



together anywhere, together anytime



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TA2

Together Anywhere, Together Anytime

Large Scale Integrating Project

ICT – Networked Media

D8.8 User Evaluations of TA2 Concepts

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Abstract

The TA2 project focuses on the design and evaluation of innovative telecommunication, multimedia and gaming applications that help to improve *social communication amongst groups of people that are separated in time and space*. It concentrates on people with ‘strong ties’ and on social communication and *social experiences*. This focus fills a gap that is relatively little explored by *human-computer interaction* (HCI), with its focus on individual use or one-to-one communication, and *computer supported cooperative work* (CSCW), with its emphasis on group communication in task-related contexts.

We present and discuss the Social User eXperience Framework (SUX), which is intended to help both academics and practitioners to better understand and evaluate people’s experiences when they engage in social communication via ICT applications. The framework deals with such social experiences in terms of *aesthetics*, *interactics* and *meaning*.

Furthermore, we report on various user studies (2010-2012), in which all TA2 demonstrators were evaluated. We conducted experiments with Low Delay Audio, Spatial Audio, Video Orchestration and Family Game, and field trials with My Videos, Storytelling / TA2 Lite and Connected Lobby. Moreover, we articulate several recommendations for the design of ICT applications that aim to facilitate social communication and social experiences.

Target audience

Those interested in or responsible for designing and evaluating ICT applications for group-to-group communication in social contexts, in particular managers and team members of such projects.

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Glossary

- Aesthetics or aesthetic experiences: people's experiences of the sensorial qualities of the system that enables social communication, often very closely related to human perception of acoustic, visual and metaphorical information. Aesthetics can be evaluated using the following constructs: Social Presence and Presence (SPP), Naturalness (N) and Immersion/Engagement (I/E).
- Arousal: one element of emotion, ranging from high-arousal or feelings of excitement to low-arousal or feelings of boredom (cf. emotion, pleasure and dominance) (Bradley and Lang 1994).
- Challenge (Ch): a person's subjective experience of challenge when engaged in a situation or task, closely related to experience of flow, which is optimal when the difficulty level of the task and the skill level of the person are comparable (not too difficult, not too easy).
- Copresence: A and B share the same physical environment, enabling both to see and hear what the other is doing and looking at.
- Cotemporality: B receives at roughly the same time as A produces. In most conversations, an utterance is produced just about when it is received and understood, without delay.
- Design elements: the characteristics and features of the system, product or service which a designer can manipulate.
- Dominance: one element of emotion, ranging from high-dominance or feelings of being-in-control to low-dominance or feelings of being-controlled (cf. emotion, arousal and pleasure) (Bradley and Lang 1994).
- Embodied interaction: social interaction and communication in real life that is embodied, in persons, space and objects used in communication
- Emotion, in the context of TA2: a person's subjective experiences of a situation, interaction or task, typically evaluated in terms of pleasure (positive-affect versus negative-affect) arousal (high-excited/low-bored) and dominance (high/being-in-control versus low-being-controlled) (Bradley and Lang 1994).
- Experiences, in the context of TA2: the experiences that people can have when using the system, product or service for (mediated) social communication.
- FtF: Face to face communication, i.e. unmediated communication.
- Form/setting: The visual, acoustic, metaphorical information, e.g., the technical context of the interaction, and how acoustic, visual and metaphorical information is presented, closely related to perception and cognition.
- Function/narrative: The interaction flow and functionality, e.g. the narrative context of the interaction, the "story" that is designed to frame the social interaction, typically interpreted through cognitive and reflective processes.
- Group Attraction (GA): a person's subjective experiences and feelings of belonging to a group and being part of a group.
- Immersion/Engagement (I/E): a person's subjective experience of being immersed and engaged in social communication and interaction, and in the situation.



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- Interactics or interactive experiences: people's experiences of interacting with the system and with others via the system, typically based on human cognition (briefly) before, during and (shortly) after interaction, requiring cognitive involvement during interaction. Aesthetics can be evaluated using the following constructs: Quality of Communication (QC), Social Connectedness (SC), Challenge (Ch), Group attraction (GA), Inclusion of Other in Self (IOS), Overlap of Self, Ingroup and Outgroup (OSIO) and Emotion.
 - Interaction rituals: recurring everyday activities that are the building blocks of our social habits, and can have varying frequencies of occurrence (Goffman, 1961). Interaction rituals can be characterized by: a mutual focus of attention; a common mood amongst participants; a common feeling of a barrier to the outside world; engagement in the situation; and a reciprocal acknowledgement of each other's engagement.
 - Inclusion of Other in Self (IOS): a measure for interpersonal closeness, the measure correlates with measures of both feeling close and behaving close.
 - Meaning or experiences of meaning: people's experiences of social communication in the broader context of daily life; meaning emerges through using the system in daily life and the meaning and value people associate to this kind of mediated communication. Key constructs for understanding meaning are: Social dynamics, Shared activities and Social ecology.
 - Naturalness (N): a person's subjective experience of social communication and interaction as feeling 'natural', depending on: co-location and synchronicity, the ability to convey and observe facial expressions and body language, and the ability to convey and listen to speech.
 - Overlap of Self, Ingroup and Outgroup (OSIO): a measure for closeness to a group, based on the measure of interpersonal closeness addressed.
 - Pleasure: one element of emotion, ranging from pleasant or positive affect to unpleasant or negative affect (cf. emotion, arousal and dominance) (Bradley and Lang 1994).
 - Presence (P): a person's subjective experience of 'being there' in a situation that is represented through a medium
 - Quality of Communication (QT): a person's subjective experience of understanding and being understood, being able to communicate one's intentions and having the feeling the others can do the same, knowing how the other is feeling during the social interaction and about having the feeling the other knowing your feelings as well.
 - Reviewability: B can review A's messages. Speech fades quickly, but in media such as email, letters, and recorded messages, an utterance stays behind as an artefact that can be reviewed later by either of the partners – or even by a third party.
 - Revisability: A can revise messages for B. Some media, such as letters and email, allow a participant to revise an utterance privately before sending it to a partner. In face-to-face and telephone conversations, most self-repairs must be done publicly.
 - Sequentiality: A's and B's turns cannot get out of sequence. In face-to-face conversation, turns ordinarily form a sequence that does not include intervening turns from different conversations with other people.



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- Simultaneity: A and B can send and receive at once and simultaneously. Sometimes messages can be conveyed and received by both parties at once, as when a hearer smiles during a speaker's utterance.
 - Social Connectedness (SC): a person's subjective experience of feeling connected and being together with others during interaction, and feeling satisfied about the intimacy during social interaction.
 - Social Ecology: the combination of different parallel social spaces, mediated and unmediated, digital and physical, face-to-face and distant, formal and informal, public and private.
 - Social Objects: objects that are used as anchors for social conversations.
 - Social Presence (SP): a person's subjective experience of awareness of (an)other person(s) during social communication or interaction.
 - Social Presence/Presence (SPP): a combination of a person's subjective experience of awareness of (an)other person(s) during social communication or interaction, and of being 'there' in a situation that is represented through a medium.
 - Social identity: a person's self-concept derived from perceived membership of various social groups (Tajfel 1982).
 - Strong and weak ties: characterizing qualitative differences in personal relationships to others (Granovetter, 1973), e.g. "strong ties" between relatives and friends, and e.g. "weak ties" between casual acquaintances.
 - SUX: Social User eXperience Framework: a conceptual model with on one side *design elements* (see above) and on the other side *experiences* (see above), and the relationships *design elements* and *experiences*
 - Thinking about each other (TA): a questionnaire construct that measures whether a person thinks about (an)other person(s).
 - Togetherness, in the context of TA2: a person's subjective experiences of being together through mediated social communication and interaction; consisting of aesthetics, interactics and meaning.



Executive summary

The goal of the TA2 project has been to improve social communication amongst groups of people that are separated in time and space. A series of demonstrators of telecommunication, multimedia and gaming applications were developed and evaluated in close cooperation with different groups of users.

This deliverable presents the main findings from a series of user evaluations of the TA2 demonstrators that were carried out during 2011 and 2012. It builds on previous project deliverables D8.1 Evaluation plan, D8.4 Evaluation of TA2 concepts and D8.7 User evaluations.

This work is intended to fill the gap that exists in the field of human-computer interaction (HCI), which typically focuses on applications for individual use or for one-to-one communication and in the field of computer supported cooperative work (CSCW) or computer mediated communication (CMC), which typically concentrates on communication and cooperation in task-related contexts.

The theoretical contribution of this deliverable is the development of the Social User eXperience Framework (SUX) (Chapter 2). This framework is intended to better understand how people use and experience mediated social communication and to better understand how to design systems, products and services that enable people to engage in mediated social communication. It consists of two parts: design elements and experiences, —and of the relationships between design elements and experiences.

Design elements are understood as those features of a system, product or service that a designer can manipulate, such as the visual, acoustic, metaphorical information (form/setting) and the ways in which these are presented (closely related to perception and cognition); and the interaction flow and functionality (function/narrative), the narrative of the interaction, the “story” around the interaction.

The term *experiences* is used here to refer to people’s experiences when they interact with systems, products or services, as well as their experiences when they communicate and interact with others via these systems, products or services. Experiences are conceptualized as happening on three levels: *meaning*, *interactics* and *aesthetics*:

Meaning (the ‘higher’ layer of experience) refers to people’s experiences of social communication in the broader context of daily life. Meaning emerges through using the system in daily life and the meaning and value people associate to this kind of mediated communication. Experiences of meaning can be understood as consisting of the following concepts:

- Social dynamics: which is dependent upon social identity and on strong and weak ties between people
- Shared activities: which include interaction rituals and communication in a group
- Social ecology: the combination of different parallel social spaces, mediated and unmediated, digital and physical, face-to-face and distant, formal and informal, public and private.

Interactics (the ‘middle’ layer of experience) refers to people’s experiences of interacting with the system and with others via the system. Interactic experiences are based on human cognition (briefly) before, during and (shortly) after interaction; they require attention and cognitive involvement and emerge through this cognitive involvement. Interactic experiences can be understood as consisting of the following concepts or constructs:

- Quality of Communication (QC): experiences of understanding and being understood, being able to communicate one’s intentions and having the feeling the others can do the same, knowing how



the other is feeling during the social interaction and about having the feeling the other knowing your feelings as well.

- Social Connectedness (SC): experiences of feeling connected and being together with others during interaction, and feeling satisfied about the intimacy during social interaction.
- Challenge (Ch): experiences of challenge when engaged in a situation or task, closely related to experience of flow, which is optimal when the difficulty level of the task and the skill level of the person are comparable (not too difficult, not too easy).
- Group attraction (GA): experiences and feelings of belonging to a group and being part of a group.
- Inclusion of Other in Self (IOS), interpersonal closeness, closeness to another person.
- Overlap of Self, Ingroup and Outgroup (OSIO), interpersonal closeness, closeness to a group.
- Emotion: experiences in terms of positive/negative affect (pleasant/unpleasant), high/low arousal (excited/bored) and high/low feelings of dominance (being-in-control/being/controlled).

Aesthetics (the ‘lower’ layer of experience) refers to people’s experiences of the sensorial qualities of the system that enables social communication: the way the system looks, feels and sounds. Aesthetic experiences are closely related to human perception (of acoustic, visual and metaphorical information)—little cognition is involved and experiences are quite immediate and intuitive. Aesthetic experiences can be understood as consisting of the following concepts or constructs:

- Social Presence/Presence (SPP): experiences of awareness of (an)other person(s) during social communication or interaction, and of being ‘there’ in a situation that is represented through a medium.
- Naturalness (N): experiences of social communication and interaction as feeling ‘natural’, depending on: co-location and synchronicity, the ability to convey and observe facial expressions and body language, and the ability to convey and listen to speech.
- Immersion/Engagement (I/E): experiences of being immersed and engaged in social communication and interaction, and in the situation.

The practical contribution is in the evaluation of all the TA2 demonstrators (Chapter 4):

- Lab experiments with Low Delay Audio and Spatial Audio (2011) (section 4.1)
- Lab experiments with Video Orchestration (2011 and 2012) (sections 4.1 and 4.6)
- Lab experiments with Family Game (2011) (section 4.2)
- Lab experiments with My Videos (2011) (section 4.3)
- Field trials with Storytelling / TA2 Lite (2011) (section 4.4)
- Lab experiments and field trials with Connected Lobby (2010-2012) (section 4.5)

From the 2011 experiments with Low Delay Audio and Spatial Audio, we learned that Naturalness (for Low Delay Audio) and Immersion/Engagement (for Spatial Audio) affect the way in which people experience Quality of Communication. From the 2011 Video Orchestration experiments, we learned that Social Presence/Presence and Naturalness affect experienced Quality of Communication. In addition, we found a hierarchy in the Aesthetic constructs; we found that Social Presence/Presence



influences Naturalness, and that Naturalness influences Immersion/Engagement ($SPP > N > I/E$). We also found that Naturalness is most important; the more ‘natural’ the experience, the better the experienced Quality of Communication.

In the 2012 Video Orchestration experiments, in which people used and evaluated video mediated communication with different ways of editing and presenting different camera shots to facilitate communication and interaction, we found that Video Orchestration helped people to collaborate more effectively. Video Orchestration made them act and interact more effectively, and people experienced improved Social Presence/Presence, Naturalness and Immersion/Engagement (compared to conditions with no orchestration and with randomly edited conditions).

In the Family Game experiments, people played the Family Game and a board game and, as part of playing the game, one group in one location communicated with the other group at another location. Interestingly, their experiences between these conditions were very similar. Though people tended to prefer a real-life situation, the Family Game is a very good alternative to have high quality social interaction with others when no other means are available.

In the experiments with MyVideos, in which people used and evaluated MyVideos to view video clips of a shared event (a school concert) and created narratives (video compilations) of this event, we found that people’s experiences of closeness to others improved, when comparing before and after using the application (from IOS and OSIO scores). This was also found in the Family Game experiments. In particular, using Family Game and MyVideos helped to strengthen weaker ‘strong ties’, e.g., ties to people that are one or two steps away, such as the friends of your friends, with whom you play a game (for Family Game), or the friends of your daughter, who also performed at a school concert (for MyVideos).

In the field trial with *Storytelling / TA2 Lite*, we learned a lot about what people actually do with the TA2 system. We found that what they do with the system is very similar to what people already do. People domesticate or appropriate new technology in ways that match their current behaviour. People used the TA2 system to support social and shared activities in their daily lives, rather than using it only to facilitate conversation. E.g., people left the system ‘on’, while they went on with other activities and while walked around in the room and even walking in and out of adjacent rooms (which is different from how people would typically use, e.g., Skype: turning it ‘on’, having a conversation, and then turning it ‘off’). People experienced the TV screen as a window to the other room.

In the Connected Lobby field trial, in which people used video communication on their TV sets in their living room, we found that people appreciate using the TV for video communication in a social manner. Young children used it to communicate naturally, e.g., with their grandparents. Video communication was perceived as an inter-group communication medium, with the household (in each location) as the ‘unit of communication’. From two additional experiments, we found that people appreciated using the ambient lighting device for ‘calm notifications’, and that people appreciated coordination methods (needed for synchronous communication) that balance control and ease-of-use.

We can conclude that people are willing to adopt video communication on a TV screen for social communication. Furthermore, we speculate that people will appreciate a second camera—in addition to the camera fixed to the TV—which they can move more freely through the living room or house. This brings to the fore the possible need for video orchestration to help people to communicate naturally while using multiple cameras.



We propose the following recommendations for the design of systems, products and services that aim to promote social interactions, based on our theoretical understanding and practical findings:

Overall, one has to bear in mind that a new system/application will have to match and build upon people's current practices. That is likely to increase processes of domestication, appropriation and adoption. In other words: Please do not invent or introduce entirely new activities, and do not over-optimize the system/application for one type of usage. Rather, it is better to create space for people to modify the system/application to fit their daily lives and their shared activities. For example, in the TA2 Lite field trial, people were provided with a virtual deck of cards, which existed on two tablet computers on the two locations, allowing people to find ways to use these for their own games.

In line with this, we recommend to implement the system so that people can leave it 'on', while they are engaged in other, daily activities (the system will then actually support shared activities), to implement the system so that people can use it across the entire living room, e.g. with a second camera, which they can move freely around, and to make the system 'open' so that people can find their own ways of using it. (These recommendations match the overall goal of TA2 to facilitate social communication regardless of time and space.)

Furthermore, it is recommended to design the system/application so, that it provides good visual information and cues, and provides a 'natural' environment. Such a form/setting and function/narrative will help people to experience Social Presence/Presence, Naturalness and Immersion/Engagement, so that they can experience Social Connectedness and Quality of Communication.

Moreover, it is recommended to create a good integration between task-related elements and communication-related elements of the system/application. If this integration is poor, there is the risk that people focus on the 'task' and forget the communication, or focus on the communication and forget the 'task'—task is between quotes, because in the case of TA2, the 'task' may very well be a game. Examples are: the integration of the game and the communication (in Family Game), the integration of watching TV and video communication (in Connected Lobby), and the integration of, e.g., playing a game on the coffee table, and, e.g., the video communication in the TV screen (in TA2 Lite). In other words: facilitate for integration of social activities (that happen 'in the whole space') and communication (that happen partly 'in the screen').

Finally, if the system/application is intended to improve social communication between diverse groups and people, e.g. across generations, it is necessary that diverse people, e.g. young children as well as older people, with diverse skills and preferences, can actually use the system. A possible solution is to design different interfaces for different people. Another solution is to 'move' some of the controls to 'the other side of the screen', so that a person with sufficient technical skills can set-up or configure the technical part of the application/system.



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1 Introduction

This deliverable presents the main findings from diverse user studies and evaluations carried out in the TA2 project between 2010 and 2012. This deliverable (D8.8) can be seen as a continuation of previous project deliverables *D8.1 Evaluation plan*, *D8.4 Evaluation of TA2 concepts* and *D8.7 User evaluations* (available online at: <http://www.ta2-project.eu>).

1.1 The goals of TA2

The overall goal of the TA2 project has been *to improve social communication amongst groups of people that are separated in time and space*. More specifically, the goal has been to develop and evaluate innovative telecommunication, multimedia and gaming services that aim to support social interactions and social experiences between groups of people who already have firm social relationships, such as family and friends. Social experiences enabled by TA2 technologies and insights would make it easier for family and friends to keep in touch when they are apart and to share moments of laughter and fun as well as moments of sorrow or unpleasantness.

In other words, the experiences demonstrated within the TA2 concepts should enable people to nurture social relationships that exist between people that have ‘strong ties’ (Granovetter, 1973; Wellman, 2005; Ling, 2008). This focus on groups of people with strong ties differentiates TA2 from telecommunication services that focus on one-to-one communication, and from many social network services, which focus on facilitating communication between people that have ‘weak ties’.

1.2 Advancement of the state of the art

A lot is known about the ways in which people use and experience ICT, both in terms of evaluating systems and in terms of designing systems. For example, in the field of human-computer interaction (HCI) one typically focuses on designing and evaluating ICT applications for individual use or for one-to-one communication. In the area of computer supported cooperative work (CSCW) or computer mediated communication (CMC) one typically focuses on group-to-group communication in work or task-related contexts.

However, recent years have shown a shift in HCI towards a ‘third wave’ (Bødker, 2006), a move from individual to social, from work and tasks to social and daily life, and from usability to experience. The rise of social media is related to this (McCarthy, 2011). The TA2 project fits in this ‘third wave’ since it focuses on ICT services for group-to-group communication, on usage of such services in social contexts, and on the ways in which these services facilitate social interactions, social experiences and social relationships. In addition, the TA2 project focuses on *affective* and (social, leisure-related) embodied communication, rather than on *effective* (formal, task-related) exchange of information.

Relatively little is known about how to design for social interaction or about the ways in which affective and embodied group-to-group communication in social settings can be evaluated. The TA2 project aims to further our understanding of the ways in which innovative telecommunication, multimedia and gaming applications can help people to participate in social interactions and social experiences, and to nurture social relationships.



More specifically, the TA2 project aims to contribute to the state of the art in two ways:

- Theoretically, it develops a Social User Experience Framework (Chapter 2), that helps to understand social experiences;
- Practically, it evaluates the demonstrators that are developed in TA2 (Chapter 4), and at provides recommendations for designers and developers.

1.3 Research questions

The following research questions are addressed:

- *How can we understand the ways in which telecommunication, multimedia and gaming applications can help people to participate in social communication and interaction and to nurture social relationships?*
This (theoretical) question is addressed in Chapter 2.
- *How do people experience the various TA2 applications? And what are the effects of specific features of these TA2 applications on people's social experiences?*
These (partly theoretical / practical practical) questions are addressed in Chapter 4.
- *What are recommendations for the design of telecommunication, multimedia and gaming applications that aim to promote social interactions?*
This (practical) question will be addressed in Chapter 5.



2 Theory

In this chapter, people's experiences of togetherness when using ICT applications for social communication are examined theoretically. We address the following question: *How can we understand the ways in which communication, multimedia and gaming applications can help people to participate in social interactions, to have social experiences and to nurture social relationships?*

Togetherness is the underlying concept of this entire chapter—even though the word *togetherness* itself is not used very frequently below. Instead, the concept of togetherness is analysed in terms of aesthetics, interactics and meaning, and these terms subsequently further analysed in a number of concepts/constructs, which can be evaluated practically.

2.1 Introduction

This section is a continuation of earlier discussions of user experience (cf. earlier TA2 deliverables D8.1: pp. 10-12; D8.4: p. 15; D8.7: pp. 16-22, available at www.ta2-project.eu) (Roto et al 2011; Hassenzahl & Tractinsky 2006; Law et al, 2009; Law et al., 2008), and it is an update of the state of the art in user experience research which is fine-tuned to social communication and social experiences.

Product and service design is shifting from supporting a user's completion of a task towards creating products and services that are domesticated by the users and that form an integrated part of a user's everyday life. Aspects like satisfaction, entertainment, enjoyment, a sense of community and identity play an ever more important role. These qualities are not properties of technology; they are outcomes of a user's interaction with a product/service in a specific context and of the user's subsequent sense making of this interaction (McCarthy and Wright, 2007). The outcome of this process is often referred to as the User eXperience (UX).

This shift from supporting user tasks towards a product/service experienced as an integrated part of everyday life creates a situation in which the success of a product/service and the product/service value for the user cannot be fully understood in terms of usability or Human Computer Interaction theory. User eXperiences are created through a complex interplay of aspects and processes such as: product interaction, a user's sense-making of this interaction, a user's predisposition (e.g. moods, goals, preferences, earlier experience, etc.) and the context (e.g. physical, social, virtual) in which the interaction takes place. The value of technology for the user can therefore only be determined when we broaden our view on innovative products to include not only usability aspects but also these additional processes and aspects as well. As Bannon (1991) put it, we need to move our focus 'From human factors to human actors'.

One of the goals of the TA2 project is providing *new user experiences* that help in the nurturing of social relationships. But what are these new user experiences? And in what sense are they important and contributing to social relationships? Over the last 4 years we have been developing a UX framework that helps to explore the design space and choices to be made during development of systems that should create these new experiences for nurturing social relationships. We therefore prefer to use the term Social User eXperience (SUX) rather than UX (User eXperience).

In the following sections this SUX framework is explained in more detail, based on our earlier work and according to the latest additional insights used in the final evaluations of the TA2 demonstrators.



2.2 Social User eXperience Framework: Understanding how people experience mediated social communication

The SUX framework presented here is an effort to better evaluate, understand and influence the experiences evoked by products and services used: for; in; or to enhance, social communication. In the beginning it was heavily drawing on the frameworks as formulated by McCarthy and Wright (2007), and by Desmet and Hekkert (2007) as well as on earlier research by Vermeeren and Kort (2006).

In the last two years the framework was fine-tuned towards experiences hypothesized to play an important role in social relationships, social interaction and social communication.

The framework covers two main interests of the TA2 project—see Figure 1:

- **Design elements:** Design elements are characteristics and features of the system, product or service which a designer can manipulate, such as
 - The visual, acoustic, metaphorical information, which will be referred to as *form/setting*
E.g., the technical context of the interaction, it corresponds to how acoustic, visual and metaphorical information is presented—closely related to perception and cognition.
 - The interaction flow and functionality, which will be referred to as *function/narrative*
E.g., the narrative context of the interaction, the “story” that is designed to frame the social interaction—typically interpreted through cognitive and reflective processes.
- **Experiences:** People have various types of experiences when using the system, product or service for (mediated) social communication:
 - Aesthetics: People’s experiences of the sensorial qualities of the system that enables social communication (the term *aesthetics* will be used in this specific sense here)
Aesthetic experiences are often very closely related to human perception (of acoustic, visual and metaphorical information), there is not much cognition involved and experiences are quite immediate and intuitive.
 - Interactics: People’s experiences of interacting with the system and with others via the system (the term *interactics* was coined within TA2 and is used in this specific sense here)
Interactive experiences are based on human cognition (briefly) before, during and (shortly) after interaction. They require attention and cognitive involvement during interaction with a product, service or other(s) and emerge through this cognitive involvement.
 - Meaning: People’s experiences of social communication in the broader context of daily life (the term *meaning* will be used in this specific sense here)
Meaning emerges through using the system in daily life and the meaning and value people associate to this kind of mediated communication. E.g., the experiences from regular social interaction, resulting in feelings of social cohesion, social identity, etc.

This framework is intended to better understand how people use and experience mediated social communication and to better understand how to design systems, products and services that enable people to engage in mediated social communication.

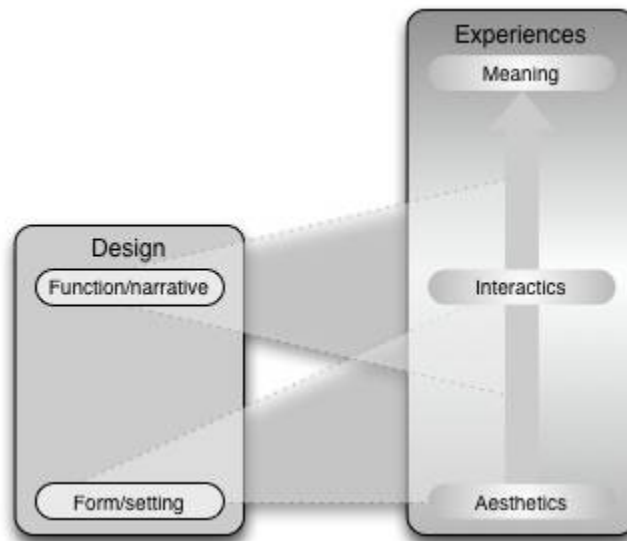


Figure 1. The Social User eXperience Framework (SUX)

The line of thought underlying it is as follows:

- People always find themselves in social *relationships*. The way they experience these relationships are affected by their *experiences* of *social interaction/communication* with others. Their social experiences are shaped by the ways in which they interact and communicate in these social relationships. And their social experiences, in turn, affect their social relationships.
- *Mediated* social interaction/communication provides people the opportunity to communicate and interact with others when they are separated in space and/or time. In the case of TA2, mediated communication is enabled by *capacities of information and communication technologies*, such as audio and video telecommunication, online social networking or online gaming.
- These technologies enable people to engage in social interactions, social communication and to participate in shared activities, to share emotions, to exchange information, to socialize and play games with each other, to jointly enjoy media and shared memories, etc. These technologies enable people to have social experiences and to nurture social relationships—see Figure 2.

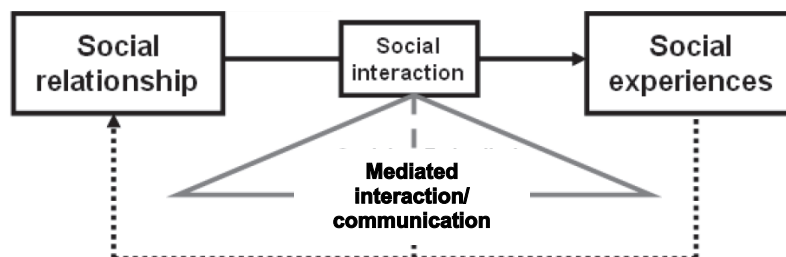


Figure 2. The relations between social relationships, social interaction and social experiences, and the role of mediated interaction/communication



The relationships between design elements and these experiences comes to life through a users' internal processes called sense making (McCarthy and Wright, 2007). Sense making includes:

- anticipation (based on prior experiences and expectations);
- connecting (first experiencing without actively giving meaning to it);
- interpreting (relating to goals, desires, hopes and fears);
- reflecting (evaluating experiences in hindsight);
- appropriating (making experiences your own, letting the product become part of your life);
- recounting (reliving experiences and finding new meanings in them).

Some of these sense making processes involve (conscious) cognitive processing, while other are a direct result of perception and/or sensation. These sense making processes can happen simultaneously or sequentially.

In the following a summary is given of additions made to the framework to include the different experience levels and the (social) experiences used in different evaluations performed with the TA2 demonstrators. These additions resulted in the SUX framework. The (social) experiences relevant to TA2 were selected based on literature mainly from the area of (social) communication theory, sociology, social psychology, media space research, CSCW, and CMC. By adding this theory, the UX framework was fine-tuned for social experiences, their design and evaluation.

The design space (form/setting and function/narrative) is addressed first based on theory, mainly from the area of social communication/interaction and mediated communication theory. In the following we address which elements within the design space are important within TA2 for creating social experiences. Form/setting elements will thereby mainly affect aesthetic experiences and function/narrative elements will mainly affect interactive experiences.

The aspects (aesthetic, interactive or meaning) of the experiences that are most relevant for the evaluation of the TA2 demonstrators is described in sections 2.4 to 2.6.

2.3 Designing for social communication

In (social) communication theory face to face communication in which people converse in the same physical space is often used as the baseline situation with which to compare mediated communication. Face to face communication is natural. It is the “original” form of communication (Kock 2004; 2005) and certainly the first we learn. Our brains have developed to support face to face conversation, and this this, therefore, comes most naturally to us and takes the least cognitive effort.

Clark (1996) and others described communication between people as a coordinated process or shared activity, assuming a vast amount of shared information or common ground – that is, mutual knowledge, mutual beliefs, and mutual assumptions (Clark & Carlson, 1982; Clark & Marshall, 1981). To coordinate this process, people need to update their common ground moment by moment. The process of building this common ground and its accumulation is called grounding (see Clark & Schaefer, 1987, 1989; Clark & Wilkes-Gibbs, 1986; Isaacs & Clark, 1987). The process and quality of grounding is closely related to specific design features of the communication medium. Clark summarizes these features which are related to the design of *form/setting* in the SUX model.



Next to design elements from *form/setting* that affect or set the stage for the emergence of social experiences there are *function/narrative* aspects that affect the emergence of social experiences as well. The two main aspects found in literature indicate that ‘what the social interaction is about’ and how people interact with each other and the system are the main interests in this area at this moment.

2.3.1 *Form/setting* in TA2

With mediated communication, the process of grounding is often more difficult than with face to face communication.. theories such as the media richness theory, media naturalness theory, presence and social presence, social translucency, etc. either directly or indirectly refer to these difficulties. Our communication and our experiences thereof changes when communication is mediated. Clark describes different constraints in grounding we encounter in mediated communication that contribute to changes in communication and experiences brought about by mediated communication. These constraints are closely related to the design of mediated communication means or more specifically form/setting. Furthermore Clark’s constraints cover most other relevant design aspects addressed in other theory such as mentioned above.

Here are eight constraints that a medium may impose on communication between two people, A and B and that affect grounding and therefore the effort needed to maintain high quality conversation.

1. Copresence: A and B share the same physical environment, enabling both to see and hear what the other is doing and looking at.
2. Visibility: A and B are visible to each other. In mediated communication this can be maintained but it is often more difficult to see what the other is doing or looking at.
3. Audibility: A and B communicate by speaking. Both communication partners can take note of intonation and timing.
4. Cotemporality: B receives at roughly the same time as A produces. In most conversations, an utterance is produced just about when it is received and understood, without delay.
5. Simultaneity: A and B can send and receive at once and simultaneously. Sometimes messages can be conveyed and received by both parties at once, as when a hearer smiles during a speaker’s utterance.
6. Sequentiality: A’s and B’s turns cannot get out of sequence. In face-to-face conversation, turns ordinarily form a sequence that does not include intervening turns from different conversations with other people.
7. Reviewability: B can review A’s messages. Speech fades quickly, but in media such as email, letters, and recorded messages, an utterance stays behind as an artifact that can be reviewed later by either of the partners – or even by a third party.
8. Revisability: A can revise messages for B. Some media, such as letters and email, allow a participant to revise an utterance privately before sending it to a partner. In face-to-face and telephone conversations, most self-repairs must be done publicly.

Some of these technology features or design aspects are used in in the evaluations of TA2 pathfinders to see how they differ from each other in terms of design or grounding constraints and their resulting experiences on the aesthetics level.



2.3.2 *Function/narrative in TA2*

Next to *form/setting* we can design the *function/narrative* of the (social) interaction within which TA2 should evoke social experiences such as social connectedness, social identity, etc. With *function/narrative* we can design the shared activities, which are said to evoke these kinds of experiences. Not only in terms of communication/conversation as a shared activity such as addressed by Clark but also other shared activities that contribute to the experience of social connectedness, such as addressed by Durkheim as *interaction rituals* (shared activities in a much broader context than that of communication/conversation, see below). Shared activities/ interaction rituals are important in experiencing social identity, group identity, social connectedness and social cohesion.

Interaction rituals themselves are defined by: a mutual focus of attention; a common mood amongst participants; a common feeling of a barrier to the outside world; engagement in the situation; and a reciprocal acknowledgement of each other's engagement

For designing mediated shared activities it is therefore important to provide a function/narrative that supports these aspects of interaction rituals. The shared activity should stimulate a shared focus of participants (e.g. a cooperative game), it should be engaging and one should be able to observe the other participants engagement and experiences of the shared activity. It might be clear that some aesthetics aspects from form/setting such as addressed by Clark also will affect or be important in the design of interaction rituals themselves. From additional literature we've abstracted some additional important design aspects for function/narrative. We've summarized them briefly below. Some aspects are more or less related to the interaction between participant/user and the system, others are more or less related to the design of the communication with other people.

2.3.2.1 *Social objects*

A mutual focus of attention, creating a common mood, a common feeling of a barrier to the outside world and an engaging situation are important characteristics of interaction rituals. In the literature on Object Centred Sociality, introduced by Knorr-Cetina (1997) and popularized by Engeström (2005), it is explained that social objects can be used as entities that serve as anchors for conversations.

Within TA2 we've used this concept in different manners. In the Family Game for example, a cooperative game is designed as the social object around which interaction is taking place and organized. In MyVideos creating, editing and sharing videos takes a central stance, with social objects such as the event from which video material is used, the resulting video material itself which is shared, etc. Additional means to communicate about the event and videos are used to socialize further around these social objects. Last but not least TA2 lite provides many different social objects (e.g. games, digital books, etc). Users have, besides these objects, the opportunity to introduce their own object present in the home, given on birthdays, etc. The TA2 pathfinders differ in the manner in what these objects are (events, videos, shared activity, physical objects) and the degree of freedom offered to users to create their own social objects. In Family Game the object is given, in MyVideos people partially create their own social objects and in TA2 Lite people can introduce their own objects whenever they like. These social objects contribute to a mutual focus of attention; a common mood amongst participants; a common feeling of a barrier to the outside world; and an engaging situation.



2.3.2.2 *Embodied interaction*

Engagement in the situation and a reciprocal acknowledgement of each other's engagement in a situation is often brought about by the fact that social interaction and communication in real life is embodied, in persons, space, objects used in communication, etc. (see section 2.6). This embodied interaction is again closely related to form/setting aspects in terms of what is perceived about the social situation/context. In function/narrative it is related to the interaction with the system itself and with the other people, the process of interaction. By providing more natural means to interact with the system and the other people, in terms of (for example) gestures, the manipulation of physical object such as webcams, cards, etc. not only the interaction with the system becomes more intuitive and natural but in a social context the interaction and behaviours of the individuals become more observable as well. In Family Game the Kinect sensor is used, in combination with an RFID reader to control the gameplay and game flow. Because of this people 'on the other side' can more easily see what is happening in the other room. In TA2 Lite the interaction with the system and the others is arranged in a similar fashion, often by physically interacting with objects and these activities are shown on the other side either directly on the television screen or indirectly as for example a lay-over effect on the screen (e.g. virtual books with interactive features on the television). Embodied interaction will not only provide a better overview and more information about the social situation but will also enhance experiences such as fun, enjoyment, flow and engagement in these situations, thereby stimulating a shared/common mood among participants.

