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Scenarios of use for sociable mobile TV

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Abstract: Mobile TVs have been available for many years, without ever becoming very popular. Moreover, the first wave of research has been mostly concerned with technology and standards, which are necessary to ensure interoperability and market acceptance. Although, there has been a significant body of computer supported co-operative work (CSCW) and mobile human-computer interaction (HCI) research findings, there is limited investigation in the context of leisure activities, such as TV. In this article, we propose three concepts that drive the main paths for research and practice in mobile and social TV: 1) Mobile TV as a content format, 2) Mobile TV as user behavior and 3) Mobile TV as interaction terminal. Finally, we provide particular directions to be considered in further research in social and mobile TV.

Keywords: Interactive TV, mobile TV, computer mediated communication, social aspects

Introduction

One explanation for the slow diffusion of interactive TV (ITV) in the information society is that the difference between the broadcast and the telecommunications mentality has imposed an artificial distinction between content distribution and interpersonal communication. As a result, content has to be distributed and consumed through broadband, unidirectional and inflexible TV channels and interpersonal communication takes place over low-bandwidth bidirectional channels. However, the convergence of the telecommunication and content distribution platforms could be beneficial for viewers, as well as the commercial TV stakeholders. In addition, new devices and new types of content facilitate the emergence of novel consumer behaviors. In this article, we explore the interplay of these three concepts (device, content, behavior) in the context of mobile and social TV.

TV content gradually finds its way through Internet and mobile platforms. Besides triple-play services, which offer integrated access to voice, content and data services, there are opportunities for new services enabled by the mobile infrastructure. Indeed, the convergence of broadcast, mobile and data platforms has offered many opportunities for integrated content and communication services, which we refer to as 'social TV'. We define social TV as a socio-technical system that involves more than one user and networked audiovisual devices.

Previous definitions have been focused only on the technological aspects and ignored the fact that even traditional TV is inherently social. Nevertheless, the origins of traditional TV viewing is a social gathering event in the living room and not the isolated viewing typical of recent decades. For example, viewers compete mentally with quiz show participants, or between co-located groups. Moreover, viewers react emotionally to TV content, they record and share TV content with friends and discuss about shows either in real-time, or afterwards. In this context, it is necessary to not only pay attention to usability issues, but also to the social practices that surround TV viewing. Indeed, ethnographic and survey studies have documented the social uses of TV (Duchenaud et al 2008, Lee and Lee 1995), but they have not described the user requirements of applications that facilitate the social uses of TV. For this purpose, we explore the related academic literature, we identify the user interface requirements of those computer mediated communication applications that enhance the social dimension of TV.

The rest of the article is structured as follows. We begin with an analysis of the social uses of mobile TV. In Section 3, we outline the multiple roles of mobility in social TV. Finally, we describe the implication of such systems for practice and future research.

Social and Technological Aspects of mobile TV

This section explores the social and technological dimensions of TV and other related audiovisual media. In addition, we present a brief overview of technological support for TV sociability.

Social Value of TV

Although TV has been blamed for the reduction of social interaction within the family and the local community, there is a significant body of previous research that considers TV as a social medium, because it provides opportunities for shared experiences and group viewing. In particular, mobile phone applications that support sociability within families or distant groups might enhance the attractiveness of ITV as a leisure activity. This section draws on interdisciplinary literature and empirical research in order to raise the main research issues of the multiple roles of mobility within social TV.

Despite the many criticisms on the quality of TV content and on the passive nature of the watching activity, the social uses of TV have been documented in acclaimed research (Gauntlett and Hill 1999, Kubey and Csikszentmihalyi 1990). It has also been established that viewers have adapted TV in many ways to meet their everyday life needs (Lee and Lee 1995, Rubin 1983). The findings of these works frame a set of opportunities for the design of social communication services in mobile TV.

The majority of previous research on ITV has over-emphasized the benefit of increased choice of content and of the interactivity with content. Instead, a worthwhile effort would be the fulfillment of seamless communication over, or about televised content. Such services could support human connectedness (Agamanolis 2006) over a distance (e.g. synchronous communication over a TV program between diasporic households), or enhancement of the shared experience that comes with TV co-viewing. For this reason, we explore an integrated view of the interpersonal communication together with the shared experience of mass communication.

