

**Media Center Buddies:
Instant Messaging around a Media Center**

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ABSTRACT

In this paper we present a prototype instant messaging system that allows multiple simultaneous users to access their instant messaging whilst watching TV together in the same room. Three key factors led the design presented in this paper:

- 1) Some of the devices on which people watch TV are now capable of simultaneously performing personal communications functions.
- 2) People often watch TV with their friends and family present in the room.
- 3) Both TV viewing and instant messaging are popular, especially amongst teenagers.

In response to these factors, we prototyped and user tested an instant messaging system for use during TV viewing. It featured a gradual fade-in and fade-out of incoming messages, thus reducing distraction; and multiple concurrent logged-in users at a single terminal. We explored the design choices made, especially around the issues of interruption and privacy, and present the results of a 32 participant user study. Unlike many user studies of PC applications, the participants were paired to more faithfully recreate typical leisure-time viewing habits. The study found that the messaging was not a significant distraction due to our design. Some confidentiality issues were also resolved, and we uncovered unexpected privacy concerns.

Author Keywords

Media Center, Instant Messaging, TV, Single Display Groupware.

ACM Classification Keywords

H.5.2 [Information Interfaces and Presentation]: User

Interfaces; H.5.3 [Information Interfaces and Presentation]: Group and Organization Interfaces;

INTRODUCTION

This paper presents the experiences and results from a research project into Instant Messaging (IMing) at a PC whose main function is media consumption. Such PCs, called Media Centers, are increasingly popular and are designed to be located in the family living room or student dorm. They combine media facilities like TV viewing, photo browsing, and listening to music, with traditional PC functionality. Since people often use their PC's communications features (e.g. email and IM) we needed to explore what an application that allowed communication in addition to TV viewing would be like.

Such a combination is attractive to many users, but we were particularly motivated by teenagers and early adopters of media technology. Countless studies have shown that these groups find constant access to lightweight communications important. (An example study is [11].)

Similarly, several studies of TV usage show that TV content is often consumed by groups of people physically gathered around the TV, for example a family watching a quiz show together or friends watching a film together. (An example study is [12].) Hence multiple simultaneous usage is the first main issue tackled in our design.

When combining different dynamic functions onto one screen, one runs the risk of having one function interrupt the usage of the other. This is particularly problematic when the material present on the screen may not represent our interaction with the application, but the interaction of someone else in the room. Hence interruption is the other main issue tackled in our design.

We built an application where the incoming instant messages do not interrupt the TV viewing of the people in the room with the Media Center. We recognize the fact that TV viewing is often not a solitary experience, so we cannot assume that there is only one user sat at the PC. Our application allows multiple users to sign into IM at the same time in the same room so that IMs arriving for any of them are displayed on the screen. Inevitably that leads to interesting privacy concerns which we explored.

People are increasingly comfortable communicating alongside media consumption, just as they were at pre-Wagnerian theatre. The communication may be tightly integrated with the media consumption or just coincidental in time. When integrated, the integration can take place either at the application level (e.g. media sharing chat rooms), the service level (e.g. SMS messages to radio DJs), or at the usage level (e.g. friends chatting online whilst watching a soccer match on TV).

One characteristic feature of Media Centers is that they can be used from across a room. That is, one can sit back on a sofa and still control the media elements of the system. We call such interaction a 10' UI or a 10' experience, to contrast it from the typical 2' PC user experience. Another challenge of our IM interface is to make it usable at 10' and to keep it consistent with other 10' UI elements.

RELATED WORK

There is interesting past work looking at the continuum between communication and broadcast, i.e. between self authored content (chat) and professionally authored content. This started with projects like Piazza Virtuale [1] and 21st Century Vaudeville [2], which were really exploring the possibilities of networked interactive TV. The YORB [3] developed the idea further, coining the phrase "Inhabited TV" which has been studied at length (e.g. in [4])

However, most of the work on integrating (not merging) communication modes into TV is commercial rather than research. Broadband Bananas [5] has a nice page of screenshots of various offerings, mainly adding chat to TV but there are examples of IM and email too. They all rely on reducing the picture size and dedicating screen-space to the communications features, as opposed to allowing the main attention to remain on the TV content.