In the following sections, the different types of experiences that people can have when interacting with a system for mediated communication. These different types of experiences are discussed in terms of aesthetics, interactics and meaning. Moreover, the constituent elements or underlying concepts in each layer of the SUX Framework will be discussed—see Figure 3.

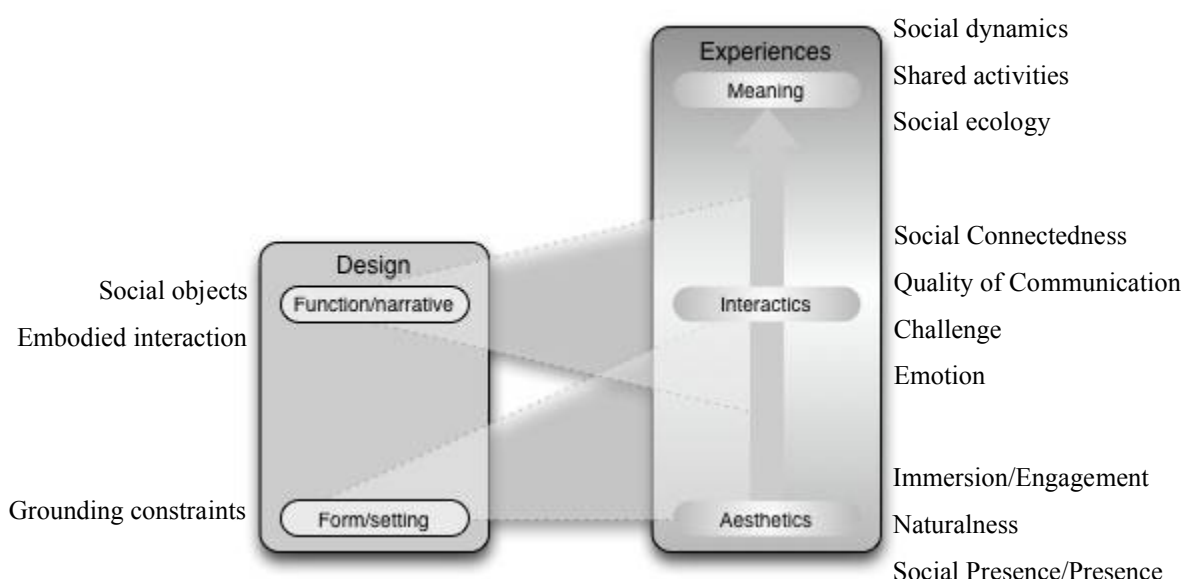


Figure 3. The Social User eXperience Framework and its constituent elements or underlying concepts



2.4 **Aesthetics:** Experiencing the sensorial qualities of the system for social communication

Aesthetic experiences mainly result from design elements in *form/setting*. These design elements affect perception and the immediate, intuitive understanding of what is going on within a (social) setting at specific moments during interaction. These design elements can create good common ground when implemented correctly according to the grounding constraints as addressed by Clark.

There's much theory on experiences that are affected by Form/Setting. Based on the grounding constraints we've chosen to address the following since they are said to be related to social experiences as well (at least in terms of their effect on the quality of social interaction):

- Social Presence/Presence (SPP)
- Naturalness (N)
- Immersion/Engagement (I/E)

Presence is generally defined as a user's subjective sensation of 'being there' in a scene depicted by a medium (Barfield, Zeltzer, Sheridan, & Slater, 1995). Lombard & Ditton (1997) define presence as 'a perceptual illusion of non-mediation'. Presence can be a measure of the degree to which: an individual feels physically located in a given mediated space; senses that a mediated environment 'becomes more real, or present, compared to the real physical world', Presence is a subjective feeling, a mental manifestation, and therefore an experience. The experience of presence relates to different grounding constraints or design elements from Form/Setting such as Copresence (being located in the same space); Visibility (being able to see each other); Audibility (being able to speak to each other and take note of timing and intonation); Cotemporality, Simultaneity and Sequentiality (sending and receiving at the same time without external interruptions or pauses in communication, taking turns).

Social presence refers to the degree of awareness of (an)other person(s) in a communication interaction. According to communication theory, communication is effective if the communication medium has the appropriate Social presence required for the level of interpersonal involvement required for a task. This can be understood in terms of both parties acting out certain roles and with developing or maintaining some sort of personal relationship. Social presence is also a subjective feeling or mental state and therefore an experience.

Social presence relates to different grounding constraints as well, such as copresence, visibility, audibility, cotemporality, simultaneity and sequentiality.

Media naturalness theory is an elaborate theory that incorporates and explains many other issues and phenomena addressed in for example the media richness theory, social translucency, presence and social presence. Media naturalness theory states that human beings have been engineered by evolutionary forces to communicate primarily in a co-located and synchronous manner, as well as through facial expressions, body language, and speech. It thus seems reasonable to assume that natural communication involves at least five key elements: (1) a high degree of co-location, which would allow the individuals engaged in a communication interaction to see and hear each other, as well as share the same environment while engaging in communication, (2) a high degree of synchronicity, which would allow the individuals engaged in a communication interaction to quickly exchange



communicative stimuli, (3) the ability to convey and observe facial expressions, (4) the ability to convey and observe body language, and (5) the ability to convey and listen to speech.

Furthermore three dependent constructs are identified for media naturalness: Cognitive effort (the amount of mental activity involved in a communication interaction); Communication ambiguity (absence of information-giving stimuli is likely to lead to a higher portion of misinterpretations, and thus ambiguity); Physiological arousal, face-to-face communication triggers physiological arousal in human beings. Mediated communication in which elements of natural face-to-face communication tend to suppress this physiological arousal). A decrease in the degree of naturalness of a communication medium leads to the following effects in connection with a communication interaction: (1) an increase in cognitive effort, (2) an increase in communication ambiguity, and (3) a decrease in physiological arousal.

Media naturalness relates to grounding constraints such as copresence, visibility, audibility, cotemporality and simultaneity.

Immersion/Engagement is said to be positively correlated to Social Presence/Presence. The latter especially in social situations/communication. We hypothesize immersion and engagement will be positively correlated to naturalness of the medium as well. The more presence, Social Presence/Presence and Naturalness a person will experience in the interaction, the more Immersed/Engaged this person will feel in the social situation and communication. The degree of Immersion/Engagement can, in our view, be seen as a result of good implementation of the grounding principles as well as a good implementation of the use of social objects and embodied interaction (function/narrative).

2.5 **Interactics:** Experiencing interactions with the system and with others via the system

Interactive experiences mainly result from design elements in Function/Narrative. These design elements affect the experience of the interaction, shortly before, during and briefly after interaction. Function/narrative elements can create feelings belonging to interaction rituals such as social identity, social connectedness, fun, enjoyment, flow, challenge, etc.

In social science literature there are many different experiences mentioned which result from interaction with systems and/or other people. We have chosen to address the following interactive experiences in our research:

- Quality of communication (QC)
- Social connectedness (SC)
- Challenge (Ch)
- Emotion, in terms of affect (positive versus negative); arousal (relaxed versus aroused); and dominance (being in control versus. being controlled), measured with SAM items (Bradley and Lang 1994).
- And several higher level social experiences that lean towards meaning (see 2.6) such as Group Attraction ; Inclusion of Other in Self (IOS) and Overlap of self, ingroup, and outgroup (OSIO) and experiences of a long term relationship in general.



Quality of communication is about: understanding and being understood; being able to communicate one's intentions and having the feeling the others can do the same; knowing how the other is feeling during the social interaction and about having the feeling the other knowing your feelings as well.

Social connectedness (during interaction) addresses the experience of feeling connected to the others, of being together with them during interaction, and being satisfied about the level of intimacy during social interaction.

The ways in which people experience challenge is related to the experience of the activity itself and its difficulty level. Whether someone enjoyed the activity without feeling bored or anxious, whether one is stimulated by the fact that one's skills are gradually improving at performing the activity. Challenge is said to be closely connected to reaching a state of flow. It is important to experience engagement and to immerse in the activity and social interaction.

The emotions which people experience are important in terms of whether people have a positive or negative experience, to what degree, with which intensity, and did they feel overwhelmed or in control. These basic dimensions of emotion tell us something in general about how positive/negative and intense the experienced emotions during social interaction were. Emotions can be evaluated in terms of positive/negative affect, high/low arousal and high or low feelings of dominance.

Group attraction addresses the experience of having the feeling of belonging to and being part of a group. Inclusion of Other in Self is a measure for interpersonal closeness, the measure correlates with measures of both feeling close and behaving close. Overlap of Self, Ingroup and Outgroup (OSIO) is a measure for closeness to a group, based on the measure of interpersonal closeness addressed above. Experience of the long term relationship is divided in aspects such as personal effort put into a relationship; thinking about each other; how one experiences sharing experiences with the other(s) and staying in touch with them; and how much one recognizes the other and how the other is doing within the social relationship.

Though many of these aspects are addressed in literature, it is largely unclear how they are affected by design aspects from function/narrative or the lower design layer form/setting. The experiments with the TA2 demonstrators therefore are besides measuring 'social connectedness' tuned as well to exploring the relationships that can be found between design aspects and experiences, and among experiences themselves in this area.

2.6 **Meaning:** Experiencing social communication in the context of daily life

Meaning relates to how users interpret the interactions enabled by the TA2 system and how the experiences they produce relate to their social relations and the goals towards which TA2 ultimately wants to contribute. These experiences do not stem from product/service interaction directly but from adopting and integrating a product/service into one's daily life because of the meaning it is given by the user. The section deals with some of the theoretical foundations from social science for design choices and delimitations made within TA2.



2.6.1 Social dynamics: social identity and strong ties

2.6.1.1 Social identity

In many real-life gatherings, such as family parties, vacation travels, etc., people participate not only as individuals, but also as part of a social group – e.g. their family, school class, sports club, etc. This strengthens the feeling of being part of a group and how that group relates to other groups. It creates and maintains bonds between people and groups as well as a feeling of “*togetherness*”.

Our sense of self includes not just a personal identity (our sense of personal attributes and attitudes) but also collective identities. According to Social identity theory (SIT), social identity is the individual’s self-concept derived from perceived membership of various social groups (Tajfel, 1982, Hogg and Vaughan, 2005). We understand and evaluate ourselves partly by the groups of which we consider ourselves a member. Having a sense of “we-ness” strengthens our self-concepts, and we seek not only respect for ourselves but pride in our groups.

Social psychological research has showed that human interaction has emergent properties that endure and influence other people, which cannot be reduced to the individuals themselves (ibid.). Proponents of “symbolic interactionism” argue that the self emerges and is shaped by social interaction. SIT is mostly used to describe relationships in and between social groups, and in particular how in-groups (“us”) tend to have a favourable subjective bias over out-groups (“them”). SIT emphasizes the importance of social identities, of being and belonging together with others in our in-groups, as a fundamental way of understanding who we are (ibid.). Unless we actively nurture these group relationships, they fade away, losing meaning and influence.

Locations and objects can be of importance for social identity, for example when it comes to family identity. The concept of “the home” holds great importance in western culture, and a family generally identifies strongly with this physical location (Morley 2000, p. 24-26); “home” is the place where the family belongs. This refers not only to the location of the home, but physical objects connected to the family, which are brought with them when moving, might even hold greater importance for the family identity than the location itself.

In TA2, we recognize that social identities, in addition to personal identity, are fundamental for humans. It is however clear that we spend less time socializing in group settings and more time socializing with one individual at the time (Wellman 2005). While we spend a great deal of time communicating with others, Wellman (2005) suggests that we are moving towards a society based on “networked individualism,” where most communication is both mediated and conducted on an individual basis, as opposed to taking place in group settings. Most mediated communication today such as phone, email and chat, and even online social networks, are primarily subjectively experienced as one-to-one communication. In contrast, being together with friends in a real shared activity such as a party creates a subjective feeling of “us” that goes beyond the feeling of the self and strengthens the social identity of the participants. TA2 is ultimately about supporting group relationships between people, particularly families and friends who, for some reason, can’t meet physically as often as desired.

2.6.1.2 Strong and weak ties

Mark Granovetter (1973) introduced the concept of *strong and weak ties* as a way of characterizing qualitative differences in personal relationships to others. He argued that society needs not only



healthy “strong ties” between relatives and friends but also ample and fluid “weak ties” between casual acquaintances.

The recent interest we have seen in many online social networking sites, such as Facebook and LinkedIn, address exactly this need for nurturing one's weak ties. However, while weak ties are important, especially when e.g. one is looking for a new job, the strong ties to our closest family and friends are even more important to us and our sense of identity. While we communicate with our weak ties only at certain occasions and using only certain communication channels, we tend to communicate with our strong ties frequently and using any means available (Wellman, 2005). But according to recent empirical research, the number of really close friends we have, the ones that we feel that we can share our deepest thoughts with, tend to be shrinking (McPherson et al, 2006). McPherson et al, (2006) write: “If we assume that interpersonal environments are important (and most sociologists do), there appears to have been a large social change in the past two decades. The number of people who have someone to talk to about matters that are important to them has declined dramatically, and the numbers of alternative discussion partners has shrunk.” (ibid, p. 371).

We recognize the need for supporting both strong and weak ties, and the weak ties networks are quite well supported through various online tools, but this is not the case for strong ties. Thus, TA2 explicitly focus on nurturing the strong ties in someone's network.

2.6.1.3 *Togetherness*

Togetherness is the name we have given the subjective feeling of being part of a common social group and sharing a common life that occurs within groups with strong ties. A necessary, but not sufficient, condition for people to experience togetherness is a means of communication shared by the group and that belongs to that group only. This means of communication can either be technically mediated or consist of physical meetings. By definition, togetherness is a subjective feeling that is hard to capture and operationalize. For this reason we have concentrated on using togetherness as a framework that contains the different subjective and objective concepts, listed in this chapter. The TA2 project contains different components and pathfinders that target a subset of these concepts in their evaluations. Togetherness constitutes the family of concepts to which the individual concepts belong and in any given situation, togetherness can be formed by utilizing different subsets of these concepts depending on the local conditions. For example the ways in which a group of friends will reach togetherness will be different to the ways a grandmother achieves togetherness with children and grandchildren.

Togetherness is not a concept with a strict scientific meaning; however it has some properties that together allude to what it is. Togetherness is a family of subjective feelings that looks different for different people. Togetherness needs a material support in the form of communication between members of the group but it can both have too much and too little of it. Togetherness has a temporal endurance in that the feeling does not disappear when the contact ends (unlike Social Presence). Instead, it slowly decreases until it gets recharged at the next interaction ritual.

Togetherness is a second or third order design outcome. This means that we cannot design directly for increased togetherness. What we are able to do is provide *capacities* with which users can perform *interactions* that leads them to have *experiences* of togetherness that in the end nurtures their social *relationships*.



2.6.2 Shared activities: Interaction rituals and communication in a group

2.6.2.1 Interaction rituals

In sociological terms, TA2 wants to support social cohesion within groups primarily relying on strong ties (as defined by Granovetter, 1973). Sociologists have studied how groups are created and maintained, and what holds them together. According to Durkheim (1971), social cohesion and solidarity can be seen as the glue that binds groups together, and social cohesion is created and maintained by interaction rituals.

Interaction rituals (Goffman, 1967) are recurring everyday activities that are the building blocks of our social habits, and can have varying frequencies of occurrence. Examples range from shaking hands and how we divide the turn to speak between participants, to celebrating birthdays and playing games together. When taking part in an interaction ritual, we (re-)create a small portion of the social bond between us and the other participants.

The concept of ritual is confusingly wide, including both grand religious rites and small communication phenomena, like turn taking. The grander rituals are often built up by smaller ones. To clarify the concept, rituals can be understood as both a noun and an adjective (Rothenbuhler, 1998). Rituals as nouns are events such as weddings, birthday celebrations and playing games. A TA2 session as a whole is a ritual in this sense. Rituals as adjectives are ritualistic aspects of any kind of interaction such as greetings, turn-taking (how we divide the turn to speak between participants) and feedback (how we convey that we are listening to someone); phenomena that follow commonly established rules or norms.

Defining characteristics of an interaction ritual are: a mutual focus of attention, a common mood among the participants, a common feeling of a barrier to the outside world, engagement in the situation, and most importantly --- reciprocal acknowledgment of each other's engagement (Collins, 2004). While some form of communication channel is necessary, it might not be sufficient in itself, and thus TA2 is attempting to provide possibilities for *shared activities* in union with the face-to-face-like communication.

In order to support social cohesion through interaction rituals, and the establishment of social identity, a long-term perspective is needed which includes recurring intense interaction rituals of various kinds, as well as moments of reflection, planning, anticipation and looking forward to future shared activities. This includes both asynchronous and synchronous communication within the group and between parts of its membership that take place in different social ecologies (see the section on social ecology below).

Interaction rituals change with time or at least should do so (Wolin & Bennett 1984). When humans age, rituals might need to be adapted. What is an appreciated bedtime ritual by a 4-year old is not necessarily appreciated by a 13-year old. TA2 recognizes that different activities might be suitable for different ages and that there might be a need to adapt the activities as the children grow, e.g. you might cheat in a game in order to let a young child win, but at a certain age you would probably cease doing so.

When it comes to social identity, locations and objects might be important for interaction rituals. Some rituals take place in the home, especially at times of grander rituals like Christmas (Morley 2000). Sometimes objects are used in rituals. These objects can be given great importance and be the focus of



the mutual attention (Ling 2008: 50-51). They can also be a reminder of the ritual and group cohesion for the participants after the ritual is finished. Durkheim (1971) also discussed this, in union with grand religious rituals and called these objects *totems*.

2.6.2.2 Communication as ritual or transmission

Communication in itself can be defined as ritual, though most definitions of communication focus on transmission and information exchange (Carey, 2008; Rothenbuhler, 1998). The ritualistic definitions recognize that communication often includes an information exchange, but claims that the aim is sometimes on another level; it's about maintaining and confirming social structures and relations rather than transmitting specific information. In fact, much of the communication that takes place might not transfer new information between the participants (Rothenbuhler, 1998). The common greeting stands as a good example: it is difficult to consider a greeting an exchange of information; when you ask someone e.g. what their day has been like, you might not actually be that interested in the information provided by the reply. The aim is instead to reinforce and refresh the relationship between the participants, for example by using a certain form of address and/or way of greeting.

To strengthen and maintain relationships is also a goal of TA2. However, if the message is not completely transmitted, due to social or technical reasons, the transmission view of communications also becomes important. This is where the social presence theory enters the picture. Different contributors to the social presence theory share the transmission view of communication; there is a focus on the possibility of transmitting different type of cues, generally nonverbal (e.g. Short et al., 1976; Daft & Lengel, 1986; Kock, 2005; Walther & Parks, 2002). If fewer cues are transmitted the quality of the communication is considered lower.

This lack of certain cues might decrease the possibility of successful rituals. Knapp and Vangelisti (2005: 175) claim that: "*Interaction rituals are created and sustained by the existence of communication rules.*" These communication rules could be seen as the smaller ritualistic aspects of communication. In a phone call some cues are not transmitted and for example feedback, the signals we send to convey that we are listening, might suffer since we cannot convey with nonverbal cues that we are listening to the same extent as in a face-to-face situation, which sometimes raises the question whether the communication partner is still there. In order to provide possibilities for successful rituals-as-nouns, rituals-as-adjectives have to be taken into account; in order to reach a ritual aim of communication; the goals of information exchange must be fulfilled to some extent.

TA2 is taking the theory of interaction rituals into account by shifting the focus of analysis and design from communication to shared activities. When we focus on shared activities, we are referring to embodied processes, taking into account the spatiality of the room, objects that are present and are being used and the material disposition of bodies and of information. Similar approaches to interaction can be found in the developments in embodied gameplay such as the Nintendo Wii and pervasive gaming, for example using a whole city as a game area. However TA2 extends this to include multiple locations. This requires a new design thinking since the embodied aspects of the interaction must not only be represented for the co-located users, but also for the users in the other locations. This raises questions both of how the interactions in one location are captured by the system (by audio, video and tangible interfaces) and how that information is represented to the other locations (through orchestration, Spatial Audio or as metaphorical representations).



2.6.2.3 Games as interaction ritual

One of the avenues explored in the TA2 project was the use of games as a group activity. Using Collins' (2004) model of the interaction ritual (as proposed by Goffman, 1961) where several "ritual ingredients" combine to produce specific "ritual outcomes". The use of games as interaction rituals has been explored over the course of the project; specifically, how good design can facilitate the use of games in this regard. These ritual outcomes include positive feelings in a group, feelings of group solidarity, etc, and are subsequently very applicable to the goals of the project as a whole. By looking at how components of games tie into the different ritual ingredients, insights were gained into how games produce these effects. For example, the "barrier to outsiders" ingredient (Collins, 2004) ties into the so-called "lusory agreement" of the game which is the group equivalent of Suits' (1978) "lusory attitude"; knowing who is playing, i.e. having agreed to follow the rules of the game, and who is not. This rapidly changes the meaning of specific actions – what makes less sense without a lusory agreement, such as e.g. mimicry in a game of charades, takes on a radically different meaning when playing said game.

Both Goffman (1961) and Collins (2004) used games as examples of interaction rituals, and specifically how interaction could be eased: *"I would like to take a speculative look at some of the conditions, once removed, that seem to ensure easeful interaction. Again, there seems to be no better starting point than what I labelled gaming encounters. Not only are games selected and discarded on the basis of their ensuring euphoric interaction, but to ensure engrossment, they are sometimes modified in a manner provided for within their rules, thus giving us a delicate tracer of what is needed to ensure euphoria"* (Goffman, 1961 p. 66-67). Xu et al. (2011) also uses both Goffman and Collins in their study of board game interaction, examining how a particular feature of board games ("chores") affects their function as an interaction ritual by looking at Collins' ingredients.

2.6.2.4 Social adaptability

Since the activities performed using TA2 is not an end in itself but a tool to aid the construction of togetherness, there is a risk that if not properly designed, the activities will consume all the focus of attention.. One way of acknowledging this is through the concept of social adaptability. Within game studies, social adaptability is "a characteristic of games that are explicitly designed to function in changing social environments" (Björk et al. 2005). These games are designed to not disrupt the social environment. An example of a game that disrupts the social environment is a real-time game in a social environment that requires the user to take breaks from playing. Within TA2, social adaptability can mean designing activities that allows the participants to simultaneously engage in conversations or designing digital versions of familiar games where the users set the rules according to their habits rather than having the system impose rules.

2.6.3 Social ecology

Improving social relations can, in the end, only be accomplished by the people who maintain the relationships. It is up to these people how tools for mediated communication are used within the space of possible interactions enabled by them.

TA2 as a system creates a social space where the interactions performed create social experiences, but this is not enough to determine how social relations are being affected. To understand this, TA2 must be placed in relation to the broader social ecology, consisting of several parallel social spaces, both



mediated and unmediated. In real life use, the TA2 system will co-exist with other media and other social exchanges beyond the system. It is fundamental for the adoption of the system that the social and technical interfaces between different social ecologies are understood and properly designed.

A way of conceptualizing this is using the concept of “media ecologies” (McLuhan 1964) which deal with how different kinds of communication media determine what kinds of social relations are possible. The field of media ecology also deals with how social relations and social interactions move across different kinds of media (Jenkins 2006). However, the set-up of TA2 - with its focus on strong ties that also meet face-to-face - requires non-mediated social spaces to also be considered.

Social spaces are scenes where interaction takes place (Lefebvre, 1991). The social interactions of any group or individual is made up of a number of such social spaces where different kinds of communication takes place; digital and physical, face-to-face and distant, formal and informal, public and private. Taken together, these social spaces form a 'social ecology'. Astely (1983) defines social ecology in an organisational setting as *"the proactive communal arrangements that organizations forge as they attempt to supplant the exogenous "natural" environment [...] by a collectively constructed and controlled "social" environment"* (pp. 577). Further, he suggests that *"[b]y joining with others in systems of mutual support, organizations can produce a collectively managed environment that is buffered, at least partially, from the vagaries of the outside environment."* (pp. 577) This means that any social group arranges social spaces where the group interact as group, separated from the outside, where each member of the group is involved in numerous other social spaces.

The social ecology should not be understood as merely an aggregate of independent social spaces, but as a dynamic system, in the sense that the introduction of a new social space in this ecology shifts the balance between, and use value of, other social spaces. With the introduction of a new social space into a social ecology, some other spaces might be discarded (in the way email largely replaced fax) while some might complement each other or even be strengthened by the new social space (the way twitter is used as a companion to watching TV). Often social relations migrate over time from one social space to another such as when a relation begins with communication over the internet only to later migrate to contact over mobile phones and face-to-face meetings (Jenkins, 2006).

In TA2, we use this concept to understand how to make sure that the system is compatible with several other social spaces. Otherwise, there is a risk that we would end up in an all-or-nothing situation where TA2 either fully replaces other means of communication, or is rejected by the social ecology altogether. The adoption of TA2 into the social ecology of the target group can be done both by looking at how novel interactions enabled by TA2 can flow between the system and other social spaces, as well as looking at how already established social practices can be supported or enhanced by the TA2 system, by for example becoming able to be performed at a distance.

When considering the relation between social groups and their social spaces, it is important to give both equal weight. Changes in the social ecology can give rise to new social groups, and new social groups can, in turn, effect changes in the social ecology. At the same time, a social group can be somewhat independent from the social spaces it makes use of and persist even if the social spaces which gave rise to it are replaced by others. It is also important to place physical and mediated social spaces on equal footing. Groups that formed in non-mediated settings are shaped by the physical social spaces in their environment (examples include the size of apartments (nuclear family or larger) and the access to public spaces (Jacobs, 2002) and should not be taken more or less for granted than the ones formed by mediated social spaces.



3 Methodology

In this chapter, we briefly discuss the methods we used in order to conduct the various evaluations and user studies. The main goals of these user studies were to better understand the ways in which people experience the various TA2 applications and to better understand the effects of specific features of the TA2 applications on people's social experiences. We were interested both in people's experiences (in relation to technology) and in technology (in relation to people's experiences).

See also TA2 *D8.10 Lessons learned and Visions* for a discussion of human-centred design methods.

3.1 Mixed methods

There are many methods available for conducting user studies and user evaluations. TA2 followed a 'mixed-methods' approach, which aims to apply a range of different methods to meet specific purposes in the course of the project. Different methods were applied in different phases of the project.

Moreover, these methods were used in an iterative process, so that these methods were used cyclically.

- At the start of the project, and also later on, research-oriented, exploratory methods such as literature research or Family interviews were used, because these help to explore concepts (like 'togetherness') and to understand people's daily life experiences;
- During the project, design-oriented, generative methods were used, such as focus groups in which storyboards of the demonstrators were discussed with potential users, and workshops and interviews with potential users, e.g. for MyVideos ;
- During the project, and especially at its end, evaluation-oriented, summative methods were used to study relationships, such as lab experiments for Low Delay Audio, Spatial Audio and Video Orchestration prototypes, and for Family Game and MyVideos demonstrators.

The diversity of methods can also be understood by making two broad distinctions:

- Design-oriented methods (typically or often qualitative), such as workshops or interviews, versus evaluation-oriented methods (typically or often quantitative), such as usage logging or surveys.
- Methods that are more situated in people's daily lives, such as field trials, which offer higher realism (and less control), versus methods that are less situated in people's daily lives, such as lab experiments, which offer more control (and less realism);

Following these distinctions, the methods that were used in TA2 can be plotted into a grid with two axes—see Figure 4:

- A vertical axis from high situatedness (e.g. field trials), to methods with low situatedness (e.g. lab experiments)
- A horizontal axis from design-oriented, qualitative methods (e.g. workshops) to evaluation-oriented, evaluative methods (e.g. surveys)



The user studies and evaluations reported in this deliverable are the following:

- Lab experiments with Low Delay Audio and Spatial Audio (2011) (section 4.1)
- Lab experiments with Video Orchestration (2011 and 2012) (sections 4.1 and 4.6)
- Lab experiments with Family Game (2011) (section 4.2)
- Lab experiments with My Videos (2011) (section 4.3)
- Field trials with Storytelling / TA2 Lite (2011) (section 4.4)
- Lab experiments and field trials with Connected Lobby (2010-2012) (section 4.5)

In 2008-2010 the evaluations were generative and mainly qualitative (left hand side of Figure 4); they were oriented towards generating ideas for design and evaluating ideas and concepts during the design phases, as part of the iterative process. Conversely, the evaluations in 2011-2012 were evaluative and mainly quantitative (right hand side of Figure 4), that is, they were oriented towards evaluation of the developed prototypes and demonstrators and towards studying correlations between variables.

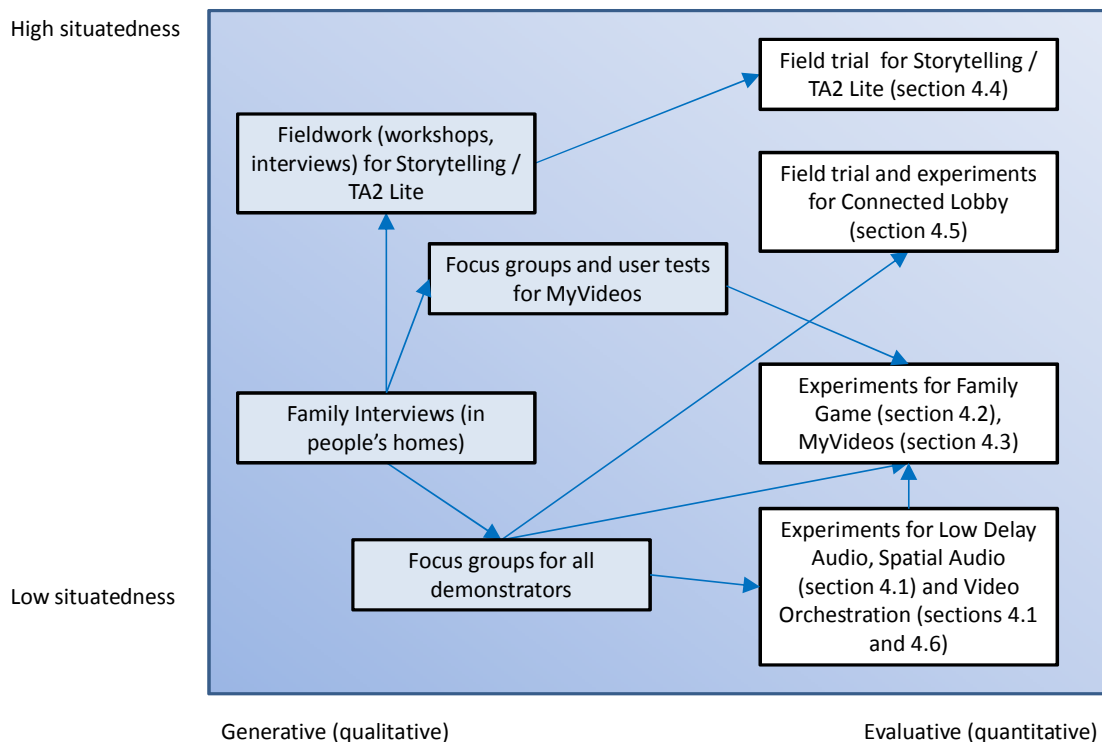


Figure 4. Diverse methods for user studies and evaluations

Overall, the iterations of research, design and evaluation, and the parallel development and evaluation of different TA2 demonstrators (see also D8.10 Lessons learned and Visions) helped to improve the *validity*, *reliability* and *generalizability* of the findings reported in this report. Moreover, the



evaluations of the different TA2 demonstrators helped to develop an overall understanding of the different layers of experience. See Figure 5 for a plotting of the different experiments and field trials unto the different layers of the Social User eXperience Framework.

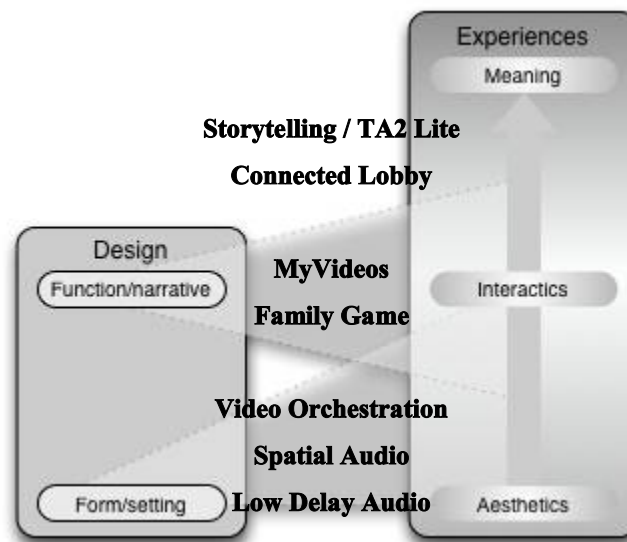


Figure 5. The different experiments and field trials plotted unto the different layers of the Social User eXperience Framework

In the next three sections, we briefly discuss three traditions that we drew from in organizing our evaluations and user studies: *action research* (Kock 2011), *social-constructionism* (Shotter 1993; Easterby-Smith et al. 2002) and *design thinking* (Cross 1995, 2006, 2011).

3.2 Action research

Our ways of combining theoretical and practical questions can be understood within the tradition of *action research*, which—in the context of TA2—can be understood as ‘the study of how technology is applied in the real world and the practical consequences of technology-enabled action’ (Kock 2011).

The TA2 project-team members that organized the diverse user studies and evaluations were involved in *action research* in the sense that they tried ‘to provide a service to a research “client”’ (op. cit.), in this case the vision holders and technical coordinators of the various TA2 demonstrators and prototypes, ‘and at the same time add to the body of knowledge in a particular domain’ (op. cit.), in this case the domains of user experience (HCI and CSCW) and social science. In effect, action research needs to ‘satisfy two “masters”’ (op. cit.), in this case the TA2 project and the broader research community. Kock (2011) argued that ‘it has been harder to satisfy the latter, especially in fields of inquiry where Action Research has not traditionally been used very often, such as in technology-related research.’



In action research one often starts with (practice-based or theory-based) *research questions*—rather than with *hypotheses*, which would be typical in, for example, experimental research (Kock 2011)—see Chapter 1 for TA2’s research questions, which are indeed based on both practice and theory.

Furthermore, action research is often conducted ‘through multiple iterations’, rather than a “one shot,” non-cyclical research design’ (op. cit.). This ‘action research cycle’ often ‘involves the identification of practical problems, the solution of those problems, and reflection on the part of the researcher, which is then followed again by the identification and solution of problems, new reflection, and so on’, which ‘tends to add validity and credibility to the research findings, as repeated observations in various iterations lead to the identification of clear patterns’ (op. cit.).

3.3 Social constructionism

Our approach draws from social-constructionist approaches (Easterby-Smith et al. 2002), which is quite different from positivist approaches.

Positivist approaches are based on the assumptions that ‘the social world exists externally’ and that a researcher’s task is to measure its properties, whereas social-constructionist approaches are based on the idea that “‘reality’ is determined by people rather than by objective or external factors’ and that a researcher should be concerned with ‘what people, individually and collectively, are thinking and feeling, and attention should be paid to the ways they communicate with each other’ (Easterby-Smith et al. 2002, pp. 30-31). Positivism is typically appropriate for studying fixed, reproducible situations, such as phenomena in nature (in natural sciences), whereas social constructionism is typically appropriate for studying complex and unpredictable situations, such as situations that involve people and groups (in social sciences). Moreover, the TA2 project aims to better understand *specific, contextualized* ‘real life’ social situations and ways to improve these via design (intervention), rather than aiming for finding *general, universal* facts or law-like relationships (reproduction).

Please note that in social constructionism—just like in positivism—one needs to seriously address concepts like *validity*, *reliability* and *generalizability*. However, the meanings of these concepts are rather different in these two approaches (Easterby-Smith et al. 2002, p. 53): in positivist approaches, *validity* refers to how closely the measures correspond with reality, *reliability* refers to whether the measures yield the same results on other occasions, and *generalizability* refers to whether the study confirms or contradicts existing findings, whereas in social-constructionist approaches, *validity* refers to whether access is gained to the experiences of the people studied, *reliability* refers to transparency in the process of making sense from the data, and *generalizability* refers to whether concepts from one study are relevant to other settings.

In TA2, we aimed for *validity* by making sure that we indeed access the people’s experiences, e.g. by using various methods (observation, interviews, workshops, trials, experiments, etc.), we aimed for *reliability* by reporting transparently about the process of moving from ‘raw data’ to conclusions—cf. the way in which we *first* present our findings as objectively as possible, and *then* discuss and interpret them (Chapter 4)—and we aimed for *generalizability* by attempting to make our findings relevant to other settings, e.g. to articulate conclusions and recommendations, for both scholars and practitioners.

