Social ways to manage availability in mediated communication

Social Ways to Manage Availability
in Mediated Communication

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I must not fear. Fear is the mind-killer.
Fear is the little death that brings total obliteration.
I will face my fear.
I will permit it to pass over me and through me.
And when it has gone past I will turn the inner eye to see its path.
Where the fear has gone there will be nothing. Only I will remain.

Nie można się bać, strach zabija duszę.
Strach to mała śmierć, a wielkie unicestwienie.
Stawię mu czoło.
Niech przejdzie po mnie i przeze mnie.
A kiedy przejdzie, odwrócę oko swej jaźni na jego drogę.
Którędy przeszedł strach, nie ma nic. Jestem tylko ja.

Frank Herbert 'Dune'

To my husband and my mum: the most important people in my life

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Abstract

We live in times, in which both professional as well as social relationships are created and maintained not only in a physical but also in the digital world. However, if one takes a closer look at many communications conducted through mediated tools, it appears that people are not able to act in social ways with similar grace and cohesion as during face-to-face encounters. Messages tend to arrive at the wrong moments, are often imprecisely formulated, uneasy to act upon and tend to cause information overload. Yet, does it mean that we, who so elegantly interact with each other in the physical world, suddenly turn selfish and insensitive when moving to the digital domain? Or maybe the fault is of technology that insufficiently supports social behaviours?

This thesis presents an array of studies that aim at leveraging social behaviours in mediated communication. The notion of Social Translucence proposed in 2000 by Thomas Erickson and Wendy Kellogg [51] is used to direct my research efforts as I aim to better understand what constitutes a higher level of social awareness in the digital domain. I argue that the next great improvement in tools supporting mediated communication could be achieved through leveraging social abilities of people rather than defining new algorithms to protect them from unwanted communications. As a user group I chose knowledge workers who are representatives of people who frequently suffer from poorly timed digital interactions.

In Chapter 1, I describe prior research in the domain of supporting availability management, formulate research goals pertaining to attainment of socially salient behaviours in mediated settings and outline the research work described in this thesis.

1.1 Introduction

The basic premises of this research are as follows:

- professional environments are open social systems in which information needs to be constantly processed [106] but there is limited capability to do so [42, 131];
- communication, whether collocated or distributed, physical or digital, synchronous or asynchronous is the most successful means to share information in nowadays offices [97, 116];
- generally, communication is built upon subtle indications of people's intentions towards getting involved in a conversational activity with another person that is based on commonly accepted social rules and norms [31, 25, 95, 67];
- many tools supporting mediated communication lack means to convey social cues, which, in consequence, leads to the feeling of asymmetry in control over the communicative exchange experienced by communicators [32, 112, 51, 93].

In working environments people use a variety of communication means (also referred to as communication channels) to support information sharing and contact with others. A communication channel can be defined as a line of communication that is used to transmit information from a sender to a recipient and it can be rooted in either the physical or the digital domain. The channel selected to communicate plays an integral role in the context and the process of a communicative exchange [80, 97, 94, 44]. Basically, any decision behind channel selection can be seen as an optimization process: people consider which channel helps them best express their intentions and needs [155]. A strong correlation is shown between, for example, the medium selection and the complexity of a desired interaction [3]. Richer media such as face-to-face or phone are more likely to be chosen to deal with potentially complex and ambiguous tasks such as conflict solving or decision taking. Less rich media, such as email or Instant Messaging tools, are more likely to be employed for resolving simple tasks like scheduling or confirming earlier agreements. The choice of the communication channel can be further influenced by the initiator's knowledge of the recipient's context as well as the need for either synchronous or asynchronous communication (which, for example, could relate to the immediacy of the communication subject)[80].

The most frequently used channels are: face-to-face, phone, Instant Messaging and email. The main differences between them pertain to the richness of the channel which is embodied in the variety of signals that are shared between communicators and also in the provision of the reference points supporting the discussed content.

They also differ in their nature which relates to how synchronous or asynchronous a particular channel is, which enables pacing communication according to the needs and desires of both communicators. Furthermore, different channels offer different levels of control the initiator and the recipient have over the communicative occurrence, which is substantiated in the possibility for them to choose when and how to react to communication initiation. Finally, these different channels provide a variety of means to convey contextual awareness supporting communicators to choose the right moment to initiate communication.

1.1.1 Face-to-face communication

Face-to-face communication is considered the richest channel supporting an establishment and maintenance of human relations [115]. Such richness is possible due to sharing physical space and referring to common artifacts [32, 122, 170]. It shows to best embed the social ritual [67] between communicators allowing them to gauge their decision about communication by producing and also observing each others' verbal and non-verbal cues such as gestures or mimics describing their explicit and implicit intentions [95, 46, 43, 42, 151, 87, 109]. The obtained social bond enables people to feel emotionally connected and to pay attention to the information that is exchanged [31, 81].

The synchronous nature of face-to-face communication can, however, have a large negative effect: it invokes high costs for communication recipients in terms of interruptedness to their primary task [38, 69, 1, 13, 12, 14, 11, 91]. Even if the initiator with the best intentions inquires about the recipient's availability before engaging in a conversation, this often is considered disruptive and likely to cause a lag in the recipient's primary task [69, 70]. Moreover, recipients tend to feel obligated to react in some way to a face-to-face communicative attempt, even in situations in which they are truly unavailable and therefore find themselves in a vulnerable position compared to the initiators who have the possibility to select the communication moment according to their own needs and plans [115, 93]. The positive outcome of such an interruption can be that the recipient receives information that is unlikely to be obtained through other channels, at least not with the same salience and timing [91, 121]. On the negative side, face-to-face communication can take time from time-sensitive activities, causing stress and influencing one's state of total involvement in the performed task [70, 100, 101, 110].

1.1.2 Phone communication

Phone is considered as a less rich communication means comparing to face-to-face channel, as it only offers an audio channel for information exchange and does not

support the transfer of non-verbal signals such as, for example, gestures. Naturally, voice intonation is, per se, a persistent, non-verbal signal, yet it is devoid of visual cues* it is more difficult to interpret and potentially misleading [32]. Nonetheless, phones permit quick and often informal communication across both short and long distances [32, 111, 103], and support interaction that embody many of the features of a face-to-face conversation.

The main disadvantage of phone communication is that people think of it in terms of bi-directional social bonding rather than incoming communicative requests [172, 133]. Similarly to face-to-face communication also phone motivates recipients to answer the phone even at the moments inconvenient for them. Another problem with phone communication stems from the lack of contextual awareness regarding the present situation of the recipient [124]. Due to such lack of contextual information, initiators are not able to infer whether the call is initiated at a convenient moment and run the risk of interrupting at unwanted times or trying to reach them at locations that their intended recipients already left [111]. Busy signals indicate extreme unavailability but the phone call does not provide communicators any possibility to negotiate their communicative contract[133, 172]. The deluged recipients can react by turning their phones off but then they are running the risk of missing important information [102]. Voice mail is providing a partial solution to that problem; however, it also increases social pressure on the recipient to react to the message that was left on the machine.

1.1.3 Instant Messaging communication

Instant Messaging was introduced in 1996 by the Israeli startup Mirabilis. It is a near-synchronous communication channel that facilitates exchange of short messages between a person and his or her *buddy list*. Instant Messaging applications support impromptu, brief communications which can be paced according to the preferences of both communicators [116, 78, 89]. Its great success can be attributed to its flexible nature [89, 71] and a relatively low cost of interruptedness [60]. It also stems from the fact that Instant Messaging applications provide some form of contextual awareness by indicating whether other users are connected to the network and whether or not they are potentially available for communication [60]. At the same time, the limitation regarding one's presence and availability information provides users with the possibility to employ *plausible deniability* when they elect to ignore or postpone responding to a message [116, 6, 21].

*Recently, video-phones become more widely accessible. They are likely to address the aspect related to the lack of visual cues. At the same time, however, such technological advancement seems to bring about new challenges related to conveying social cues, like, for example, unintentionally conveying information about parallel activities of the communicators.

While many advantages of Instant Messaging applications come from its near-synchronous nature, it is the possibility to asynchronize such communication that seems to render additional benefits [10]. Since Instant Messaging can be inherently asynchronous, users are able to choose when or whether to respond to an incoming message. Because of this unique characteristic Instant Messaging is regarded as less interruptive comparing to face-to-face or phone communication [60]. This asynchrony, however, means that messages can arrive when a user is engaged in an important and potentially urgent task. Staying on task and not responding may come at a cost to the initiator, who may need some information from the recipient. The recipient may also incur a social cost from being portrayed as unresponsive. Engaging in conversation, on the other hand, often causes a delay in the recipient's ongoing work and leads to postponing of that work [168]. Moreover, as the initiator has little information about the recipient's situation, the recipient might find him or herself in a situation which requires sharing attention among multiple conversational threads, which in consequence might lead to an increase in stress and anxiety related to the feeling of information overload.

1.1.4 Email communication

Email is the least rich communication channel that was first introduced at MIT in 1965. It enables instant transmission of information at a very low cost [105]. Its major advantage stems from the fact that it does not require presence of both communicators for communication to occur. Due to its nature email provides more symmetry in the communicative exchange comparing to other more synchronous communication channels as the recipient is free to choose when to uptake communication and to control the conversation by pacing it according to his or her own needs [163, 164, 134]. Moreover, email can be stored, retrieved and forwarded and thus allows for social memory and establishes accountability [31, 112]. However, other costs become prevalent when using email out of which the feeling of email overload is the most profound [171, 169, 41].

At first, the term *email overload* was used by Whittaker and Sidner [171] and referred to the many different functions that email was employed for: as a calendar, a ToDo list, a data archive, and a contact list. Since then, the term 'overload' has been broadly reinterpreted as the feeling of being overwhelmed by a large volume of incoming messages [167]. The feeling of email overload stems from the fact that an incoming email requires the recipient to decide how to deal with its content [134, 18]. In many situations people tend to answer emails as soon as they arrive. Consequently, the response time is often expected to be closer to that of synchronous communication. People tend to monitor their inboxes even though they realize that each message produces an interruption and is likely to make them feel overloaded

[90]. Those, who decide to either turn off their mailboxes or only periodically check emails are reported to experience ever higher overload as they are exposed to situations in which many emails require their immediate attention [41].

Email overload is further substantiated by the fact that email enables the distribution of often unnecessary high volumes of email. Emails sent to multiple recipients tend to lead to situations, when many people simultaneously receive the same request. It can, further, imply work duplication if more than one person reacts to the same request. Moreover, multiple emails regarding the same subject might expand one request to several, each request involving numerous tasks (communicating with multiple persons, finding information, running reports, etc.). In this aspect the email volume is the main stressor, leaving people with a feeling that there is always more work waiting for them [90].

Summary

In this section, I briefly described advantages and disadvantages of the commonly used communication channels in terms of their richness, synchrony, contextual awareness and control communicators assume when initiating communication. As shown, richer and more synchronous channels better embed social rituals [67] that determine ways interaction unfolds. However, they also impose higher asymmetry in control over the communication between communicators that *'arises because while initiators benefit from rapid feedback, the recipients are forced to respond to the initiator agenda'* [115, 93]. Such an asymmetry can be further gauged by the social and professional relationship between the actors [95, 128] or aspects such as, for example, the recipient's own time-pressure [87, 14, 70]. To summarize, communication arriving through a rich channel might lead the recipient to incur costs related to stress, annoyance and anxiety arising due to the delay in his or her primary task [1, 11, 13].

Less rich channels tend to offer the recipient a possibility to asynchronize communication which, as a consequence, brings them more control over its pace. However, lack of richness can also to lead to misunderstandings regarding each other's communicative needs. As the recipient is largely unaware of the context within which communication was initiated, he or she is more likely to miss signs indicating, for example, relative urgency or importance of this communication. Moreover, in the less rich media, the initiator lacks sufficient indications as to what is happening with the communicative exchange he or she initiated, which may lead to an increase of social tension between the actors and which, as a consequence, could have a negative impact on their future interactions. Finally, receiving multiple even asynchronous communications at the same time might further cause problems such as an experience of being overloaded with high volume of hard to digest information and multiple requests for action. Based on these observations, I define the first goal of this research as follows:

> The first goal of the research reported in this thesis is to understand what elements of face-to-face negotiation could be translated into a mediated setting so that they lead to a better assessment of the communicative needs of the recipient and also the initiator.

This research goal introduces the notion of communication negotiation as a part of communication (see: Figure 1.1). In this negotiation the recipient needs to assess the expectations of an initiator [1, 95] and the initiator has to interpret signs indicating if the moment to communicate is appropriate [17, 57, 87, 121]. The recipient usually has a choice to immediately engage in communication or to decide not to engage in communication at that particular moment [93, 31]. For any communication to be successful, both communicators need to reach an agreement on how to cope with its content within the given time limitations [172]. An adequate behaviour is often motivated by the social and professional relationship between the actors [95, 128]. Such a behaviour is also contingent upon aspects such as recipient's own time-pressure or the next activity planned [87, 1, 14, 70]. In the related literature, such communication negotiation is often referred to as an *interruption* and introduces the notion of availability management as a means to determine an appropriate moment of communication initiation [39, 140, 69, 70].

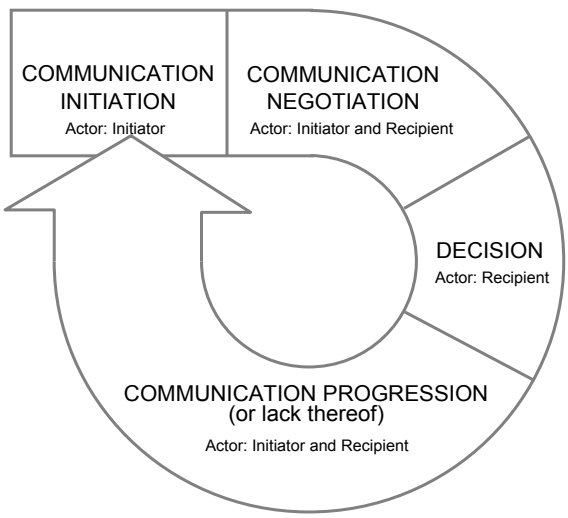

Figure 1.1: The model of the communication process. The research described in this thesis focuses on the first phase of that process where the communicators negotiate their communicative contract.

1.2 Interruptions and availability management

As previously mentioned, initiating communication regardless of the channel being used to do so is recognized to frequently interrupt the flow and continuity of the recipient's ongoing activity and to bring that activity to a temporary halt [91]. People, however, have some natural abilities to dynamically adapt their behaviours to accommodate interruptions [109]. Yet, without proper coordination, a person, who aims at initiating communication, risks interrupting the recipient in the midst of his or her task. Also recipients are likely to experience difficulties when returning to the disrupted task once the interruption is over [37, 64].

1.2.1 History of interruption-related research

The research on interruptions has a long history, going back to experiments of Zeigarnik and Ovsiankina in the 1920s [178, 126]. Their initial interruption-related research aimed at a better understanding of the effect of interruptions on task recall in a physical setting. Those works formed a basis for defining a psychological phenomenon called the *Zeigarnik effect* showing that people are better in recalling details of an interrupted task comparing to an uninterrupted one [165]. In the 1940s, interruption research began to focus on examining how to reduce the assumed disruptive effect of interruptions in technology-enhanced environments such as, for example, flight decks in airplanes [53].

In the 1980s, researchers started to investigate interruptions to better understand their effect on people's post-interruption task performance [64, 36, 27, 98, 88, 1, 13, 14, 12, 11, 38, 125, 101, 100]. It was shown that the negative effects of an interruption depended on the complexity of the primary task, the similarity between the interruption and the primary task and on the interruption frequency. It was also observed that people are able to efficiently accommodate interruptions, especially if the environment allowed for flexibility in task performance and a variety of methods to respond to the interruption. Some researchers discovered contexts in which interruptions actually increased human performance although often at the cost of increased stress and annoyance [148, 28, 107].

Not only technology initiated interruptions gained researchers' interest since the 1980s. The subject of human-human interruptions either direct or technologically mediated became a focal point of works by Lustig [104] and Zimmerman and West [180]. The interest in the subject became prominent in the 1990s after the initial propagation of personal computers and global introduction of the Internet. Soon after researchers began to discuss people's strategies to handle email [105, 135] and then to deal with Instant Messaging communication [116, 10, 8, 9, 7, 157] as well as mobile phone communications [111, 172, 133].

Nowadays people are exposed to an increasing number of physical and digital interruptions out of which the majority are requests to communicate, which with an average occurrence of every 9 minutes and recovery time up to 25 minutes, may be difficult to manage [38, 69, 70, 166, 82]. Researchers are investigating solutions for supporting people to manage their availability for communication, especially communication taking place in the digital domain [17, 56, 159, 6].

1.2.2 Presence versus Availability

In order for communication to occur, the communication recipient needs to be present but also become available for the communicative exchange [16, 58]. Many communication systems merely offer means for indicating one's presence through detecting device activity rather that providing information about one's ability to communicate. However, it is possible that if one is intensely typing, one might be deeply concentrated on writing an important document or composing a difficult message and, although present, not necessarily available for communication [83].

To help bridging the gap between the estimation of presence and providing an actual availability state a line of research emerged called here *reachability management*. This trend in the fields of Human-Computer Interaction (HCI)[†] and Computer-Supported Cooperative Work (CSCW)[‡] pertains to supporting interruption handling that is built upon the premises regarding a visible asymmetry in control of interruptions between the initiator and the recipient [116, 93]. To deal with such asymmetry, researchers proposed and tested mechanisms to support automatic provision of recipient's availability information [47, 119, 16, 172]. In that approach, the system takes a role of an interruption mediator and both the initiator and the recipient are expected to fully rely on its performance. To minimize the effort that users have to invest to keep their status up to date, such systems collect data from their environments and then feed it to computational models, which, in turn, attempt to determine the degree to which the recipient is available for communication.

Alas, automatic systems incur a number of problems. Firstly, computational models which form the basis for defining one's availability state need considerable time to register a transition from one contextual state to another and update the status accordingly [17]. Then, substantial time is needed to construct a model that effectively predicts one's communicative behaviour. Finally, these models are not very successful in interpreting the impact that social relationships between people have on their communicative behaviour [8]. Due to these reasons potential communicators

[†]The Association for Computing Machinery (ACM) defines HCI as *'a discipline concerned with the design, evaluation and implementation of interactive computing systems for human use and with the study of major phenomena surrounding them.'*

[‡]CSCW is defined as a term, which *'combines the understanding of the way people work in groups with the enabling technologies of computer networking, and associated hardware, software, services and techniques [144].'*

are likely to treat the availability indication inferred by the system as insufficiently reliable and tend to neglect the status presented by the system.

In addition, availability indication provided by automatic systems often tends to be too generic or displays context that is insufficiently informative for the initiator to judge when an appropriate moment to start communication is. Systems using computational models to assess people's communicative state tend to generalize that state into three levels indicating that someone is either available, moderately unavailable or highly unavailable [58, 160]. Such generic information about people's availability often does not allow for an assessment regarding which moments are appropriate for initiating communication and which are not.

Other systems, besides providing generic status indication, offer a video channel as an additional source of information regarding people's communicative state [160, 139, 108]. A video channel seems to only partially succeed to inform people about the state or activities of their colleagues. Seeing on a video that someone is sitting in front of the computer and looking at the screen may mean that that person is concentrated working on an important report or maybe just browsing news on the Internet. To provide more cues regarding one's availability, such systems could, further, offer a view of the recipient's screen. Such a solution, however, is likely to induce a large privacy threat regarding both personal information potentially visible on the monitor as well as exposure of recipient's on-screen activities. It seems that providing a video channel is still insufficient to support effective assessment of whether one should initiate communication or not.

Summary

Applications that support communication aim at providing connectivity but at the same time they tend to incur high demands on people to manage their availability for communication [114]. This problem is especially pronounced in systems that support sustained and almost continuous updates of a person's or group's status: whether one is connected to the communication network, one's location, one's status, etc. [24, 16, 161]. Many researchers have demonstrated the benefits of providing availability information in supporting and triggering communication. However, such information, if not well signaled may wrongly suggest always-on availability, give rise to false expectations, and lead to a constant flow of undesired interruptions or, on the other extreme, cause a complete isolation [141, 4].

Although automatic status detection requires no effort to produce an indication about one's availability it seems to suffer from a number of problems such as prolonged time needed to construct a reliable model of one's activities, insensitivity to subtle changes in one's situation, and insufficiently detailed indication about one's status. All these shortcomings trigger initiators to neglect the availability indication

of the recipient that proposed by the system. In this thesis I would like to address the issue of what constitutes a successful way of indicating one's availability state, so that others can sufficiently assess when it is socially preferable to initiate mediated communication.

> The second goal of the research reported in this thesis is to investigate what information should be shared between communicators so that a successful level of visibility regarding their availability for communication is formed.

I choose elements of Instant Messaging communication as the test-bed to address the above mentioned research goal. Instant Messaging applications already offer means to convey one's availability status both in an abstract (by providing automatic indication of one's presence in front of the computer) and detailed (in terms of enabling provision of a status message) way to define one's communicative state. I would like to build upon these mechanisms to verify their applicability for conveying socially significant information about one's status and to seek ways to improve them in future systems.

1.2.3 Solitude versus Sociability

A parallel research line originated from the work of Altman [4] and aimed at protecting people's interpersonal privacy through regulating an access to the self in mediated communication [127, 22, 138, 141]. Altman defined privacy as a border regulation process through which people decide how much interaction with the environment should take place. His model acknowledged that individuals continuously reassess and modify their borders in response to the stimuli from the environment and their own needs for interaction. One can visualize this process as a control-feedback loop in which one continuously matches the effectiveness of a privacy border with one's privacy needs (see: Figure 1.2).

Altman's definition failed, however, to represent the influence of others on how one's intentions and behaviours are modified. It also did not address the fact that both communicators are responsible for establishing a communicative contract [132]. Petronio's approach considers the perspective of both communicating parties and depicts the tension that arises from the potential conflicting interests. The need to repeatedly adapt one's privacy borders during interaction with others seems to regulate one's intentions and to acknowledge understanding of the existing representations of others. The process of privacy borders adaptation usually occurs outside the information exchange and aims to reach out others in social ways. It shows the importance of supporting the pre-interaction process to find an optimal time to contact others [116].

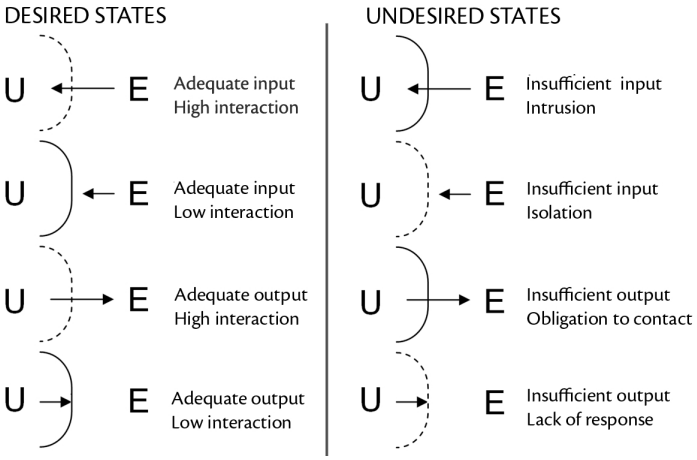

Figure 1.2: The model of privacy border regulation proposed by Altman [4] and obtained from Romero [141]. The model depicts four desired and four undesired privacy states. Letter U is an abbreviation for a user, while E for an environment. The solid line represents a border that is closed, while the dashed one depicts a border that is open for interaction.

Boyle and Greenberg [22] further described the process of privacy regulation by means of (among others) *solitude control*[§] that refers to the control of one's access to the self. In mediated communication solitude mechanisms allow people to depict their intentions regarding the desired level of interaction.

Palen and Dourish [127] distinguished among three types of conflicts pertaining to one's privacy: (i) the need to keep information private, (ii) the need to define one's actions in an intended way and (iii) the need to align one's behaviour so that past events could serve as a basis for interpreting one's current actions. The authors introduced the concept called *genres of disclosure* that aims to support people in aligning their expectations and desires of how they are presented in the system. In such a way people are able to produce the correct social expectations, guide the interpretability of their actions and consider the dynamics of technology and social practices when assessing one's availability for communication.

Systems aiming at interpersonal privacy protection tend to provide people with a lightweight manual way to determine their communicative state. Buxton [26] argues that elements embedded in people's environments that are manually operated (e.g., doors) can be used to determine the virtual representation of one's communicative

[§] The other two means for regulating one's privacy borders are: *autonomy* and *confidentiality*. *Autonomy* reflects ways in which one expresses one's image and identity in the system. *Confidentiality* pertains to the regulation of the access to one's personal information.

state and at the same time allow people to control that representation through a physical interaction with that particular object. Milewski and Smith [111] showed that people are inherently motivated to update their availability status especially if they can see a potential benefit for their actions and at the same time the effort to do so is not extensive.

Systems supporting manual availability indication offer advantages missing in automated systems. They allow for adapting the representation of one's communicative state at any time, also at moments when an automatic system detects no change in one's state or activity. Such a solution also offers a possibility to keep the overall status unchanged even though the observable activities might change, e.g., when a person is writing a report, he or she might be reading relevant material, searching on the Internet for additional information and writing the text. Those are different activities but the overall status might indicate that one is very concentrated and available only for urgent matters. Furthermore, manual availability indication gives people the possibility to define their availability as reaction to others' intentions to interact for both short and long periods of time (like hours or even an entire day) although the main risk is that people may easily forget to update that status when their situation changes [111]. Manual status adaptation also provides room for ambiguity [6, 21] by allowing people to decide in what way their communicative state should be reflected in the system so that they can protect their solitude and self-image at all times regardless of their present situation or activity [67, 127].

With their system *Negotiator*, Wiberg and Whitaker [172] tested in what ways people could be supported in effective scheduling of incoming communications which arrived at a moment of an intellectually demanding activity. *Negotiator* was inspired by a metaphor of a timer: a simple yet powerful means to indicate a delay in communication. An initiator would be asked to adjust the timer to indicate to the recipient when he or she would like to initiate communication. If the suggested time was not appropriate for the recipient, the initiator would be required to propose another time. Such a process would be carried out until both communicators reached an agreement. The results of their study pointed at the fact that participants preferred to take responsibility for returning calls rather than waiting for the initiator to repeat the call request to avoid stacking up recalls. They also preferred to schedule communications as soon as possible rather than deferring them until a time when they were truly available for them. These results showed how manual availability management might create social tension for the interacting parties.

