Short Messaging Service on the Networked Television Environment

A Thesis
Presented to
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ABSTRACT

Television has long been a source of entertainment for the population. Recently, with the advent of interactive television (iTV), new features have been added to the current TV viewing experience to extend its experience in a more interactive way. For instance, subscribers to iTV now have access to information including sports news and information about the weather. They can also play along with their favourite game shows and cast votes. Shopping through TV is now a reality, with phone operators being replaced in favour of handling orders straight through an iTV application.

The iTV feature that this study focuses on is the communication activity between iTV viewers. TV viewers have traditionally communicated during and after TV programmes, using the contents of programmes to fuel discussions and maintain relationships. They might communicate face-to-face if they happen to be watching TV in the same location, or they might use appliances like the telephone as they are geographically distant. People now have the ability to communicate in real time through the TV thanks to iTV technology. This research consists of developing an application called TxtTV that offers this feature of real-time communication through the sending of instant messages.

Evaluation of the new iTV application was carried out by having people try out the application and also trying to communicate using the telephone and mobile phone while viewing a TV program. Usability data was collected then from a survey that asked about how the participants felt about the new application, a quiz on the TV programme contents to test understanding and a survey to measure cognitive workloads.

This data was used to make two investigations into the usability and usefulness of the TxtTV application compared to the telephone and mobile phone. The resulting analysis indicates that TxtTV or communicating in general using text messages through the television is a viable feature that could be important in the development in future iTV applications. A couple of paradoxes do arise and generally indicate that there are usability issues that have to be solved. Yet, the results are encouraging for human-to-human communication while watching TV.

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DECLARATION

I declare that this research study is entirely the product of my own work and that it has not been taken from the work of others. When the work and ideas of others has been used in the study, the work has been properly cited in the text.

This study has been adapted and is being revised in the journal "Computers in Human Behaviour"

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I also appreciate that major funding for this work was provided by Massey University, including the Massey University Masters Scholarship. Finally, I am grateful to my family for their continuing support in all that I do.

PREFACE

This thesis is concerned with the development of a new Interactive Television application for communicating between people while they are viewing television programs. The new application is designed to help enhance social interaction between viewers.

The thesis consists of 6 chapters. Chapter 1 introduces the new television environment based on the new technology named Interactive Television (iTV). Chapter 2 provides a background to the study with a description of the human-to-human communication issues in the current TV environment and introduction of a new TV design to address these issues. Following on this, Chapter 3, 4 and 5 intend to describe the experiment carried out to evaluate the new TV environment and outlay the investigations carried out based on the results. Finally, Chapter 6 describes the lesson learnt from this study.

This work took place during 2006 in the Institute of Information and Mathematical Science at Massey University's Albany campus. Dr Hokyoung Ryu supervised the thesis.

Chapter 1 Introduction

When someone arrives home after a day at school or the office, what household appliance might they turn on for some entertainment? It seems that the television is the very common appliance that most people turn on to spend some time. It is convenient and in general, watching TV is not a serious activity for a human to solely engage in. People might tune in to watch the news while they have their evening meal, or to relax and watch a movie at night. They might change the channel to one that plays music for background sound as they go about their other activities at home. Sometimes, there are television programmes which are documentaries on specific areas of interest to the viewer.

Traditionally, a conventional TV is largely an output device. The unique input that a viewer can provide to the TV environment amounts to changing the channel or adjusting the volume. In traditional terms, the viewer cannot interact with any of the TV programmes or interact with any other viewers in a different location through the TV set.

This has recently led to the advent of Interactive Television (iTV). Now, iTV viewers can interact with TV programmes that they are watching. Viewers can choose their contents to watch or play along with studio contestants in a game show, for example. Comparing this with the traditional TV environment, the question of whether or not we might have the same TV viewing experience arises. This establishes the main research theme of this thesis.

Basically, the current iTV technologies focus on delivering additional contents to viewers. For example, there has been a recent development of basic iTV functionality such as the "Red button" on the TV remote for SkyTV™ as shown below in Figure 1.1.

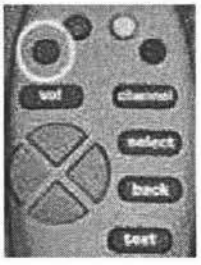

Figure 1.1 The "Red button"

Using this red button, users of BBCi (BBC's interactive TV service), for instance, have access to features including the latest local, national and international news, and a menu of multiple screens for video updates, all available 24 hours a day and up-to-the-minute sports news and results, plus a choice of coverage with extra live matches and alternative commentaries.

Yet, social interaction has not been paid much attention on the current iTV environment. Recently, this situation is changing with Microsoft developing sending instant messages while watching TV (Gizmodo, 2006). They have also integrated the chatting features into their products, i.e., Windows XP MCE and Xbox 360 Media Extender (Gizmodo, 2006). Still, the viewers are mostly interacting with the TV programmes but not with each other. Using the current iTV technologies is still an isolated TV viewing experience with the TV set, only including an interactive way with the programme viewing.

After all, the technologies for iTV have been advanced for years and the price does not represent a large barrier to adoption. Yet, the uptake of iTV has not been dramatic. A possible explanation for this is that iTV mainly provides human-to-machine interactions, thus making the television just another source of information. One could argue that a

personal computer is more adequate for this purpose already, e.g., TV on Computer. Another issue that blurs the line between iTV and a personal computer is the fact that the current TV controller has obvious limitations when it comes to entering text because there are only small numbers of buttons. Most iTV products require the viewer to use a keyboard, something that the viewers might find to be big and clumsy.

Following on this, the issue of how to support human-to-human interactions based on the current network environment is an interesting and timely question. Consider the pervasive use of technologies like e-mail and mobile phones even while watching TV. We can then consider extending the TV with iTV technologies to not just be another source of information, but as a way to communicate and connect with other people (Lull, 1980; 1982; 1990). This idea is not new. Even before that, communication is in fact happening now with regards to television programmes. During or after watching TV programmes, one might discuss the contents of the programme with family, friends or colleagues. One would assume that a portion of the communication about TV programmes is retrospective, that is, discussion about the programme contents generally happens after the programme has finished.

This research takes this idea further by proposing to implement communication tools on the TV using iTV technologies and to make the largest portion of the communication real-time, while watching TV programmes.

This study thus addresses how we can apply a networked TV environment to increase social interaction, and especially, human-to-human communication via a future TV environment. Also, and more importantly, usability issues will be identified. The following chapter provides a background to the study with a description of the human-to-

human communication issues in the current TV environment and introduction of a new TV design to address these issues. Following on this, Chapter 3, 4 and 5 intend to describe the experiment carried out to evaluate the new TV environment and outlay the investigations carried out based on the results. Finally, Chapter 6 describes the lesson learnt from this study.

Chapter 2 Background

This chapter first introduces how the traditional TV environment supports human-to-human communication (Section 2.1). Following on this, section 2.2 discusses the new TV environment and provides an overview of its development history, the technologies used and several commercial applications proposed. The question of how human-to-human communication is possible in the new TV environment is explored with some examples in Section 2.3. Finally, Section 2.4 concludes by introducing TxtTV, a new application that the author has developed. The main purpose of this chapter is thus to highlight the potential issues of human-to-human communication in the new TV environment and then to introduce a new TV design called TxtTV to support the human-to-human communication issue.

2.1 Introduction

2.1.1 Human-to-Human Communication in Traditional TV Environment

Traditional television is generally believed to be a passive environment where viewers cannot be highly interactive with the setting. Only simple interactions like tuning into various channels and tuning the volume are performed. Thus, the viewers with the traditional television can only have a very low-level of interaction with the TV set, following the "push" model that programmes and advertisements are provided to viewers by the broadcasters, without any uplink from the viewer to the broadcaster. It means that the current TV environment allows a one-way interaction between the TV and the viewer.

However, there are other styles of interactions with the traditional television environment, and that normally takes place between the viewers via the TV environment.

Gauntlett and Hill (1999) illustrate the current TV viewing experience in terms of communication with the excerpt shown below.

> "With my husband, we talk about all the programmes we watch – some only by a passing comment, but many more deeply... With our family, when we phone each other – we often mention programmes we have enjoyed to each other. Also if we spot anything forthcoming of interest we point it out" (*58-year-old female school teaching assistant*, p.128, Gauntlett & Hill, 1999)

The passage represents a social use context and clearly, the female school teacher is very willing to consolidate intimate relationships with her social contacts, i.e., family members, friends, or partners, through communication triggered by her past or present TV viewing experience. Lull (1980; 1982; 1990) defines this TV viewing experience as a way of establishing common grounds among viewers for their *relational uses* or *social uses* of TV, emphasising that viewers employ their TV viewing experience to facilitate communication, or at least, as a means to open up conversation. Himmelweit *et al.* (1958) also stressed the social use of TV, identifying that their interviewees with richer social ties would like to be more attracted to the contents that they would share later. Other studies posited the TV viewing experience as an effective human-to-human communication tool. For instance, Kubey and Csikszentmihalyi's study (1990) revealed that TV viewers are talking with their family members at home or their friends over telephones during around 60 percent of their TV viewing time. Furthermore, to some extent, they identified that the contents of communication are heavily reliant on what they

have seen or heard on TV. That is, they claimed that the current TV viewing experience mainly includes getting pleasure from TV contents they are watching (i.e., individual use) and making them further engaged in their social interaction situations (i.e., social use). Following on this understanding, Gray (1992) observed, based on several ethnographical studies, that a very important part of the pleasure of TV contents is to "gossip about them the following day" (p. 14). Morley (1992) and Palmer (1986) also concluded that the communication activity which derives from the current TV viewing experience is a critical part of our everyday lives. In effect, one of the key parts of the current TV viewing experience is thus to be able to communicate and share media experience within members of a social network. This line of literature raises an interesting issue of the future TV environment. As discussed above, the interaction between the current TV itself and the viewers is very limited; by comparison, the interaction (or communication) among the viewers seems to be common. This thesis thus intends to address this research question, whether future TV technologies can go along with supporting the human-to-human communication among the viewers.

An important note should be made here. Most of the early studies on the TV viewing experience, except Kubey and Csikszentmihalyi's study (1990), have considered the nature of the communication activity via the current TV environment as being retrospective, in other words, the communication activity happens later after viewing TV. Whilst it is very true, many communication activities, e.g., chatting with family members about the questions in a Quiz show, can also be done while they are watching TV. For instance, phone conversations while viewing TV, as Kubey and Csikszentmihalyi identified, are capable of communicating with someone beyond housebound. Even more

recent surveys on media uses (e.g., Miller, 2005) show that SMS (Short Message Services) texting and other user interactions in response to TV programmes have gained a lot of popularity lately in the current TV viewing experience. The new TV environments which are introduced in the next section accommodate these use cases with various technologies.

2.2. New TV Environments

Interactive TV (iTV) is recently revolutionising the way that viewers use their TV sets, allowing viewers to enjoy more interactive ways with the TV set, as shown in Figure 2.1.

