

# CollaboraTV: Making Television Viewing Social Again

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## ABSTRACT

With the advent of video-on-demand services and digital video recorders, the way in which we consume media is undergoing a fundamental change. People today are less likely to watch shows at the same time, let alone the same place. As a result, television viewing, which was once a social activity, has been reduced to a passive and isolated experience. To study this issue, we developed a system called CollaboraTV and demonstrated its ability to support the communal viewing experience through a month-long field study. Our study shows that users understand and appreciate the utility of asynchronous interaction, are enthusiastic about CollaboraTV's engaging social communication primitives and value implicit show recommendations from friends. Our results both provide a compelling demonstration of a social television system and raise new challenges for social television communication modalities.

## Categories and Subject Descriptors

H.5.3 [Group and Organization Interfaces]: Asynchronous interaction

## General Terms

Design, Experimentation

## Keywords

social television, interactive television, social tagging, instant messaging, asynchronous communication, video

## 1. INTRODUCTION

Television is undeniably a major component of modern society. In the United States, it is not only the dominant media activity but is also considered the most exciting and influential media type [10, 17, 22]. Despite increasing competition from the internet, television usage has been steadily increasing and is now at its highest level since viewing data

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was first collected, a 50% increase since the 1950s, and a 12% increase from 1996. The average person watches 4.5 hours of programming a day, with the average household tuned in for more than 8 hours [10].

Given the significant place that television holds in our daily lives, our research focuses on understanding the social aspects of television viewing – especially in today's age of social behavior-altering technological advances – and the utility of social television systems for meeting the new challenges that such advances bring about.

## Declined Social Interactions Around Television

Television was once championed as the “electronic hearth” which would bring people together [23]. Indeed, television shows provide a common experience, often affording even total strangers a social connection on which to initiate conversation. This effect blossomed in the 1950s when two-thirds of all Americans tuned in to watch “I Love Lucy” [17] with their families. However, a fundamental shift in how we consume media is degrading such social interactions significantly – an increasing number of people are no longer watching television shows as they broadcast. Instead, these users are favoring non-live media sources, such as Digital Video Recorders (DVRs), Video-On-Demand services (e.g. Apple's iTunes Video Store), and even rented physical media (e.g. DVDs via Netflix). To complicate matters further, televisions are outnumbering people in the average home; less than a fifth of households have a single television [5, 9]. This is leading to a decline in ability for people to interact and is eroding once strong social ties. People are increasingly watching TV without their families, with some studies suggesting at least half of Americans usually watch alone [17]. However, all indications point towards a lack of ability to communicate, not a lack of desire.

## The “Water-cooler Effect”: Thing of the Past?

Television shows often act as a conversation starter, enabling the “water-cooler effect” [17], where groups congregate and discuss a television show, automatically assuming everyone in the group has seen it. For example, co-workers could discuss a show from the previous night at work the following day. However, this effect is heavily dependent on a property of live television: shows have a fixed broadcast time. This means that after a show has aired, everyone who wanted to see it, must have watched it (or missed it). DVRs enable people to watch shows days, weeks, and even years after they first air. This trend towards asynchronous viewing, although not omnipresent today, is becoming a dominant

media consumption mode. DVRs are already found in 20% of American homes [3] and worldwide adoption is predicted to reach 250 million users by 2011 [2]. On-demand commercial video downloads are also booming, jumping 255% from 2005 to 2006 [4]. Similarly, Netflix, the most popular DVD rental company, has experienced nearly 50% growth in subscribers annually since 2002 [1].

What does asynchronous viewing mean for the water cooler talk? Many people will not have watched the most recently aired episode by the following day. In fact, some people may be multiple episodes or even seasons behind. This makes conversing about a show considerably more problematic. If a group of friends meet and talk about the latest episode, those who have not seen it are left out. It is even possible that some may avoid the conversation entirely, fearing that yet-to-be-seen episodes will be spoiled. People may also moderate their conversations in order to prevent revealing spoilers to friends that are one or more episodes behind. However, this hampers the exchange of important and interesting details that were revealed in recent episodes. Moreover, by the time lagging people do catch up, and want to discuss the show, it is likely others will have forgotten important details or simply have lost interest, substantially degrading the quality of interaction.

## Unprecedented Level of Program Choice

Television viewers today can easily be overwhelmed by the number of channels as well as programs. Gone are the days when one could flip through a 40-page TV guide and decide what to watch. Given the plethora of content today, the task of finding something relevant to watch has become very difficult. As a result, viewers often resort to randomly scanning multiple channels (‘channel surfing’) to find a show of interest. Digital TV service providers have tried to respond to this information overload problem in a few ways. Electronic program guides, which are little more than digital forms of their paper predecessors, still require viewers to sift through a multitude of static choices. Vendors also provide basic search capabilities along with TV programming service, but again the task of searching for the illusive “good” show rests on the viewer. Despite the availability of technology aids, viewers still prefer channel surfing as a method to select what to watch, often expressing considerable dislike for onscreen program guides [21]. DVR systems, like the TiVo, even automatically record shows they think users will like. But the quality of such system-recommended shows is questionable [25].

Our efforts to address the 3 afore mentioned issues are organized around 3 research questions (RQs):

- RQ1.** Does CollaboraTV provide users a sense of social presence? Does it enrich the viewing experience?
- RQ2.** How well does CollaboraTV support asynchronous television viewing?
- RQ3.** Can friend networks present in social television systems be leveraged to help users choose what to watch?