Kock (2004) identified three issues that one needs to cope with in action research: *uncontrollability* (in e.g. focus groups or field studies one has less control over the social situations, compared to, e.g. a lab experiment); *contingency* (in e.g. focus groups or field studies, one cannot isolate one aspect of the



social situation, compared to, e.g. a lab experiment); and *subjectivity* (in e.g. focus groups or field studies one is likely to be more subjective, compared to, e.g. in a lab experiment).

We chose to cope with these issues by using ‘mixed methods’, an approach in which we conducted different forms of user studies, offering different benefits. E.g. the benefit of field trials, of testing out prototypes in people’s homes over the course of weeks, has benefit of realism, but also has the drawbacks of relatively high levels of *uncontrollability*, *contingency* and *subjectivity*. On the other hand, the lab experiments offer the benefits of low *uncontrollability*, *contingency* and *subjectivity*, but are less realistic. By combining methods, we hope to get ‘the best of both worlds’.

3.4 Design thinking

In addition, our approach draws from *design thinking* (Cross 1996, 2006, 2011; Lawson 2006), which is quite different from, for example, science or engineering.

Science is typically concerned with describing and understanding past or current situations and with discovering ‘facts’, whereas design is concerned with envisioning and realizing alternative situations, and with both facts and values. Furthermore, engineering is typically concerned with solving a problem that is given beforehand and finding one ‘best’ solution, whereas design is concerned also with exploring, discussing and articulating alternative problem definitions and with exploring and developing and evaluating alternative solutions.

Design thinking can be understood as *abduction*, a term coined by pragmatist philosopher C.S. Peirce for a type of reasoning that is different from deduction or induction: ‘deduction proves that something must be; induction shows that something actually is operative; abduction merely suggests that something may be’ (C.S. Peirce, quoted in Cross 1995).

In design thinking, one acknowledges that design is concerned *both* with exploring and articulating problems, *and* with exploring and developing possible solutions—and that these processes are intimately intertwined: the ‘design process involves finding as well as solving problems’ (Lawson 2006, p. 125) and the ‘problem and solution co-evolve’ (Cross 2006, p. 80). Thackara (2006) summarized design thinking as simultaneously and iteratively addressing these two questions: ‘where do we want to be?’ and ‘how do we get there?’

Our approach can be understood as design thinking in that we organized simultaneous and iterative activities for research and design and evaluation, during which project-team members focused on the understanding of togetherness, on designing for togetherness and on evaluating of togetherness.

Design thinking can be understood as a way to cope with uncertainty and complexity, and to make progress in spite of this uncertainty and complexity, e.g. by organizing iterative processes in which project-team members develop and evaluate all sorts of scenarios and demonstrators in the course of the project, in order to both explore and articulate the problem, and to explore and develop possible solutions—in a process of gradually developing shared understanding of what the project is about and of what needs to be done (Steen et al., forthcoming) and as a process of collaborative design thinking, (Steen, forthcoming).



4 User studies and evaluations

In this chapter, we address the—seemingly simple—research questions: *How do people experience the various TA2 applications? And what are the effects of specific features of these TA2 applications on people's social experiences?* We report on a range of user studies that were carried out in 2011 and 2012. For each user study, we report the following five issues:

1. Introduction: research questions or working hypotheses
2. Approach: the method(s) used to make the evaluation
3. Findings: reported as objectively as possible
4. Interpretation: offering a discussion of the findings
5. Implications: conclusions and recommendations for design

The evaluation results reported here do not constitute all the results from user studies generated from TA2 but they do bring together the results that have systematically explored how the concept demonstrators developed within the project affect the elusive construct, togetherness.

Evaluations that are *not* reported here include those of early stage demonstrators such as JumpStyle, a concept demonstrator developed in the first 18 months of the project designed to enable young people to learn dance moves together. Findings from focus group discussions about JumpStyle are reported in public deliverable D8.4 Evaluations of TA2 concepts (pp. 36-40). Likewise the results of Music Tuition, which followed a twin-track approach, and reported ethnographic observations of traditional face to face music lessons on the one hand and proof of concept trials of a system based on the successful integration of TA2 components with a commercial video conferencing system. The results of investigation concerning Music Tuition are reported in public deliverable D3.5 Summary Report: Application Design and Implementation (pp. 53-62).

4.1 Low Delay Audio, Spatial Audio and Video Orchestration experiments (2011)

4.1.1 Introduction

In the TA2 project several technology capabilities that we believe will *improve social communication amongst groups of people that are separated in time and space* have been developed. These capabilities are used in the development of the five concept demonstrators. In this section, we focus on the evaluation of three of these capabilities apart from their existence within a wider concept demonstrator. The capabilities in question are:

- Low Delay Audio: the ability to encode and transmit audio between locations with minimal delay. The anticipated benefit of Low Delay Audio is that it makes communication better, more natural since delays will be reduced so that they are close to those experienced in normal face to face communication.
- Spatial Audio: the ability to place sounds from a distant location at a particular position in the sound field of the local location. Thus someone speaking who can be seen to be on the right hand



side of the remote room is heard more prominently through the right hand speakers.

The anticipated benefit of spatial audio is that, because it will mirror the spatialisation of sound that most of use experience in normal face to face communication it should make the communications better in some way.

- Video Orchestration: the ability to automatically choose one camera angle (from many) to transmit the scene, or a portion of it, from the remote location to the local screen.
The anticipated benefit of video orchestration is that it provides a more engaging representation of the remote scene and where multiple end points are involved provides a better representation of the social interaction. Whereas Low Delay Audio and Spatial Audio attempt to make the system appear more like real life, video orchestration attempts to use a new learned language – that of film to better represent the interaction.

The three constructs Social Presence/Presence (SPP), Naturalness (N) and Immersion/Engagement (I/E) were probed through each the experiments.

4.1.2 Approach

Lab experiments were organized in which people experienced and evaluated the three prototypes capabilities. These experiments were conducted in controlled environments. Before, during and after the experiments, participants were asked to fill-out questionnaires. The questionnaires contained the following kinds of questions:

- Questions concerning participants' backgrounds
- Questions concerning experiences on the level of Aesthetics:
 - Social Presence/Presence
 - Naturalness
 - Immersion/Engagement
- Questions concerning participants' overall evaluation of Quality of Communication

In addition to these questionnaires, video recordings and logging of participants' usage of the system were made.

4.1.2.1 Low Delay Audio and Spatial Audio

The Low Delay Audio and Spatial Audio experiments were conducted at Fraunhofer. 30 people participated in the Low Delay Audio experiments. 36 people participated in the Spatial Audio experiments. All participants were Fraunhofer employees that knew each other.

During the low audio delay experiment five different delay conditions were tested: 100ms, 150ms, 200ms, 400ms and 800ms. Half of the participants went from a low towards high delay according to these conditions. The other half went from high towards low delay, to test on interaction effects. Furthermore after each condition people rotated clockwise (two persons changed rooms after each condition) to compensate for the effects from for example personal communication styles, etc.

During the spatial audio delay experiment three different conditions were tested: mono sound, stereo sound and spatial sound. Half of the participants went again from worst quality (mono) to best quality (spatial) and the other half of the group from best (spatial) to worst (mono). The first condition people



got was repeated after the last condition to observe possible interaction effects, which were not found. Therefore, each participant played in 4 conditions (the first condition repeated). After each condition participants rotated again clockwise (2 persons switched rooms) to prevent personal biases such as those introduced by personal communication styles.

In both experiments, people played in groups of six, each time divided over two rooms (three people per room), for 10 minutes in each condition. After each condition they filled out a questionnaire. The game they played was Pictionary. One could win a point either by drawing a picture that was guessed correctly or by being the first guessing a picture correctly, so with each new turn 2 persons could score a point. The game was played with a touch table that presented the assignment (word to be drawn), the drawing board and the status board which indicated how many points each person collected. Players had to monitor the rules and move the game pieces themselves.

4.1.2.2 Video Orchestration

The Video Orchestration experiments were conducted at Goldsmiths. A total of 32 people participated in these experiments. These people knew each other well, as they were recruited as groups of friends.

In the video orchestration experiment, three different conditions were tested, no orchestration, orchestration (real time editing to represent the social situation and gameplay best from 5 different camera's) and random orchestration (in which the video camera feeds were randomly chosen, manipulated and presented). These conditions were 'randomly controlled' tested with groups of 4 people at a time playing Pictionary. The same rules as in the audio experiments applied. One could win a point by drawing a word that was guessed or by guessing a word correctly based on the drawing. However, the game was played with a real pencil and paper which participants had to show to the others present. Furthermore people did not rotate but stayed in the same room.

4.1.3 Findings

First, we examined whether the theorized experiences are sufficiently robust and reliable. All the items used (12 in total) used a 5 point scale ranging from 'totally/strongly disagree' to 'totally/strongly agree'. Experiences were measured using multiple items: combining them resulted in more reliable proxies and estimators of those experiences:

- Social Presence/Presence (SPP) (6 items)
- Naturalness (N) (3 items)
- Immersion/Engagement (I/E) (3 items)

We found that all experiences were empirically verified by Factor Analysis (method: principal axis factoring, oblimin rotation), see Table 1.

The Cronbach's Alpha of the three constructs (SPP, N, I/E) were calculated. Cronbach's Alpha is a reliability measurement which tells us how much the items within a certain construct (group of items) measure the same 'thing' based on intercorrelations (Hair et al., 2005). The generally agreed upon lower limit for Cronbach's Alpha is .70, although it may decrease to .60 in exploratory research. The number of items affects Cronbach's alpha in a positive way. The more items are placed within a construct the more stringent the result of the Cronbach's Alpha should be interpreted. The smaller the number of items the less stringent the criteria addressed above should be used.



Table 1. Values of Cronbach's Alpha's for various experiments

	Low Delay Audio	Spatial Audio	Video Orchestration
Social Presence/Presence (SPP)	.831	.754	.767
Naturalness (N)	.732	.825	.843
Immersion/Engagement (IE)	.816	.740	.858
N Delay	150 (30)		
N Spatial	108 (36)		
N Video	96 (32)		

N of experiments are based on person-period file.

N between parenthesis are real number of test subjects.

Second, we used variance analysis to determine whether delay, spatial, and orchestration had any influence on these experiences. The results are listed below.

For Low Delay Audio:

- Delays within the 100ms, 150ms, 200ms, 400ms and 800ms range do not significantly affect Social Presence, Naturalness and Immersion / Engagement.
- However, some substantial differences were found indicating that Low Delay Audio influences some lower order aspects such as Social Presence and Naturalness.
- Increasing Delay negatively affects interaction performance (number of drawings correctly guessed on the other side).
- From 150/200ms and larger delays these affect start to show.

For Spatial Audio:

- Spatial Audio significantly affects Immersion/Engagement (spatial audio is best, followed by stereo audio and mono audio).
- Spatial Audio does not affect Naturalness, Social Presence/Presence.

For Video Orchestration:

- Video Orchestration does affect Social Presence/Presence, Naturalness and Immersion/Engagement significantly. The non-orchestrated condition scored highest on all three experiences.

Next, correlations were calculated and regression models¹ were examined to examine to what extent the experiences influence the Quality of Communication (QC). In Table 2, Table 3 and Table 4

¹ All regression models were checked for multicollinearity, but this was not present. Although, some non-significant effects switched sign when the dimension they correlated highest with was left out of the model. However the effect itself remained non-significant. Several models (leaving dimensions out randomly) were run but resulted in similar results.



correlations are presented for delay, spatial, and orchestration respectively. These findings show that all experiences are positively correlated with each other. In addition, experiences are positively and significantly correlated with Quality of Communication.

Table 2. Correlations between dimensions and experienced quality – Low Delay Audio

	N	IE	Quality
Social Presence/Presence (SPP)	.593**	.307**	.426**
Naturalness (N)	-	.361**	.547**
Immersion/Engagement (IE)		-	.429**
N Delay	136		
**= sign. $p < .01$ (two-tailed)			
N based on person-period file			

Table 3. Correlations between dimensions and experienced quality – Spatial Audio

	N	IE	Quality
Social Presence/Presence (SPP)	.734**	.665**	.535**
Naturalness (N)	-	.569**	.678**
Immersion/Engagement (IE)		-	.583**
N Spatial	103		
**= sign. $p < .01$ (two-tailed)			
N based on person-period file			

Table 4. Correlations between dimensions and experienced quality – Video Orchestration

	N	IE	Quality
Social presence/Presence (SPP)	.719**	.701**	.517**
Naturalness (N)	-	.689**	.584**
Immersion/Engagement (IE)		-	.425**
N Video	96		
**= sign. $p < .01$ (two-tailed)			
N based on person-period file			

Finally, regression analysis was conducted to study which experiences are most important for Quality of Communication and which are relatively less important—see Table 5, Table 6 and Table 7. The higher the coefficient, the more important the experience. These tables also show which experience has a significant relationship with Quality of Communication, controlled for the other experiences. In general, Naturalness is most important for a good evaluation of overall Quality of Communication.



Table 5. Regression on experienced quality (Low Delay Audio)

	B	Beta
Constant	.045	
Social Presence/Presence (SPP)	.111	.116
Naturalness (N)	.371**	.390
Immersion/Engagement (IE)	.245**	.252
R ²	.356	
N	135	

**= sign. $p < .01$ (two-tailed)

N based on person-period file

Table 6. Regression on experienced quality (Spatial Audio)

	B	Beta
Constant	1.135**	
Social Presence/Presence (SPP)	-.073	-.087
Naturalness (N)	.409**	.559
Immersion/Engagement (IE)	.271**	.306
R ²	.496	
N	103	

**= sign. $p < .01$ (two-tailed)

N based on person-period file

Table 7. Regression on experienced quality (Video Orchestration)

	B	Beta
Constant	2.129**	
Social Presence/Presence (SPP)	.226*	.220
Naturalness (N)	.348**	.455
Immersion/Engagement (IE)	-.036	-.042
R ²	.341	
N	96	

**= sign. $p < .01$ (two-tailed)

N based on person-period file



4.1.4 Interpretation

The three constructs that were used to measure aesthetic experiences—Social Presence/Presence (SPP), Naturalness (N) and Immersion/Engagement (I/E)—hold across all experiments.

For Low Delay Audio and Spatial Audio: Naturalness (mainly resulting from Audio Delay) and Immersion/Engagement (mainly resulting from Spatial Audio) are important for the experienced Quality of Communication. However, the game design seems to have relatively more effect on Immersion/Engagement.

For Video Orchestration: Social Presence/Presence and Naturalness are important for the experienced Quality of Communication. For task performance, that is, the ‘number of correct guesses during the game play’, the orchestrated condition was best, even though the experiences of Social Presence/Presence and Naturalness are lower in this condition compared to the randomly orchestrated condition.

Overall, the effects in the Video Orchestration experiments were larger than the effects in the Low Delay Audio and Spatial Audio experiments. In other words: video had larger effects than audio.

All experiences are positively and significantly correlated with each other. In addition, experiences are positively and significantly correlated with Quality of Communication. However, based on regression analysis Naturalness seemed most important. The more natural the experience; the better the perceived Quality of Communication.

4.1.5 Implications

There are very limited effects of Low Delay Audio on people’s experiences within the 100ms-800ms delay range. Also, the effects of Spatial Audio are confined to Immersion/Engagement. In contrast, Video Orchestration had larger effects on people’s experiences. It is thus important, when designing for social interactions, to provide good visual information and cues, and to provide a ‘natural’ environment.



4.2 Family Game experiments (2011-2012)

4.2.1 Introduction

The Family Game demonstrator was developed as a novel approach to support shared activities and mediated communication within and between groups of people who already share strong social ties. Family Game supports synchronous communication through audio/video and shared activities by means of cooperative games in which people in two or three locations have to work/play together during a short period of time. Communication is organized during and around these games. The aim of Family Game is to demonstrate that shared activities can contribute to an enhanced feeling of social connectedness in addition to the social audio/video communication means that are available commercially at this moment.

The Family Game concept demonstrator consists of different technological parts. It uses video orchestration and spatial audio to represent the game as well as the social situation and it includes the game itself. The game is set within a space ship. All persons involved in the communication are part of the crew and the goal is to get back to earth by visiting planets along the way to gather energy for the spaceship. You can gather energy by playing mini-games available at each visited planet. The mini games tested during the evaluation of Family Game are: Space Cruiser, Meteorite Girl and Pitch Matching. The mini games tested were set-up for two room playing and communication (three rooms can also be supported). Interaction for the mini games was through a Kinect motion sensor and/or RFID card reader for the RFID cgame cards.

Space cruiser was implemented such that in one room a captain of the cruiser was steering the space ship through an asteroid field by holding an 'invisible steering wheel' and by moving this wheel towards or away from him/herself to go up or down. A player in the other room had the role of wiper, meaning he/she had to wipe asteroids from the screen before they would hit the space ship.

Meteorite Girl is played by two people cooperating as well. In one room a player would stand up before the television screen and would see him/herself represented as an outlined figure. Falling asteroids that should be avoided were not visible on this screen, only the impact of an asteroid hitting the player. A player on the other side would give instructions to the other player to correctly avoid falling asteroids. In this room the player at the other side was visible on the television screen as an outlined figure, as well as the falling asteroids.

In Pitch Matching one person from each room tries to sing a tone that matches a tone presented to the users by the Family Game system. After the tone was presented a bar would start moving across the screen indicating the tone pitch and a singing arrow would move up and down along with the tone height of the singers moving up and down. The goal was to match the presented pitch. The longer the presented pitch was matched, the more energy the participants gathered for the space ship.

4.2.2 Approach

The Family Game evaluation consisted of two parts. The evaluation of the Family Game itself, as well as an evaluation of the board game *The Forbidden Island*. Both games are cooperative and similar in that each player has a turn and that communication and interaction with other players during the game is necessary. Furthermore, each player had his/her own specific role with specific activities/abilities.



We used the board game as a comparison situation to the experiences while in the Family Game setting. We are aware of the differences between these two situations of game playing. The underlying game mechanics and in the interaction itself are different. The board game is played on a board, with cards and other game pieces and people communicate directly with each other (not-mediated), whereas Family Game is played through interaction with the Kinect and RFID cards and reader and people communicate through audio/video communication (mediated).

During the evaluation we used multiple methods for data collection, including several questionnaires:

- A general questionnaire beforehand (asking for information about the relations of a specific person towards others in the group playing the game and to the group as a whole)
- Questionnaires after each condition (playing the Family Game or playing the board game);

Group interviews were used after playing the games to obtain qualitative information about the experiences people had. Furthermore video recordings were made throughout the evaluations (in both conditions). Before the experiments started, people filled-out consent forms, indicating they agreed to the evaluation activities, data gathering, treatment of data, storage, and further usage of materials gathered during the experiments. After the experiments they signed a form for transferring 30 euros in addition to their traveling costs to their personal bank accounts.

Each evaluation group consisted of four people that knew each other well (families or groups of friends). Participants were recruited through TA2 project personnel and through a recruitment agency. In total 36 people participated in the experiments. Half of the groups started with the Family Game (45 minutes) and then played the board game (45 minutes). The other half of the groups started with the board game and then played the Family Game. The youngest participant was 9 years old, the eldest 59. The mean age of the 36 participants was 22.5 years old.

Before starting the board game, people received 15 minutes of instructions on how to play the game, after which they started playing the game. During the tests people would get instructions on how to use the system (one game round) before playing a second game round completely by themselves.

Participants were invited to fill-out several questionnaires:

Before the evaluations:

- Background information (name, age, sex, etc).
- Characteristics of their personal relationship with the others and with the others as a group (personal effort; thinking about each other; sharing experiences; staying in touch; recognition group attraction; IOS (Identification of Other in Self) and OSIO (Overlap of Self; Ingroup and Outgroup) (the latter two constructs are oriented towards ‘meaning’).

After each condition (Family Game and board game):

- Characteristics of their personal relationship as experienced at that moment (immediately after playing) (personal effort; thinking about each other; sharing experiences; staying in touch; recognition group attraction; IOS and OSIO).
- Aesthetic experiences: Social Presence/Presence (SPP); Naturalness (N) and Immersion/Engagement (I/E).



- Interactive experiences: Quality of communication (QS); Social Connectedness (SC); and Challenge (Ch) and Emotion: affect (positive versus negative); arousal (relaxed versus aroused; and dominance (being in control versus being controlled))

After all the evaluations:

- Group interview in which the focus was on how people experienced both conditions in terms of social connectedness and a feeling of togetherness and a comparison between conditions to learn in what way the FamilyGame could be enhanced in terms of supporting social connectedness even more.

4.2.3 Findings

In addition to the group interviews all 36 participants filled out questionnaires beforehand and after each condition (playing the Family Game or the board game).

Table 8 summarizes the Cronbach's Alpha's for the aesthetic constructs used in earlier experiments compared to the Family Game evaluation: Social Presence/Presence, Naturalness and Immersion/Engagement.

Table 8. Cronbach's Alpha for Social Presence/Presence, Naturalness and Immersion/Engagement.

	Audio delay	Spatial audio	Video orchestration	Family Game	Board game
	Earlier experiments			Current experiments	
Social presence/Presence (SPP)	.831	.754	.767	.899	.640
Naturalness (N)	.732	.825	.843	.851	.877
Immersion/Engagement (IE)	.816	.740	.858	.897	.635

From this table we can conclude that the Cronbach's Alpha's are consistent enough over different measures/evaluations. Meaning the constructs show 'internal validity' across measures for the aesthetic constructs. The SPP for the board game is somewhat different from the other Cronbach's Alpha's, this is due to the fact that one item (measuring the feeling of presence in the virtual situation) was lacking. IE in the board game has a lower Cronbach's Alpha as well. We assign this result to the fact that in real life situations or in this case playing the board game the item related to 'feeling part of the activity' is interpreted differently than it is in a 'virtual situation' as is the case in the other measures. When this item is left out of IE, the Cronbach's Alpha goes up and is .660, a little higher.

When we compare the Cronbach's Alpha's for the Quality of Communication (QC); Social Connectedness (SC) and the Challenge (Ch), all part of interactive experiences, we see that the Alpha's are very similar across playing the board game and playing Family Game—see Table 9. This indicates that these constructs have sufficient 'internal validity' over both tested situations.



Table 9. Cronbach's Alpha for Quality of Communication; Social Connectedness and Challenge

	Family Game	Board game
Quality of Communication (QC)	.866	.861
Social Quality (SC) (2 items remaining)	.889	.824
Challenge (Ch)	.785	.851

When we look at the aspects playing a role in long term relationships and how these are experienced over time (e.g. Personal effort, Thinking about each other, Sharing experiences, Staying in touch, Recognition, and Group attraction) we see that only the Cronbach's Alpha's for Thinking about each other (TA) and Group attraction (GA) carry sufficient internal validity—see Table 10.

Table 10. Cronbach's Alpha for Thinking about each other and Group Attraction

	Before start of experiment	After Family Game	After board game
Thinking about each other (TA)	.700	.545	.603
Group attraction (GA)	.858	.903	.851

The reason why these two constructs are interpreted in the same way when asked in the context of one's relationship or after playing the game (Family Game or board game) is that they ask about an experience on a specific moment in time (e.g. a contact moment in the past and what happens after that in terms of experiences). The other constructs carry items that more generally ask a participant about their experiences of a social relationship over time, not a specific moment therein. When asked in the context of your relationship to the others, the items are therefore differently interpreted then when asked about your experience of a specific contact moment. Most of these items could be placed in the Meaning category of experiences.

Other remaining items that were used in the evaluation but as separate items not belonging to constructs were: IOS; OSIO and the three dimensions of emotions: affect (positive versus negative); arousal (relaxed versus aroused); and dominance (being in control versus. being controlled), measured with SAM items (Bradley and Lang 1994).

Findings from the questionnaires show that IOS scores improve by playing the Family Game and the board game for the second and third personal relation in the questionnaire. People tend to fill out the IOS questions about 'how close they are to another specific person in their group of four people' by mentioning the person first to which one feels closest, followed by persons with which one feels less closeness, etc. These results indicate that a close relationship is NOT changed by playing, but that a more distant relationship is experienced as more close after playing. The Family Game has a moderate effect on IOS, the board game has a larger effect. Though the results are not statistically significant, they are substantial.



These results indicate that a close relationship is *not* changed by playing, but that a more distant relationship is experienced as more close after playing. The Family Game has a moderate effect on IOS. The board game has a larger effect. Though the results are not statistically significant, they are substantial.

For the experience of closeness to the group (OSIO) we found a similar trend, but no statistically significant results. There is no difference between ‘before the start of the test’ and the Family Game, but there are substantial differences between the ‘before the start of the test’ score on OSIO and the OSIO score after the board game and between the Family Game and the board game. The OSIO measure before the start of the experiment is lowest, followed by the OSIO score after playing the Family Game and the OSIO score after playing the board game is highest.

Thinking about each other (TA) and Group attraction (GA) do not differ over the three conditions (before the evaluation, after the Family Game, after the board game).

If we look at the other constructs, we see differences in means between the Family Game and the board game, but most of these differences are not statistically significant—see Table 11.

- On Social Presence/Presence (SPP); Naturalness (N); Immersion/ Engagement (IE); Challenge (CH); Social Connectedness (SC) and Quality of Communication (QC) the board games scores on average a little bit better.
- For the emotional arousal (part of the SAM measure), the Family Game scores best and this difference is statistically significant. The emotional affect (part of the SAM measure) is higher compared to the board game, but this difference is not statistically significant.

Table 11. Paired Sample Tests: Family Game versus Board game

	Dif. Mean	S. Dev.	Sign.
Social Presence/ Presence (SPP)	-.714	.921	.000
Naturalness (N)	-.676	.921	.000
Immersion/ Engagement (IE)	-.509	.845	.001
Challenge (CH)	-.396	.768	.004
Social Connectedness (SC)	-.287	.643	.011
Quality of Communication (QC)	-.456	.661	.000
Affect (SAM)	.444	.909	.006
Arousal (SAM)	.139	.990	.406*



Thinking about each other (TA) and Group Attraction (GA) are not affected by playing the Family Game or playing the board game.

4.2.4 Interpretation

The overall findings from the group interviews indicated that people in general liked the social interaction during playing the board game better than during playing the Family Game. The main reason for this is that the board game made continuous communication and cooperation a necessity during each participants turn. During the Family Game two people (one in each room) were playing the mini game with each other, sometimes interacting a lot (e.g. during meteorite girl), sometimes interacting a little bit less (e.g. during space cruiser or pitch matching). The other participants, i.e. the remaining two players, often watched the gameplay and had fun while doing so. This way of interacting is different from playing a board game—where different does not mean better or worse, but different.

Furthermore, while playing the games, the main focus and most of the television screen was on/used for the game representation. People watched the activity mainly and were paying less attention to the social situation on the other side (the smaller window on the television screen).

Related to the fun people had during both games, people often report a preference for the board game, but they sometimes had more fun during playing the Family Game. We think this is largely related to the fact that the Family Game was more thrilling, there was more tension in short periods of times, than was the case during playing the board game. In the board game fun was often related to the social communication and a feeling of connectedness and direct contact. In the Family Game fun was often related to the thrill of playing the mini games.

In addition, we learned the following from the observations, group interviews and questionnaires:

During the Family Game tests the system did crash sometimes (on average once during each test). This did affect the experience people had related to the usability of the system. Furthermore, participants were not always clear how they should interact with the system and sometimes the test leader had to provide advice. Though we did test on experiences after people had the change of playing with the Family Game system without any crashes it might have affected the experiences of the participants a little bit. The stability and usability of the system are at least points of attention that need to be addressed in further development.

Most participants liked the social interaction better in the board game compared to the Family Game. In the group interviews this was explained as the board game needing continuous social interaction to play the game, while the Family Game required less social interaction (you could play some games on your own without communication with the other side). Furthermore the Family Game was designed such that the gameplay and social interaction were supported in different windows on the television screen. The ‘game window’ taking quite a lot of space and the ‘social interaction’ window being much smaller. While playing the mini games participants’ main attention was on the gameplay itself (the ‘game window’) and sometimes people hardly or didn’t even notice the window representing the ‘social interaction at the other side’. These results are confirmed in the questionnaire by the IOS scores. People tend to score their ‘closeness’ to the second and third person (with whom the ties are less strong compared to the first person) as being improved more by the board game, followed by the Family Game, though these results were substantial but not significant. The same trend is observed in the OSIO scores. Before the start of the experiment this score is lowest, after the Family Game it is



higher and after playing the board game it is highest. Group attraction scores remain the same before and after all tests. This is not surprising since Group attraction addresses ‘an overall feeling of involvement, being part of and unity’ in the group which will most probably only change after longer periods of time. The differences in experiencing Social Presence/Presence are quite large (.714 dif. means with the board game experience being best) but not significant. The same goes for naturalness (.676 dif. means), Immersion/Engagement (.509 dif. means) and Quality of Communication (.456 dif. means) (also not statistically significant). Social quality (.287 dif. means) did not differ very much between the board game and the Family Game).

With respect to fun, people said they liked the board game better. This seemed to be related to the social interaction during the board game. The Family Game was more thrilling to play due to the short periods of intensive gameplay in the mini-games and the fun it provided during these periods. This is confirmed by the questionnaire results in terms of the measured emotions (affect and arousal). The experience of the Family Game was more positive (.444 dif. Means) compared to the board game (though not statistically significant). Arousal was higher in the Family Game (statistically significant). Overall, it can be concluded that the Family Game did very well compared to the board game in these tests since there are only few significant differences. Though people tended to experience a real life situation better and socially more enjoyable, the Family Game is a very good alternative to have high quality social interaction with others when no other means are available.

4.2.5 Implications

The results obtained by testing Family Game and comparing it to the base line situation of playing a cooperative board game have the following implications for the design of the Family Game:

- The stability of the system and the usability of interacting with the system could/should be improved.
- The social interaction and the experiences following from this interaction can be improved by better integrating the shared activity in Family Game with the social interaction with the other room. This suggests that social interaction and the shared activity could be made more in line with each other so that social interaction is an even larger necessity to perform the shared activity (as it was with the board game). In earlier test with for example orchestration the shared activity (playing Pictionary) and the social situation (representation thereof) were completely integrated since people had to show their drawings on paper to the other side. Such solutions might be thought of.
- The social interaction could also be improved by creating game mechanisms in which people do not perform so much on their own (having their own specific task in the mini games) on which they focus very much during play. One could for example use game mechanisms that maybe provide less individual thrill and excitement but are to a higher degree dependent on the performance and monitoring this performance of the other players involved in the shared activity.



4.3 My Videos experiments (2011-2012)

4.3.1 Introduction

The MyVideos concept demonstrator has been developed as a novel approach to mediate communication within groups of people who already have social ties. Specifically, it addresses asynchronous communication and scenarios in which groups of people are motivated to edit and share audiovisual material over extended time periods. The aim of MyVideos is to demonstrate how a relatively dynamic social group – in this case, families that may otherwise have limited interactions – can be brought together by contributing media assets for common use. Unlike many collaborative editing systems, the primary purpose of the content sharing is not the publishing of completed assets, nor the joint development of a collective common work, but the provision of support for telling stories to each other when people are not together, replicating asynchronously, though mediation, the habit of chatting and discussing events in which family and friends took part.

During the first phase of MyVideos, a complete prototype implementation was developed and tested (cf. project deliverable D7.9 Lite Authoring Tools for Personal Narratives). Following a long-term human-centred design process, the prototype was evaluated in the Netherlands (Guimarães et al. 2011) by a group of people who had recorded a concert of their relatives and friends. The insights gained from the evaluation, together with further focus groups, have been used for designing and architecting MyVideos 2.0 (cf. project deliverable D7.14 Lite Authoring Tools for Personal Narratives).

For the second phase of MyVideos, a new set of use cases for the concept demonstrator were developed based on feedback and lessons learned after the evaluation of MyVideos 1.0. A new set of application components were designed and built with a strong emphasis on both the exploration of a media space and the authoring of a personalized narrative as separate, but complementary activities. Both can be enhanced through user interaction and the gathering of user behaviour profiles to assist with personalization and recommendation.

Figure 6 shows the key components in MyVideos Phase 2 and how they fit within a simple user workflow. Each column represents a stage in the workflow with a specific user goal, and the inputs to, and outputs from, each stage are shown in red.

The first stage is common to both MyVideos 1.0 and 2.0 and provides the mechanism by which digital media is captured during an event, and subsequently processed to create a collection of media clips which are accompanied by structured annotations. The structure and semantics of these annotations are dictated by the requirements of the subsequent stages. Deliverable D7.14 (Lite Authoring Tools for Personal Narratives – Final Release) describes in detail how the Capture and Annotation workflow has been enhanced in MyVideos Phase 2.

The second stage is focused on media browsing and navigation. It investigates enhanced ways to access a vault of digital media while making use of personalized narratives. It includes two new components, which build on those developed during MyVideos 1.0.

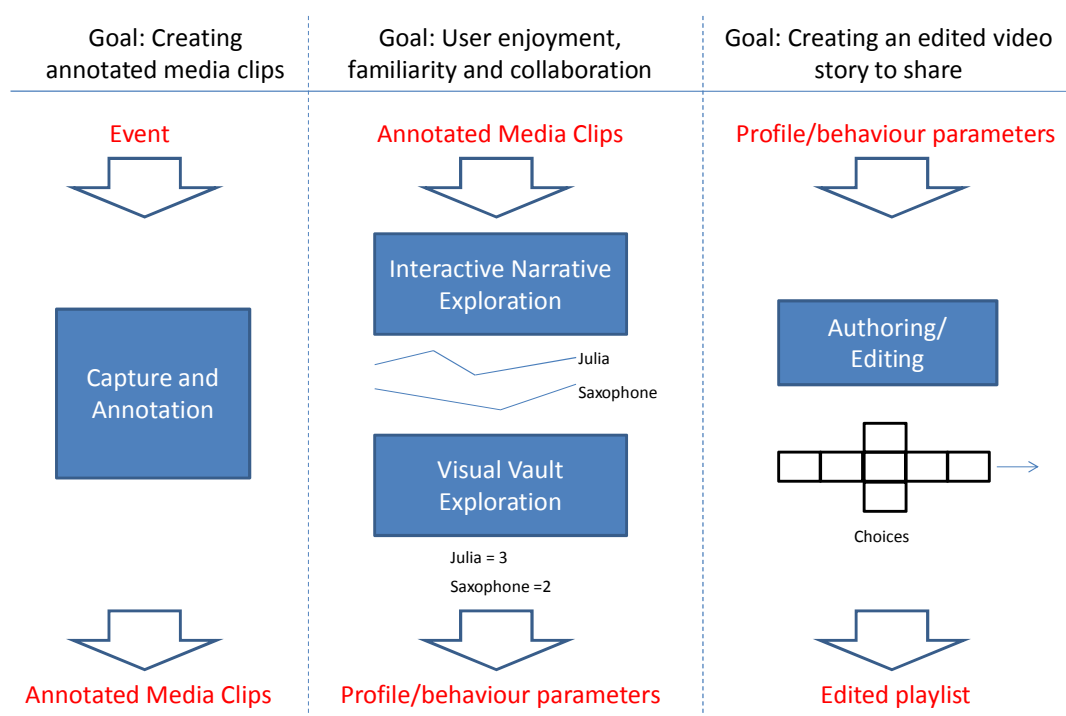
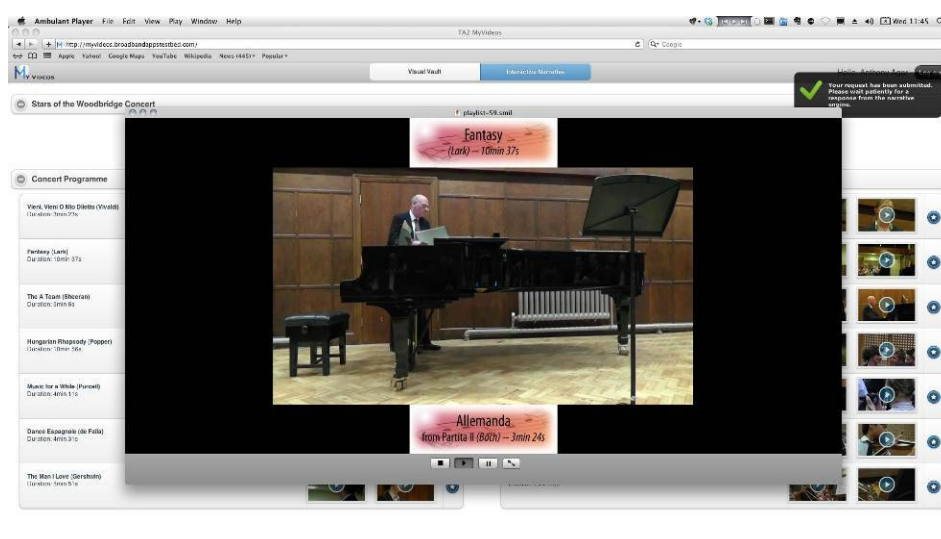
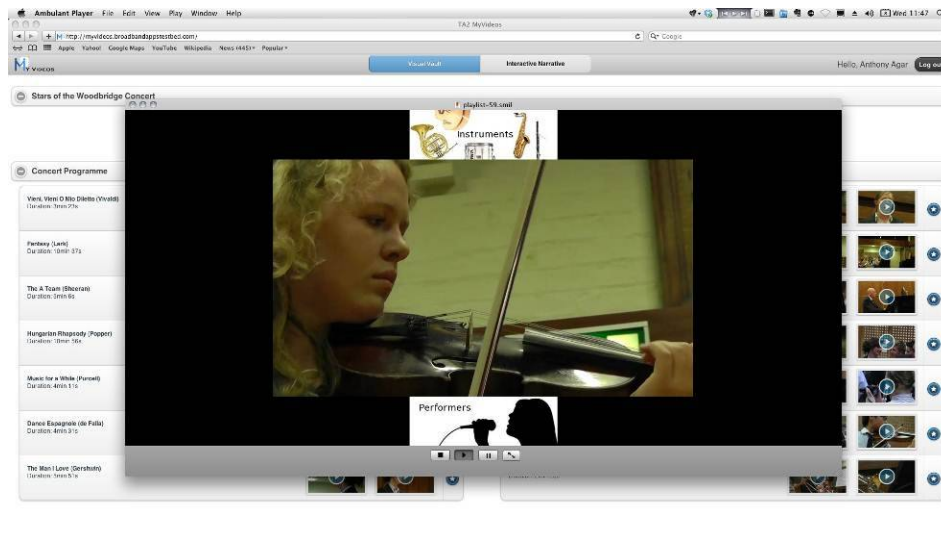


Figure 6. MyVideos Phase 2 Components and workflow

Interactive Narrative Exploration focuses on automatically compiled narratives, which can be influenced during playback by user interactions. Similarly, user interactions can be stored as an indication of the changing nature of their ‘profile’ while watching the narrative. In Figure 6 this is represented by the stylized graph showing how a user’s interest in keywords ‘Julia’ and ‘saxophone’ may change over time. See Figure 7 and Figure 8.