There is a growing academic interest on social TV systems, which consist of technological solutions for integrated interpersonal communication and content distribution. Although, there has been a significant body of computer supported co-operative work (CSCW) research on supporting interaction among geographically distributed co-workers, there is limited investigation in the context of leisure activities, such as TV. Similarly, research on interpersonal communication in the human-computer interaction (HCI) field has regarded video-mediated communication at work (Veinott et al. 1999). As a matter of fact, there is not much knowledge on designing applications for leisure or informal content-enriched communication.

Cross-media infrastructure

In the past, TV content in the living room has been provided either by broadcast, or optical discs, such as DVDs. A basic ITV system includes a set-top box (STB) that decodes the signal and provides processing and storage capabilities that enable interactive applications. Nevertheless, the disagreement on a common open middleware platform has been an obstacle for the development of sophisticated interactive applications that are independent from the STB hardware. On the other hand, there is agreement over the specifications for the digital video broadcasting (DVB-S/C/T/H specifications satellite, cable, terrestrial, mobile). Furthermore, TV content can be efficiently distributed over peer-to-peer (P2P) networks. In this way, the variety of video content has been increasing with the support of new Internet technologies, which allow new ways of distributing video (e.g., broadband connected TV set-top-boxes). Thus, ITV applications are neither limited to the traditional TV device and broadcast delivery, nor to the typical channels of satellite, cable, and digital terrestrial networks. Alternative and complementary devices

and distribution methods should be considered, such as mobile phones (mobile DTV).

Social TV builds upon the convergence between different technological infrastructure, such as broadcasting, telecommunication, and internet. The convergence has been realized in different forms. On the one hand, Internet content may be accessed through television Web browsers, or linked to ITV programs (e.g. interactive advertisements). Communication applications such as messaging, chatting, or voting during certain programs (quizzes, contests etc.) strengthen viewer's loyalty to the specific program. However, Internet access via television may disrupt current viewing patterns. Besides user interaction, at the network-level, internet connection facilitates video transfer over P2P networks. Moreover, the distribution of TV content over IP-based platforms, known as IPTV (Internet protocol TV), provides additional opportunities for the delivery of a wide variety of TV programming. In addition, 3G mobile networks could be used to distribute and control TV content.

Related research in the HCI and CSCW fields

One of the first approaches for a closer integration between TV content and social communication was the "Inhabited TV" research effort (Craven et al. 2000), which developed a collaborative virtual environment, where viewers could interact with other viewers or virtual objects. In this case, viewers were watching TV within the virtual environment and not within physical space. Thus, the TV experience was extended by enabling social interaction among participants and increased interaction with content. In an Inhabited TV application, the television becomes an actor and a part of a group interaction within a virtual online world.

There are various approaches to integrate social communication features into TV, such as chat, IM and email. There has been particular commercial interest on integrating the SMS into TV. Indeed, SMS TV is very popular, which is based on the familiarity with SMS and the availability of the technical infrastructure. Besides SMS services, there is a growing body of research and development, which is presented next.

Coppens et al. (2005) have reported the development of a 'social TV' system, but their description focuses on the technical details, the features and the potential of the system for end-users. The 'Amigo TV' system provides a technological platform for integrating content delivery, communities, and interpersonal communication (Coppens et al. 2005). In addition, the content of the broadcasts can be personalized by sharing personal photos and home videos. Amigo TV supports online user meetings and buddy lists. Interpersonal communication is based on voice, text, and video formats, as well as animated avatars.

Regan & Todd (2004) describe a system for messaging over TV content. The Media Centre Buddies system integrated TV technology into an instant messaging application. The main aim was to allow multiple users to log into an instant messaging client that was running next to a TV channel.

User generated and distributed content

TV content production has been regarded as a one-way activity that begins with the professional TV producers and editors and ends with post-production at the broadcast station.

As a matter of fact, television viewers have long been considered passive receivers of content, but a new generation of computer literate TV viewers has been accustomed to make and share edits of video content online. Furthermore, the wide-availability of video capture (e.g., in mobile phones, photo cameras, etc.) and easy-to-use video editing software (standard in many desktop computers), opens up additional opportunities for wider distribution of home made content (e.g., through peer-to-peer, portable video players, etc). User generated content and social communication about media content has been also proposed by Resnick (2001), who suggested that interactions could create productive resources, which he refers to as socio-technical capital. This capital may consist of artifacts created from the interactions or relationships and practices developed through repeated social interactions. Such capital can enable future social interactions.