Nardi et al [116] observed that the exchange of cues regarding one's availability, inhabiting and maintaining a shared communication space and managing the process of interaction to large extent occurs outside of the content exchange and should be

supported through a separate channel called the *outeraction* channel[¶]. The Push-to-Talk system [174, 173] built based on Nardi's research is one more example of a system that implements a set of *outeraction mechanisms* that allow users to manually coordinate their availability without interfering with the communication protocol. Mobile connections between communicators could be established through the Push-to-Talk protocol. To start communication the initiator had to choose the recipient from the list of contacts and push a button. If the recipient was willing to accept the incoming communication, the initiator would hear a sound confirming his or her intention to talk. If, however, the recipient was not interested in engaging in conversation, he or she could employ plausible deniability [6] and pretend that the call went unnoticed. As there was no indication of the intent for communication left on the device (such as, e.g., a voice message or a missed call indication) the recipient could feel free to decide whether and when to call the initiator back.

A similar approach was put forward by Romero [141] who, applying Clark's theory to describe how a communication initiation is cooperatively negotiated, proposed the concept of privacy grounding mechanisms as an interactive means to enable users to negotiate their mutual privacy borders. She illustrated this approach with the design of three mechanisms: one-click, drag-and-drop and cylinder aimed to support easy communication intentions to interact in mediated settings. The one-click mechanism allowed the recipient to indicate to the initiator that the message sent through an Instant Messaging application (namely, Community Bar [108, 139]) was seen though the recipient is not just yet getting engaged in a conversation at that moment. The drag-and-drop mechanism provided communicators with a list of customizable replies (e.g., 'I will catch up with you in 5 minutes' or 'I am on the phone right now'), which could be selected and sent in a lightweight manner. Finally, the cylinder was a tangible device that supported communicators to signal a time-frame within which the ongoing conversation could be resumed; its physical nature allowing users to interact with it even when not sitting in front of their computer e.g., when in a meeting. Such mechanisms provide communicators with means to represent their intentions to interact; however, they miss out on the aspect of establishing of mutual awareness of these representations, especially in cases where one does not take the step to signal one's intentions or acknowledge a signal of another person.

Summary

Prior works regarding interpersonal privacy regulation showed that managing availability is a dynamic process that depends on the continuously changing context [16, 141] and that technologies supporting mediated communication often disrupt the ex-

[¶]Outeraction is seen as an array of linked processes that create awareness among communicators by providing continuous feedback loop about what is going on with each other.

change of cues regarding that context [127]. Nardi et al [116] saw that information exchange can be successful only through subtle negotiations about availability as a way to establish and maintain connection by inhabiting and maintaining a shared communication zone. The process of negotiating availability binds people more tightly together for a specific interaction as they establish a particular *attentional contract* which is likely to have consequences for future communications.

In the context of negotiating communications, the ability to provide awareness regarding the availability status should be seen as one of the most important features of tools supporting mediated communication. Petronio [132] points at the fact that availability negotiation is a process wherein both communicators agree on the most desirable communicative contract. Nardi [116] shows that in order to support a successful negotiation of that contract there is a clear need for attaining mutual awareness of the state and intentions of both actors. Therefore, following the research line proposed by Romero [141], I argue that to successfully establish communication it is crucial to form a social protocol that smoothens potentially awkward interactions by allowing communicators to gracefully negotiate their communicative contract and at the same time protect their interactive borders.

> The third goal of this research is to investigate ways of attaining mutual awareness regarding the availability of communicators in mediated communication as means of forming a foundation for accountability based on the mutual knowledge of each other's actions in the system.

As in the previous case, I selected an Instant Messaging application to become the test-bed to address this research goal and I aim to build upon the results of the previous studies to show how attainment of mutual awareness regarding one's information and actions visible in the system helps people to develop social rules for interactions in mediated settings.

1.3 Theories about the rules of social interaction

In this research I aim at identifying information needs and communicative processes that could help people to establish optimal conditions for mediated communication. These processes are likely not only to shape individual communicative exchanges but also to define long-term social relationships among communicators [116, 115]. The two approaches described in sections 1.2.2 and 1.2.3 (*reachability management* and *interpersonal privacy regulation*) seem to insufficiently support coordination of communication in mediated settings. The reachability management approach assumes the availability state to be persistent and therefore misses out on the role the initiator has in shaping it. The interpersonal privacy regulation approach incorporates the

role of both communicators in choosing the moment of communication. It, however, omits the issue of attaining mutual awareness regarding communicative needs of the actors as a basis for accountability for each other's actions.

Hereby, I introduce two theoretical approaches describing ways in which people negotiate communications. *Common Ground* reflects on such processes occurring face-to-face and pertaining to the exchange of content and context related signals. *Social Translucence* defines communication negotiation in mediated settings in terms of a social process, which evolves based on mutual knowledge of what socially significant information is made visible in the system.

1.3.1 Common Ground

The Common Ground theory formulated by Herbert Clark [31] proposes to consider communication as a process in which communicators coordinate both the content and the context of the exchange they are engaged into [32]. Clark argues that people are not able to predict in advance their communicative acts and behaviours as they are not able to predict the reaction of their communicators. Therefore, they need to constantly monitor the progression of any communicative act and look for evidence indicating whether their intentions were correctly understood.

Any communicative activity requires coordination of its content using a second channel to establish shared understanding regarding the progress of the exchange. The source of communicators' ability to coordinate communication is their *common ground*: a set of knowledge, beliefs and suppositions that they believe they share [152, 33]. Each communicative act consists of two phases. The *presentation phase*, in which the initiator presents his or her content, which is enriched by other (e.g., non-verbal) signals that help the recipient understand that content. The *acceptance phase* is the phase in which the recipient indicates the degree to which he or she understands, and accepts or rejects the initiator's contribution. People interpret each iteration through a signaling system, which depends on the already established level of the communicators' common ground. Common ground is considered the basis which enables two persons to coordinate what the speaker means and what the hearer understands the speaker means by a certain communicative act. Communicators accumulate common ground with joint signaling events, which move them from one point in the communication to another.

Regardless of the character of communication both communicators try to manage each other's communicative acts with *the least collaborative effort*. Minimizing such effort should lead to more efficient communications but at the same time it may have a negative impact on their effectiveness, for example, referring to facts that are incorrectly assumed to be commonly known might lead to misunderstandings that need to be explained at a later stage. Reduction of such effort can be possible thanks to

producing signals that go beyond an exchange of words and include facial expressions, gestures and shared awareness of actions and objects in the environment [23].

The Common Ground theory has been defined through the observation of face-to-face communications. Clark saw that each communication is governed by a set of social constraints derived from, among others, the situation in which the conversation is carried out [67, 25]. These social constraints are likely to lead to many indirect forms of communicative acts such as expressions derived from the body language or eye gazing. But Clark and Brennan [32] also noted that the level of effort people need to invest to effectively communicate through other channels changes dramatically with each communication medium. The techniques leading to the reduction of the effort necessary to produce a communicative utterance that are available in one medium may not be present in another; also the cost of making conversation may be larger in one medium compared to another [112]. Asynchrony of communication, lack of audio- or visual channel or physical absence are the examples of constraints that affect ways communication evolves (see: Table 1.1). These constraints lead to the additional costs of making conversation such as cost of formulation (effort pertaining to the decision how to formulate a communicative act) or cost of delay (the impact a delay in communication can have on its progress and outcome). Therefore, Clark sees grounding techniques to depend both on the purpose of communication and on the medium that is used to communicate. But regardless of the medium, all communicators share the same goal: to understand each other's utterances. With the impoverishment of the channel to support grounding, more effort is required from communicators to make their communicative act successful.

Clark defined communication mainly as an intellectual process of continuous assessment of its progress [31]. He saw grounding as *'communicators' needs to evidence both understandings and misunderstandings of their contributions in achieving an effective conversation'* [141] that predominantly occurs on the linguistic level. He also argued that technologies introduce grounding constraints that could be translated into conversational costs of ongoing communication (see: Table 1.2).

He only partially discussed the notion of a conversation being a social endeavour and did not specify how that social nature is addressed on the level of communicators' awareness of each other's needs. I argue, that the social nature of communication is, in fact, a foundation through which communicators establish and maintain their connection and also create a desirable image of themselves [68, 67, 95]. Therefore, it is crucial, next to enabling sharing of content and context information, to support the formation and exchange of social signals. Clark tackled upon this issue in discussing the signals pertaining to the context of communication, which is in detail elaborated upon in the PhD thesis of Romero [141]. Romero's Privacy Grounding Model discussed how people build a shared understanding of their privacy borders based on explicit and intentional signals (rather then information automatically available in

Table 1.1: A list of grounding constraints imposed by different technologies as proposed by Clark and Brennan [32].

Grounding constraints	
Co-presence	communicators share the same physical environment and can use its elements to ground their communicative utterances
Visibility	communicators are visible to each other and they can ground their communicative utterances thorugh non-verbal signs like facial expressions and gestures
Audibility	communicators communicate through speaking and they ground their communicative utterances through natural language
Co-temporality	communicators receive communicative utterances at roughly the same time as they are produced so delays are easily noticeable
Simultaneity	communicators can simultaneously send and receive communicative utterances, which allows for backchanneling
Sequentiality	turns of communicative utterances cannot get out of sequence
Reviewability	communicators can review each other's messages, can review the history of communication
Revisability	communicators can revise each other's messages, they can edit their utterances before presenting them to each other

the system). The model did not consider what about each individual is visible in the system and it did not provide a complete account of how mutual awareness regarding their actions is constructed. It also did not address the issues defined as goals in this thesis: namely that in order to create social basis for mediated communication people need both provide socially significant information[‖] about themselves and also attain mutual awareness regarding what of their actions and information is visible in the system.

[‖] Socially significant information can be defined as a piece of information visible in the system that enables communicators to assess the current or future social situation of each other and based on that assessment be able to determine how communication should progress.

Table 1.2: A list of costs of grounding that relate to the grounding constraints imposed by different technologies as proposed by Clark and Brennan [32] and reported in Romero [141].

Costs of grounding	
Cost of formulation	effort to decide what an utterance should be
Cost of production	effort to say an utterance
Cost of reception	effort to hear an utterance
Cost of understanding	effort to understand an utterance
Cost of start-up	effort to initiate an utterance
Cost of delay	impact of a delay in communication
Cost of asynchrony	impact of a loss of a communicative sequence
Cost of speaker change	effort to decide when and how to address a new speaker
Cost of display	effort to signal (point at) a physical aid to an utterance
Cost of error	effort to address and recover from an error in either producing or understanding an utterance
Cost of repair	effort to address and fix a misunderstanding regarding an utterance

1.3.2 Social Translucence

Sharing social signals is as important as an exchange of information in determining human behaviours and serves as basis for inferences, planning and coordination of activities [65, 5, 117]. People make countless decisions based on the actions and activities of others around them. Their actions and reactions, in consequence, become social rituals that guide ways in which people interact with each other. The Social Translucence framework proposed by Thomas Erickson and Wendy Kellogg [51] aims at defining ways in which such social signals could be made pertinent in mediated settings. The authors note that in current digital systems most of the social information goes unnoticed and they aim at addressing the blindness towards such signals. Erickson and Kellogg focus on defining how to design systems enhancing mediated communication and collaboration so that they support coherent and graceful interactions similar to those occurring in face-to-face encounters. The authors use an example of a door design to elaborate on their observations:

> 'In the building where we work there is a door that opens from the stairwell into the hall. This door has a flaw: opened quickly, it will slam into anyone entering from the other side. In an attempt to remedy this situation, a sign was posted: "Open Door Slowly". As you might guess, the sign is not very effective. We like to contrast the sign approach with a different sort of a solution: putting a glass window in the door. The glass window is effective for 3 reasons. First, as humans, we are perceptually attuned to movement and human faces and notice them more readily than we notice a sign. Second, once we become aware a person is present, our social rules come into play. I don't open the door quickly because I know you're on the other side and I was raised in a culture that frowns upon slamming things into others. There is a third, subtler reason for the glass window's effectiveness. Even if I haven't been properly acculturated and don't care about harming you, I may still refrain from slamming into you because I know that you know that I know you're there, and therefore I will be held accountable for my actions.' [50]

Based on the above observations, Erickson and Kellogg argue that communication systems could support socially salient behaviours by making people and their activities visible to others. The framework incorporates the different properties of face-to-face communication described in the above example, namely: *visibility*, *mutual awareness* and *accountability* into any mediated setting. Visibility defines the degree to which socially significant information is made visible in the system. It is, in fact, the extent to which provided information is likely to be perceived as significant by all system users and also how well that information is represented by the system. Mutual awareness reflects the extent, to which all users of the system know what information is being shared among them and also what others can see about their behaviour** Finally, accountability can be seen as a basis for acting in accor-

**The notion of the term: *awareness* has multiple interpretations in the fields of Human-Computer Interaction (HCI) and Computer Supported Cooperative Work (CSCW) The initial definition of awareness related to the generic ability of people to perceive, understand and adapt their behaviour to their immediate context [48]. This definition was further detailed for groupware systems and it addressed the issue of providing contextual information about past, present and future activities as the means enabling users to understand what is going on and adapt their behaviour to the changes in a shared environment [147, 145]. There are other definitions of awareness such as *group awareness*, *workspace awareness*, *context awareness*, *activity awareness*, etc. The details about these definitions can be found in the article of Schmidt and also Guerrero et al [145, 73]. The above mentioned definitions focus on understanding what information should or should not be shared among the system users (which according to the Social Translucence framework pertains to the aspect of visibility). I argue that the Social Translucence framework provides an important clarification regarding the notion of awareness by distinguishing between the aspects of (i) sharing of socially significant information among the system users and (ii) attaining mutual awareness of what of each other's information and actions can be seen in the system. I believe that distinguishing between the aspects of visibility of shared information and mutual *awareness* of that information is likely to clarify the problem of defining awareness and, in consequence, help to better design awareness systems.

dance to social norms as a consequence of a mutually understood possibility of being held responsible for one's actions. Attaining a sufficient level of visibility and mutual awareness about socially significant information available in the system should allow for making the social knowledge reusable in future interactions and define new sets of social rules for mediated settings.

Moreover, the Social Translucence framework discusses the vital tension that occurs between the need for privacy and the visibility of the information that is made visible in the system in terms of *the power of constraints*. The authors note that both in the physical and the digital domain, people like to keep some information private and some public. An example of such a behaviour in the digital domain is explicated in ways in which people set up their profile information in social network applications such as Facebook [99]. Sharing personal information in social network applications is built upon a shared trust that these who have the access to that information are not going to abuse it by, for example, publishing it somewhere else without the owner's permission. However, with a growth of one's social network, one has less and less control of what happens to one's information. Therefore, system users are likely to become more conscious of what information they choose to share with others as means to control the visibility of private information about oneself. Another way to deal with the problem regarding tension between one's privacy and visibility would be to provide awareness for both individuals and groups as who is able to follow their interactions and information. Finally, the authors discuss three approaches to visualizing the socially salient information in mediated settings:

- The *realist* approach that tries to project social cues produced in the physical domain directly to the digital domain. Examples of such systems can be tools enabling a video channel. However, as discussed in section 1.2.2 the social signals conveyed through video are often impoverished by its resolution and also prone to be misunderstood as there is insufficient context information provided to interpret them in a correct way.

- The *mimetic* approach that tries to mimic social information from the physical space in the digital domain by using virtual reality systems and avatars. However, such systems demand from the users to continuously adapt their avatars to mirror their physical situation. Such systems are similar to those described in section 1.2.3 and their main disadvantage is that they require constant effort in order to keep the social information up to date.

- The *abstract* approach that aims at presenting social cues in a way that is not too closely tied with their digital references. Such cues could be presented through simple textual and graphical forms, which prove to have many powerful characteristics such as ease of production and manipulation. Such abstract

> cues can persist over time and leave interpretable traces for either the one who produced them or those who would like to learn more about a particular interaction. Their applicability would, however, have to be tightly coupled with the level of understanding they provide to the system users regarding their current and future situation. Otherwise such signals might incur cognitive costs pertaining to their learnability and remembrance.

Erickson and Kellogg relate the Social Translucence framework to the Common Ground theory by defining social signals as common ground representations of previously established understandings and shared experiences. They see communication as more than an intellectual and cognitive action. The authors consider it as a social process in which people present both information and the image of themselves to others. This social nature is the core of communication and personal motivation to get engaged into it. Communication over a digital medium has one additional important characteristic: it persists over time and can be traceable [32]. Therefore it makes shared information accessible to other people, in different places and at later times. That persistence could be seen as a means to produce social signals that could be later reused and contextualized and, consequently, change people's social behaviours.

Summary

The Common Ground theory considers communication mainly as an intellectual endeavour and only partially discusses its social nature [67, 95]. Erickson and Kellogg [51] address the social aspect of communication and their framework could be seen as a super-ordinate of the grounding process as defined by Clark. The Social Translucence framework could be seen as a way to think about the larger scale context within which communication occurs. It states that communication environments should be designed so that they provide social cues which could then be mined for common ground. It aims at ensuring that certain cues are available under certain conditions and that both the cues and circumstances under which they are available are known to everyone who inhabits that context. Such an enriched environment offers the possibility to construct common ground more easily (especially with respect to the communication process). It further gives the ability for communicators to control what cues about themselves are available to outsiders who may have interest in them. Erickson and Kellogg build upon the Common Ground theory in two ways:

- They argue that communication environments should be designed so that they provide perceptual cues which can be mined for common ground. Whatever is made visible should be available both to the immediate participants of the communication and to the larger audience so that outsiders can be privy to cues that allow them to notice, follow, engage in, or avoid ongoing communications.

- They elaborate and define in detail how grounding in the digital domain could be seen as a social process in terms of visibility, mutual awareness and accountability. It proposes these to become a new set of signals that are shared in order to enable graceful and productive interactions. It also argues that in order to create social rituals the common understanding of these signals needs to be established.

I would like to reflect on the three constituents of Social Translucence in the context of the definition of *common ground* provided by Clark [31]. In its core, the goal of the grounding process is to explicate whether communicators understood each other's contributions in a communicative exchange. In other words grounding means: (i) noticing that something was said, (ii) comprehending the message, (iii) understanding the message and (iv) understanding the meaning of that message. So, the grounding process implies taking turns in the communicative exchange in the following way:

- ascertaining that the recipient understands what the initiator said;
- ascertaining that the initiator knows that the recipient understood what the initiator said;
- ascertaining that the recipient knows that the initiator knows that the recipient understood and so on [141].

The development of common ground produces a set of understandings all communicators believe they share. In such a way common ground becomes the foundation for the creation of communicative representations that pertain to common interaction rules and norms. Clark considers such process of common ground development mainly from the perspective of face-to-face communications. Erickson and Kellogg, however, note that in a face-to-face situation mutual awareness and accountability co-occur as a natural consequence of people's behaviours (both embedded in the conversation and as a part of defining their context like, for example, through their body language). This is not the case in the digital domain. In mediated tools, it is difficult to obtain mutual awareness of each other's activities and also one may not be as easily held accountable for one's inappropriate actions. Making social cues visible in the system might be seen as a *presentation phase*, while assuming mutual awareness of that information as a *acceptance phase* as defined by Clark [31].

Based on the analysis of the characteristics of the Common Ground theory and the Social Translucence framework I chose to use the latter one as a carrier for my research. I think that the framework incorporates the main paradigms of Common Ground and expands them by introducing the exchange of social cues, which have a

crucial role in maintaining common ground in mediated settings. Moreover, it distinguishes among visibility, awareness and accountability as means to achieve common ground, which is a vital notion for interactions occurring in a digital domain, where communication is conducted in turns and lacks the rich contextual data available in face-to-face encounters.

1.4 Research motivation

Information sharing is the main goal of any communication regardless of the channel that is being used. However, by focusing exclusively on information exchange, it is easy to overlook the social processes that scaffold that exchange [115]. Prior works indicate the necessity for considering the context within which communication occurs to improve human-human availability management but does little to explicate the social rules and constraints that form people's communications through mediated tools. In the research described in this thesis I explore what constitutes the socially significant information about people's availability state and how to attain mutual awareness of that state. Following the reasoning of Erickson and Kellogg I argue that attaining a sufficient level of visibility and mutual awareness leads to the increase of socially salient behaviours in mediated communication based on the conjoint understanding of the possibility to be held accountable for one's actions. Following the assumptions of the Social Translucence framework this research aims to develop the notion of sharing social cues as the means to support graceful and socially salient interactions in digital settings. Assumptions that define the scope of this research, that are based on the analysis of the prior work, are as follows:

- availability status is an indication of a desired level of interaction with the environment,
- availability status is a dynamic rather than a persistent state that is likely to change under the influence of the communication initiator and often reflects the communication history between the initiator and the recipient as an important element of context,
- both communicators conjointly shape that state during interruption negotiation which happens at the beginning of each communication,
- that negotiation leads to agreeing upon a *communicative contract*, thus defining how to proceed with communication process,
- interruption negotiation is a social process that leads to the establishment of common ground between communicators and also defines the rules for their future interactions.

1.4.1 Research goals

This research aims to operationalize the Social Translucence framework in the context of designing mechanisms leveraging socially responsible behaviours in mediated communication. Based on the analysis of the related literature described in the previous sections I elaborated then main research goal in the three following sub-goals:

- The first sub-goal of the research reported in this thesis is to understand what elements of face-to-face communication negotiation could be translated into a mediated setting so that they lead to a better assessment of the communicative needs of the recipient and also the initiator.

- The second sub-goal of the research reported in this thesis is to investigate what information should be shared between communicators so that a successful level of visibility regarding their availability for communication is formed.

- The third sub-goal of this research is to investigate ways of attaining mutual awareness regarding the availability state of communicators in mediated communication as means of forming a foundation for accountability based on the mutual knowledge of each other's actions and behaviours in the system.

By achieving these goals I hope to show the applicability of the Social Translucence framework for designing mechanisms supporting socially salient behaviours based of the possibility to be held accountable for one's actions in digital settings and to inform the design of future digital tools supporting mediated communication.

1.4.2 Research approach

The first part of the research presented here utilizes a combination of ethnographic and laboratory approaches to examine the ways people negotiate communications (see: Figure 1.3). The ethnographic investigations allow for collection of rich qualitative data that defines the foundation on which this research is built. Verifying these initial assumptions in the laboratory allows to quantify aspects such as the quality of the subject and communication timing as well as manipulate factors like social relationship between communicators, which are difficult to measure and almost impossible to manipulate in a field setting. This mixed field- and lab-based approach allows for validation of the results found in the field through those obtained in the lab.

In the second phase of this research, I apply a *research through design* approach (see: Figure 1.3). Such an approach aims at providing the designer with insights regarding the specific user-product relationship [45, 96, 179]. In my view, designing mechanisms supporting socially salient behaviours requires an approach in which the research does not always precede but at a certain point becomes a part of the

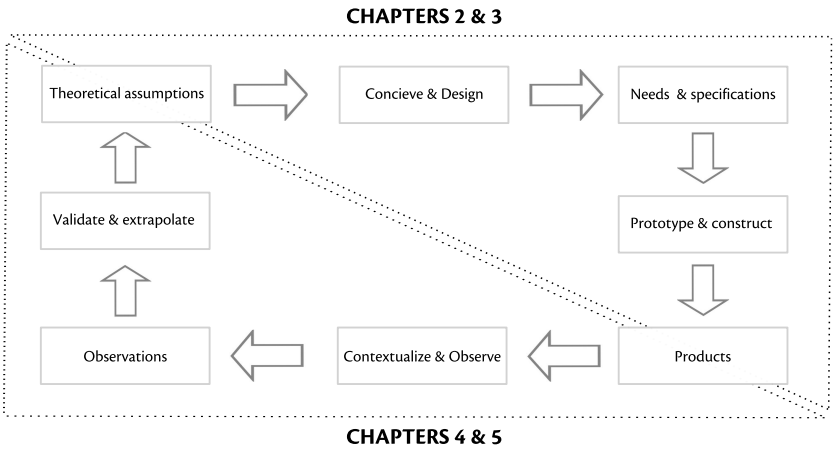

Figure 1.3: An illustration of the relation between the research approach and the content of this thesis. The area marked by the top triangle indicates the research phase focused on ethnographic and laboratory studies. The area marked by the bottom triangle depicts the research-through-design studies. This illustration is based on *the research focus in the design cycle* model proposed by prof. J.-B.Martens in the course DBB04: Quantitative Research Methods.

design activity. The research through design approach mainly aims at showing how the insights obtained from a theory can assist in creating design concepts for concrete products. Validating such concrete products can lend support for new insights that can inform the theory itself. I hope to examine the practical applicability of the Social Translucence framework for the design of tools supporting mediated communication. In this way, I would like to show that Social Translucence proposes a new way of thinking about designing such tools to leverage socially responsible behaviours. Moreover, I hope to add to the understanding which moments in the communicative exchange need to be provided with adequate mechanisms to create and maintain the common ground regarding the rules of interaction that satisfy all communicators.

The approach to data gathering is predominantly driven by collection of qualitative insights into participants' needs which is supported by quantitative insights collected through data logs. I argue that while quantitative data tends to focus on defining ways people interact it rarely provides deep understanding into the motivations behind these actions. Since my focus lies in comprehending the complexity of sending and receiving social signals in mediated settings, I see the need for an extensive qualitative analysis of the data set collected in the course of this research. In the conclusions of this thesis I reflect on the methodological impact of this re-

search in terms of its applicability for design of new communication tools that aim at leveraging implicit user needs like, for example, their desire to be sociable.

As already mentioned in sections 1.2.2 and 1.2.3, I choose for Instant Messaging communication to become my test-bed. Instant Messaging combines the qualities of rich synchronous communication with the qualities of asynchronous channels (see: Section 1.1.3 for more details). It already offers means for the formation of social rituals [67] by providing some contextual awareness regarding communicators' availability. It also creates space for plausible deniability by supporting manual adaptation of the automatic status indication. Finally, it is a valuable tool for both on and off-site communication and enables people to remain involved in communications and activities regardless of their actual physical presence. Therefore, I argue that users of Instant Messaging tools are likely to be more perceptible in assessing advantages and disadvantages of mechanisms designed in the course of this research.

1.4.3 Thesis overview

The reminder of this thesis is structured as follows.

- *Chapter 2* presents an investigation into different factors influencing interruption behaviours. The chapter surveys behaviours aimed at both administrative assistants and knowledge workers in a face-to-face setting. It further investigates the applicability for the identified factors as carriers of social information when dealing with email communications. In this chapter I discuss the dynamic nature of the availability state and motivate the need to leverage information about the nature of the communication subject and also the anticipated communication duration as means to increase visibility regarding the information needs of the initiator. I argue that providing such information is likely to positively influence interruption behaviours of both communicators and lead to interactions that are more productive and graceful.

- *Chapter 3* investigates the interplay between a professional relationship between an interruptor and an interruptee and two different system approaches to support handling interruptions. The study shows that communicators are more likely to be considerate of each other's activities, when they share a common goal. It is also demonstrated that people who do not share a common goal are likely to behave in a socially salient manner to increase their chances for having an interruption immediately handled. Finally, the role of social reciprocity in defining interruption behaviours is discussed.