The remainder of the paper is organized as follows. We first survey related work, illustrating how we build on or advance it. We then describe the CollaboraTV system, highlighting distinctive features that appreciably affect usage. The heart of the paper describes a month-long deployment of CollaboraTV as a system to support social interactions

while consuming video content; we focus on how our results answer our three research questions. Finally, we discuss the implications of our results for future design and research.

## 2. RELATED WORK

### Social Television Systems

Television-based communication has been the focus of substantial research. Many of the ideas in CollaboraTV are extensions of successful elements in previously developed systems. However, CollaboraTV distinguishes itself in several significant ways.

Xerox PARC’s Social TV [15] envisioned the use of a shared audio channel, where groups of users could interact verbally. The project also introduced the idea of a movie theater-themed visualization scheme for user presence. Indeed, CollaboraTV’s virtual audience is a direct descendant of this concept. However, unlike Social TV, avatars in CollaboraTV are dynamic and used as a conduit for communication (comments, gestures and expressions).

AmigoTV represents one of the earliest efforts in this domain [6]. Like Social TV and CollaboraTV, avatars are used to visualize user presence. The system offers a series of faces as avatars, and allows users to select a demeanor (e.g. happy face, angry face), allowing avatars to operate on an additional dimension: emotion. Users can also generate shared video effects, for example a flaming ball whizzing across the screen. Like Social TV, AmigoTV allows users to communicate via speech.

ConneTV is a tightly integrated instant messaging and television application [7]. From a user’s perspective, friends are placed into one of three groups: “watching this channel”, “watching another channel”, and “not watching”. In addition to being able to chat with friends that are watching the same show, the system also allows messages to be sent to friends watching different shows. The latter serves as an invitation to switch channels and join the sender. If a user is not available when the invitation is sent, it will be saved until that user comes online, at which point the user can start watching the associated content sent by the friend. The Media Center Buddies system [18] by Microsoft, is similar.

Telebuddies [14] promotes communication amongst synchronous viewers using a series of events incorporated into the media stream. The authors offer a quiz example, where users are formed into groups and compete. A text-based chat interface is provided to allow users to deliberate.

Unfortunately, evaluation of social television applications has been lackluster. Although there has been considerable investigation of particular social television elements (e.g. [11, 12, 24]), no comprehensive field studies have been conducted on the usability, impact, and potential adoption of full systems. While systems such as AmigoTV and Telebuddies appear to have been developed, no formal user study has been published. Also, current systems do not distinctly support asynchronous communication. With a clear trend towards on-demand media consumption, systems that do not support this form of communication have significantly diminished value. In this regard, CollaboraTV is unique.

### Avatars

The benefit of avatars in communication systems has been widely researched (e.g. [8, 16, 19, 20]). Television is traditionally watched in groups, which makes avatars an obvious

technique to simulate presence. Avatars humanize remote users, or in the case of CollaboraTV, potentially teletemporal (literally meaning far in time) as well. Moreover, avatars have been shown to be ideal for non-textual communication; emotions, gestures and postures offer a universal dimension of expression that people find familiar and natural.

### 3. SYSTEM DESCRIPTION

CollaboraTV was designed from the ground up to support synchronous and asynchronous viewers in a unified interface. The resulting system allows communication in and between these two viewing modes, providing a high level of interaction potential.

#### Temporally-Linked Annotations

CollaboraTV allows users to create text comments while watching a show. The text content is attached to the media stream at the corresponding temporal index. When other users encounter this point in the show, the comment is displayed on screen for several seconds.

This annotation method inherently supports asynchronous communication. Previously generated comments will be shown to later viewers as they watch the show. Although the mechanism is simple, the effect is great – past users appear to make comments as if they were watching in parallel with you. In a synchronous situation, when one or more users are concurrent, comments are shown immediately to all group members allowing them to chat (live) like they would with an instant messaging client. Additionally, because these (chat) comments are attached temporally to the media, subsequent viewers will see the conversation unfold in “real-time” even though the conversation took place in the past.

This communication scheme has several important qualities. Foremost, synchronous user groups can communicate without hindrance while simultaneously interacting with asynchronous commentary. Secondly, lone viewers who would otherwise have no communication are exposed to a wealth of previous interaction. This may motivate them to participate in the conversation knowing that subsequent viewers will see their remarks. Lastly, as more users watch and comment, the richer the dialog becomes for later viewers.

CollaboraTV supports a second type of temporally-linked annotation: the interest point. Like comments, interest points are attached to the media stream at the temporal index they were created. However, instead of containing text, interest points are used to indicate a positive or negative reaction to a show’s content (e.g. a particularly funny joke or exciting action scene). Users are free to associate the polar nature of this feature however they see fit (e.g. thrilling/dull, witty/cheesy, and suspenseful/predictable).

Besides text comments and interest points, CollaboraTV allows users to temporally link expression annotations to the media stream. Users can express their feelings at any time during a show by selecting from a set of common expressions (happy, sad, angry etc.) Along with text comments and interests points, expressions provide CollaboraTV users with a rich set of primitives that help digitally recreate the communal viewing experience.

#### Virtual Audience

The most prominent feature of the CollaboraTV user interface is the virtual audience. A series of avatars are used to visualize both current (synchronous) and past (asynchronous)

viewers. The effect of a movie theater, where people are seated and shown as silhouettes below the content screen, is used. Each avatar is named and has a static seating position throughout the show. A “watching live” label is displayed below avatars that represent synchronous viewers.

