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How and Why Users Use Social TV Systems? A Systematic Review of User Studies

John Robert Bautista^{1,2}, Trisha T.C. Lin² & Yin-Leng Theng^{1,2}

¹Centre for HEalthy and Sustainable CItieS (CHESS), ²Wee Kim Wee School of Communication & Information,
Nanyang Technological University, Singapore
john0028@e.ntu.edu.sg; trishalin@ntu.edu.sg; tyltheng@ntu.edu.sg

Abstract

The development of social TV systems has gained momentum in the past decade. However, it is unclear how and why users use social TV. The goal of this systematic review is to identify trends in social TV user studies and understand how and why users use it following Geerts and De Grooff's social TV features. After searching for articles in major engineering and social science databases, we found 10 user studies that are mainly exploratory. They are predominantly qualitative and lack theory-based research and system design rationale. In general, users have positive reception on the usability and sociability of social TV systems despite expressing privacy concerns and insufficient control. Text chat is preferred than voice chat as a mode of communication. TV show genre and plot structures influence system usage. This review contributes to social TV research by offering a comprehensive understanding of social TV features that influence system usage.

1. Introduction

Social TV attempts to engage viewers by supporting social practices in TV viewing [1]. Its potential to revolutionize TV viewing has generated large industry and academic interests since its recognition by MIT Technology Review as one of the ten breakthrough technologies of 2010 [2]. The development of social TV systems for commercialization is driven by positive revenue forecast. One estimate suggests that social TV revenue will increase to US\$256 billion in 2017 from US\$151 billion in 2012 [3]. This review focuses on user research on integrated social TV systems which refers to audiovisual systems that allow distant or collocated TV viewers to communicate with each other by employing synchronous or asynchronous interpersonal

communication modalities, such as open audio or video channels, instant messaging, emoticons, etc. [4].

Despite the optimism associated with social TV's future, there is a lack of understanding on how and why users actually use social TV systems. Furthermore, although user studies have been conducted, there has been no attempt to synthesize findings from these studies. In a practical sense, understanding how and why users have used this technology will help promote the development of user-centric social TV systems. It is also worthwhile to review the research methods utilized in these studies in order to improve the quality of future studies. In response to these concerns, this systematic review aims to answer the following research questions: First, what are some trends in social TV user studies in terms of (a) author country and affiliation; (b) study setting and duration; (c) participant characteristics; and (d) data collection method and analysis? Second, how and why users use social TV systems? By answering these questions, this review hopes to shed light on the status quo of social TV user studies and discusses user-centric social TV features that influence system usage.

This paper is structured in five sections. The second section provides an overview of the systematic review process including the framework of analysis. The third section discusses the search and review procedure. The fourth section presents the results of the systematic review based on the research questions. In the last section, results are summarized to identify research gaps and provide practical and theoretical recommendations to guide future social TV research and development.

2. Related concepts

2.1. Systematic review process

Systematic reviews, which aim at summarizing results from a collection of previous studies [5], is

distinguished from traditional literature reviews in the sense that they utilize ‘systematic’ approaches to answer research questions. According to Khan et al. [6], a review is systematic if it is “*based on a clearly formulated question, identifies relevant studies, appraises their quality and summarizes the evidence by use of explicit methodology*” (p. 118). Results from systematic reviews are essential since they can provide recommendations to improve future studies in a particular area.

To the best of our knowledge, there has been no research that conducted a systematic review of user studies of social TV systems. Given the great potential of emerging social TV technologies, there is a need to understand how and why users have used them in previous studies. To guide our review, Khan et al.’s [6] recommendations were adopted by formulating specific research questions and identifying relevant articles. Moreover, the results were summarized under an appropriate framework which will be discussed in the next segment.

2.2. Sociability features for social TV

Conducting a systematic review requires the use of an appropriate framework in order to synthesize findings from multiple research studies [5]. In this review, we utilized Geerts and De Grooff’s [7] sociability features for social TV as the analytical framework. The features were developed through a grounded theory analysis of multiple data units (i.e. observations, surveys and interviews) collected from a series of preliminary social TV user studies. Overall, they have developed 12 sociability features for social TV (section 4.2 provides the list of the features).