Figure 7. In Interactive Narrative, a video compilation is created automatically, based on user interaction—here: *Song choice*

Figure 8. Interactive Narrative: *Shot type choice*

Visual Vault Exploration focuses on a highly structured, visual representation of the digital media space and makes use of personalized recommendations. As with Interactive Narrative Exploration, user interactions can be used to indicate a ‘profile’, but these are more likely to be captured as values rather than changing over time. See Figure 9, Figure 10 and Figure 11.

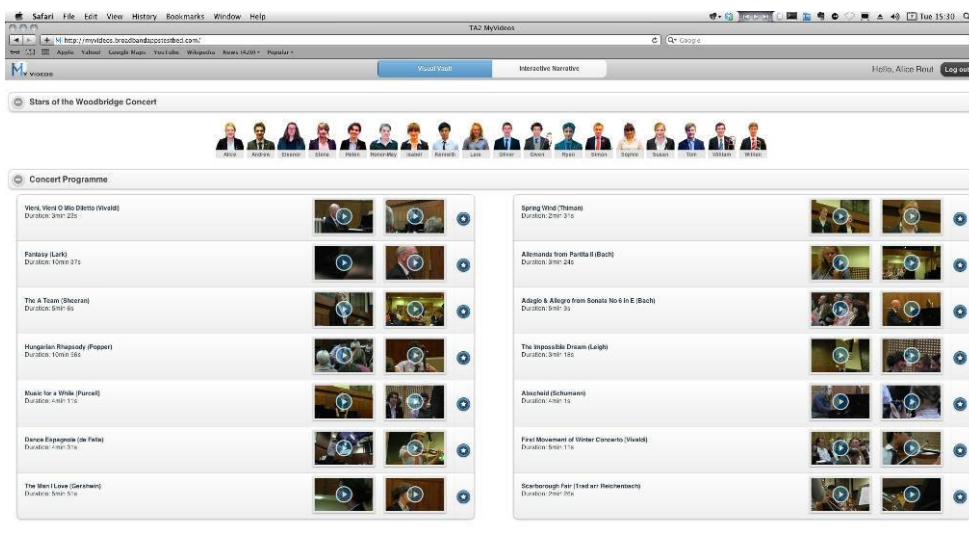


Figure 9. In Visual Vault, one can browse through a collection of video clips, presented in the form of ‘thumbnails’

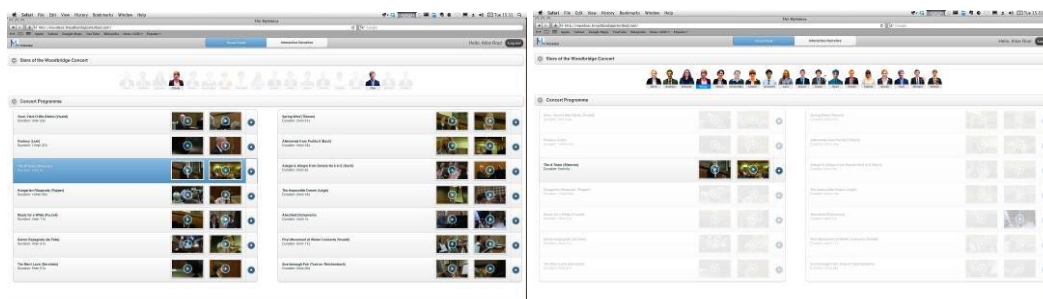


Figure 10. The Visual Vault, with *Song* highlighted (left) or *Performer* highlighted (right).

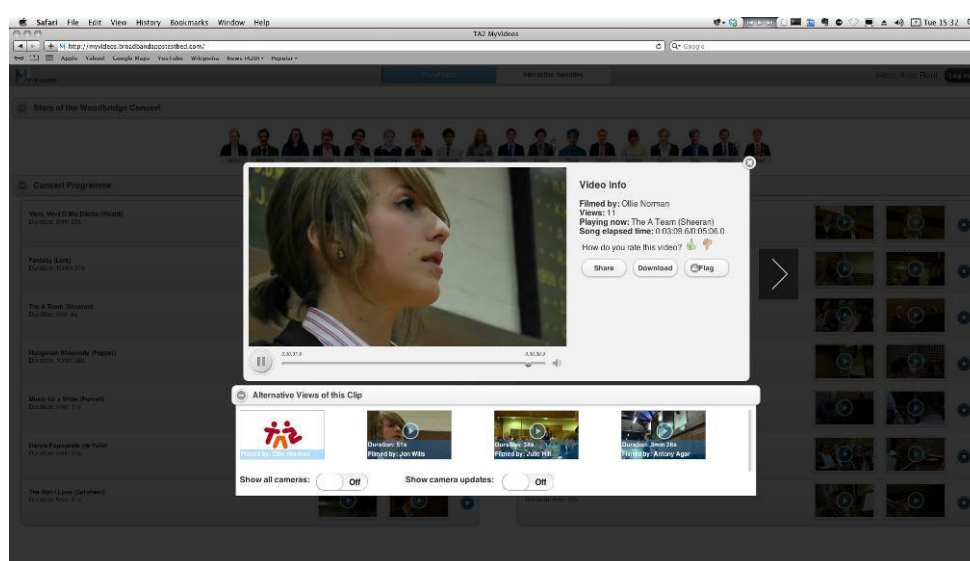


Figure 11. The Visual Vault, with *Clip* playing, and showing *Alternate Clips Available*

In the evaluation of MyVideos Phase 1, participants appreciated automatic generated compilations because the final product was considered visually compelling and reflected their preferences. However, participants were not really interested in authoring before sharing videos. In MyVideos Phase 2 we investigated how authoring concepts can be seamlessly integrated within the exploration of shared media space, and we evaluated if these approaches are translated into the amount of personal content produced and shared with people about whom the users care..

The Director's Cut (authoring and editing) tool brings together automatic and manual processes by using the narrative engine to generate an initial playlist, and by assisting users in the editing of their productions. We investigated the usage of the narrative engine not only for the generation of playlists, but also for providing alternatives that will replace specific parts of the initial video compilation. See Figure 12, Figure 13 and Figure 14.

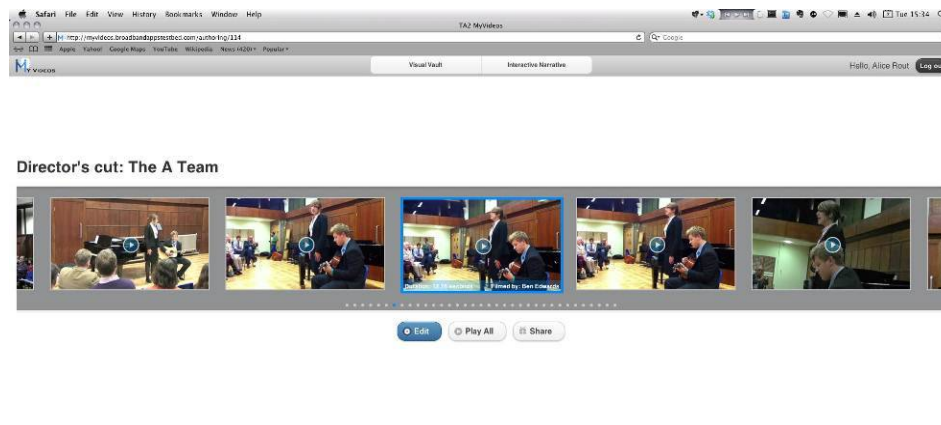


Figure 12. In Director's Cut, a video compilation is created automatically by the system—here: *Timeline*

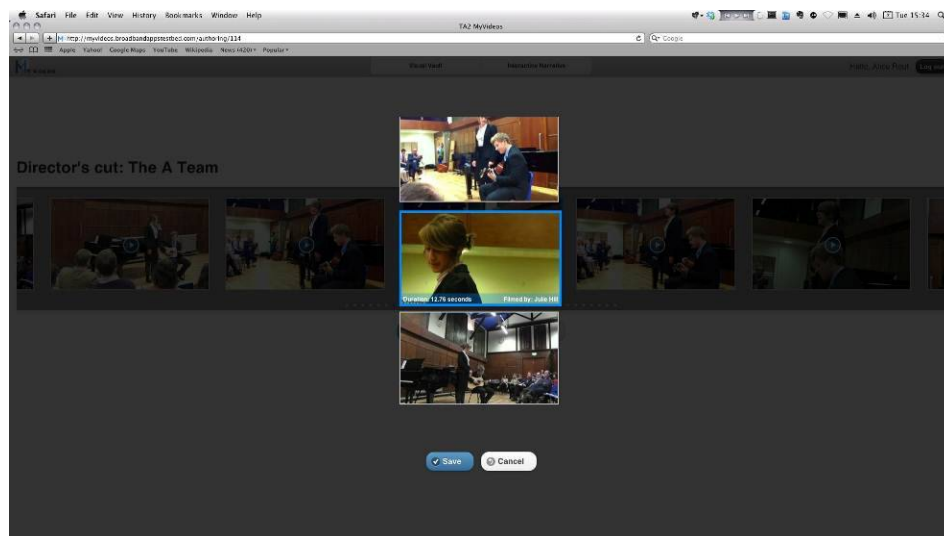


Figure 13. Directors Cut: *Alternative clips available*

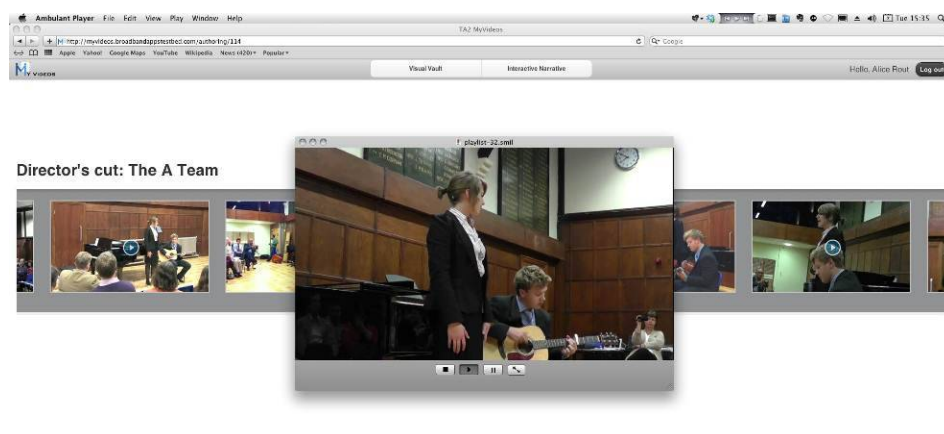


Figure 14. Directors Cut: *Song player*



4.3.1.1 *Social multimedia*

MyVideos is part of an extended study to better understand the intersection of social multimedia and social interactions. The goal is to provide technological solutions for improving social communications between families living apart. Potential users have been involved in the process since the beginning, starting with interviews and focus groups, leading up to the evaluation of the first prototype including a set of parents from a high school in Amsterdam who actively collaborated with this research. In December 2009, the parents were invited to a focus group that took place in Amsterdam; in April 2010 they recorded (together with some researchers) a concert of their children; from Jul-Sep 2010 they used our prototype application with the video material recorded in that concert.

Based on the feedback and results, the software was re-designed and is being tested again. This time, we involved a high school in Woodbridge (UK), where a concert was recorded in November 2011. This section reports on the second MyVideos evaluation that took place between Jan-Feb 2012.

In the beginning of November 2011 recordings took place again in the Woodbridge high school (UK). The concert lasted around 1 hour and 20 minutes, in which 18 students performed in 14 songs. A total of twelve cameras were used to capture the concert. The master camera was placed in a fixed location, front and sideway to the stage, set to capture the entire scene (a ‘wide’ shot) with no camera movement and an external stereo microphone in a static location. Eight cameras were distributed among parents, relatives, and friends of performers. Members of the research team used the other 3 cameras. In total over 300 raw video clips were captured, some of which were recorded before or after the event. All the material was kindly provided by the camera people for the content preparation and annotation phases.

In the MyVideos phase 2 the songs were sub-clipped and annotations made to identify songs and performers. The time spent examining, sub-clipping and preparing the footage was about 156 man hours. This included a number of tasks around the actual assigning of annotations to clips such as importing and transcoding all the videos to the same format, sub-clipping the footage, assigning annotations, transferring the annotations to machine readable CSV (Comma-Separated Values) files via OCR (Optical Character Recognition) and error checking. The outcome of this process was the creation of 667 sub-clips – or media objects out of the 331 original videos – used in the MyVideos phase 2 evaluation discussed here.

4.3.2 *Approach*

We used multiple methods for data collection, including interviews, questionnaires and actually using the MyVideos application. Because we expected people’s practices to be quite different, and as a point of contrast, we followed a semi-structured and allowed for some flexibility and improvisation in the way we conducted the experiments. The experiment started with an explanation about the high-level goals of the TA2 project and the MyVideos demonstrator. Then, the participants were invited to fill-out the following paperwork:

- Consent form: participants had been informed beforehand that their actions and conversations would be audio and video recorded for research purposes;



-
- Questionnaire about social practices around personal videos (31 questions; cf. Cesar et al., 2010 and Guimarães et al., 2011): to investigate the participants' recording and video editing habits, their intentions behind these practices and their social relations around personal media;
 - Affection survey (cf. Cesar et al., 2010 and Guimarães et al., 2011): to understand the social relationships between the participants and the concert performers. Each participant had to specify how well s/he knew at least one of the performers;
 - Individual/group closeness survey (the same questions that were used in the Family Game experiments, above): to analyze the closeness to individuals (that appear in the video clips) and closeness to these people as a group (that appear in the video clips).

After that, the interaction with the MyVideos prototype consisted of three sessions (approximately 20 minutes each). The order in which these sessions took place was mainly Visual Vault → Interactive Narrative → Director's Cut.

Each session started with a brief description of the component, and participants were instructed to describe their experiences. We used the session about the Visual Vault as an opportunity to understand how the participants conceptualized the concert. The session about the Interactive Narrative component was used to investigate the interaction patterns while watching dynamic video compilations. Unlike the other two components that were Web based, the Interactive Narrative experiment whilst initiated within a web browser resulted in users watching and interacting with the generated playlist in the Ambulant desktop player. The last session (Director's Cut) was dedicated to investigate the video editing functionalities and media sharing routines of the participants. After each session, each participant filled-out the following questionnaires:

- Component assessment: to evaluate the functionalities of the tested component;
- Aesthetic experiences: to study Naturalness, Immersion/Engagement and Social Presence/Presence (questions were adapted from questions that were used in the Low Delay Audio, Spatial Audio and Family Game experiments);
- Interactics experiences: to study Social Connectedness and Fun/Flow (questions were adapted from questions that were used in the Family Game experiments);
- MyVideos overall assessment: to evaluate the MyVideos framework in general. This questionnaire was applied after the last session.

The laboratory study allowed us to overcome some implementation and performance issues. More importantly, as the participants were invited to think aloud, it gave us sensible information about their common practices, and feelings as they using the system.

The experiment setup consisted of 3 machines running Mac OS X 10.6 with a Web browser (Chrome or Safari), Flash plug-in installed, Ambulant desktop player 2.3 (with Python glue) and Internet connectivity. For recording the user trials we used 2 video cameras (SD and HD). We also took notes during the interviews aiming at examining interesting incidents in detail later.

Nine (9) people (of 4 families) were recruited for the trial, among relatives and friends of the kids that performed in the Woodbridge school concert. All the participants were English speakers and were currently living in the UK. Five out of nine participants (parents of the performers) were over 40 years old. The other four were in the 11-20 years old; three of them performed in the concert. Five



participants were female. The rationale used for recruitment was to gather as many roles as possible in order to better understand the social needs of our potential users. See Figure 15.



Figure 15. Typical situation during the MyVideos experiments

Participants kindly volunteered themselves for their participation, and the experiments were conducted during January 2012. The review group was kept small so that we could establish directed and long-term relationships. The qualitative nature of our interactions provided us with a deep understanding of the ways in which people currently share experiences to foster strong ties. It is worth mentioning that in the previous evaluation of MyVideos phase 1 we cooperated with a group of seven people in The Netherlands, some of whom have been recording their kids in the concert, involved in previous focus groups dating from December 2009 (about ten-month span as described in Cesar et al. 2010). These two groups of participants represent a realistic sample for the intended use case: all the parents have children at the same high school, all of them tend to record their children, and some of them have some experience with video editing tools. Moreover, the parents recorded their children playing in a concert.

4.3.3 Findings

Overall, people were enthusiastic about using MyVideos, e.g one person remarked:

'I liked it a lot. Needs a few bugs ironing out though, before I could use it. I was especially keen to use this to create a video of Andrew playing cello to share with my father who lives in Wales and isn't mobile. I was especially impressed with the synchronization between sound and video and the relative ease of viewing different angles.' (from video of discussion afterwards)

Another person remarked

'Overall, I had great fun. It was more than just getting into that concert, again. It was doing something completely different. Almost like another activity. Which could almost have been anything. But the fact that it was this concert, with my daughter in it, made it extra special.'

One of the children, who performed at the school concert and who appeared in the video, remarked

'It was nice to hear my performance back.' Cause when you play, you cannot really listen to yourself. Or see yourself. I can imagine it being really useful to have one [camera shot] of my hands [moving



her hands through the air, as if playing the piano], for teaching.’ (from video of discussion afterwards).

Furthermore, people made remarks about the different functionalities of MyVideos. Concerning the Visual Vault Vault, e.g., one person remarked

‘Very easy to use. Performers at the top image, a good idea. Easy to click between the video clips’ and also suggested ‘Needs a preview for the different cameras, so that you can select the angle required rather than click blind’ (from notes on the questionnaire). Another person remarked *‘Liked generally’* and added *‘Would like easier representation of which clips available at which points in the performance’* (from notes on the questionnaire)

Concerning Interactive Narratives, one person remarked:

‘In itself, it was a fun thing to do. It was [...] a utility software to give you the best impression of the concert, but let’s you have some fun as well.’

Concerning Director’s Cut, one person remarked:

‘It started to do like a produced version. And I quite liked that because it almost felt like we had gone up a level. It was more interesting somehow. It was keeping my attention. Whereas if you just get the same static shot. Because on TV, they seem to switch every two or three seconds, don’t they? So you’re getting a similar—obviously not as good—a similar experience to what you are used to. I felt more immersive.’

When asked to compare the different functionalities, the following conversation occurred:

Woman: *I didn’t like the Interaction one, I must admit. I liked seeing the clips of people coming in [Visual Vault?] [...] I thought it was really easy to use, actually, I quite liked it.*

Man: *I liked the Director’s Cut. Because in the end, you can just say, I don’t do anything [?] but it just gives you that option, to tweak it later.*

Girl: *The Director’s Cut one, not the Interaction one. I don’t see the point of just random clips [the Vault?].*

In addition to these (qualitative) findings, we also performed quantitative analysis of questionnaires results. Please note that in this analysis only the first 9 participants’ questionnaires were analysed (group of 4, on 4 Jan, group of 2 on 25 Jan, group of 3 on 1 Feb).

As a first step in this analysis, we calculated the Cronbach’s Alpha for the various constructs (cf. section 4.2.3, above). The Cronbach’s Alpha is a measure for the quality of the measuring instrument, i.e., of the items in the questionnaire. If the Cronbach’s Alpha of a construct is stable across different measurements, then the questions have ‘internal validity’, so that we can proceed with the analysis of the findings of those constructs. We tested the α for the following constructs—see Table 12:

- The Cronbach’s Alpha for Naturalness (N), Social Connectedness (SC), Challenge (Ch), and Group Attraction (GA) are sufficiently stable for MyVideos. For Immersion / Engagement (IE) the Cronbach’s Alpha is also sufficient, although it does fluctuate, which can be due to the relatively small number of observations.



- For Social Presence/Presence (SPP) the Cronbach's Alpha of MyVideos is much lower than for the Family Game and Aesthetics experiments. Therefore, we will not further analyze Social Presence/Presence for MyVideos. This is not problematic, since Social Presence/Presence is less relevant for MyVideos, which focuses on asynchronous communication, than it is for Family Game, which focuses on synchronous communication.
- For Quality of Communication (QC) and Thinking about each other (Th), the Cronbach's Alpha is not sufficiently stable. Also, the questionnaire items that were used for Quality of Communication were different from the items used for Family Game (three items instead of six items, and different wording). We chose not to further analyse Quality of Communication (QC) and Thinking about each other (TA) for MyVideos. This is not problematic, because these are less relevant for the asynchronous communication of MyVideos than for the synchronous communication of Family Game.

Table 12. Cronbach's Alphas for Naturalness (N), Immersion/Engagement (I/E), Social Connectedness (SC), Challenge (Ch) and Group Attraction (GA) are sufficiently stable

	Visual Vault	Interactive Narrative	Director's Cut
Social Presence/Presence (SPP)	.452 (8)	.486 (6)	.403 (3)
Naturalness (N)	.967 (7)	.974 (8)	1 (5)
Immersion/Engagement (IE)	.780 (8)	.964 (8)	.614 (4)
Quality of Communication (QC)	.567 (6)	.955 (7)	1 (4)
Social Connectedness (SC)	.696 (8)	.737 (8)	.694 (5)
Challenge (Ch)	.837 (7)	.940 (6)	.963 (4)
Thinking about each other (Th)	.776 (8)	-.439 (6)	.583 (4)
Group attraction (GA)	.905 (8)	.972 (5)	.964 (4)

The number in parenthesis indicates the number of observations.

We compared the means of Naturalness (N), Immersion/Engagement (IE), Social Connectedness (SC), Challenge (Ch), Group Attraction (GA), to the means of these same constructs for Family Game—see Table 13.

We found two significant differences: for Immersion/Engagement and Group Attraction, where Interactive Narrative scores lower than Family Game (indicated with *). (Some differences—though not significant—were found for Naturalness (Visual Vault higher than Family Game), and for Social Quality and Challenge (Interactive Narrative lower than Family Game).



Table 13. Means of Naturalness (N), Immersion/Engagement (IE), Social Connectedness (SC), Challenge (Ch), Group Attraction (GA) for MyVideos, compared to Family Game

	N	Minimum, observed	Maximum, observed	Mean	Std. Deviation
<i>Family Game Naturalness (N)</i>	36	,00	4,00	2,5833	,92711
Visual Vault Naturalness (N)	9	,67	4,00	2,9444	1,14867
Interactive Narrative Naturalness (N)	8	,00	4,00	1,9583	1,32662
Director's Cut Naturalness (N)	5	2,00	4,00	3,0000	1,00000
<i>Family Game Immersion/Engagement (IE)</i>	36	,00	4,00	3,0463	,86978
Visual Vault Immersion/Engagement (IE)	9	,33	4,00	2,7963	1,06646
Interactive Narrative Immersion/Engagement (IE)	8	,67	4,00	2,0625*	1,43631
Director's Cut Immersion/Engagement (IE)	5	2,00	4,00	2,8000	,86923
<i>Family Game Social Connectedness (SC)</i>	36	1,00	4,00	2,3611	,56555
Visual Vault Social Connectedness (SC)	9	,67	4,00	2,3333	1,02740
Interactive Narrative Social Connectedness (SC)	8	,67	3,33	2,0417	,93329
Director's Cut Social Connectedness (SC)	5	,33	3,33	2,1333	1,16905
<i>Family Game Challenge (Ch)</i>	36	1,00	4,00	2,8542	,79816
Visual Vault Challenge (Ch)	9	1,00	4,00	2,6667	,90139
Interactive Narrative Challenge (Ch)	7	,75	4,00	2,0357	1,27008
Director's Cut Challenge (Ch)	5	2,00	4,00	2,7500	,79057
<i>Family Game Group attraction (GA)</i>	36	1,00	4,00	3,0926	,85305
Visual Vault Group attraction (GA)	9	1,00	4,00	2,6111	,82496
Interactive Narrative Group attraction (GA)	6	,67	4,00	2,0556*	1,20031
Director's Cut Group attraction (GA)	4	2,00	4,00	3,1667	,88192

* = $p < .10$ when Interactive Narrative and Family Game compared (comparison based on one sample T-test (T-test value = mean of Family Game))

Furthermore, we analysed participants' responses to three questions concerning their emotional state. Participants were invited, after each test, to select one visual representation of feelings of pleasure (ranging from positive to negative), feelings of arousal (ranging from high/stimulated to low/relaxed), and feelings of dominance (ranging from feeling-being-controlled to feeling-in-control). We compared their responses across the three functionalities of MyVideos.



For pleasure, the average score was 3 (on a reversed 0-4 scale), see Figure 16, green circle.

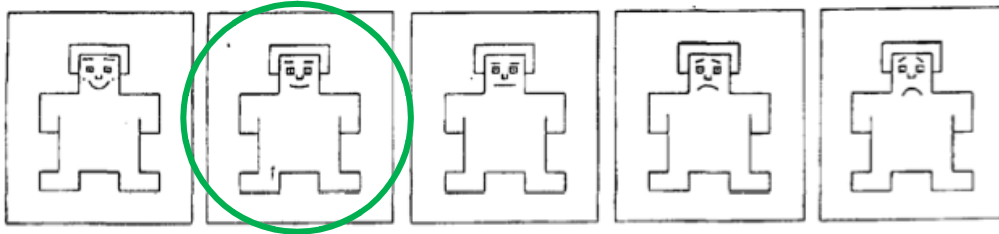


Figure 16. Questionnaire item used to measure pleasure, with average score indicated

For arousal, the average score was 1 (on a reversed 0-4 scale), see Figure 17, green circle.

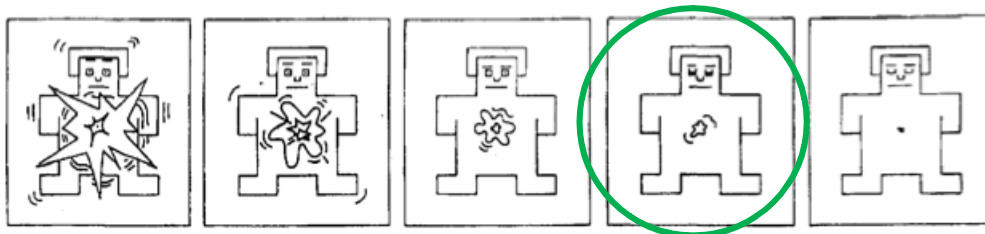


Figure 17. Questionnaire item used to measure arousal, with average score indicated

For dominance the scores differed for the three functionalities—see Figure 18, green circles:

- Visual Vault scored relatively high (2,78 on a 0-4 scale, n=9);
- Director's Cut also scores relatively high (2,8 on a 0-4 scale, n=5);
- Interactive Narrative scores relatively low (1 on a 0-4 scale, n=7).

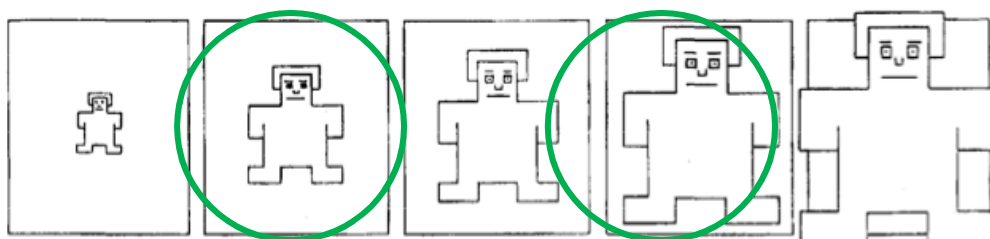


Figure 18. Questionnaire item used to measure dominance, with average score indicated

Finally, we compared participants' feelings of closeness before and after the experiments—see Figure 19. People were invited, before and after using MyVideos, to indicate how close they felt to three specific people (people on stage, in the video), where they put the person to whom they felt closest first, and to indicate how close they felt to these people-as-a-group (the people on stage, in the video).

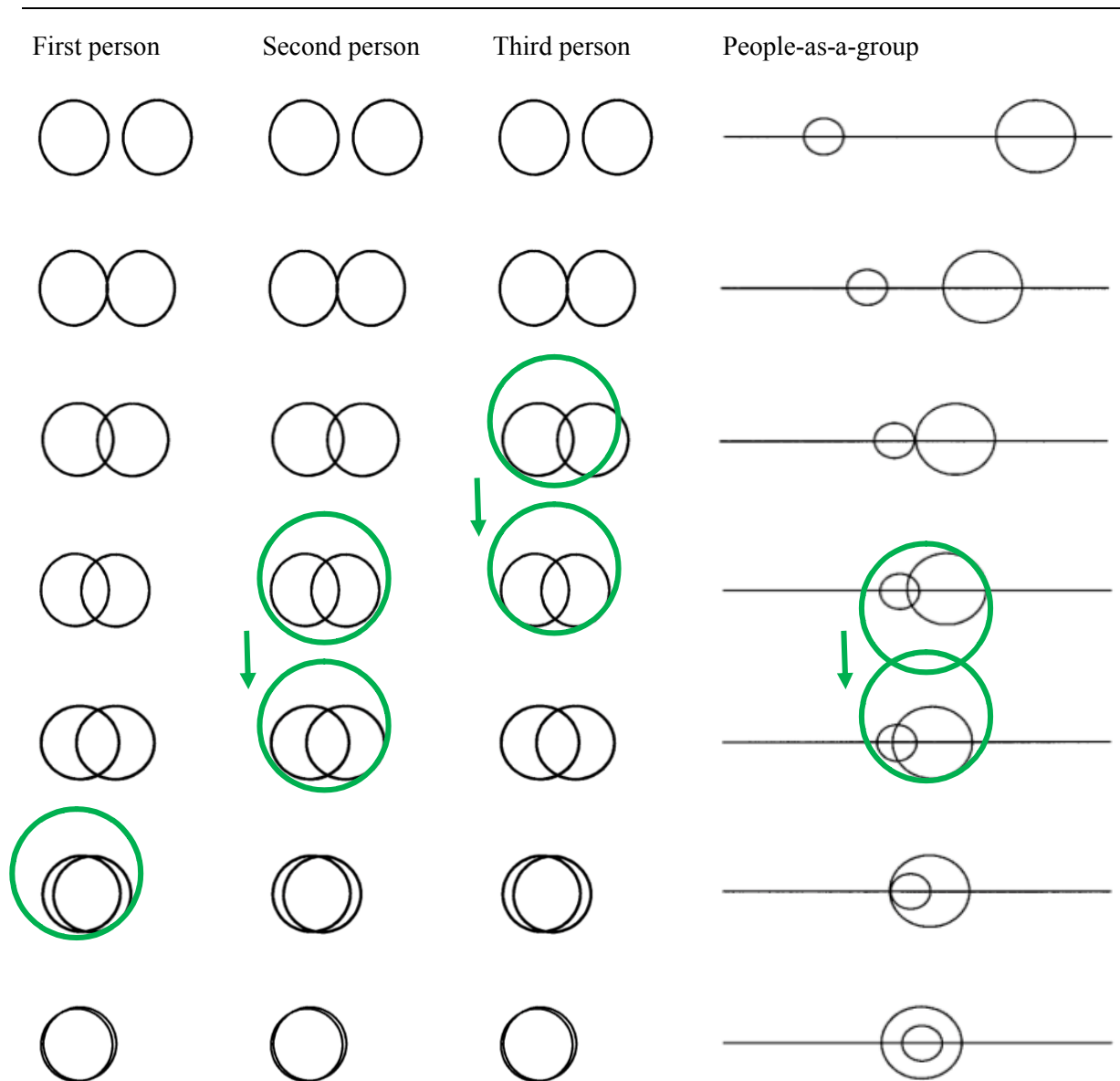


Figure 19. Questionnaire items used to measure Inclusion of Other in Self (IOS, a measure for interpersonal closeness, left) and Overlap of Self, Ingroup and Outgroup (OSIO, a measure for closeness to a group, right), with average score indicated before and after the experiment.

The closeness with the people-as-a-group significantly increased: from 3.44 to 3.89 (on a 0-6 scale). There were also substantial increases in closeness with individuals, but not significant, probably due to low sample size.



4.3.4 Interpretation

If we look at the increases in closeness to individuals, we see increases mainly in the second and third person. We can therefore attribute the increase in closeness to the people-as-a-group mainly to increases in closeness to the second and third person. In other words: using MyVideos can make one feel closer to a group of people, especially to those who are one or two steps further away than your most dearest one. Or, more informally: using MyVideos may not change how close you feel to your son or daughter, but it can make you feel closer to, e.g. the friends of your son or daughter who also performed at the school concert. Or, if we imagine a context different from this school concert, MyVideos may not change how close you feel to your spouse and children, but it can make you feel closer to your cousins or your family in law—to those to whom you have weaker forms of strong ties.

These findings match some of the remarks people made during the experiments.

One person remarked: *'It definitely brings me closer to the group.'*

And another added: *'I don't think it actually affected social relation, though it made me feel closer. I guess if I'd actually produced something that I could share, then it would have a positive impact.'*

4.3.5 Implications

As was already touched upon, there are several differences between Visual Vault, Interactive Narrative and Director's Cut, for example a difference in the way in which and the extent to which people feel 'being in control' or feel 'being controlled'.

- Visual Vault scored relatively high (2,78 on a 0-5 scale, n=9), probably because one can feel 'in control' when browsing through the video clips;
- Director's Cut also scores relatively high (2,8 on a 0-5 scale, n=5), probably because one can feel 'in control' when the system creates automatically the compilation for you;
- Interactive Narrative scores relatively low (1 on a 0-5 scale, n=7), possibly because it has an ambiguity, which can make people feel as if they lack control: it neither gives you full control in the sense that you can manually edit, nor does it give you full control in the sense that the system will work for you.

This means that the three functionalities can be positioned differently, in order to meet different people's needs and preferences:

- Visual Vault could be positioned as an application that gives you control when exploring the media space. It provides a number of automatic processes (i.e. recommendation of videos) and contextual information (i.e. alternative view for a camera and filters). The user is 'in control';
- Director's Cut could be positioned as a system that automatically generates a playlist at the start point of the editing process. It also provides a number of other automatic processes, e.g., it helps users by recommending alternatives to parts of the compilation the user wants to edit. The user is 'in control' but he or she does not need to start from scratch.
- Interactive Narrative could be positioned as an application which provides a relaxed functionality of the system doing a large part of the work with the option for people to do some small part of the work—in situations where the user does not need to be, or want to be, 'in control'.