- *Chapter 4* compares two ways of presenting availability to understand how to achieve a sufficient level of visibility of people's communicative status. Some

aspects of the Social Translucence constructs are further operationalized into a questionnaire and the relationships between these constructs are tested. The results show that to design socially translucent systems it is insufficient to only visualize people's availability status.

- *Chapter 5* explores the means to attain mutual awareness of recipient's availability status. The study uses a prototype of an Instant Messaging application. The results show that displaying status indication in the chat box encourages communicators to show respect towards the availability state of their colleagues. The study also shows that to achieve accountability mutual awareness needs to be maintained not only during communication initiation but also throughout the entire communication duration.

- *Chapter 6* summarizes the work presented in this thesis. The important results are highlighted and areas for future research are discussed. The chapter ends with the concluding remarks reviewing the major contributions of this work.

2

Dynamic nature of availability

*

Abstract

As shown in Chapter 1, the topic of availability management has already been broadly investigated in related research. However, thus far the approach to this subject was primarily motivated by the need to protect an interruptee from an unwanted interruption. It this approach availability status was assumed to be static: either the interruptee was interactive, thus willing to accept an interruption or interpassive, thus prone to reject it. In this research I would like to propose a different approach for supporting availability management in mediated communication that aims at leveraging social abilities of communicators that are applied in face-to-face communications. For that purpose I defined two assumptions: that availability status has a dynamic rather than a static nature and that both communicators conjointly influence that status. In the studies descried in chapter 2, I explored the nature of the availability status and also attempt to recognize the factors that are likely to influence it through an array of empirical investigations. These studies have shown that availability state of the interruptee is likely to be influenced by factors such as: social proximity, nature of the communication subject and anticipated interruption duration. I have, then, examined the relative impact of these factors on mediated email communications. I observed that while social proximity was shown to be a crucial factor for assessing face-to-face communications, it appeared to have little impact on the availability status in email communications.

*This chapter is based on the following articles: A. Szóstek Matysiak and P. Markopoulos *Factors defining face-to-face interruptions in the office environment*, in extended abstracts of CHI 2006, ACM Press [156] and A. Szóstek Matysiak, P. Markopoulos and B. Eggen *The nature of availability*, to be published in the special issue of The Ergonomics Open Journal, Bentham Open, 2010

2.1 Introduction

As discussed in Chapter 1, each communication is born through an opportunistic attempt of one person to initiate a communicative exchange that often causes an interruption of another person's ongoing activity. In order to establish communication both communicators first enter an interruption negotiation process during which a recipient needs to assess what are the expectations of an initiator [1, 95] and the initiator has to interpret signs indicating whether the moment is appropriate to initiate communication [17, 57, 87, 121]. In this negotiation process the recipient has usually a choice to become interactive – immediately engage in the communication or interpassive – decide not to engage in the communication at that particular moment [31, 93]. Such a decision is proven to depend on the recipient's availability but is also likely to be influenced, for example, by the subject of the interruption. One may be willing to immediately accept an interruption that helps one's progress with one's primary task or when it contains information one's was waiting for even at a point of high unavailability [121]. Therefore, as a first step in this research I set out to understand what factors are likely to have an impact on the decision of the interruptee about how to deal with an interruption. I argue that factors such as, for example, the importance of the initiator or the urgency of the communication subject are likely to show significant impact on the interruptee's availability state and could alter the decision regarding the interruption outcome.

2.2 Motivation

Erickson and Kellogg [51] pointed out that to leverage social behaviours among communicators it is crucial to make relevant information visible. Following their line of reasoning, I think that a better understanding of the factors influencing the availability status and, in consequence, the communication negotiation process is likely to provide a comprehensive set of relevant information needs for both the initiator and the recipient that should be made visible in systems supporting mediated communication. Therefore, the objective in this study was to answer the following question:

> What factors are likely to alter the recipient's availability state and influence their decision regarding the interruption outcome?

To answer this question, an array of studies was conducted. I began with an observational study of how administrative assistants assess face-to-face interruptions aimed at both their managers and themselves. Next, semi-structured interviews with twelve knowledge workers were conducted that aimed to better understand the dependencies among different factors influencing their interruption behaviours. Both

studies focused on face-to-face communication that is considered the richest communication channel and at the same time imposing the heaviest burden caused by a communicative attempt in terms of resumption lag to the primary task of the interruptee [101, 12] and also high social cost for both communicators [31, 67, 25, 95]. Therefore, as the last step, I conducted a diary study that assessed the impact of the identified factors on the decision how to handle emails.

2.3 Administrative assistants and handling interruptions

The work of administrative assistants has not been extensively studied within the CHI and CSCW domains. A recent study by Erickson et al [49] aimed to capture the complexity of assistants' job. The authors showed that maintenance of situational awareness, the continuous use of extensive background knowledge regarding the organization and its processes and also collaborative skills well describe assistants' responsibilities. As part of their daily tasks, assistants are also professional interruption mediators. They routinely use a sophisticated set of self-defined heuristics to assess and negotiate interruptions both for their managers but also for themselves. Interruption negotiation methods of assistants could provide a great source of information to better understand what factors influence the decision about how to handle interruptions. The assistance they offer can be used as inspiration to assistance researchers attempt to create in systems supporting mediated communication.

Dabbish and Baker [40] investigated strategies assistants apply for negotiating interruptions using semi-structured contextual interviews [19]. They identified two factors which are central to deciding whether to allow or disapprove an interruption: importance of the interruptor and importance of the interruption subject. According to their model the calculation of the importance of the subject seemed to be a combination of how important the problem at hand was to the interruptor combined with the importance of the interruptor as a person. Individuals of low importance tended to be asked what their business was, whereas individuals of high importance were given immediate access whenever possible. Their study, however, derived its results from participants' retrospective accounts rather than trying to capture their momentary reflections within a specific situation of interruption handling [92]. In the first study, I set out to verify the model of Dabbish and Baker [40] through an observational study that supported capturing the richness of the interruption handling process by analyzing interruption events at the moment of their occurrence. By selecting such a method, I hoped to be able to identify what other aspects influencing the change in the availability state of the assistant and in consequence the interruption outcome, e.g. urgency [101, 69] or social costs [67, 68].

2.3.1 Study design and analysis

I chose to study how interruptions were handled by three administrative assistants (two from an academic and one from an industrial environment). All assistants were female and had more than 10 years of working experience at similar positions. They all managed the schedule of their bosses, handled communications by mail and phone and receive visitors. They also dealt with issues of employees of their work groups.

Observations and interviews were conducted in-situ and concerned both interruptions directed at the assistants and at their managers. Assistants were observed as they dealt with interruptions for a day each. The observer monitored all incoming interruptions and coded them according to the following criteria:

- importance of the interruptor (based upon an organizational chart).
- urgency of the interruption subject assessed by the assistant.
- importance of the interruption subject assessed by the assistant.
- assistant's availability level (coupled to the performed task).
- interruption outcome (immediately handled/postponed).

The observer attempted to assess each interruption as completely as possible just by observing an event. Whenever in doubt, she requested clarification from the assistant. Observations impossible to classify were redirected to the assistant in a form of the following open question: 'How would you describe this interruption?', followed by closed questions asked according to the above described criteria whenever the answer provided by the assistant did not render adequate data. All interruption events were recorded in a spreadsheet and given a unique identifier. In addition, each interruptor was asked to fill in a questionnaire (see: Figure 2.1) printed on a card with questions reported on a 5-point Likert scale and concerning:

- *urgency* of the interruption subject (which was operationalized by assessing the time frame, within which the interruption should be handled),
- *importance* of the interruption subject (which was operationalized by assessing how important the interruption subject was for the interruptor).

The cards were then entered into a sealed box, which only the observer had access to. Questionnaire cards could be linked with the adequate spreadsheet records through a unique identifier.

At the end of each observation day a semi-structured contextual interview was conducted with all assistants. All interruptions of the study day were revisited and questions regarded ways of handling interruptions, factors influencing the evaluation


TU/e department of industrial design

Please mark your answers
and put the questionnaire into the ballot box located outside the office:

1. How fast did you want your problem to be handled?
   - Whenever
   - This week
   - Today
   - In the next 2 hours
   - Immediately

2. How important was the interruption subject for you?
   - Unimportant
   - Rather unimportant
   - Not so important
   - Important
   - Very important

Thank you very much for your help

All information gathered in this study is strictly confidential

Figure 2.1: The questionnaire card provided to the interruptors arriving at the assistant's office.

of each interruption and strategies for screening them. Assistants were presented with the spreadsheets containing the data collected during the day so that they were able to base their reflections on the actual events. Each interview lasted about 60 minutes and was audio-recorded for further analysis.

The data collected during the observations was first checked for completeness. I considered a data point complete when it contained a depiction of the observed assistant's behaviour linked to the impression about that interruption described by the interruptor. In such a way, a set of 48 data points was formed. Next, the causal variables (the importance of the interruptor, urgency and importance of the interruption subject, and availability of the assistant) were coded in the following way:

- interruptors marked on the 5-point scale as either very important or important were coded as *important*, while those marked as equally important, less important or unimportant were coded as *unimportant*
- interruptions marked on the 5-point scale as either very important or important were coded as *important*, while those marked as equally important, less important or unimportant were coded as *unimportant*
- interruptions marked on the 5-point scale as either to be immediately handled or to be handled in the next 2 hours were coded as *urgent*, while those marked as to be handled today, this week or whenever were coded as *not urgent*

- availability state of the assistant marked on the 5-point scale as either available or rather available were coded as *available*, while those marked as to be slightly unavailable, rather unavailable or unavailable were coded as *unavailable*

Then, the binomial values together with the confidence intervals were separately calculated for each of the causal variables and the dependent variables (i.e., interruption outcome) [54]. Finally, a comparison of median values was made for the differences in perception of interruption importance and urgency between the assistants and the interruptors.

Then the interview recordings were transcribed and each statement was summarized on a post-it note. Next, a qualitative analysis of the transcripts was conducted, including open-coding (where categories emerged from the data rather than being defined a priori) [154] and card sorting with affinity diagrams to let higher order relationships between these categories to be defined [74, 19].

2.3.2 Results

A number of 48 interruption events were observed in the study: 44 that were intended directly for the assistants and 4 intended for their bosses, for which assistants acted as gatekeepers. Among these interruptions, 26 immediately handled occurrences were observed, 9 that were postponed and 13 occurrences that were diverted either to another person or back to the interruptor.

Importance of the initiator

Assistants showed to have a clear distinction regarding the differences in the importance of the interruptor. Other managers and external guests were considered to be important interruptors. Members of the group managed by the manager the assistant was working for and also other assistants were considered as holding a similar position to that of the assistant. Students and support staff such as cleaning crew were considered as organizationally less important. The interruptions observed in the study, which were aimed directly at the assistants, were in the majority of cases initiated by interruptors holding a position that was considered similar in organizational importance to that of the assistant. All four interruptions aimed at the managers, for which assistants acted as gate-keepers, were initiated by important interruptors.

It was observed that interruptions initiated by people of equal or lower organizational status and those initiated by people with higher status had a similar chance to be immediately handled or to be postponed (see: Figure 2.2). These results imply that importance of the interruptor cannot be seen as a reliable predictor of the assistant's interruption behaviour.

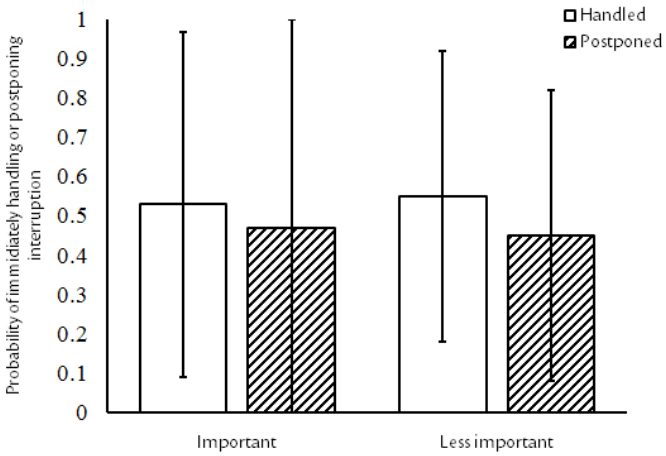

Figure 2.2: The probability regarding the influence of the importance of the interruptor on the assistant's decision how to handle an interruption.

Two strategies for handling interruptions by the assistants could be further distinguished; one for managing interruptions aimed at managers and another for interruptions aimed directly at them. In the first case, they did not ask an important person about the problem but allowed an interruption providing that the manager was available. If the manager was busy, the assistant would interrupt in an appropriate manner and negotiate an apt moment for handling the interruption. When an important person came to interrupt them, assistants would always inquire for the reason and then prioritize the problem according to its urgency, estimated time needed to deal with it and their own availability.

Importance and urgency of the interruption subject

This study went beyond the observations of Dabbish and Baker in noting that, next to the importance of the interruption subject, also its urgency showed to play an important role when deciding on how to handle interruptions. The collected data suggested that interruptions considered as urgent, important or both had a higher probability to be immediately handled than to be postponed (see: Figure 2.3).

The data also showed that the perception of the importance of the interruption subject seemed equal for both assistants and interruptors (see: Table 2.1). Among the interruptions identified as equally important were direct orders from the manager or urgent problems of the employees. No difference regarding the interruption handling behaviour between the industrial and the academic environment was observed.

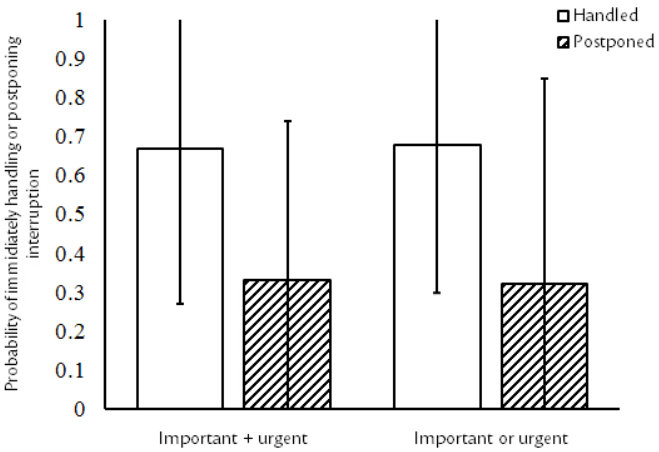

Figure 2.3: The relative impact of the urgency and importance of the interruption subject on the assistant's decision how to handle an interruption.

Table 2.1: Medium values regarding the perceptions of the importance and urgency of the same interruption subject by the interruptor and the assistant.

Measurement (median)	Interruptor	Assistant
Urgency of the interruption subject	4	4
Importance of the interruption subject	4	3·5

A particular type of interruptions was eminent in this study: confirmative interruptions. Interruptors dropped by the assistant's office to check whether an earlier request had been taken care of, e.g., whether a hotel booking for an expected guest had already been arranged. In such a way interruptors tried to convey the urgency of the issue at hand through their physical presence or receive acknowledgements regarding the status of the task at hand.

Availability of the assistant

In general, assistants considered themselves as generally available for interruptions ($median = 4$). The collected data showed that an interruption could be equally probably immediately handled as postponed in the situation when the assistant was available (see: Figure 2.4). Interestingly, though it was noted that an interruption had a higher probability to be immediately handled when the assistant considered

him or herself unavailable.

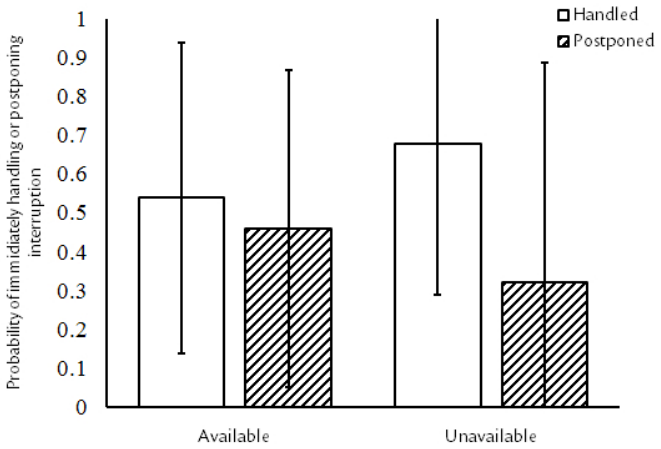

Figure 2.4: The relative impact of the influence of assistant's availability on his or her decision how to handle an interruption.

Interestingly, not a single interruption was perceived as annoying by the assistants. All participants commented during the post-observational interviews that they consider dealing with interruptions as part of their professional responsibilities and that they derive personal satisfaction from helping other solve work-related problems. Assistants also stated that, in the majority of cases, it was not difficult for them to recover from the interruption so it seemed that the cost of an interruption was relatively low compared to that reported for knowledge workers [38, 1, 13, 14, 12, 88].

2.3.3 Discussion

This study evaluated and extended the model proposed by Dabbish and Baker that aimed at establishing factors influencing the decision of an assistant regarding an interruption outcome [40]. The results showed that an interruption considered as important, urgent or both had a high probability to be immediately handled regardless of how busy the assistant was. Interestingly, an interruption has a higher probability to be immediately handled at moments when the assistant considered him or herself unavailable. It could be explained by the fact that, in the situations of unavailability, assistants preferred to deal with the interruptions right away as a way to avoid having to remember about it later on. The interviews also revealed that many interruptors used physical presence as an indication of the increased urgency of the interruption

and also means to remind the assistant about some problem that needed to be dealt with (e.g., booking a flight for an upcoming business trip).

Contradictory to the results reported by Dabbish and Baker [40], no positive impact of the importance of the interruptor on the interruption outcome was observed. Assistants seemed to equally often immediately handle as to postpone interruptions coming from both the important and less important people from their organization. From the interview results showed that the importance of the interruptor seemed to play a role only in the case of interruptions aimed at managers, where assistants acted as gatekeepers. This result, however, would have to be further confirmed as only a limited number of instances of interruptions aimed at the managers was detected. For interruptions aimed directly at the assistants, a different strategy was applied: the assistant would then find out first the importance and the urgency of the problem and subsequently prioritize according to these two factors. The importance of the interruptor seemed to have a lesser value in that process. This result might be, however, biased by the fact that the study was conducted in The Netherlands, where the perception of the organizational hierarchy is rather low.

Finally, a new determinant for interruption behaviours emerged in this study. The analysis of the qualitative data collected during the post-observational interviews showed that short interruptions seemed to have a higher chance to be immediately handled comparing to these requiring larger amount of time. The possible impact of this factor needed yet to be confirmed by future research.

In the conclusion of this study, I would like to note that, although assistants could be perceived as most capable to analyze the relevance of interruptions at work, they may not be the optimal subjects for assessing the interplay of different factors and potential change in the availability status of the interruptee. Assistants appeared to be, generally, available for interruptions at any time. They also showed a very positive attitude towards the incoming interruptions regardless of their own availability level. They considered it a part of their job to be interruption driven and derived a job satisfaction from helping others resolving their problems. Due to such an attitude they often found themselves in a weaker position compared to the interruptor as they did not want to mistreat a person who took an effort to personally come to their office. While assisting others is a primary task for assistants the nature of the work of knowledge workers is radically different. Handling interruptions is a distraction rather than a main task. Therefore, in next step an investigation to better understand the interruption handling practices employed by this user group. The focus was twofold: (i) to better understand the nature of knowledge workers' availability status and (ii) to further explore the relative influence factors such as urgency and importance of the interruption subject, the importance of the interruptor and also interruption time-demand could have on that status.

2.4 Knowledge workers and handling interruptions

As discussed in Chapter 1, prior research pointed at the fact that, in face-to-face communication, an interruptee has less control over communication compared to the interruptor [116, 115, 93] and also pays the higher price in terms of the resumption lag, information overload and increased level of stress [12, 1, 88]. Therefore, when analyzing interruption behaviours researchers tend to take the interruptee's perspective on interruption negotiation [69, 38, 172] and consider availability as the best predictor of an appropriate interruption moment [58]. However, the previous study showed that availability can be altered by factors such as, for example, importance or urgency of the communication subject. This study regarded availability management of knowledge workers whose interruption behaviours are expected to differ from those displayed by the assistants. I argue that exploring these differences helps to better understand which information needs of communicators need to be addressed to leverage social behaviours in mediated communication.

Once more face-to-face communications were examined, as they are considered the richest communication channel [115] and therefore most likely to derive a comprehensive set of factors influencing ways interruptions are handled. This time the study took the form of semi-structured contextual interviews. The interviews were chosen as the data collection method as they enable to obtain rich accounts of participants' perceptions regarding their interruption behaviours. I realize that when people report on their experiences, the experiences themselves should be accessible to introspection allowing for accurate reports [146]. When the report reflects a recent episode, people draw on their episodic memory, retrieving specific details of the recent past[92, 153]. Likewise, global reports of past experiences are based on semantic knowledge. When asked how they 'usually' experience a particular activity, people tend to draw on their general beliefs and its attributes. The actual experience does not play a vital role anymore in that report as it is no longer available to the introspection and episodic reconstruction. Therefore, to avoid collecting global instead of episodic experiences the focus was set on eliciting participants' opinions that were linked to interruption occurrences that happened in the near past.

2.4.1 Study design and analysis

A total of 5 developers and 7 researchers (9 male, 3 female; 28 – 45 years old) from two industrial companies (7 and 5 persons per company) volunteered to participate in the study. Company A is a large international producer of hardware and software for consumer electronics and medical products. Its research department is directly linked to the business lines and business managers are the clients for each research project. Researchers work in well-defined projects and under clear yet often quite

long-term deadlines. The development departments of company A are directly dependent on business lines, also work on projects but under much shorter deadlines comparing to the research department. Company B is a large international producer of office hardware. Its research department is sponsored by the company and therefore the link between research projects and either development or business is much less pronounced comparing to company A. Researchers in company B have a lot of freedom to choose their own projects and areas of interest and are rarely working under pressure of deadlines. Conversely, the development department of company B is much faster paced comparing to the research department and also remains in the direct dependency with the business department. However, as company B is predominantly focused on hardware development, the general pace of the projects is slower comparing to company A.

All participants were asked, in a form of a semi-structured interview, to describe their experiences with handling interruptions by answering the following questions:

- Describe the last three face-to-face interruptions you experienced. How did they differ from other interruptions?
- Can you describe a recent face-to-face interruption which you decided to handle immediately although you were busy? How did it differ from other interruptions?
- Can you describe a recent face-to-face interruption that you decided to postpone although you were not that busy? How did it differ from other interruptions?

Interviews lasted about 60 minutes, were recorded and transcribed. Each statement was written on a post-it note, with an annotation whether it referred to an immediately handled or a postponed interruption. In this way, 178 statements were labeled. Next, an independent coder was asked to perform an open coding on the statements using Affinity Diagrams [74]. After distributing all statements into 6 clusters the coder described the characteristics of each cluster and named them. Next, the second coder coded all statements using categories derived by the first coder. He was encouraged to create his own clusters if the statements did not fit into the provided categories. Then, both coders met in a joint session to discuss the identified categories and let higher order relationships among them emerge in a form of a tree diagram [113] (see: Figure 2.5). Finally, the definitions of each category and subcategory were formulated and exemplary quotes were selected[†].

[†]This analysis was repeated by 3 teams of Master students from the Industrial Design department of Eindhoven University of Technology as a part of the Qualitative Research Methods course. Although the analysis itself was less rigorous, the results obtained by the student teams confirmed the outcome of the analysis presented in this thesis.

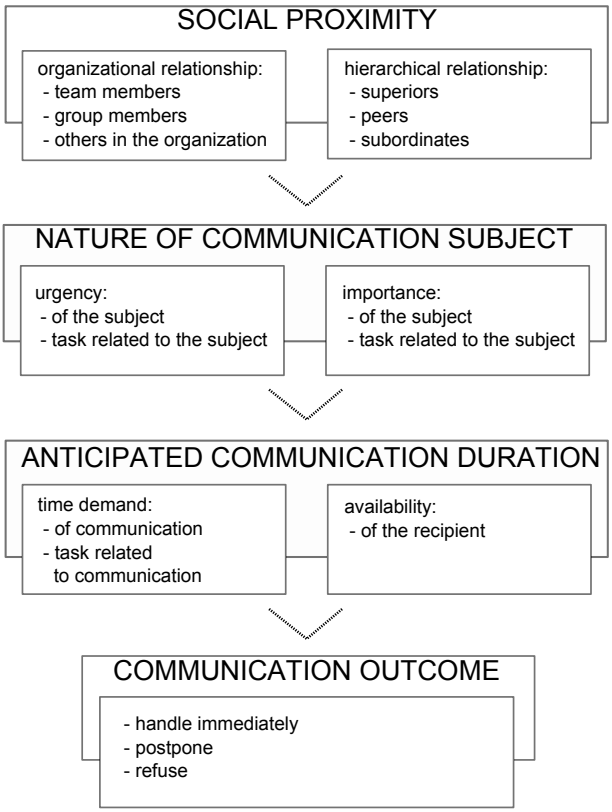

Figure 2.5: An illustration of the relationships between the categories derived from the interview results analysis.

2.4.2 Results

Participants reported 56 occurrences of face-to-face interruptions: 41 that were immediately handled and 15 that were postponed[‡]. The analysis of their statements resulted in the formulation of three categories depicting factors influencing the decision how to handle face-to-face interruptions: social proximity, the nature of the interruption subject and the anticipated interruption duration. Social proximity consisted of two subcategories: organizational and hierarchical relationship between commu-

[‡]The aggregated results of the collected data is available in Appendix B

nicators. The nature of the interruption subject was found to contain the following subcategories: urgency and importance of that subject. The anticipated communication duration was constructed out of two subcategories: interruption time demand and interruptee's availability state.

Social proximity

Social proximity characterizes the professional relationship between communicators and was mentioned by all participants as a crucial motivator for deciding how to deal with face-to-face interruptions. Participants distinguished between two social dependencies: organizational and hierarchical. They discriminated organizational relations among:

- team members – a relationship in which both actors share a common goal and collaborate together to achieve it;
- group members – a relationship, in which both actors perform their tasks independently, while collaborating to achieve their own objectives;
- other members of one's organization – a relationship, in which both actors perform their own tasks in total disconnection with each other's activities and goals

Team members were likely to receive immediate attention regardless the interruption subject, all of which were motivated by sharing a common goal (27 immediately handled, 7 postponed). Granting attention to a group member or another person from the organization seemed to depend on participants' availability state (7 were immediately handled and 8 postponed).