In addition to embodying concurrent and teletemporal viewers, the virtual audience is used as the primary communication conduit. Temporally-linked comments are shown in translucent, comic book-like speech bubbles, which are rendered above the source user’s avatar. In addition, avatars raise and lower their arms to make thumbs up/down gestures. These correspond to user-generated positive and negative interest points. Finally, expression annotations selected by viewers are seen as animations of the avatars. For example, when a user selects ‘happy’, the user’s avatar turns around revealing a smile on its face. These subtle effects enhance the perceived interactivity. Users can optionally turn off the virtual audience. Figure 1 provides an example of each of these items.



Figure 1: A partial virtual audience from a live user’s perspective. Other avatars represent past viewers. Note the comment in a speech bubble to the left, the center avatar’s facial expression and thumbs-up gesture on the right. These annotations are also temporally displayed on the progress bar seen above the virtual avatars.

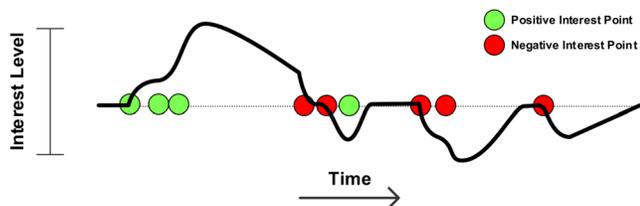
#### Buddies, Sharing and Privacy

A user may consider their comments and interest points personal, and only wish to share them with friends and family. To achieve this, CollaboraTV employs a simple social network to determine how user-content is shared. A unidirectional subscription model is used. If comments, expressions and interest points are to be exchanged between two users, they must explicitly befriend each other by adding the other to their buddy list. This bi-directional communication would be most typical among friends and families. However, there are some instances where unidirectional communication is valuable. For example, it would be possible to watch a television program with the one of the show’s actors. This would be achieved by subscribing to that user. Because the subscription is only one-way, the user would not appear in the actor’s virtual audience.

#### Interest Profiles

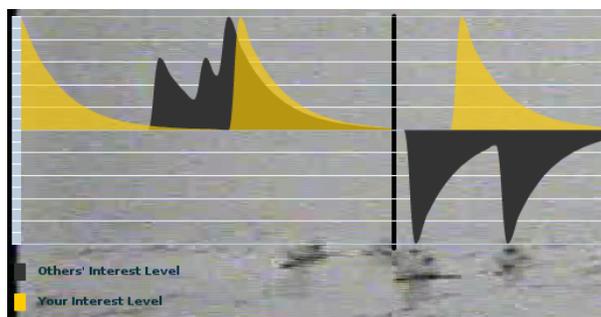
Although temporally-linked annotations are primarily used for communication purposes, their location, frequency and

content can be leveraged for other purposes. Interest profiles are a notable example. These are created by interpolating a continuous interest level from a series of interest points. Data from a single user or group of users can be used. Because positive and negative interest is assumed to be transient, the interest level slowly decays to a nominal level (Figure 2).



**Figure 2: A set of discrete interest points is used to form a continuous interest profile.**

This data of how a viewer’s interest level swings between positive and negative over the time period of a TV show may be interesting to viewers. In response, the feature is exposed graphically in the CollaboraTV user interface. While a show is watched, two interest profiles are calculated: one for all previous viewers and one for the current user. The two interest profiles are superimposed (Figure 3), which helps visualize the magnitude of agreement/disagreement between the user and the group. It was thought that highlighting sections of agreement and disagreement may spark additional discussion, increasing social interaction.



**Figure 3: Group and user interest profiles displayed concurrently. Current location in the media is noted by the vertical line that doubles as a slider which can be used to jump to a different point in the media**

## Interface Design

The CTV GUI consists of the following 5 elements:

- 1. Buddy Information (View/Join)** – A list of buddies of a user along with an indication of whether or not the buddy is currently viewing CollaboraTV. A user has the ability to ‘join in’ on a buddy and start watching at the same point in the show as the buddy. Thus a user can catch-up with a buddy who may not be too far along into a show.
- 2. Program Guide** – A listing of all available shows in the CollaboraTV system, along with show descriptions. Shows viewed by buddies of a user are marked in the program guide. The program guide also has a separate list of shows that have

been viewed by a user’s buddies, as well as a list of popular shows across all users of the CollaboraTV system.

- 3. Virtual Audience** – discussed previously.
- 4. Progress Bar** – displays the current position in the media stream. The temporal locations of annotations (comments, interest points and expressions) are denoted using icons on the progress bar (Figure 1). When the show progresses to an annotation as seen on the progress bar, the avatar corresponding to the user who made the annotation is animated to display a comment bubble, thumbs up/thumbs down gesture or expression on its face.
- 5. Interest Profile Visualization** – discussed previously.

## System Architecture

CollaboraTV uses a client-server architecture. The client was built using Adobe Flex and provides the GUI functionalities described previously to list available content, launch programming, and control playback. A central JBoss server, in coordination with a Flash Media Server, delivers video content to the clients and coordinates the communication between multiple clients. A central MySQL server provides a common data store for user generated data (annotations, buddy lists, show ratings) as well as show related data. CollaboraTV uses MythTV, an open source media center application with DVR capability, for recording shows and accessing show information for its program guide.

Although currently built for TV content, CollaboraTV could be easily extended to several other media forms. User annotations are tied to television shows using a unique show ID and a time index. It would be trivial to generate temporal annotations for DVDs, online videos (e.g. YouTube), downloadable content (e.g. iTunes) or any non-static media such as audio and e-books.