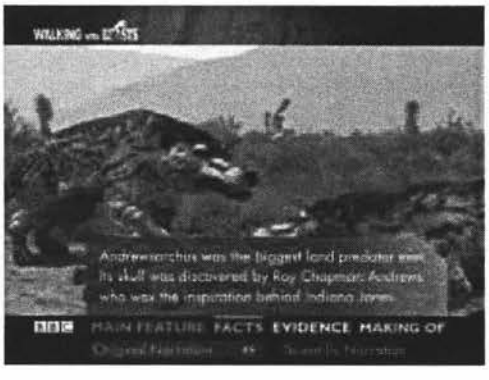

Figure 2.1 Interactive TV Programme

To do so, as shown in Figure 2.1, most interactive TV environments employ set-top boxes (STB) that are a computing device that processes (encode and decode) digital information. STB serves as a gateway between the TV and the broadcaster, allowing information to be received by the TV from the broadcaster and also supporting an uplink known as the "Return Path" or "Back Channel" from the TV back to the broadcaster.

Thanks to the STB, previously passive user experiences with the TV set have been turned into more active one. For instance, activities that viewers can perform with iTV currently include:

- **Interacting with Information**: At anytime, for instance, find out who an actor/actress is and more information about him/her. Viewers can also retrieve customised and localised information such as news, weather and sports
- **Commerce**: Provide shopping experiences directly on the TV without having to deal with human operators
- **Entertainment**: Participate in interactive betting and play along in quiz shows and enjoy standalone games on the TV, for example
- **Communication**: Send emails and photos to friends and family.

The following sections provide more details of these applications with some relevant commercial examples.

2.2.1. Interacting with Information

A successful example of an application that provides information on the traditional TV environment is *Teletext*. In the beginning of 1970s, BBC™ had kicked off a research activity of some ways to send closed captioning information to audience, in particular for hearing-impaired people. As the research continued they became increasingly interested in using the same system for delivering any sort of information, not just closed captioning for the TV programmes. Following on this research, the BBC news department put together an editorial team to develop a news and information service. Initially limited to 30 pages, the Ceefax™ service was later expanded to 100 pages and was launched

formally in 1976. It was followed quickly by ORACLE and Prestel service. Actual uptake of the development was limited until the first TV sets with built-in decoders started appearing in 1977, but by 1982 there were two million such sets, and by the mid-80s they were available as an option for almost every European TV set. Most televisions provide this functionality and using it, viewers have access to the information like upcoming TV programmes, weather forecasting, and so forth, as shown in Figure 2.2.

Figure 2.2 Teletext Front Page

Teletext has enjoyed a huge success and popularity mostly in Europe and one of the most important services it provides is the closed captioning information for some TV programmes. Closed captioning information is subtitles for certain programmes that have to be decoded by the television. Once decoded, subtitles are displayed for the programmes, helping people with hearing disabilities and people in noisy environments to understand the TV programme. However, Teletext does not allow a uplink to the broadcaster and thus the interaction with the TV set seems to be very limited.

More advanced iTV applications allow viewers to access more customised and localised information. For example, Sky™ New Zealand's "Weather Channel" is a

service, created in partnership with local data provider MetService. It allows viewers to access up-to-minute weather information including national and regional forecasts, radar and satellite maps, and other marine information, which they can personalise with the service. This leads a huge change in the traditional TV viewing experiences, in conjunction with swapping their passive TV viewing experience with a more active one, as shown in Figure 2.3.

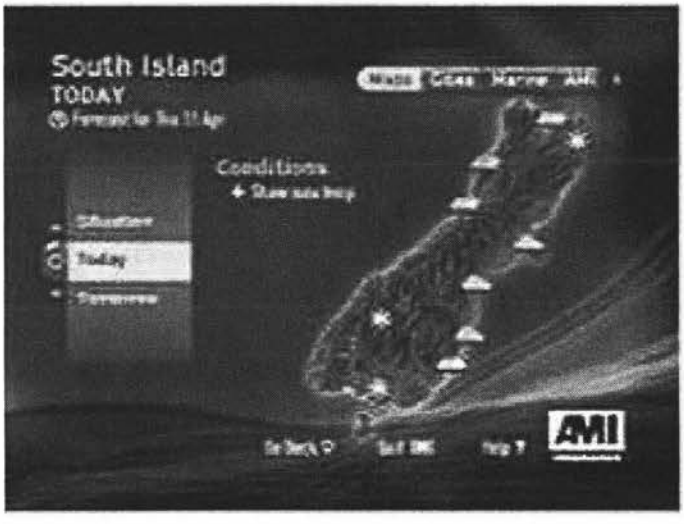

Figure 2.3 The "Weather Channel"

Another example is an application that the BBC offered to viewers during Wimbledon Tennis Championship 2001. The application featured the ability to access 5 video streams - 1 court per stream - at will. Millions accessed it over the SkyDigital™ networks. Using the application, viewers were not limited to viewing the current results of a single match, but all the matches. They could also choose which player to watch and change courts at will as shown in Figure 2.4.

Figure 2.4 Wimbledon 2001 BBC Service

In effect, this information perspective of iTV has been a significant issue in the development of the future ITV, but this has not made a huge spark to the customers. Providers of interactive services have to provide much more than just information features to their users. Entertainment could be argued as a more important feature, based on the traditional motive of being entertained when people turn on their TV sets. Following on this, some technologies from a business perspective have also been proposed to add more applications which are explored in the next section.

2.2.2. Commerce

Some ITV applications shed lights on the opportunity of T-commerce, where viewers can use their remote control to make purchases through their television sets. For instance, Home Shopping Network™ (HSN), a company in U.S.A is working with GoldPocket™ to develop software that works in existing digital set-top boxes to allow viewers to purchase some items on the TV set directly or indirectly. HSN™ brings up an interactive screen where viewers can make some purchases, clicking 'select' button on the remote

control (Grant 2005). Viewers who have already registered their credit card information with HSN by phone or the Web can use the application to purchase the item currently being showcased on HSN's linear broadcast, as well as the two items that were showcased immediately before it. They can also use it to purchase throughout the day whichever item is being featured as HSN's "Today's Special". This application replaces the TV programmes that advertise a product and require viewers to telephone a number and deal with a human operator.

2.2.3. Entertainment

The very first truly interactive TV program was the regular children's series, "Winky Dink And You" which ran from 1953 to 1957. Children should purchase special kits which contained a special plastic sheet that was attached to the TV screen and held in place by static electricity, generated by rubbing the screen with a special cloth that was included in the kit. In the show, a cartoon character would encounter many problems, like a tiger chasing him to the edge of a cliff. The show then asks children to help the cartoon character by using a special crayon to draw a bridge on the plastic screen, so the viewer could help the cartoon character escape from the tiger. The children would experience a form of interaction with the television contents, allowing an entertaining and educating experience. iTV has also made possible a number of additional features and applications to programs like quiz shows, allowing audiences to play along the contestants in the studio. For instance, on New Zealand's C4TV channel, the program "Select" shows allows viewers to send text messages to select the particular music videos that they would like to view, as shown in Figure 2.5. The host also sometimes takes telephone calls and

lets the caller make a request. This is a simple form of interactivity and is in fact employing a separate technology for the communication task. It might be possible to use the TV set itself in the future.

Figure 2.5 C4TV's "Select" Programme

Two Way TV™ has developed the first interactive cable television version of "Who Wants to be a Millionaire?" which is a very popular programme over the world. Subscribers to NTL™ or Telewest™ in the U.K. were able to take the hot seat at any time of day and play an interactive game based on the hit television quiz as shown in Figure 2.6. Interactive players will be able to ask the audience, phone a friend or take a 50:50 as they climb the money tree to the million pound question. The top three highest scorers each week will be guaranteed to win big cash prizes (Informitv, 2005).

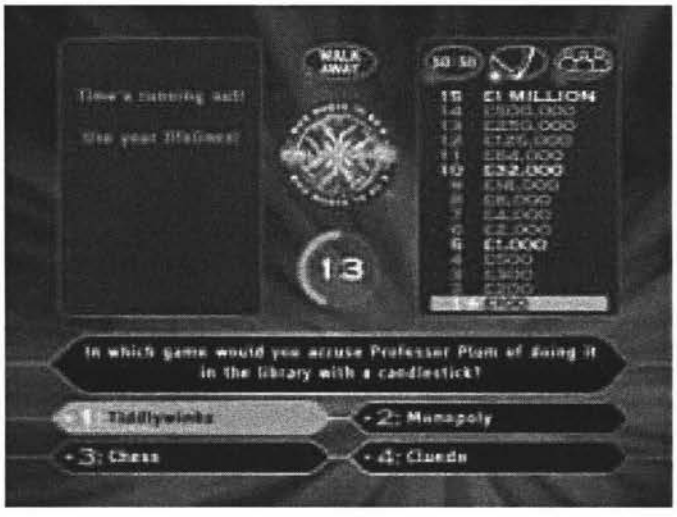

Figure 2.6 Interactive Game Show

Entertainment applications provide a large part of the functionality in the iTV environment but they have yet provided enough incentive for viewers to purchase iTV subscriptions en masse. The author supposes that this is because traditional technologies like the telephone and personal computers are still adequate for the entertainment aspects. Human-to-Human communication would be of great interest to potential buyers of iTV environment, which is the main research issue in this thesis. In the next section, we look at the last area of functionality that that is provided in the iTV environment.

2.2.4. Communication

In the iTV environment, the TV seems to be perceived as another PC environment with an internet connection The set top box replaces the personal computer "box" and keyboards are provided to perform tasks that can also be performed in the personal computers. For instance, Microsoft's MSNTV™, viewers can communicate with each other by emails or live chatting. MSNTV™ allows viewers to use broadband without

using their personal computers but this come with additional costs that could be seen as redundant and most people already own a personal computer. As communication via iTV is the main focus of this research, the following section will explore examples of communication applications in more detail.

2.3. A Possible Human-to-Human Communication in the new TV environment.

There have been proposed many ways (e.g., emails and chatting) to support human-to-human communication in the new iTV environment. The following sections will describe the different technologies that have been adapted to the TV environment and possible user interface issues will be discussed.

2.3.1 SMS

Short message service (SMS) is a globally accepted wireless service that enables the transmission of alphanumeric messages between mobile subscribers and external systems such as electronic mail, paging, and voice-mail systems.

In terms of human-to-human communication, viewers of a TV programme could employ texting to discuss the content of the programme with each other in the traditional environment. In New Zealand, certain TV programmes allow viewers to send SMS messages to the programme so the messages can be displayed at the bottom of the screen as a stream of text.

A drawback of this approach is for a viewer to pay too much attention to the messages displayed on the TV and inevitably missing some part of the TV program. On the other hand, a part of the TV program might be so interesting that the viewer focuses completely on it, thus missing out on a specific message from a friend. This "spray and pray" approach indicates that the human-to-human communication using SMS messages and the TV environment is more of a novelty, but is lack of directness. After all, if the viewers were serious about getting their message across to their friend, they could just use the traditional SMS service on their mobile phones.

Using mobile phones also implies another possible distraction. When composing SMS messages on the phones, viewers would have to take their attention off the TV programme, at least visually, and thus miss out on certain segments of the programme. Even worse, a viewer might have to keep switching their attention and focus from the programme to their mobile phone.

Given the issues, SMS messages combined with the new TV environment is not intended to support direct human-to-human communication. However, the widespread use of SMS is taking a place for the further TV environment. For example, MiXTV is a patent-pending technology that aims to employ messaging to drive applications like family games and quiz show channels (Miller, 2005). SMS messages will be used by viewers as input that is sent back to the broadcasters. SMS has much potential in the iTV environment for human-to-machine interaction and with an adequate improvement, such usability issues can be addressed. In fact, that is the main point of this thesis. The author aims to adapt SMS to the TV environment and endeavour to answer the usability issues outlined above.