Although Geerts and De Grooff’s sociability features were originally developed to assist developers to design social TV systems that support social interactions [8], it can also be used as an analytic framework for three reasons. First, their proposed features can be treated as benchmarks to compare results from various social TV user studies. Second, it provides a specific list of social TV functions that are likely to be utilized by users across different systems. Third, these features provide a basis to understand how and why social TV systems are used. Based from these justifications, these features can be validly used as a framework to analyze how and why users have used social TV systems in various user studies.

3. Search and review procedure

To answer the research questions, a systematic literature search was conducted in major social science

and engineering databases such as ACM Digital Library, EBSCO Host, IEEE Explore, Springer Link and Web of Science from November 2014 to January 2015. The literature search was limited to peer-reviewed articles or conference proceedings published from January 2000 to December 2014. Studies published before 2000 were not included as social TV development only gained traction from 2000 [9]. As this review focuses on social TV systems, the search string “social TV” OR “social television” was used to facilitate the literature search on each database. Overall, the search procedure yielded 729 citations.

The initial 729 citations were checked for duplicate titles. As a result, 685 citations were retained and underwent title and abstract screening. Among 685 citations, only 137 of those were found to be directly related to social TV. To narrow down the search procedure and to identify studies to be included in this review, the following inclusion criteria were used: (a) full text of the article was available; (b) text was written in English language; (c) a social TV system was described and used in the study; (d) and adequate user data were collected and analyzed. After filtering the studies by using the inclusion criteria, we only included 10 relevant social TV user studies published between 2006 and 2013 for the review (see Appendix 1 for details of each study). Figure 1 shows a flow diagram of the search procedure.

Figure 1. Search procedure

Ten studies were thoroughly reviewed in order to extract and synthesize relevant findings. To organize the findings in each study, the social TV sociability features [7] were used as the framework of analysis. Aside from social TV use and implications, we also

coded each article for relevant study characteristics (i.e. study setting and duration; participant characteristics; and data collection method and analysis) to identify important trends in social TV user studies.

4. Results

4.1. Social TV user study trends

4.1.1. Author country and affiliation. Majority of the social TV user studies were published by Western-based authors. Of the ten studies, five studies were from the United States of America [12, 14, 15, 18, 19] followed by four from European countries (i.e. Austria [17], Belgium [20], Finland [8] and Portugal [11]). Only one study in Japan [16] represented Asia. As there are few published studies from other regions, there is a need for careful generalization of research findings. For example, recommendations derived from studies utilizing Western participants may not be readily applicable in Asia due to socio-cultural and technological differences.

Interestingly, the studies were not only published by researchers from academic institutions. Specifically, five studies were published by authors from the industry (i.e. Motorola Labs [12, 18, 19], Motorola Mobility [14] and NHK [16]) followed by four studies from universities [8, 11, 15, 20] and one study from an independent research center (i.e. FTW [17]). One possible explanation on why industries engage in social TV research and development is due to the technology's potential for revenue generation [3, 10]. Please refer to Appendix 1 for more information.

4.1.2. Study setting and duration. Social TV user studies were mostly conducted in the field [11, 12, 14, 16, 18, 19] than inside a laboratory [8, 15, 17, 20]. Specifically, studies that were conducted in the field had participants that used social TV in their respective households. The choice of setting was influenced by the research objectives. For instance, studies that were conducted in the field aimed at understanding how participants used social TV in natural and less restrictive environments (e.g., living room) while laboratory studies examine participants' responses to certain social TV features in a controlled environment (e.g., experimentally compare usability between voice and text chat).

In terms of study duration, the median number of days for conducting the study was 11 days ($SD = 25.60$). However, there were differences in the duration of the study based on the setting. For instance, studies conducted in laboratories ranged within a day to a

maximum of 8 days ($Median = 1.5$, $SD = 2.9$) while, field studies have longer duration ranging from within a day to a maximum of 89 days ($Median = 24.5$, $SD = 27.9$). Appendix 2 includes more information.

4.1.3. Participant characteristics. The number of participants in each study ranged from 5 to 58 ($Median = 16$, $SD = 14.33$). There were not much difference between the median numbers of participants recruited for laboratory ($Median = 16.0$, $SD = 7.12$) and field trial studies ($Median = 15.5$, $SD = 17.47$). Loss of data was not prevalent among the studies except for Almeida et al.'s study [11]. In their study, only half of the 22 initial participants were able to answer the required questionnaire. Only one study [12] did not report their initial and final sample size.