## 4. EXPERIMENT

Past studies of social television systems have been largely confined to restrictive and, often times, artificial lab settings. To gauge the true utility of a system such as CollaboraTV would require a longitudinal study of a live system deployment. During the spring of 2008, we conducted a field study to investigate the usefulness of CollaboraTV to support the communal viewing experience. Participants accessed and used CollaboraTV from their personal computers, interacting with their buddies freely and naturally over the duration of the study. Such an open and natural design preempted the need to simulate the experience of watching programming remotely with others, and also gave users sufficient time to form an opinion about the system.

## Participants

The participants were recruited using a mailing campaign directed at students who had interned at a large corporate research lab during the previous summer of 2007. The summer interns presented an interesting group to recruit from. They had often stayed in the same summer housing, traveled to work together, had lunch together as well as socialized during many events for summer interns. Thus, new friendships were made and new cliques formed. After the summer internship, the interns returned to their home towns, within and outside the US. This group now had an important property that made it ideal for our study – cliques of friends who were geographically separated. The presence of

cliques within the potential participant pool was vital, as CollaboraTV depends on the notion of buddies. We used a survey to find participants amongst this group of interns and their friends who regularly watched television. 16 qualified subjects participated (14 male and 2 female; mean age of approximately 25). Their backgrounds were mainly in IT.

## Procedure

Participants used CollaboraTV for 4 weeks. They completed a pre-study survey about their TV viewing habits and selected a group of buddies with whom they would like to watch shows on CollaboraTV. Participants could either choose buddies from the list of interns or invite other friends. Following the initial survey, we invited each participant to view a short online video providing an overview of CollaboraTV. At the end of the study period, we conducted another online survey where participants informed us of their experiences with CollaboraTV.

Participants viewed streaming video from the CollaboraTV server using a web browser. Once logged in to the system, they had access to a list of 37 shows across 17 genres. These shows were selected from the highest rated shows across different genres on a popular TV show rating website. These initial shows were recorded using MythTV and transcoded into Flash video format to enable viewing in a web browser with flash player installed. During the course of the study, participants could request shows to be added to the system. They could also modify their buddy list, and make annotations while they watched a show.

We told participants to use CollaboraTV just as they wanted: they could watch any show of their choice, add or remove anybody to their buddy list and use any system feature. To ensure minimal usage levels, we asked participants to view at least 2 shows. We offered a modest incentive: a randomly selected user who participated at the minimum level received a \$50 gift certificate. 70% of the subjects met the requirement.

## Experimental Design

To test the effect of CollaboraTV’s social features in providing users a sense of social presence (RQ1), we asked users to create a buddy list and observed the interactions that took place between buddies. These buddies were, in most cases, other interns with whom participants had fostered friendships over the last year as a result of a joint summer internship experience. In other cases, participants invited a family member or a friend to be their CollaboraTV buddy. Annotations made by participants while watching a show were persisted and shown to their buddies. Users understood that their buddies would see their avatar’s annotations and this provided the necessary social context to engage users. Besides observing the logs of annotations made by users, we asked about their experiences using the social features of CollaboraTV while watching shows with their buddies.

Many existing social television systems have explored the dynamics of synchronous communication. To better understand the potential of asynchronous communication, one of CollaboraTV’s most distinctive features, our study focused on this mode of interaction (RQ2). We asked users to watch a specific show episode with a buddy(s) in a time-shifted manner. This was either a new episode of a show found in the viewing history of the user or buddy, or alternately one of their own choice.

Digital television services today pose a significant content selection problem. Rather than taking the algorithmic route such as recommender systems, CollaboraTV employs a simple yet powerful mechanism. Informational Social Influence [6] tells us that when we do not know what to do, we often times copy other people. CollaboraTV aids such behavior via certain interface features. Users can view a list of shows that their buddies have been watching called PopularShows(Buddies). Another list, called PopularShows(All), is also available that anonymously displays names of shows that have been recently viewed by any system user, not only buddies. Shows recently viewed by buddies are indicated in the program guide. To learn if friend networks present in social television systems could be leveraged to help users choose what to watch (RQ3), we observed usage logs for instances when users selected a show displayed under either PopularShows(Buddies) or PopularShows(All). We also asked survey questions to find out if participants found these lists useful.

## 5. RESULTS

At the start of the study, participants completed a survey that gave us sufficient background regarding their familiarity with different video viewing technologies and their attitudes towards television viewing. On the question of television expertise and usage, almost all of the participants had used televisions for more than 10 years, with 75% viewing between 1-3 hours per day.

We asked questions about familiarity and usage of DVR technology, to which 56% of participants said they use it often, while 37.5% of users had either heard of it or used it a few times. We felt that the familiarity with DVR technology would lend itself nicely to the asynchronous viewing mode in CollaboraTV. Only 3 participants had used online social television systems before. Figure 4 shows usage levels of some popular video-related technologies.

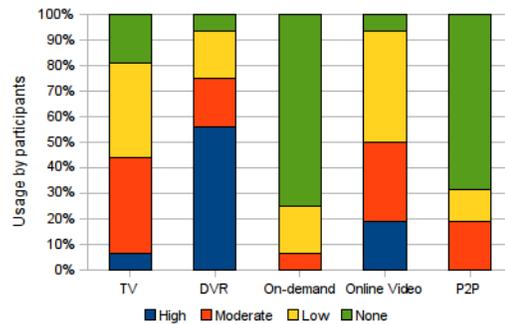


Figure 4: Usage of different video-related technologies

With this background about participants, we now address the core of our results, which are organized around our 3 research questions. We begin with RQ1, describing how participants felt about the social features of CollaboraTV. We follow by identifying opportunities for improving the communication primitives based on participant feedback, and then address RQ2, which focuses on asynchronous viewing. At this point, we explore the related issue of privacy in social television systems before finally looking at a possible solution to the content selection problem described in RQ3.