2.3.2 Email

Email is one of the most common applications used in networked systems. Users compose their messages and send them off to the recipient to communicate. Companies like Microsoft™ and AOL™ have introduced products to bring, among other applications, email to the television environment.

MSNTV™ has a thin client (a device that does not handle much of the processing) that outputs on the TV screen. A keyboard is included as part of the system for input. Users can send and receive emails and photos. With this service, human-to-human communication can be achieved in the TV environment only to the extent that the TV is being used as an output device. However, viewers cannot use the email application while viewing TV programmes. It seems that MSNTV™ aimed more at replacing the functions of the PC in homes that are increasingly filled with appliances. According to Nielsen (1997), the iTV communication system is less useful without the keyboard as it is needed for email applications which he regards as the killer application of the Internet. Entering URLs is also a frustrating exercise without a keyboard. This brings the viewer closer to using the TV as a PC, and social interaction based on the TV programs does not really occur, at least not in real time.

Figure 2.7 MSNTV E-mail Application

2.3.3 Chatting

MSNTV™ also allows text chatting with other viewers. This text-based human-to-human communication via TVs is being widely shared in other types of the future TV technologies, e.g., AOL TV™. However, text-chatting on MSNTV™ or AOL TV™ does not allow people to continue to view the TV programme, leading them through a mode change from viewing to communicating. Also, an early usability study performed by Nielsen (1997), even though it was based on an early version of MSNTV™, showed that the text-chatting use was not a great user experience. Indeed, MSNTV™ is still perceived by most public as another form of PC use rather than TV viewing, in the sense that to use it properly, users should sit closer to the TV set (less than one metre is normal) with a wireless keyboard and mouse. The current TV viewing experience is basically "lean back" interaction, which means that one does not want to watch TV as if using a PC.

2.3.4 Summaries of Human-to-Human Communication

As discussed above, current technologies in the new TV environment do not support human-to-human interaction during the viewing of TV programmes. Usage of devices like mobile phones for SMS messages causes much distraction from TV programs and other technologies like MSNTV™ support communication but do not allow the continued viewing of the TV program. They also move further from the traditional "lean-back" TV viewing towards a more engaged usage of the TV set, something which viewers have resisted.

The question then is how current technologies that are adapted to the iTV environment can improved to better provide functionality for viewers to communicate during TV programmes and to lessen the dependence on traditional PC ideas about the user interface for input. A new application must be designed and then tested with potential viewers. This research question has led the author to design a new application called TxtTV.

2.4 Texting on TV: TxtTV

None of the new TV environments reviewed previously is able to support both TV viewing and human-to-human communication at the same time. The concept of TxtTV is based on the two assumptions that, firstly, a future Internet-based TV environment may be of interest to bring people together, enabling them to make use of the shared reference points while they are watching the same TV programme (AOL patents, cited in the New York Times June 28, 2004). It may help people to perpetually stay in contact with their

friends or family over a period of TV viewing time. The concept of TxtTV also supports the vision of a conversationally-based knowledge community. TxtTV provides activity support, where it sustains the initiation and conduct of social activity in digital media. In particular, TxtTV might support long running, deep and coherent conversations that can be steered by participants based on the TV programme content (Carroll, 2002).

Secondly, the concept owes much to the vast success of SMS on mobile phones. Of course, its success cannot be taken for granted in the other domains, but several sociological accounts propose potential application of text messages for the Internet-based TV environment. For instance, Ling (2004), Licoppe *et al.* (2001), and Ryu (2005) maintained that asynchronous text-based communication (i.e., SMS) is of value to enhance a broader and ongoing relationship between senders and recipients rather than highly attentive phone calls or chatting on PCs, so that subsequent communication is more easily reciprocated in their attitude. Further, it seems to be the most favoured communication style in relatively casual and informal situations that are closely equivalent to the current TV viewing experience.

(a) (b)

Figure 2.8 A Prototype of TxtTV (a) and the remote control for TxtTV (b)

To implement TxtTV, the WebTV™ and AOLTV™ environments were considered first. However, since it was not possible to develop code in them, an open-source interactive Java™ TV emulator – xletview (see more details at xletview.sourceforge.net) was used for the development of an experimental apparatus. To provide a realistic TV viewing setting, two 25-inch LCD-TV units, as shown in Figure 2.8(a), were set up in two separate rooms. Also, the remote control (Figure 2.8b) for texting was developed, with similar dimensions to the general remote controls used in traditional TV sets and the same layout with common mobile phones. In fact, while a cordless keyboard is adopted in most Internet-based TV environments the remote control was used here, since the experiments described below considered a naturalistic TV viewing circumstance being distinct from PC uses. The keypad layout on the remote control was similar to that of common mobile phones, so that one could compare the SMS use on mobile phones with

TxtTV. A pre-recorded TV programme from a VCR was synchronised between the two TV sets using the operating system's scheduling feature and a video player that would play the TV programme in full-screen mode automatically.

To exchange text messages on both TV sets, a simple mechanism was implemented over TCP/IP protocols. The two computers were connected using the campus wired network. Each computer was assigned a static IP address that was programmed into the TxtTV instance present on them. One of the computers served as a server that would receive messages and forward them to itself or the other computer.

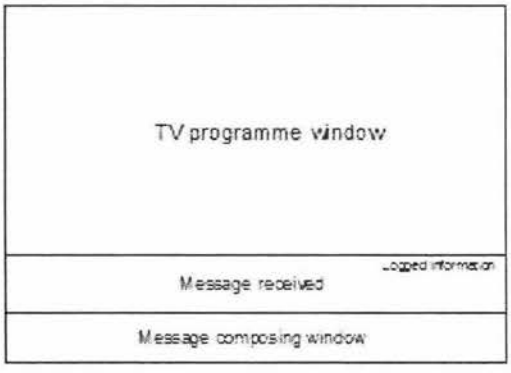

Figure 2.9 Layout of TxtTV

Figure 2.9 shows the screen layout of TxtTV. There are two message windows, i.e., the window for text messages received, and the window for composing text messages. In addition, there is logged information on the right, which shows the people who have logged to the Ethernet switching system. It is very similar to the "buddy list" in most chatting software. For editing text messages, TxtTV considered the multi-tap method. That is, the user presses each key one or more times to specify the input letter, e.g., the '2' key is pressed once for the letter 'a', twice for 'b', and three times for 'c', which is

currently the most common text input method for mobile phones. 'Times New Roman', as a font, is used, and the font size of the messages is 20 points for easier reading level at 2 metres distance from the TV set. Evaluation of the layout, according to the dialogue design guidelines (Sutcliffe, 1995), shows that there is adequate feedback when a message is sent and received. The status of the users is thus shown as being online or offline and the backspace button allows users to escape from a situation where they would make a mistake.

According to cultural diversity theory (Shneiderman, 1998), only English was available as the language for communication. There was also no consideration for how people of some cultures might read from right to left instead of left to right.

The intention of this research was to explore whether the text-based communication activity on TV could be effectively associated with the TV viewing experience without any significant difficulty-performance tradeoffs. If this is the case, then we seek to answer how a new TV environment can best serve this communication activity in terms of relevant usability issues.

To address this issue, the research aimed to measure the perceived system use and the usability. Two types of measures were chosen. The first type measures the subjective reactions of the participants to TxtTV along four scales. The second type of measures is quantitative, measuring the objective performance of the participants. These two different types of measures were chosen to achieve a more complete assessment of TxtTV. The effects were measured based on the independent variables of the three different types of communication system used during television viewing (TxtTV, SMS and telephone) and

the intimacy level of the participant pairs (close friends, acquaintances and people who had never met before). The subject of intimacy has been explored in various studies on mobile phone use. For example, in one study it was mostly young respondents who use the mobile phone to expand their circle of relationships (Pertierra, 2005).

The perception of the systems was measured on four different scales. Scale 1 was "The system added enjoyment and entertainment to my TV viewing", which measured how much enjoyment was added by TxtTV compared to other systems. It is expected that TxtTV would add the most enjoyment.

Scale 2, "The system made me feel closer to her or him", measured whether the same independent variables would enhance their social engagement through the system. It is expected that TxtTV will enhance the intimacy most. Scale 3, "The communication with him or her made me miss some TV contents", was intended to measure how much this communication activity would cloud the participants' perceptions of the television programme content. It is expected that using TxtTV would allow participants to comprehend more of the TV contents. Scale 4, "The system was very comfortable and easy to use", was a common measure for overall system usability. It is expected that TxtTV would be the most comfortable and easy to use.

While these four scales seem to be qualitative, this research also considered more quantitative measurements to determine the performance of the participants. The first measurement was the number of messages sent between the participants that were relevant to the program that they were watching. This was intended to measure whether the TxtTV would actually support the communication activity based on the TV

programme contents as opposed to everyday conversations. The second measurement was the comprehension of the TV contents which was performed using quizzes about the TV programme contents which were administered after the experiment. The final measurement was the workloads that the participants experienced during the experiment sessions. It employed the NASA TLX measure which is a multi-dimensional rating scale based on a weighted average of ratings on six subscales (Hart & Staveland, 1988).

2.5 Conclusion

This chapter has introduced the new TV environment and the new applications that have been provided to users and usability issues have been noted for the applications that support human-to-human communication. At the end, a new application called TxtTV has been introduced that attempts to address these problems. The next chapter focuses on how experiments are designed to test the new application with viewers using a prototype.

Chapter 3 Experimental Task

This chapter describes the setting and procedures for the experimental tasks that were carried out to evaluate TxtTV with participants. Section 3.1 first introduces the needs and purposes of the experiment and then Section 3.2 describes the participants recruited for the experiment. Following on this, section 3.3 and 3.4 describe the experimental setting and the experimental procedures respectively. Section 3.5 concludes this chapter.

3.1 Introduction

The experiments considered in this thesis were designed to let people try the TxtTV application described in Chapter 2. The main concern of the experiments was to explore whether the human-to-human communication while watching TV would be in the great interest of our participants. Therefore, the TxtTV usage was compared with using telephones and mobile phones to communicate during TV viewing. Participants would first use either telephones or SMS messages to communicate in the first session. This would serve as a control and a comparison with the TxtTV application which they would use in the second session.

The results from the experiments separately served the evaluation of TxtTV: the perceived usefulness of the system and the performance of the users. The former represents the kinds of behaviour expected of a user with the activity, whereas the latter provides analytic accounts by focusing on routine behaviour of doing the activity (Simon, 1988). These two aspects allow one to identify how a new technology achieves critical

user experience in the near future and eventually the acceptance of the new TV technology.

To explore perceived usefulness of TxtTV, after exposing TxtTV to the participants after one or the other control conditions, the participants' perception of each system was collected using five-point Likert scale. This approach has been well validated through many usability studies for predicting user acceptance and explaining system use of newly developing systems (Dadayan & Ferro, 2005; Davis, 1989; Mathieson, 1991). Performance was assessed with a wide variety of measures, depending on the contexts of the experimental task. The NASA TLX scale was chosen to measure the workloads of the participants.

The evaluation described in this section was suggested by one of the notions from Chapter 2, that points out the text-based communication activity in the current TV viewing experience might be useful to capture most TV viewers' interests in future TV environments. In this vein, texting on TV was predicted to present more enjoyable viewing, with less distraction from the TV programme viewed.