There were variations in terms of the ages of the participants in each study. Following Petry's age classification scheme [13], most of the studies had participants that were young adults (aged 35 years and below; $n = 8$) followed by middle-age adults (aged 36-55 years; $n = 5$) and older adults (56 years and above; $n = 2$). Of these studies, some had participants that belong to two or more age groups [7, 14] while some focused in a single age group like young adults [8, 15] or older adults [16]. Only one study [12] did not specify the age range of their participants.

Of the ten studies, five studies used a mix of male and female participants [7, 12, 14, 17, 18] while two studies used male-only participants [8, 19]. The remaining three studies did not specify the gender of their participants [11, 15, 16]. Future research may need to fully describe their participants in order to understand the link between the results and user characteristics. Appendix 2 contains more information.

4.1.4. Data collection method and analysis. Most of the studies used multiple methods of data collection. Of the ten studies, five used three data collection methods [11, 14, 15-17] while three studies used two methods [8, 12, 19]. There was only one study utilizing either one [20] or four [18] data collection methods.

The studies used a diverse range of data collection methods. The three most utilized data collection methods were personal interview ($n = 9$), system log ($n = 7$) and survey questionnaire ($n = 4$). Other data collection methods include voicemail diary ($n = 1$), focus group ($n = 1$) and overt observation ($n = 1$).

The use of qualitative analysis was evident in most of the studies ($n = 7$) since most of the data were collected through personal interviews. Only a few studies used quantitative ($n = 1$) or a combination of qualitative and quantitative analysis ($n = 2$).

Most of the studies were conducted without any explicit use of theories to guide their research design

and social TV system development. Only few studies [12, 14, 19] used theory in the form of grounded theory to guide their methodology and data analysis. Appendix 2 provides more information.

4.2. How and why users use social TV systems?

Most of the studies featured a social TV system that was designed and developed by their respective authors. Only two studies [17, 20] used a social TV system that was not developed by the authors of the study. Specifically, both studies used *Amigo TV* which was developed by Coppens et al. [21]. Features of each system will be discussed in detail in the following segments. Appendix 1 shows the list of the system names, features and main study findings.

4.2.1. Feature 1: Availability of different channels and levels for communicating freely. There were three ways on how users communicated using social TV. These include voice chat, text chat and graphic symbolic chat (i.e. emoticons). Although some social TV systems were developed to provide either exclusive voice-only [12, 15, 20] or text-only chat [11, 14, 16], some systems allowed users to communicate using combinations of voice-and-text [19], voice-and-emoticon [17], text-and-emoticon [18] or all of the three methods [8].

In terms of preference, most of the studies focused on comparing text and voice chat. Accordingly, there was a gradual shift in the preferred communication channel through the years. Earlier studies found that users mostly prefer voice chat as it promoted greater social presence [12, 17, 20]. Another study suggested that the level of realism during voice chat led to more engaging conversations [15]. However, one critical downside of using voice chat is that it causes user distractions because it is difficult to shift attention back and forth between the audio from voice chats and TV shows [20]. Multiple users speaking at the same time also prove to be highly distracting [12].

Another reason that voice chat is distracting is that it is prone to technical glitches [12, 15]. In one study, a delay of more than three seconds for a voice message to be received can create irritation and distraction [15]. Other glitches may include unbalanced voice and TV volume [12].

In more recent studies, user preference to text chat is greater than voice chat despite that both can potentially distract users while watching TV [14, 19]. For instance, Huang et al. [19] found that only six voice messages were sent as compared to 1,287 text messages. The preference to text chat can also be evidenced through the development of social TV

systems that offer text chat as the only means of communication between users [e.g., 11, 14, 16, 18]. When comparing text and voice chat, users perceived the former to be less distracting [8, 17, 12, 19, 20] and easier to use while watching TV [19]. Others also indicated that text chat enabled message retrieval [14, 16, 19] and provided greater privacy [8].

4.2.2. Feature 2: Use awareness tools for communicating availability. Seven out of ten social TV systems described in the reviewed studies did not have a mechanism for users to identify presence or availability of other users.