> 'Who I usually allow to interrupt me right away is a person from my team. I work with them, so I assume that their questions are relevant to me as well.' (P_3)

> 'A person from your group is one step further than your team. There is some sense of belonging but, in fact, he is not working with you directly that you don't interact that often. So, if he asks a question I have a bit less difficulty saying to him: "Well, I am busy now, come another time".' (P_7)

Social proximity is further assessed according to hierarchical relationship between communicators that depicts the power distance between them. The higher the interruptor's hierarchical position, the more likely he or she was to receive participants'

immediate attention. Such behaviour was detected in 7 cases and was motivated by the appreciation of superior's time and participants' eagerness to maintain a positive professional image of them.

> 'When my manager interrupted me I was really focused, so I didn't directly respond to him but asked: "One second, I have to finish this one sentence". I finished the email I was writing and then I was all ears. If he comes it means that something is going on. The problem itself can even be trivial but he is also judging my work and I want to make a good impression.' (P1)

> 'You can't just refuse him (the boss) because he is a person who has little time and if he comes to you, you feel really involved. You have to be involved because it might be hard for him to come back later. And his decisions might have a high impact on my job.' (P8)

The nature of the interruption subject

Once an interruptor arrived at the office, 8 out of 12 participants would always inquire about the reason for the interruption first before deciding whether to accept or postpone the interruption. In such a way they tried to assess its importance and urgency. Urgency pertains to how quickly the interruption should be handled and was assessed in terms of a deadline to the task that related to the interruption. Importance indicates the subjective value of the interruption subject to both communicators. It is crucial to note that urgency and importance level is not necessarily equal for the interruptor and the interruptee. In such a case participants tended to compare the importance and urgency of their own task with that of the interruption. Three participants chose to postpone an interruption to verify the importance of its subject (assuming that the interruptor would return if the issue was really important). Four participants decided to keep on postponing an interruption (which, in fact meant rejecting it) because its subject was of no interest to them.

> 'He tried to solve it himself and only after he couldn't handle it and it had to be ready for the next day, he came to me. So, I helped right away.' (P10)

> 'They came to my room and asked me to make a poster for them. I thought I was too busy to help them out. So, the discussion became, in fact, a negotiation between how important it was for them that I did it and also when it had to be finished. As it turned out really important and I was the only person who could do it, I decided to stay at work late and have it ready by the next morning.' (P3)

Anticipated interruption duration

The remaining four participants tended to begin with assessing the anticipated interruption duration when dealing with face-to-face interruptions. Interruption duration pertained to the balance between the time they had to put to handle the interruption effectively and their own availability. Interruptions that required little time were often immediately handled (33 immediately handled, 6 postponed) while those perceived as long are more frequently postponed until participants could dedicate sufficient time for them (4 immediately handled, 13 postponed). The main reason behind immediately handling short interruptions was to prevent future commitments and to avoid having to remember about coming back to the interruptor. Participants felt that the cost of having a small break in their present task was usually lower than having to return to the interruptor at a later stage. Three participants reflected that a large number of interruptions, even if each one of them was rather short, caused a feeling that, with interruptions piling up, they fail to carry on their tasks.

> 'He came to my room and asked: "Do you have 5 minutes for me? I have this small question". If it is that short then my own availability doesn't really matter, then I can do it for you anyway. If it is longer than 5 minutes, then it comes in last after all the other things I have to do today, it goes into a cue.' (P9)

> 'It is not the number of interruptions but the time they take. Yesterday, I've got a very annoying interruption, it took whole day. He just kept me for so long that I didn't manage to get my own work done.' (P2)

2.4.3 Discussion

The results derived a set of factors influencing the availability state of knowledge workers and determining the decision regarding how to handle an interruption. Consistently with the study of assistants' interruption behaviours, also this study showed that the decision how to handle an interruption is based on its nature (with urgency and importance as attributes) and its anticipated duration (with time-demand as an attribute). Contrary to the results derived from the assistants' study, this study revealed social proximity between communicators to be an important motivator for deciding how to deal with an interruption. As discussed in section 2.3.3, such a result could be explained by less profound relationships between an assistant and other workers comparing to the working relations among co-workers. Due to their job characteristics, assistants are rarely deeply entangled in collaborative activities that lead to one's professional success of failure. Therefore, they may be less sensitive to the organizational dependencies such as a team or group membership comparing to

knowledge workers. They may also have a different perception regarding the hierarchical dependencies across the organization as they negotiate for their bosses the interruptions coming from important people (like other managers). Likewise, social proximity is more likely to have impact on interruption behaviours of knowledge workers due to multiple professional and private dependencies relating to past or future collaborations but also different levels of reciprocity.

Thus far a set of factors influencing the decision how to react to a face-to-face interruption was considered. I chose to examine face-to-face communications since they are considered the richest channel that supports an immediate feedback regarding communication subject and also for seamless negotiation of its duration [115, 43, 42] and therefore most likely to derive an extensive account of factors influencing interruption behaviours. A crucial difference between the face-to-face and mediated communication is the way the communication is negotiated [159]. Any mediated channel is, in its nature, less rich comparing to face-to-face in terms of social cues [32, 149] and therefore communication negotiation often appears more clumsy and graceless. The difficulties people experience when starting mediated communication (be it phone, Instant Messenger or email) show how impoverished these channels are in comparison to face-to-face communication. Media of lower richness level such as Instant Messaging or email tend to convey fewer cues regarding the context of communication and restrict access to immediate feedback regarding the interruption content and timing [159]. On the other hand they introduce uncertainty regarding the communication follow-up as they enable plausible deniability [6], supporting the interruptee in attending the communication subject at her own convenience. Lowering the richness of the communication channel might then show a strong impact on which factors are likely to impact on interruption behaviours. Therefore, a further understanding of the impact of the previously identified factors on the decision regarding how to handle mediated communications is likely to help identifying the ways to design support for communication negotiation. The goal of the next study was to examine what is the effect of social proximity, nature of the communication subject and anticipated interruption duration on the change in the availability for communication in the least rich communication channel, namely email [32].

2.5 Knowledge workers and handling emails

In recent years email became an integral means to communicate in both professional and private settings. It is composed out of a number of unique characteristics that were already described in Chapter 1 such as being asynchronous [163], textual [164], shared [41], traceable [31, 112], instantaneous [105] and efficient [134]. The use of email was widely investigated in the 80-ties and 90-ties. Back then the focus was

primarily set on technology efficiency [76, 105]. Since then, people became aware of its advantages in accelerating the transmission of information, reducing the transaction time and regularizing communication. However, email popularization brought a large disadvantage: email overload. This phenomenon has been anew investigated, and many researchers point at various reasons behind the feeling of email overload. One of the primary issues is that information relevant or important for the recipient does not stand out. Email notification mechanisms seem to work only in a binary mode – people are either informed about all messages or none.

The feeling of email overload is caused, among other factors, by the fact that messages tend not to visually differ in importance, urgency, required effort and interest, which then needs to be deduced either from the message subject or directly from its content [164, 169, 52]. Hair et al [75] argued that to reduce the level of stress induced by a large volume of newly arriving emails and to restore the control over this communication channel it is crucial to define and measure the 'orientations' towards email. An 'orientation' is an email characteristic that helps people to define whether to handle a particular message immediately, postpone or delete it. I argue that factors such as social proximity, nature of the communication subject (thus its importance and urgency) and anticipated interruption duration could be perceived as such 'orientations' and I investigate the interplay between them and the interruptee's decision regarding email handling.

2.5.1 Study design and analysis

A total of 10 persons (6 male, 4 female) agreed to record their email communications through a diary study for a period of one day. Diary studies show high ecological value as they are carried in situ [38]. On the negative side, they impose high burden on the participants as they require systematic recall of events. Furthermore, they run a risk of invoking a 'Heisenberg effect': participants' recalls could be influenced by the observing process itself [136]. Despite these disadvantages, diary studies allow for conducting analysis regarding factors influencing interruption behaviours in asynchronous communication based on ecologically valid data that is likely to give insights into patterns pertaining to dealing with emails. Each entry in the booklet was supposed to be entered at the exact moment of email arrival and consisted of the following information: time-stamp, email subject and interruptor's identifier. Furthermore, participants judged each email according to the following criteria:

- To record participants' availability level: How busy were you when the email arrived? – (5) very unavailable, (4) unavailable, (3) somewhat unavailable, (2) rather available, (1) available.

- To record email's urgency: How quickly, you felt, should this email be handled? – (5) immediately, (4) in the next 2-3 hours, (3) today, (2) this week, (1) whenever.

- To record email's importance: How important was it to handle the email immediately? – (5) very important, (4) important, (3) somewhat important, (2) rather unimportant, (1) unimportant.

- To record email's time demand: How much time, did you think, you had to dedicate to handle it? – (5) more than 1 hour, (4) about 1 hour, (3) about 10-30 minutes, (2) about 5-10 minutes, (1) less than 5 min.

- To record social proximity between the participant and the email sender: What is your relationship with the sender?

- To record the action on email: Should this email be – (1) immediately handled, (2) postponed or (3) deleted?

Participants were reminded every 2 hours about updating the booklet, so that data about emails was collected as close to their arrival as possible. Since the reminders were sent by email, participants were asked to discard these as data points. They were also asked to ignore messages coming from mailing lists and spam.

After the study conclusion each data point was inspected and 44 (out of 134) incomplete entries were removed. Such a surprisingly large number of incomplete data entries could be explained in two ways: Participants reported to have received some emails which they considered to be junk messages in the process of their evaluation. Therefore, they did not attempt to finalize their description in the diary. The remaining incomplete data entries were explained by the fact of being distracted from filling in the diary by another person or activity. In such situations participants seemed to have forgotten to finalize the email evaluation. For the remaining 90 emails, the causal variables (the importance of the interruptor, urgency and importance of the email subject, time-demand of answering and availability of the interruptee) were first coded in the following way:

- interruptors marked on the 6-point scale as either superiors or team members were coded as *important*, those marked as group members or other members of the organization were coded as *unimportant*. Finally, all professional or private external contacts were coded as *external*[§]

[§]This cluster, new in this study, was identified in an earlier study of Instant Messaging communications by Avrahami and Hudson [8].

- interruptions marked on the 5-point scale as either very important or important were coded as *important*, while those marked as equally important, less important or unimportant were coded as *unimportant*
- interruptions marked on the 5-point scale as either to be immediately handled or to be handled in the next 2 hours were coded as *urgent*, while those marked as to be handled today, this week or whenever were coded as *not urgent*
- interruptions marked on the 5-point scale as either requiring less than 5 minutes or about 5-10 minutes were coded as *little time-demand*, while those marked as requiring about 10-30 minutes, about 1 hour or more than 1 hour were coded as *large time-demand*
- availability state of the interruptee marked on the 5-point scale as either available or rather available were coded as *available*, while those marked as slightly unavailable, rather unavailable or unavailable were coded as *unavailable*

The binomial values together with confidence intervals were separately calculated for each causal variable and the dependent variables (i.e., interruption outcome) [54].

2.5.2 Results

A total of 90 emails were recorded in the study: 53% of them was immediately handled and 47% postponed or ignored. Participants were contacted by team members in 10% of cases ($n = 8$) and by group members in 8% of cases ($n = 7$). 23% of recorded messages came from participants' superiors ($n = 21$). 22% arrived from other people from their organization either geographically collocated or distributed ($n = 20$) and 38% from external contacts, both professional and private ($n = 34, professional = 22, private = 12$).

Nature of the email subject

In line with the expectations, the nature of the email subject proved to be a sufficient predictor of an action on email. The collected data showed that if the email subject was both important and urgent, it had higher probability to be immediately handled as to be postponed (see: Figure 2.6). Surprisingly, a higher probability could also be seen for an email to be immediately handled with respect to emails that were considered as neither urgent nor important.

Anticipated email handling duration

The anticipated email handling duration also appeared to be a good predictor for an action on email. Emails with low time demand were likely to be immediately

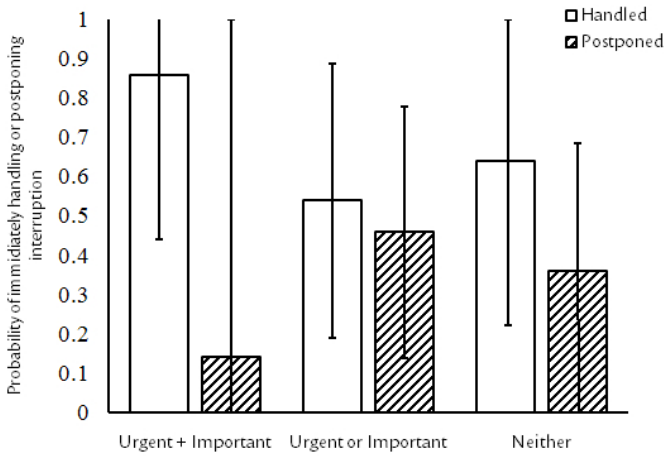

Figure 2.6: The relative impact of the importance and urgency of the interruption subject on the interruptee's decision regarding an action on email.

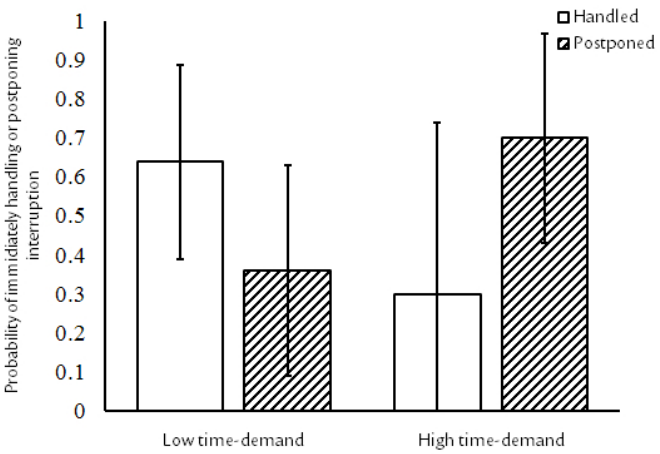

Figure 2.7: The relative impact of the interruption time-demand on the interruptee's decision regarding an action on email.

handled, while those considered as requiring large amount of time were more likely to be postponed (see: Figure 2.7). The data further revealed that emails requiring low time demand were likely to be immediately handled even if the interruptee appeared unavailable ($median = 3$). It was also noted that emails requiring no more than 10

minutes to be answered were frequently immediately handled although their subject was neither important ($median = 2$) nor urgent ($median = 1.5$).

Social proximity

The study revealed that social proximity was not a good predictor of an action on email. The important, less important people from participants' organization as well as their external contacts had almost the same probability to have their emails immediately answered as postponed (see: Figure 2.8). There was approximately a chance of 51% that emails from superiors, team members, group members as well as other people from the participants' organization would be immediately answered. Emails coming from external contacts had a 55% chance to be immediately handled.

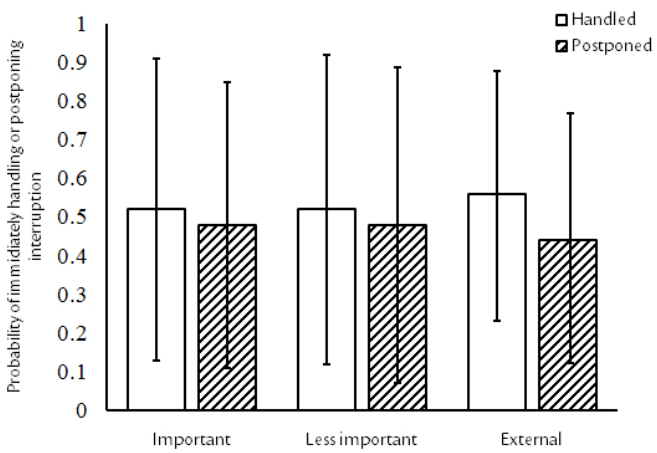

Figure 2.8: The relative impact of the importance of the interruptor on the interruptee's decision regarding an action on email.

Availability of the interruptee

Similarly to the results of the study regarding the interruption handling behaviours of the assistants, also this study showed that the availability level was also not a good predictor of an action on email. An email had almost an equal probability to be immediately handled as to be postponed regardless of the fact whether the interruptee was available or unavailable for email communication (see: Figure 2.9).

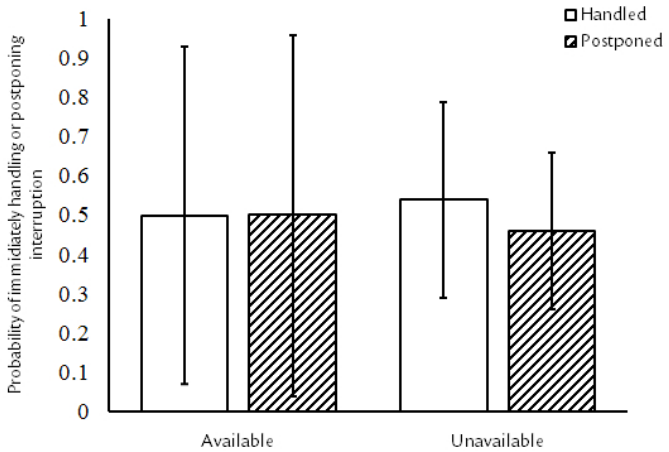

Figure 2.9: The relative impact of the availability of the interruptee on his or her decision regarding an action on email.

2.5.3 Discussion

The goal of this study was to explore the impact of factors found in the previous studies on interruption behaviours in asynchronous communication. It was observed that, contrary to qualitative insights collected from knowledge workers regarding face-to-face communications, social proximity appeared to have little impact on an action on email. Emails coming from team members and superiors had similar chance to be immediately answered as to be postponed. The same was observed for emails coming from other people from one's organization and one's non-professional contacts. This result seems to contradict the findings of [118] who argued that the social relationship is an important predictor on an action on email.

The results showed that the anticipated handling duration could become a good predictor on an action on email. It might, therefore, be interesting to investigate ways to depict it. For example, indicating email length next to the subject might appear indicative of the potential time demand required to produce a response. The results also showed that emails considered as important and urgent had a high probability to be immediately handled. As previously stated, current email clients do little to help distinguishing among emails. It might be, therefore, valuable to provide additional metadata regarding email content. Stating the urgency or the importance of the message (e.g., by marking a deadline to the task described in the message) might indicate to the recipient how quickly the response is desired and take away an implicit assumption that a sender expects an immediate response.

2.6 General discussion

Many prior works tried to find means to suggest an 'appropriate moment' for an interruption [17, 16, 56, 159, 172]. However, it seems that indicating availability prior to communication initiation does not always determine ensuing interruption behaviours [16, 58]. The results from three empirical explorations described in this chapter suggest that factors such as social proximity, nature of the interruption subject and anticipated interruption duration influence and accordingly transform the availability state of the interruptee. Such a view on availability aligns with the definition of interpersonal privacy status by Altman [4]:

> 'As a regulatory process, privacy can be viewed from two perspectives: a personally defined ideal level of interaction that a person or a group desires and a resulting outcome or achieved amount of actual interaction, which may or may not match what was desired.'

If assuming that the availability of an interruptee changes under the influence of the aforementioned factors, it becomes understandable why interruptors sometimes seem to neglect status indications about interruptee's availability like it was observed during the evaluation of the Lilsys system [16]. As the interruptors knew they could influence the initial availability status, they carried on with the interruption attempting to weigh the respective importance of, for example, the interruption subject against the availability state of the interruptee.

An initial illustration of factors influencing availability state emerges thus far (see: Figure 2.10) which shows that in order to stimulate social behaviours in communication it is vital, not only to present an accurate state on the interruptee's availability, but also other information that helps both communicators successfully agree upon a communicative contract, in terms of the aforementioned factors. It is important to not that the relative order of importance regarding each factor differs depending on the communication channel; while in Face-to-Face communication social proximity could be seen as having high impact on the recipient's interruption behaviour, the anticipated communication duration and the nature of the communication subject become stronger determinants regarding the interruption outcome in email.

Such an exchange of social cues seems to be easier obtained when establishing communication through a rich and synchronous communication channel like face-to-face. In such encounters both communicators have various means to express their needs and agree on how to best handle the communication subject. However, less rich communication channels like email do not support sharing of such cues. Due to lack of awareness regarding the availability of the interruptee and the needs of the interruptor it becomes more difficult for communicators to agree on the most optimal communicative contract. For example, social proximity seems to have a large

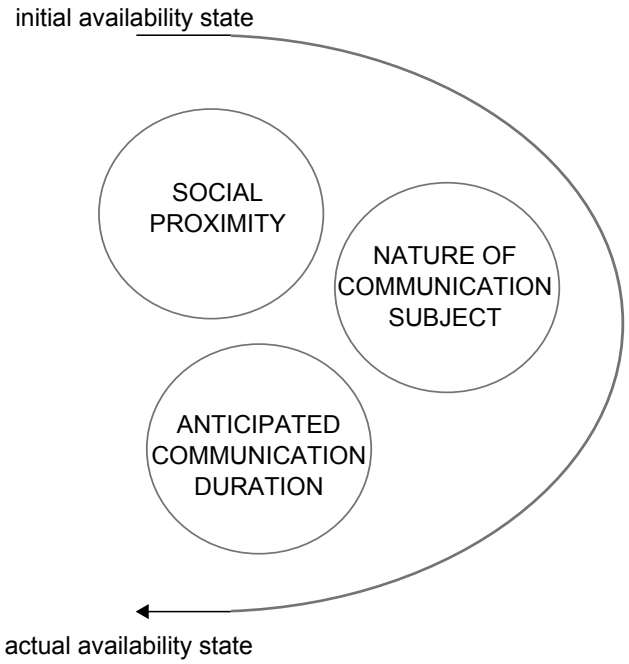

Figure 2.10: The initial illustration of the availability state adaptation based on the work of Altman [4] fig. 1.1 (p.7) and fig. 9.4 (p.155).

impact on synchronous communication, in which actors meet face-to-face, but it has far lesser influence on mediated email communications, where the physical presence does not regulate interplay between the actors. Therefore, it might be easier for a team member to convince another team member to, for example, stay after working hours to meet a deadline for the common project through a face-to-face encounter than in email. The same team member could be, however, more successful in conveying his or her need, if the email systems offered a convincing way to state the urgency and importance of its subject. I would, therefore, argue that in order to leverage social behaviours it is crucial to visualize the discussed factors during the communication negotiation process (regardless of the fact whether the communication occurs in physical or digital world, and if it is synchronous or asynchronous in its nature) as means to increase visibility of the communicative context and establish mutual awareness regarding that context between communicators.

2.7 Conclusions

In this chapter, three empirical investigations that aimed at exploring the dynamic nature of the availability status and also investigating factors that influence that status were described. Three groups of such factors: social proximity, nature of the interruption subject and anticipated interruption duration were identified. I have further examined the impact of these factors on interruptees' decision regarding how to handle face-to-face and mediated (email) communication. Ii was observed that any communication requiring little time had a large chance to be immediately handled regardless of the communication channel it was initiated through. Also communications considered as urgent and at the same time important were often immediately acted upon. Surprisingly, while social proximity was indicated to be a crucial factor for assessing face-to-face communications, it appeared to be an insufficient predictor for the action on email. These studies confirmed the assumptions for this research formulated in Chapter 1 that one's availability for communication is a transformable rather than a constant state and that both communicators conjointly shape that state. That observation suggests the importance of introducing social mechanisms supporting interruption negotiation in systems supporting mediated communication. It further reveals the value of supporting the provision, next to the availability status, of other indicators pertaining to the context of an interruption (like the urgency and the importance of its subject) as a way to leverage social behaviours among communicators. The next chapter experimentally tests the interplay between social proximity, interruption content and interruption timing in mediated communication.

3

Social proximity and the availability status

†

Abstract

In studies described in chapter 2, I investigated how availability status changes under the influence of social proximity between the communicators, the nature of the communication subject and the anticipated interruption duration. In particular, differences in the impact of social proximity of that status were observed that seemed to depend on the channel selected for communication. To better understand the phenomenon of communication negotiation, an experiment was conducted that tested the interplay between a working relationship between an interruptor and an interruptee and two system approaches supporting handling of interruptions. Participants were assigned to two social conditions and their interactions were measured in terms of the quality of the exchanged content (reflecting the negotiation regarding the nature of the communication subject) and the quality of the communication timing (reflecting the negotiation regarding the anticipated interruption duration). The results showed that both interruptors and interruptees were more likely to be considerate of each other's availability for communication, when they shared a common goal. I could also see that people who did not share a common goal were likely to behave in a social way to increase the chance for receiving valuable feedback. Finally, the results showed an important role social reciprocity played in defining participants' interruption behaviours.

†This chapter is based on work published by N. Romero, A. Matysiak Szóstek, M. Kaptein and P. Markopoulos, *Behaviours and Preferences when Coordinating Mediated Interruptions: Social and System Influence*, ECSCW 2007, Springer Verlag [140]. Here, I report on the impact of the social condition on interruption behaviours. The impact of the system condition is described in the PhD thesis of dr Natalia Romero, chapter 5 [141].

3.1 Introduction

The study described in this chapter builds on the series of experiments pertaining to the subject of handling interruptions and stating the availability status in mediated settings. The experiment conducted by McFarlane [110] was primarily concerned with coordinating interruptions in a computer-based multitasking context. Participants were asked to play a *Jumpers' Game* as their primary task, in which they had to save virtual game characters jumping from a building (see: Figure 3.1 on the left). While playing this game they were frequently interrupted by another task that was automatically imposed by the computer.

McFarlane observed that participants' performance improved after they were able to control interruptions by choosing the right moment for them to occur. McFarlane concluded that in order to support interruption mediation there is a need for tools that allow for assessing and announcing an appropriate interruption moment. Such an implication may hold for human-computer interaction, in which the recipient is likely to prefer to choose the optimal moment for the system to initiate an interruption (e.g., receiving a notification about an update installation or being requested to initiate a certain background process). However, as shown in Chapters 1 and 2, a situation regarding human-to-human communication is different: in any communicative attempt an initiator is likely to have an influence on the decision regarding the acceptance or rejection of that interruption. Therefore, there is a need to better understand the interplay between the initiator and the recipient when negotiating a communicative contract in a mediated setting as previously argued in Chapter 1.

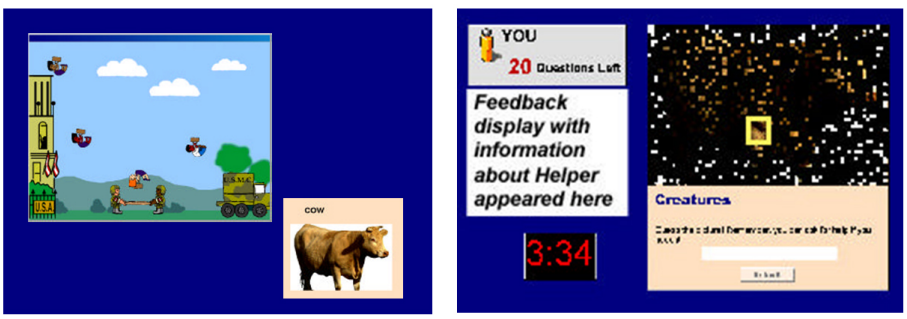

Figure 3.1: The screens showing the Jumpers' Game and the Image Guessing Game used by Dabbish and Kraut [39] to assess the impact of awareness displays on interruptors' behaviours in near-synchronous mediated communication.