3.2 Participants

The participants were gathered from a class that the author's supervisor was lecturing in. Their participation was part of their assigned that involved learning how to conduct usability testing. 56 pairs were assigned randomly to the experimental setting of "Telephone use in viewing TV" and "SMS use in TV" in the first session. 41 pairs knew their partner prior to the experiment, whilst 15 pairs did not. In particular, 17 out of 41

pairs defined themselves as close (or best) friends. All of them had no experience of using Internet-based TVs. All the participants had a higher level of English proficiency in order to ensure their understanding of the TV contents and their communication activity in English. In terms of the demographics, the participants were all university students so their ages were mostly in the twenties. There was a mix of ethnicity and the majority of the participants were male.

3.3 Experimental Setting

Two rooms were set up for the participants to try a prototype of the TxtTV application. The TxtTV prototype was used to elicit information from the users, such as the necessary functionality of the system and the operation sequence (Preece, 1994). There was a computer in each room which had a network connection to the other. Each computer had a 25-inch LCD-TV unit to simulate a real TV viewing experience. To make it more realistic by emulating the TV environment more, chairs for the participants were set up 2 metres away from the screen. Each computer also had a keypad connected to it which represented a TV remote control. The decision to use a keypad which simulated a TV remote control as opposed to using a wireless keyboard was based on trying to differentiate the TV viewing experience as much as possible from computer usage. The keypad had stickers on the keys which provided a new interface to the user, one that resembles a mobile phone see Figure 3.1.

Figure 3.1 Modified Keypad

The telephones (Panasonic™ KXTG5632M) and mobile phones (Samsung™ MT200) were located in the separate rooms for the participants. Two Olympus™ S723 portable recorders were used to record the telephone conversations for subsequent analysis. Also, all the text messages exchanged on the mobile phones and TxtTVs were collected.

A pre-recorded TV programme was uploaded to both computers and synchronised to both viewers would always be watching the same part of the programme as the experiment session went on. Two different TV programmes were used to see if there was as effect from the type of programming watched. One programme was from the evening news and the other programme was from a reality TV show.

Instructions were prepared for the mobile phone usage and also the general experiment procedure for both the participants and the experimenter. Questionnaires for perceived usefulness were also prepared to see how the participants felt about using the

systems and the NASA TLX (http://www.nrl.navy.mil/aic/ide/NASATLX.php) was also loaded on both computers for the participants to complete. The TLX measures helped to gather information about the various workloads that the participants experienced. To see how much information the participants could retain from the TV programmes while communicating, a quiz which consisted of 10 multiple questions, 5 easy and 5 difficult in random order was formulated. This served to reveal the distraction level of communication activities while watching TV. More technical details about TxtTV can be found back in chapter two where it was first introduced. This could help with reproducing the experimental setting.

The system used for the experiment was not highly advanced so the experience might not be as realistic as we experience in the real world. For example, the remote control was not cordless as opposed to being wireless for a real TV remote control. Also, the free development platform (xletview) for the TxtTV application affected the features available. For instance, there was no way to make transparency on the text message box. This inevitably led to a loss of some screen estate for the TV programme. A final limitation was the screen used in this experiment, which were smaller than actual TV sets. However, the high resolution that the apparatus provided can help to even out the effect of having a smaller screen.

3.4 Experimental Procedure

The experiment consisted of two sessions: first and second session. The second session was held in one week after the first session. Contact was made with the participants

before the experiments for them to book two times on two different days. As described in the next section, the first experiment session had the participants experiencing the communication activities while they were watching TV.

3.4.1 First Session

In the first experiment session, the participant pairs were asked to communicate with each other while watching TV. They used traditional technologies like telephones and mobile phones.

Each pair of participants was first provided with the instructions regarding the experiment. These gave information about the experiment, the purpose of the study, and the data protection policy. Participants were told that this was an experiment examining how people could communicate over a TV set. To ensure that both participants were comfortable with the experimental condition as given a pre-trial session was made and they were given the option of withdrawing from the experiment.

The participants were told that the task was to communicate with their partner while watching TV and that their partner had the same view as they did. Also, they were told that they could send text messages, and call or hang up the phone whenever they wanted to. After each of the pair was entered into the separate room, the experimenters simultaneously turned on the two TV sets and started the recording devices.

After the participants had finished viewing the programme (which went on for about fifteen minutes), they were asked to complete the TLX survey, a paper survey about their attitudes to the activity and finally, a quiz about the contents of the TV programme they had just watched. The participants then selected a time for the next

session. They would have a week in between the sessions to minimise the learning effects of the first session.

3.4.2 Second Session

The second session had the participants use the TxtTV application instead. They were introduced to the system and were given a brief session to try it. The main session then began when the experimenters simultaneously turned on the TxtTV application, starting the TV programme and the facility for sending text messages. The messages were recorded by the application for subsequent analysis. At the end of the session the participants were again asked to complete the surveys and the quiz.

3.5 Conclusion

This chapter described the experimental sessions that would provide data for the two investigations of TxtTV: the perceived usefulness of the TxtTV application and the performance of the users. It should be noted that the samples chosen for the experiments do not represent the population as a whole. The participants were mostly male university students. This limitation will be further discussed in chapter 6.

Chapter 4 Investigation 1: Usefulness of TxtTV

This chapter describes the first investigation based on the data from the experimental tasks. Section 4.1 goes through the purpose of this investigation and then Section 4.2 details the investigation design. Section 4.3 presents the results and Section 4.4 concludes the chapter.

4.1 Introduction

The evaluation described in this section was suggested by one of the notions from Section 1, that points out the text-based communication activity in the current TV viewing experience might be useful to capture most TV viewers' interests in future TV environments. In this sense, texting on TV (TxtTV) was predicted to present more enjoyable viewing, with less distraction from the TV programme viewed.

The data was collected in a relatively naturalistic TV viewing context, staging with three experimental settings: *"SMS use in viewing TV"*, *"Telephone use in viewing TV"*, and *"TxtTV"*. In particular, the first two settings were control conditions to interpret the size of effects of the TxtTV setting. The experiment involved exposing participants to one of the experimental settings, controlled for TV contents and viewing time, and then asking them to give seven ratings on four questions. The experimental task involved pairs of participants, which asked them to communicate with their experimental partner while watching TV. The participants who used telephones were asked to hang up or call whenever they want. Likewise, the users of SMS and TxtTV were told to send short text

messages if they wished to do. In this way the author was able to examine how much each experimental setting was perceived to be useful and usable, simulating a naturalistic TV viewing circumstance.

The seven ratings likert scales assessed different aspects of the communication activity. Three statements assessed how much participants thought that the communication activity they did while viewing TV enhanced their current TV viewing experience: *'how much enjoyment was there '*, *'whether they found themselves being more intimate to their partner through the activity'*, and *'how much the communication activity was effective to view the current TV programme'*. The other question collected their negative feelings towards the communication activity, how *"interruptive"* and *"uncomfortable"* it was.

The purpose of this evaluation was thus to determine under what circumstances this sample of participants found the communication activity useful. To answer this question the ratings were analysed in terms of their absolute level, i.e., did the mean rating indicate agreement or disagreement. Indeed, a more plausible measure to address the question, e.g., how many times the participants communicated, was not considered in this investigation, but in investigation 2 instead. Analysis of variance was used to compare the size of the effects of the independent variables.

The following table shows the breakdown of the users into groups based on the system they used and their intimacy level with their partner.

Table 4.1. The nine conditions and number of participant pairs

		System			
		SMS + TV	Telephone +TV	TxtTV	Total
Intimacy	Close friend	5	6	6	17
	Acquaintance in the class	7	7	10	24
	Never met before	5	5	5	15
	Total	17	18	21	56

4.2 Experimental Design

The investigation design was a 3 by 3 between-subjects factorial. The medium used for the communication activity was the main between-subjects independent variable (SMS, Telephone, and TxtTV), and the social relationship of pairs (close, acquaintance, or never met before) was a between-subject nuisance independent variable. The nine experimental groups were formed by factorially combining the possibilities, given in Table 4.1. The dependent variables used the seven ratings as discussed above.

4.3 Results (Perceived system use)

Results are presented separately for each rating scale. Two questions were asked of these data: (i) under what conditions did the mean rating indicate general agreement, i.e., when was the mean rating above the neutral rating of 4.00, and (ii) how did the two independent variables, communication medium (Telephone, SMS, and TxtTV), and the

level of intimacy (close, acquaintance, and never met), affect the ratings. The former question was answered by inspecting the means. T-tests were carried out to assess whether each mean was significantly higher or lower than the neutral value 4.00. The latter question was answered by carrying out a two-way between-subjects analysis of variance. Levine's test for heterogeneity of variance was used to assess whether the assumptions of the analysis of variance were met.

Table 4.2. Mean ratings for Scale 1, 'The system added enjoyment and entertainment to my TV viewing'. A rating 1 indicates the participant strongly disagrees with the statement, a rating of 7 that they strongly agree (mean/s.d).

		System			
		SMS + TV	Telephone +TV	TxtTV	Total
Intimacy	Close friend	4.60 (1.51)	4.08 (1.62)	4.25 (1.42)	4.29 (1.50)
	Acquaintance in the class	2.79 (1.42)	3.71 (1.27)	4.50 (1.54)	3.77 (1.57)
	Never met before	2.40 (1.26)	2.90 (1.52)	3.80 (1.23)	3.03 (1.43)
	Total	3.61 (1.50)	3.21 (1.65)	4.26 (1.43)	3.73 (1.57)

Scale 1: "The system added enjoyment and entertainment to my TV viewing"

Scale 1 asked which TV viewing experience with the communication activity they used was most enjoyable, with TxtTV expected to receive the highest ratings as it presents a novel approach. Table 4.2 gives mean ratings for the three experimental settings across the three personal relationships. Looking at the figures in the total row and column in

Table 4.2, it can be seen that there is an effect of communication medium and intimacy. TxtTV (mean 4.26) gives the highest rating rather then the others, and the close friends (mean 4.29) seemed to have more enjoyment. A mean rating above 4.00 indicates that on average people agree rather than disagree with a scale.

A two-tailed T-test assessed whether the mean ratings were significantly different from 4.00, revealing that all the means are not significantly different from 4.00 except for mean ratings for TxtTV. This was further analysed by a two-way between subjects analysis of variance, giving main effects for medium and intimacy ($F_{2, 47} = 3.88$, $p<.05$; $F_{2, 47} = 6.29$, $p<.01$), but no higher order interaction effects. As noted above, ratings were significantly higher in TxtTV (mean 4.26) than the other conditions (mean 3.21 for 'SMS + TV' and 3.61 for 'Telephone + TV'). A Tukey test (at $p \leq .05$) also supported these observations.

It is striking that TxtTV is favoured in their enjoyment against both SMS uses and verbal conversations. A possible explanation for these results would be the novelty effect of TxtTV. Another account would be the fact that the difficulty of using SMS might be correlated with these ratings. Also, the lower ratings for the phone conversations while viewing television imply that the participants were more attentively conversing with their partner rather than both getting pleasure from the TV contents and making them engaged in their social interaction. Further accounts of these findings are considered in the discussion.