Among the three studies that provided such feature [8, 15, 18], there were two ways on how social TV systems enabled users to identify other users' availability: on-screen and off-screen. On-screen tools involved the use of buddy lists [18] or avatars [8] that were displayed on the TV screen. These on-screen displays were developed to inform users that other people are currently watching TV shows through the social TV systems. Findings indicate that users greatly appreciate the use of on-screen awareness tools.

On the other hand, indicating user availability off the TV screen involved the use external devices that are connected to the social TV system. For instance, the use of ambient devices as an off-screen awareness indicator was demonstrated by Harboe et al. [18]. Specifically, they utilized an orb and "chumby" to provide users an off-screen visual method to indicate if other users were using the social TV. Their study suggests that ambient devices served as a first point of contact for users to initiate communication to other users. It also conveyed social presence; however, users felt that it lacks the capability to specifically identify other users that are currently using social TV. Other off-screen methods include the use of second screen devices such as mobile phones [15].

Between the two methods, the on-screen display can be programmed to allow users to identify online users and what specific TV shows they are watching [8, 18]. Nonetheless, the use of an off-screen method is a convenient method for users to check online social TV users. In cases where notifications are highly distracting to be displayed on-screen, second screen devices such as mobile devices can be programmed to display notifications.

4.2.3. Feature 3: Allow both synchronous and asynchronous use. Communication through social TV were mostly synchronous (at the same time) with other users. Only three studies had social TV systems that enabled both synchronous and asynchronous communication and all of them were systems that had text chat function [14, 16, 19]. Aside from

asynchronous text communication, these studies also enabled users to view past messages. Only Huang et al.'s [19] social TV system has the feature that allowed users to see the TV viewing history of other users.

Some studies found evidence on the social impact of synchronous and asynchronous social TV use. For instance, although users were not able to see each other while watching TV, several studies indicate that those who have used synchronous social TV systems felt virtual co-presence with other viewers while they were watching and communicating using social TV [8, 12, 17, 18, 19]. This result suggests that interacting with social TV while other users are currently using it can elicit social presence. Moreover, in the context of asynchronous communication, Basapur et al. [14] described an event called "pseudo-sociality" wherein users who had read earlier posts of their friends (who have already watched a TV show) felt some degree of social connection as they shared information even though their friends were not logged-on in the system.

4.2.4. Feature 4: Support remote as well as co-located interaction. Three studies [14, 16, 17] involved individual participants that were remotely located from each other when using social TV. In this set-up, there was only one participant that used the social TV in each location and they communicated with other participants remotely. On the other hand, most of the studies were designed to have multiple participants that used social TV simultaneously in both co-located (within the same room) and remote (different households/rooms) settings [8, 11, 12, 15, 18-20]. In Colaço et al.'s [15] study, one trial involved 8 male and female participants that were divided into two groups as such that there were four participants in each room. Another study involved 11 participants that were divided into three separate rooms to test how social TV was used by multiple users in multiple groups [8].

4.2.5. Feature 5: Exploit viewing behavior for informing and engaging other viewers. Only three studies characterized how viewing behavior can be used to inform and engage users [8, 18, 19]. According to Harboe et al. [18], using ambient devices (devices that flashes if other users are watching a TV show via social TV) served as a first-point of contact for TV-based conversations. The use of ambient devices also helped establish a social mindset for the TV as it indicated that other users are currently online. Similarly, creating a system where users are informed when someone is online provides useful cues to engage other users. Huang et al. [19] found that users felt more comfortable to communicate if their friends were marked as 'online' in the on-screen buddy list.

Otherwise, knowing what other users are currently watching was also helpful for others to decide whether or not to watch a particular TV show [8, 19].

4.2.6. Feature 6: Give the user appropriate control over actions and system settings. Most of the studies gave users very limited control on the use of social TV. In some cases, there were social TV systems that did not allow users to configure any setting [11, 15, 20] or were deliberately disabled [18]. Among systems that provided control, most of them gave users the ability to customize certain chat settings. For instance, giving users the option to select "on-off" or "always-on" voice chat improved viewing experience [17]. Similarly, being able to adjust the voice and television volume through a remote control solved the volume imbalance problems associated with voice chat [17]. Users also appreciated when they were given the freedom to use text or voice chat simultaneously [17]. Moreover, giving users the ability to control the visibility of their messages for different recipients was favorable [14]. On the other hand, malfunction in control settings tend to irritate users. For instance, Palviainen et al. [8] found that the use of virtual spaces caused irritation when users could not view TV shows in full screen mode due to a technical malfunction.