There has been lots of interest (again commercial and not academic) on integrating SMS into TV. This may be because SMS is popular with the target demographic (teenagers) or it may be that SMS bypasses the need for complex infrastructure. Some interesting presentations on SMS + TV are collected in [6].

There is a wealth of research on IM. For example [7] is a good study of IM in the workplace while [11] studies its use in the home. These studies show the ubiquity of IM and hence show how useful it might prove alongside TV. There are also studies on the balance between interruption and attendance for notifications (for example [13]). Such notification studies concentrate on typical work based PC use, while we focus on leisure activity and in particular video. Hence for us the lack of interruption is more important. This is a topic we return to later in the paper.

Joint interaction at a single TV to use a communication application is not studied academically or present commercially. [8] is interesting in that it shows how for teens, even SMS messaging from a phone is a collaborative experience: friends sometimes pass the phone around as

they compose the message as a token of the level of their friendship. On TV, Two Way TV [9] have provided interactive TV games that allow several family members to play simultaneously, though since ceasing to provide their own hardware this option is rarely supported in the service.

As far as we know our work is unique in presenting research into co-located IM usage, and in studying IM that overlays continuous media.

EXPERIENCE DESIGN

In this section we elucidate the design decisions and options left open during the refinement of our prototype. There were two main experiences catered for. One involved chat around a media event where the chat is as much a focus for those in the room as the event. This is shown in Figure 1 and involves reducing the size of the media window to make room for the surrounding chat room functionality. We concentrated our design effort on the second, where the main focus is media consumption but occasional messaging takes place. This was mentioned in the previous section as typical of existing approaches. In these the proportion of the screen dedicated to media is reduced to allow for communication. However, recent graphics technology allows us to place unobtrusive semi-transparent overlays above the video, and our main experience made use of this.

(NB We used MSN Messenger as our IM client infrastructure and use the terms IM and Messenger interchangeably.)



Figure 1: Chat and Reduced Area TV

Log-on

The first stage required to use Media Center Buddies is to log in to Messenger. We considered two main modes:

1) Automatic login, where Messenger automatically logs into the primary account associated with the current Windows user. This mode is particularly useful for Media Centers that are only ever in use by one person, and Media Centers where the users have set up a new Messenger account to share on the Media Center.

2) Manual login, where users can type their Messenger username and password, or use the up and down arrow keys on the remote control to cycle through the cached username and password pairs.