Table 4.3. Mean ratings for Scale 2, 'The system made me feel closer to her or him'. A rating 1 indicates the participant strongly disagrees with the statement, a rating of 7 that they strongly agree. (mean/s.d)

		System			
		Telephone +TV	SMS + TV	TxtTV	Total
Intimacy	Close friend	6.00 (0.74)	6.10 (0.74)	5.83 (0.58)	5.97 (0.67)
	Acquaintance in the class	4.93 (1.77)	5.64 (1.60)	5.20 (1.58)	5.25 (1.63)
	Never met before	5.10 (0.74)	4.50 (1.78)	6.10 (0.74)	5.23 (1.33)
	Total	5.33 (1.31)	5.44 (1.56)	5.60 (1.23)	5.46 (1.36)

Scale 2: "The system made me feel closer to her or him"

Scale 2 tested whether communication activities in the TV viewing experience enhanced the intimacy of the relationship between partners. It predicts all the media would be more likely the same in that this question only reflected their general perception of communicating while viewing TV. Indeed, this scale seems to be somewhat inappropriate, since it may be too subjective and often affected by other factors not considered in this evaluation, e.g., the pairs who are in love or the messages exchanged. However, it might tell us how much the benefits of the communication activities the participants saw in the current TV viewing experience. Table 4.3 depicts these means. All of them were greater than 4.00 (two-tailed T-tests), which reasonably indicates that the communication activity *per se* made people believe that they were getting more intimate communication with their partner.

A two-way between subject analysis of variance was not appropriate for these data as Levene's test for heterogeneity of variance was found to be significant ($F_{8, 47} = 3.49$, $p<.01$). A Kruskal-Wallis test was performed to compare the 21 pairs using TxtTV against the other pairs, i.e., collapsing across intimacy. This was not significant (K-W = 1.38, n.s). The same test applied to the intimacy also indicated a non-significant difference (K-W = 5.58, n.s). These results support the general benefits of human-to-human communication in the current TV viewing experience irrespective of both their relationship and the medium used. Also, the novelty effect of TxtTV does not seem to be sensitive in this scale.

Table 4.4. Mean ratings for Scale 3, 'The communication with him or her made me miss some TV contents'. A rating 1 indicates the participant strongly disagrees with the statement, a rating of 7 that they strongly agree. (mean/s.d)

		System			
		SMS + TV	Telephone +TV	TxtTV	Total
Intimacy	Close friend	5.90 (2.13)	6.42 (0.90)	4.58 (1.78)	5.62 (1.79)
	Acquaintance in the class	6.50 (0.65)	6.14 (1.09)	4.50 (1.47)	5.56 (1.47)
	Never met before	6.70 (0.48)	6.50 (0.85)	4.00 (1.21)	5.73 (1.55)
	Total	6.38 (1.26)	6.33 (0.96)	4.40 (1.52)	5.63 (1.58)

Scale 3: "The communication with him or her made me miss some TV contents"

Scale 3 was intended to assess general negative feelings about the communication activity in the current TV viewing. Table 4 depicts these mean ratings. Most of the

ratings were very high, i.e., above rating 4.00, indicating general agreement with this statement. Only the TxtTV condition consistently gives a low rating around 4.00 indicating neutrality with this statement (two-tailed T-tests).

Again, a two-way between subject analysis of variance was not appropriate for these data as Levene's test for heterogeneity of variance was found to be significant ($F_{8, 47} = 3.49$, $p<.05$). A Kruskal-Wallis test was performed. Despite these much higher ratings, the non-parametric test shows TxtTV is perceived as a significantly less distracting from the TV contents (K-W = 12.41, $p<.01$). Yet, there is no intimacy effect on Scale 3 (K-W = 4.22, n.s) either.

It is very striking that TxtTV is believed to be a less interfering medium to perform the task given rather than the telephone conversation. It is generally thought that the telephone conversation is a common medium that people normally use in their current TV viewing experience (Kubey & Csikszentmihalyi, 1990; Steuer & Hustedt, 2002). A possible account of these results would be that the telephone conversation requires more attention, so that participants might feel that its use is more disruptive to TV viewing. On the other hand, the participants with TxtTV were less sensitive to the communication activity, probably due to its asynchronous nature of communicating with a partner. However, this explanation cannot be applied to SMS use, because it seems to be the most challenging activity took their attention off the TV contents. More explanations of these findings will be discussed later.

Table 4.5. Mean ratings for Scale 4, 'The system was very comfortable and easy to use', for the three media of communication in the three relationship of the participants. (mean/s.d)

		System			
		SMS + TV	Telephone +TV	TxtTV	Total
Intimacy	Close friend	2.10 (1.29)	3.00 (1.71)	3.17 (1.64)	2.79 (1.59)
	Acquaintance in the class	2.79 (1.37)	2.64 (1.95)	3.35 (1.35)	2.98 (1.55)
	Never met before	1.70 (1.25)	1.90 (1.66)	3.40 (1.35)	2.33 (1.58)
	Total	2.26 (1.36)	2.56 (1.80)	3.31 (1.41)	2.75 (1.58)

Scale 4: "The system was very comfortable and easy to use"

Scale 4 was to directly test how comfortable the system was to use. The ratings for this question were uniformly low, indicating that none of the systems resulted in means ratings indicating agreement with this statement (see Table 4.5). The system coming nearest to a mean rating 4.00 was the TxtTV (mean 3.31), however a T-test indicated a non-significant difference.

Despite the much lower absolute ratings, the pattern of results is similar to that of Scale 3. A two-way between-subjects analysis of variance gave main effects for medium ($F_{2, 47} = 5.11$, $p<.01$), but not for intimacy ($F_{2, 47} = 1.40$, n.s). As these results parallel those for Scale 3, the lower levels of agreement appear to have reduced the sensitivity of the test to a degree where the effect of intimacy is no longer significant. There was no significant effect ($p >0.05$) from the television programmes viewed as well.

Even though TxtTV was generally rated better than the others, the participants perceived the communication activity itself as being less comfortable. These findings present something of a paradox. In both Scale 1 and 2, the participants clearly saw the benefits of the communication activity along with TV viewing; however, scale 4 response showed that they still felt that the activity was uncomfortable or difficult to use. One possible explanation of these results may be that the communication activity as the secondary task gives rise to negative attitudes toward the primary task (TV viewing), but it may be acceptable in terms of usefulness (Scale 1 and 2). This might be seen that critical user experience with future TV technologies seems to go beyond usability.

4.3.1 TV Programme Effect

Some consideration was given to the type of TV programme that was viewed by the participants. The participants viewed two different kinds of programmes for their first and second sessions, news and a reality show. A certain type of programme like the news could have given more opportunity for discussion and thus the increasing of intimacy between the participants in a pair. To investigate this, an analysis was done which showed that the means for the intimacy levels were similar for the two programmes used (3.46 for the news and 3.48 for the reality show). There was no significant effect of the TV programmes shown. Perhaps other kinds of programs like soap operas with an ongoing plot that a pair could communicate more about would have more effect on the enjoyment and intimacy level of the viewers.

4.4 Discussion and Conclusions

Firstly, the hypotheses of the experiment were reviewed by the scales that measured the perceived system uses. Scale 1 was to identify that TxtTV would add the most enjoyment to the TV viewing of the participants compared to the other systems. The results showed that this was true. The hypothesis for Scale 2 was that TxtTV would increase the intimacy levels more compared to the other systems. It was found that there is no significant difference in increase of intimacy levels when the three systems were compared. Rather, all three systems facilitated communication that similarly increased intimacy levels. The hypothesis for Scale 3 was that communicating using the TxtTV system would let the users watch and comprehend more of the TV programme contents. The outcome of the experiment confirmed this. Finally, the hypothesis for Scale 4 tested whether users would find TxtTV to be comfortable to use compared to the other systems. This was shown to be the case with higher ratings for TxtTV.

The main outcome to be drawn from these results is that certain levels of social communication activity can be effectively integrated to the current TV viewing experience. That means that highly attentive social communications like the phone conversation would not be well associated with the current TV viewing experience. This seems to contradict the early studies, e.g., Kubey and Csikszentmihalyi (1990), which noted telephone conversations as an effective social interaction tool over TVs. However, the verbal conversation was the unique way to communicating at that time of study, so it is not right to compare it directly with the results from this paper. This consequently implies a practical contribution of this experiment. Following on this account, text-

chatting on TV, as adopted in MSNTV™ or AOLTV™, might be less useful, since it appears to be a highly attentive and synchronous communication activity.

The pattern of results was broadly in line with the predictions made. In particular, TxtTV gains more favour from the participants. There are a number of possible explanations for these results. One is the novelty of the technology. The participants who used TxtTV might have been attracted by the new technology, and enjoyed it more as a result. Yet, this novelty effect of TxtTV was insensitive in the other questions, i.e., Scale 2, 3, and 4. Also, the participants saw that TxtTV could be a less distractive way of communication while viewing TV, hence it was easier to use and less distracting rather than the telephone conversation. Indeed, it is true that the SMS use in the current TV viewing experience would be the most challenging activity, but it is very striking that the telephone conversation is also perceived as another challenging one. This account seems to be contrary to what the multiple resource theory (e.g., Allport, Antonis, & Reynolds, 1972; Kantowitz & Knight, 1976) predicts. According to this theory, the telephone users can use two modalities to separately process two types of information (auditory modality for telephone conversations and visual modality to mainly process images from TV). Of course, while the auditory modality should process the verbal information from both the telephone conversation and the TV programme, the interference should be minimised over that of SMS and TxtTV, which mainly employ visual modality for both text messages and TV contents. The experiment described in this section cannot explicitly tell us how these results should be interpreted. It is only possible through more controlled experiments, and is beyond the scope of this paper. Another explanation could be the experimental task. In this experiment, the participants were allowed to use telephones at

any time, which intended to simulate a realistic TV viewing situation. Paradoxically, this naturalistic TV viewing situation made many of them (10 pairs out of 18 pairs) hold on the phone without hanging up in the whole experimental session. This means that they were more engaged in the communication activity (secondary task) rather than the TV viewing activity (primary task). This may account for the lower ratings for Scale 3 and 4.

Another empirical contribution of this research is that the participants appear to use the TV contents as a motive for their communication. Actually these data were not described above, because the telephone conversations were very poorly recorded, so that a further analysis on them was not possible. Yet, both the SMS data (16 out of 17 pairs) and messages on TxtTV (20 out of 21 pairs) clearly show that many users are using the TV contents as their communication motive, which is very much in line with the early studies on TV uses (Gray, 1992; Himmelweit et al., 1958; Morley, 1992; Palmer, 1986).

Even if this evaluation seems to be sufficient to guide a potential application for being adopted in the future TV environments, there would be difficulties in interpreting such a result like Scale 4. The following investigation directly assessed this issue, removing the problems found in this one.

Chapter 5 Investigation 2: Usability

This chapter describes the second investigation based on the data from the experimental tasks. Section 5.1 goes through the purpose of this investigation and then Section 5.2 details the investigation. Section 5.3 presents the results and finally Section 5.4 concludes the chapter.

5.1 Introduction

While the previous evaluation identified the relative usefulness of texting on TV over conventional ways of communication, it was still too implicit to tell if texting would achieve essential usability in future Internet-based TV environments. The evaluation in this section was designed to address this question, setting out three purposes.