4.2.7. Feature 7: Guarantee both personal privacy and group privacy. Most of the studies did not have any finding regarding privacy concerns. In most cases, privacy settings were not part of the system design [e.g., 11, 15, 17, 19, 20]. Some had privacy settings but were deliberately disabled [18] or were not discussed in the study [8]. In the case of Harboe et al., [18], the system for users to disconnect from the social TV was disabled which prevented users to watch social TV privately.

Only three studies provided details on how certain social TV functions have an implication to user privacy. Harboe et al.'s [12] study suggests that the use of voice chat (as compared to video chat) provided a certain degree of privacy where participants have the option not to respond to others if they wanted to do so. Moreover, their study also revealed that the idea of using video chat was quite problematic as some users were not visually presentable while watching TV.

In another study, users appreciated being able to select to whom they could share their comments [14]. Specifically, they could choose to share content either to friends or to everyone. This enabled users to have flexibility in controlling privacy settings of shared comments. Finally, privacy settings also influence communication pattern over social TV. According to Miyazaki et al. [16], elderly users posted more comments in closed groups ($M = 3.8$) as compared to

users in open groups ($M = 0.4$); however, when users from the closed group were asked to participate in an open group, their average number of comments became lower ($M = 1.8$).

4.2.8. Feature 8: Minimize distraction from the television program. Distractions often result to a decline in the quality of TV watching experience [17, 20]. Most of the distractions related to the use of social TV were related to communication modes available to users (see 4.2.1 for the discussion). Aside from the mode of communication, distraction can also occur from other features of social TV systems. For instance, the ambient devices used by Harboe et al. [18] were configured to flash slowly thus preventing distraction due to sudden flashing. Next, the use of virtual spaces and avatars were distracting for some users as these features reduced the display area of a TV show relative to the TV screen [8]. The irritation caused by the virtual spaces also worsened when the controls to make the video in full screen did not work properly.

4.2.9. Feature 9: Notify the user of incoming events and situation changes. Only half of the studies have social TV systems that provided event and situation notifications. Results from these studies indicated that participants welcomed the idea of receiving timely notifications most especially when it informed them that other users were using social TV [8, 11, 15, 18, 19]. These notifications can be conveyed by using ambient devices [18], second-screen devices [15] or notifications shown on the TV screen [8, 11, 19].

Some studies offer interesting results on how notifications create an impact on TV viewing. For instance, the use of audio cues such as hearing the sound of a closing door was helpful to notify participants that other users were logging out of the social TV system [15]. Next, in the context of social TV games, Almeida et al. [11] found that users would look at “bet trends” first before deciding what to bet in a social TV game. This finding suggests that keeping users aware of what others are deciding during the game creates excitement and engagement in social TV games.

4.2.10. Feature 10: Adapt to appropriate television program genres. Majority of social TV systems in the studies did not have a function that responds to various program genres. Palviainen et al. [8] was the only one to develop a system that allowed customization of the TV screen based on program genres. Specifically, they created a “sports room” virtual space for users who were watching sports related TV programs. Another virtual space includes a movie theater when watching

other types of programs (e.g., drama, movies). Although the use of various virtual spaces was received positively, one disadvantage is that it reduced the screen size for video viewing on the TV screens.

Program genres also affected users’ preferences in using social TV. Among the six studies that asked participants on which genre social TV would be ideal to use, there is general consensus that it is well suited for a sports channel [8, 11, 15, 17-19]. Other suggested genres include quiz shows, reality shows, talent shows and news. On the contrary, findings from Huang et al. [19] indicated that users would not use social TV while watching movies or TV shows that require close attention and concentration (e.g., drama).

Some studies also showed that users adjusted their usage of social TV depending on the plot structures of TV programs. For instance, the use of voice chat peaked during a promising moment of a sports event [15]. Basapur et al. [14] found that viewers were more likely to use text chat when a TV show enters a low-intense plot moment (e.g., judges discussing participants and brief breaks in a football match). Others found that communicating using social TV was performed to relieve boredom during commercial breaks; however, its usage started to fade when the show resumed from the commercials [14, 18].