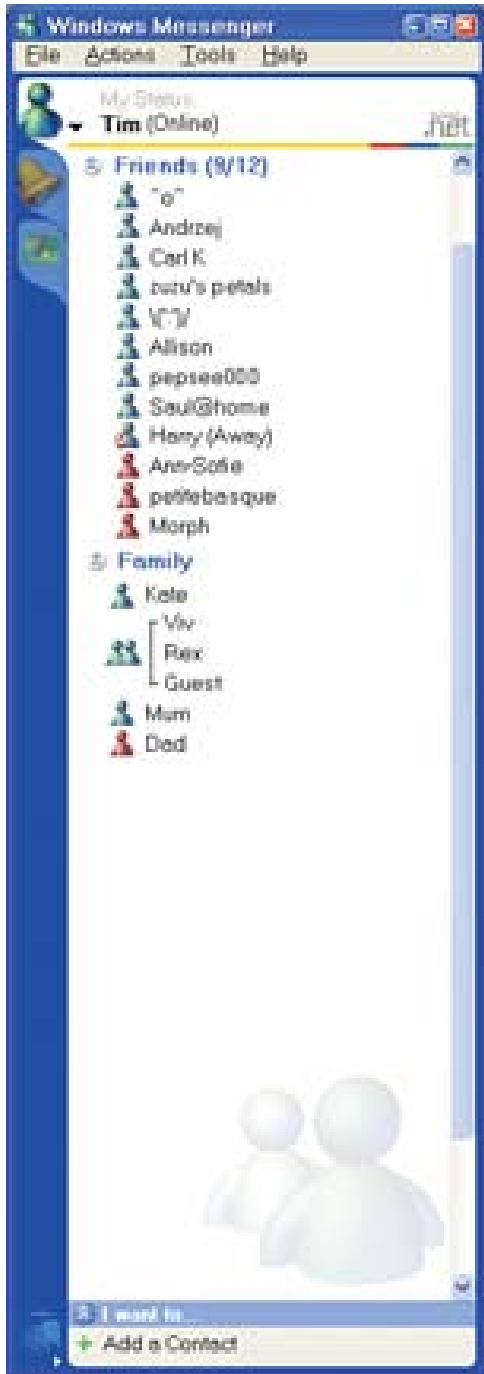


Figure 2: Remote Messenger

When a new user logs on a dialogue box checks whether they want their username and password cached on the Media Center. Like all detailed settings, it is intended that

users may later manipulate these settings in the standard 2nd Messenger UI.

Plausible reasons for users wanting to use the guest button include:

- Forgotten username or password
- No messenger account
- Speed
- Not wanting to alert others to the identity of the visitor

We did not explore how do people using their remote control to enter their username and password enter the special characters included in stronger passwords, though that is a real problem that would need to be overcome in a product. In our user studies participants used the keyboard supplied.

Obviously users were also free to not log onto Messenger at all. As we shall see when presenting the results of our study, some people use the TV as time away from communication with friends.

Remote User

The most glaring problem facing users of IM in a communal setting is that of privacy. What happens if one of your buddies sends you a message that insults someone who is present and reading the message with you? Our approach to this problem was to alert the remote party as to the status of the user. Our mocked screen for this feature is shown in Figure 2. Here you can see the standard MSN Messenger buddy list, but the users who are logged-in at the same Media Center are shown grouped together. Even now some MSN Messenger users use their screen name to convey status information (e.g. "Dave in Beijing", or "Tim in a meeting") and our application could just use that mechanism to indicate the communal setting if changing Messenger functionality was not an option.



Figure 3: Incoming Message

Incoming IM

Having logged on and shown up as online on friends' buddy lists any of the users present in the room at the Media Center can receive incoming messages. On a PC,

MSN Messenger uses ‘toasts’ (i.e. pop-up alerts) in the corner of the screen to make the user aware of an incoming message, its sender, and its contents. Toasts work well in a standard PC context, as the movement of the pop-up is enough to momentarily grab the user’s attention. During TV viewing we wanted the incoming messages to be less distracting, so that users could choose to attend to them or to zone them out. Hence our incoming messages gradually fade in and fade back out over the top of the video, avoiding attention grabbing movement. An example fade-in message is shown in Figure 3 Notice that unlike standard incoming instant messages ours required the name of the receiver as well as the name of the sender to differentiate who the intended recipient was out of those present and logged-on. Our initial prototype allowed further differentiation as users could use the arrow keys on the remote to reposition the message on the screen. From then on, messages to that user would be displayed at the same position, thus allowing those present to quickly distinguish messages to them from messages to other users present. We dropped this feature before the user study since such fine grained windows manipulation using the remote control was considered out of keeping with the Media Center user interaction principles. Instead messages queued and were faded in and out one after the other at the bottom of the screen.

Users were given four possible responses to incoming instant messages, three of which were accessed using the arrows on the remote to focus, and the OK button to select. The first of these responses dismisses the incoming message and sends an auto-generated reply. The auto generated replies would be configurable by users and could contain tokens which would be instantiated at send time to indicate channel and other users present if required. So, for example, a user named Stella could choose the automatic message “Stella is watching <CHANNEL> with <OTHER USERS’ NICKNAMES>, please try later” which would be filled in with actual channel information and user screen-names as it was generated for sending. The second response placed a cursor in the message so that the user could type in a free-form reply, either with a keyboard (probably wireless) or with the remote control using triple-tap. The third option just dismisses the message without generating a response while the fourth option is to leave the message to fade-out in its own time.