First, it is to examine the mental workloads of each communication activity used in the previous experimental settings. The contention is that a user who uses TxtTV could have a lower level of workloads based on the results of Scale 4 in the previous evaluation. To test this contention the author makes use of the NASA TLX measure, not disturbing primary task performance (Hart & Staveland, 1988). Second, it is evident that to some extent the communication activity *per se* makes TV viewing hard. Scale 3 in the previous experiment indicated that TxtTV might be less distracting than the other two conditions. To reconfirm the assessment, the author used ten questions based on the TV programme that the participants had viewed, so that how much the communication distracted their TV viewing could be measured. Following this, finally, the level of engagement with the

communication activity while viewing TV was analysed. The experimental task forced the participants to comprehend the TV contents, but allowed them to communicate with their partner. Therefore, one can see how the participants recognise the communication activity in such a limited purpose, i.e., either whether they only concentrated on the TV programme; or whether they would like to communicate with their partner about the TV contents, or simply do their communication activity only. To do this the author was interested in measuring (i) how many participants engaged in the communication activity, (ii) whether messages exchanged were relevant to the TV contents, and (iii) how many messages were exchanged. They can partially support Scale 1 and 2 of the previous evaluation. An important note should be made in here. Telephone use seems to be the most convenient as opposed to SMS or TxtTV. It means that the simple analysis of the absolute figures may be of little interest to understanding human behaviour. Instead, a relative figure, i.e., the number of messages relevant to the TV contents out of the total messages exchanged, was investigated.

This investigation differed from the first one in three ways. First, the measures are not the same, which paid more attention to usability rather than usefulness. For the quiz questions, the two different programmes that the participants viewed were used. Another was that there is no consideration of intimacy between participants, since the previous investigation had already identified that the effect of social ties or relationships was minimal to determine the benefits of the communication activity in the current TV viewing experience. By manipulating these three aspects in this experiment, the author hoped to increase understanding of the issue in TV viewing.

5.2 Experimental Design

The experimental design was a one-way between-subjects factorial. The medium used for the communication activity was the between-subjects independent variable (SMS, Telephone, and TxtTV). The dependent variables were the number of messages relevant to the TV contents out of the total messages exchanged, quiz performance, and NASA TLX scales. For all the statistical analyses presented in all the experiment, the sampling unit was the participant pair. There were 17 pairs for SMS + TV, 18 pair for Telephone + TV and 21 pairs for TxtTV for a total of 56 pairs as shown in Table 5.1.

Table 5.1. The number of participant pairs

		System			
		SMS + TV	Telephone +TV	TxtTV	Total
Participant Pairs	Total	17	18	21	56

5.3 Results (Performance)

Number of messages relevant to the TV contents

Table 5.2 represents the data obtained from this evaluation. The dependent variable of primary interest is the proportion of messages relevant to the TV contents out of the total messages exchanged.

Table 5.2. Communication performance to the three experimental settings. (mean/s.d)

		System				
		SMS + TV (n=17)	Telephone +TV (n=12)	TxtTV (n=21)	$F_{2, 47}$	p
Perfor-mance	Number of pairs who communicate more than once	17	12	21	-	n.s
	Messages relevant to the TV contents/ Total messages exchanged (per cent)	70.23 (15.62)	45.24 (11.54)	65.75 (17.29)	4.21	<.05

F is the statistic computed to compare the three experimental conditions. p gives the statistical significance of this test

Looking at the first row, which presents the number of pairs who communicated with their partner more than once, it was clear that all the participants were engaged in the communication activity. This gives an insight of one side of human behaviour in the current TV viewing experience, even though the primary task was to comprehend the TV contents. This was not statistically analysed due to the ceiling effect.

Comparing the figures in the second row reveals there seems to have a considerable difference, i.e., text-based communication (SMS and TxtTV) tends to be more oriented to the TV contents they had watched. This was analysed by a one-way analysis of variance, revealing that they were significantly different. A Tukey test showed that the telephone condition was significantly lower than both SMS and TxtTV uses, which were not significantly different between each other. A possible explanation for these results would be cost-benefit trade-offs. It is very true that the efforts to use TxtTV and SMS are much higher than the verbal conversation, so that the participants sought to maximise the use of

text-based communication activity to purport their primary task, i.e., comprehension of the TV contents.

Comprehension of TV contents

Table 5.3 gives the mean performance of the ten questions about the TV programme that the fifty pairs had viewed. Comparing the figures reveals that the verbal conversation seems to be slightly higher than the other experimental conditions, but a one-way analysis of variance test showed this difference was not significant.

Table 5.3. Quiz performance to the three experimental settings.

		System				
		SMS + TV	Telephone +TV	TxtTV	$F_{2, 47}$	p
Quiz Result	Performance (max: 10)	7.41 (1.83)	7.77 (1.34)	6.86 (1.57)	2.76	n.s

F is the statistic computed to compare the three experimental conditions. p gives the statistical significance of this test

In conjunction with the previous results, even though many pairs were engaged in the communication activity, their comprehension of the TV programme was not quite hampered by the activity. This empirical data indicate that the task – watching TV is not a highly cognitive task, so it allows other activities to take place at the same time, which is very much in line with the early studies (e.g., Gauntlett & Hill, 1999; Kubey & Csikszentmihalyi, 1990). A practical contribution of this paper empirically supports the early studies. It also suggests that future TV technologies might consider the

communication activity as a usable function to associate with the current TV viewing experience.

Workloads

NASA TLX is a multi-dimensional rating scale that derives an overall workload score based on a weighted average of ratings on six subscales (Hart & Staveland, 1988): *mental demand, physical demand, temporal demand, effort, performance*, and *frustration* level. It can be generally used for an estimate of the attention demands of a task, considering the demand a task imposes on a user's resources (Proctor & van Zandt, 1994). Workloads could thus be conceived of as the inverse of usability (Fairclough, 1991). Table 5.4 summarises the data, together with the mean scores for the six workload items.

Table 5.4. Mean ratings of workloads for each measure.

		System				
		SMS + TV	Telephone +TV	TxtTV	$F_{2, 47}$	p
Workload	NASA TLX: Total (max:100)	64.46 (15.64)	57.89 (13.55)	51.18 (13.85)	8.00	<.01
	Mental demand	68.82 (16.00)	70.00 (19.89)	53.57 (20.43)	8.47	<.01
	Physical demand	43.24 (21.84)	35.63 (17.90)	45.71 (22.51)	1.75	n.s.
	Temporal demand	67.94 (21.78)	53.96 (20.16)	50.48 (17.87)	7.73	<.01
	Performance	59.71 (20.48)	58.33 (18.81)	56.19 (20.74)	1.04	n.s
	Effort	59.41 (23.48)	52.71 (20.38)	53.10 (13.92)	1.28	n.s.
	Frustration	62.21 (25.50)	47.92 (21.96)	48.69 (18.84)	4.40	<.05

F is the statistic computed to compare the three experimental conditions. p gives the statistical significance of this test

Overall, TxtTV seems to have the least workloads and SMS use while viewing TV is the highest. A Tukey test showed that TxtTV was distinct from the others that were not different from each other. In each workload item, one-way between-subjects analysis of variance was applied, resulting there are significant differences in terms of mental, temporal demands, and frustration. A Tukey test showed that, in terms of mental demand, TxtTV was significantly lower than the other two conditions which were not different from each other. Both the temporal demand and frustration were also analysed by Tukey tests, revealing that SMS use was significantly worse than the others that there was no difference between them.

5.4 Conclusions

The first hypothesis of this investigation was whether the number of messages sent which were relevant to the TV programme contents would be largest for TxtTV. The result was that TxtTV and SMS had significantly higher numbers of relevant messages compared to the telephone use, but were not significantly different between them. This implies that the benefit of TxtTV may be equivalent to the SMS use in a way of great success in communication activities. The second hypothesis was that the users of TxtTV would comprehend more of the TV programme contents compared to users of the other systems. Based on the results, users of all three systems performed fairly well in comprehension of the TV programmes. There was no significant difference between the systems which implies that all three systems do not cloud the comprehension of the users even though they are communicating at the same time. This may have been the case because the

participants would have communicated about the TV programme contents too, therefore increasing their comprehension. The final hypothesis was that TxtTV users would experience less workloads compared to users of the other systems. The results confirmed that this was true. This may be attributed to the design of TxtTV. For example, the messages were displayed on the screen together with the TV contents so the participants would not have to take their attention away from the screen to compose and read messages on their mobile phones. A final example is that the TxtTV messaging system resembles instant messaging where a delay is generally expected between messages whereas with telephone use, there is social pressure to continue the conversation at a constant and higher pace.

This section detailed the investigation into the performance of the participants in the experiment tasks. The 3 aspects that were looked into were the number of messages (relevant and irrelevant) sent, the comprehension of the TV programmes by the participants and the participants' workload. The results show that text-based communication (SMS and TxtTV) tends to be more oriented to the TV contents they had watched compared to telephone communication. The results also show that even though many pairs were engaged in the communication activity, their comprehension of the TV programme was not quite hampered by the activity. TxtTV is also shown as having the least workload associated with it. The next section discusses the limitations of the study and lessons learnt.

Chapter 6 Discussion

Newly developing TV technologies, e.g., Interactive TV, MSNTV™, AOLTV™, and IPTV, have been drawing attention to the connection between the Internet and the traditional TV environment, as a primary direction of the future TV environment (Miller, 2005). Most of them stressed the convergence as a fundamental need from the perspective of human-to-human interaction, allowing us to be able to chat or email on TV while viewing TV. However, the paradox of the convergence is that it may increase opportunities to create and maintain human-to-human interaction (social use of TV), but tends to overlook other TV use, i.e., individual use of TV. That means that communication activities on TV demand a set of engagements at various levels that differ substantially from the current TV viewing experience. It is the main motivation of this research.

6.1 Limitations of the Research

A basis for future work would be to address some limitations of this study. The main limitation would be the amount and variety of participants that would use the new system. Probably, the majority of the users (primary user group) would be the elderly who watch more TV and are isolated.

The system used for the experiment was not highly advanced so the experience might not be as realistic as we experience in the real world. As described in section 3.3, the remote control for the TxtTV system was not wireless. The other limitation was the

free development platform (xletview) that the TxtTV application was developed on. Features like transparency on the text message box were not available. This resulted in a loss of some screen estate for the TV programme. A final limitation was the screen used in this experiment, which were smaller than actual TV sets. This effect was compensated for as the screens used had a higher resolution compared to TV sets.

To address these issues in future work, testing should be done with an elderly group to measure their perceptions of the TxtTV system and their performance. Shneiderman (1998) found that elderly users who explored word processors and educational games felt quite satisfied with their performance and were eager to learn more.

A newer version of TxtTV could be developed on a commercial platform which would have more features available. A possible solution for the loss of screen estate used by iTV applications is called Enhanced TV where users of these services have their TV and computer in the same room, and navigate their web browser to a particular program-specific Web site that is synchronized to the live programme by the broadcast TV network (Ha, 2002).

6.2 Lessons Learnt

The apparatus devised for this paper provided a naturalistic TV viewing situation, but in the context of the different communication activities. Comparisons of the three configurations in this paper allow us to assess the potential value and issues of the communication activities available in this experimental context.

The first evaluation in this paper suggested texting on TV could enhance human-to-human communication, without disturbing the current TV viewing experience much. It was displayed in Scale 1 and 3 of Investigation 1. For Scale 1, the participants indicated that TxtTV provided more enjoyment to their TV viewing, compared to phone and SMS use. However, the enjoyment levels were uniformly average. A reason for this might be that the participants were so absorbed in the communication itself that this detracted from the enjoyment that they would receive from viewing the TV programme. Scale 2 was more encouraging for TxtTV, with the participants indicating that they were more likely to lose information when using SMS and telephones instead. A probable reason for this with respect to using the telephone is that while the participants could receive the visual information, the audio information from the programme was obviously competing with the audio information from their communications. For the SMS use, composing a message on the mobile phone would require the participants to direct their visual attention to the phone and probably their audio attention as well. The same thing would happen when they receive and read a message from their partner as well.