4.2.11. Feature 11: Let users share content flexibly. Most social TV systems in the user studies did not have any function that let users share content. This was due to the focus on testing the different usage of the systems while watching live [8, 11, 12, 14-16, 18, 19] or recorded TV shows [8, 14, 17, 20].

Only two social TV systems enabled users to share content [8, 14]. In Basapur et al.’s [14] study, users viewed 24% of the video clips shared by other users and most of them were viewed during commercial breaks or after the end of TV shows. Furthermore, their study showed that shared contents facilitated greater discussions among users as the social TV system became a platform for shared media (e.g., pictures and videos) that increased user engagement. Next, Palviainen et al. [8] also developed a means to share content on the social TV system by sending of URL links via text chat.

4.2.12. Feature 12: Encourage shared activities. Earlier studies used social TV systems that did not have any mechanism to encourage shared activities among users [e.g., 17, 20, 12]. In some studies, visual cues were helpful for users to, at least, start communicating with each other. For instance, the use of ambient devices [18], buddy lists [18, 19] and virtual spaces [8] provided visual cues (indicating user

presence) that encouraged users to communicate using social TV.

Other than indicating presence, shared activities were performed in various ways. Almeida et al. [11] found that social TV can be enhanced through gamification. Their findings indicate that incorporating games on social TV (i.e. placing bets related to an outcome of a reality show) was received positively by users and generated user engagement. Their study also revealed that users were more motivated to use the social TV because of the game element rather than simply using it to watch TV shows. User engagement can also be achieved by making social TV systems a one-stop hub for contents relevant to a particular TV show. According to Basapur et al. [14], using *FanFeeds* encouraged social activities by allowing users to share ephemeral reactions, knowledge, opinions and media content directly or indirectly related to a popular TV show.

Interestingly, providing other users' personal information was found to encourage users to participate in social TV-based communication. For instance, Miyazaki et al. [16] gave elderly users the capability to view other users' profile information and map of residence in their social TV system. Although it may seem to sacrifice users' privacy to some degree, providing such information helped create a sense of security which enabled elderly users to be familiar with other users. This in turn provided more confidence when communicating with others.

5. Discussion and conclusion

This review aims to identify current trends in social TV user studies and understand how and why social TV systems were used. Out of the 729 initial citations retrieved from the extensive search procedure, this study reviewed findings from 10 user studies published between 2006 and 2013. Overall, our review presented interesting findings that can guide future social TV research and development.

In general, our review suggests that social TV user research is in the early stage. This is understandable as social TV, as a whole, is still an emerging technology. To date, most of the reviewed user studies were western in origin. As social TV diffuse to other regions of the world, we anticipate that non-western user studies will also begin to emerge. It is also interesting to note that social TV user studies were mostly conducted by industry-based researchers. We expect that this trend will continue due to positive forecast on social TV revenues.

As an emerging field of research, most of the studies were exploratory in nature. This is evidenced

by the predominant use of qualitative research methods (e.g., interview, observation). Although qualitative research is generally useful to establish preliminary information on how and why users use social TV, future studies are advised to complement it with quantitative findings from large sample sizes. This is needed in order to validate qualitative findings and generate more generalizable results. Aside from methodological issues, most of the studies also lack theoretical rationale to understand factors affecting social TV usage. Theories that focus on understanding social interactions over communication technologies, such as social information processing theory [22] and social presence theory [23], can be used to understand how and why users use social TV. As such, this review calls for more utilization of theories when conducting user studies on social TV. Moreover, a multidisciplinary approach to research will improve the research design and benefit social TV user studies as an emerging and promising research area in the long term. Thus, we recommend developers and engineers to collaborate with social science researchers especially those with communication and information specialization.