Buddy List

Thus far we have described the log-on, incoming messages, and replies. Although, as mentioned earlier in this section, we concentrated design efforts on sporadic messaging over media consumption we did investigate the provision and browsing of the buddy lists. We choose a design where the buddy list appeared as a whole, with each user’s buddies intermingled into the alphabetic order. We initially tried separate buddy lists, and a buddy list with separate headings where each separate user’s buddies were listed, but we settled on a merge of the buddy lists. The buddies status

were indicated with the usual MSN Messenger icons. We added an additional icon to show users who were at a Media Center. When the selection bar moved over such users, if they had their media consumption settings set to public, a fly out window would show the user what media their buddy was consuming. The intention was to add a “follow me” interaction via a remote button so that having browsed to see what media a buddy was consuming, i.e. what TV channel they were watching or CD they were listening too, the user could switch to the same media and chat about it. Note that while the media pop-out breaks our no movement rule, by the time the users are browsing a buddy list we assumed that the attention of everyone present was on that task.

Though media consumption is the main 10’ experience at the Media Center, there are also some shell tasks (e.g. setting preferences) and some navigation tasks (e.g. browsing an Electronic Programme Guide or a CD collection) that our instant messaging UI needed to interact with. To achieve this we included typical screenshots from such tasks to ensure that our UI did not jar (Figure 5 shows an example).

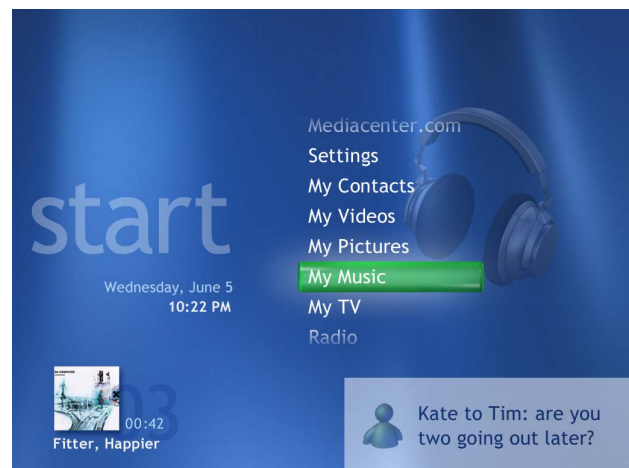


Figure 4: Incoming Message Over 10' Shell

THE USER STUDY

We conducted a user study to explore peoples general experiences using instant messaging while consuming continuous media as well as to test the efficacy of some of our design choices.

Participants

32 participants were recruited for the study. These were screened to ensure that they were familiar with PC use, used their PC for media consumption (e.g. listening to music), and used MSN Messenger at least 3 times a day. We recruited the participants in pairs, first recruiting one from our company’s database of volunteers, and then asking them to recommend a friend whom, if willing, we called and screened. Thus we were able to use pairs of participants who were existing friends in our user study. 10

Of our participants were women. Our participants ranged in age from 16 to 39 and in profession from a massage therapist and a casino card dealer to a project manager and a pharmaceuticals researcher. We skewed the sample towards those who might be interested in buying such a platform: media savvy professionals and students. The relationships between the pairs were friends house-mates, girlfriend and boyfriend, husband and wife, father and daughter, and brothers. The length of their relationships varied from 9 months to 30 years.

Task & Design

The study was conducted in five stages.

Firstly the participants answered a brief questionnaire which asked demographic questions about them and their relationship.

Secondly we gave the participants a brief training session where we familiarized them with the application and how to interact with it using the remote control. We ensured that they could each successfully log onto MSN Messenger within the application and took a copy of their buddy list.