This extended TV viewing experience can let TV viewers interact with one another or with contents associated with the TV programme they have viewed by sending text messages that are displayed on the TV screen. Scale 2 shows this and also that current relationships between the viewers are also enhanced. This is the case for all the technologies used, which perhaps is because in general, communication between the participants increases their intimacy. Of note is that the highest values of increased intimacy come from close friends using telephones and SMS and people who have never before using TxtTV. Perhaps the close friends were already more accustomed to using

telephones and SMS to maintain their relationship so using TxtTV did not have that much of an impact. Also, it seems that using TxtTV provided participants who had never met before with a means to become more intimate. Perhaps the usage of the new technology itself was enough to increase their intimacy, disregarding the contents of their messages.

A real challenge that was identified is to meet user's needs and usability, which was reflected in Scale 4. The paradox exists where users enjoy the new system but find it uncomfortable to use. An explanation could be that the users did find the system difficult in terms of understanding the TV programme and communicating at the same time. However, overall they were satisfied based on the benefits of increased enjoyment and the increased intimacy level that using TxtTV provided. If the usability issues can be solved, there will be much more incentive to use the new application.

In terms of usability, the second investigation quantitatively confirmed the significant advantages of TxtTV over the other conventional communication ways. In particular, the workload was significantly less for users of TxtTV compared to the other means of communication. Users of TxtTV and the other technologies had no problems integrating the TV programme contents into their communications. The percentage of relevant messages for the telephone users was smaller, and this could come from convenience of the telephone. The participants would not have to give much thought to their messages and there is essentially no time needed to compose messages. The comprehension of the TV programmes was reasonably good for the participants using all of the technologies. However, another paradox appeared where the participants indicated less workloads needed when using TxtTV and comprehending the TV programme contents. Yet, their performance on the quiz to judge their comprehension revealed that

they in fact did worse then when they used the other technologies. A possible explanation for this is that given the novelty factor of TxtTV and the perception that it is a newer and thus better technology, the participants rated their workloads lower. This raises the fact the NASA-TLX scale is based on subjective results from the participants. This also ties in with the other paradox earlier to strongly suggest that there are usability issues that need to be solved. Still, the results for TxtTV in the mean time are encouraging, demonstrating the feasibility of text message-based communications during television viewing as a feature. None of these possibilities had been demonstrated empirically before, which implies a practical contribution of this paper.

Of course, other samples in other contexts may give different results and the generality of these results can only be tested by further studies. However, taken at face value, the results are encouraging. They suggest that as the text-based communication on TV becomes more familiar, and television users learn to use the communication applications, the benefits will be of much interest in light of the widespread use of SMS on mobile phones. That is, as texting on TV has entered popular consciousness and use, it may follow the same track as the development on mobile phones. One can view the measures taken by Scale 1 and 2 of Experiment 1 in this light. Finally, design and testing the right attributes of newly developing systems means leaving the laboratory and consideration for the system and its functions in the environments of real use. To do so the author extended Monk *et al.*'s usability testing technique (2004) to review the usefulness and performance of TxtTV in a naturalistic situation. The experimental method (combination of perceived usefulness and performance) demonstrated here provides a way of testing the new inventions and exploring the hypotheses set out above.

It is to be hoped that, by applying the method to other conditions and contexts, researchers can provide the insights needed to make the new technology more useful and usable.

6.3 Using Results for a Future TV Design

The results of this paper implies that social interaction seems to become a key factor that influences critical user experiences with new TV technologies (Roibas & Johnson, 2006). The assumption underlying this development is that TxtTV can be more usable by careful attention to both the social use of TV and the current TV viewing experience. In this light, texting on TV would have the place for the future development. Improvements would have to be made to make using TxtTV easier to use so that users would spend less time composing messages and thus miss less of the TV contents. Mental workloads would also have to be reduced for a more comfortable experience.

Yet, current developments of Internet-based TV, e.g., MSNTV™ and AOLTV™, seem to focus on a synchronous communication method as one see on PCs, i.e., text-chatting. A tentative answer for this approach would be negative because it intrinsically asks us to pay too much attention to the communication activity at the expense of missing all the TV contents, as the verbal conversations in the two experiments described above. Of course, to confirm this answer, many other studies that could be performed to increase our understanding of human behaviour are undoubtedly needed, which is planned for the near future.

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Appendix A - Instructions for Participant 1

Massey University

Experimental procedure: Participant A - John

Please follow the task procedure specified below. As you complete each step, please tick it off.

Practice Session One

1) Please take the remote control and sit down on the chair.

2) Please look at the remote control. This remote control is a prototype for the interactive TV system, so please accept this low-quality. This system uses the multi-tap method that is commonly used on cell phones.

2.1) When you press a key on the remote that has numbers and/or letters on it, you get the first letter shown on the screen.

2.2) If you press the same key on the remote again within a second, you will get the next letter shown on the key.

If you press the same key after one second instead, you will repeat the first letter on the key.

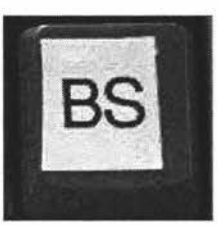
2.3) Please keep pressing the key on the remote until you get the number/letter that you want on the screen.

3) Please enter the username "JOHN" with the remote and press enter to complete the login process.

3.1) Press the '5' key on the remote to get the letter 'J'.
3.2) Press the '6' key on the remote three times within a second to get 'O'.
3.3) Press the '4' key on the remote two times within a second to get 'H'.
3.4) Press the '6' key on the remote two times within a second to get 'N'.

4) Please try typing in a few messages within the next 2 minutes. Whenever you have typed a message, press the enter key.

4.1) Backspace Key



If you have made a typo when inputting your message, you can use the backspace key to delete the letter before.

4.2) Case Change Key

You can switch between upper and lower case by using this key.

4.3) Space Key

You can use this key to insert a space before the next letter or number.

Main Session 1

Scenario: John and David are friends from university. John comes home from university one day and turns on the television to watch the news. He then logs into the chat system to see if anyone else is watching the news and is logged in too. John doesn't see anyone online on his buddy list so he continues to watch the news program.

David turned on the news at the same time as John but decides not to login. Instead, he prepares a sandwich in the kitchen while listening to the news from the living room. He then grabs his sandwich, sits down in front of the television and logs into the chat system. John is alerted by the chat system that David has just logged in and David sees that John is online on his buddy list. John and David then greet each other and begin sending messages to each other while watching the news program.

1) Please enter the user name "JOHN" and press enter to log in. You can change the case for any of the letter in the user name if you wish by pressing the Case Change Key.

2) Please continue watching the news program without sending any messages.

3) Please notice that your partner "David" has logged in and greet him.

    3.1) Enter your greeting message with the remote.
    3.2) Press the Enter key to send the greeting message.

4) Please use the chat system to communicate as much as possible with your partner "David" by sending more messages.

    4.1) Enter your message with the remote.
    4.2) Press enter to send your message.

Appendix B - Instructions for Participant 2

Massey University

Experimental procedure: Participant A - David

Please follow the task procedure specified below. As you complete each step, please tick it off.

Practice Session One

1) Please take the remote control and sit down on the chair.

2) Please look at the remote control. This remote control is a prototype for the interactive TV system, so please accept this low-quality. This system uses the multi-tap method that is commonly used on cell phones.

2.1) When you press a key on the remote that has numbers and/or letters on it, you get the first letter shown on the screen.

2.2) If you press the same key on the remote again within a second, you will get the next letter shown on the key.

If you press the same key after one second instead, you will repeat the first letter on the key.

2.3) Please keep pressing the key on the remote until you get the number/letter that you want on the screen.

3) Please enter the username "DAVID" with the remote and press enter to complete the login process.

3.1) Press the '3' key on the remote to get the letter 'D'.
3.2) Press the '2' key on the remote to get 'A'.
3.3) Press the '8' key on the remote three times within a second to get 'V'.
3.4) Press the '4' key three times within a second to get 'I'.
3.5) Press the '3' key on the remote to get the letter 'D'.

4) Please try typing in a few messages within the next 2 minutes. Whenever you have typed a message, press the enter key.

4.1) Backspace Key

If you have made a typo when inputting your message, you can use the backspace key to delete the letter before.

4.2) Case Change Key

You can switch between upper and lower case by using this key.

4.3) Space Key

You can use this key to insert a space before the next letter or number.

Main Session 1

Scenario: John and David are friends from university. John comes home from university one day and turns on the television to watch the news. He then logs into the chat system to see if anyone else is watching the news and is logged in too. John doesn't see anyone online on his buddy list so he continues to watch the news program.

David turned on the news at the same time as John but decides not to login. Instead, he prepares a sandwich in the kitchen while listening to the news from the living room. He then grabs his sandwich, sits down in front of the television and logs into the chat system. John is alerted by the chat system that David has just logged in and David sees that John is online on his buddy list. John and David then greet each other and begin sending messages to each other while watching the news program.

1) Please enter the user name "DAVID" and press enter to log in. You can change the case for any of the letter in the user name if you wish by pressing the Case Change Key.

2) Please wait for your partner John to send you a message and then reply.

2.1) Enter your greeting message with the remote.
2.2) Press the Enter key to send the greeting message

4) Please use the chat system to communicate as much as possible with your partner "John" by sending more messages.

4.1) Enter your message with the remote.
4.2) Press enter to send your message.

Appendix C - Instructions for Experimenter 1

Massey University

Experimental procedure: Participant A - John

Please follow the task procedure specified below. As you complete each step, please tick it off.

Practice Session One

1) Please take the remote control and sit down on the chair.

2) Please look at the remote control. This remote control is a prototype for the interactive TV system, so please accept this low-quality. This system uses the multi-tap method that is commonly used on cell phones.

2.1) When you press a key on the remote that has numbers and/or letters on it, you get the first letter shown on the screen.

2.2) If you press the same key on the remote again within a second, you will get the next letter shown on the key.

If you press the same key after one second instead, you will repeat the first letter on the key.

2.3) Please keep pressing the key on the remote until you get the number/letter that you want on the screen.

[Experimenter] Turn on the system
[Experimenter] "This is an interactive TV system we developed, which you can contact your friends while you are watching any programmes. Basically, you can use this system as a chatting tool, but it is more likely to facilitate your interaction with your friends"
[Experimenter] "This black box in the bottom is being used for your communication with someone"
[Experimenter] "On the bottom right, you can see the buddy list. If someone's name is blue, that means that he or she is online. If their name is red, that person is offline."
[Experimenter] "You are now watching an NZ tourism programme. This is a practise session where you can get used to the multi-tap method."
[Experimenter] "Throughout the experiment, you will be using the user name "John".
[Experimenter] "Now, please enter the user name JOHN. To do so..."

3) Please enter the username "JOHN" with the remote and press enter to complete the login process.

3.1) Press the '5' key on the remote to get the letter 'J'.
3.2) Press the '6' key on the remote three times within a second to get 'O'.
3.3) Press the '4' key on the remote two times within a second to get 'H'.
3.4) Press the '6' key on the remote two times within a second to get 'N'.

[Experimenter] "Now, you are logged in. Everyone on your buddy list is offline. You can see that all the other names in the buddy list are red."
[Experimenter] "This session is for you to practise the multi-tap method. Please use the next 2 minutes to try typing in messages."

4) Please try typing in a few messages within the next 3 minutes. Whenever you have typed a message, press the enter key.

4.1) Backspace Key

If you have made a typo when inputting your message, you can use the backspace key to delete the letter before.