Dabbish and Kraut [39] were first to experimentally test the context of human-to-human communication in a mediated setting by extending McFarlane's experiment and investigating the use of an awareness display as a means to support interruption

coordination in the context of a synchronous collaborative task. The role of the awareness display was to convey information about the status of a recipient's primary task and his or her potential availability for communication. Dabbish and Kraut examined how such awareness displays influence the choice of the interruption moment, how sharing a common goal increases their success ratio and, how the richness of presented information affects the interruption handling behaviours. They too used the Jumpers' Game as a primary task for the interruptee and introduced an *Image Guessing Game* as a task for the interruptor (see: Figure 3.1). To successfully complete their task interruptors frequently needed help from their assigned interruptees.

The authors used the relationship between the players as a dependent variable in their experiment. They tested the extent to which that relationship influenced interruptor's behaviour when initiating an interruption. Their assumptions were as follows: recipient's time is worth to the initiator as much as the information the recipient can provide. When the initiator has no stake in the recipient's performance, he or she has no motivation to delay communication and look for a moment that is convenient for the recipient.

The results of this experiment showed that, whenever people shared a common goal, an awareness display could have been a sufficient stimulus for the initiator to prompt him or her to initiate an interruption at a right moment. It also showed that in a non-shared goal situation interruptors were likely to display somewhat individualistic behaviour: they were prone to interrupt whenever they were in need for help without paying attention to the interruptee's availability status.

A number of questions arise from the experiment of Dabbish and Kraut. This experiment, although addressing the issue of interruption negotiation in a mediated setting, assumed that recipient's availability is a static rather than a dynamic state. Their experimental manipulation did not encounter for other factors influencing the interruption behaviours such as the nature of the communication subject or anticipated interruption duration. I showed in Chapter 2 that such factors are likely to influence the recipient's decision about interruption handling and change his or her initial availability state. Therefore, in this experiment a new game was proposed in which interruption characteristics such as quality of its subject and also quality of interruption timing could be operationalized into dependent variables.

Dabbish and Kraut also contrasted two social relationships: a team and an independent condition. The team condition was defined as: *'being in a group with another person and having outcome interdependence'*; while the independent condition described a situation, in which: *'the interruptors were rewarded based exclusively on their own performance'*. This distinction resulted in an effective manipulation, but was arguably not representative of the interruptions concerning co-workers. While the team condition is characteristic for the office environment, the independent condition is fairly rare for workers who are not directly dealing with customers or the

general public. A more common source of interruptions comes from people working for the same organizational unit (i.e., the same department) though not on the same project (and thus not sharing a goal). Such a social relationship is likely to be shaped by social reciprocity as defined by Perlow and Weeks [130]: *'The likelihood of receiving an interruption from the interruptee in the near future'*. Therefore, in this experiment a *group condition* rather than an independent one was selected. The basic premises for this condition were similar to the independent condition in the Dabbish and Kraut experiment, meaning that the players independently played for the highest score in the game. To achieve the group feeling, each pair of participants was informed that in the second (hypothetical) round of the game they would exchange roles, so that interruptors assume the role of interruptees and vice versa. For such a condition, an assumption could be made that participants were going to display social behaviours as a way to attain 'social credit' [68] from their partners in the game.

Finally, next to the social relationship between the actors, this experiment attempted to compare the manual and automatic approach to handle interruptions. The automatic system dealt with interruptions according to the paradigm of reachability management described in Chapter 1 and it managed interruptee's availability by constantly filtering the flow of interruptions. The manual system could be seen as supporting interpersonal privacy protection: It gave participants full control over selection of moments to handle interruptions [116]. In this experiment the impact was of these two systems was examined on leveraging socially responsible behaviours of the interruption actors in the two social conditions described above.

3.2 The game

As previously mentioned, the Jumpers' Game and the Image Guessing Game used in the earlier experiments did not provide a sufficient means to measure interruption characteristics such as quality of its content and also its timing. Therefore, two new games were designed: (a *Word Guessing Game* and a *Quiz Game*), which would take into account the aforementioned variables. Although the proposed games were quite different from the Jumper's Game and the Image Guessing Game, they bore some fundamental similarities. As in the earlier experiments, the current setup aimed to create *'an abstract help-seeking situation, in which two parties are collaborating'* [39]. Furthermore, the two actors were: an Asker seeking help and a Helper engaged in an own task and having means to provide assistance to the Asker's game.

Like the earlier games, also this one provided participants with a simple awareness display that automatically deduced and displayed an availability status of the Helper. The display was constructed out of two progress bars: the task bar that represented the progress of the Helper's task and the time bar that showed how much time was left for him or her to finish that task (see: Figure 3.2). Based on the information

provided by the Awareness Display, the Asker could decide when the right moment was to interrupt. Furthermore, the Asker could also select which question to ask out of a fixed set of questions. Helpers could choose whether to accept or to reject the interruption and, unlike in the earlier experiments, they could also vary the quality of their responses.

Figure 3.2: On the left: the awareness display represented Helper's *availability* for communication – the task bar is ahead of the time bar meaning that the Helper advances well with the task and experiences low time-pressure. On the right: the awareness display represented Helper's *unavailability* for communication – the time bar is ahead of the task bar meaning that the Helper stays behind the task and experiences high time-pressure.

For the purpose of this experiment, two systems for interruption management were implemented: a *manual* and an *automatic* system. The common structure of the two systems was defined so that neither system intervened with the Asker's decision to initiate the interruption [39]. The difference between the systems rested in the way how they dealt with incoming interruptions. The manual system allowed all interruptions initiated by the Asker to get through to the Helper, so that the Helper had to decide whether to accept or reject each interruption request. The automatic system monitored the Helpers' performance and automatically rejected interruptions occurring whenever the Helper might have experienced high time-pressure related to his or her primary task (so interruptions were allowed through only when the Helper performed well in the Quiz Game). It did so by filtering interruptions that were considered as poorly timed according to the ratio between the number of answers that the Helper still needed to provide to complete his or her task and the time left to do so (see: Figure 3.2 on the right). It also automatically notified the Asker that his or her interruption had been rejected. An interruption initiated when the task bar was ahead of the time bar meaning that the Helper advanced well with the task and experienced low time-pressure was always interpreted as a 'timely' interruption and let through by the automatic system (see: Figure 3.2 on the left).

3.2.1 Quiz Game: Helper

In the Quiz Game, the Helper was asked to answer 10 trivia questions by listing 6 items (e.g., 'List six European capitals') and had 1 minute to answer each question*. Every consecutive answer scored more points (so the first item scored 1 point and the sixth scored 6 points). After 1 minute a new question was displayed. Giving more points for each consecutive answer aimed at invoking a feeling of time pressure: with time passing, coming up with a new answer was likely to become more difficult. Also, as each answer brought more points, Helpers were likely to want to continue with their own game (to earn points) rather than deal with the Asker's requests.

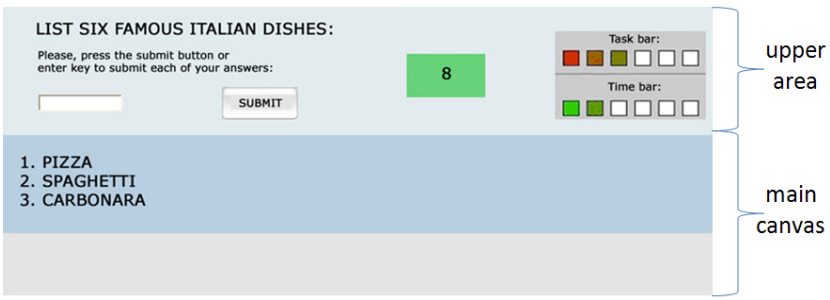

Figure 3.3: The Quiz Game – the upper area contains: the quiz question, the field to enter the answers, the timer and the awareness display. The main canvas contains the answers to the quiz question that are already submitted by the Helper.

The screen of the game was divided in two areas. The upper area displayed the quiz questions (one at the time) and provided a text-field wherein the six answers could be entered (see: Figure 3.3). It also contained a timer showing the number of questions left in the quiz (and thus indicating in minutes the time remaining to complete the round). Finally, it showed the awareness display representing Helper's own progress in terms of a number of already given answers and (in blocks of 10 seconds) time left to answer the current question (see: Figure 3.2). On the main canvas, the list of submitted answers was displayed (see: Figure 3.3).

The Helper carried on with his or her own Quiz Game as long as the assigned Asker did not decide to send a request for help. When the Asker's question arrived, the upper area changed so that the quiz was blocked and, instead of the field to enter answers, two buttons: 'Answer' and 'Reject' were shown (see: Figure 3.4). Before deciding whether to accept or reject the question the Helper could see the points the Asker would score when providing a correct answer. In such a way the Helper was able to assess the quality of the question before deciding how to act upon it. If

*The trivia questions used in the Quiz Game can be viewed in Appendix C

the Helper chose to reject it, the quiz was reactivated and the Asker automatically received a reply stating: 'Ask later' (the Helper was informed at the beginning of the experiment what would be the answer the Asker received in the case of rejection).

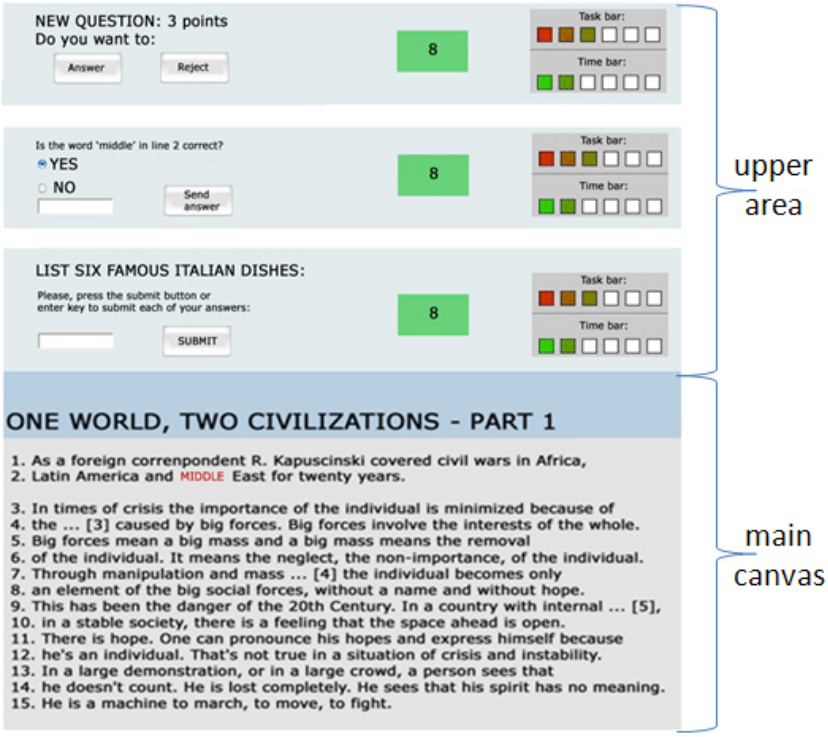

Figure 3.4: Helper's screen when the Asker's question arrives – the upper area contains the notification of the new question replacing the quiz question, the form to answer the question, the timer and the awareness display. The main canvas contains a text that the Asker is reading with the correct answer highlighted.

If the Helper decided to answer, the main canvas was replaced by the same paragraph that the Asker was reading at that moment with lines numbered and missing words marked in red. The upper area was replaced by the Asker's question (e.g., Is 'middle' the correct word for line 2?). The Helper could either answer 'Yes', if the selected word was correct or 'No' if the word was incorrect. Optionally, he or she could enter the correct word in the text field below the question form, and in such a way provide (with some additional effort) some additional help for the Asker. Entering the correct word was seen as providing a high-quality response at a possible cost of lowering the Helper's own score in the Quiz Game.

3.2.2 Word Guessing Game: Asker

In the Word Guessing Game the Asker was presented with an article divided in paragraphs, with 4 missing words per paragraph [†]. He or she had to fill in these missing words and scored points for each correct answer. The correct answer had to be chosen from a list of related words (called 'synonyms' in the game). Different missing words had a different number of related words to choose from: some had one related and one correct word while others had four related and one correct word to choose from. A case with one related and one correct word scored 2 points, while a case with four related and one correct word scored 5 points. In such a way the differentiation between low and high-quality of the interruption subject was introduced. The Asker could confirm whether the chosen word was correct with an assigned Helper who had access to the complete article, but who was busy playing the Quiz Game. Before interrupting, the Asker could check the Helper's availability by recalling the previously described awareness display (see: Figure 3.2).

The screen of the Word Guessing Game was also divided in two areas. The canvas contained the consecutive paragraphs of the article (with missing words) and a form (on the right-hand side) to enter the answers (see: Figure 3.5). The Asker could use the 'Next' button to submit the answers and move on to the next paragraph (there was no possibility for the Asker to return to the previous paragraph once the answers were submitted). He or she was asked to continue reading the text and filling in the missing words until the end of the text was reached or the game was over.

The upper area contained (from left to right) a 'Send Question' form to send questions to the Helper. the form was constructed out of a drop-down menu listing numbers representing the four lines containing missing words and a text field to enter the word, which needed to be verified by the Helper. The Asker could send a question by pressing the 'Ask Helper' button. The reaction of the Helper was shown at the same place on the screen and could be removed by using the 'Close' button.

The upper area further contained a timer and two buttons: 'Check Progress' and 'Select Synonym' button. The timer counted down the time for each round in minutes except for the last minute, which was counted in seconds. The 'Select Synonym' button, when pressed, activated a list with the related and correct words for all the missing entries per paragraph (see: Figure 3.5). the list was being displayed for 10 seconds and in that time interval the Asker needed to make a decision which word fitted the text best or decide which word he or she would like to inquire about.

The 'Check Progress' button, when pressed, activated the awareness display showing for 10 seconds the Helper's task and time progress. As previously described, the task bar represented the task progression with each block representing one of the 6

[†] Both articles and also the selection of the related words for each paragraph used in the Word Guessing Game can be viewed in Appendix D

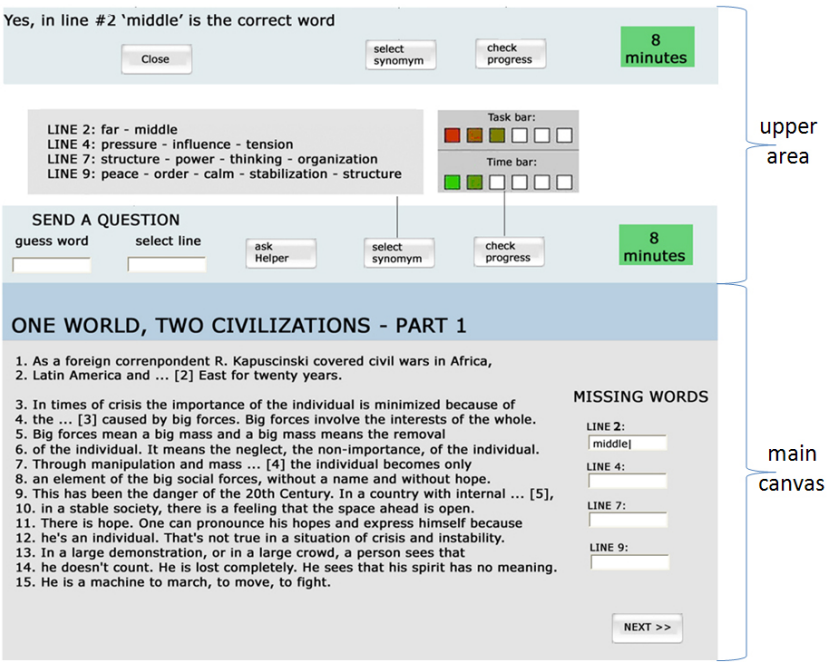

Figure 3.5: The Word Guessing Game – the upper area contains the form to ask questions and receive answers, the timer and two buttons: one activating the awareness display and another displaying the selection of the related words. The main canvas contains the text of one paragraph of the article and the fields to enter missing words with a 'Next' button to submit them and move to the consecutive paragraph.

items to be filled in by the Helper and the time bar represented time progression with each block representing 10 elapsed seconds of the time assigned to answer each quiz question, which was 1 minute (see: Figure 3.2). The awareness display was updated every 10 seconds and was reset each time the Helper received a new question in the quiz. Based on the information provided by that display the Asker had to decide when the most opportune moment was to send the question for help.

3.3 Experiment Description

The experiment aimed to test the impact of social proximity on interruption behaviours of the players. It concerned a *team condition* as defined in Chapter 2: a relationship in which both parties share a common goal and collaborate together to achieve it. This definition closely resembles the one used by Dabbish and Kraut [39] to define a shared-goal condition . It also considered a *group condition* as defined in

Chapter 2: a relationship, in which each person performs their tasks independently, while collaborating to achieve their own objectives. This definition is supported by results regarding social structures at the office by Chrysanthis et al [30] and Patil and Lai [128]. Both social relationships were furthermore shaped by *social reciprocity* between the partners in the game as defined by Perlow and Weeks [130]: '...the likelihood of receiving an interruption from the interruptee in the near future'.

The social relationship between the actors was compared in the context of the use of a *manual* and an *automatic* system. As previously described, the manual system in no way intervened with Helper's decision regarding how an interruption initiated by the Asker would be handled by the Helper. The automatic system, however, filtered the occurrences of 'untimely' interruptions. An 'untimely interruption' was defined as a moment of interruption initiation when the Helper appeared unavailable. An interruption initiated when the Helper appeared available was always interpreted as a 'timely' interruption and passed on by the system. In such a way I wanted to test which system was more likely to leverage socially salient behaviours.

3.3.1 Definitions and Hypotheses

Following the results of the studies described in Chapter 2 pertaining to the nature of the communication subject and the anticipated interruption duration, two time-related and two content-related interruption behaviours were identified. Each interruption concerned behaviours displayed by both actors and had an altruistic (social) or an individualistic (egocentric) connotation (see: Table 3.1).

Askers and Helpers in the *team condition* were expected to display more altruistic behaviours when dealing with interruptions compared to those in the *group condition*. For the Askers this meant matching the interruption moment with the Helper's availability status and asking high-quality (thus scoring many points) questions. Helpers were also expected to accept majority of incoming interruptions and put effort in providing a high-quality response. Such behaviours would remain consistent regardless of the system the team uses, so that team members would show similar behaviours in both the manual and the automatic system.

Askers in the *group condition* were expected to interrupt at all times without being considerate about Helper's availability. They would also be primarily concerned with their own goal and therefore ask both high and low-quality questions. Helpers in the *group condition* would be willing to accept interruptions only when they performed well and did not experience time-pressure imposed by their own task. They would, however, not be willing to put effort to sustain the quality of their answers.

The *automatic system* was expected to influence the behaviours of people in the *group condition*, so that they begin to act in a more socially responsible, altruistic manner compared to their attitude when using the *manual system*. I believed that interrup-

Table 3.1: Descriptions of the predicted time and content-related behaviours of the Askers and the Helpers invoked by the experimental setup.

ASKER	HELPER
Altruistic and individualistic behaviours that are time-related	
Timely interruption: Asker's altruistic behaviour expressed by initiating interruptions when the awareness display shows Helper's availability for communication.	*Timely reaction*: Helper's altruistic behaviour expressed by accepting an incoming interruption.
Untimely interruption: Asker's individualistic behaviour expressed by initiating an interruption even if the awareness display shows Helper's unavailability for communication.	*Untimely reaction*: Helper's individualistic behaviour expressed by rejecting an incoming interruption.
Altruistic and individualistic behaviours that are content-related	
High-quality question: Asker's altruistic behaviour expressed by initiating an interruption with a high value associated to its content.	*High-quality response*: Helper's altruistic behaviour expressed by providing high quality response.
Low-quality question: Asker's individualistic behaviour expressed by initiating an interruption with a low value associated to its content.	*Low-quality response*: Helper's individualistic behaviour expressed by providing response with a low quality associated to its content.

tion filtering would encourage Group-Askers to pay more attention to Helper's availability status and try to time their interruptions better. I also thought that Group-Helpers would be more willing to accept interruptions and be more considerate about providing high-quality responses if the interruptions appear at the right moments.

To test these expectations, the following hypotheses were formulated:

> *Hypothesis 1*
> Players in the *team condition* will display altruistic behaviours towards each other in any situation regardless of the system they use. Hypothesis 1 was expected to hold for Team-Helpers and Team-Askers and apply to time and content-related behaviours in both the manual and the automatic system.

Hypothesis 2
Players in the *group condition* will display altruistic behaviours only if an automatic interruption filtering is added to shield Helpers from 'untimely' interruptions. Hypothesis 2 was expected to hold for Group-Helpers and Group-Askers and to apply to time-related and content-related behaviours.

3.4 Participants

A total of 60 persons: 35 males and 25 females participated in the experiment (41: 20–30 years old, 17: 30–40, 1: 40–50 and 1: 50–60 years old). Out of all participants 25 worked in academia, 7 in industry, 26 were students and 2 were unemployed at the moment of running the experiment. They presented different educational backgrounds: technical ($n = 18$), design ($n = 18$), psychology ($n = 3$), economics ($n = 7$) and others ($n = 14$). Their educational level varied among undergraduate ($n = 20$), graduate ($n = 28$) and PhD ($n = 12$).

Participants came from various countries and all were non-native English speakers. Most participants ($n = 42$) reported having more than 2 years of experience using English on a daily basis; the rest of the participants reported an experience between 1 and 2 years. All except one assigned pair were complete strangers to their partners in the game. In the last case the players reported to be acquainted with one another on a social basis but had not worked together neither ever before nor were they in any way professionally linked.

3.5 Experiment design

The experiment was a 2x2 mixed-subject design. The within-subject factor was the system condition, which offered (i) a manual or (ii) an automatic approach to handling interruptions. The between-subjects factor was the social condition, which identified two social relationships: (i) the team condition representing people sharing a common goal and (ii) the group condition representing those who did not share a common goal but assumed social reciprocity.

3.5.1 Procedure

The experiment was conducted by the author of this thesis and another researcher (dr Natalia Romero) on the premises of the Eindhoven University of Technology, The Netherlands. It took form of a game, in which one Asker and one Helper could win a prize of 25 euro each. An equal number of participants was assigned to the team or the group condition. 10 participants were invited for one session (6 sessions in

total). Each group was divided in pairs and randomly assigned to their roles. The players were then placed in separate rooms so that they could not interact with each other (see: Figure 3.6). Each pair played two rounds of the game: one using the automatic and another the manual system (the order was counter-balanced to avoid the order effect). The game began with an exploration phase of 5 minutes, during which players could get acquainted with the game. During the actual game, each round lasted 10 minutes. A Focus Group [55] was conducted at the end of each session eliciting participants' opinions regarding their interruption behaviours.

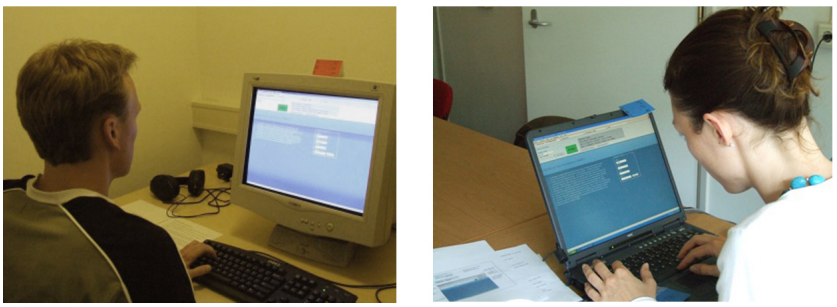

Figure 3.6: Participants playing the Word Guessing Game.

In the team condition, each Asker-Helper pair competed against the other pairs; their scores were summed up and the best pair won the prize. In the group condition, each Asker and each Helper individually competed with other Askers and Helpers; their individual scores were summed up, and the best Asker and the best Helper won the prize. To create a feeling of a social reciprocity [130] participants in both conditions were told that there would be a second phase of the game, in which they would swap their roles of Askers and Helpers.

3.6 Results

The first hypothesis in this experiment predicted that players in the team condition would display altruistic behaviours towards each other in any situation regardless of the system they used. The second hypothesis assumed that players in the group condition would display altruistic interruption behaviours only if an automatic interruption filtering was added to shield Helpers from untimely interruptions. Table 3.2 provides an overview of eight dependent variables concerning all examined interruption behaviours that are defined to reflect the definitions regarding the behaviours of Askers and Helpers as described in Table 3.1. The variables were clustered according to whether they pertained to time or content-related criteria.

Table 3.2: The definitions of the dependent variables regarding players' time and content-related behaviours formulated based on the descriptions of their behaviours invoked in the game (see Table: 3.1).

ASKER	HELPER
Dependent variables for time-related behaviours	
Timely interruption: interrupting Helper when the awareness display shows task bar being equal or ahead of the time bar.	*Timely reaction*: accepting an incoming interruption
Untimely interruption: interrupting Helper when the awareness display shows time bar being ahead of task bar.	*Untimely reaction*: rejecting an incoming interruption.
Dependent variables for content-related behaviours	
High-quality question: inquiring about words that score either four or five points.	*High-quality response*: providing the correct word if Asker's guess was incorrect.
Low-quality question: inquiring about a word that scores either two or three points.	*Low-quality response*: providing only a 'No' answer if Asker's guess was incorrect

It is important to note that for brevity purposes only the results regarding the altruistic behaviours are reported. Such a decision was motivated by the fact that a relatively small number of individualistic behaviours was noted indicating that no significant differences between conditions were observed. It was further motivated by the fact that the individualistic behaviours noted in the experiment followed the patterns consistent with the hypotheses and reverse to the altruistic behaviours discussed below, so they did not add any additional insights to the discussion.

3.6.1 Quantitative results

The two hypotheses were tested using a *two-way mixed model ANOVA* (also known as Two-way Mixed factorial ANOVA and split-plot factorial design) [86], with two independent variables (1 within and 1 between subjects). Each hypothesis was separately tested for Helpers and Askers, both for time-related and for content-related dependent variables. Figure 3.7 shows four graphs representing the obtained results that relate to the experiment hypotheses showing the number of altruistic behaviours for each variable.