Thirdly we conducted two sessions with the prototype. The participants were given five minutes to watch any of the clips they choose. During that time the usability engineer sent them IM messages. To get a feel for messages that could be ignored and ones that required an answer, participants were instructed that they only had to respond to messages about arrangements for the weekend. Other messages they were free to ignore if they choose to. The two conditions contrasted having both participants logged-on with having just one of the two participants logged on. These two conditions were conducted within-subject and were balanced between pairs. We also mentioned to participants that they would appear to their buddies as Online during the sessions and so they might receive incoming messages from their buddies. We left it up to the participants how they dealt with such incoming messages and explained that the auto-reply feature was set to "I'm in a user study at Microsoft, I'll talk later". After each session both participants answered a brief questionnaire asking about their sense of enjoyment the interruption by the incoming messages etc.

Fourthly we walked the participants through the buddy list feature – both on the Media Center and the view that their remote buddies would see. We showed them the media fly-out and asked them to explain it, and checked whether they could identify the people on the buddy list.

Finally we had a more open ended session structured around a questionnaire that covered the participants' current media and communications set-ups and their feelings about the prototype.

Quantitative Results

Existing Behavior

To find out if the participants currently combine instant messaging with media consumption we asked them "Do you use IM and buddy lists whilst consuming media (i.e. watching TV, listening to music, etc)?" 97% reported using IM while listening to music on their PC while 78% had used IM while watching TV.

Since having multiple people logged on to an instant messaging system at the same PC is not possible on most current systems, we asked the question "Have you ever used Instant Messaging when someone else is present in the room with you?" to see if users would find that uncomfortable. 100% of participants reported experiencing this.

We asked "Do you ever use IM to coordinate media consumption (i.e. pass on a music file, recommend a film, ...)?" and 92% of the participants reported doing so.

Session Comparison

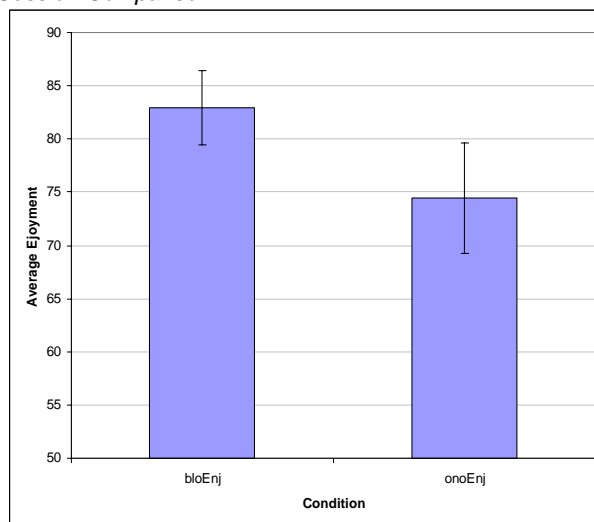


Figure 5: Enjoyment

We compared two measures across the two sessions to see if both being logged on differed from just having one participant logged on. Figure 5 shows how the answer to the question "How much did you enjoy this session?" varied. The answer was given on a 100 point scale with 0 representing "Not at all" and 100 representing "Very much so". The enjoyment measure grew from a mean of 74 with one participant logged on to a mean of 83 with both participants logged on. This is significant at the 5% level (one tailed t-test gives $p = 0.04$). Our second measure looked at interruption. We asked "Did the incoming IMs interfere with your enjoyment of the TV content?". Figure 6 shows the results. The answer was given on a 100 point scale with 0 representing "Not at all" and 100 representing "Very much so". The interruption measure gave means of 24 during the joint log-on session for the participant who

logged on both times, 21 during the joint log-on session for the participant who logged on once, 12 during the single log-on session for the participant who logged on both times, and 21 during the single log-on session for the participant who logged on once. I.e. the mean score of 12 came from the participants who were logged on when the other participant was not. The decrease from 24 to 12 is significant at the 5% level ($p = 0.025$). There is a wide variation in the measured sense of interruption, the overall mean is 20 (range 0 to 75) and standard deviation 21.