### RQ1. Does CollaboraTV provide users a sense of social presence and enrich the viewing experience?

We asked participants questions to understand if they valued the experience of watching with others in the first place. 81% indicated that they watched television with family or friends, and said that watching with others was more fun than watching alone. 19% also added that watching programs/films that elicit strong emotions with friends or family helped bring them closer together. These responses encouraged us to believe that participants would use and value the social interaction primitives of CollaboraTV at the onset of the study.

## Annotation Activity

During the period of the study, we logged all the annotations made by the participants with the intention of using annotation activity as a measure of success of CollaboraTV in enriching the viewing experience. In all, participants created 213 annotations, an average of 14 per person (min: 0; max: 72; std: 22.5). 137 (64%) were text comments, 24 (11%) were interest points, and 52 (25%) were expressions. The difference in usage of the 3 types of annotations could be because of the ease of use and expressiveness of text chat. In many cases, viewers used chat-style emoticons embedded in their text comments.

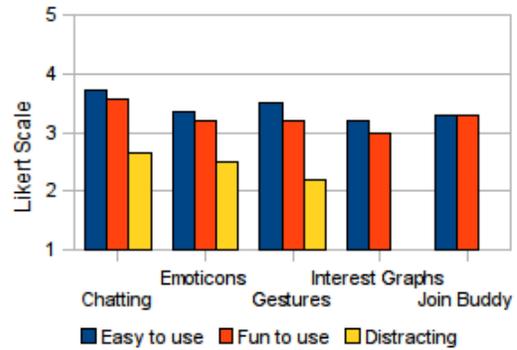
## Chat Content

After the study was complete, we assigned each of the participants' 137 messages to one of 6 categories. We adopted the classification scheme used by Weisz et. al. [24]. A reliability check was performed between the first author and an independent coder, and a good inter-rater reliability of 83% was achieved after two iterations. Each line of chat was coded under one of these categories – show content, evaluations of the show, personal topics, laughter, system-related comments and greetings/partings. Laughter, which was often embedded in text comments, was coded separately as either occurring by itself or co-occurring with text. A breakup of the chat content is shown in Table 1.

Our results were similar to those reported in [24]. A significant amount of chat was about the show content as well as personal interactions triggered by the content. For example, a participant said, “do you like Chandler? Would you date him?”, to which a buddy said, “haha prob not, he’s too much like my first bf” while watching an episode of a popular sitcom. Laughter in the form of “hehehe”, “lol”, “:.)”, “:D” etc. occurred very frequently, with users often mixing it in with chat, but more often occurring by itself. Close to 20% of chat consisted of solely laughter. This is roughly the same as the number of times the expression annotation representing ‘laugh’ was used during the study. Moreover, the high usage of chat-style emoticons such as “:D”, “:.)” could explain why expression annotations were not directly used as much. The chat-style emoticons are quicker to create and users are already familiar with them.

## Attitude Towards Text Chat and Other Social Interaction Features

In the final survey, participants were asked if they liked the social interaction mechanisms that CollaboraTV offered such as text comments, expressions and interest points. More than half the participants agreed or strongly agreed that



**Figure 5: Evaluation of CollaboraTV’s social features by participants, on a 1 to 5 Likert-scale. Participants were not asked about ‘distraction’ in the case of viewing an interest graph or joining a buddy in viewing a show, as they are not interruptions triggered by the system, unlike using text, emoticon or gesture annotations.**

CollaboraTV is fun to use ( $m=3.57$ ,  $sd=0.65$ )<sup>1</sup>, while 71% agreed or strongly agreed that the system is easy to use ( $m=3.71$ ,  $sd=0.73$ ). Most participants (57.1%) had no trouble learning to use CollaboraTV ( $m=3.64$ ,  $sd=0.84$ ). When asked if the system was useful to them, 85.7% responded affirmatively ( $m=3$ ,  $sd=0.55$ ), saying in 78.5% of the cases that it supported what they wanted to do to a large extent ( $m=3.07$ ,  $sd=0.73$ ).

Participants liked the movie theater seating effect of avatars and expressed the desire for interactions between proximately seated avatars. They were not very enthusiastic about the possibility of customizing their avatars.

We asked participants to evaluate each of the social interaction features on the dimensions of how fun and easy they were to use. Given that viewing annotations made by others via their avatars may be considered as distracting, we also asked users if this was the case in their experiences with CollaboraTV. Figure 5 shows the responses of participants.

When asked about distractions caused by chatting and viewing others’ comments, 64% of participants were ambivalent about creating text comments, while close to half were undecided about their attitude towards viewing others’ comments while viewing television. Likewise, 50% of the participants were undecided about how distracting the virtual audience was as a whole. This is despite the fact that more than half the users found chatting to be a fun activity. Past research that studied chatting while simultaneously consuming video reported that viewers found the activity fun as well as distracting [24]. Our work confirms this finding. To accommodate such users, it would be worthwhile to investigate alternative visualization schemes, in particular ones with smaller visual footprints. These could be offered as alternative visualization modes in a future version of CollaboraTV.