Overall, users from the reviewed studies were positive with using social TV systems and some studies found qualitative evidences that such technology can promote social presence and user engagement [e.g., 8, 12, 17-19]. However, more research should be done in order to improve the usability and sociability of social TV systems. This review suggests that providing users with adequate control in all functions and features of social TV has a great impact on its usability. The improvement of controls in the design should be aimed at (1) reducing distractions while watching TV; (2) enhancing shared activities through seamless content sharing and synchronous/ asynchronous communication, (3) and providing multiple modes of communication that provides flexibility based on user needs and preferences. Furthermore, developers should identify various privacy concerns and offer users with settings to ease their worries. Future social TV systems should be designed for various types of users and scenarios. For instance, elderly users may need simplified interface design in using such system [16]. Most importantly, users should be able to enjoy excellent TV watching by themselves or with other users either in remote or co-located environments. In summary, these recommendations may need to be considered when developing future systems and user studies on behavioral use of social TV.

This study also found that the sociability features developed by Geerts and De Grooff [7] provided a comprehensive means to understand how and why

social TV systems have been used and how users respond to it. However, as these features were developed in 2009, it is crucial to integrate recent social TV-related technologies to make them relevant. For instance, multi-screen viewing through second screen devices (e.g., smartphones, tablets) seems to provide better ways of promoting socialization among users [e.g., 15].

This review has several limitations. First, this study examined social TV user studies by clustering results based on Geerts and De Grooff's [7] sociability features for social TV. Although some may argue that this approach is quite limiting, this review was able to synthesize large amounts of information about social TV system user studies in a systematic manner. However, we encourage that future reviews should provide an alternate interpretation of results. For instance, others may utilize Preece's determinants of sociability and usability [24] as the framework of analysis. Second, since this study primarily focused on synthesizing findings from users who have actually used dedicated social TV systems, this review did not include articles that depict other forms of social TV such as using social media (e.g., Facebook and Twitter) to interact while watching TV or videos [25]. For subsequent reviews, we recommend researchers to review studies related to this popular and fundamental form of social TV and make comparisons based on what has been found here. Third, considering that we only found 10 eligible articles for review, it is critical to note that the findings may not be highly generalizable to all forms of social TVs. Future reviews with different foci may need to include more articles as compared to what has been reviewed here.

To conclude, this paper provided a systematic review of trends in social TV user studies as well as uncovering how and why users use social TV systems. Despite of the limitations, this review contributes to social TV research by offering an understanding of previous user studies and discussing user-centric social TV features that influence system usage. The findings provide valuable insights that may inform how engineers as well as industries can create more user-centric social TV systems. Finally, more theoretically-sound and rigorously-designed social TV user studies are needed to narrow down methodological and theoretical gaps identified in this review.

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Appendix 1. Summary of social TV user studies