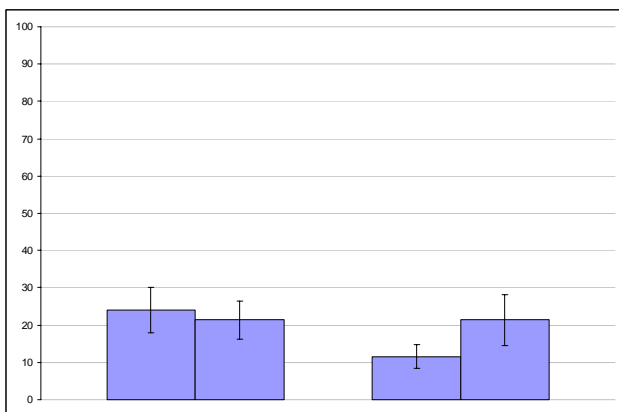


Figure 6: Interruption

Responses to the Application

93% replied yes to the question “If you had a media center, would you want to use it to IM with buddies while watching TV at 10’?”. 75% replied yes to the question “Would you and a friend both log-on to messenger at a media center if it were an available feature?”. 93% replied yes to “Would you use auto-reply messages for IM replies whilst watching TV with a friend?”.

Qualitative Results and Discussion

Existing Behavior

Our participants were clearly avid media consumers, and regular users of IM, so the fact that 97% of them had used IM while listening to music on the PC was not a surprise. Music often serves as a nice background accompaniment to other tasks anyway. More surprising was the 78% who reported using IM whilst watching TV since, on further questioning, we found that this often required moving and setting up a PC or the TV in a different room. This confirmed that to some people, constant access to IM was important enough to go out of their way to achieve it while watching TV.

That 100% of participants had at some time experienced using IM while someone else was present reassured us that the shoulder to shoulder nature of instant messaging at our application may not be too far beyond users’ current experiences. The scenarios under which this happened were twofold. One set were around friends gathering around a home PC, for example while getting ready to go out. The second set were around support at work. If one person is

helping another with a PC problem at their desk they will often enlist the help of a third party over IM. Many participants had anecdotes describing embarrassing moments where a message had appeared in company that it was not intended for. We return to this and other privacy concerns in the next section.

Session Comparison

Since people watch TV together, and enjoy instant messaging on a PC, we assumed that allowing several people to instant message at a Media Center while watching TV would increase enjoyment. It did. While our participants enjoyed the application even when only one of them was logged in (scoring a mean of 74 on a 100 point scale) the enjoyment score went up significantly (to a mean of 83, significant at the 5% level).

We also tested interruption and saw that the participants sense of interruption was uniformly low (scoring a mean 20) but that there was a significant drop in the sense of interruption from the participant who was logged-on without the other participant logging on (mean score dropping from 24 to 12, $p < 0.05$). This implies that while the incoming instant messages were not overly interrupting, participants were more distracted by messages that they knew could not be for them. But, the variation in these figures is large (overall mean is 20 and SD is 21), and indeed some of the participants found the messages less distracting when they were not logged on (5 participants found it less distracting to be logged on when the other participant was too, 4 participants found it less distracting to be logged off when the other participant was logged on, and 7 reported no change).

Buddy Lists

There were several aspects of representing buddy lists on TV that we wanted to understand further: using them to initiate outgoing messages, browsing buddies media status, and potentially using them to filter incoming messages.

When designing our buddy list we vacillated between marking each buddy to say which logged-on user they were buddies of, separating the buddy list into separate sub-lists, giving each user their own list, or just merging everybody’s buddies into one list. Giving each user their own list would add a level of indirection since the application cannot tell which of the logged-in users is handling the remote control, and so would have to offer an additional step to choose which list to display. For the study we implemented the one unstructured list solution. We also choose to represent buddies by their screen name alone, rather than their screen name and email address. With each pair of participants we ran through the resultant buddy list and identify the people on it and whose buddy list they originated from. Throughout the sessions there was no confusion as to the identity or origin of an entry on the buddy list. However there would need to be an additional way to access the

underlying email address for cases when multiple people choose the same screen name.