<sup>1</sup>The survey used a Likert-style one to five scale with the following labels: 1) Completely disagree, 2) Disagree 3) Neither agree or disagree, 4) Agree, and 5) Completely agree. Survey results use this form unless otherwise noted.

Table 1: Examples of chat in each coding category

Category	Example chat (original form)	% chat
Television Show	“does she leave him there or something?” “that’s dakota fanning indeed” “Colbert took the book apart”	34.3
Evaluations	“oh man . . . bad driver” “if this wasn’t already planned, this dude’s the funniest astronaut out there” “nice choice of music”	8.0
Personal	“I want to sit next to you” “do you like Chandler?” “I’m hungry”	18.9
System	“it works fine even with limited bandwidth” “they should cut out all commercials” “test . . .”	16.8
Laughter	“:D”, “hehehe”, “lol” and many variations thereof “I’ve seen this show too many times :)”	18.9 solo 5.1 mixed
Greetings & Partings	“hi”, “hey”, “bye” and many variations thereof “I’m out of here”	2.2

## Overall Activity Level

CollaboraTV had a collection of close to 600 episodes from 37 shows in 17 popular genres during the study, which were updated based on requests from participants. Despite this large and flexible selection and the positive survey responses and general feedback to the social features, CollaboraTV experienced only low to moderate levels of activity. On average, participants viewed 4 shows and created 14 annotations. Several factors could be used to explain this paradox. One obvious reason could be that participants did not find other buddies online to interact with. As one characteristic participant said: “very few people [online]; the more people and friends there are, the better the experience”. We could solve this issue by providing users an invitation mechanism.

A reason for low number of annotations could be the common habit of viewers carrying out some other task in parallel to watching television. 68% (m=3.75, sd=0.93) admitted to normally doing something else along with watching television, explaining that they seldom solely watch television. Another reason could be the current input modalities of CollaboraTV, where users are expected to use their keyboard to make annotations. We discuss alternate temporal annotations that could remedy this in our ‘Future Work’.

In the pre-study survey, 4 participants had indicated a preference to watch television alone, as they felt watching with others was distracting. At the end of study, we checked to see if their opinion had changed as a result of using a social television system first hand. 3 of these 4 users, who had earlier strongly agreed that watching programs with others is distracting admitted that the virtual audience was not distracting while watching a show. All 4 were ambivalent when judging if the CollaboraTV experience with its virtual audience was more engaging and enjoyable when compared to traditional TV. Finally, one of the 4 now strongly agreed that the ability to join shows and watch in parallel with other users in a virtual audience is compelling. These changes in opinion, though minor, are an interesting side effect of using our system.

As a whole, over half of the participants agreed (m=3.21, sd=0.89) that when compared to traditional TV, the experience of viewing in the company of a virtual audience is more engaging and enjoyable. Also, participants said the

ability to join shows and watch in parallel with other users was compelling (m=3.29, sd=0.83). In both cases, 35.7% agreed or strongly agreed.

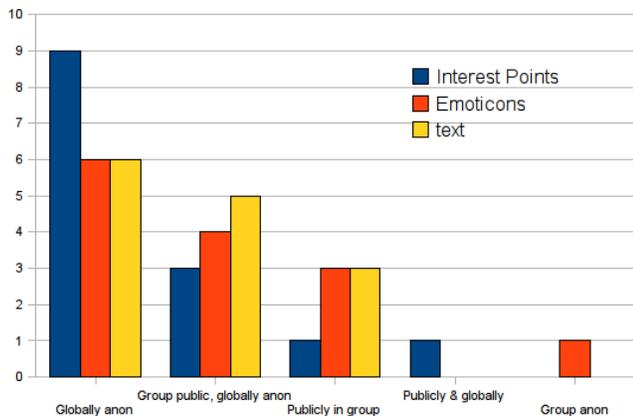
## RQ2. How well does CollaboraTV support asynchronous television viewing?

The asynchronous viewing capability of CollaboraTV is meant to help preserve interactions like the “water cooler conversations” that build social capital. But before studying the utility of this capability, we wanted to learn if participants valued “water cooler conversations”. We verified this by asking users questions regarding the social role of television in their day-to-day lives. 75% (m=4, sd=0.73) strongly agreed that watching the same programs as friends or family provided them with common ground for conversation. Additionally, in 19% (m=2.75, sd=0.86) of the cases they explained that watching programs that elicit strong emotions with friends or family brings them closer together.

Next we asked participants how frequently they (a) used conversations about programs/films as conversation starters, (b) used examples from programs/films to illustrate points in conversations with others, and (c) used conversations about programs/films as a way to clarify values and opinions to others. A new Likert scale with these labels was used: 1) Never 2) Infrequently 3) Neither frequently nor infrequently 4) Frequently 5) Very Frequently. In response 37.5% (m=2.69, sd=1.2) admitted to (a), 37.5% (m=2.69, sd=1.2) claimed to often employ (b) and 18.8% (m=2.44, sd=1.03) said they clarified their values as in (c).

To focus on the asynchronous communication, we asked participants to watch a specific show with their buddy(s) during week 3 of the study, while bearing in mind that their buddies would also be viewing it later during the week. We did this to ensure that all participants got a chance to experience time-shifted viewing of a show first-hand and to give them the basis for evaluating both asynchronous and synchronous viewing modes.