Finally, it is important to mention that MyVideos has the potential to facilitate social connectedness in various ways, between various groups of people. For the sake of clarity, we can distinguish three roles:

- Performer: the people at the event, that appear in the videos, in this case, the teenagers that performed at the school concert;
- Editor: the person that views and/or edits the videos and creates and/or shares the compilation, typically that teenager's parent;
- Viewer: the recipient of the video compilation, typically a family member or friend of both performer and editor, e.g. the teenager's grandparent.

Between these groups of people, there can be different types of social connectedness:

- Between performer and editor: If the editor feels 'together' with the performer(s) while viewing and/or editing the video clips.
- Between editor and viewer: If the editor feels 'together' with the person she is making the compilation for and/or the other way around.
- Between performer and viewer: If the viewer feels 'together' with the performer(s) while viewing the compilation and/or the other way around.

In the experiments we have only studied the first type of togetherness: whether the editor feels together with the performers. It would be interesting, for example in future studies, to also study the other types of togetherness.



4.4 Storytelling / TA2 Lite field trial (2011-2012)

4.4.1 Introduction

The purpose of this study is to examine how a system embodies the essence of TA2, i.e. it involves a shared activity and the ability to see and hear each other and includes a Storytelling application is used and integrated into the domestic environment of users.

The aim of the study is to learn about higher level objectives of the project and the primary focus is on the layer of *meaning* in the SUX Framework. Though the system lacks some of the functionalities of the full-featured TA2-system, e.g. orchestration and the possibility of connecting more than two locations at the same, it still contains fundamental features of TA2 and thus it is possible to test ideas such as group communication for fun using high quality real-time communication as well as the possibility of shared activities. This cut down version of TA2 system is sometimes referred to as TA2 Lite (cf. public deliverable D3.5 Summary Report: Application Design and Implementation, pp. 25-30). Testing TA2 in a domestic environment can also provide novel insights on the *aesthetics* and *interactics* layers of the SUX Framework (Chapter 2).

The Storytelling application was selected for the trials since it could work with the limited setup but during the trials other applications were also developed.

A particular motivation for the setup of the study is to evaluate inter-generational use. The ambition has been to include at least 3 generations in each family. Before these trials, several workshops and demos took place at a social center for elderly people, from where some of the participants were recruited.

4.4.2 Approach

Evaluations were conducted in Sweden, through in situ trials within people's homes. TA2 Lite systems were made available along with Storytelling and a few other applications. The families used their own TV or replaced it by a borrowed one if their TV did not meet the technical demands. All participants chose to use their normal TV watching location for the system, which was either in the living room or, in two cases, a separate TV room. In one case the family put the borrowed TV next to their regular one.

All but one of the families were also provided with Internet or upgraded Internet. A couple of families were not able to get optimal bandwidth for TA2 Lite, and thus the quality was reduced. All could receive the highest quality but were not able to send it, owing to asymmetrical subscriptions.

Video cameras were positioned on top of the TV, leaning downwards towards the seating area normally used for watching TV, whilst the microphones were placed underneath the TV screen and the speakers on each side of it.

Ten families were involved with the evaluations, each using the system for between 1 and 6 months. The trials were meant to be about 1-2 months but several trials were extended due to technical issues and one family didn't really get started in time before the project was finished because of problems of getting Internet connection.

The participants were between 4 and 78 years old. All together there were over thirty people testing the system. Figure 20 displays the composition of the different families.



Family 1 was connected to families 2 and 3. Families 4 and 5 were connected to each other, as were families 6 and 7. Families 8, 9 and 10 were all connected to each other, though 9 and 10 lived very close to each other and were only connected since they both had a system anyway. There were three generations in all groups except between families 1 and 3 and between families 4 and 5. In the former there were only two generations and in the latter there were four generations. In family 5 all the participants did not live together, but gathered in one location to use the system. The distances between the different connections are depicted Figure 21.

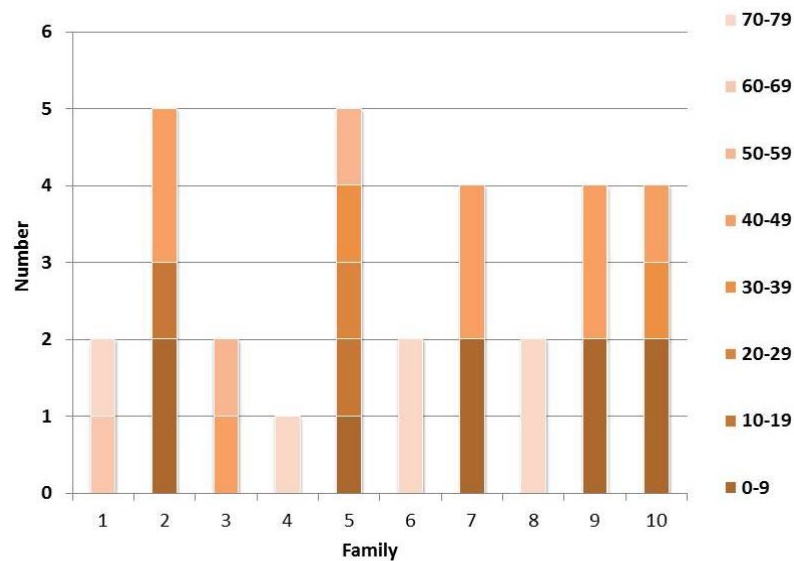


Figure 20. Age distribution in the families

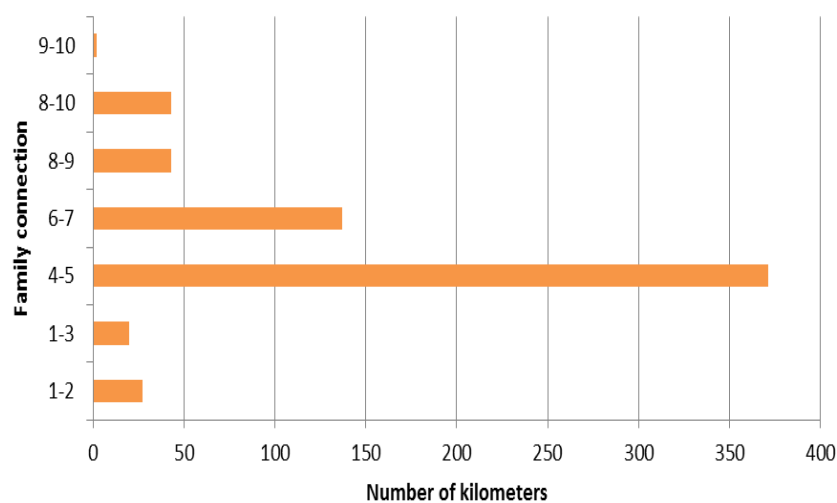


Figure 21. Kilometres by road between family connections



It was a convenience sample, since the participants had to fulfill a wide range of requirements in order to be suitable for the evaluations, for example some distance between the locations was required. Most of the participants have expressed a desire to spend more time together than is currently possible. They are often able to contact their strong ties at any time but hoped that the TA2 system would provide new forms of contact and would make more social contact possible. There were difficulties finding enough participants to take part in the study (discussed below).

During the trials, three semi-structured interviews were conducted as well as sessions filming and observing the use of the system. The system also collected data on frequency of use and showed how the Storytelling application was used. The participants were also encouraged to keep a diary logging when and how the system had been used.

This material was analyzed and turned into design recommendations but there was also a shorter feedback loop where data from the study led to changes in the system implemented before the study ended, thus directly affecting the interactions. The applications developed for the iPad during the trials were a Memory game, an interactive whiteboard and a free form card game. A secondary hand-held camera was also introduced.. The participants could move this new camera around and were able to view close-ups of objects and get a top-down image of horizontally placed objects like board games. Participants could easily select this camera at a push of a button.

Due to the changes in TA2 Lite during the evaluation and to differences in the composition of system in the different locations, for example which iPad version was being used, it is not possible to compare use between different families. Instead, the study provides design ideas from different types of families.

4.4.3 Findings

4.4.3.1 Group communication

That communication took part in group was considered different from the possibilities of the communication technology previously used between the households, i.e. phones.

...it is a completely different thing, since you talk all four. – Man 52

There has been a communication [between grandmother and grandchildren] that would not have been there otherwise, that has felt meaningful and positive. - Man 41

It has absolutely been so that it is rewarding to be able to see, it adds something qualitatively new or different compared to a telephone call, because there are more [people] who can take part in the conversation. - Man 41

... that [you can communicate as a group] is really good. It is a clear advantage over the phone. Absolutely and that we should say that that we have also been, since the children come when we speak with [my son] and then comes one and then another and maybe one runs away, it depends. [...] But it is clearly a positive effect. [...] That [spoken more with certain people] I have done, because everybody comes into the same context, when it was that Halloween then they came in, dressed up and each and every one told about what they had done. - Woman 68

...that you see all of them here, that you can talk to several [people] at the same time. On the phone, then it is mostly just [my son] or [his wife]. – Woman 71



Participants also mentioned the [possibility of being able to connect more than two households at the same time:

...The optimal would have been if you could connect even more [places]. You know, you could share the picture. You could have dad in one end, and my sister [...] in the other end. And similarly my sister then, she would see my dad and me... - Man 52

Have you done anything with more parties? Because now there are two, now there have been two parties all the time, but you could imagine that cousins or further away then, additionally someone, some friend or relative, also be involved. Is it easy to run multiple parties in some way? [...] Because that is, would also be interesting sometimes at least, to get more [people] in the same session. - Man 41

In one TA2 Lite session people typically come and go. This is described by one participant:

Then we leave and come back, kind of like that when we are connected, which is also something you cannot do in a phone conversation, that you come and leave as you want to. – Man 41

In this way different subgroups were formed. The system can however only properly transmit one utterance at a time, whilst people being in the same room have the possibility of moving closer to certain people and engage in another conversation with them. Participants sometimes did talk about different topics across the system simultaneously, but they had to listen to what the other people were saying before returning to their own topic. Subgroups did however occasionally form in the separate locations; in the background whilst someone was talking across the system to the people in the other location.

Communication and gaze were also mostly directed to the persons in the other location and participants in the same location often helped each other to formulate messages or ask questions to each other in order to make people tell something that were already known to them. For example you could hear a father ask his son: “Did you tell grandma that..?” One participant described this:

...Most of the time you talk to the ones on the other side, so to speak. [...] It could happen if it is something my husband says: “What day was that?” and then he looks at me: “Well, yes that was last Wednesday”. “Yes, that was last Wednesday ,dad” If it was something that we had done or so. Woman - 47

4.4.3.2 Communication rules and different types of presence

Several aspects of communication differed when the media was being used as compared to FtF interaction, e.g. the participants did not adapt interpersonal distances or spatial orientation, but stayed in their normal positions in front of the TV, which will be further discussed below.

Utterances during the observations demonstrate that the participants tried to get eye contact and there was also a comment of the connection to (social) presence:

Then I should try to look there, but I want to look at you. - Woman 68

Can you look straight into the camera, so that I can see? – Man 56

Eye contact affects the sense of presence – they feel very far away. - Woman 41



Pointing to things at the other side of the TA2 system and showing things worked to some extent. Participants managed horizontal directions better than vertical. This could be related to the fact that cameras were positioned on top of the TV screens and leaning downwards.

One young girl also had problems with hearing and for her the extra cues were especially useful:

And [my granddaughter] has some problems with her hearing so it's important to be very clear with her and that I think, that is good like this she can see the mouth also when you talk with her. She stood close and watched me when I said the sentences to her, so it was a big favor that she could see the mouth. –Woman 70

Facial expressions and gestures were visible and mentioned as a source of closeness or social presence:

There is a greater closeness [...] You see the facial expressions; I can see my son when he is joking a bit. He moves his mouth... - Woman 68

Yes, it has an enormous importance the body language. That I have discovered as the years have passed, how much it really means [when you are] with people. [...]... and now you can get this, when you sit in the sofa and speak and gesticulate [...] It was very good image, you saw exactly everything – facial expressions and all. -Woman 78

Another observation relating to gestures came from one participant, who was dealing with reduced video quality due to a poor Internet connection:

When you know the persons, then you know kind of how they work too, so you might fill in [the blanks] yourself there. Had it been some completely different persons, then maybe it is more important that you see everything, all the time. – Man 42 (2:2)

People used the gesture of waving in combination with verbal messages for greetings; in FtF interaction they would likely have greeted each other by hugs or handshakes. Waving is a greeting used when people can see each other but cannot get close enough to touch.

In fact no participant commented on the fact that touch was lacking even when they were asked about the difference between using the system and meeting FtF. Most participants claimed that there was some difference between using the system and meeting FtF, but struggled to explain what that difference was. Comments on the difference included the fact that it was not 3D or that you don't have to (cannot) offer people food.

People compared the new system to other types of interaction, both with and without being particularly asked to do so. It was mostly compared to meeting FtF or talking on the phone, which were the major types of interaction previously used by the participants. It was generally described as similar to face-to-face conversation and different from telephone conversation:

... it is like you're sitting in the same living room. Maybe not straight in the beginning, but then after a while you fall in to it, somehow, and it is exactly like you sit and talk in the same room.- Woman 47

It is a greater closeness, it is like you get into their living room. You get in, and sit in the sofa, so to speak. – Woman 68

Last time we were talking to [the other location] for several hours, it was kind of like we had been sitting around the table here. - Man 75



It is that you have the image, so it can become something different than talking on the phone. - Woman 78

You get another contact than on the phone. - Woman 78

It also seems that seeing the room, in itself helped to create this sensation.

But here, I think that you get such a good image here. You, kind of, you see the entire room and you, I believe that you come, get another contact, I think, that you get. It is like being at each other's home. -Woman 78

Different expressions of “being in the same room” was also the most commonly used metaphor for describing the sensation. Other expressions such as “meeting for real”, “being together” or “actually meeting” were less common.

4.4.3.3 *Spatial behaviour*

The interactions with the TA2 system have been spatial in the sense that they have made use of the whole room as an interaction device rather than the “talking heads” situation of much video communication.

I don't think it is the same thing, I mean that in a computer you often just see the face of the person you are talking with, but here you see, kind of, well, not the entire room, but you see a large part of the room anyway, you see several people. - Woman 47

In one home in particular the room was organized in such a way that a large part of the room was visible from the other location through the camera. This included the area behind the sofa that connects the stairs leading up to the second floor, the front door and several rooms on the ground floor, including the kitchen. Therefore people moving through the house often become part of the interaction space of TA2, often without knowing that there was a session going on.

... because here things happen in this room or with the camera they see even here behind [the sofa] and the children are active and friends come and someone comes home from work and you cook food in the kitchen, well things happen here... - Man 41

In one observation from this home, the youngest son was playing Memory with his grandmother, when the older brother entered the house with some friends. The grandmother saw this and greets the older brother. Then one of the friends walks up to the TV and asked the younger brother what they are doing. The grandmother answers, which prompted the boy to greet her. To be able to share rooms with each other was also considered something special and the comment is from the same family constellation:

...but it is also exciting to see straight into someone else's living room. That is also a fun ingredient. Similarly, to send your own room to someone else, with everything that happens in it... - Man 41

The choice of room clearly mattered:

But it is a lot funnier when it is in the living room. Otherwise it is in some dull office room far away and you have to get there, hassle [...] It would be fun to find a similar solution, where you could have it in the living room like this. - Man 41



A quote from one woman also indicates that it might be of some importance to use the same type of room in both locations and that the current TV location might not always be the best option:

If I would have chosen... Yes, maybe, that was interesting, because maybe if I would have had a TV in the kitchen and grandma would have had a TV in the kitchen, then maybe...- Woman 32

As already mentioned, each family has more focus on the people in the other location than on the people in the same room. Families were using their normal TV location for the system and furniture was positioned in the room for watching TV. This was not changed for using TA2 Lite and the suitability of the furnishing varied between the different locations. The fixed seating arrangements forced rather peculiar spatial behaviour both considering interpersonal distances and orientation. Maybe as an adoption from watching TV people generally chose to sit where they could see, not necessarily where they would be seen. Figure 22 shows an example of seating arrangements in one of the connections.

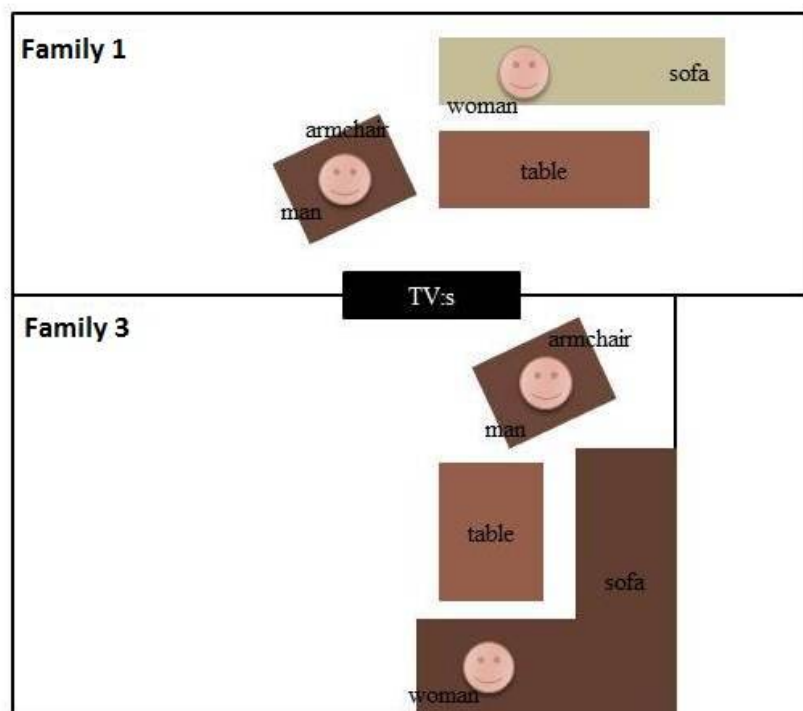


Figure 22. An example of seating arrangements in one of the connections.

In both locations the women were somewhat in the background and all of them had in fact their own allocated seat in front of the TV and this was used when using the system as well:

That my husband mostly sits there, that is because it is his armchair, because he has bad vision [...]. ...this is kind of my place and that is his armchair. – Woman 47

From the same example it was also clear that turn-taking was suffering from the seating arrangements. The fact that people had different distances to the microphones provided an advantage for the person



being closer in taking the turn. Since the participants mostly looked at the TV screen, it also affected their possibility to pick up nonverbal turn-taking cues from people in the same location, especially when the seating arrangements meant that the person sending the cues sat behind them.

When asked about if they would have liked a different seating arrangement, some people did (but never did change anything):

You would have been somewhat closer to the camera then [if you would have a different arrangement], I mean you feel a bit far away from them. On the other hand they sit rather close, [...] it doesn't feel like they have as far between their screen and the sofa where they sit, but they sit closer to the camera then, but we are a little bit far away from the camera here. - Man 41

I wouldn't mind if he could get a bit closer... but then they would have to refurnish. - Woman 68

Another issue with using the TV furniture was the lighting, since optimal lighting for TV watching is different from video recording.

Here, we have had a bit bad lighting, so I have brought home some of that video lighting. If you hang it up, then it becomes, then we are a lot better visible in the image than we are otherwise. So the lighting is important for how good the quality gets. [...] I mean there [behind the sofa, towards where the current lighting is directed] it is very good focus and there it is clearly visible but since you sit a little bit in front of that light you become a shadow. - Man 41

4.4.3.4 Activities

There have been attempts to perform a wide range of different of activities such as:

- conversations
- playing card or board games
- solving crossword puzzles
- playing musical instruments i.e. drums
- show-and-tell of things
- showing what is going on in the home
- making decisions together e.g. children deciding what grandma should crochet, writing wish-lists for Christmas
- helping each other, by demonstrating
- eating dinner and drinking coffee together
- helping children with home work
- practicing skills with children e.g. reading, spelling, writing and mathematics
- using the provided applications
- using other iPad/iPhone applications, i.e. Wordfeud

In general, the system has been used to perform activities that the participants were already comfortable with and that they would do if they met physically, for example engaging in music or eating. Participants were also keen on integrating domestic objects and activities, for example show-and-tell of things found around the house.

Conversations and show-and-tell of things seemed to be the most common activities. When it comes to objects there was a special focus on showing new objects, or objects that were not known to the people



in the other location, for example children were showing their Halloween costumes, birthday presents or adults showing their new purchases.

My grandson keeps running up to his room to get things to show. It is very fun, or he experiences that very much, I don't know how many times he runs up to his room. It was his birthday and he showed his birthday presents and how they worked ... - Woman 68

And then it is this that you can show things to each other all of a sudden, you cannot do that on the phone. "Now, I'll show you that nice thing I bought" or "now I have bought a present" – "What did you get?" and then you have to explain what it was. Since we girls, we want to do this... If you've been out shopping, you really want to show it to your friend... – Woman 47

In one connection there was also an ongoing activity that was returned to in several sessions. A grandmother was crocheting items for her grandchildren and kept showing them the progress and allowed them to participate in decisions around this:

Since they have a caravan, I have crocheted the car there to it, and then they get to be apart – "what color do you want? I have these yarns and so on." So a car is finished, the caravan will come and that monster [my grandson] has ordered so that is also finished. [...] And then I have an order for a crocodile [...] – with sharp teeth. [...] And he himself got to decide where the dots should be, and colors and other [things on the monster]. [...] [We did this via the system] but I have also crocheted in between there. "But now I am working on this then, and what should I continue with that or what do you want?" [...] So it often comes ideas when you sit and talk. - Woman 68

The extra camera was added after observations of participants using the system. It was clear that they enjoyed showing things, and sometimes struggled to do so. The extra camera was added to address these issues and it was appreciated:

Some time I have used it in order to show that there are some [people] up on the bridge [visible part of their second floor] watching grandma and [her man] or so, "here is the oldest son and his friend" or something like that then. [...] Yes, [it is useful with the second camera] I think, because that you could say that if you watch TV, then it is very rare that they only have one camera, but there are a line of different cuts between many different camera position and so and it becomes that you have possibilities of seeing more things with the extra camera. - Man 41

It was also used to get close-ups on people being further away, in this sense to control spatial behavior.

There was also a desire to be able to show things on the Internet easily for people in the other location by using the iPad:

...and also just to be able to show things, I don't know maybe that was there, but if you say that you find some fun videos on Youtube or something, then it would be nice. [...] well, in some way to be able to show things, then if it is on the iPad or the TV I don't know. I guess it is better on the iPad, since you see each other so. [...] I surf on something and show so their iPad surfs in the same way. - Man 41

The applications on the iPad provided by TA2 have been used as one activity among many others and the iPad is not at center stage of the interactions. Participants also seemed to struggle to perform activities by using the iPad if it was not an activity they would normally perform if meeting in person, e.g. reading and playing games.



The possibility of show-and-tell was also used for demonstrating in order to help each other:

I also have some specific memory of that I have, well, that there is something that is qualitatively different, that we don't have in the other communication, which this enables. There is another level of support, if you say so. It happens sometimes that mum calls and have questions connected to the mobile phone or the computer and it is not always that easy to instruct or help with this over the phone. There are so many different steps; you kind of need to point at different places. [...] So it provided another presence in, in that instruction, in that meeting than what you get on the phone. - Man 41

The Storytelling application was developed primarily as a way to increase communication between grandparents and grandchildren. It was used to some extent but mostly in order to practice reading with grandchildren, rather than reading for them.

[When we used Storytelling] then we read every other page, or kind of with the little one so that he learns himself. - Woman 68

One reason to why storytelling was not used very much was that TA2 Lite was used in the living room or a special TV room:

And this with story reading, it doesn't really work when you sit up like this in the living room. It should almost be putting them to sleep then. -Man 70

Being in the living room often meant that many people were present, and participants might have preferred other activities for that reason. Participants who didn't use to read with their grandchildren also found it more difficult to do so using the system. Another reason was the lack of control one could have over children in another location:

You need some kind of control, if you want that type of, if you want it like usual. Indeed, you can flip the pages even if the child is in the lap and tries to read – they can flip the pages, but it feels like it was easier that they accidentally flip the pages, because there is no physical control in that way. - Man 41

Different books suit different ages and it was difficult to get a good number of books to make each of the different children engaged by at least one.

The Memory application was the most popular with children requesting to play again and again. It was also an activity that all participants were already familiar with.

[The grandchildren] are with [us] and say hi and talk a little bit [...], if you get Memory started, then they sit. Then you can go on for a long time. Then they also win all the time. – Man 70.

...since Memory started to work and [my sons] got quite caught by that, so it has been pretty... [we] talk for a while first, maybe equivalent to what you usually call in the weekend and something, and just talk, "hi", something like this, for ten minutes – a quarter. Wave a bit at each other and then there is a Memory session of about 40 minutes maybe [...] It might be I that take the initiative and start it but then when we are all in place there, then they want to play Memory of course. That's the funniest. - Man 41

The Interactive Whiteboard was the most versatile of the applications. It was used for playing Hangman, practicing spelling, writing and mathematics, as well as used by the children just to draw for the sake of fun.



...usually, it get as bit like they draw for a while too, that they draw a car or something fun. [My oldest son] maybe shows that he can write a few words as well. So some writing practice maybe you could call it. - Man 41

The card game was never used much, probably because it is rather complex to learn how to use.

Helping grandchildren with their homework was desired by many in the older generation. It is however worth pointing out that there were two retired teachers among the participants.

And we started with the iPod, or Ipad it is called and then I gave her some assignments that she should do on it and it was in English: "Draw a green frog" for example "draw a grand bear"... [...]Then [my other granddaughter] came and then it was homework in English for her too and there were plenty of sentences that we should do and that we discussed around then. [...] She did have some days for this but now she took the opportunity to do most of it then, since she could get help and we discussed the whole, why it was like this or that. -Woman 70

Whilst parents said it was difficult to find time to help with homework grandparents had the time and desired to help.

Because it is difficult for us to get time to sit with the children's homework, and mum says that she'd be happy to help and do the home works via this system then. [...] That could be a challenge because there we notice ourselves that we need to sit rather close and focused with the child, in order to help them get through the home work. [...] So I can imagine that it is difficult when someone sits there on the other side of a screen and then to get that focus. - Man 41

Some participants also tried to practice skills such as spelling with their grandchildren without it being a set piece of homework. For example a grandmother drew something on the Interactive Whiteboard and then asked the child what it was and then asked how that was spelled and wrote it etc. and another grandmother provided this quote:

And in addition I think that you could have much fun with math puzzles and these things. And I think that you could benefit from the iPad and do mathematical puzzles and discuss mathematics frankly. So there, that I believe in because this with drawing and showing and explaining with pictures how things are connected. - Woman 70

While many different activities have been tried, some have worked better than others. The limitations were sometimes technical, e.g. that the activity requires close-up of text and these limitations were generally solved in some creative way throughout the trials. Some activities enhanced the level of interaction between the groups while some put more focus on performing the activity itself and less on the group on the other side. At these moments the video link did not seem to add anything to the interaction, though there could be communication via the video connection in between for example game sessions.

The combination of activity and video communication was also appreciated together (at least by some); the activity discussed is Wordfeud:

Well, I also think that both [my son] and mum want to have, I mean that they want to play simultaneously as they see each other. So then they have one each, one hand computer each and the connection too and play, because both presumably want direct feedback - "now I have put, what do you put?" kind of. Whilst when I play myself, then it is more that, when you have time



you take it, but they presumably want to play more in real time, so to speak. [...] Because then it becomes an activity in life, that you play, you perform that activity then. Whilst I can feel, for my part that I don't have time to play, but I take it at some point when I have time, when I'm going to sleep or when I sit on the train, then I can do some Wordfued. I mean, it becomes an "activity to fill up time", whilst for them it is presumably more a – "now we shall have fun and do this activity together". - Man 41

Often when larger groups were present, particularly when children were involved, there were multiple activities going on at the same time oscillating between the foreground and background.

I don't know. Maybe it gets more focused when you speak on the phone; you only talk to one person at a time then. Now it is more like, more things going on and the kids have some [things] between themselves and, well, it's a bit like when you meet. [...] no matter where that is it gets a bit like you are not into the same thing all of you then. - Man 70

Activities were also especially used with children, whilst adults mostly just talked or had coffee together:

...But it is also for us adults, pretty nice to just sit and talk a little bit. We have done, sometimes, that they drink coffee and we drink coffee here then, kind of. Now they cannot serve cookies through the TV, but anyway. It is ... that you can just sit and talk for a little bit. Pretty nice actually. - Man 41

4.4.3.5 Social ecology

Sessions are mostly started spontaneously with one family using phones to call the other location to see if they are available. The activities performed were also decided spontaneously while the session was under way. A few families have scheduled sessions in advance, especially between families 4 and 5. This was in order to be able to have more people present, though this did often not work out as planned and interactions were postponed.

Starting the system required both sides to connect and there was no indication of an incoming call. This was not considered ideal by any participant and there were some discussions on how this could be done. This was however not a focal point of this study and we refer to the Connected Lobby study for a deeper investigation into this problem. It is however important to comment on the fact that participants used it in a similar way to a phone; they called when they wanted to communicate and though it was facilitated by using the TV screen there was no strong connection to the TV itself i.e. people were not watching TV when they decided to connect, rather the opposite - if they were busy watching TV they did not use the system.

We haven't known anything and then he calls and maybe I am about to watch some program or something then, if there is some documentary or you know, when you want to see or something and then he calls: "ah, can you connect now...?" -Woman 47

...but there is some competition. [My wife] might want to watch some program then and then this comes in the way also in the evenings. It is not all day that you can do this; they work and come home late, so it has to happen in the evenings. [...] And if you wanted to have [this] then you should have another TV somewhere else. - Man 70

Even though it was not tried participants also imagined being able to use the system during commercial breaks:



... It could be that both they and we are watching some program [...] say Idol then or something else and then there are pretty many commercial breaks, that you could imagine that you sit and talk about the show or something completely different and then zap back. – Man 41

Conversations between the households were described by participants as being longer, more relaxed and including more topics than when using the phone:

All of a sudden it is like you talk to each other like you are sitting in the same sofa. It kind of becomes like that. You talk to each other about all sorts of things all of a sudden. In the phone you just take the most necessary. [...] We talk a lot more with this, than we have normally done on the phone. -Woman 47

It is another thing when someone calls to just check what is happening. Then [using the system] you sit down more in peace and quiet and maybe talk for a quarter all of you. Telephone is so focused. I [!] talk to someone over there, for a certain period. If you sit and take a cup of coffee then it can be the two of us, or us and the children, but when they are joining, they are also joining somehow. It is still kind of coffee, but also spending time with them somehow. - Man 41

There was however at least one person who believed it was more relaxed not to be seen and experienced the phone as more relaxing than a TA2 Lite session:

[...] ... it is also nice, I feel, for my part, to have telephone calls, have another relaxation in it, I mean I can yawn or lay on the bed and still take a phone call, but if I should sit, even if it is in a completely different room, only me and the video camera, then it is in another way. - Man 41

There were also examples of increased interaction between households:

...It has not replaced phone really. We call each other about once a week. So this has been and addition, that first there is a phone call. "Ok, now lets run (the system) for a little while and then is there anything else that is new?" And then we start. So, this is more two things, two conversations extra every week. - Man 41

It was also considered to be a good way to keep in touch, since meeting in person can require a lot of effort (and then maybe not happen at all):

...but I think this is a good way to stay in touch without having to [travel], because it is always more work for everyone, I was about to say, that you should manage to get everyone gathered. So in one way you can see that this is an easier way to spend time together. - Woman 68

A reason for it being a good way to keep in touch was the possibility to meet anytime:

There is a great value in this, that you can see each other and spend time together like this. You know when it comes to my son and his wife, I'm not there often but now I can be there anytime if I want to. – Man 75

Sometimes it was not considered appropriate to communicate via the system according to some participants e.g. for funerals or serious stuff, like telling about someone being seriously ill, or when discussing more personal matters that did not concern the entire group, or that was not suitable for the children.

However, normal life also often got in the way of using the system:



But [my granddaughter] she is, I know she is extremely stressed and it is the same with my daughter and her boy over there. I mean they are so stressed. They cannot, they cannot even speak on the phone, they don't have time. Unfortunately, it is like that in life and I think it is very sad, that it is that way. Woman – 78

Yes, well we usually call in the evening, when it feels like I could be suitable. But it has been a lot that we have to take the initiative otherwise... so sometimes you've kept from [calling], because it shouldn't become nagging. – Man 70

In all extended families the older generation has expressed that the younger generation is too busy to stay in touch as much as they would desire; they work, they go to university, they have to prepare dinner, kids should be put into bed and during the evaluation period there were also unexpected events such as one family buying a new house, one participant quitting his job, lots of people getting sick, people going abroad etc.

Sometimes the idea of how communication across the system should be handled was quite varied in the different locations, especially between families 4 and 5:

It is a little bit stupid to think, but what does grandma do? She is in her apartment. It could be so that it was a part of the TV, that we only have to be visible in the TV. And then we could live our life here, that you could just talk. [...] That you would more have an open link to each other. That's what I thought. – Woman 32

It was never like that and all sessions were planned in advance; grandmother and granddaughter had somewhat different ideas of why:

...we have to decide [time] you know, because they have so many different times and... Well, I can, almost anytime. So for me it is not that tricky. But it is very... [difficult?]. People work and go to school and it is, you know. You have to be a bit prescient. – Woman 78

...the aim was that I should call grandma when my children and I would talk to grandma. [...] But grandma wanted to decide a time and a day, when she could sit down more. A little [like] booking time. – Woman 32

It was also difficult for elderly people to learn how to use the system and people commented on the fact that a system like this needs to be simple to start in general:

...I believe there were many different parameters there, but mum's bad technical knowledge [...] and habits then that is number one, as I see it and in combination with bad vision. – Man 56.

... I think you could run [it] almost like when you zap on the commercials, just like that: "well, let's zap over and check if they are online". Close enough. That is where you want to get, [that it] feels like it is just there, almost like another channel on the TV. - Man 41

Difficulty with new technology and bad vision were other reasons behind why families 4 and 5 really struggled to use the system in union with the issues mentioned above.

A majority of the participants expressed desire to keep the system, and to use this communication technology with other people, both family and friends, sometimes in connection to activities like playing bridge or playing musical instruments together. There was a desire to use the system both with people living at a distance and with people living in the same city, especially with elderly people who might struggle to get to places.



It is at least the ones that you anyway in some way visit at home or that comes to your home, at least there, but probably additionally a little further. The ones that you maybe not really, say that someone has moved to USA or something. It is rather difficult to go over and have dinner then just like that, so even them of course maybe most important, the persons that are a little further away, but that you used to meet before they disappeared then, away somewhere China or India or wherever they are now. - Man 41

There was however also doubt about how much it would actually be used if they did have a system:

But I don't know if it would be that very much if you would get this stuff anyway. – Man 70

...it has been too large part of the time that there have been problems then, to be able to really say if this is something we would use or not. - Man 41

Several participants also discussed how much it would be worth in terms of money. They would like to use this type of technology but it did matter how much it cost, both considering the system in itself but also the expensive Internet connections required.

People have also downloaded other applications and used together and they have integrated other media into this:

And there grandma had the idea that she and [her grandson] should play Wordfeud, and [my son] does that on his iPod Touch and then grandma on the iPad. - Man 41

One man also discussed the possibility of having this system on his mobile phone:

I could very much consider having, in the future, having my mobile phone and, well, be able to look, have it next to me and have communication with mum whilst she sits by the TV. I believe in that. - Man 56

4.4.4 Interpretation

There were several difficulties in finding participants. The requirements of participating in a user trial might seem overwhelming to an already busy family with young children. To introduce new media to your children that disappears after a month, or to just get more contact and then not being able to keep it might not be desired. Other people might have chosen not to participate because they didn't believe in the idea, or because they thought it was difficult to learn how to use new technology. Other people might just not have suited the study, for example not having children, or all children living too close. It is, however, vital for the result that the people, who chose to participate, were the ones being positive already in the beginning.

4.4.4.1 Group communication

The possibility of group interaction was positively received by the participants, who experienced it as adding new dimensions to the already existing communication between the households. They also claimed that they would appreciate the possibility of being connected to more than one household at the same time, which is already addressed in TA2, though not possible with TA2 Lite.

The strong focus in TA2, on groups of users and on shared activities, has created novel interactions not envisioned by the TA2 project beforehand. Participants in this study move in and out of an ongoing session, thereby forming a dynamic switching between different social constellations leading to a diversity of activities succeeding each other in one session. The switching between different



constellations is also typical for FtF meeting, which makes this resemble an actual meeting (Goffman 1990).

However, group communication across the system was also significantly different from FtF group communication. The system did control possible subgroups, since there could not be several subgroups involved in interaction across the system simultaneously. People had to wait for their turn. This would not be the case in FtF, where participants can break down into subgroups by choice and move around more freely in the room to get closer to certain people.