4.2) Case Change Key

You can switch between upper and lower case by using this key.

4.3) Space Key

You can use this key to insert a space before the next letter or number.

[Experimenter] Wait for 3 minutes.
[Experimenter] "This session has ended so please stop using the remote."

Main Session 1

[Experimenter] "Next, we have the first main session. In this session, you and your partner will follow a scenario."
[Experimenter] "Please read over the scenario as the systems are being set up for the main session."
[Experimenter] Change the settings of xletview so that the program is the news video instead.

Scenario: John and David are friends from university. John comes home from university one day and turns on the television to watch the news. He then logs into the chat system to see if anyone else is watching the news and is logged in too. John doesn't see anyone online on his buddy list so he continues to watch the news program.

David turned on the news at the same time as John but decides not to login. Instead, he prepares a sandwich in the kitchen while listening to the news from the living room. He then grabs his sandwich, sits down in front of the television and logs into the chat system. John is alerted by the chat system that David has just logged in and David sees that John is online on his buddy list. John and David then greet each other and begin sending messages to each other while watching the news program.

[Experimenter] Start xletview and the chat system
[Experimenter] "Now as John, please log into the chat system."

1) Please enter the user name "JOHN" and press enter to log in. You can change the case for any of the letter in the user name if you wish by pressing the Case Change Key.

[Experimenter] "Please note that David is not online because his name is still red on the buddy list."

2) Please continue watching the news program without sending any messages.

[Experimenter] Sees that David has logged in.
[Experimenter] "Now you can see that David has logged in. Please greet him."

3) Please notice that your partner "David" has logged in and greet him.

3.1) Enter your greeting message with the remote.
3.2) Press the Enter key to send the greeting message.

[Experimenter] "For the next 8 minutes, please use the chat system to send messages to your partner "David".

4) Please use the chat system to communicate as much as possible with your partner "David" by sending more messages.

4.1) Enter your message with the remote.
4.2) Press enter to send your message.

[Experimenter] wait 8 minutes
[Experimenter] "This session has ended so please stop using the remote."
[Experimenter] give questionnaire to participant.
[Experimenter] "Now, please take about 5 minutes to fill in this questionnaire."
[Experimenter] Collect questionnaire from participant.
[Experimenter] set up NASA TLX program on both computers
[Experimenter] "Please complete the NASA TLX questionnaire"
[Experimenter] give participant the quiz about the program.
[Experimenter] "Please complete this quiz about the content of the program that you have just watched."

[Experimenter] Show the participants out.
[Experimenter] Prepare the system for the next participants by changing the TV program back to the NZ tourism one and changing the server setting so there is no connection between John and David.

Appendix D - Instructions for Experimenter 2

Massey University

Experimental procedure: Participant A - David

Please follow the task procedure specified below. As you complete each step, please tick it off.

Practice Session One

1) Please take the remote control and sit down on the chair.

2) Please look at the remote control. This remote control is a prototype for the interactive TV system, so please accept this low-quality. This system uses the multi-tap method that is commonly used on cell phones.

2.1) When you press a key on the remote that has numbers and/or letters on it, you get the first letter shown on the screen.

2.2) If you press the same key on the remote again within a second, you will get the next letter shown on the key.

If you press the same key after one second instead, you will repeat the first letter on the key.

2.3) Please keep pressing the key on the remote until you get the number/letter that you want on the screen.

[Experimenter] Turn on the system
[Experimenter] "This is an interactive TV system we developed, which you can contact your friends while you are watching any programmes. Basically, you can use this system as a chatting tool, but it is more likely to facilitate your interaction with your friends"
[Experimenter] "This black box in the bottom is being used for your communication with someone"
[Experimenter] "On the bottom right, you can see the buddy list. If someone's name is blue, that means that he or she is online. If their name is red, that person is offline."
[Experimenter] "You are now watching an NZ tourism programme. This is a practise session where you can get used to the multi-tap method."
[Experimenter] "Throughout the experiment, you will be using the user name "David".
[Experimenter] "Now, please enter the user name David. To do so..."

3) Please enter the username "DAVID" with the remote and press enter to complete the login process.

3.1) Press the '3' key on the remote to get the letter 'D'.
3.2) Press the '2' key on the remote to get 'A'.
3.3) Press the '8' key on the remote three times within a second to get 'V'.
3.4) Press the '4' key three times within a second to get 'I'.
3.5) Press the '3' key on the remote to get the letter 'D'.

[Experimenter] "Now, you are logged in. Everyone on your buddy list is offline. You can see that all the other names in the buddy list are red."
[Experimenter] "This session is for you to practise the multi-tap method. Please use the next 2 minutes to try typing in messages."

4) Please try typing in a few messages within the next 2 minutes. Whenever you have typed a message, press the enter key.

4.1) Backspace Key

If you have made a typo when inputting your message, you can use the backspace key to delete the letter before.

4.2) Case Change Key

You can switch between upper and lower case by using this key.

4.3) Space Key

You can use this key to insert a space before the next letter or number.

[Experimenter] Wait for 2 minutes.
[Experimenter] "This session has ended so please stop using the remote."

Main Session 1

[Experimenter] "Next, we have the first main session. In this session, you and your partner will follow a scenario."
[Experimenter] "Please read over the scenario as the systems are being set up for the main session."
[Experimenter] Change the settings of xletview so that the program is the news video instead.

Scenario: John and David are friends from university. John comes home from university one day and turns on the television to watch the news. He then logs into the chat system to see if anyone else is watching the news and is logged in too. John doesn't see anyone online on his buddy list so he continues to watch the news program.

David turned on the news at the same time as John but decides not to login. Instead, he prepares a sandwich in the kitchen while listening to the news from the living room. He then grabs his sandwich, sits down in front of the television and logs into the chat system. John is alerted by the chat system that David has just logged in and David sees that John is online on his buddy list. John and David then greet each other and begin sending messages to each other while watching the news program.

[Experimenter] Start xletview and the chat system
[Experimenter] "Now as David, please log into the chat system."

1) Please enter the user name "DAVID" and press enter to log in. You can change the case for any of the letter in the user name if you wish by pressing the Case Change Key.

[Experimenter] "Please note that John is also online because his name is blue on the buddy list."

2) Please wait for your partner John to send you a message and then reply.

2.1) Enter your greeting message with the remote.
2.2) Press the Enter key to send the greeting message

[Experimenter] "For the next 8 minutes, please use the chat system to send messages to your partner "David".

4) Please use the chat system to communicate as much as possible with your partner "John" by sending more messages.

4.1) Enter your message with the remote.
4.2) Press enter to send your message.

[Experimenter] wait 8 minutes

[Experimenter] "This session has ended so please stop using the remote."
[Experimenter] give questionnaire to participant.
[Experimenter] "Now, please take about 5 minutes to fill in this questionnaire."
[Experimenter] Collect questionnaire from participant.
[Experimenter] set up NASA TLX program on both computers
[Experimenter] "Please complete the NASA TLX questionnaire"
[Experimenter] give participant the quiz about the program.
[Experimenter] "Please complete this quiz about the content of the program that you have just watched."

[Experimenter] "This experiment has been completed."
[Experimenter] "Thank you very much for your participation. If you would like a copy of the final report, please email myself or the lecturer. The details are on page two.
[Experimenter] Show the participants out.
[Experimenter] Prepare the system for the next participants by changing the TV program back to the NZ tourism one and changing the server setting so there is no connection between John and David.

Appendix E - Questionnaire for Telephone and TV Users

Questionnaire

The task that you have just performed in the experiment was to communicate with your partner. This questionnaire asks you how you feel about using telephone calls to perform the task of communicating with your partner and to improve the general TV viewing experience.

Please circle a number from 1 to 7 for each statement. 1 means Strongly Disagree and 7 means Strongly Agree.

Statement	Strongly disagree						Strongly agree
1. Using calls on the phone would make me improve the quality of my TV viewing experience.	1	2	3	4	5	6	7
2. Using calls on the phone would give me greater opportunity over my TV viewing experience.	1	2	3	4	5	6	7
3. Using calls on the phone would make my TV viewing experience richer and more interesting.	1	2	3	4	5	6	7
4. Using calls on the phone would enhance my TV viewing experience.	1	2	3	4	5	6	7
5. Using calls on the phone would increase the relationship with my friend.	1	2	3	4	5	6	7
6. Using calls on the phone would improve my performance or information from my TV viewing.	1	2	3	4	5	6	7
7. Using calls on the phone would allow me to accomplish more work (or social interaction) than would otherwise be possible in my TV viewing.	1	2	3	4	5	6	7
8. Using calls on the phone would enhance my effectiveness in my TV viewing.	1	2	3	4	5	6	7
9. Using calls on the phone would make it easier in my TV viewing.	1	2	3	4	5	6	7
10. Overall, I feel that using calls on the phone would be useful in my TV viewing experience.	1	2	3	4	5	6	7

Please circle a number from 1 to 7 for each statement. 1 means Strongly Disagree and 7 means Strongly Agree.

	Strongly disagree						**Strongly agree**
1. I would find using calls on the phone cumbersome to use while I am watching TV.	1	2	3	4	5	6	7
2. Using calls on the phone will be easy for me while I am watching TV.	1	2	3	4	5	6	7
3. Interaction with calls on the phone will be difficult.	1	2	3	4	5	6	7
4. I will find it easy to use the calls on the phone to share information with my friend while I am watching TV.	1	2	3	4	5	6	7
5. The calls on the phone will be rigid and inflexible to interact with while I am watching TV.	1	2	3	4	5	6	7
6. It will be easy for me to contact my friend using calls on the phone while I am watching TV.	1	2	3	4	5	6	7
7. Using calls on the phone will require a lot of mental effort.	1	2	3	4	5	6	7
8. I feel that it will take a lot of effort to become skilful at using calls on the phone while I am watching TV.	1	2	3	4	5	6	7
9. My interaction with my friend on the phone will be clear and understandable while I am watching TV.	1	2	3	4	5	6	7
10. Using calls on the phone will require a lot of physical effort.	1	2	3	4	5	6	7
11. I feel that I may miss some information as I call to my friend while I am watching TV	1	2	3	4	5	6	7
12. Overall, I feel that the calls on the phone will be easy to use while I am watching TV.	1	2	3	4	5	6	7

Please circle the number for agree/disagree for each statement below.

1. Overall, I am satisfied with how easy it is to perform this task of communicating

←Strongly Disagree					Strongly Agree →	
1	2	3	4	5	6	7

2. It was simple to use phone calls for the task of communicating

←Strongly Disagree					Strongly Agree →	
1	2	3	4	5	6	7

3. I can effectively communicate using phone calls while I am watching TV

←Strongly Disagree					Strongly Agree →	
1	2	3	4	5	6	7

4. I am able to communicate effectively using phone calls while I am watching TV

←Strongly Disagree					Strongly Agree →	
1	2	3	4	5	6	7

5. I feel comfortable using phone calls while I am watching TV

←Strongly Disagree					Strongly Agree →	
1	2	3	4	5	6	7

6. It was easy to watch to the TV programme while I am talking with my friend over the phone

←Strongly Disagree					Strongly Agree →	
1	2	3	4	5	6	7

7. I believe I became productive or entertained using phone calls to communicate with my friend

←Strongly Disagree					Strongly Agree →	
1	2	3	4	5	6	7

8. Overall, I am satisfied with using phone calls to communicate with my friend while I am watching TV

←Strongly Disagree					Strongly Agree →	
1	2	3	4	5	6	7