The feedback we received about the asynchronous viewing experiences was generally positive. Participants were able to carry out the task smoothly and glitch-free. While the major topic of conversation was the show content, participants also made jokes and talked about their lives in the context



**Figure 6: User preferences for sharing of different types of annotations**

of the show. For example, they put themselves in the situations on-screen characters got into (“would you date him in an elevator?” – in the show, a character attempts to court another in an elevator). Participants were able to successfully converse online, using the show as a backdrop as well as conversation starter.

To follow up on these informal impressions, we queried all participants about the asynchronous mode of viewing in the final survey. We asked participants to consider two systems, one where their comments and interest points were only shown to synchronous viewers, and another where their comments and interest points were shown to both synchronous and later asynchronous viewers. Users strongly favored participation in the system that supported both communication modalities ( $m=3.5$ ,  $sd=0.85$  vs.  $m=2.07$ ,  $sd=0.83$ ).

## Sharing and Privacy

Any system that encourages social interaction in the form of users sharing their annotations would have to address the privacy concerns of users. In CollaboraTV, the privacy of all annotation types (comments, interest points and expressions) is handled in the same manner. At the onset, it was unclear if users placed different levels of sensitivity on these items. In the final survey, users were asked how they would prefer to be share their different annotations. The results in Figure 6 indicate that users generally consider comments and expressions to be more personal than interest points. When queried about the granularity of control desired in sharing comments, 57% preferred a global program setting that applies to all shows, while show or episode level granularity did not appeal to participants.

The most striking observation however, is that participants favor anonymously sharing their annotations globally, irrespective of the type of annotation, versus any other scheme of sharing. They even prefer to share annotations anonymously, over publicly sharing within their friend group. A strong bias towards anonymous sharing schemes is visible in Figure 6. However, this is not a blind bias, as participants also seem to care about sharing their comments with as many people as possible This can be seen in their preference of the ‘anonymous global’ scheme over the ‘publicly within group, anonymously globally’ scheme or even the ‘anonymously within group only’ which would seem the

most conservative of the schemes. Participants seem to desire striking a balance between their privacy and enriching the viewing experiences of others with their anonymous comments. The willingness of users to consider the social good and share bodes well for a system such as ours.

In CollaboraTV, a user’s buddy group defines who can appear in the virtual audience, and by extension, which people’s communication can be seen. When asked if they would prefer (a) automatic group placement, (b) the ability to select their own group, or (c) have both the previous options available, 71% of participants preferred the option with the most flexibility, namely (c), while the remaining 29% opted for (b). This result, although seemingly obvious, further confirms that users have a personal stake in the virtual audience, and care about whom they share the experience with.

## RQ3. Can friend networks present in social television systems be leveraged to help users choose what to watch?

At the start of our study, we had asked participants questions about how they plan (if at all) what they watched on television. 55% strongly disagreed when asked if they planned ahead on what to watch ( $m=2.63$ ,  $sd=1.15$ ). While users claimed to tune in to watch a specific show often (62%,  $m=3.63$ ,  $sd=1.02$ ), they also explained that they watched programs/films when it is convenient, rather than to see something specific for the majority of the time (56%,  $m=3.38$ ,  $sd=0.96$ ).

So when users do find a convenient time to watch some television, how do they decide on what to watch? Participants said that they mostly browse channels until they find something interesting to watch (51%,  $m=3.38$ ,  $sd=0.96$ ). This reiterates the popularity of the ‘channel surfing’ behavior as reported in previous research [21]. Based on these responses, and using the categorization described in [13] we found 25% of participants to be “watchers” or those who know exactly what they want to watch, and 50% to be “grazers” or those who generally channel surf.

Close to 90% of our participants watch only low to moderate amounts of television weekly. This minimal television viewing, coupled with the ad hoc “grazer” habits described earlier, could mean that users would likely not want to waste their precious viewing time channel surfing. CollaboraTV employs a simple, yet powerful method to help users select a show to watch quickly. Users can view two lists – PopularShows(Buddies) and PopularShows(All) – which are lists of shows that have been recently viewed by buddies or all system users respectively. The idea here is that when users are having trouble deciding which show to watch, they can turn to what their like-minded friends have been watching recently, or optionally pick a show that a lot of system users seem to be watching lately.

We asked participants if their viewing choices were influenced by those around them. More than half the participants said that they watched video content recommended by family, friends or colleagues ( $m=3.19$ ,  $sd=0.75$ ). Further, a fair number of them admitted to having watched content that others had been talking about or were the current media buzz ( $m=2.9$ ,  $sd=0.57$ ). These responses give credence to our recommendation technique.

At the end of the study, we asked users if they found the PopularShow lists useful. 57% ( $m=3.71$ ,  $sd=0.73$ ) strongly

agreed that the ability to see what others in their buddy group have been watching i.e. PopularShows(Buddies), was useful. In contrast, only 42% found the PopularShows(All) list useful. Despite responding positively towards the utility of the PopularShow lists, observing our usage logs revealed low usage in terms of users actually clicking on shows in these two lists. This could be because the lists are not very accessible in their current location inside the program guide. To make the recommendation method using these lists more effective, future versions of CollaboraTV will have a splash screen similar to those found in popular social networking site. Recent activity of buddies will be displayed, which in turn would encourage users to explore and interact more with the system. 62% of participants also said that they already share video content today (e.g. by sending a friend a link to a website). Such explicit behavior will also be supported allowing users to send and receive show recommendations.

