finger in any direction. After an idle period, the message would shrink back to thumbnail size.

- Uncover or hide a message. The ScanBoard screen, shown in Figure 5, included controls for moving between messages. The BACK button removed the top-

most thumbnail image, uncovering whatever was beneath it. The FORWARD button reversed this.

- Move a message. Touching a thumbnail image for a few seconds selected the message, which could then be dragged to a new screen location, a new level within the collection of thumbnails, or a new message board.

These operations affected only the local display, except for posting and moving messages, which affected the shared set of thumbnail images as well. By means of a shared database system, each ScanBoard display was automatically updated to show the latest configuration of the selected board.

Discussion of IPL and ScanBoard Prototypes

Casablanca's social communication prototypes were presented internally in several informal demonstration sessions. From the unstructured but extensive discussions that followed, we concluded the following:

- **Intentionality and aesthetics made IPL attractive.** We were wary of an awareness-based prototype after the unenthusiastic response to PresenceLight. The industrial designers thus saw IPL as a challenge to good interaction design, and they met it. The Curtain and Lampshade devices were well-received and even strongly desired. The success of IPL shows how an artifact can compellingly convey an unfamiliar concept, particularly when the artifact has strong production values and appropriate user interactions.

- **Scanning and sharing made ScanBoard attractive.** Scanning physical objects into ScanBoard's shared virtual space produced a novel and intriguing user experience. It was particularly satisfying to scan and share comic strips and photographs, and to be able to comment about these in handwriting. However, some observers wanted an easier way to quickly reply to a message than by scanning. Also, board selection buttons should light up to indicate changed content.

- **Expressiveness and simplicity made both attractive.** The IPL and ScanBoard prototypes all featured simple, appliance-like user interactions. Moreover, the most visible parts of these devices were implicitly personalized. With ScanBoard, even commonplace written materials served as a rich means of expression.

DESIGNING SOCIAL COMMUNICATION FOR HOMES

Casablanca encompassed multiple investigations into how media space ideas could be incorporated into households and family life. Over the course of the project, we created early and later sets of prototypes, studied homes with lightweight ethnographies, and conducted exploratory market research with novel social communication concepts. This paper has presented findings from all these efforts. From these activities, the most noteworthy conclusions are as follows:

- **Homes are a distinct domain.** This point cannot be emphasized enough. Casablanca showed repeatedly that homes are a distinct design domain, and that household priorities and concerns are quite different from those of workplaces. This point is expanded upon at length in a related paper by Hindus [5].

- **Media spaces in homes will span a wide range.** Our initial ideas about bringing media spaces to homes changed during this research. The media-rich, multimodal, high-bandwidth connectivity that we originally envisioned evolved into simpler, lightweight and essentially asynchronous interactions.

  The pragmatics of household internet communication have altered only slightly since the Casablanca work, with slow dial-up connections still preponderant. Nonetheless, Casablanca showed that rich interactions such as high-quality audio spaces will be well received when they can be properly supported.

- **Social communication is a suitable research topic.** Casablanca demonstrated that innovation in the design of social communication devices is possible and well-received. Furthermore, household technology is an underexplored research area. There is little work on how adult women approach home technologies, for example. Another promising topic is that of homes as sanctuary; privacy concerns within households arose in a number of ways. We were surprised at the subtlety of those concerns, and see this as a challenging aspect of designing new communication technologies.

For designers of household communication devices, Casablanca yielded additional guidelines that are specific to the home context, as follows:

- **Express just enough meaning, but not too much.** Designers need to respect the value of perceived simplicity as well as the need for enough information and for expressiveness on the part of users.

- **Social interaction should not be imposed on users.** Designers need to allow users to fulfill their existing social obligations without adding new ones. Users already feel increasingly obliged to keep in touch, and can see added communication as extra responsibilities.

From its starting point in home media spaces, the Casablanca project has demonstrated that the space of new domestic communications technologies is enormous. We believe further research can produce new and compelling ideas in this space. An obvious direction for future work is to develop sufficiently realistic, robust and scalable devices for lengthy in-home trials.

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