Although most mobile media players are inherently personal devices, they offer several technological features that can transform the traditionally solitary media consumption into a social experience. Mobile and wireless technology open up opportunities for new, interesting social practices, where media consumption and sharing can take place in a variety of social, physical, and temporal contexts. Advanced mobile phones are equipped with digital cameras, multimedia processing and multiple mobile communication technologies (such as short or long-range, low or high-bandwidth). Since a mobile phone remains constantly with the user, it could potential store a large amount of details about social interactions. Then, search and sharing of media content could benefit from this social dimension of smart phones: the user could share audiovisual content with those related (in terms of place or terms of social proximity) without investing effort to select these people. TunA (Agamanolis 2006) is one example of a mobile application where users can tune in to eavesdrop on the playlists of nearby users and listen to the same music in a synchronized way.

Content-enriched interpersonal communication

Social TV systems offer one or more computer-mediated communication features, which are closely integrated with the TV watching experience. Computer-mediated interpersonal communication over distance, or over time could employ various communication modalities such as audio, text, video, photos, and non-verbal cues (e.g., emoticons, avatars). We refer to integrated content and communication services as 'content-enriched communication.' Content-enriched communication over a distance refers to two types of sociability: 1) synchronous, when viewers get together and watch the same show at the same time and 2) asynchronous, when viewers interact after the show has already been seen by each one, independently and at different times. Communication between spectators is real-

ized at two levels: 1) direct communication, such as chat or instant messaging and 2) indirect communication, such as cooperating in a team to win a quiz.

In brief, there are four basic scenarios of social TV (Chorianopoulos and Lekakos 2008):

- **Synchronous viewing over a distance:** This is probably the most interesting scenario, because the requirement it poses is to recreate the experience of co-located group viewing, when the viewers are located in two or more distant places. For example, distant viewers should be able to watch together popular social TV content, such as sports, quiz shows, series, reality shows. A good starting point is to consider ways to disclose presence and status of viewers, to continue with support for multiple interpersonal communication modalities (non-verbal most notably), and to summarize the social experience with automated highlight production, which could motivate further discussion and social bonding between the distant viewers.
- **Asynchronous viewing over a distance:** This is a feasible scenario if we consider that distance viewers might have very different time-schedules, patterns of daily life activities, or even live in distant time zones. Then, the probability of synchronous co-viewing is rather limited. In this case, a social TV system could record and share shows and viewing habits with the members of the social circle. In addition, a social TV system should allow annotation of content and recording of interactions, such as pausing, skipping, replaying and content browsing. In this way, each time a particular TV program is accessed, it keeps a trace, which is exploited at the next access, in order to personalize the content and most notably to provide a placeholder for interpersonal communication. This could be rather subtle, such as visual annotation of the content highlights, or could be more explicit such as audio and text comments.
- **Asynchronous viewing at the same place:** The main motivation for the development of social TV systems is based on the need to bridge the distance between social circles of people, but there is also the case that co-located groups of people do not manage to meet as often as they wish for a social TV night. A subset of the functionality that was described in the previous case might be the most appropriate here.
- In addition to the above, social TV designers should consider the **traditional TV watching scenario**, where a group of viewers gathers in the same place to enjoy a favorite TV program. Although this is a case that content enriched communication is least needed, there might be worthwhile benefits in employing a social TV system. In all cases, designers should consider extended functionality for user generated content. For example, the ability to upload personal music, photos and videos might be used to achieve communication through content. In particular, the au-

tomated production of personal TV channels that keep track of individual life streams captured with a mobile device (e.g. music, photos, personal videos) could be multiplexed with broadcast TV watching behavior. Indeed, Kubey and Csikszentmihalyi (1990) have found that everyday life experience is correlated with TV watching behavior. Thus, interpersonal communication could start with a screen displaying media use of each party during the past few days or hours. In practice, this scenario is rather feasible to implement, because the respective services have been very popular (e.g., YouTube, MySpace, Flickr, etc.)

Although mobile and social TV is thought to be suitable for the distant and synchronous communication scenario, there are several other opportunities. For example, multiple mobile terminals could be employed at the same place to control content on a shared big-screen. Moreover, user generated mobile TV content could be posted online and latter-on be annotated by other mobile TV users, when triggered by a particular location or other condition. This could create a kind of public “wall” mosaic of individual image sources being combined in a large-scale matrix that would be viewed by many people at once.