Another feature we showed our participants (in the form of a UI mock-up) was the fly out window to show what media buddies are watching. All our participants felt that being able to see what music a buddy was currently listening to, what TV Channel they were tuned to, or what DVD they were watching was a good idea, especially if they could easily join them in watching the same content (when available). However, when we asked if our participants would be willing to reveal their viewing to their buddies many participants were less keen. Interestingly the female participants said they would not mind their buddies knowing what they were watching. All of our male participants expressed some reservations; the two explanations that were given by more than one participant were that they did not want their girlfriends/mother knowing they were watching pornography, or that they did not want their buddies knowing they were watching Martha Stewart (a feminine home improvements presenter).

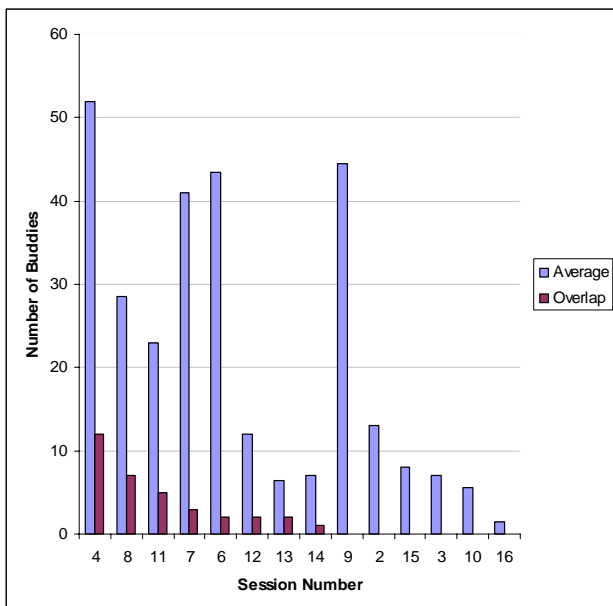


Figure 7: Buddy List Overlap

We were also interested in using the buddy lists to screen incoming messages. Originally, we had hoped that through discussion with the participants we may get some clues as to what was an acceptable message to display and what should just be given a notification. One possibility was that if the message was from a buddy who was on all the logged-on user’s buddy lists (i.e. from the intersection of the lists) then it would be immediately displayed. This proved naïve – our participants reported too complex an assortment of possibly private messages. But there was also far less overlap between our participants buddy lists than we expected. Figure 7 shows the number of people on each participant’s buddy list, and the overlap between the two

lists (ordered by overlap). It is surprising that the overlap is so small, and it requires further research to establish if this result is generalizable – i.e. what is the expected overlap between two friends buddy list?

To preserve privacy we designed the remote view described already and shown in Figure 2. Our participants felt that this would adequately address their privacy concerns. However there are some modes for which it may break down. For example, if you are in a long conversation with a buddy over IM you may not repeatedly check to see if their status has changed to group. One anecdote from our study indicates this. During one session, one of our participants who had brought his girlfriend as the other participant received an IM from his ex. This led to an argument and some hasty patching up. Interestingly, he was the only participant to have blocked someone on his list when told that buddies might IM during the sessions.

Another area of privacy that we had not addressed and which was raised by one of our participants was privacy of the buddy list itself. She reported being disappointed once when she realized that a buddy who she had felt was her special pal was also on several other friends’ buddy lists.

One unexpected issue that arose repeatedly in participant’s comments was that they would not want the full list of their buddies to be able to contact them during TV viewing. While they wanted the feature, they did not think it appropriate for everyone on their lists. Current buddy lists do not support changing status for just a subset of buddies (e.g. I’m shown as “away” for these people) but that would be necessary for Media Center Buddies to succeed.