As another approach to solving the show selection problem, we can use interest profile data for collaborative filtering based recommendation. Most contemporary systems rely on an overall rating (e.g. two thumbs up, five stars). Interest profiles, on the other hand, provide essentially a scene-level granularity. For some content, even finer grained feedback may be available, for example, the individual jokes and gags in a sitcom. With this level of detail and personalization (e.g. user liked this joke, but not that one), such recommendations could be more accurate.

## 6. DISCUSSION AND FUTURE WORK

In our study, we have taken the first step towards creating social television systems that support both synchronous and asynchronous viewing modes. Further, we have demonstrated the importance and utility of a rich set of communication primitives in recreating the social experience of viewing television with others, while also illustrating the value of receiving recommendations implicitly from other users. We now discuss the future implications of our work.

### Alternate Temporal Annotations

To provide us with future direction, we asked study participants to consider 3 alternative annotation categories (1) illustrations, where users could draw something on the screen, (2) audio, where users could record short voice annotations, and (3) video, where users could attach a video clip of themselves. 52% voted for a voice-based annotations, while 32% showed interest in illustrations. Video annotations did not seem to resonate with respondents (15%), which could be due to the overhead of maintaining a presentable countenance while watching television and loss of privacy in general.

### Integration with Social Networking Sites

In answering RQ3, we explored the potential of exploiting buddy networks within CollaboraTV for the purpose of making implicit show recommendations. The next logical step would be to tie CollaboraTV to popular social networking websites such as Facebook or MySpace that have open APIs for developers. We can imagine an application on any one of these sites that would display a visualization of shows that a user has been watching recently, allowing her buddies to discuss the show or even follow a link back to CollaboraTV to view a show that everyone is talking about.

## Show Highlights

Interest profiles can be used in several powerful ways. One application for the data is an interest-based media seek feature. Most media navigation controls provide the ability to skip forward and backward using a fixed-time step. However, by taking advantage of interest profile data, it would be possible to provide a skip feature that advanced users to the next section that was highly rated by previous viewers. Consider if this feature was available for a soccer game. The portions of high interest (as rated by previous users) are likely to be intense periods of game play, shots on goal, and actual goals. Using the interest-based seek feature, one would be able to progressively advance through the game, seeing only the most highly rated sections.

Another example is a feature that collapses programming down to a fixed time. For example, a user could ask the system to collapse a baseball game down to only the most exciting (i.e. highly rated) hits. This would be achieved by identifying the highest rated sections of the game, and reassembling them into a new (and shorter) program. This feature could also be applied to a genre of programs, for example, a sporting event, where the most highly rated plays of the day would be pulled out and synthesized into a custom game summary (Figure 7).

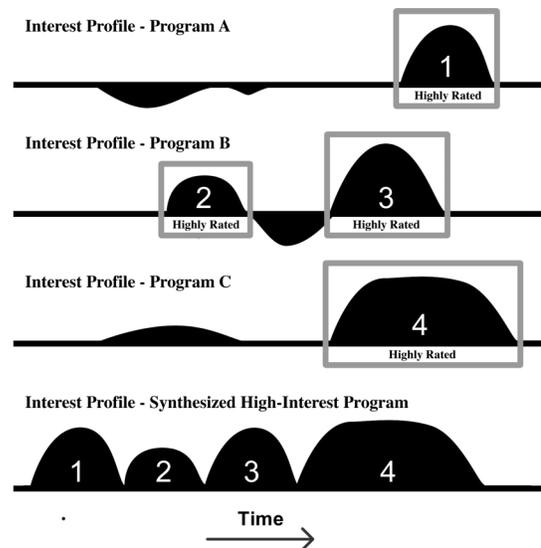


Figure 7: Highly rated sections from three programs are identified and synthesized into a new program.

## Show Recommenders

64% of users were willing to share their annotations with a show recommendation system ( $m=3.57$ ,  $sd=1.28$ ) to receive personal recommendations, while 57% were comfortable with sharing their annotations for the purpose of providing recommendations to other system users. This being the case, we could explore recommendation techniques based on user annotations. Implicit user feedback in the form of annotations can be used as a good substitute for explicit ratings. Such a method would do away with the issue of scarcity of ratings that many collaborative filtering-based recommender systems face.

## Limitations and Learnings

While having a set of participants who are geographically spread across the world provided an ideal setup for testing CollaboraTV, this was not without its shortcomings. Delivering instructions via email and following up with participants who we cannot meet face-to-face can be quite challenging. We believe that it would be more fruitful to have a set of users who we can meet in person at the beginning and the end of the period of study to learn first hand about their experiences with the system. Online surveys lack the ability to explore serendipitous questions and conversations that are possible with meetings.

We chose an open-ended model of running our experiment to observe realistic interactions and use cases that are hard to capture in manufactured lab settings. However, we realized that in order to study interesting user behaviors (e.g. synchronous and asynchronous modes of communication), we would have to engage with participants with specific tasks geared towards these behaviors. It is important to balance the freedom of using the system as one wishes with specific tasks and events.

## 7. CONCLUSION

CollaboraTV allows people to interact in synchronous, asynchronous, and mixed television-viewing situations. This unique ability offers users a unique way to communicate, and ultimately reconnect with friends, family and colleagues. Results from our field study reveal that the virtual audience was successful in engaging users and humanizing people who were remote or teletemporal. Users are enthusiastic about asynchronous communication and found value in receiving implicit show recommendations from their friends. Overall, we believe CollaboraTV achieves our goal of bringing people closer together, making the ever-present “electronic hearth” social again.

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