Scenarios for sociable mobile TV

In this section, we propose three main directions of mobile TV research, and we offer suggestions for future research and market developments. Besides TV watching on-the-move, mobile TV has significant potential, both as a personal TV set and as a tool to establish a closer interaction with the television programs (e.g., TV voting).

Mobile TV as a Content Format

Digital mobile TV systems have been designed to complement mobile networks with broadcast and multicast capabilities for spectrum-efficient delivery of multimedia services on mobile devices in both outdoor and indoor environments. In particular, the DVB-H standard is based on the widely deployed series of DVB standards (DVB-S/C/T) and includes enhancements for mobile terminals, such as reduced power consumption and reception while on the move. Although the technical standards are suitable for mobile TV reception, it is clear that mobile TV prospects should be examined not as an alternative but as a complementary service to traditional living-room TV. This is because the perceived quality of TV on a mobile phone and the solitary experience are not the favored mode of watching TV, at least with regard to popular living-room content formats (e.g. TV series, sports).

For some time television has been the only major media format that has been missing from mobile phones. Technological advancements in wireless broadband

(e.g. WiFi, 3G, 4G, DVB-H) and multimedia mobile terminals (e.g. multimedia mobile phones) have made a reality the reception of digital TV on the move. The distribution of TV content to mobile devices over broadband wireless raises the issue of video quality. Video quality depends on many aspects of the video encoding systems, such as bit rate and algorithms that model human perception of video on small screens. Most of the research on the effect of screen sizes in the field of consumer electronics has examined the impact of increasing the image size in the viewer's visual field by means of large physical displays or projection areas. The results show that larger image sizes are more arousing, better remembered, and generally preferred to smaller ones (Reeves et al. 1999).

There are many services that aim to provide users with audiovisual content while on the move. Although many of these services sound appealing, the end-users' subjectively perceived quality is an important factor for their success. The properties of video quality have many similarities between the different application domains (e.g., Internet, broadcast, etc.), but the characteristics of mobile devices define a special set of constraints. The biggest differences to other application domains are the limited bandwidth, which leads to high-level requirements of compression and the limitations of the mobile devices such as display size, power resources, processing capabilities and memory. In addition, the wireless transmission of the content is prone to errors. Accordingly, the production of video under these special requirements should regard the possible distortions in the subjectively perceived quality (Knoche et al 2008). For this reason, subjective quality evaluation tests during product development are necessary, in order to ensure acceptable quality of service. In particular, the subjective quality of service for mobile TV depends on the perceived audio-visual quality of the consumed content and the interaction through which the user has to go to access it (e.g., the delay between selecting content and start of play).

Further research in mobile TV should investigate authoring tools that enable automatic post-production of video that is targeted for viewing on the move. Currently, mobile service providers encode and deliver existing broadcast material and interactive applications without additional editing, because it is more cost-effective than re-editing. Future research should improve on intelligent cropping mechanisms that present only a part of the original shot. On the application side, cross-media multimedia authoring tools should consider the diversity of screen formats and sizes in mobile devices. Besides content adaptation, further research should investigate the uses of user generated content and provide templates that facilitate creation and distribution (sharing) of end-user content.

Mobile TV as User Behavior

Early studies on user behavior and mobile TV systems have indicated short watching sessions (Södergård 2003), which are suitable for particular TV genres, such as news and sports highlights, and music videos. More recent research by the same group (VTT, Finland), has tracked the evolution of mobile TV usage (Oksman et

al. 2007). They have identified that in mobile TV there is no prime time, only 'prime place', such as while commuting.

In contrast to living-room TV sets, which are shared displays for audiovisual content, mobile phones are natively social devices. Since their introduction, users have learned to use them as social connectivity tools, with voice-calls and text messages as basic functions. Therefore, the mobile TV user behavior might be shaped by established practices of interpersonal communications over a distance. Indeed, researchers have identified that for some users mobile TV might be a rather personal activity (Cui et al. 2007). In particular, they have identified that mobile TV is employed to privately watch content, at places and situations that are not socially appropriate for TV watching (e.g., business meeting, school lectures). They have also reported that mobile TV is also employed at home, when other TV sets are employed for different programs than the ones preferred by the mobile TV users.