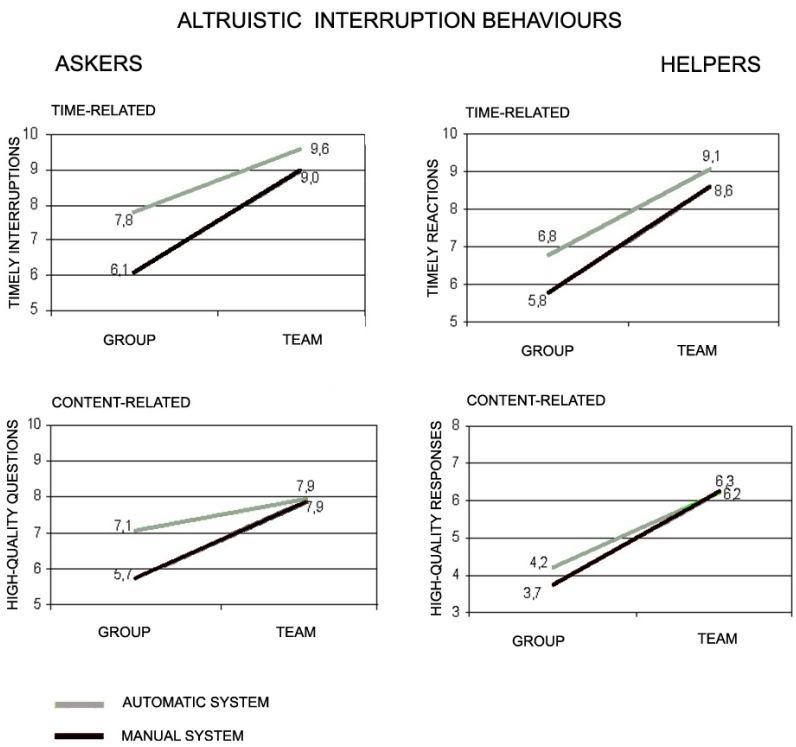

Figure 3.7: A graphical representation of the mean values regarding the number of altruistic interruption behaviours of the players. Results are presented separately for Askers and Helpers, for both their content-related and their time-related behaviours.

Hypothesis 1 stated that for all dependent variables, team players would display more altruistic behaviours than group players. A graphical inspection of the data presented by Figure 3.7 shows that, for the altruistic measures, team players scored higher than group players. This should result in a significant main effect of the social condition, which is not the case. It was, however, observed that the main effect of the social condition on Askers' timely behaviours is indicative: $F(1, 28) = 3.228, p = 0.083$. This is also true for the effect on Helpers' content-related behaviour: $F(1, 28) = 3,571, p = 0.069$. Based on the obtained results, it cannot be concluded that the social condition had a significant impact on the interruption behaviours. A trend can only be observed indicating that players in the team condition were more likely to act in an altruistic manner when handling interruptions.

Hypothesis 2 stated that the positive effect of the system type, thus the higher number of altruistic behaviours in the *automatic* system would be stronger in the *group*

condition. This hypothesis refers to an interaction effect between the system type and the social condition. Graphically this would result in converging or diverging lines in the graphs in Figure 3.7. Contrary to the assumptions defined for this experiment, the interaction effect is not significant in any of the four cases. This experiment did not show that the system-type had an effect on the two social conditions. Thus, no evidence was found to support *Hypothesis 2*.

In order to take a closer look at the data regarding *Hypothesis 2*, individual differences between the team and group conditions for each system were analyzed. An *independent samples T-Test* was calculated to see whether the system shows an effect on altruistic behaviours for each social condition. It is interesting to mention a difference in the effect of the system on the altruistic behaviours of Group-Askers that is not present in the team condition (Automatic-Group $M = 7.8$; Manual-Group $M = 6.07; t(14) = 2.284, p < 0.05$). It is possible that the manipulations in this experiment were not strong enough to clearly show this interaction effect in the full two-way model. This result is by no means a sufficient evidence to support *Hypothesis 2* but it opens a discussion about the potential influence of the system-type on interruption behaviours in the group condition.

3.6.2 Qualitative results

Six Focus Group sessions were conducted with each group of participants at the end of the experiment. The recordings from these sessions were then transcribed and resulted in a collection of 212 statements. Only those statements that contained a claim about participant's opinion about a particular system or behaviour and providing a motivation for such an opinion were considered for further analysis ($n = 85$). Statements that lacked such a motivation (i.e.,'I, basically, answered all the questions asked by the other person.'), presented a hypothetical solution for future systems (i.e.,'If those questions could be added to my ToDo list and I could attend them when I feel like it, then I would have felt more in control.') or were confirmative of the statement provided by another participant (i.e., 'I was never rejected'; 'I was rejected once.') were removed from the data set. Each statement was marked according to whether it was expressed by an Asker or a Helper and also which social condition the participant was assigned to (see: Figure 3.8).

The statements were coded using the Direct Content Analysis [85] by two independent coders. Each statement was first coded according to whether it described a time or content-related behaviour and also either the manual or the automatic system. Then the related statements were clustered within each group to reflect either altruistic or individualistic behaviours so that the differences between various motivations could emerge.

System	Social Condition	Role	Statement	Coder 1	Coder 2	Motivation for the statement
Automatic	Group	Helper	If we were playing as a team in our pair, it would have felt much more socially connected.	to neglect	to neglect	a suposition
Automatic	Group	Asker	I was more dependent on the Quiz Players but I thought that I needed to create certain trust feeling between each other. I tried to cheat at the beginning, so I entered all options and I got a very strange answer, so I was not sure if I could trust the Quiz Player.	favourite	to neglect	building trust in the group condition
Automatic	Group	Asker	I didn't want to bother the Quiz Player too much because I didn't want him to find be too obtrusive. I thought that if I ask every now and then only then I have higher chances for getting good answers. So, I would go for asking questions with the highest score only and guess the rest myself.	favourite	favourite	personal traits, motivation by content
Automatic	Group	Asker	After being rejected three times I just stopped asking because I lost hope that I am ever getting my answers.	favourite	favourite	personal traits; connection to social condition
Automatic	Group	Helper	I saw this strange question and I didn't want to answer it correctly because I thought that it was a bad question. Then I answered the next questions putting the correct word but after that I felt more pressure and then I answered with No answer only.	to neglect	favourite	general reflection: motivation by content and time
Automatic	Group	Helper	The worst thing was when the question was blocking the quiz window when I was typing because I couldn't finish my word. It was very annoying.	to neglect	to neglect	A comment reflecting the design of the game rather than the interruption behaviours
Automatic	Group	Helper	I feel that there was a bit of a team feeling because I knew that if I didn't help the other person could not score, so I wanted to help.	favourite	favourite	personal traits; connection to social condition
Automatic	Group	Asker	I would rarely look into the progress bars. I just wanted to win, so I would keep on sending requests without paying attention. I just wanted to win.	favourite	favourite	no presence of social return factor; strong presence of group condition
Automatic	Group	Helper	I was getting stressed by it because I had answers to my questions and I couldn't type them in when a question from the Article player appeared. I was so much more inclined to reject it then. On the other hand when I didn't have answers, I wanted to be useful and I wouldn't get the questions then. That was annoying because the system wasn't really displaying my availability.	favourite	favourite	negative reflections regarding the behaviour of the automatic system

Figure 3.8: An illustration of the results of the open-coding process. Two coders coded each statement marking whether it reflected an opinion pertaining to the content or the time aspect and also if it related to an altruistic or an individualistic behaviour of the participant.

Time-related interruption behaviours of Askers

The obtained results showed that Askers were generally motivated to initiate timely interruptions regardless of the social condition they were assigned to. Their reasons for displaying such behaviours were as follows. Askers wanted to be timely with their questions to avoid being rejected by the Helper who might have been busy at the particular moment. They also acted in a timely manner to avoid losing time waiting to receive Helper's answer. Finally, they showed willingness to avoid interrupting at wrong moments as a way to display a social concern towards their partners.

> Team: 'I used to keep one question ready to be sent. I continued reading and then waited for the right moment and then just pressed the "Send" button. Sometimes, I wouldn't need to send this question at all in the end. But I would just fill the question in and tried to be ready to send it whenever the moment was right.'

> Group: 'I looked at the progress bars all the time. It helped me to develop my strategy regarding when to ask a question and have a high chance not to be rejected. I could see when the other person was getting stuck in his game and also when he was ahead of time. So, I would just ask my question then and while waiting I would select the next question and also concentrate on reading the text.'

> Group: 'If the time bar was ahead of the task bar I would not ask any question. I was waiting a bit, checking again and if the situation didn't change, I would not bother him.'

The results also showed that in some cases the automatic system positively influenced Askers' interruption behaviours. They displayed more concern towards the Helper's status comparing to their attitude when using the manual system as a way to save effort in producing a question that would be automatically postponed.

> Team: 'With the automatic system, you check progress bars more often because you want to ask the question only when it is a good moment to do so to avoid (system's) rejection.'

In other cases, the automatic system seemed to take away Askers' concerns about interruption behaviours. They tended to check the progress bars less frequently and kept sending questions, knowing that the system would notify them each time the interruption was untimely. In some cases, they checked the progress bars after sending a question to verify their chances for receiving a reaction from the Helper. Interestingly, in the case of rejection, they frequently perceived that the 'Ask Later' reaction was provided by the system and not by their partner (even if sometimes the rejection came, in fact, from the Helper).

> Team: 'But the second time (when using the automatic system) I just asked whenever I felt like it because I knew that I would be rejected by the system if he was too busy. So, I let the system decide for me.'

> Group: 'In the case of the other (automatic) system I kept on sending questions because I knew that if timing was wrong, the system would deal with it. And I didn't mind the system rejecting me.'

Finally, the results showed that while team players tended to rely on each other's willingness to collaborate from the beginning of the game, the group members needed to be build up the trust towards each other in the course of the game. The Group-Askers reported that sending the first few questions was for them a way to see how the Helper would react. Similarly, the Group-Helpers mentioned that they tended to show consistency in their answering behaviour to indicate to the Asker the pace of asking questions and also the type of the questions they were willing to answer. After such a 'contract' was mutually agreed upon both players were likely to develop trust towards each other and even show more altruistic behaviours than initially assumed.

> Group: 'I hesitated to ask my first question but when I got the answer I thought: "Ok, I can try to ask some questions". So I built trust towards him in a way.'

Content-related interruption behaviours of Askers

Askers were primarily motivated to ask high-quality questions as a way to improve their individual score regardless of their social condition. They often decided to guess answers to low-quality questions themselves since the eventual loss of points was small and they did not want to waste time waiting for Helper's response.

Askers were further motivated to ask high-quality questions as a way to show social concern towards Helpers and avoid asking questions that could be perceived as intrusive. They also tended to ask only high-quality questions when they saw that the Helpers were experiencing high time-pressure in their game. Finally, Askers decided to inquire only about words that scored more points as a way to maintain a good relationship with their partner in the game, especially if they previously got rejected.

> Group: 'I didn't want to bother him too much because I didn't want him to find me too obtrusive. I thought that if I ask every now and then, only then I have a high chance for getting good (high-quality) answers. So, I would go for asking questions with the highest score only and guess the rest myself.'

> Team: 'I didn't want to wait for easy answers. So, I just started with the difficult ones, which gained more points and then put the rest of the answers in myself, while I was waiting for the answers.'

> Group: 'I got rejected on the third question and then I decided: "I am not going to bother him with any questions except from the most difficult ones". So, I was only asking about the last word (high-quality) of the paragraph and always got the response.'

Time-related interruption behaviours of Helpers

Helpers reported to perceive that neither the manual nor the automatic system supported them well in displaying their actual availability state. They noticed that if they had ample time they would not receive interruptions, whereas whenever they were busy with their own game, interruptions would feel to be more frequent. Helpers often mentioned to have missed the opportunity to indicate to the Asker that they were willing to accept a question. They also mentioned that an awareness display showing Asker's progress in the game would likely support them in the decision whether to help the Asker or continue with their own game.

> Group: 'If I didn't know anything about the question, so I thought: "I've already lost this one, I could at least help her". And then the questions wouldn't come.'

> Team: 'I wanted to tell him in some way: "Look, if I am busy now, I will answer to you right away but just let me finish and I will give all the time to you".'

> Group: 'I was getting stressed by it (receiving questions from the Asker) because I had answers to my questions and I didn't have the time to type them in. I was so much more inclined to reject them then. On the other hand when I didn't know the answers, I wanted to be useful and I wouldn't get the questions then. That was annoying because I felt that the system wasn't really displaying my availability.'

Surprisingly, examples of team-like behaviour were noted that were displayed by Helpers in the group condition, which was motivated by the dependency between the players created through the game setup. Helpers realized that Askers had limited chances to win their game if not supported by the associated Helper and therefore, Helpers felt social obligation towards the Askers. Furthermore, an influence of social reciprocity on Helpers' behaviours could be seen. Helpers thought that in the next (hypothetical) round when the roles were reversed, they would need similar help from their partner and they considered that their own attitude is likely to be reciprocated by the Asker once they change the roles.

> Group: 'I felt that there was a bit of a team feeling between us because I knew that if I didn't help, the other person could not score. So, I wanted to help.'

> Group: 'I felt that he asked questions when he really needed, so although I was in a difficult position, I would answer anyway. Especially, because we thought we would change roles later.'

Content-related interruption behaviours of Helpers

I further saw that the content-related behaviours in the team condition were primarily motivated by Helpers' willingness to achieve the optimal joint result. Team-Helpers noted that a high-quality answer in the Asker's game was more valuable for the final score than their own answers, so they would provide high-quality response to these questions rather than continue with their quiz. Team-Helpers also tended to reject low-quality questions when they assessed that their own answers in the quiz were likely to be more valuable for the final score.

> Team: 'The points shown with the question (from the Asker) really helped me to decide what to do. If I saw that his question had a high score, I would drop my question and rather answer his because his answer I knew for sure that it was correct.'

> Team: 'At some point I got a question, which had only few points and I thought: "I am going to gain more points with my answers than this one", so I rejected.'

Regardless of the social condition, providing high-quality answers was for Helpers a way to optimize their performance (not giving the right answer would increase chances of being very quickly interrupted again and receiving the same question once more). Moreover, providing a high-quality answer was, for some Helpers, seen as a way to balance their inability to help at all times. Conversely, giving a low-quality reply was considered as a method to show the pressure of their game.

> Team: 'I thought it's just a waste of time to say "No" only. Then you get the same question again. It is just easier to give the answer.'

> Group: 'Then I answered the next questions putting the correct word but after that I felt more pressure and then I answered only "No".'

> Group: 'I felt that he asked questions when he really needed, so although I was in a difficult position, I would answer anyway. Especially, because we thought we would change roles later.'

3.7 Discussion

The quantitative results of this experiment were not able to demonstrate that Helpers and Askers in the *team condition* presented more altruistic behaviours and were more likely to respect each other's availability comparing to the players in the *group condition*. No evidence showing an effect of the system-type on the two social conditions

could be found. Nonetheless, partial results testing participants' behaviours suggest a positive effect of the *automatic system* on interruption behaviours in the *group condition*. Although I was not able to reach significance in the quantitative part of this analysis, the experiment enabled us to place the participants in a situation in which they were forced to explicate their individual interruption behaviours. Based on their post-study interviews, a number of behavioural patterns was noted that could inform the design of future systems supporting mediated communication.

The results showed that that even in the case where a static team or group relationship was defined between the communicators, the two actors did not always act in an equally straightforward way as a team or as a group. Two patterns of reasoning emerge as motivations for such altruistic behaviours: a pragmatic need to make one's game efficient, and a social need to maintain a good relationship with the partner. For example, Askers in both conditions tended to ask questions at moments when the Helper appeared available as a way to avoid waiting for an inconclusive response. They also asked high-quality questions to gain highest outcome of their interruption. Askers further asked both timely and high quality questions as a way to avoid being perceived as intrusive. Helpers tended to provide a comprehensive rather than a parsimonious response to avoid receiving the same question multiple times. They also acted upon the dependency between the players to ensure reciprocity in the next (hypothetical) round in which they would play the role of Askers.

In line with the results of the earlier studies described in Chapter 2, also this experiment showed that, regardless of the social condition, Helpers complained that neither automatic nor manual system sufficiently supported them in managing their communications. They did not only receive questions at moments when they experienced time-pressure and appeared unavailable, but they also did not have the means to indicate to the Asker when the right moment to communicate was. This observation once more points at the importance of ensuring visibility of the interruptee's communicative state and also awareness regarding the interruptor's needs (in terms of the nature of the communication subject and its anticipated duration). A comprehensive visualization of each other's needs is likely to help both communicators to act in a social manner by choosing an appropriate moment to communicate. Communication systems could also support queuing requests for the interruptee. In such a way, the interruptor would be supported in 'offloading' the interruption subject and at the same time provide the interruptee with an opportunity to discard poorly timed communications and attend them at a moment that is most convenient for them.

The results finally suggest that people who experience reciprocity are likely to act in a social manner, especially if they become aware of social costs associated with their inappropriate behaviour. A way to address this issue is to support indicating the potential cost assigned to the interruption. A mutual representation of such costs could offer a way to enhance accountability regarding peoples' interruption behaviours.

3.8 Conclusions

This chapter described an experimental study evaluating the influence of a social condition on communicators' interruption behaviours (content and time-related). I compared the behaviour of interruption actors who shared a common goal versus those whose only dependency was potential social reciprocity. The qualitative results indicated that, regardless of the social condition both interruptors and interruptees tended to act in a socially salient manner towards each other to (i) achieve an optimal result for their task and (ii) to maintain a social relationship with their partner.

These results confirm the findings obtained in the studies described in Chapter 2 in two ways. Firstly, they confirm that availability is a dynamic state, which cannot be straightforwardly defined in terms of a model or an algorithm. Secondly, this experiment showed that social proximity, although has an impact on interruption behaviours, cannot be defined purely through an organizational or hierarchical dependency between communicators. I, further, saw that important role of social reciprocity in inducing socially salient behaviours. Participants tended to act in a socially salient way once they observed the willingness of their partner to reciprocate that attitude. However, if they thought that the partner was not considerable towards their needs, they would often decide to act in any way that would help them to optimize their result.

This experiment has suggested a number of design implications and inspirations, which I shall try to answer in the following chapters of this thesis. Firstly, it has shown the importance of attaining a successful level of visibility of one's availability status as a way to create the feeling of a *collaborative spirit* between the interacting parties. Next, it brought to light an issue of representing social costs pertaining to inappropriate interruption behaviours as a way to invoke accountability for one's action. These two aspects seem to be valuable constituents for the creation of a socially translucent system for supporting mediated communication [51]. In the next chapter, I present a design study investigating two different ways of presenting people's availability status and discuss the need for providing mechanisms supporting the attainment of mutual awareness regarding that status in an Instant Messaging application, which is a tool supporting mediated communication that combines the synchronous and asynchronous nature of mediated communication (as already discussed in detail in Chapter 1).

4

Attaining visibility of the availability status

‡

Abstract

In this chapter, the implications of the Social Translucence framework for designing systems that support mediated communication are explored. In studies described in Chapters 2 and 3 I identified a number of factors that influence interruption behaviours and transform the availability status of the communication recipient. Chapter 3 has, in particular, pointed out the importance of visualizing relevant availability indicators. As the next step, two ways of communicating availability status were empirically evaluated to understand what constitute successful way to achieve visibility of people's communicative state. Some aspects of the Social Translucence constructs: visibility, awareness and accountability were further operationalized into a questionnaire and relationships between these constructs were tested through path modeling techniques. It was found that, in order to improve visibility, communication systems should support people in presenting their status in a contextualized yet abstract way. Visibility also showed to have impact on *one-way awareness* and accountability but no significant relationship was seen between such one-way awareness and accountability. Based on these results, a conclusion was drawn that to design socially translucent systems it is insufficient to only visualize people's availability status. It is also necessary to introduce mechanisms stimulating mutual awareness that allow for maintaining shared, reciprocal knowledge about communicators' availability state, which then can encourage them to act in a social manner.

‡This chapter is based on work published by Agnieszka Matysiak Szóstek, Evangelos Karapanos, Berry Eggen, Mike Holenderski, *Understanding the Implications of Social Translucence for Systems Supporting Communication at Work*, in Proceedings of CSCW 2008, ACM Press [158].

4.1 Introduction

Many systems supporting mediated communication aim at automatically inferring people's availability status based on video-streaming [160], through the analysis of their calendars [17], or by logging computer activities and various sensory data captured from people's surroundings [16, 57, 58, 56]. An automatic status detection is, however, not very successful in leveraging socially salient behaviours. It was found that co-workers did not always respect their colleagues' status and participants were not able to establish ways allowing them to demand respect of that status. The reasons why automatic status detection is not very successful in leveraging social communication behaviours are in detail described in section 1.2.2 and briefly outlined here:

An automatically detected availability state seems insufficiently reliable to potential communicators. The experiment described in Chapter 3 showed that the decision to become available for communication is context reliant and deeply embedded in the social relationships between communicators. Many automatic systems assess people's communicative state by analyzing their agendas [16], or by looking into their activities [56, 161, 17]. Based on the obtained data these systems attempt to create computational models determining the degree to which a person is available. However, it is difficult for such models to evaluate an actual human intent as they are insensitive to subtle changes in users' state [17].

An availability indication provided by automatic systems remains too generic or displays context that is insufficiently informative. Systems using computational models tend to generalize people's communicative state [58, 56, 160]. In consequence, initiators are not informed about the reasons behind a certain status and prone to misjudge it (e.g., an indication that one is moderately unavailable might give an impression that most communication, except from the social ones, would be accepted). Other systems provide an additional source of information regarding people's communicative state through a continuous video-link [139, 108, 159]. However, video only partially succeeds in conveying people's communicative state. It only represents the physical dimension of a certain activity, e.g., sitting in front of the monitor, without providing information regarding what the actual goal of this activity is and it's status.

Automatic systems do not provide space for ambiguity regarding people's communicative state. To attain sufficient visibility of their availability state people need to be able to display a status that represents their psychological rather than observable state (and these two might be different). An automatic system detects and displays objective rather than intended information, which, in turn, might be perceived as threatening people's privacy [17] because, e.g., it might negatively affect their *professional face* * [67] by displaying certain information about themselves. People also seem to

*A *professional face* is an image of the self that one wants to display to the others in the environment. Such an image might differ for different groups and different settings. For example, one might want to

feel threatened by the fact that they have no control over what information is being presented by the system and therefore they have no control over the image they are projecting to others [22].

Based on the aforementioned observations, I would like to argue that, to become sufficiently informative, availability indication should consist of information that allows communicators to effectively assess what are the appropriate moments to initiate communication with their colleagues. Moreover, to overcome the possible privacy threats it is necessary to provide people with ways to control information that is presented in the system and also allow them to adapt it whenever necessary.

4.2 Study objective

An alternative to systems automatically inferring the availability status can lay in providing people with a lightweight manual way to determine their communicative state. An idea of a manual availability indication is not new and pertains to the research line about interpersonal privacy regulation, which is in detail described in section 1.2.3. By providing users with the possibility to manually manipulate their availability representation, systems allow for adapting that representation as a consequence of a communication negotiation that happens between the recipient and the initiator. It also provides room for ambiguity [6, 21] by allowing people to decide in what way their communicative state should be reflected in the system so that they can protect their solitude and self-image at all times regardless of their present situation or activity [67, 127, 22].

Exemplary mechanisms for manual adaptations of the automatic representation of one's communicative state were implemented in the Community Bar system [108] and are based on the *Focus* and *Nimbus* model of Rodden [137]. Focus is a mechanism that enables people to direct their attention towards some colleagues but not to others, while Nimbus allows them to control what about themselves they broadcast [139]. Blurring is another mechanism that allows people to control the granularity of information they display to others by allowing them to distort their video image [22]. Those mechanisms are successful in supporting ambiguity but they still seem to fail to be sufficiently informative about people's communicative state. Therefore, the first objective of this study was to further explore the design space for systems supporting manual availability indication and try to answer the following question:

> *Question 1:* How to achieve visibility of one's communicative state in mediated communication?

appear as a sensitive and sympathetic person to one's friends and as a career-oriented and tough employee at work.

As previously mentioned one reason why systems automatically inferring people's availability status are not succeeding to become socially translucent might occur due to the fact that they insufficiently support visibility of people's communicative state. As visibility I define an ability to represent socially significant information about one's communicative state in the system. Another reason might be that, even if sufficient level of visibility is achieved, such systems fail to support mutual awareness of that status. As already stated in Chapter 1, mutual awareness reflects the extent, to which all users of the system know what information is being shared among them and also what others can see about their behaviour. I argue that current systems seem to only support what can be called 'one-way awareness' meaning that only a communication initiator knows whether he or she viewed and conformed to the availability information that is presented in the system. As there is no mutual awareness achieved, there is no basis for leveraging accountability thus a basis for creation of social norms as a consequence of a mutually understood possibility of being held responsible for one's actions. Therefore, the second objective was to answer the following question:

> *Question 2:* What other mechanisms are needed in order for a communication system to become socially translucent?

By answering these questions I hoped to derive design guidelines allowing for attaining of a sufficient level of visibility regarding people's communicative state and provide insights into how systems supporting mediated communication should be designed so that they can become socially translucent.

4.3 Design

Earlier I discussed reasons why automatic systems fail to invoke visibility on one's communicative state, namely: inadequate reliability, insufficient informativness and/or poor support for ambiguity. In the next step, those aspects were reformulated into the following design principles:

- The system needs to offer a reliable availability indication thus should provide status information that appears believable and motivates people to comply with it [16, 58].
- The system needs to be informative about people's communicative state thus it should provide co-workers with a socially significant explanation about moments, in which communications are likely to have a disruptive effect on people's performance. As shown in the related literature those are moments of high concentration and increased time-pressure due to incoming internal or external deadlines [69, 70]. Increased annoyance due to an interruption can

also be caused when a person is exposed to multiple interruptions in a short period of time [1, 14, 131].

- The system needs to support ambiguity thus should provide space for opening and closing one's communicative borders regardless of the state of activity one is involved in and at the same time it should protect one's privacy [6, 21, 127].

The first of the aforementioned principles in the design of two solutions by allowing for manual rather than automatic status indication was addressed in the following way. As shown by the related literature and also by the experiment described in Chapter 3, automatic solutions are (i) often perceived as not sufficiently reliable for the initiators and (ii) are not able to effectively protect the recipient. Therefore, I wanted to verify the applicability of a manual status indication with respect to how reliably it represents one's communicative state.

The other two design principles were addressed in the following ways. To attain a sufficient level of informativness and at the same time maintain space for ambiguity, in AvBox (see: Figure 4.1) availability information took the form of an abstract graphical representation of the availability, concentration, time-pressure and disturbance levels[†]. Different levels were visualized on a 7-point scale on which: level 1 (marked on the device with a green line) indicates high availability and low concentration, time-pressure and disturbance level, and level 7 (marked on the device as a red line) indicated high unavailability, concentration, time-pressure and disturbance levels. In StatusME (see: Figure 4.2) availability information was presented as a short textual message chosen by the user to best describe his or her availability.