The interaction through the system can be characterized as group-to-group interaction, i.e. one group is talking to another group; they did not merge into one. This is due to the “the fact that the participants focused so much on the TV, that they faced each other, that they helped each other formulating messages and the fact that only one conversation can be maintained through the system at a time. To some extent this might also be natural in the sense that the people living in the same household might already know the things about each other that is discussed with the other location.

To some extent there were also more issues because it was group-based rather than based on individuals. Turn-taking, orientation etc. are different in groups and it is more difficult to manage eye contact when the participants are spreading out across a screen rather than staying in the center of the camera focus.

4.4.4.2 *Communication rules and different types of presence*

The fact that some nonverbal cues could not be transmitted was not considered an issue when the participants were asked about it, though it might have impacted the communication in some ways. There could for example be a relation between the lack of nonverbal cues and the circumstances when the system was not considered suitable, i.e. telling about serious matters, which is a context that normally includes touch. In order to comfort someone you might want to be able to put an arm around them, hug them or just hold their hand. Participants also expressed that reading or doing homework with children across the system might be difficult due to lack of focus and physical touch. Sometimes physical touch might be needed in order to have control over children.

The limitations in eye contact, pointing, touching etc. might impact the possibilities to perform successful rituals across the system, since rituals could be seen as built up by communication rules (Knapp & Vangelisti 2005). These limitations are also connected to somewhat lower social presence, since nonverbal cues generally are considered important for social presence (e.g. Short et al., 1976; Daft & Lengel, 1986; Kock, 2005; Walther & Parks, 2002). Another sign of somewhat lower social presence is the fact that people were focusing on the TV as much as they did. This indicates that humans are not able to pick up as many cues from the people on the screen as from the people in the same room; they had to watch the people on TV to keep the communication going. Lots of cues are in fact not transmitted, though the communicative importance of cues in the areas of for example haptics and olfactics are debated. This result is supported by Collins (2005 p. 36):

When human bodies are together in the same place, there is physical attunement: currents of feeling, a sense of wariness or interest, a palpable change in the atmosphere. The bodies are paying attention to each other, whether at first there is any great conscious awareness or not.

Collins (2005) believed that physical co-presence was necessary for interaction rituals to take place, though he did agree that it was a belief and it had not been investigated. In TA2 we believe that interaction rituals can take place by using mediated communication, but Collins (2005) claim of co-



presence is still important. If people using the system experience lower social presence the interaction ritual might be weaker. It might be more difficult to get a mutual focus of attention or a shared mood.

The lack of transmitted cues also impacted the communication with the people in the same room, since the extra focus put on the TV decreased the possible focus on people in the same room. If the communication, with people in the other location and in the same room, requires a lot of extra focus, compared to a situation where they are all in the same room, it might also impact how much more focus one can put on for example mutual activities. An activity in itself is not a guarantee of increased interaction.

The participants were also not aware of what the differences between using the system and meeting FtF actually were, and many nonverbal cues are sent and received with a low level of awareness or maybe no awareness at all (Argyle 1988). Therefore it is useful not only to make interviews or questionnaires but to observe people using the system.

On the other hand, there were many comments around the fact that it felt like they were in the same room and this indicates rather high both presence and social presence. The utterances are connected both to presence; being in the other location or almost forgetting that the communication is mediated and to social presence; being with the other people. Both topics were often included in the same sentences, for example: “...it is exactly like you sit and talk in the same room.” and where thus difficult to differentiate. The fact that “being in the same room” was the most common metaphor when describing the similarity to FtF meetings, in union with comments on that there is a greater closeness when you see the entire room and not just the head of the person you talk to, indicate that seeing the room in itself was important in creating a feeling of being in the same place, i.e. presence was important for social presence.

4.4.4.3 *Spatial behaviour and domestication*

The TA2 system, due to its ability to capture high quality video and audio across a large room and display it with great detail, has the ability to make use of these personalized spaces in many different ways. This allows for interactions which are characterized by the participants “inviting” the other group into their room and make them a part of the interactions that take place there. This is different from a situation where the interactions experienced as taking place on the screen and the participants are only present there as “talking heads” with no context visible. The TA2 system should therefore be understood as an interaction space distributed throughout the participating rooms and not something that takes place solely on the screen.

Due to its integration in a heavily domesticated and personal environment, the context of where the TA2 system is used matters more than a system that creates its own environment or that exists in a neutral context such as a meeting room in an office environment. The placement of the system in the domestic environment should be seen in relation to the home and its objects being important for family identity construction and sometimes for interaction rituals. The fact that the family can use their own home and objects encourages family identity construction (Morley 2000).

Social presence theories generally only focus on disadvantages of mediated communication; Culnan and Marcus (1987) argued that new possibilities of mediated communication should also be taken into account. By allowing the people in both locations to be home and to have access to their personal objects, TA2 Lite enables a special communication environment. This allows families to integrate their separate homes in new ways.



By using the normal TV location and thus furnishing, the communication through the system suffered; the activity of TV watching interferes with the communication. This type of effects should be expected when putting technology into a domestic environment, especially when utilizing a screen that is otherwise used for a different kind of purpose. Orientation and distances were mostly just adopted from the TV watching which created unnecessary distance and the wrong kind of lighting. TA2 works best with light sources coming from behind the TV and shining on the faces of the participants while in a TV watching situation, light sources are usually placed behind the viewers so as to not disturb the eye. Having a separate area for the system might be ideal, though maybe not possible economically or spatially.

The addition of the extra camera also allowed the participants to control spatial behavior in new ways, by enabling them to show parts of their home that would otherwise not have been reachable from the location of the system.

4.4.4.4 *Activities*

That participants are using already domesticated objects and activities indicate that TA2 Lite is used to mimic activities performed when the group meets physically rather than introducing new activities. It also suggests that the activity becomes meaningful for them by personalizing the activities and the scene that the other side can see. Personalized or domesticated objects and spaces are an important way of communicating shared and personal identity (Morley 2000). It is also important in creating a common mood and understanding of the situation which is important for interaction rituals (Collins 2005).

It is also clear that showing objects, often new possessions, to the other participants was a common activity, maybe in order to integrate these into the already existing family objects. If a new object is shown it can be returned to in other conversations and is something the participants have in common. It could also be a part of personal identity construction, since your personal objects set you apart from others.

The results indicate that activities might be an aid in interaction, especially with children, but it is not necessarily the case. The fact that the participants need extra focus on the people on the screen might also mean that there is less extra focus to put on activities. If the activity requires a lot of attention, the participants might not gain anything from the extra cues possible in the video communication.

4.4.4.5 *Social ecology*

The fact that people experienced longer conversation, wanted to keep using the system, wanted to use it with other people, and believed it brought new dimensions to their communication, especially since it was in a group supports the overall goal of the TA2 project—to *improve social communication amongst groups of people that are separated in time and space*.

It is important to remember that to “improve social communication” shouldn’t necessarily involve making the facilitation of the communication easier. The goal of technology for social ends is not just to make the everyday as comfortable as possible. Some users said that with the TA2 system they wouldn’t even have to go down to *Mötesplatsen* (the meeting place for elders where we have conducted workshops) since they could stay at home and watch the activities through the TA2 system. However, as part of the pedagogy of *Mötesplatsen*, and for both health reasons and social reasons, the staff wants to encourage the elderly people to make the effort of actually coming down to the meeting



place. They believe that the social contacts and the self-esteem benefits from having made and overcome the obstacle of travelling to the meeting place can mean a lot for an elderly person. Just as a hand written letter can be more meaningful to the recipient than an email; social interactions that also involve an effort can signal commitment and strengthen the feeling of togetherness. Compared to other forms of mediated communication such as text messaging, social networking and phone calls, TA2 requires a considerable effort in delegation of time and attention to the interaction. While not the same level of commitment as a FtF meeting, it therefore weighs more heavily than other forms of mediated communication.

The system was integrated in the existing media ecology with sessions being set up through phone calls. The phone is the most reliable way of inquiring if a person is available, no matter if they are home or not. It would be difficult to match this feature using only the TA2 system which is stationary. There is a balance between making setup easy and making it adaptable to the social and media ecologies that the participants are already embedded in. On the one hand, the present way of connecting with TA2 Lite used in the experiments is a temporary solution and somewhat complicated because it requires both participating groups to call each other at the same time with no indication that the other side is trying to call. On the other hand, it can be an advantage that TA2 explicitly tries to become an integral part of the participants' media ecology rather than a completely stand-alone system. Setup could therefore be negotiated with such things as mobile phone apps or from within social networking sites if participants are already making use of them. The media ecology might also be different in the different locations so having different options might be useful, especially to be useful for people in all ages.

Already existing relationships seemed to impact how much the system was used. When the participants did not normally communicate often, they often did not communicate often using the system either. This was especially the case of a grandmother with adult grandchildren, which normally just communicated a couple of times a year – though they wished it to be more often. There were many reasons to why there was not much contact through the system in between these families; technology failures, usability issues, different concepts of how it should be used etc.

All families struggled, to some extent, to find time to use the system, and especially the younger generations were very busy. Technology cannot solve those problems, especially if you are looking at a form of mediated communication, like TA2, that by its nature requires a fairly large chunk of time per session. This type of technology can help families to stay in touch that don't have the possibility to visit very often, but it still requires effort and if you don't seem to find the time to call someone, you will not find the time to talk to them, using the TA2 system. TA2 is a possibility that can aid in strengthening togetherness, not a solution for difficulties in maintaining social relations.

4.4.5 Implications

Some of the novel phenomena of video communication in group, as well as general issues in video-mediated communication, could be addressed, e.g. it might be possible to make it more of one group talking together and less of one group talking to another group on the other side of the system. It might be possible to enable more than one interaction to take place across the system at the same time, for example using multiple communication channels for this, such as a written chat as well as video. Other differences, like the problems around spatial behavior and turn-taking could possibly be addressed in the future with new technical solutions or in some cases by just informing users how to improve the communication, e.g. by explaining how lighting can be important for better focus.



When developing group communication technology, research on group communication also needs to be taken into account as opposed to just considering communication theories in general that are often based on one-to-one communication.

It is also important to not just consider limitations, but also possibilities of mediated communication not found in FtF communication, for example how two homes can be socially present at the same time. This is also important to take into consideration when designing. Rather than just focusing on how mediated communication can be as similar as possible to FtF communication, new possibilities should also be tested.

It is also vital to consider the fact that a large part of the room was visible and played an important role in creating a feeling of presence. By addressing some of the issues in the communication mentioned above, the positive effects of seeing the room could be lost. Whilst the full-featured system with orchestration could solve issues around spatial behavior and maybe eye contact, a lot of zooming and cutting between different camera position might also risk losing this sense of being in the same room.

The fact that participants made use of the entire room creates an opportunity for design where accessories spread out across the room takes on an important role; accessories that can both be high-tech and low-tech. Examples of these being used in TA2 lite is high-tech solutions like the iPad applications and the second camera and low-tech solutions such as board games. To have an easily movable system might also be useful. One woman mentioned that she might have used it more if it was in the kitchen and one man said that it was difficult to read stories to the children when the system was in the living room.

Applications for the TA2 system or similar systems should be focused on supporting opportunities for the users to create activities that are meaningful for them rather than to try to direct interactions too much. Example of such accessories are the hand-held camera, the interactive drawing board and card game application that do not make use of predefined rules. The TA2 system should avoid creating its own space where interactions take place but allow to as large extent as possible that the users are able to create a personalized environment that makes use of interactions, objects and environments already established as meaningful in their relations.

It is therefore suggested that the applications that are created to support interactions in TA2 are of such nature that they allow the participants to create their own personal interaction narratives rather than trying to create a space of interaction directed by the system. An example is making socially adaptable card games or board games without built in rules and time management so that these can be negotiated by the participants in their own way.

When it comes to interaction between grandparents and grandchildren helping with home works seems to be an area that could be useful. Tools can be developed to support assisting with homework or learning in general. Storytelling could be developed to support practicing reading and Memory could, for example, be used for reading practice or learning new words in a different language i.e. instead of matching identical images you should match an image with a corresponding word.

In order for activities to be meaningful in union with the video communication, they should not require too much focus in themselves. Video communication requires more focus than FtF communication, and activities that require lots of focus could take focus away from the interaction instead of supporting it. It is a fine line when designing for activities, but this should be taken into account. Some activities encourage interaction more than others, e.g. a questioning game or Pictionary.



It is also important to integrate the TA2 system in existing media ecologies. While TA2 is a stationary system in a fixed location, other means of communication such as mobile phones are more flexible and a better way of reaching a person. Preexisting tools for communication has fixed norm and routines for establishing contact and new ones are introduced all the time so it's more important to make sure TA2 can function as a complement to these.

Due to the fact that there was no connection between the activity of watching TV and using the system it might be important not to integrate the system too much with the TV, i.e. it should be easy to see if someone else is online or tries to connect no matter if the TV is on or not. Another challenge for status notification in TA2 is that there is no easy way of defining what it means to be “online” in TA2 since the only activity it supports is the actual calls. This can be compared to a social network such as Facebook where being “online” means that the person is doing something else at [facebook.com](https://www.facebook.com) and can therefore be reached immediately. A person might be available for a TA2 interaction within the near future while at the same time being in a completely different room or even outside of the location where TA2 is stationed. To indicate status, a user would therefore have to actively remember to update the status even when not using TA2, unless this can be set automatically for some conditions. An example of the latter would be if a user’s status is automatically set online as soon as some mobile or fixed sensor system recognized that they have come home.

Especially elderly people learn technology slowly and only learn very specific tasks. It is important therefor to not assume that elderly are familiar with technology or interfaces that are common in the rest of society. One way around this is to design the interface differently for different people and also shift functions to the site that has the most technical skills. For example, the more technically skilled site can control functions at the site of the elderly persons or have override functions when children are using applications.

Some of these matters are already being addressed by the TA2 project. TA2 Lite, as a prototype, lacks some of these functions. The addition of the hand-held camera is a hint that orchestration might aid the communication. This might help in providing eye contact and help in turn-taking and address the issues that the seating arrangements created. This could also make self-view less important or even unnecessary which would provide a more natural feeling.

Another area that is being addressed is the possibility to connect more than two locations to each other, which were also sought after by the participants.



4.5 Connected Lobby Field experiments and field trial (2010-2012)

In this chapter, we report on three studies:

- An experiment that focused on the usage of light for notification (October 2010);
- A field trial that focused on the usage of video chat on a television for group-to-group communication during (March 2011);
- An experiment that focused on different methods for coordination (January 2012).

4.5.1 Introduction

In this study we are interested in two main research questions. First, we want to further investigate the acceptance of television as a device for group-to-group video communication in the home, which was also studied in the Storytelling / TA2 Lite field trials (above).

This includes its influence on communication patterns within the family and between remotely located families, its effects on perceived social expectations or obligations, and whether it will raise any privacy issues. Secondly, since the television is not typically an always-on device, we are interested in using ambient lighting as a notification and awareness system.

The main research question is: *to what extent is television a valid and accepted device for group-to-group communication within the family?* In particular:

- How often and why do people use video communication if it is on television?
- How does the television as a video communication medium influence other communication forms?
- Does using television as a video communication medium create social obligations and privacy issues?

The second research question is: *to what extent is ambient light suitable as an availability notification system in this context?* In particular:

- How to design lighting notification for a television based communication system?
- Is light notification valued as a calm technology?
- How well does light notification trigger interaction?

To answer the questions above, we ran a lab study for designing the lighting notification system. It serves to better understand the possible usage of lighting as a notification system and how it is perceived by potential users. This lab experiment allowed us to calibrate the light notification for the field study.

Then, we ran a long term field study with three households of a same family, where the television has been enabled with a system allowing group-to-group video communication. The ambient lighting device provided light notification about the status of the system and the received call, allowing the validity of the conclusions from the lab study to be tested.



4.5.2 Study 1: Using Lighting for Notification

4.5.2.1 Approach Study 1

To be able to use light notification in a field study, it is important to first look at how we can use lighting to provide ambient information about the communication system we want to evaluate.

For our study, we use light notification to provide awareness information about the communication system and to notify when someone is calling via the television. For this we use Philips' LivingColors lamp and therefore need to test this lamp in a lab study to pilot the design of the light notification.

We want to understand the user's preferences (colours, type of flash), the visibility and annoyance of the lighting notifications and get feedback from the users about the general idea in order to improve it for the field study. It is also important to test if the light notifications are correctly understood and recalled in regard with the criteria for ambient displays of Holmquist (2004).

These tests were performed in the following laboratory experiment by comparing different lighting possibilities (frequency and amplitude of the flash, colour, central versus peripheral placement) in different conditions (watching television, reading a book).

The research questions for this laboratory experiment focus on the lighting patterns, the colours, the placement of the lighting display, and general feedback of the user about the concept of lighting notification for our inter-group communication system. These are

- How well can people memorise the lighting patterns? What are the main features that people remember (colour, frequency, and intensity)?
- Are the lighting patterns appreciated or found annoying? Is this way of notifying about the systems status in the living room accepted by participants? How can the system be adapted, or improved?
- Are the lighting patterns noticeable during an activity next to the lamp? What are the chances that one misses a notification and what are the possible implications?

The aim of the experiment is to have a first general view on the answer of these questions such that we can tune our first idea of light notification of the TA2 system. Answering these questions will eventually help us to implement the light notifications system for the field study.

To answer the specific research questions, a controlled lab experiment was set up. It involved both qualitative data using small interviews and feedback from participants, and quantitative data using questionnaires about the lighting patterns. First, a pilot test on four participants was run to choose the best settings to test during the main experiment.

The study consisted of a within subject lab-experiment where dependent variables were:

- Number of errors (missed signals)
- Qualitative feedback about acceptance of the light notification
- Understanding and recalling of the light notifications

The independent variables were

- Position of the lamp (next to the sofa, next to the television)



- Activity (watching television, reading book)

In each condition an identical pattern of lighting notification varying in colour and pulsing speed were displayed by the lamp:

- In the first condition, the lamp was positioned next to the television. Participants were invited to watch television for 10 minutes. The intensity of the lamp was low.
- In the second condition, the lamp was next to the sofa, directed on a wall on the side of the sofa. The participant was asked to read a book for 10 minutes. The intensity of the lamp was low.
- In the third condition (control), the lamp was positioned next to the television. Participants were asked to read a book for 10 minutes. The intensity of the lamp was low.

We used four kind of lighting patterns, varying in colour, frequency and amplitude. Each setting lasted 10 minutes and showed two blue flash notification and three green notifications. The lighting notification order is the same for each setting. It started white and changed from red to green two times.

The experiment was performed by 9 participants (5 males, 4 females) between the 24 and 42 years old. They volunteered to take part in the study, recruited at their working place (Philips department) where the lab experiment took place.

4.5.2.2 Findings Study 1

Results shows that participants had hardly any problems to understand and remember the meaning of the green ambient light (someone is online), the red ambient light (no one online) and the green flashing light (someone is connecting)—see Figure 23. On the other hand, the blue flash light (someone is calling) was only remembered by 50% of the participants. Between the three conditions, the control condition (lamp next to the television, reading activity) was the one where participants were the most unlikely to detect the lighting notifications. This was also the condition with the highest number of missed notifications. However, in all three conditions, most participants saw most, if not all, lighting notifications. In addition, participants showed some concerns about being able to see the light notifications in their real living room during the day because they had the impression the room was darker than their own living room.

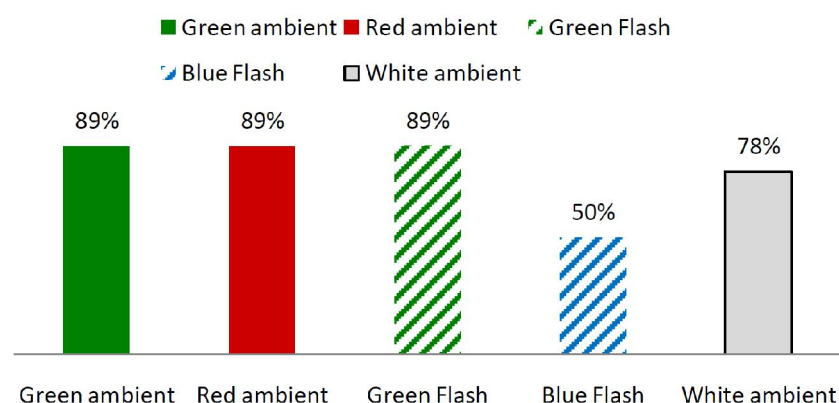


Figure 23. Percentages of participants recalling the meanings of the light notifications correctly.



Data showed that the lighting and the light notifications were not disturbing to participants during their activities and that the system could potentially be accepted at home without troubles or rejection from participants—see Figure 24. The system itself sounded interesting to most participants as most of the reactions were positive. Eventually, participants suggested using nicer colours and avoiding red, to only blink or change colour to trigger a change and to position the lamp where it can be best seen without distracting too much.

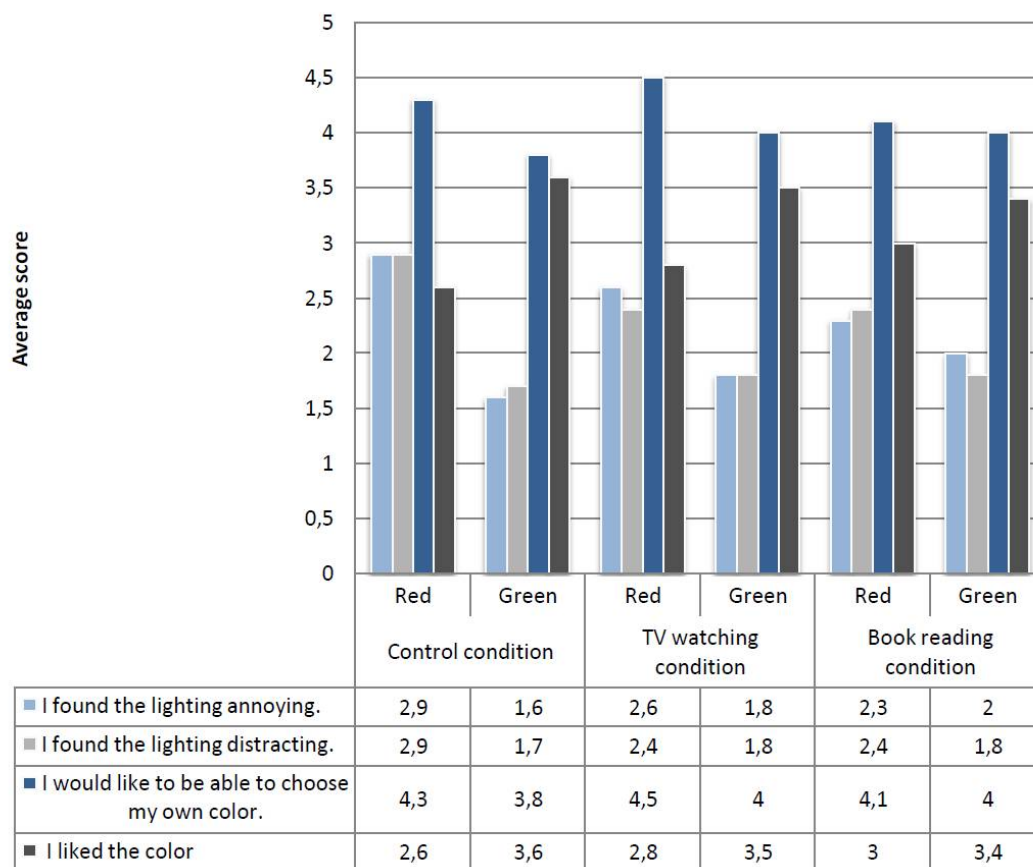


Figure 24. Participants' agreement (1=completely disagree, 2=fairly disagree, 3=neutral, 4=fairly agree, 5=completely agree) with four statements, which are indicators of their likelihood to accept ambient lighting.

4.5.3 Study 2: Group-to-group video communication and lighting notification in the field

4.5.3.1 Approach Study 2

The second part of this study was a field trial of four weeks, in which prototypes were installed in people's homes. As part of this field trial, a pilot study of one week was used to provide a technical test of the system and the lighting notification. The first week of the field study served as a baseline



measurement in order to get to know the communication patterns and television usage of the family members. Then during the following three weeks the TA2 system was installed in three households who were all part of the same extended family. At least two members of each home took part in the study. The TA2 system is a computer-based system enabling video communication, chat and audio call using the television as a medium. A LivingColors lamp was linked to the system to provide notification about the system status such as when someone connected, called, or when there was a missed call.

We looked at the experience and influence of video communication on television between remote households in the field. Also, using the lab study results for designing the light notification system, we would like to better understand how lighting notifications are experienced by users in the field. The focus is therefore both on evaluating video chat on television as a group-to-group communication system, and on evaluating people's experience of the lighting notifications.

The research questions focus on the user experience and the evaluation of the communication medium and the light notification system. Evaluating a computer mediated communication (CMC) product is not a straightforward task and depends on different factors that go beyond the quality of the communication. Namely the quality of a product is not only based on how well it works but also how well it fulfils non-functional needs. In particular, in CMC, different indicators have been shown to be important, such as the costs for the users in term of privacy and social obligations (IJsselsteijn, Baren, Markopoulos, Romero, & Ruyter, 2009). To measure the influence of the system in the home we used system logs, questionnaires and diaries during the field study (Benyon, Turner, & Turner, 2005). Moreover, we used semi-open interviews to further our qualitative understanding of users' experiences (Benyon, Turner, & Turner, 2005).

Our focus is on the video communication system as well as the lighting notifications system, the communication patterns, and the influence of the TA2 system on them as well as the social obligation and privacy issues generated by the system.

Logs of the system usage provided exact information on the usage of the system such as the number of calls, the status of the system or the duration of the communication. Questionnaires were used for demographic data and specific variables measurement such as expectations, social obligations, privacy, and evaluation of TA2 features. Participants were asked to keep a diary on a daily basis, focusing on communication patterns, experiences with TA2, problems encountered and reason of usage (or non-usage) of the system during the day. Eventually, we also used the interviews to gather in-depth qualitative information about the user experience during the field study.

Participants were members of three households from the same family and living in the same city. They were recruited with the requirement of owning a large flat television (over 30 inches), not reluctant in trying new technology (self-reported) and having an active social relationship between each of the households (being close family or close friends). The requirement that each household should live at a long distance (over 100km) from each other could not be met for practical reasons.

Ages varied, from 67 for the grandparents, 38 and 44 for the parents and 13 and 4 and 1 for the children. In total 7 participants gave feedback during the study and all participants, including the two youngest, made use of the system.



4.5.3.2 Findings Study 2

Diaries and interviews of the field study were transcribed and the data was then organised per theme. The chosen themes were the ones originally chosen when designing the interviews and diaries, such as getting to know the participants, technical issues, experiences with the lighting system, experiences with the communication system, privacy and social obligation issues and differences with other communication media. The data from the questionnaires were also organised per theme and treated accordingly. The log information was processed by an automatic script in order to compare the information about the usage of the diaries with the real usage as registered in the logs.

The questionnaires were all fully answered. The quality of answers in the diaries varied, with an average 65% of the questions answered from the received diaries.

Comparing the log output with the diary's information about the system usage, we see a correspondence of the logs and the diary data of 94%. Only three days in the diary did not match with the log information, participants indicating they used the system while the log did not record any call.

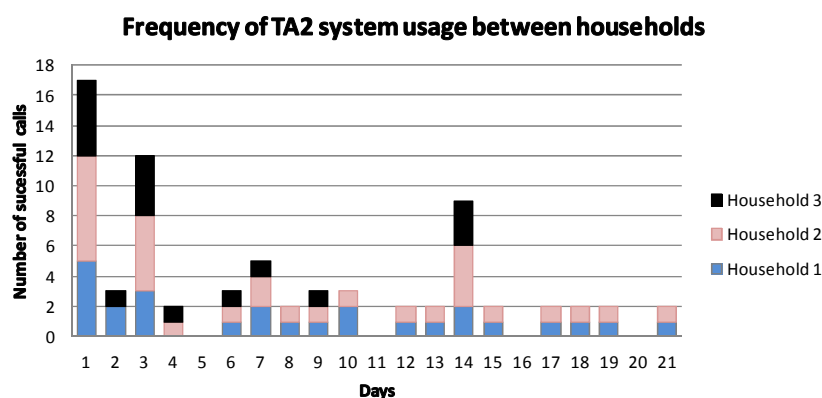


Figure 25. Frequencies of usage of the TA2 system by each household

Figure 25 shows the frequency of usage of the TA2 system by each household in terms of successful calls. This information was extracted from the logs information for more precision (the diaries mainly indicated whether they had used the system at all on a given day). The graph clearly shows the low frequency of usage by household 3, in comparison to the relatively higher frequencies of usage by household 1 and household 2.

4.5.4 Interpretation Studies 1 and 2

The lab study mainly focused on how well the ambient lighting device was received by potential users in the context of an artificial living room, how well they could understand and recall lighting notifications and the annoyance or disturbance of these lighting notifications during other tasks, such as reading a book or watching TV. The field study was used to test how the design from the lab study and test was accepted and experienced in the field.

We found that participants could understand and recall signals with few problems, especially when the colours and patterns were consistent with their traditional meaning. However, it seems that in the lab



study, participants are not able to remember a lot of different signals. Literature suggests otherwise, as it appears that pairs of users can develop their own “light language” in the Lumitouch study (Chang, et al., 2001). During the field study, we used few lighting patterns (four different patterns) and participants indicated they understood it without any problem. However, some participants were actually not using some available notifications as they did not notice the “missed call” notification (slow pulsing). They said they actually “felt” it without being explicitly aware of it. Also, both in the lab study and the field study, participants indicated they would like to be able to personalise the lighting notification by choosing the colours and the kind of information provided.

These results and the literature (Chang et al., 2001) suggest that users are able to remember and use a larger number of lighting signals if they had more time to use and learn the system, and had a better awareness of possible lighting notifications and were allowed to personalize the lighting notifications.

Another important variable of the lighting notification is its acceptance in the home. The lab study already suggested that the LivingColors lamp was not perceived as annoying or disturbing. The field study confirmed this hypothesis as participants were very positive about the lamp. Only one household found it too luminous and wanted to be able to dim it more. Once again, the personalisation possibilities seem an important variable for the acceptance of the device.

Furthermore the lamp, as a calm notification device, was successful. During the field study, we found that the perceived importance of missing or not answering a call was minimal. The light notifications, though visible, are easily ignored and not annoying. Plus, it seems that ignoring a light notification is a more socially acceptable way of denying someone’s presence. Eventually, it appears that the lamp was such a transparent technology that it was cognitively invisible, not described as a part of the system, which is an excellent sign for a successful technology (Weiser & Brown, 1996).

Video -chat on TV: It’s like paying each other a visit

The main focus of our research was on the communication possibilities that video chat offers on television. It can be more than just a way to enhance television viewing experience. Namely, using video chat on television as a medium for inter-group communication has been a unique (as quoted) experience for the participants.

In particular, we have seen that video-chat on TV enabled young children to communicate in a very natural way. The enthusiasm of using this system was particularly shared with their grandparents and mother who could reinforce the social bonds between them via the system and use it to speak about the day in a playful manner. This was already observed in previous studies (Evjemo et al., 2004) (Ames et al., 2010) and confirmed that such a system could be especially interesting for families with children living at a long distance from each other to improve family togetherness.

Our results suggest that video chat using television is an experienced akin to a face to face interaction. Participants compared the interaction like “visiting each other”, “going for a coffee” and use it for playful activities, discussing the day, rather than a way to communicate more functional or factual pieces of information. In line with previous studies in the field of video communication (e.g. the field trial with Storytelling / TA2 Lite) suggests that video creates more social presence and is similar to a face to face experience (Biocca et al., 2003; Bos et al., 2001; Short et al., 1976).

Moreover, the system was definitely received as an inter-group communication medium with the group of family members in each household as the basic unit of communication. Besides the advantages we just reviewed, it appears to come with several drawbacks as well.



Participants experienced some lack of privacy when communicating with this system, in particular for people who did not necessarily want to be involved in the discussion. One reason is the fact that it was not possible to say or do something discretely in the room when the communication was going on. Moreover, although the wide angle of the camera allowed seeing a large part of the living room, participants indicated they had to stay in front of the TV and could not easily multi-task during the interaction, diminishing the communication time.

Another important aspect of the study is the interaction between video-chatting and watching television. The results suggest that the transition between watching TV and video-chatting should be less abrupt, enabling people to watch TV as they start the communication. One possibility could be to start the video communication in a picture into picture frame while enabling the television. However, this could be still annoying for users watching television, and switching to the same channel (concept of Social TV) would be a better solution. Another possibility is to allow a soft transition between TV watching and video chat. This soft transition could also function as a moment for negotiating time for later contact when everybody in the room would be available for a video communication. This solution could be realised by allowing answering first with text chat or voice only before switching to the video communication. Namely, in the STV2 study (Harboe et al., 2008) enabled chat and voice communication with remote friends while watching the same video channel. Users explained they rarely started audio communication directly, preferring to first ask with the chat feature if they could.

4.5.5 Implications

4.5.5.1 *Study 1: Using Lighting for Notification*

This laboratory experiment gives useful feedback on how to improve the light notification prototype but also shows that there is still a lot to investigate in this direction for future studies. The goal of this lab study was mainly to give us insights on how the lighting notifications provided by Philips' LivingColors lamps were received by potential users. In particular, this study suggests limiting the number of lighting notifications, e.g. to three types of notification, and to matching the colours to established meanings (green for someone online, red for no one online). Allowing personalisation would also be interesting. The results are positive about the acceptance of the lamp in the home but extra care should be put on the visibility of the signals in daylight. However, one should remember that a laboratory experiment is an artificial environment and does not necessarily reflect the real experience of the participants. Therefore, we need to confirm these results, not only with previous literature on the same topic but also with studies in the field.

4.5.5.2 *Study 2: Group-to-group video communication and lighting notification in the field*

This research confirms that using a TV is an interesting device for social communication in a group setting between remote households for social or playful activities. We think it would be very interesting to look further into this topic, in particular with a system where the communication could be initiated by a text message or voice connection before switching to video communication, in the case where participants are already engaged in watching TV. It could be also be that a phone call could be transferred to the television for a video call, as suggested in previous studies (Chen, 2009; Demey, 2010). These kinds of implementations could considerably lower the threshold for starting a communication and could make the effort of using the system very low so that it would naturally integrate in everyday activities.



Furthermore, it would be interesting to further investigate the difference between video chat on television and face-to-face communication. In particular, as participants said that communicating with the TA2 system felt like paying a visit to each other, one could compare the real differences and similarities experienced in each case. Also, our conclusions confirm that video-chat on television gets close to a face-to-face experience. In particular, the social cue of distance between people via the television seemed to play a role in the distance participants sat from the television. However we saw this effect might be moderated by some technical issues (hearing better by getting closer). These are known effects of video communication but it may be interesting to compare this effect with face-to-face activity and group-to-group video communication in a lab experiment to better understand how this system creates social presence.

As suggested earlier, it would be important for a field prototype to better integrate with the basic television functionality (watching television). This could be done in the context of Social TV with adding the possibility of a ‘picture in picture frame’ containing the video chat image while participants watch the same channel. Another way would be to allow a soft transition with a first chat message or voice communication while watching television for negotiating the full video communication before the television functionality is turned off.

The TA2 system used was a computer running on Windows XP with Skype and Google Chrome installed. The interface was made as simple and large as possible such that only the options “Internet” and “Calling” were available on the desktop of the computer. Skype was used to make video calls and chat. The Google Chrome browser allowed participants to surf the Internet, in particular on YouTube XL, a special interface for YouTube. The computer was connected via HDMI (i.e. including audio) to the television. Internet was available via a Wi-Fi connection through a USB Wi-Fi dongle. The system could be controlled by a Bluetooth remote “Air Keyboard” that could be used like a pointing device as well as a keyboard (full QWERTY keyboard). An external Logitech webcam (1.2Mpix) was installed on the top of the television and connected to the computer. An RF USB dongle was making the connection between the computer and the Philips Living Colors Lamp. This radio dongle received commands from a Java server that could send commands to the lamp. The commands were sent by a script listening to window messages generated by Skype allowing the system to react on notifications.

For a commercial device, but also for further study, it is important to focus on the quality of the image and sound provided by the system to avoid interference with the experience of the communication. In particular, we saw that the image was not always very fluid because of some connection problems. More importantly, the audio connection between the households should not be interrupted as it influences the natural flow of the conversation (O’Conaill, Whittaker, & Wilbur, 1993).