CONCLUSIONS AND FUTURE WORK

We have shown that the convergence of media consumption and communications devices can be harnessed in a novel application, Media Center Buddies, providing IM over TV viewing. The application was carefully designed to minimize the disruption caused by incoming messages on the TV experience while still allowing users to read their messages.

To be sensitive to the communal nature of much TV viewing we provided the facility for several people to log-on simultaneously at the same Media Center. We also carried out a user study on paired participants. We hope that readers agree that this better reflects the usage scenarios of many leisure devices, and thus uncovers many real world issues. It is our hope that this paired participant study is used more frequently when designing leisure based applications for the living room.

We saw that people enjoyed using the application and did not find it unduly interrupting. Enjoyment increased if both parties were logged in.

One surprising aspect of the work which we are not planning to expand upon is gender differences. As motioned, all of the men on our study did not like the

proposed feature of revealing their current viewing choice to their buddies. A common explanation for this was typified by one participant who stated "I don't want my mom to know I'm watching porno". One may imagine that this reflects a lack of interest in pornography from the women participants, and while this may be true in general, we did have a female participant point out that she liked watching pornography and that she did not mind if that information was available to her buddies. Obviously we cannot draw any psychological conclusions from an unexpected finding in a small usability study. But there are established gender differences around the secret nature of transgression: women with a drinking problem are significantly more secretive about it than men [10]. Perhaps in media consumption women's public and private habits coincide, while men's do not.

The main aspect of work we have conducted since building this prototype and conducting this study is to turn Media Center buddies into a product-quality application. The decisions made in terms of which features needed to be cut, changed, or further developed is beyond the scope of the current paper. <Note to reviewers> I'd like to close with some kind of announcement about the availability of this idea in shipping Media Centers, but I cannot do that yet. Hopefully, by the time such information was formally required it will be public. </Note to reviewers>

REFERENCES

1. Van Gogh TV (1992). "Piazza Virtuale". <http://www.vgtv.com/n,100010,1.html>.
2. Telemorphix (1993) "21st Century Vaudeville" <http://www.itvt.com/etvwhitepaper-5.html>
3. O'Sullivan, D (1993) "YORB" <http://fargo.itp.tsoa.nyu.edu/~dano/proj/yorb.htm>
4. Benford, Greenhalgh, Craven, Walker, Regan, Morphett, and Wyver (2000) "Inhabited Television: Broadcasting Interaction from within Collaborative Virtual Environments" <http://portal.acm.org/citation.cfm?doid=365058.365095>
5. Broadband Bananas "Mobile & Messaging Applications" <http://www.broadbandbananas.com/vvmessaging.html>
6. SMS and TV Convergence Whitepapers <http://www.smsmeetsv.com>
7. Isaacs, Walendowski, Whittaker, Schiano, and Kamm (2002) "The character, functions, and styles of instant messaging in the workplace" <http://portal.acm.org/citation.cfm?doid=587078.587081>
8. Taylor and Harper (2002) "Age-old practices in the 'new world': a study of gift-giving between teenage mobile phone users" <http://portal.acm.org/citation.cfm?doid=503376.503455>
9. Two-Way TV <http://www.twowaytv.co.uk>
10. Gomberg ESL. (1993) "Gender issues: Women and alcohol". In M Galanter (Ed.), *Recent Developments in alcoholism: Ten years of progress.* (Vol. 11). (pp. 95-107). New York: Plenum.
11. Grinter, R. and Palen, L. (2002) "Instant Messaging in Teen Life". In *Proceedings of the 2002 ACM Conference on Computer Supported Cooperative Work (CSCW '02)*, New Orleans, Louisiana.
12. Kubey, R.W. & Csikszentmihalyi, M. (1990) "Television and the Quality of Life: How viewing shapes everyday experience". Lawrence Erlbaum Associates.
13. McCrickard, D. S., Czerwinski, M. & Bartram, L. (2003) "Introduction: design and evaluation of notification user interfaces". In *International Journal of Human-Computer Studies*, 58, 509-514.