The choice of these two visualizations followed the recommendations of Erickson and Kellogg regarding the value of the abstract visualizations of socially salient information in mediated settings (see: section 1.3.2 for details). Such cues could be presented either through a textual or a graphical form, which, they argued, have many powerful characteristics such as ease of producing and updating. I was particularly interested in assessing which status representation would prove more efficient to represent participants' status and at the same time least effortful for them to manipulate. More specifically, the goal was to see which of these two solutions would be perceived as the best representation of one's communicative state: the one representing the availability information in an abstract yet predefined way or the one offering the possibility to describe person's communicative state in an open, direct manner.

AvBox (see: Figure 4.1) was built with Phidgets [176]. Four Phidget Sliders and three leds were connected to a Phidget Interface Kit 8/8/8 and communicated with the PC over USB. The status was indicated by setting the sliders according to the

[†]As indicated earlier, these are the three moments, when interruptions seem to have the most disruptive effect on the recipient's performance.

7-point scale graphically represented on the device. This 7-point scale was mapped onto the 1000-scale of the Phidget Sliders and communicated to a Java program on the PC, which published the value on a central server over TCP sockets.

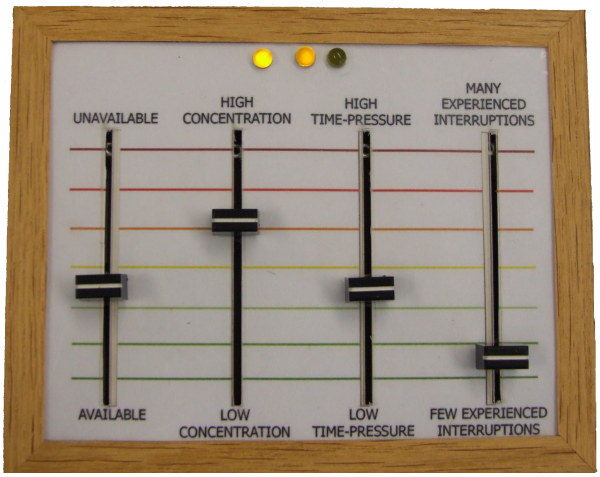

Figure 4.1: AvBox.

Participants could indicate their availability status by adjusting the first slider (ranging from available to highly unavailable) and were also able to provide additional explanation of that status by indicating their concentration, time-pressure and disturbance levels. AvBox was further equipped with three LED-lights used to indicate time since the last update (the first light would get lit after one hour, the second after two hours and third after three hours have passed since the last status update). In this way I wanted to ensure unobtrusive yet pervasive feedback for the AvBox user stimulating frequent use of the tool.

StatusME (see: Figure 4.2) was an application running on the PC and highly resembling functionality offered by various Instant Messaging applications and identical to that existing in Twitter, a service supporting social networking through the broadcast of short textual messages describing people's present status or activity [177].

Figure 4.2: StatusME.

To indicate their status participants needed to type in a relevant text and submit it to the server. The message could be changed at any time by clicking on the text box and entering a new message. The status could also be cleared using the 'Clear' button, so that no message was broadcasted. The StatusME application remained semi-transparent and always on the top of other documents or applications opened on the screen as an unobtrusive reminder to update it whenever necessary. It was implemented in Tcl/TK and communicated with the central server over TCP sockets.

Figure 4.3: The Status Viewer displaying exemplary status indications of two study participants.

All statuses entered into AvBox and StatusME could be viewed through a Status Viewer (see: Figure 4.3) a web-based Flash application that retrieved the status of all connected participants from the central server and displayed it in the browser.

AvBox and StatusME pushed any change to the server that was implemented in Tcl/TK and resided on a server on the local network (see: Figure 4.4). The server subsequently pushed the changes to the Status Viewer in real time. It would initially display buttons with participants' names and the time of the last update. Once a button was pressed, a graphical representation of the positions of the AvBox sliders (mapping the 1000 scale of the sliders back to the 7-point scale) and/or the textual entry from the StatusME would appear. The status indication would remain visible until the button was pressed again, allowing to simultaneously view status indications of multiple persons.

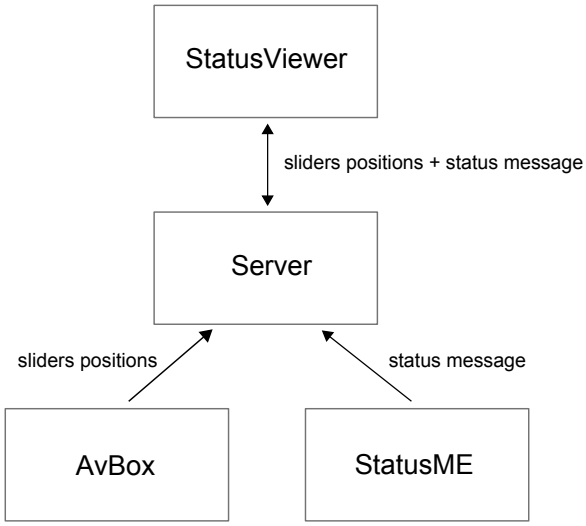

Figure 4.4: A visualization of the system architecture representing the communication protocol between avBox ans StatusME, the server and the Status Viewer.

4.4 Method

Ten employees of one university department (7 male, 3 female) of whom 4 were frequent users of Instant Messaging applications agreed to participate in the study. The group consisted of 2 professors, 4 researchers, 2 employees of the financial department and 2 administrative assistants. In order to counterbalance for their professions, participants were divided into two groups, so that 1 professor, 2 researchers, 1 employee of the financial department and 1 administrative assistant formed each group (the choice per group per profession was also counterbalanced).

The study lasted three weeks. During the first week one group was asked to use AvBox and the other to use StatusME (see: Figure 4.5). In the second week both groups used the other system so that in these two weeks all participants were able to experience both systems, find ways to express their status through them and formulate their preferences. In the final week they were asked to use either their preferred tool or both tools at the same time. The goal was to see whether participants would display a clear preference for one of the proposed solutions.

To study an impact of new technologies on people's interactive behaviours it is crucial to get a critical mass of users that would potentially benefit from the proposed solution. I was not able to equip every member of the participants' department with AvBox and StatusME due to the limitations pertaining to the cost related to building

Study week	AvBox	StatusME
week 1	Group 1 5 participants	Group 2 5 participants
week 2	Group 2 5 participants	Group 1 5 participants
week 3	Group 1 + 2 10 participants	

Figure 4.5: Reminder of the study setup.

the sufficient number of prototypes. However, to attain adequate attention to the study an email was sent to all employees with an explanation of the study goals and the address (URL) of the Status Viewer. Participants were asked to forward that email to their students and colleagues. Finally, two computers displaying the Status Viewer were located on the department corridors nearby participants' offices (see: Figure 4.6 on the left), and placed study posters on participants' office doors (see: Figure 4.6 on the right). To each poster an envelope was attached containing cards that explained the purpose of the study and also provided a link to the Viewer. The cards were the size of a business card and every visitor was encouraged to take one and place it on his or her desk.

4.4.1 Data collection and analysis

This study aimed to collect data allowing to analyze participants' interactions with the two proposed solutions, elicit their preferences regarding ways, in which Social Translucence could be achieved in systems supporting communication at work, and also examine their perceptions regarding causal relationships between visibility, one-way awareness and accountability. All interactions with AvBox and StatusME were logged and the following data was recorded: interaction date, time and the used system. The user ID and status ID was noted for each interaction (each message entered through StatusME and the value of each slider update on AvBox) (see: Figure: 4.7).

The study was followed by five sessions (with two participants per session) using the Repertory Grid Technique (RGT) [59] as data elicitation method. The choice to invite two persons per session was motivated by the expectation that participants would be able to better reflect on their tacit knowledge by contrasting their experi-

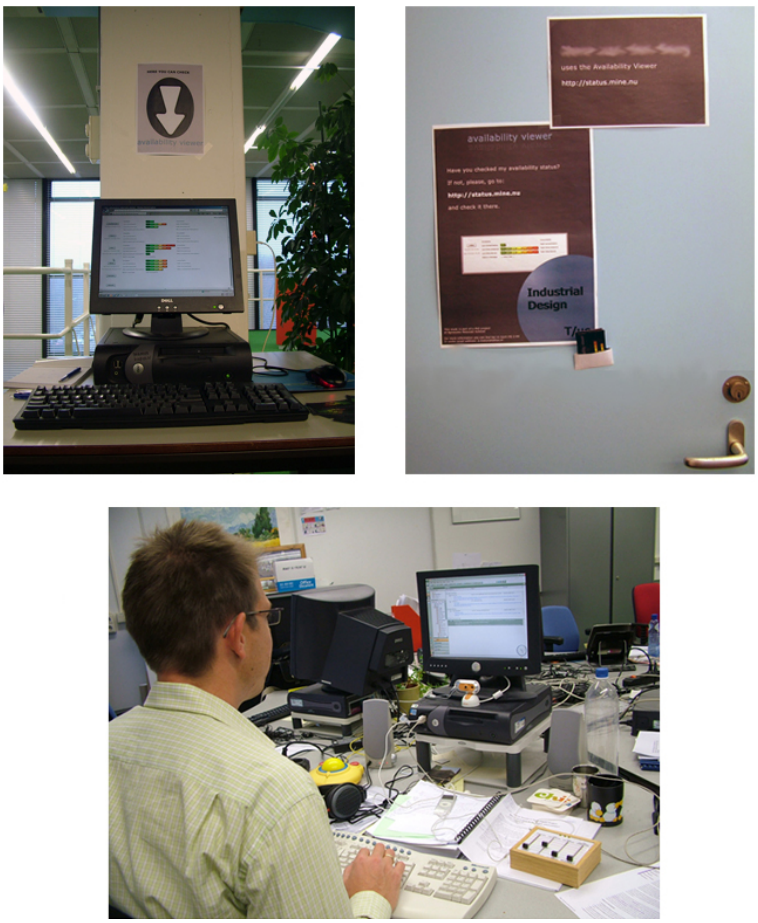

Figure 4.6: The picture of one of the public computer displaying the Status Viewer and located on the corridor nearby participants' offices (the upper left). The picture of the participant's door with a poster on it (the upper right). The picture showing AvBox positioned on the participant's desk (on the bottom).

ences regarding the systems with those of the peer-participant. During the interviews the two proposed systems (AvBox and StatusME) were compared with Outlook Calendar which served as a reference of an automatic system (see: Figure 4.8). Although Outlook Calendar cannot be considered as a socially translucent system, nonetheless, it reflects certain properties of automatic systems: it attempts to model people's availability by reflecting the content of their agendas and it does so by showing abstract and generic rather than contextualized availability status.

Date	Time	Change type	Participant's ID	StatusID	Availability value	Availability level
2007.11.13	07:34:05	status:change	P1	voorbereiden dag		
2007.11.13	07:59:29	status:change	P10	busy		
2007.11.13	08:04:31	status:change	P10	available		
2007.11.13	08:21:19	viewer:view	Comp1	P2		
2007.11.13	08:21:21	viewer:view	Comp1	P9		
2007.11.13	08:21:23	viewer:view	Comp1	P10		
2007.11.13	08:21:25	viewer:view	Comp1	P1		
2007.11.13	08:35:29	viewer:view	Comp2	P9		
2007.11.13	08:35:35	viewer:view	Comp2	P2		
2007.11.13	08:35:40	viewer:view	Comp2	P1		
2007.11.13	08:35:43	viewer:view	Comp2	P10		
2007.11.13	08:39:18	status:change	P1	Bestuursvergaderinge n DB en MT tot 12:00		
2007.11.13	08:40:00	viewer:view	CompPrivate	P9		
2007.11.13	08:43:22	sensor:change	P8	interruptions	754	6
2007.11.13	08:43:22	sensor:change	P8	time-pressure	799	7
2007.11.13	08:43:22	sensor:change	P8	concentration	910	7
2007.11.13	08:43:22	sensor:change	P8	availibility	988	7
2007.11.13	08:45:09	sensor:change	P3	interruptions	982	7
2007.11.13	08:45:09	sensor:change	P3	time-pressure	434	4
2007.11.13	08:45:09	sensor:change	P3	concentration	445	4
2007.11.13	08:45:09	sensor:change	P3	availibility	0	1
2007.11.13	08:46:50	viewer:view	CompPrivate	P3		
2007.11.13	08:51:03	sensor:change	P8	availibility	965	7

Figure 4.7: An excerpt from the data log.

The systems were grouped in 1 triad, namely (see: Figure 4.9):

- Outlook Calendar and AvBox versus StatusME,
- AvBox and StatusME versus Outlook Calendar,
- Outlook Calendar and StatusME versus AvBox.

The order in which the combinations were presented to participants was counterbalanced to avoid the order effect. For each combination participants were asked to describe *a quality that makes two systems alike and discriminates them from the third.* After coming up with a quality term, they were asked to describe the opposite pole, thus elicit a bipolar quality dimension that was used by them to differentiate among the three systems. Finally, participants were requested to judge *which of the two qualities they consider to be a positive and which a negative characteristic of a system supporting mediated communication.*

Figure 4.8: Three systems compared using the Repertory Grid Technique: AvBox, StatusME and Outlook Calendar.

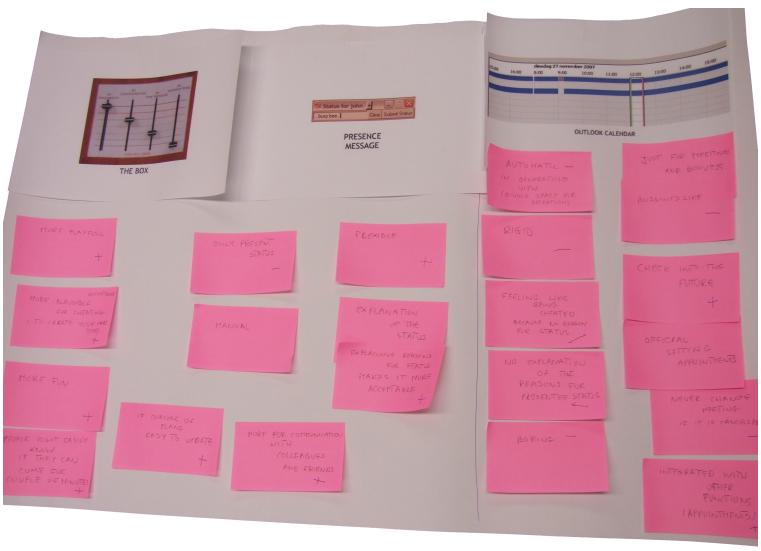

Figure 4.9: Employing the Repertory Grid Technique: participants described qualities that discriminate among the systems and marked which quality was perceived by them as a positive and which as a negative characteristic of a communication system.

As a last step, participants were asked to rate the three systems (AvBox, StatusME and Outlook Calendar) with respect to how successful they were in becoming socially translucent. Since no prior work has operationalized the concept of the Social Translucence into a questionnaire, a set of questions was formulated that attempted to capture some of its preconditions, namely whether valid social cues were produced in the system. Note that these measures were only intend only to assess participants' feelings whether the offered social cues were effective in expressing their availability. The questionnaire looked at how well people felt they controlled their availability information and whether they thought that sufficient cues were provided for others to act in an appropriate manner. It did not aim to take up the issue of reciprocity in awareness, neither it addressed the role of accountability in the process of social norms creation. The choice to only look at 'one-way awareness' was motivated by two reasons. Firstly, I believe that the first step in creating a socially translucent system is making sure that social cues are indeed successful, which means that they are perceived as sufficiently expressive by the recipient, and that they are legible to initiators. Secondly, as the current communication systems offer such *one-way awareness*, I wanted to test whether there is, indeed, a need to provide explicit mechanisms supporting mutual awareness, or whether provision of relevant social cues could alone become a basis for formation of new social rules in a mediated setting.

First, an set of 21 questions was formed (7 questions per construct). Those questions were qualitatively evaluated in a Focus Group session with four researchers in the domain of HCI. The resulting questions were employed in the questionnaire using 5-point Likert scale. A confirmatory factor analysis was conducted to verify the convergent validity of the questions. The three (out of the seven) questions with the highest loadings on each respective construct were assumed to best measure and were used for further analysis.

Visibility was evaluated with the following questions:
Q1: I find it easy to express my availability status well.
Q2: The status I am broadcasting is well representing my availability.
Q3: My status is presented in a clear and understandable way.

One-way awareness was assessed with the following questions:
Q4: I feel that I control availability information I broadcast to others.
Q5: I provide enough information for others to understand my availability status.
Q6: I feel that people are well informed about my availability status.

Accountability was measured with the following questions:
Q7: I request from people to check my status.
Q8: I can see that others feel obligated to check my status.
Q9: I can see that others are obligated to comply with my status.

Convergent and discriminant validity of all constructs was assessed using the Partial-Least Squares tool [61]. Convergent and discriminant validity is shown when individual scales of an assumed theoretical construct (e.g., visibility) load highly on that latent construct and display low correlation to other constructs. Both convergent and discriminant validity of the Social Translucence model was judged satisfactory (Cronbach's α: $Visibility = .850$, $Awareness = .826$, $Accountability = .729$).

4.5 Results

In this section the results from the three data sources are described. The quantitative and qualitative data gathered from the AvBox and StatusME logger demonstrates participants' behavioural patterns and preferences about the presentation of their status information. The analysis of the statements obtained during the interviews provides insights into the desired behaviour of systems supporting mediated communication. Finally, the outcome of the questionnaires suggests possible relationships between visibility, awareness and accountability.

4.5.1 Logs

731 interactions were logged during the study: 485 interactions using AvBox and 246 using StatusME. AvBox was more frequently used (n.s.) during the first and the second study week (see: Table 4.1). A significant difference was noted regarding the use of both systems in the third week during which participants could choose between both systems ($t(9) = 4.42, p < .005$). Significant difference was also detected regarding the use of both systems throughout the entire study ($t(9) = 3.38, p < .01$). In that last study week, two participants chose to present their status using only AvBox and eight participants used both AvBox and StatusME to describe their availability. No participant selected StatusME alone to express his or her communicative state. There was no order effect detected between the two groups.

Changing one's status indication only 1 to 3 times per day (as it was the case with some of the study participants) may seem an insufficient representation of one's communicative state. There might be a number of explanations for that result. Firstly, despite of a lightweight way of interacting with the tested mechanisms, the interaction threshold might have been still considered too high for the participants. This feeling could have been enlarged by the fact that neither system was connected to any communication channel regularly used by participants (e.g., email or Instant Messaging). This feeling could have been even further amplified by the fact that the proposed system did not provided participants with the means to attain mutual awareness of that status and therefore participants did not get an impression that the system was helping them in sustaining their desired level of interaction. Finally, such a result could

have also been caused by the novelty of the proposed systems: participants might not have had enough time to find their ways and rhythms of using the systems. This novelty effect could have been combined with the fact that not all members of the participants' department were equipped with the new technology. Therefore, there was no basis provided to create a social ritual around the use of the systems.

Table 4.1: Mean values representing number of interactions using AvBox and StatusME per day for each study week. The first two rows represent how often participants updated their status using the assigned tool. The last row shows how often participants would select each tool once they were provided with an option to choose between them.

	AvBox (Mean)	StatusME (Mean)
Week 1	3.76	2.26
Week 2	2.75	1.48
Week 3	5.58	2.81
Overall	4.03	2.18

AvBox

The first step in the analysis of participants' interactions with AvBox was to convert the recorded Phidget Sliders' values into the 7-point scale graphically represented on the device. Then all interactions were divided into events. An event was considered as singular whenever the consecutive events from the same user were detected 5 minutes apart. Any activity that was conducted within 5 minutes was treated as one event. Then, for each participant, all successive representations of their availability were reconstructed so that their status representations, rather than only transitions from one state to another, could be analyzed.

The analysis of the status representations showed that only in five cases the availability slider alone was used to represent participants' communicative state. In the remaining 480 cases at least two sliders were used to represent their status. The analysis of the consecutive adaptations of status representations showed no difference regarding the use of either four, three, two or one slider to describe participants' status. In 202 cases four sliders have been simultaneously adapted to express their availability, in 71 cases three sliders were used, in 53 cases 2 sliders and in 159 cases one slider was adapted (in 107 times it was the availability slider). Finally, no difference was noted regarding the frequency of use of the sliders: the availability slider was used 387 times, the concentration slider 307 times, the time-pressure slider 286 times and the disturbance slider was used 299 times.

StatusME

All StatusME messages were analyzed using Conventional Content Analysis [85]. First, they were inspected by the author and those considered similar were clustered together in three groups. Next, for each cluster the unique characteristics of the messages were described as follows:

Availability Messages: status messages explicitly stating one's availability status without providing any context (e.g.: 'available', 'busy' or 'do not disturb').

Contextualized Availability Messages: status messages explicitly stating the availability status and providing a contextual explanation for that status (e.g.: 'out of office for the next hour: doing sports', 'going home in 15 minutes').

Contextual Messages: status messages stating the context to one's situation without explicitly indicating the availability status associated with that context (e.g. 'doing assessments' or 'working on the report').

All messages were again coded by the author of this thesis and one independent coder (interrater agreement = 92%). The conflicting messages were discussed and assigned to the relevant category. Finally, all messages were once more coded according to whether they stated an availability or unavailability status. The messages explicitly stating participants' availability were coded accordingly (see: Table 4.2). Such an analysis was not possible with respect to the *Contextual Messages* as those messages were not meant to straightforwardly indicate if someone was available or not.

Table 4.2: The three types of StatusME messages: the Availability Messages, the Contextualized Availability Messages and the Contextual Messages and counts showing which of them indicated an availability and which an unavailability state of the participants.

Status message	Total	Stating availability	Stating unavailability
Availability Messages	58	46	12
Contextualized Availability Messages	80	13	67
Contextual Messages	108	n.a.	n.a.
Total	246		

The results showed that the *Availability Messages* were mainly used to state participants' availability for communication, while the *Contextualized Availability Messages* were more frequently used to determine participants' unavailability. In many cases, however, participants decided to enter the Contextual Messages as descriptors of their communicative state. Those messages required an understanding of their working situation in order to be effectively interpreted by others.

4.5.2 Qualitative results

Direct Content Analysis was used to examine 88 statements collected during 5 Co-discovery interviews [85]. Firstly, all paired comparisons were coded according to the predefined categories (visibility, awareness and accountability) by two external coders in two iterations. They firstly coded the statements independently (interrater agreement = 76%). Then, in a joined session, they discussed the conflicting statements and assigned them to the category they both agreed upon (interrater agreement = 88%). Statements ($n = 10$) that remained arguable were removed from the dataset.

Visibility

Participants saw a possibility to manually set their availability status as enabling them to control the professional face [67] they displayed to their colleagues. They liked the contextualized way AvBox offered to explain their communicative state; they thought that the three descriptors (concentration, time-pressure and disturbance levels) were well depicting possible reasons for their unavailability for communication. Participants did not propose any additional descriptor they would like to use to describe their status. A need, however, was expressed to assign different importance levels to the descriptors. For some participants (e.g., employees of the financial department) time-pressure was considered to be the most crucial descriptor, while for others (e.g., researchers) concentration would be the most important one. It did not, however, mean that in the financial department, sliders other than the time pressure slider were not used. It could, nonetheless, be noted that for different types of jobs different sliders were likely to become the dominant ones.

Participants generally disliked describing their availability status through textual messages entered via StatusME. Such messages were perceived as either uninformative (messages like 'busy' or 'working' were not providing interpretable context to their situation) or otherwise possibly threatening their privacy as they could be wrongly interpreted or misused by others.

Participants liked when their status was presented in an abstract and graphical way. Such a representation allowed them to (i) remain ambiguous about their own state and manage their time according to their needs and, (ii) adapt the meaning of a status representation depending on who was interrupting them and for what reason.

Furthermore, an abstract representation was likely to hide situations, in which participants forgot to update their status as it was possible that the same status description was adequately representing different activities (e.g., high concentration can equally refer to writing a report and also describe attending a tele-conference).

Finally, participants expressed that they would like to be able to display their present availability status together with activities they planned for the future (e.g., indicating that one is available for the next 30 minutes and then has a meeting). They also thought that some activities, such as meetings or business trips could be automatically indicated as such activities are generally known to their co-workers and unlikely to raise any privacy concerns. However, participants wanted to always have a possibility to overwrite this information in cases when their plans changed or they preferred to conceal them.

> 'These two (AvBox and StatusME) are dedicated to set availability. I can say through them: "I am concentrated but if you have something urgent come for few minutes". This one (Outlook Calendar) is too complicated for that. With it people never know if they can come for few minutes or not. Especially if I block my time without specifying the reason... You might also be free and suddenly you are interrupted and need to do something else – you are not immediately updating your Outlook Calendar about it. This is why it seems so unreliable. You simply need more information besides whether someone is in the office or not.'

> 'These two (AvBox and Outlook Calendar) give you more freedom in expressing what you do. You can always say that you are unavailable because you are concentrated getting the highest score in Tetris. With this one (StatusME), you have to think about a perfectly acceptable message or a perfectly acceptable activity. You can't write that you are browsing info for your holidays while having coffee. You write about things that are acceptable at work and if you do something that is not acceptable you simply don't write about it. It invites to enter an untrue but perfectly acceptable status.'

> 'With those two (Outlook Calendar and AvBox), I don't have to provide specific information about what I am doing right now. I can do that with StatusME and that specific information can be used against me. It might invite comments, like: "Have you been doing this or that for so long" It leaves traces.'

Interplay between visibility, one-way awareness and accountability

Participants reported that the more effort they put into setting their status the more they expected their colleagues to comply with it. They thought that the system should ensure that their availability indication was seen by the initiator. The evaluated systems did not offer such a insurance and therefore made participants feel that they were setting their status without any guarantee that it would be consulted. Moreover, participants indicated that information about who was checking their status and who was not would allow them to differently treat people who consulted their status many times and then decided to come and those who did not consult it at all.

Participants further wanted a system to clearly indicate to their colleagues whether the communication moment was well chosen. They felt that personally confronting the initiator about a poorly timed communication might be a threat to their relationship. Therefore they would prefer if the system took away part of this social tension by automatically indicating that the interruption moment was incorrectly selected.

> 'In these two (AvBox and StatusME) whatever you input becomes an output and your benefit depends on it. If you enter a vague message or just slide the availability slider, you know that others can't interpret it. If you put more explanation, others can use to see if they can interrupt you or not. There is personal information available here, easy to interpret, which increases my chances to understand what someone is doing and being more successful in my attempts to reach that person. In this one (Outlook Calendar) there is no possibility to personalize my status, unless I give someone full access to my calendar and this happens very rarely. The automatically generated message might be easy to interpret but is not useful; I can only see that someone is busy.'