Mobility means that content consumption takes place in various dynamic mobile contexts e.g., on the go, in the bus or at work, a direct contrast to the static embeddedness of living-room TV. Mobility thus means limited attention spans, but with increased user readiness for interruptions and interaction. Furthermore, mobile displays are considerably smaller than living-room screens. The consequence of these contextual factors is that the living-room TV is superior in creating immersive, passive media experiences. Mobile TV might never be able to lull people in the same way as high definition television, but on the other hand it allows for more interactive and intimate experiences. Although there is a significant body of research on sharing content such as photos and music through desktop and mobile media, there is not much research on video sharing through mobile devices. Therefore, further research should consider the practices of sharing user generated video content.

Mobile TV as Interaction Terminal

Mobile phones include some kind of standard and familiar input and output facility. The most common input device on a mobile phone is a simple numeric keypad, a few function keys and navigation keys. In short, in terms of input capabilities, a mobile phone is very similar to a common TV remote control. Some contemporary phones have removed the numeric keypad in favor of a larger touch screen, which might dynamically render a numeric keypad or many any other input arrangements depending on the application. Moreover, mobile phones feature media rich output capabilities, such as full-color high-resolution (in comparison to size) screens and audio support. As a matter of fact, the output capabilities of contemporary mobile phones are equal or better to early TV sets. In addition to user input and output devices, mobile phones have several data networking capacities. Text messages are a common standard in mobile phones and they have been successfully exploited by TV channel operators as voting and chatting input devices.

The use of the input and output facilities of mobile phones as alternative communication channels for TV programs (e.g. voting, chatting, TV on the move) has been a straightforward and expected development. Cesar et al. (2007) has explored the use of mobile multimedia touch screens to augment the living room TV experience. They have demonstrated that besides remote control, personal mobile terminals could provide additional content, as well as annotation of content. Mobile TV broadcasts transmit content to all mobile terminals within the footprint of a base-station, which is relatively narrow when compared with terrestrial broadcasts. The presence of multiple base-stations is the main advantage of mobile broadcasting, because the content could be personalized to fit both the terminal and the context of use (e.g., time of the day, geographic location).

Conclusions

Mobile and social TV applications could be feasibly offered through triple play infrastructures, which combine content delivery, voice, and data services. In this way, the network operator can provide interaction between the TV viewers on TV channels using an interactive broadband link. Triple-play services have been introduced on the assumption that telecommunication, content and data services could be delivered over the same technological infrastructure thanks to the convergence of the respective technological platforms. Although the convergence of previously distinct technological platforms is a significant benefit both for consumers and service providers, there are also additional benefits from a closer integration of platforms at the user-level. Content providers could be benefited by metered communication services, while telecom providers could be benefited by content distribution. In both cases, the users could gain access to intuitive content enriched communication.

In addition, mobile DTV infrastructure offers many opportunities for converged personal communication and content services. In particular, the availability of broadband wireless technology is rather suitable for the delivery of content enriched communication services (e.g. active content sharing, synchronous co-viewing or asynchronous notifications over a distance, discussion and annotations about shared content). Wireless network operators have invested in broadband licenses and infrastructures, but most of the services offered are only video communication, or only video on demand. The introduction of content enriched communication services is a worthwhile direction, because it offers an excellent balance between the basic need of users to communicate with a mobile device and the need of network providers for increased revenue by added value broadband services, such as mass media content distribution.

In further research, social TV should not only regard verbal and synchronous telecommunications. It seems likely in the future that being able to annotate video with one's comments will become as common as marking up a paper static text

document and handing it off to someone else to appreciate or use. Until recently, it has been rare to experience a movie with someone's verbal, and audio comments all over it. In upcoming social TV systems, comments could appear as speech or thought balloons over the imagery being viewed, or appear as sub-captions or in a panel below, like the crawling news headlines of standard broadcast video now. It seems likely that mobile multimedia terminal are a necessary user interface to perform content enriched communication tasks, because they offer both a relatively rich input system, as well as a screen sufficient for personal views on the content.