A television that supports video chat would typically have a built-in camera. We suggest that it should be possible to rotate the camera or even detach the camera from the television. In the interviews, people expressed that they twist the camera to show new furniture and move objects in front of the camera. A moveable camera would then be an advantage rather than a drawback. This finding is similar to the findings from the Storytelling / TA2 Lite field trial, and both hint at the added value of video orchestration so that multiple cameras can be used conveniently and naturally.

This research confirms that lighting is a suitable medium to provide information in the home. It is well accepted, and can potentially be designed to be perceived by users as a calm technology that informs but does not disturb the users. Our results suggest that the information transmitted can be versatile and emotional if users are either provided with customization possibilities or are better informed about the different lighting signals.



Furthermore, this research shows that bringing video chat onto the television adds a new dimension to communication using technology by enabling groups to communicate synchronously, while making it close to a face to face experience. The system needs to be well designed to prevent too many privacy issues. Also, it brings new evidence that television in itself is a good medium for communication between households and could be used in multiple ways for enhancing communication between remote family members of different generations.

4.5.6 Study 3: Methods of coordination

4.5.6.1 Introduction

In order to nurture family-to-family relationship through technology, one must address its sociability in addition to usability. Usability is concerned with how intuitive and easy it is for individuals to learn and interact with a product. Sociability is the extent to which the communication environment mediated by social software is perceived to facilitate social interaction and to enhance social connectedness (Gao et al, 2010; Preece, 2001). Social connectedness is defined as a “positive emotional appraisal which is characterized by a feeling of staying in touch within ongoing social relationships.” (IJsselsteijn et al, 2003). This is different from social presence which is the “moment-to-moment awareness of co-presence of a mediated body and the sense of accessibility of the other being’s psychological, emotional, and intentional states” (as cited by IJsselsteijn et al, 2003). An example of when social connectedness is high, while social presence is low is when someone sends you a postcard. A handwritten postcard is often personal; the message is written for its recipient and its physical presence can create a feeling of social connectedness. Postcards do not give you the feeling that the sender is right in front of you.

The TA2 system helps provide social connectedness through synchronous video communication in their living room. One major limitation for such a method is that everyone needs to be at their respective homes at the same time, and each person may have a limited time window of leisure. With most people either working or studying during the day, leisure time is limited to evenings and weekends.

In the work on group-to-group video communication (above), three of the four main reasons for not using the system were related to timing: time constraints, (already busy) watching TV, or not at home. Participants cited that they were frequently too busy to use the system. They also had to choose between watching the current show and answering a call, which was a limitation of the particular system. In addition, participants stated that they were not at home in the evening or during the to use the system (Demey, 2011).

Even if people have the same daily availability pattern, when the other party is in another time zone, the pattern is shifted in time and the intersection between availabilities will become smaller. It is easy to assume that larger time differences would increase inconvenience, but that is not always true. An 8-hour difference was found to be more inconvenient than a 12-hour one, as someone was always working or sleeping with an 8-hour difference (Cao et al, 2010). With severe time limitations, there may not be any matching times between two families and the task of finding matching times becomes harder.

Most people communicate with their families using a “soft” routine; they have a rough idea of their families’ schedule and know when to call each other back. Also, it is easier to predict a good time to



call the other family when schedules are consistent from weekday-to-weekday or week-to-week (Cao et al, 2010). When schedules are inconsistent or sporadic, it is harder to predict a good time to call. Without explicit knowledge of availability, scheduling a time becomes guesswork. Even with explicit knowledge, it requires more effort to recognize irregularities and discontinuity in a sporadic schedule than a predictable one with more continuous blocks of available time.

4.5.6.1.1 Coordination of synchronous communication

Communication with families within the same time zone and with predictable schedules can be done relatively easily as leisure times are matched and an unplanned call during what should be an available time will most likely be received. But if availability is scarce and if time zones reduce availability intersections further, actually having a video get-together may not be that easy; it may be necessary to negotiate an explicit time for synchronous communication. Picking a good time requires availability knowledge, but other's availability may not be predictable and availability information needs to be acquired to avoid guesswork. Furthermore, when more than two families want to communicate on such a system, the complexity of the problem increases.

Using the video conferencing system can create a scheduling problem; they need to communicate and coordinate about available timeslots. Typically, the first family establishes the goal of the meeting, and then a time is determined depending on the people availability of the people that are to be present.

The task of making a proposal can become increasingly complex if the number of time zones by which families are separated increases; this decreases the available times that match both families. Another factor in task complexity is the continuity of the available time. Task complexity can increase if available time is not continuous.

4.5.6.1.2 Scheduling for TA2

Along with video communication, the TA2 system should provide scheduling support to help families solve their scheduling problem during difficult time availabilities. TA2 could provide a way for the first family to explicitly tell the other family their times of availability and then have the second family select the best option for them (Yang, 2012).

As technology has been increasingly helping us in our daily lives, we have technology helping us make decisions. If both families indicate to the system, their times of availability, the system can automatically find a meeting time for them; thus automating the decision-making process for finding the best time. This may be desirable as less effort is required from the users.

Having the system making this decision for us may be a step too far. It is possible to just have the system facilitate the process by providing an easy-to-understand view of both families' schedules of availability, including matching times of availability. Then the system can let one of the families choose a time to meet (Yang, 2012).

Parasuraman & Wickens (2008) suggest design options for the roles of humans and computers levels of automation. In computer support of scheduling meetings, there are three levels of automation possible. When user X receives a meeting proposal from Y together with some available time options, different design options are:

- Method 1: Least automated: X picks a solution.



- Method 2: Medium automation: X creates own availability data and X picks a solution, like Doodle.
- Method 3: Most automated: X creates own availability data and System picks a solution. X does not see the schedule of the other family.

These three methods differ by attributes: input effort, analysis effort, and control

In TA2, user experience is the most important aspect and the scheduling methods will be evaluated on a number of criteria: usability, efficiency, and explicit preference. Since user experience of different methods may depend on task complexity, this project addresses the following research question: *What is the joint effect of different scheduling methods and task complexity on the criterion variables?*

4.5.6.1.3 Working hypotheses

Below, we articulate several working hypotheses that are intended to guide, organize and evaluate the experiments.

When the task is difficult, Method 3 will have better usability than Method 1 because the input effort required for Method 3 will be less than analysis effort.

- Working hypothesis H1: *With hard tasks, Method 3 will have better usability than Method 1.*

When the task is easy, Method 1 will have better usability than Method 3 because analysis effort required by Method 1 may not exceed the input effort required by Method 3.

- Working hypothesis H2: *With easy tasks, Method 1 will have better usability than Method 3.*

With hard tasks, the sense of control that Method 3 lacks may be more important than the amount of analysis effort it saves. The analysis effort that Method 2 saves over Method 1 may be greater than the hassle of input effort during easy tasks.

- Working hypothesis H3: *Method 2 will have the best usability regardless of task complexity.*

With a lot of hard tasks, Method 3 should be most efficient when one needs to make multiple proposals with the same schedule.

- Working hypothesis H4: *With multiple hard tasks and only one input instanced needed, Method 3 is the most efficient method.*

As Method 2 should have the best usability regardless of task complexity, explicit preference for Method 2 should also be true.

- Working hypothesis H5: *Method 2 will have the most explicit preference.*

4.5.6.2 Approach

The experiment used a 3 x 2 design: the three methods x two task difficulties hard versus easy):

- Task difficulty was the between-subjects factor: one group participated in the easy tasks, the other group in the hard tasks.
- The method of scheduling was the within-subjects factor: all participants used the three methods of scheduling. For each method, the participant completed ten tasks where they had to schedule a meeting with a family member using prototype version of TA2.



A total of 51 people participated in this experiment. The TA2 scheduling environment was created for the experiment using Flash—see

Figure 26. The experiment was conducted on a PC using a mouse. Experiment tasks and controls were embedded in flash prototype; task instructions were given in the flash prototype. To control for varying time availabilities from participants, a paper agenda was used to inform the participant what their schedule of availability was for the experiment.

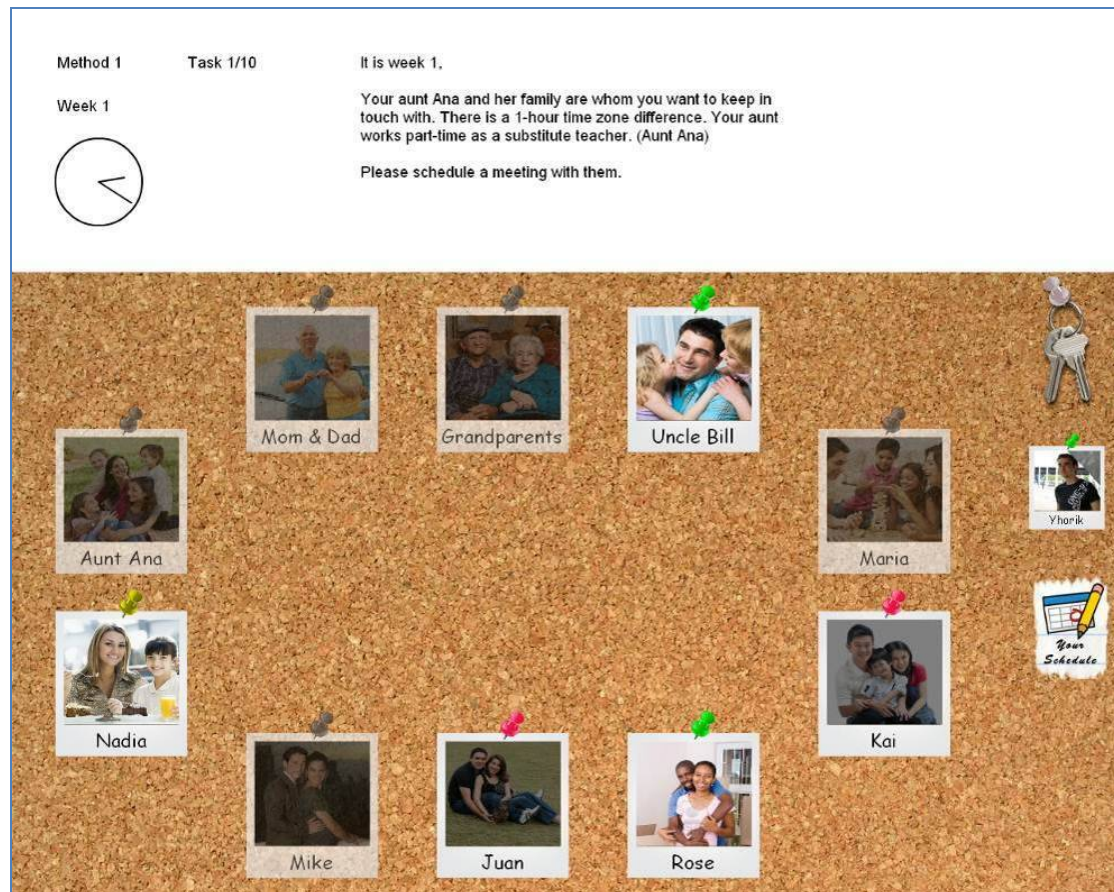


Figure 26. Screenshot of Flash prototype of TA2 for experiment

To measure usability, the Usability Metric for User Experience (UMUX) was used. These were rated by the participants using a paper questionnaire. To measure efficiency, the task time (starts with either “start” or “next task” button and ends when “meeting reminder” is displayed) was recorded via the Flash prototype.

4.5.6.3 Findings

In statistics, the p-value is an indication of how well the sample supports the rejection of null hypothesis, which in this case is the assumption that there is no difference between the average scores of the 3 methods, and between the average scores of the two task difficulty levels. When the p-value is less than the significance level, here set to 0.05, the result is said to be statistically significant.



A main effect was found to be significant for both method type and task difficulty—see Figure 27. Method type has $p=.037$ and task difficulty had $p=.006$. However, no interaction effect was found.

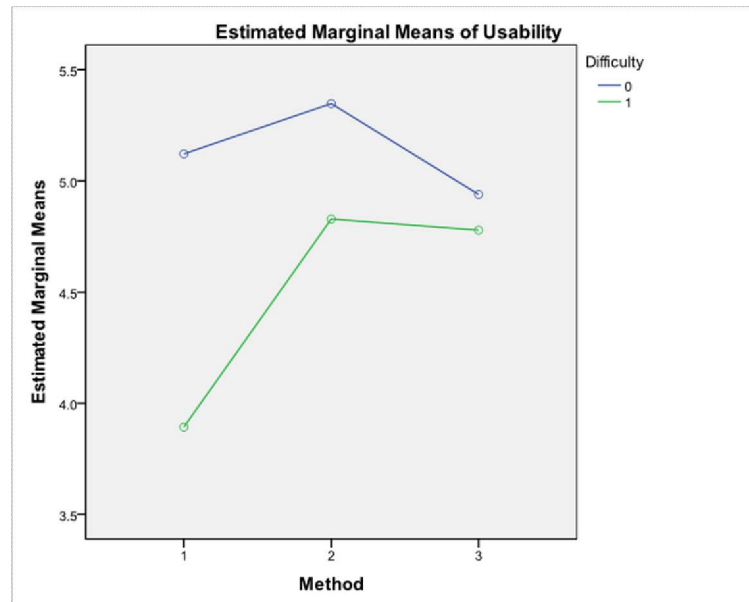


Figure 27. Mean score for Usability (ranging from 1, Strongly Disagree to 7, Strongly Agree), for methods 1, 2, and 3 and difficulty (0 for easy, 1 for hard). Generally, there is no interaction between variables when the lines in the graph do not cross.

Therefore we can accept H1, “*With hard tasks, Method (3) will have better usability than Method 1*”, H2 “*With easy tasks, Method 1 will have better usability than Method 3*” and H3 “*Method 2 will have the best usability regardless of task complexity.*”

The time that it took for each task (*task time*) was used to measure efficiency. For Method 2 and Method 3, the time that it takes to input your own schedule is recorded as Input Time and can be added onto Task Time. This new total is Total Task Time (For method 1, it already is the Total Task Time).

Only method type gave a significant effect on efficiency ($p=0.000$). Task difficulty did not lead to a significant effect. Nor did the interaction between difficulty and method Figure 28.

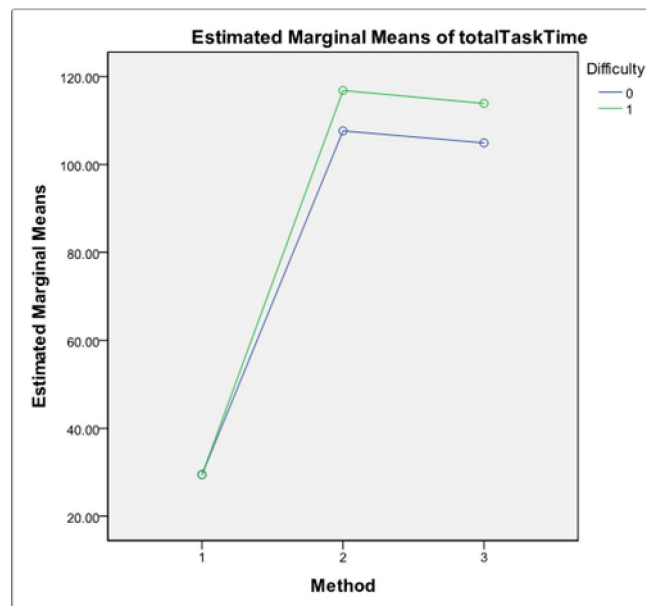


Figure 28. Mean task time in seconds, for methods 1, 2, and 3 and difficulty (0 for easy, 1 for hard). Again, there is no interaction between variables because the lines in the graph do not cross.

However, it is important to remember that efficiency of methods calculated through total task time will be different with task time. Figure 29 shows total task time and shows task time by method.

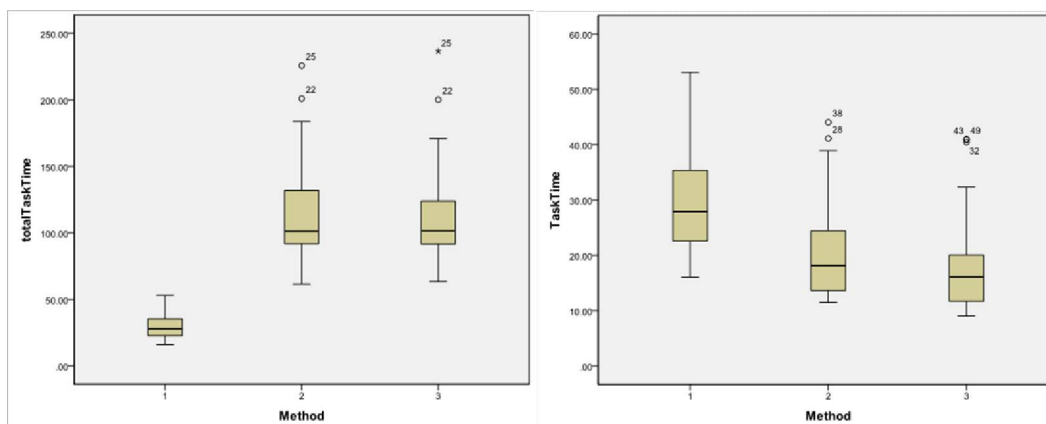


Figure 29. Total Task Time and Task Time (time without input time)

The hypothesis, H4, “*With multiple hard tasks and only one input instanced needed, Method (3) is the most efficient method*” may only be accepted if a number of proposals are made for every time one inputs their schedule.

Out of the 51 participants, 31 indicated that Method 2 was the method they liked best. This is followed by 16 who liked Method 3. Only four participants preferred method 1. Therefore it is safe to accept H5, “*Method 2 will have the most explicit preference.*”



4.5.6.4 ***Interpretation***

Method of scheduling and task difficulty can affect usability of a scheduling system. Although, its interaction effect was not significant with this study, it may be seen if another study was run with more participants and especially with proper instructions. It was rather clear that users disliked using Method 1 during difficult task, when time availability was limited and also discontinuous. However, the difference between Method 2 and Method 3 was small, even though Method 2 still had the best usability. When tasks are easy, the differences in levels of usability were less, but Method 2 was still came out on top. For easy tasks, the differences are not very pronounced, but for harder tasks it is important which method you use.

Efficiency was greatly affected by the number of times one needs to make a proposal for the week, since entering data for one's availability schedule took some time. It is easy to see that when one needs to make several appointments for the week, it is much more worthwhile to use methods such as Method 2 and Method 3.

4.5.6.5 ***Implications***

With this study in mind, designers and developers for systems that want to help people coordinated with each other should investigate how often people want to connect with each other. This goes with the same idea of whether one wants to write a script to automate a task on their computer. The initial cost of writing script will not pay off when one only needs to do the task once or twice a year. But if one needs to do the task a hundred times a year, then the effort to write the script can be well worth the effort.

Although TA2 is a European project, such a system can easily be expanded for worldwide use. Therefore, attention to one's time zone should also be taken into consideration as such a system can be even more beneficial for those who are farther than three time zones away as they will not be able to physically visit their family as often.



4.6 Video Orchestration Experiments (2011-2012)

4.6.1 Introduction

The following is a summary of the main experiments and results from the Goldsmiths orchestration trials. The purpose of these studies was to investigate the effect of orchestration (i.e. displaying camera shots on TV sets in each room, carefully selected with a view to facilitating the communicative goals of the users) on task performance and on participants' experience.

As the interest is in orchestration's effectiveness as a means to assist participants in achieving their task and communicative goals, we compare participants' performance when their interaction is orchestrated, with when it is not orchestrated. These experiments were hypothesized to show that orchestration improves the participants' ability to achieve their communication and collaboration goals, whilst also having beneficial effects on the subjective evaluation of their experience.

Three main end-user trials are reported:

- Trial 1 – April & May 2011 – Manual Orchestration
- Trial 2 – January 2011 – Manual Orchestration (revised)
- Trial 3 – March 2011 – Automatic & Manual Orchestration.

Initial experimental work that has informed these trials has been reported in (Ursu et al., 2011). The results of Trial 1 are reported in (Groen et al., 2012). Papers detailing the results of the other two trials are in preparation and links to them will be provided on the *Goldsmiths Narrative Interactive Media (NIM)* research group's website (<http://nim.goldsmiths.ac.uk/>)

4.6.2 Trial 1

4.6.2.1 Participants and design

Thirty-two students from Goldsmiths College, University of London, took part in the experiment. Nineteen were female and the age ranged between 19 and 35 ($M = 24$, $SD = 5$). More than half of the participants (17) were native English speakers and all reported normal or corrected-to-normal vision. Eighteen participants knew each other longer than 6 months. Participants received a monetary reward for their participation.

Three conditions were created:

- Orchestrated: two film directors, one per location, edited the multiple camera streams, alternating a wide shot, showing a large section of the room covering all the relevant events, objects and activities, with close-ups, showing particular scene elements, all aimed at helping the participants to achieve their communicative and task goals;
- No orchestration: a single camera displayed video imagery on the TV sets consisting of a wide shot only;
- Randomly edited: this condition was added to check that any effects found are not confounded by the effects of changes in imagery on the TVs alone. Random editing was achieved by alternating cuts between wide shots and close-ups in a random manner.



There were two teams of two participants in each session, who experienced the three different conditions in succession, giving a three factorial within-participants design. Dependent variables were the number of correctly and incorrectly guessed words in a Pictionary game and the responses to a subjective experience questionnaire.

4.6.2.2 *Apparatus and materials*

A video connection via the TA2 system was implemented between two distant rooms that were each equipped with a high definition 127 cm (50 inch) TV, a high-quality HD camera positioned centrally at the base of the TV (called main camera), providing 1 wide-shot and 2 virtual crops, that is, close-ups on each of the two persons in the room, and two lower-quality secondary cameras for close ups from different angles on the two participants. This provided five camera shots per location. Video imagery was presented on the TVs at 25 frames per second with a resolution of 720p in HDTV quality. Three computers were placed in each room: one for each camera and one for displaying video imagery on the connected TV set. There was also one computer for relaying positional audio signals, enabled by four microphones in each room. The entire system is referred to as the TA2 system. A coffee table, a sofa and an armchair were placed in each room. Figure 30 shows a layout of the rooms.

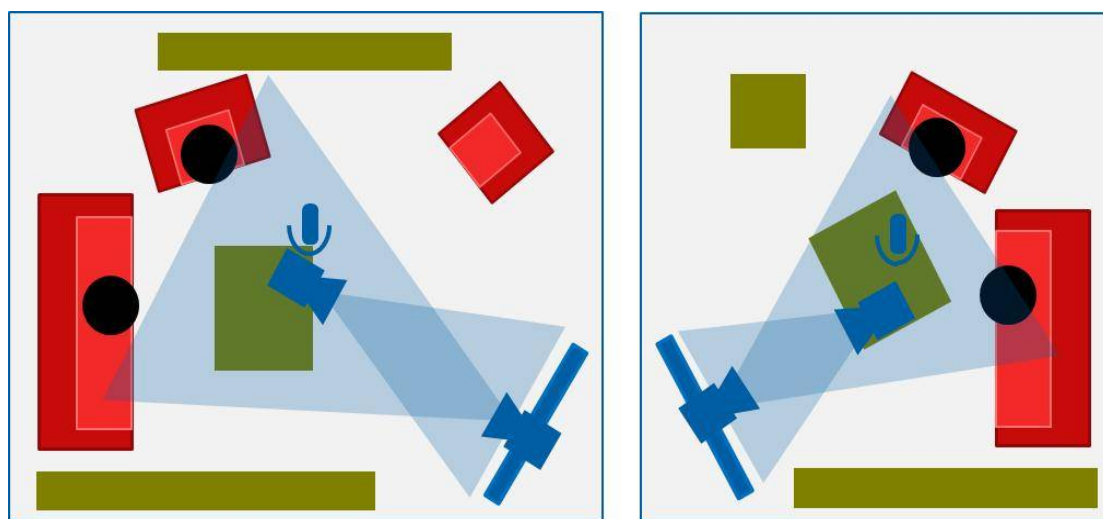


Figure 30. Sketch of the layout of the two rooms

The task was the game of Pictionary. Four participants played in teams of two, with each of the team members in one of the two rooms. The game progressed as follows. One of the team members threw a die, took a card with five words or phrases from a stack, and made a drawing representing a concept or activity corresponding to the number thrown. For example, if the participant threw a two, the second word or phrase on the card was drawn. If the participant threw a six, any of the words or phrases on the card could be chosen. The person drawing had one minute to sketch, in which time the other team member was supposed to guess the word. If the teammate guessed correctly, the turn to draw stayed with the current team. The persons drawing were free to decide when and how to show their sketches to their teammates. If a minute passed without a correct guess, the other team was allowed to guess too. If both teams failed to guess correctly, or the non-drawing team guessed correctly, the turn to draw went to the other team. Participants played the game three times for twenty minutes and could



play as many or as few cards as they liked. After each twenty minutes episode, an experimenter entered the room ending the current episode and handing each participant a questionnaire which they were asked to complete. The interaction between the participants was recorded with two separate camcorders on tapes.

In the Orchestrated condition, decisions about what to show on the TVs for each room were based on a consensus between the two editors about what should be displayed on the TVs. The editors ensured that speaking participants were displayed on the TV or the drawing pads were visible when they were presented to the team partners. In general, the editors followed the flow of the conversation and the activity, providing shots of participants and auxiliary material as they considered appropriate to enable the participants to achieve their communicative and task goals and ensure an immersive experience.

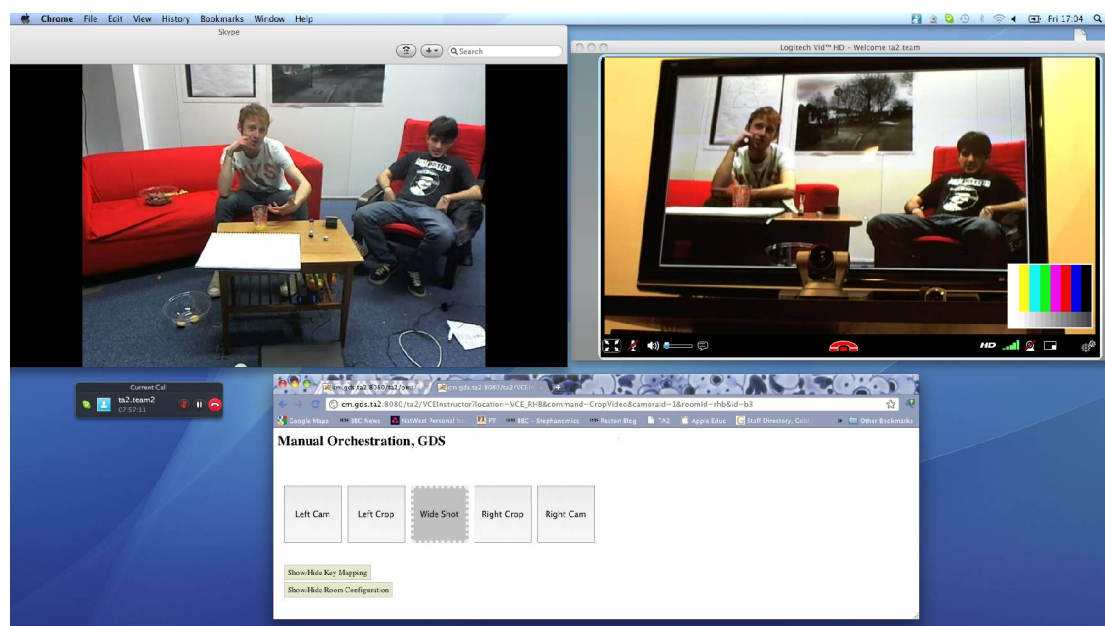


Figure 31. Sketch of the experimental setup, including the manual editing interface.

Orchestration was carried out via an editing interface that allowed human operators to select in real time the shots to be shown in each room. Each editor had a view of the overall room from which they were editing as well as of the shot currently selected, that is, what was shown on the TV screen in the room for which they were editing. See Figure 31 for an impression of the editors' screen. The shot selections were: "Left Cam" (a shot with the left secondary camera), "Right Cam" (a shot with the right secondary camera), "Wide Shot" (a shot of a large part of the other room showing the two participants and the drawing pads), "Left Crop" (a shot with the central main camera to the left of the field of view of the camera, showing the participant sitting on the right) and "Right Crop" (a shot with the main camera, showing the participant sitting on the left). In the Randomly edited condition, camera shots were selected randomly, similar to the cutting frequency of manual orchestration. Shots were selected from the five defined shot selections, changed at randomly selected times from a set of time segments comprising 3, 5, 7, 9 or 11 sec. In the No orchestration condition, the participants saw only the wide shot displayed on the TVs.



Participants' assessments of communicating and collaborating via the TA2 system were collected with the validated Sense of Presence Inventory (Lessiter, Freeman, Keogh, & Davidoff, 2001), designed to measure the subjective experience of participants of a computer-mediated communicative or interactive session. The questionnaire measured four factors of presence on a Likert scale, ranging from 1 ("Strongly disagree") to 5 ("Strongly agree"). A pilot test assessed the reliability of questionnaire items and showed that 16 items showed a high reliability associated with four factors (Immersiveness: Cronbach's alpha = .83; Naturalness = .82; Presence = .87 and Social Presence = .80). One further item was included from an International Telecommunications Union Standard that was intended to measure the experienced quality of the transmitted audio and video signals (Union, 1996). This adapted questionnaire comprised one title page and three pages containing seventeen items to record the participants' assessments of their experience after each condition.

One experimenter recorded the number of incorrect and correct guessed words or phrases in both rooms.

4.6.2.3 Procedure

The order of conditions was counterbalanced. Eight sessions were conducted with two teams of two participants. Participants first read an information sheet and completed a consent form. Then the rules of the Pictionary game were explained and they were informed that they could complete as many or as few cards as they liked. Participants were asked to confirm whether video recordings were allowed to be made and used for analysis and dissemination. Participants had the opportunity to ask questions about the study all this time. One member of each team was taken to the other room and the first part of the session started. The Pictionary cards were shuffled regularly at the start of each session. After twenty minutes of play, experimenters entered each of the rooms and handed the participants the questionnaire and asked them to complete one page with seventeen items. The experimenters then left the room for the participants to commence the second or third stage. When the last stage was reached, participants completed the last set of questionnaire items. The two participants from one room were then accompanied back to the other room where they were debriefed and were given their payment forms.

4.6.2.4 Results

4.6.2.4.1 Quantitative experience evaluation

The editing decisions of the human editors assisted the participants in correctly guessing the word or phrase the drawings represented. Although there were more words or phrases played in total in the No orchestration condition ($n=93$, Orchestrated: 88, Randomly edited: 83), there were also more errors ($n=27$, Orchestrated: 20 and Randomly edited: 25). The error rate was significantly different across the conditions: Orchestrated condition .22, No orchestration condition .29 and Randomly edited condition .30, $t(2) = 11.84$, $p = .007$, demonstrating that orchestration aided the participants, see Figure 32.

The number of correct guesses across screen, and the number of games completed with no win, considered in the context of the overall number of games played, is a good indication of how successful the medium is in conveying meaningful information – task efficiency was defined accordingly (therefore may require the qualifier "social").

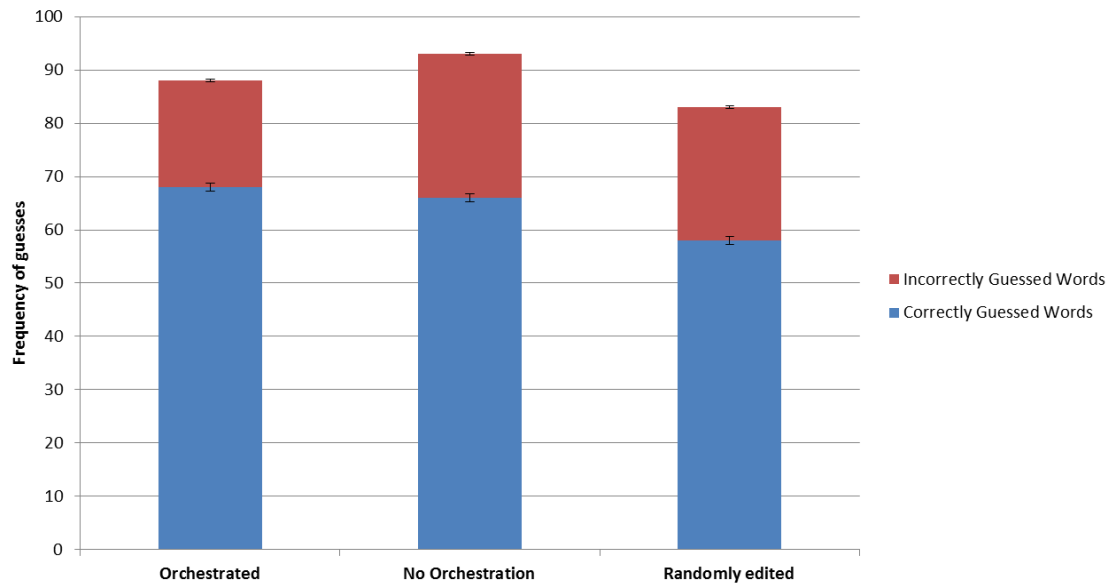


Figure 32. Frequency of guessed words or phrases across conditions.
Error bars represent the standard error of the mean.

4.6.2.4.2 Qualitative experience evaluation

A multiple multivariate regression analysis showed that orchestration affected the experience of Naturalness, $F(2, 93) = 4.72$, $p = .01$, $\eta^2 = .09$ and Presence, $F(2, 93) = 5.53$, $p = .005$, $\eta^2 = .11$. Mean experience assessment of the Naturalness factor was 3.74 ($SD = .78$) in the Orchestrated condition, 4.04 ($SD = .64$) in the No orchestration condition and 3.48 ($SD = .77$) in the Randomly edited condition. Ratings for the Presence experience in the Orchestrated condition was 3.15 ($SD = .78$), in the No orchestration condition mean was 3.35 ($SD = .64$) and in the Randomly edited condition mean was 2.75 ($SD = .81$), see Figure 33.

Post hoc Tukey HSD comparisons showed that for Naturalness and Presence this effect can be attributed to the differences in average experience assessment between the Randomly edited and the No orchestration condition, $p < .05$ (see Figure 33).

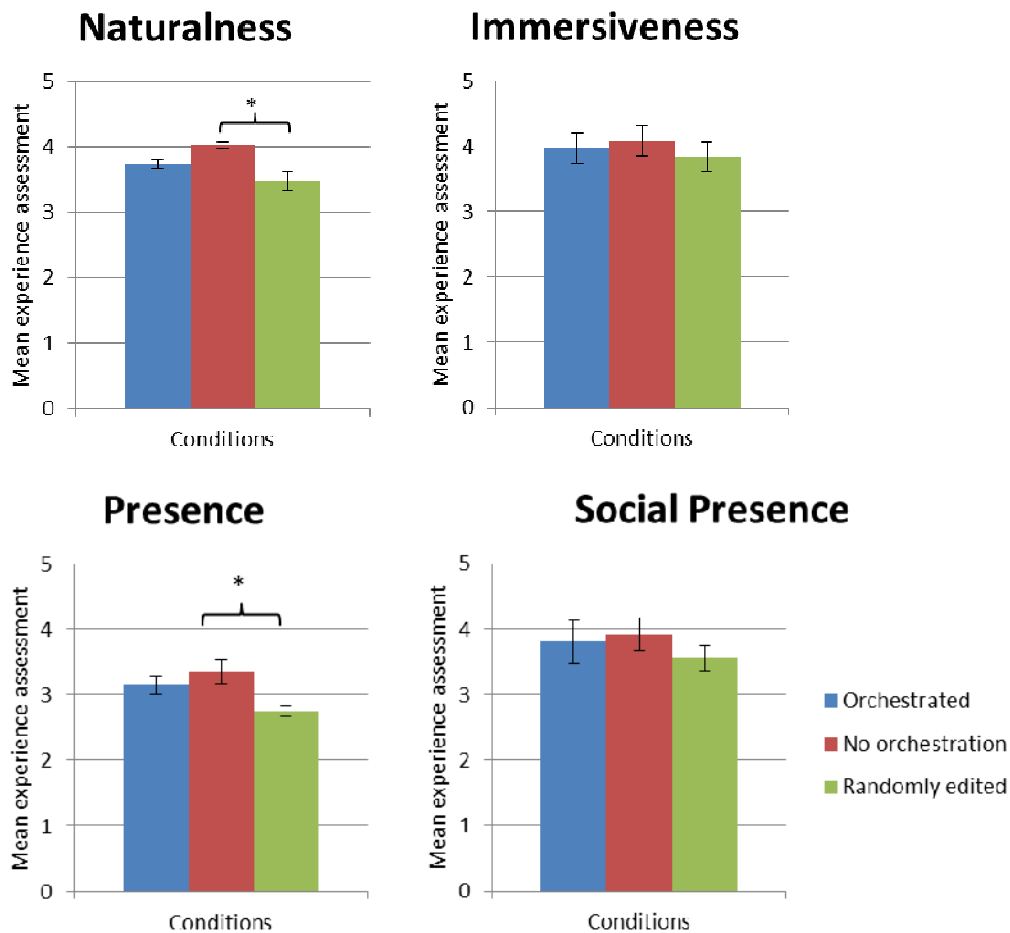


Figure 33. Average subjective experience assessments by participants using the TA2 system across conditions. Error bars represent the standard error of the mean. * = significant at the <.05 level.