Author(s), date and country	Affiliation of author/s (name of institution)	System and features	Main findings
Geerts (2006) Belgium [20]	University (University of Leuven)	<i>Amigo TV with Windows Messenger</i> Amigo TV enabled users to perform voice chat while Windows Messenger was used for text chat.	Voice chat was considered more natural, direct and easier to use when watching TV. Text chat was preferred by younger users and users with more experience to online chat.
Bailie et al. (2007) Austria [17]	Independent research center (FTW)	<i>Amigo TV</i> Form buddy groups and perform chat via text, voice and/or graphic symbols (e.g., avatar expressions and emoticons).	Voice chat was preferred than graphic symbolic chat when communicating while watching TV. Users perceived that voice chats conveyed a comparable degree of joint TV experience and social presence as in collocated TV sessions.
Harboe et al. (2008a) USA [12]	Industry (Motorola Labs)	<i>Social TV (STV)</i> Voice chat via open microphones	Overall, the findings indicate that the family is still the primary unit for TV watching. The <i>STV</i> system enhanced family ties. <i>STV</i> is an ideal technology for families that are split up and separated by distance.
Harboe et al. (2008b) USA [18]	Industry (Motorola Labs)	<i>Social TV 2 (STV2)</i> Text and emoticon chat. Presence indicated through on and off ambient device or on-screen buddy list.	The ambient displays served as a first point of contact for TV-based conversations and helped establish a social mindset. <i>STV2</i> was not used just to consume entertainment but to engage in communication that enhanced socialization between people with strong or weak ties.
Huang et al. (2009) USA [19]	Industry (Motorola Labs)	<i>Social TV 3 (STV3)</i> Text and voice chat with on and off screen presence indicator through an ambient device.	Aside from being a system to discuss matters about particular TV shows, <i>STV3</i> facilitated personal and intimate conversations. Although <i>STV3</i> makes use of familiar components (i.e. text and voice chat, TV programming), the combination of these elements led to a sociability experience that is beyond the sum of its parts.
Colaço et al. (2011) USA [15]	University (Media Lab, MIT)	<i>Back Talk</i> Voice chat with auditory, visual and tactile engagement sensing.	Users appreciated using <i>Back Talk's</i> open audio channel. Listening to comments from remote viewers resulted in more engaging conversations and more group interactions.
Almeida et al. (2012) Portugal [11]	University (University of Aveiro)	<i>Wize</i> Play quiz and betting games on TV.	<i>Wize</i> was used for gaming purposes (e.g., earn points for prizes, compete with friends, knowledge testing) than watching particular TV shows. Users showed positive attitude towards the integration of social games on TV shows.
Basapur et al. (2012) USA [14]	Industry (Motorola Mobility)	<i>FanFeeds</i> Second screen web system (mobile phone) that allows authoring and consumption of time synchronized secondary content related to TV shows.	<i>FanFeeds</i> allowed users to better connect with their TV shows and have an enriched social life. Most interactions were through comments and replies rather than additional feeds (topics). Information availability, time-coded delivery and offline discussions led to “pseudo-sociality” around time-shifted content.
Miyazaki et al. (2013) Japan [16]	Industry (NHK)	<i>Simple Teleda</i> Second screen web system (tablet) that allows the elderly to select programs to watch and communicate using text chat.	Presence of acquaintances is an important stimulation of communication when using <i>Simple Teleda</i> . Communication stimulation by facilitators is positively correlated to program viewing, number of posts made per elderly, and number of elderly who post messages.
Palviainen et al. (2013) Finland [8]	University (Tampere University of Technology)	<i>Unnamed system</i> Second screen web system (mobile phone) with text, voice and emoticon chat. TV screen featured virtual spaces (movie theater, home and sports stadium) and user avatars.	The average rating about the sociability of the system was found high in a semantic differential questionnaire. The system supported co-presence experiences by combining chat (text, voice, and emoticon) with a presentation of virtual space (movie theater, home and sports stadium) and user avatars acting together in front of a TV/movie screen.

Appendix 2. Research design and methods utilized by social TV user studies

Author(s) and system name	Study set-up (location)	Study duration	Initial sample (final sample)	Age group (gender)	Data Collection						Data analysis
					Survey	Personal Interview	System log	Voicemail diary	Focus group	Observation	
Geerts (2006) <i>Amigo TV with Windows Messenger</i> [20]	Laboratory (University)	1 day	17 (17)	17-61 (mixed)		✓					Qualitative
Bailie et al. (2007) <i>Amigo TV</i> [17]	Laboratory (Research center)	1 day	30 (29)	20-35 (mixed)	✓	✓	✓				Quantitative Qualitative
Harboe et al. (2008a) <i>Social TV (STV)</i> [12]	Field trial (house)	4 trials; 1 hr/trial	19 (unspecified)	Unspecified (mixed)		✓				✓	Qualitative
Harboe et al. (2008b) <i>Social TV 2 (STV2)</i> [18]	Field trial (house)	2 weeks	10 (10)	26-53 (mixed)		✓	✓	✓	✓		Qualitative
Huang et al. (2009) <i>Social TV 3 (STV3)</i> [19]	Field trial (house)	3 weeks	5 (5)	30-36 (male)		✓	✓				Qualitative
Colaço et al. (2011) <i>Back Talk</i> [15]	Laboratory (University)	2 days	15 (15)	19-35 (unspecified)		✓	✓			✓	Qualitative
Almeida et al. (2012) <i>Wize</i> [11]	Field trial (house)	1 month	22 (11)	25-44 (unspecified)	✓	✓	✓				Quantitative
Basapur et al. (2012) <i>FanFeeds</i> [14]	Field trial (house)	4 weeks	12 (11)	18-55 (mixed)		✓	✓	✓			Qualitative
Miyazaki et al. (2013) <i>Simple Teleda</i> [16]	Field trial (Senior community)	89 days	58 (58)	≥65 (unspecified)	✓	✓	✓				Quantitative Qualitative
Palviainen et al. (2013) <i>Unnamed system</i> [8]	Laboratory (University)	8 days	11 (11)	23-32 (male)	✓				✓		Qualitative