In summary, multimedia mobile terminals are essential elements of the next generation of social TV services. They are established social connectivity providers, personal media interfaces, content capture and sharing tools, and thus complement stationary interactive TV setups very well. The proposition of mobile TV has a major difference with the analog predecessor. Most notably, it has the potential to offer localized and interactive programs and not just the same broadcasts as seen in living-room TV. In conclusion, while counter-intuitive to many, the activities that happen during television watching can be a very sociable. Therefore, the ultimate objective is to develop technological support and content for the social practices that surround mobile TV viewing, while retaining the centrality of TV as a leisure pursuit.

References

- Agamanolis, S. At the intersection of broadband and broadcasting: How ITV technologies can support Human Connectedness, Proceedings of the 4th European Interactive TV Conference, 2006.
- Cesar, P. Bulterman, D.C.A., Obrenovic, Z., Ducret, J., Cruz-Lara, S. An Architecture for Non-intrusive User Interfaces for Interactive Digital Television. EuroITV 2007, pages: 11-20, Springer LNCS, 2007.
- Chorianopoulos, K. and Lekakos, G. Social TV: Enhancing the shared experience with interactive TV. International Journal of Human-Computer Interaction, 24(2):113-120, Taylor Francis, 2008.
- Craven, M., Benford, S., Greenhalgh, C., Wyver, J., Brazier, C., Oldroyd, A., and Regan, T. 2000. Ages of avatar: community building for inhabited television. In Proceedings of the Third international Conference on Collaborative Virtual Environments (CVE '00). ACM Press, 189-194. 2000.
- Coppens T., Vanparijs F., Handekyn K. AmigoTV: A Social TV Experience Through Triple-Play Convergence. Alcatel, White paper, 2005.
- Cui, Y., Chipchase, J., Jung, Y. Personal TV: A Qualitative Study of Mobile TV Users. EuroITV 2007: pages 195-204, Springer LNCS 2007.
- Nicolas Ducheneaut; Robert J. Moore; Lora Oehlberg; James D. Thornton; Eric Nickell. Social TV: Designing for Distributed, Sociable Television Viewing, International Journal of Human-Computer Interaction 24(2): 136 – 154, Taylor Francis, 2008.
- Gauntlett, D. and Hill, A. TV Living: Television, Culture and Everyday Life. Routledge, 1999.
- Girgensohn, A. and Lee, A. Making web sites be places for social interaction. In Proceedings of the ACM Conference on Computer Supported Cooperative Work. ACM Press, 2002.

- Knoche, H, McCarthy, J.D., Sasse, M.A. How low can you go? The effect of low resolutions on shot types in mobile TV. *Multimedia Tools Appl.* 36(1-2): 145-166, 2008
- Kubey, R. and Csikszentmihalyi, M. *Television and the Quality of Life: How Viewing Shapes Everyday Experiences.* Lawrence Erlbaum, 1990.
- Lee, B. and Lee, R. S. How and why people watch TV: Implications for the future of interactive television. *Journal of Advertising Research*, 35(6):9-18, 1995.
- Oksman, V. Noppari, E., Tammela, A., Mäkinen, M., Ollikainen, V. *Mobile TV in Everyday Life Contexts - Individual Entertainment or Shared Experiences? EuroITV 2007*, pages 215-225, Springer LNCS, 2007.
- Preece, J. *Online Communities: Designing Usability, Supporting Sociability.* John Wiley & Sons, Ltd., England, 2000.
- Reeves, B., Lang, A., Kim, E., Tartar, D. The effects of screen size and message content on attention and arousal *Media Psychology*, 1, p. 49--68, 1999.
- Regan, T. and Todd, I. *Media Center Buddies: Instant Messaging around a Media Center.* In *Proceedings of the Fourth Nordic Conference on Human-Computer Interaction.* pp. 141-144, ACM press, 2004
- Resnick, P. *Beyond Bowling Together: SocioTechnical Capital.* In J.M. Carroll (ed.), *Human-Computer Interaction in the New Millennium*, Addison-Wesley, New York, pp. 647-672, 2001.
- Rubin, A. *Television uses and gratifications: The interaction of viewing patterns and motivations.* *Journal of Broadcasting & Electronic Media*, 27(1):37-51, 1983.
- Södergård, C. *Mobile television - technology and user experiences Report on the Mobile-TV project (Rep. No. P506) VTT Information Technology*, 2003.
- Veinott, E. S., Olson, J., Olson, G. M., and Fu, X. *Video helps remote work: speakers who need to negotiate common ground benefit from seeing each other.* In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI '99).* Pp. 302-309. ACM Press, 1999.