4.6.2.5 Interpretation

4.6.2.5.1 Quantitative and qualitative evaluations

The results demonstrated that participants were indeed more effective when their communication was orchestrated comparing with their performance in the static and randomly-edited. Although participants were able to guess more cards in total in the “static” condition, participants made fewer errors and made more correct guesses in the orchestrated condition, providing robust evidence for the assistive role of orchestration.

Regarding the subjective measure, the results were inconclusive with regards to the comparison between the orchestrated and static conditions: there were no significant differences between the orchestrated condition compared to the static for all four factors.



4.6.2.5.2 Comments from professional editors

In the orchestrated condition the live-video streams were vision mixed by two professionals with experience of live editing situations. Their reactions to the editing were recorded and incorporated into the experiment design.

Editing rhythm - In social interactions and games like Pictionary there is an ebb and flow to the conversation which is effective if orchestration tracks it. There is a need to avoid reacting too quickly – too quick cuts removes puts the viewer back into a situation like he/she is watching television and not communicating. The paradigm of TV editing is very well established and viewers recognise it as a sit back experience, not a personal engaging one.

Shot size and quality - In this first experiment there were constraints on the shots available due to the cameras. The main central wide camera offered a high quality wide view but the close up front shots and side shots were of significantly lower quality which may have had an effect on the experience.

There were significant variations in picture quality between the master wide shot, the auxiliary cameras and the virtual crops. They were clearly noticeable when cutting between them. The side cameras had no lens control and the virtual crops degraded quickly with the size. At the pragmatic level, the level of detail provided was not much improved compared to the master shot. At the narrative level, they were intended as tight shots but essentially they were wide shots. The mixing rules might have been negatively affected by this aspect.

There was also the feeling that with a separate human editor the experience felt like there was another person involved in the communication link. In other words, since the behaviour was not purely deterministic, and gave the impression that someone else was involved in the communication between the two rooms.

4.6.2.6 Conclusions

The setup was such that orchestration was not *necessarily* required. Orchestration clearly addresses more complex communication configurations. Oversimplifying the configuration to allow a “fair” chance to the static condition – i.e. to include all that is relevant in a room in the wide shot – might have made the two types of experiences equivalent - both the wide and the orchestrated stream constructed with 5 shots gave a good representation of what goes on in each room.

There were significant variations in picture quality between the master wide shot, the auxiliary cameras and the virtual crops. They were clearly noticeable when cutting between them. The side cameras had no lens control and the virtual crops degraded quickly with the size. At the pragmatic level, the level of detail provided was not much improved compared to the master shot. At the narrative level, they were intended as tight shots but essentially they were wide shots. The mixing rules might have been negatively affected by this aspect.

Also, the participants had not been informed by the capabilities of the communication platform in each condition. Had they been informed, they might have been able to make better use of the features of the communication system in each condition. After all, devices come accompanied by instruction manuals.

However, there were positive lesson learnt that orchestration may in fact be a two phase process. One phase could refer to the slower paced configuration of a subset of the available cameras for a particular interaction context, which, once inferred, has a longer life-time. The other one could refer to the faster



mixing process between the streams provided by the cameras chosen through configuration, process that is more reactive to immediate cues.

In any case, transparency versus a system with explicit presence is an issue that merited further investigation.

A second experiment was drawn up to attempt to provide significant results for the *qualitative* assessment of the experience. This first trial already proved that *task efficiency* could be improved in the orchestrated condition. This sought for improvement in the qualitative measures, based on the measures listed above, was the focus of Trial 2.

4.6.3 Trial 2

4.6.3.1 Approach

The quantitative results in Trial 1 suggested that orchestrated offered made communication more effective and provided robust evidence for the assistive role of orchestration even if the qualitative questionnaire showed no statistically significant differences.

It was our hypothesis that the following would improve the experience and therefore improve the subjective experience for the participants:

- Improve the overall picture quality by employing high quality cameras for all shots
- Refine the rules further to create a more deterministic behavior in the manual orchestration thereby creating a more transparent form of mediated communication
- To modify the room layout and shot types available to provide a clearer requirements for orchestration and allow for different shot types in the orchestrated and the non-orchestrated condition.
- The editing rules needed to be applied in a more rigorous and deterministic fashion by the human editors. Consequently a more strict briefing was carried out and a set of rules laid out.
- High quality video conferencing cameras were used for all the available shots and no crops were used.
- Participants no longer drew on individual sketch pads which would be help up to the camera but rather there was a single flip chart in the room.

This layout helped create different shot types to better motivate orchestration decisions. A different central wide shot was used in the orchestrated and random condition compared with the one in the non-orchestrated conditions –non-orchestrated wide was a wider angle shot that allowed for the flip board to be seen whilst the wide in the orchestrated and random condition was a tighter shot which did not show the flip board and thus required the use of a separate close up shot of the board.

4.6.3.2 Participants and design

Forty-eight undergraduate students were recruited. The data of twelve participants had to be dropped, due to technical problems or no show, leaving 36 participants. Their age varied between 18 and 45, with a mean of 25 (SD = 5.8). There were 18 male and 18 female participants, all were fluent in English and the majority of them were native English speakers (81%). Half of the participants had



known for less than six months and all reported normal or corrected-to-normal vision. Participants received a monetary reward for their participation.

The design of this experiment was similar to the previous one, including the creation of 3 conditions (Orchestrated, No Orchestration and Random) and two teams of two participants in each session, who experienced the different conditions in succession, giving a three factorial within-participants design. Dependent variables were the number of correctly and incorrectly completed game turns in a Pictionary game and the responses to a subjective experience questionnaire.

4.6.3.3 *Apparatus and materials*

A TA2 connection was implemented between two distant rooms that were each equipped with a high definition 127 cm (50 inch) TV, like in the previous experiment. However, here we had three high-quality HD cameras positioned centrally at the base of the TV, the central camera providing a wide-shot of a sofa and the other two cameras providing a crop, that is, close-ups on each of the two persons in the room, and one high-quality camera for close up on a flip-over drawing board. This provided four camera shots per location. A coffee table and a sofa were placed in each room. See Figure 34 for an illustration of the layout of the rooms.

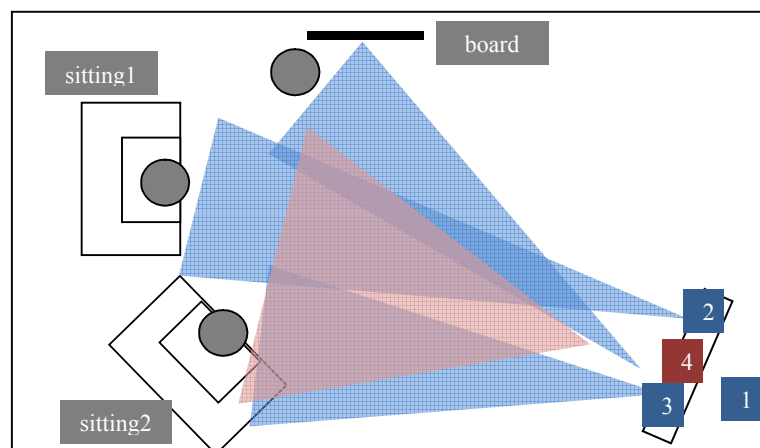


Figure 34. Layouts and shots for the orchestration condition

The task was the game of Pictionary. Four participants played in teams of two, with each of the team members in one of the two rooms. The game progressed as follows. One of the team members threw a die, took a card with five words or phrases from a stack, and made a drawing representing a concept or activity corresponding to the number thrown. For example, if the participant threw a two, the second word or phrase on the card was drawn. If the participant threw a six, any of the words or phrases on the card could be chosen. The person drawing had one minute to sketch, time in which the other team member was supposed to guess the word. If the teammate guessed correctly, the turn to draw stayed with the current team. As the drawing was done on the flip-over board and a close-up on the board was provided, this could be seen by each participant. If a minute passed without a correct guess, the other team was allowed to guess too. If both teams failed to guess correctly, or the non-drawing team guessed correctly, the turn to draw went to the other team. Participants played the game three times for twenty minutes and could play as many or as few cards as they liked. After each twenty minutes



episode, an experimenter entered the room ending the current episode and handing each participant a questionnaire which they were asked to complete. The interaction between the participants was recorded with two separate camcorders on memory cards.

The editing interface for the human editor was as already detailed in Trial 1 with 2 workstations offering views of 1 room containing participants and the edited stream of these participants provided on the television in the opposite room.

The available shots were: “Left” (a shot with the right camera on one of the participants), “Right” (a shot with the right camera on the other participant), “Center” (a wide shot of a large part of the other room showing the two participants), “Board(?)” (a close-up shot of the flip-over board. In the Randomly editing condition, camera shots were selected from the same set of four shots. They were changed at randomly selected times from a set of time segments comprising 3, 5, 7, 9 or 11 sec, thus simulating the cutting frequency of the manual orchestration. In the No orchestration condition, the participants saw only a wide shot, providing a shot of the participants on the sofa and the flip-over board.

The participants’ assessments of communicating and collaborating via the TA2 system were collected with the validated Sense of Presence Inventory (Lessiter, Freeman, Keogh, & Davidoff, 2001), as in the previous experiment.

4.6.3.4 Procedure

The order of conditions was counterbalanced. Nine sessions were conducted with two teams of two participants. Participants first read an information sheet and completed a consent form. Then the rules of the Pictionary game were explained and they were informed that they could complete as many or as few cards as they liked. Participants were asked to confirm whether video recordings were allowed to be made and used for analysis and dissemination. Participants had the opportunity to ask questions about the study all this time. One member of each team was guided from the main room to the remote room and the first part of the session started. The Pictionary cards were shuffled regularly at the start of each session. After twenty minutes of play, experimenters entered each of the rooms and handed the participants the questionnaire and asked them to complete one page with seventeen items. The experimenters then left the room for the participants to commence the second or third stage. When the last stage was reached, participants completed the last set of questionnaire items. The two participants from the remote room were then accompanied back to the main room where they were debriefed and were handed their payment forms.

Two experimenters recorded the number of lost and won game turns in both rooms. A game turn was considered won when a team guessed what the drawing represented within the allotted time frame. The game was considered lost when the time lapsed without a correct guess by the team having the game turn or when the other team guessed the word or concept. The counts of the two experimenters was highly correlated ($r = .89$).

4.6.3.5 Preliminary findings

First analysis of the qualitative data leads us to believe that, comparing the orchestrated with the static condition, there appears to be no significant difference, see Figure 35.

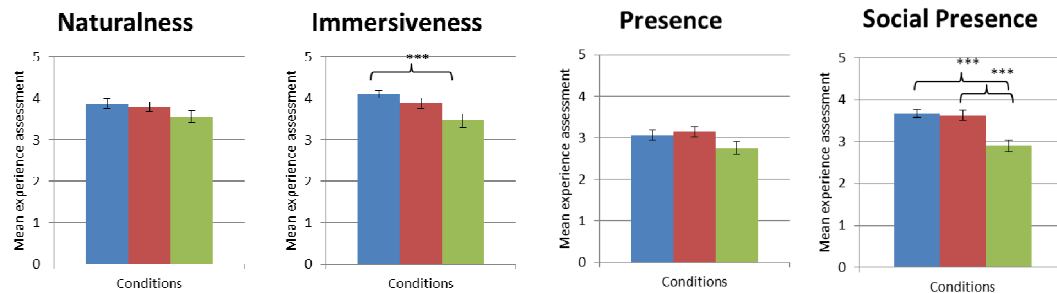


Figure 35. Differences between conditions with regards to subjective evaluation of the experience (blue=orchestrated, red=static; green=random)

Orchestration affected the assessment of two of the four factors of user experience assessments of playing and interacting via the TA2 video link (Pillai's Trace = .22, $F(8, 206) = 3.28$, $p = .002$, $\eta^2 = .11$). *Immersiveness* received an average assessment score of 4.10 (SD = .62) in the Orchestrated condition, 3.88 (SD = .73) in the No orchestration condition and 3.46 (SD = .93) in the Randomly edited condition. Only the difference between the Orchestrated and the Randomly edited condition was significant, $p = .002$ (Bonferroni corrected). *Social Presence* assessments were also affected by Orchestration, in the Orchestrated condition ($M = 3.67$, $SD = .60$) and in the No orchestration condition ($M = 3.62$, $SD = .70$) in comparison with the Randomly edited condition, $p < .001$ (Bonferroni corrected), but not between them.

One interpretation, could be that in a 2 location communication setup, when a high quality picture that includes everything that needs to be seen from the other room is available, no orchestration is needed to improve the experience. People have full control over what they see—i.e. the system does not “dictate” where they should look. They, themselves, can focus their attention on what they intend to see.

However, there is another interpretation that could present orchestration in a more positive light. The high quality static picture displayed on a large screen showing everything that is needed from the other room could be regarded as a “transparent wall” to that room—an experience very close to that of collocation.

There do appear to be some positive results. Orchestrated communication was not evaluated worst, as the random condition was for social presence and immersiveness, we can infer that this is a very positive result. Even more, with regards to the immersiveness measure, there seems to be a more significant difference between orchestrated and random, than between static and random.

This would all lead us to the conclusion that experiments with setups that motivate orchestration strongly, such activities that and room layouts that cannot be covered entirely through a wide shot, or more than two locations, need to be carried out and these will have to be done through automatic orchestration as they post significant logistical problems (number of editors, workstation, video streams required) to be carried out manually.

The quantitative results, based on the number of guesses required to complete a turn and the number of turns completed, suggested that orchestrated communication made communication more effective and



provided robust evidence for the assistive role of orchestration even if the qualitative questionnaire showed no statistically significant differences.

It was our hypothesis that the following would improve the experience and therefore improve the subjective experience for the participants:

Improve the overall picture quality by employing high quality cameras for all shots

Refine the rules further to create a more deterministic behavior in the manual orchestration thereby creating a more transparent form of mediated communication

To modify the room layout and shot types available to provide a clearer requirements for orchestration and allow for different shot types in the orchestrated and the non-orchestrated condition.

Some variation was observed in the results of the qualitative questionnaire between the first and the second experiments with the orchestrated condition now scoring the highest on naturalness, immersiveness and social presence. Whilst the variation was not significant, and the gameplay was not effected in the second trial, this improvement does suggest that early models of orchestration can be improved upon to create more effective and immersive communication experiences.

Please note these are initial findings only and require further validation. Publications reporting the final results and their interpretation are in preparation. Links to these publications will be provided on the NIM website: <http://nim.goldsmiths.ac.uk/>.

4.6.4 Trial 3

4.6.4.1 Setup

In Mar 2012 A third trial was recent carried out in Mar 2011 to evaluate in addition the automatic orchestrator.

The scenario was of 2 teams of people playing a game of *Articulate* across the video link. There were 2 teams of two and team members were separated across the video link.

The room layout was roughly as depicted in 6. There was also a coffee table in front of the participants on which the card games and hour glasses were placed, together with refreshments.

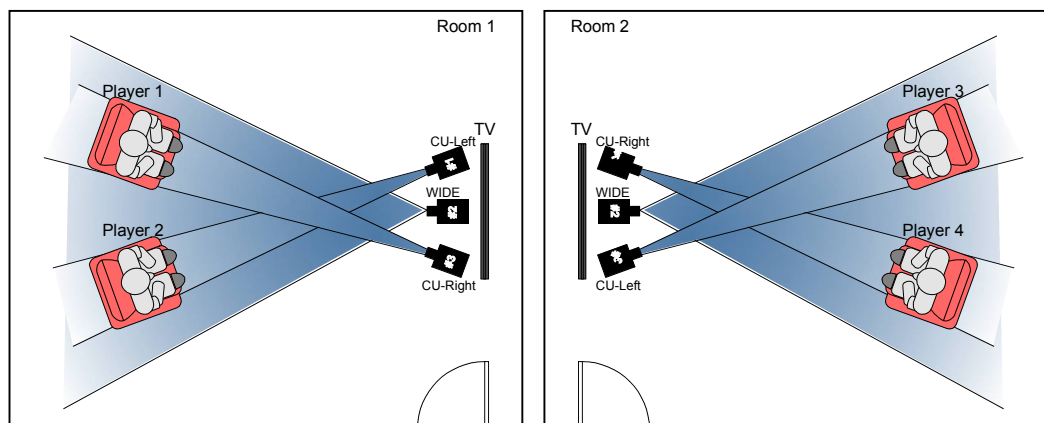


Figure 36. Room layout and positions of cameras in March 2012 orchestration trial.



Player 1 was playing in a team with Player 3 and Player 2 with Player 4. The participant guessing was sat in the chair of Player 2—see Figure 36.

For example, a turn of the game might involve Player 1 choosing a card from the *Articulate* pack. This participant then attempted to describe the word so that his partner, Player 3, could guess the word or concept being described. This continued until time ran out, when the next game turn started.

There were three cameras available, positioned as above, and they correspond to the three following shots:

1. CU-LEFT - A close-up shot on the person to the screen left on the sofa.
2. CU-RIGHT - A close-up shot on the person to the screen right on the sofa.
3. WIDE - Wide field of view from the central camera in front of the television. Shows both participants.

The editing rules were driven by changes in *communicative turns*: a communicative turn can be defined as a speech activity that lasts longer than 1 second.

Rules did not depend on where the activity took place and were:

1. If person starts communicative turn, show CU-LEFT or CU-RIGHT according to which person it is.
2. If the other person (i.e. not the one depicted by current CU) does not start a turn (i.e. there is no turnshift) for 5 seconds, then show WIDE.
3. If there is a pattern of short turns from two participants (in the same room) then show WIDE.
4. No shot change if within 2 seconds of previous shot change.

Four conditions were investigated:

1. automatic orchestration
2. manual orchestration
3. static wide shot
4. random selection of shots

Each condition was 15 minutes long and after each condition the participants were asked to fill in the questionnaire.

4.6.4.2 *Participants*

14 experiments (4 participants and 2 hours per experiment) were carried out. Therefore, we employed a total of 56 participants, each experiment had a duration of 2 hours, with 1 hour of interaction across the TA2 system. Data from 11 experiments was included in analysis. The other 3 had to be dismissed due to malfunctions of the experimental platform which interrupted the sessions.

4.6.4.3 *Data*

Qualitative data was gathered via the questionnaire used throughout the whole investigation (Lessiter 2001). Quantitative data was gathered by counting games won and lost, in a similar fashion to the



previous experiment. Qualitative data was also gathered through recorded interviews, for all the participants.

4.6.4.4 Preliminary findings

An initial analysis of the subjective evaluation data appears to show no difference between all four conditions—see Figure 37.

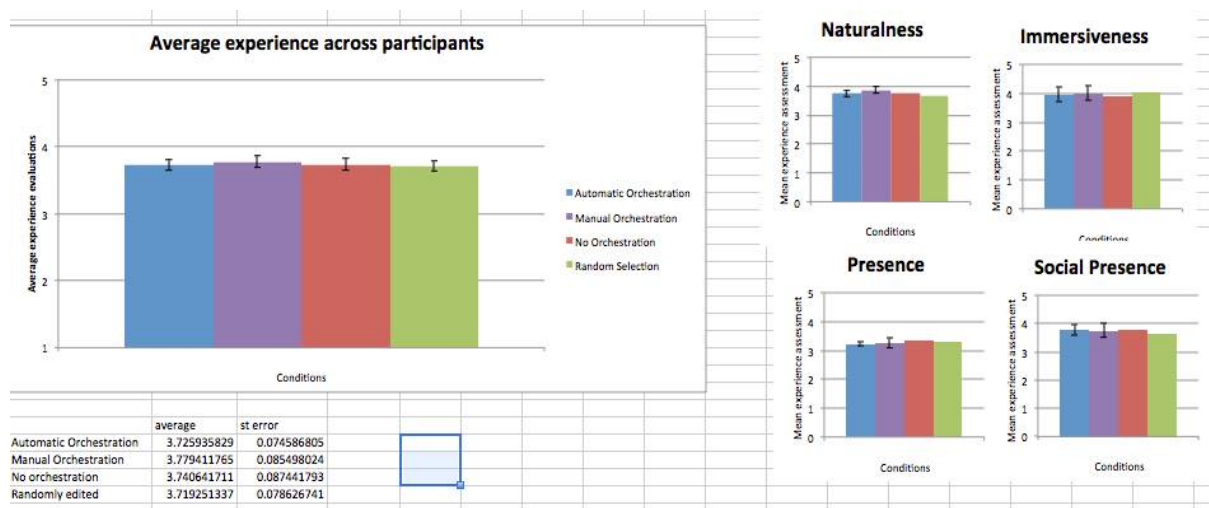


Figure 37. Qualitative evaluation of the experience in the March 2012 orchestration trial.

Looking at the quantitative data in Figure 38, orchestration, both automatic and manual, improves “social task efficiency”, compared to random mixing. It is very important to note that not the same can be said about the static condition. We take this as a very positive result for orchestration.

Even more encouraging is that there is no difference between orchestration carried out manually and automatically. The whole reasoning system, from feature extraction through analysis to the final camera selection is as good as (if not better than) human interpretation.

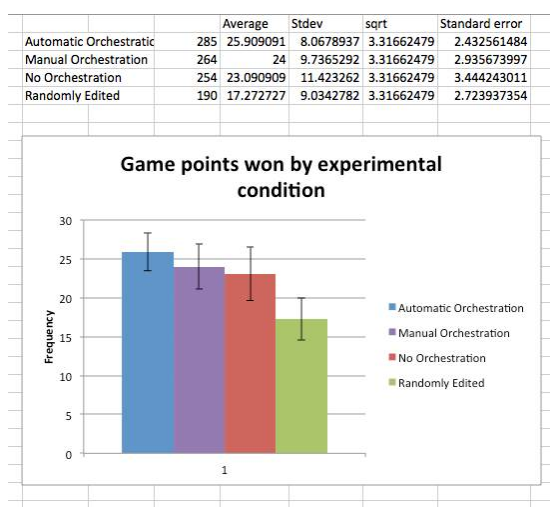


Figure 38. “Social task efficiency” measures in the March 2012 orchestration trial.



These results require further analysis and, most probably, further experiments, to validate candidate interpretations.

This is a very interesting outcome and somewhat unexpected. The fact that the experiences achieved through manual orchestration, automatic orchestration and static wide shot are in the same category is not unexpected for this particular setup, as already discussed in the context of the previous experiment. What is extremely encouraging is that the automatically orchestrated condition is in the same category with the other two.

We had feedback from some of the participants we interviewed that, when one person is talking, having a shot of the other person introduces some variety and enriches the experience. Therefore, what we called random in this context, appears to have had more meaning than initially thought. This leads to a further hypothesis which we hope will continue be explored even after TA2 is completed.

There is another perspective we acquired through the interviews. There were very strong supporters of the orchestration condition, stating with conviction that they enjoyed a better experience than offered by a single wide shot, but also strong supporters of the static communication setup, stating with conviction that it was a better experience than that offered by orchestration. The former group saw the advantages that automatic orchestration brings. The latter saw its drawbacks.

Please note these are initial findings only and require further validation. Publications reporting the final results and their interpretation are in preparation. Links to these publications will be provided on the NIM website (<http://nim.goldsmiths.ac.uk/>).



5 Conclusions and recommendations

In this chapter, we first summarize and discuss our findings from the various user studies. After that, we articulate several recommendations for the design of ICT applications that aim to facilitate social communication and social experiences.

5.1 Summary and discussion of findings

In this section, we summarize the findings from the various user studies, in order to answer the research questions: *How do people experience the various TA2 applications? And what are the effects of specific features of these TA2 applications on people's social experiences?*

Findings the 2011 lab experiments with Low Delay Audio, Spatial Audio and Video Orchestration:

- For Low Delay Audio and Spatial Audio, we learned that Naturalness (for Low Delay Audio) and Immersion/Engagement (for Spatial Audio) affect experienced Quality of Communication.
- For Video Orchestration experiments, we learned that Social Presence/Presence and Naturalness affect experienced Quality of Communication.
- When comparing the three experiments, we see that visual elements (Video Orchestration) have larger effects on people's experiences than audio elements (Low Delay Audio and Spatial Audio)
- Overall, we found a hierarchy in the Aesthetic constructs: experience of Social Presence/Presence is the most 'basic' element of experience and it influences people's experience of Naturalness, which in turn influences people's experience of Immersion/Engagement ($SPP > N > I/E$)
- Of the three aesthetics concepts/constructs, Naturalness is the most important (based on regression analysis): The more natural the experience, the better the experienced Quality of Communication.

Findings from the 2012 lab experiments with Video Orchestration:

- In Trial 1, we learned that people were more effective (i.e. in playing the Pictionary game) in the Orchestrated condition (in comparison to *no orchestration* and *randomly edited* experimental conditions). Video Orchestration helped people to collaborate more effectively.
- In Trial 2 (which involved better cameras and better editing than were available in Trial 1), we found substantial increases in Social Presence, Naturalness and Immersion for the Orchestrated condition (in comparison to *no orchestration* and *randomly edited* experimental conditions)

Findings from the Family Game experiments:

- The Family Game did very well compared to the board game in these tests since there are only few significant differences. Though people tended to experience a real life situation better and socially more enjoyable, the Family Game is a very good alternative to have high quality social interaction with others when no other means are available.
- The interaction with Family Game and the interaction with others via Family Game helped to strengthen weaker 'strong ties': Playing the game did not necessarily change people's experiences of closeness with the other person that they felt most close to, but it did improve their experience of closeness with the second and third person, and closeness with the others as a group (based on



‘Identification of Other in Self’ and ‘Overlap of Self; Ingroup and Outgroup’ measures, evaluated before and after playing)

Findings from the MyVideos experiments:

- Overall, people liked using MyVideos: They experienced pleasure (3 on a 0-4 scale) and relaxation (2 on a 0-4 scale). Furthermore, people experienced ‘being in control’ when using Visual Vault (2,78 on a 0-4 scale) and Director’s Cut (2,8 on a 0-4 scale), and they experienced less ‘being in control’ when using Interactive Narrative scores relatively low (1 on a 0-4 scale).
- Most of the functionalities of MyVideos and have similar scores for Naturalness (N), Immersion/Engagement (IE), Social Connectedness (SC), Challenge (Ch), Group Attraction (GA) when compared to Family Game.
- Using MyVideos helped to strengthen weaker ‘strong ties’ (similar to Family Game): Using MyVideos did not necessarily change people’s experiences of closeness with the other person that they felt most close to, but it did improve their experience of closeness with the second and third person, and closeness with the others as a group (based on ‘Identification of Other in Self’ and ‘Overlap of Self; Ingroup and Outgroup’ measures, evaluated before and after using MyVideos).

Based on the Family Game and MyVideos experiments, we can conclude that Family Game and MyVideos—which facilitate synchronous and asynchronous communication respectively—can help people to achieve a closeness to others. In particular, these demonstrators helped to improve experiences of closeness amongst people with weaker ‘strong ties’, e.g., people that are one or two steps away, such as the friends of your daughter, who were both playing in the school concert.

Findings from Storytelling / TA2 Lite field trial:

- What people do with TA2 is very similar to what people already do. In other words, people will adopt new systems or products in ways that match their current behaviour—this is the process of domestication or appropriation
- TA2 supports social and shared activities during people’s daily lives, rather than only facilitate conversation, which is typically the case for current video conferencing applications:
 - People leave the system ‘on’, while they go on with other activities and while they walk in and out of the room.
 - People use the system for social interaction across the entire room and adjacent rooms. Seeing the others in your own room and in the other room, across the screen, is critical for social presence. People experience the TV screen as a window to the other room.
 - Mediated (or screen-based) communication and interaction requires more focus and attention from people than face-to-face communication and interaction—which ‘come naturally’. As a consequence, mediated communication can conflict with shared face-to-face activities. (See: Recommendations, below).
- Different people, e.g. people of different generations, have very different needs. This is the case especially for young children and for older people.



Findings from the Connected Lobby experiments and field trial:

- People appreciate using the TV for video communication in a social manner. It was experienced like face-to-face interaction (like ‘visiting each other’ or ‘going over for a coffee’).
- In particular, young children used it to communicate in a very natural way, e.g., with their grandparents, which helps to reinforce the social bonds between them.
- Moreover, the video communication was perceived as an inter-group communication medium, with the household (in each location) as the ‘unit of communication’.
- People appreciated using the ambient lighting device as a ‘calm notification’ (green ‘someone is online’, red ‘no one is online’, flashing green ‘someone is connecting’) and they are able to use it.
- For the coordination between households, which is needed for synchronous communication, people appreciated coordination methods that balance control and ease-of-use. In many cases, they preferred to express their availability so that one person can pick a common timeslot (Method 2).

In addition, we can draw several conclusions, based on the Storytelling / TA2 Lite and Connected Lobby field trials:

- People are willing to adopt video communication on a TV Screen for social communication. Furthermore, people are likely to find ways of adopting video communication in their daily lives—this is the process of domestication, in which people appropriate new technologies.
- People may appreciate a second camera, in addition to the camera fixed to the TV, which they can move more freely through the living room or the house. This brings to the fore the possible need for video orchestration to help people to communicate naturally while using multiple cameras. E.g., in the TA2 Lite field trial, a second camera was added, which they could move around and switch on and off. (Being able to switch this additional camera on and off also made people less dizzy compared to moving around the camera while it remains on.)

Furthermore, we draw several conclusions on the level of *meaning*, based mainly on the in situ, longitudinal field trial with Storytelling / TA2 Lite:

Social dynamics

- The focus on group communication was appreciated by the people who tested TA2 Lite. Several participants in the studies commented on the fact that it brought a new dimension to their current communication between the households. Before the user trials, communication between the households was mostly conducted through phone calls and generally there were certain individuals within the families who used to be in contact more often. By using TA2 Lite the group was in focus and contact between certain family members increased significantly; especially communication that involved children. By spending more time as a group it is also likely that its social identity becomes stronger.
- Considering social identity, it was also evident that it was not just about the people included in the group but also the home in itself and its objects. The possibility of seeing the home and being able to show objects to each other was much appreciated and probably also contributed to family identity construction.



- Interactions with TA2 Lite not only reassembles face-to-face interactions, it also brings features that are impossible in physical gatherings, e.g., being able to show and view objects in both locations provides a new possibility.

Shared activities

- TA2 had a focus on activities and it was believed that activities would provide possibilities for interaction rituals. E.g., children typically engaged in shared activities, whereas adults often just talked to each other. Such shared activity was particularly important for children for the experience of interaction rituals, e.g. having a “mutual focus of attention” (Collins 2004).
- Mediated communication is different from communicating face-to-face and it requires more focus. When it is impossible to convey all nonverbal cues, people put extra focus on the available cues, i.e., on the audible and visible signals. As a consequence, some activities that work well when the participants meet face-to-face, might work differently in mediated communication.
- Families tried many different activities when they used TA2 Lite, but generally they attempted activities that they were already performing when meeting face-to-face. E.g., if a grandmother already reads to her children frequently, she is more likely to read to her children using the TA2 system. People did, however, creatively extend these habits into forms that would fit the kind of interactions that the TA2 system affords. Therefore more flexible activities are recommended for this type of interaction. If a game application allows for flexible rules, family members can use their personal rules and play the game as they are used to do, instead of being forced to follow predefined rules. In this way, the activity can become more meaningful for the family and this might be a way of creating a “barrier to outsiders” (Collins 2004).
- It is worth noting that the participants constructed the interaction rituals from habits from previous face-to-face meeting and not any mediated communication such as phone conversations or computer-based interaction. Since we studied groups with strong ties, they have many previous experiences of face-to-face meetings and habits of interaction rituals developed over many years. In groups with weak ties, it is possible that the system could play a greater role in the shaping of the types of interaction rituals that are performed.

Social ecology

- We had no indication that TA2 replaced face-to-face meetings. It seemed to complement them and could even be used to strengthen the desire to meet face-to-face. An illustrative example of the latter is when a grandmother had knitted figurines for her grandchildren and used the TA2 system to show the progress and allow the children to make design choices. This can create an anticipation for the face-to-face meeting when they will receive the finished figurines. When TA2 is introduced as a new medium in the social ecology, other media and social spaces acquire new roles and niches. Phone calls are still used as a more private, one-to-one means of communication suitable for certain matters, while TA2 is used as a group-to-group medium.
- Activities that used to be an intra-family matter can be a matter for the extended family by including the grandparents with TA2. An example is helping children with homework which used to be solely up to the parents. With TA2, the grandparents have in some cases partly taken up this role and this frees up time for the parents. Using TA2 can free up time for families by extending the family to grandparents or other people with strong ties to the family. Without TA2 or a similar system, this would require a face-to-face meeting which can be difficult to arrange when



households are spatially separated. A TA2-like system could therefore promote cooperation between family members, and reduce, e.g., the need for purchasing or using commercial services.

5.2 Recommendations for design for social interaction

At the start of the project, we posed this question: *How can we design telecommunication, multimedia and gaming applications in such ways that they indeed promote social communication and interactions and nurture social relations?* Below, we articulate several general recommendations for the design and development of such systems, products and services.

For the design of the sensorial qualities of the system (that is on the level of form/setting, which corresponds to aesthetic experiences), it is critical to provide clear and appropriate visual information and cues, and to provide a ‘natural’ environment (based on the 2011 Low Delay Audio, Spatial Audio and Video Orchestration experiments).

For the design of systems and applications that combine tasks/games and communication/interaction (e.g. for Family Game), it is critical to integrate very well the task/game-related elements with the communication/interaction-related elements. This refers to, e.g., the way people can effectively combine using a horizontal coffee table to play a board game or card game (task/game) and using a vertical TV screen to communicate with people ‘at the other side’ (communication/interaction). When task/game elements and communication/interaction elements are better integrated, people can better experience togetherness (based on a comparison between the 2012 Video Orchestration experiments to the 2011 Low Delay Audio and Spatial Audio and Video Orchestration experiments).

It is critical to ‘design for the whole space’, not only ‘design for the screen’. One needs to integrate very well the communication (e.g. the video communication in the TV screen) and the activity (e.g. the game play elements on the coffee table), so that these parts can mutually reinforce each other. If these parts are less integrated, there is a risk that people will focus on communication (and forget the shared activity) or focus on the activity (and forget the communication). Although, of course, it is perfectly okay to temporarily forget, e.g., the others, across the screen or the game on the table.

Similarly, it is recommended to integrate well the (new) video communication function with the (existing) TV watching function, e.g., by adding a ‘picture in picture frame’, with the video communication on top of the TV show, or by creating a soft transition from watching TV, with first a text or voice message to invite for video communication (based on the Connected Lobby field trial).

From the Storytelling / TA2 Lite field trial, we learned a lot about how people ‘domesticate’ and ‘appropriate’ systems like video communication and shared activities, such as game play, in their daily lives. We can articulate the following recommendations for design and development:

- It is critical to build upon people's current practices and *not* to try to invent or introduce entirely new activities. In other words: it is recommended to *not* over-optimize for one type of usage, but, rather, to create space for people to modify and adopt the system and the applications so that it fits their daily lives, so that they can use it for shared activities in their daily lives.
- E.g., implement the system so that people can leave it ‘on’, while they are engaged in other, daily activities. The system will then actually support shared activities in people’s daily lives.



-
- E.g., implement the system so that people can use it across the entire living room, e.g. with a second camera, which they can move freely around in the living room, and maybe in the house.
 - E.g., make the system ‘open’ so that people can find their own ways of using it. E.g., in the TA2 Lite field trial, people were provided with a ‘deck of cards’, which existed on two tablet computers on the two locations; people found ways to use these for their own games.

Finally, if it is necessary that different people, with different skills and preferences, use the system—which is the case if the system aims to improve, e.g. cross-generational social communication—then it is necessary to design the system so that different people, e.g. young children as well as older people, can actually use it. A possible solution is to design different interfaces depending on different needs, skills and disabilities. Another solution is to ‘move’ some of the controls to ‘the other side of the screen’, so that a person with sufficient technical skills can set-up or configure the communication (once), without bothering the young child or the older person with the hassle of technology.



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