> '(About AvBox and StatusME): I said to them (interruptors) that my status shows that I am concentrated but they would say to me: 'Oh well, I am already here, so I am going to ask this and that'. There is no punishment for them when they misbehave. They don't get the feedback of what is the consequence of their behaviour. I would like to show them that they were not appropriate, that they did something wrong when they didn't respect my status. I like the philosophy of Outlook Calendar more: there you can look into my agenda and then ask me whether within the time that is already available, I could meet you. It leaves the initiative with the one who is looking for the contact and then I can respond to it. In those two (AvBox and StatusME) the initiative is all in my hands, I have to set them up even for the cases when there might not be any interruption.'

4.5.3 Questionnaires

The last step was to analyze data gathered through questionnaires and test what causal relationships could be seen between the Social Translucence constructs in the systems that were tested in this study. Questionnaire data was analyzed using a Structural Equation Modeling (SEM) technique (Partial-Least Squares – PLS). SEM techniques, like LISREL and PLS, aim at testing causal relationships between latent constructs (e.g., visibility) that were measured through a set of individual scales and, at the same time, being able to assess the factorial validity of the assumed constructs through confirmatory factor analysis techniques [62]. PLS has lately gained increased interest due to its ability to cope with exploratory and confirmatory analysis, and its minimal sample size requirements as compared to LISREL. PLS heuristics suggest a minimum sample size of ten times the number of indicators of the largest latent construct in the model [62]. Since all latent constructs in this model were measured through 3 individual scales, the sample size of 30 cases (10 participants x 3 systems: AvBox, StatusME and Outlook Calendar) was considered adequate.

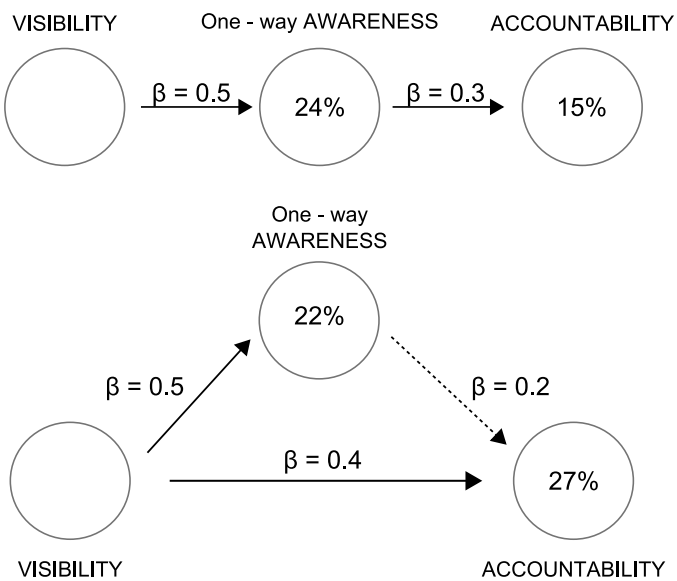

Figure 4.10: Two alternative Partial Least Square Models reflect the possible relationships between Social Translucence constructs. Note that by adding visibility as a direct predictor of accountability (Model 2) a substantially larger amount of variance was accounted for and visibility become a stronger determinant of accountability than one-way awareness.

Two alternative models were tested (see: Figure 4.10). In model 1 visibility showed a significant impact on one-way awareness (it accounted for 24% of variance in awareness data with a β value of .5), but the link between one-way awareness and accountability was weak (explained variance is only 15%). This observation was reinforced by model 2, which showed that by adding visibility as a direct predictor of accountability, a substantially larger amount of variance could be explained and visibility became a stronger determinant of accountability ($\beta = .4$), while one-way awareness showed only a small effect on accountability ($\beta = .2$). Note that the proposed causality was only a conceptual assumption regarding the three tested systems that was put into the model and therefore cannot be seen as a generalization of the relationship between the three Social Translucence constructs.

4.6 Discussion

The study described in this chapter aimed at answering: (i) how to achieve visibility of one's communicative state and (ii) what other mechanisms are needed for a communication system to become socially translucent.

The results suggest that to achieve satisfactory visibility regarding one's availability state communication systems should provide means allowing people to contextualize their status. Contextual status indication allows co-workers not only to see that their colleagues are unavailable but also to understand why they are unavailable. The three proposed status descriptors: concentration, time-pressure and disturbance level seem to adequately capture the different reasons behind different communicative states. In line with Erickson and Kellogg [51], it was also found that an abstract, graphical status representation entirely dedicated to announce availability tended to leave sufficient space for ambiguity in how people present themselves and therefore was not considered to be privacy threatening. Participants liked the way AvBox and StatusME allowed them to express their status, they did not, however, appreciate the fact that the systems offered only manual ways to set their status. According to them a system combining the automatic and the manual availability indication would have been a more efficient alternative[‡]. They wanted the system to automatically indicate the 'generic events' such as meetings, business trips, etc., preferably based on the content of their agendas. The system should, nonetheless, at all times allow people for manual correction of that automatic status allowing them to set their communicative borders to reflect their intended rather than planned activities.

This study also showed that, despite the motivation to sustain visibility of their communicative state, people frequently forgot to manually update their status after their state changed. The feedback mechanisms included in the designs (LED-lights

[‡]As already suggested in Chapter 3 and further by Milewski and Smith[111] and Romero and Markopoulos [140].

on AvBox and the always-on-the-top property of StatusME) were not entirely successful in reminding participants that their status is outdated. A possible explanation for that result might be lack of mutual awareness of participants' status indication. The Social Translucence framework states that without attaining mutual awareness, communication systems do not provide a basis for accountability. This supposition was tested through the questionnaire-data analysis. It was checked whether provision of relevant social cues in a form of *one-way awareness*, typically offered by the current communication tools, would be sufficient to leverage Social Translucence. It was observed that, for the three tested systems, one-way awareness was not sufficient to invoke accountability regarding one's communicative behaviours. Based on that result I can confirm that, in order for systems supporting mediated communication to be successful, social cues regarding people's availability need to be made perceptible and reliable. I would like to further argue that achieving a sufficient level of visibility does not guarantee that a system will become socially translucent. Given the fact that I looked at awareness as 'one-way awareness' rather the mutual, reciprocal awareness, I conclude that such 'one-way awareness' is also insufficient for a system to become socially translucent.

4.7 Conclusions

In this chapter I presented a study exploring different mechanisms enabling attainment of visibility of one's communicative state in systems supporting mediated communication. I further examined the relations among the three Social Translucence constructs. It was found that, to improve visibility, communication systems should support people in presenting their availability in a contextualized yet abstract manner. A contextualized availability status was perceived as more informative compared to the generic availability information. Its abstract, graphical representation entirely dedicated to announce availability seemed to leave sufficient space for ambiguity in how people present themselves to others and to reduce their privacy concerns.

Using modeling techniques, it was shown that while visibility had an impact on awareness and accountability the link between awareness and accountability was weak in the systems supporting 'one-way' awareness. These results confirm the assumptions of the Social Translucence framework stating that, in order to design socially translucent systems, it is necessary not only to support attainment of sufficient visibility on one's communicative state but also to leverage mutual awareness, which can become a foundation for new norms based on the reciprocated feeling of accountability for one's actions. In the next chapter I aim to explore the notion of mutual awareness and propose designs that test its applicability in attaining social behaviours in mediated communication.

5

Attaining mutual awareness of the availability status

§

Abstract

In the study described in this chapter I explored once again the implications of the Social Translucence framework of Erickson and Kellogg [51] for designing systems supporting mediated communication. Chapters 2 and 3 have discussed factors influencing interruption behaviours. Chapter 3 has pointed out the importance of visualizing relevant availability indications. Chapter 4 has shown that visualization of an availability status alone cannot guarantee a communication system to become socially translucent. Therefore, as the next step in this research, a prototype of an Instant Messaging application that aimed at leveraging mutual awareness of the recipient's availability state was designed, implemented and tested. The analysis of the quantitative and qualitative results showed that displaying status indication in the chat box encouraged participants to show more respect towards the communicative state of their colleagues comparing to situations, in which the status indication was presented only in the 'buddy list' view. The study also showed that mutual awareness needs to be maintained not only during communication initiation but also throughout the entire duration of communication.

§This chapter is based on the article by Agnieszka Matysiak Szóstek and Berry Eggen 'I Know That You Know' – Ascertaining Mutual Awareness of Recipient's Availability Status in Instant Messaging Applications, in Proceedings of INTERACT 2009, Springer Verlag [157].

5.1 Introduction

As there is no generally accepted convention regarding which behaviours for negotiating communication initiation are considered as socially acceptable, people tend to develop their own conventions that define the best practices for different situations and communities [15, 79, 31, 25, 67, 101, 109]. Chapter 1 showed that managing availability for communication is a dynamic process that depends on the continuously changing context. Since system users rely on representations of their presence and actions to understand each others' degree of availability [16, 85, 110], finding ways to share relevant contextual information is necessary to help creating more refined and socially acceptable practices [127, 51]. However, current technologies tend to focus on provision of mechanisms that relate to functional rather than to social requirements and often disrupt the exchange of cues regarding the context communicators are in [127]. For example, phones give the means to contact others anytime anywhere, yet do not provide any indications regarding whether the recipient is able to accept an incoming communication. As a result people are not provided either with sufficient information about the context, in which their communicators operate, or with means helping them to manage their communications in a way that is efficient and yet complies with social conventions similar to those used in face-to-face encounters. Oulasvirta et al [123] discussed the need for providing awareness cues to enrich the communication negotiation phase but even then such a static representation of social information seems insufficient to support the dynamic process of communication negotiation that needs to take place. As previously mentioned, Erickson and Kellogg [51] argued that systems supporting mediated communication need to present social cues and support formation of common ground among communicators. By providing such cues people are likely to regain the ability to attune to the communicative needs of others and act in a way that is considerate.

The goal of the study presented in this chapter is to investigate ways to ascertain mutual awareness about the recipient's availability status in Instant Messaging applications. In such a way I would like to once more relate the Social Translucence framework to an actual design challenge and also validate the results obtained in the previous studies. Based on the previous results, I argue that availability indication alone is insufficient to leverage social behaviours in mediated communication and that it is crucial to introduce mechanisms stimulating mutual awareness regarding the communicative needs of communicators. To reach this goal a prototype named Do^{NT}Bother was implemented, which was evaluated in a web design company for a period of three weeks. The contributions of this research include the quantitative and qualitative measurements assessing the proposed solutions and a set of implications that promise to inform the design of future mechanisms supporting the attainment of mutual awareness in Instant Messaging applications.

5.2 Related work

As described in Chapter 1, Instant Messaging systems are near-synchronous communication tools that facilitate communication between a person and their 'buddy list' by supporting an exchange of short textual messages (sometimes supported by a video channel [139]). The near-synchronous nature of the tool allows communications to be paced according to the preferences of both communicators. The great success of instant messaging can be attributed to its flexible nature [89] and a relatively low cost of interruptedness [60]. However, as the use of instant messaging is growing, particularly at work, the insufficient support for managing people's availability for communication tends to lead to communication breakdowns, which, in turn, can have negative effects on the social relationships between the system users [9, 142]. The aforementioned problem is not new and a vast body of research was conducted on this subject [116, 8, 9, 84, 7, 168].

Voida et al [168] observed that, in Instant Messaging systems, while it might be convenient for the initiator to start a conversation at a particular moment, it may be undesirable for the recipient to engage in that conversation at that moment. The recipients must then face a trade-off between continuing their current task or engaging in communication. Nardi et al [116] saw that information exchange in Instant Messaging systems can be successful only through subtle negotiations of availability as a way to establish connection by inhabiting and maintaining a shared communication space. The process of negotiating availability binds people tightly together for a specific interaction as they establish a particular *attentional contract* and this is likely to have consequences for their future communications.

In the context of mediated communication, the ability to provide awareness regarding availability status should be seen as one of the most important features of Instant Messaging clients. They typically indicate whether a user is online and whether he or she is currently active or idle by measuring keyboard activity. Most Instant Messaging clients also allow users to enter short status messages that remain visible in the 'buddy list' view until changed or deleted. In Chapter 4, it was showen that contextualized yet abstract availability indication forms a base for correct understanding of each other's communicative state. It allows initiators not only to see that their buddies are unavailable but also to understand why they are unavailable. The same study also showed that availability indication alone is insufficient to leverage socially salient behaviours of initiators.

So far, some awareness mechanisms were designed enabling initiators to 'grab' recipient's attention through the use of various audio-visual alerts and alarms. These alerts, however, miss out on indicating the nature of a communicative attempt. Hsieh et al [84] and Tang et al [162] showed that tagging of instant messages might be a valuable way for the initiator to indicate the importance of an incoming commu-

nication. However, little has been done to address the asymmetry in control over communicative exchange [115] that was already discussed in Chapter 1. This study focused on investigating attainment of mutual awareness regarding the communicative state of the recipient by attempting to answer the following research question:

> How to attain mutual awareness regarding the availability of communicators in mediated communication as means to form a foundation for accountability based on the mutual knowledge of each other's actions?

To answer this question, I investigated the extent to which people were willing to comply with the availability status of others when provided with that status during conversation initiation. I also looked into the possible effect of different status indications on people's decision to initiate communication. Moreover, I was interested to see whether mutual awareness of the recipient's status enabled participants to discard poorly timed communications. Finally, I wanted to elicit design implications regarding the attainment of mutual awareness that could help to design future Instant Messaging systems.

5.3 Design

To address this research question, a prototype of an Instant Messaging application was designed and deployed. The Do^{NT}Bother system was implemented in Java and based on an open source Jabber client: JBother [175]. JBother was chosen as it allowed for transport registration, so that participants could integrate commercial Instant Messaging clients (such as MSN or GTalk) with the prototype and receive all messages through one unified application. In this way I wanted to lower the acceptance threshold for Do^{NT}Bother and assure that participants had the possibility to integrate all their contacts and to execute all their communications through Do^{NT}Bother rather than using multiple separate Instant Messaging applications.

Firstly, I was interested to see whether having multiple options to describe one's status could render some additional advantages to the way the status is presented and perceived by others. The users were offered to choose among the following means to present their availability (see: Figure 5.1):

- The study described in Chapter 4 showed that an abstract visualization of availability was perceived as a sufficient and privacy-respecting means to describe people's communicative state. Based on that observation, *availability levels* graphically representing an overall state of participants' availability on a 5-point scale ranging from available to unavailable and represented by colours spanning from green to red were proposed. Participants could manually choose a status representation from the given range that best presented their availability state.

Figure 5.1: The availability status representations offered by Do^{NT}Bother : an expandable menu for indicating the availability level (on the left), three status buttons and a text box to enter a status message with a status repository (on the bottom of the buddy list). Both the status generated by the buttons and the status manually entered are visible to others next to the name of the user on the top of the buddy list .

- The study described in Chapter 4 also showed that a contextualized explanation of one's abstract availability state helps initiators to better judge the meaning of that state. The three descriptors chosen to describe participants' status in the study described in Chapter 4: 'concentration', 'time pressure' and 'many interruptions', proved to suitably explain their communicative state. Following these results, three manual *status buttons* ('Concentration', 'Time Pressure' and 'Many Interruptions') were designed, each generating a predefined message ('Ann is concentrated', 'Ann experiences high time pressure' and 'Ann experienced many interruptions'). Participants could use these predefined status messages to add context to their status representation by pressing one or more of the buttons appearing at the bottom of the buddy list.

- Erickson and Kellogg [51] argued that text is a powerful means for conveying social information as it allows to specify one's state. Based on that argument I decided to once more add a *status message* (previously investigated in the study described in Chapter 4): a text box, in which a personalized explanation of one's status could be entered. In Do^{NT}Bother , any status message could also be stored in a *status repository*: a drop-down list accessible after clicking on the button on the right side of the text box. Participants could enter a relevant status description through a status text box appearing at the very bottom of the buddy list view. They could also store selected messages to be later reused in the repository. Any message could be deleted from the repository by clicking the 'Delete' button appearing next to it.

The main difference between Do^{NT}Bother and other Instant Messaging systems was that, besides showing status information in the buddy list, Do^{NT}Bother also showed that information in each newly opened chat box (that was visible both on the initiator and, after sending also on the recipient's side) in two ways (see: Figure 5.2):

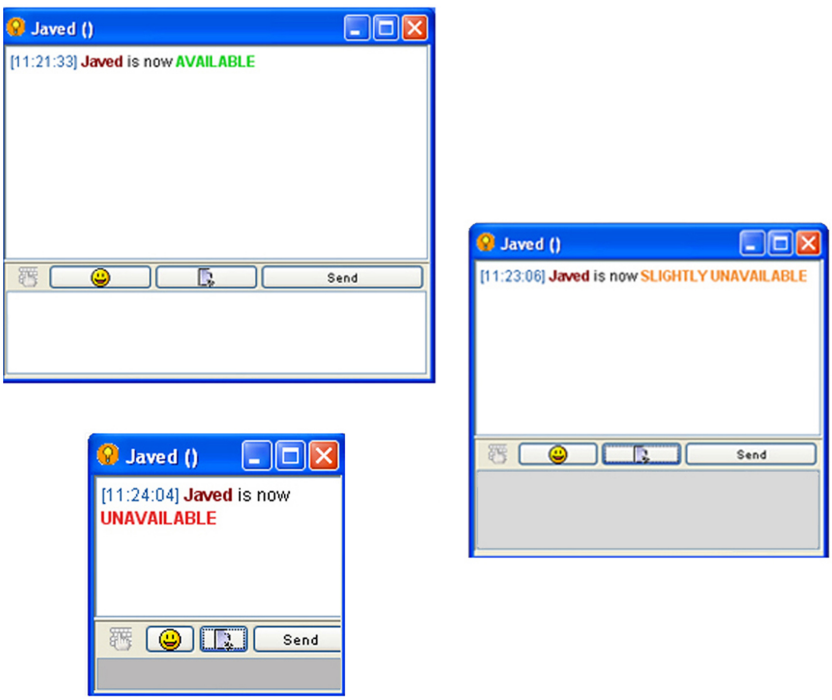

Figure 5.2: Displaying recipient's status prior to communication initiation: the representation of three different textual and graphical status updates in the chat box.

- *A textual status update*: the recipient's current status, including the availability level and also the status description if it was entered by the recipient, was shown as a line of text appearing on the top of the chat box of a newly initiated Instant Messaging conversation, so that both communicators could see it before engaging in that conversation.

- *A graphical status update*: any newly opened chat box changed its size depending on the availability level indicated by the recipient, so that it opened in full size if one indicated full availability and obtained a gradually smaller size if the status was set to other levels. Also the entry space of the chat box gradually changed colour from white to grey depending on recipient's availability. Change in the physical parameters of the text entry box was intended to indicate to the initiator the possible cost of initiating communication. The initiator was in no way prohibited from entering the text of any length. If necessary the chat box could be enlarged by dragging its right-bottom corner and the background colour could be changed by using the background-colour palette. As soon as the reply to a message was received (meaning that the recipient showed interest in engaging in a conversation) the chat box returned to its original size and colour.

The rationale behind the textual status update was to ensure that (i) the initiator was aware of the recipient's status before initiating the conversation and (ii) that the recipient was notified that the initiator was aware of his or her status. The rationale behind the graphical status update was to visually represent to the initiator the potential cost the recipient needs to face when interrupted at an inappropriate moment. The additional effort required to resize the chat box and to change the background colour of the text box was aimed at helping the initiator become aware of these costs.

5.4 Participants

Erickson and Kellogg [51] said that systems leveraging social processes should be studied in real work settings rather than in laboratory conditions. According to them, only in the real situation a real social dependence between communicators is formed, which, in turn, could begin to serve as basis for creation of new social rules. Having already examined Social Translucence in a laboratory setting, it was necessary to also study communication initiation behaviours in the field. Therefore, the study was conducted in a web-design company employing 35 people divided over five departments who were located on two floors of the same building. Prior to the study, all employees participated in a time-management course*, during which it became

*The timing of the time-management course and the study itself was coincidental.

apparent that a substantial amount of time was lost due to untimely communications and that they all should improve their communication practices.

Out of all employees, a total of 10 persons (8 male, 2 female) agreed to participate in the study. Participants were members of three different departments and were distributed across four open-office spaces. Three participants worked on the same project, others were involved in different projects. They all collaborated with each other in the past and were also likely to work together in the future. Half of the participants worked part-time (4 days a week). The data obtained through the demographics questionnaire distributed to them prior to study initiation showed that all participants were acquainted with at least one Instant Messaging application (mostly MSN). Instant Messaging was used only for professional purposes by 5 out of 10 participants. The remaining participants used the Instant Messaging system equally often for both professional and social communications. They reported to use it to communicate with other co-workers (both collocated and distributed), clients, service providers, friends and family. A total of 8 participants reported to use it daily and 2 to use it a few times a week. Only 1 participant frequently updated her status, 6 did it sometimes and 3 persons had never set their status before. The remaining employees were not willing to switch to another Instant Messaging client and did not agree for their interactions to be logged.

5.4.1 Study setup

The system was presented to the participants during a one-hour presentation before the study initiation. All participants received a software package to install Do^{NT}Bother and also to integrate it with their other Instant Messaging clients. They were provided with assistance during the installation phase and received a three-page instruction regarding the access to the features available in the system. The study lasted three weeks. After its completion two Focus Group sessions were conducted (with 5 participants present at each session).

The choice of a Focus Group was motivated in the following way. Focus Groups support the collection of a consistent set of qualitative data that is shared by the majority or by all participants. Each opinion is accordingly motivated and made precise through the discourse between participants who favour that opinion and those who do not [55]. Focus Groups also provide quality control of the collected data as participants check and verify each other's statements so that false or extreme ones are either corrected or rejected [129]. During each one-hour session participants were asked to describe the way they used Do^{NT}Bother with respect to: (i) indicating communicators' availability status, and (ii) leveraging mutual awareness of that status. Participants were also encouraged to compare the features of Do^{NT}Bother with other commercial Instant Messaging clients. The sessions were recorded and transcribed.

5.4.2 Data analysis

In this study, data was collected from two data sources. The summary of participants' interactions (see: Table 5.1 and Table 5.2) was intended to illustrate the relationship between their availability status and initiated communications. For that purpose, the following data was logged:
- user ID,
- time of the status update,
- use of the availability level indication,
- use of the status buttons,
- creation of a status message,
- use of the status repository,
- time of communication initiation,
- recipient's availability status at the moment of the initiation,
- whether the chat box was opened and also if communication was initiated or not,
- whether the initiation was responded to or not.

Data about setting the availability status aimed at extending the results of the study described in Chapter 4. I was interested how participants would construct their availability indications. Furthermore, I wanted to see the extent to which participants were willing to comply with the indicated availability status of their colleagues after being presented with status indication in the chat box. The data about whether the initiation was executed gave insights into the possible effect of the status indication in the chat box on the decision to initiate communication. The data about whether or not the initiation was responded to showed the extent to which the mutual awareness of the recipient's status provided participants with an opportunity to discard poorly timed communications.

The qualitative analysis of the Focus Group sessions aimed at providing insights into participants' opinions regarding using the representation of their availability status as means to negotiate communication in Instant Messaging systems and to see whether mechanisms supporting mutual awareness can be seen as the means to leverage socially salient behaviours. For that purpose, the transcripts from the two Focus Group sessions were, first, assessed by the author of this thesis. A total of 39 statements that did not provide any motivation for expressed opinions (e.g., 'I feel the same way' or 'It all is just personal') were removed. The remaining 106 statements were analyzed using the Direct Content Analysis [85] according to two predefined categories: (visibility and awareness. They were coded by two independent coders in two iterations (interrater agreement of 82% for the first iteration and of 91% for the second). Coding resulted in 47 statements categorized as expressing participants' observations regarding the differences in setting the availability status between

Do^{NT}Bother and other Instant Messaging tools (specifically, MSN). 69 statements reflected participants' opinions regarding attaining mutual awareness of the recipient's availability status.

5.5 Results

In this section, the results from the two data sources are described. The summary of participants' interactions aims at illustrating the ways they initiated communications for different availability status indications. The analysis of the Focus Group sessions provides qualitative insights into participants' opinions regarding the advantages and disadvantages of the given prototype in comparison to other Instant Messaging applications, especially regarding ways of both presenting the availability status and invoking mutual awareness about that status.

5.5.1 Logs

It was observed that availability levels were the most frequently chosen representation of participants' status, who adapted it approximately 3 times a day (see: Figure 5.3). Level 1 (available) was the most often used to represent that status[†] (see: Table 5.1). This result confirms the findings of Chapter 4 that an abstract and graphical status representation is the preferred means to indicate people's communicative state.

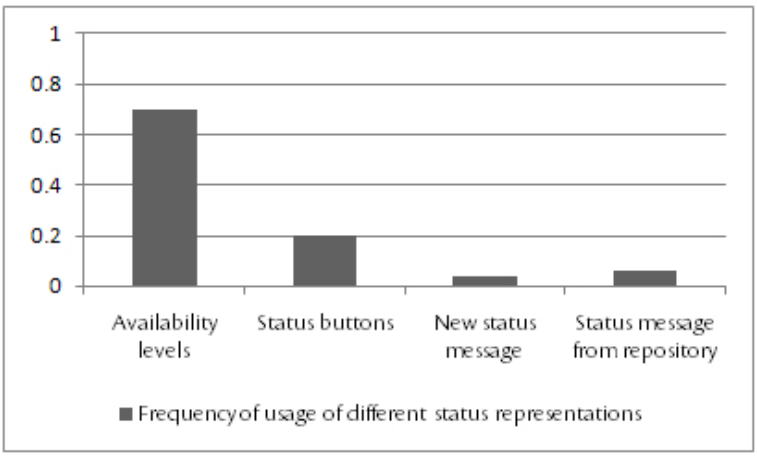

Figure 5.3: A graphical representation of the frequency of usage of different status indicators by the study participants.

[†]The large number of Level 1 indications could be explained by the fact that Level 1 was a default status used whenever a person connected to the system.

	Availability levels	Status buttons	New status message	Status message from repository
Level 1: available	314	46	8	11
Level 2: rather available	24	10	5	1
Level 3: slightly unavailable	36	31	4	9
Level 4: rather unavailable	20	14	1	4
Level 5: unavailable	22	20	3	14
Total:	416	121	21	39

Table 5.1: Frequencies regarding the use of different availability indicators to represent the recipients' availability status.

The status buttons were the second most used means to represent participants' status ($n = 121$, approximately 1 update per person per day). In 99 cases more than one button was used to depict one's communicative state. The 'Concentration' button was used 116 times, 'Time Pressure' button 67 times, and the 'Many Interruptions' button was used 37 times. This result further supports the findings of Chapter 4 that people are willing to provide an explanation of their status, especially if the effort to do so is minimal and the explanation itself does not threaten their privacy.

Status messages were the least often used means to indicate participants' status ($n = 60$). New messages were entered 21 times and existing messages were selected from the status repository 39 times. The messages fell into two distinct categories: they described a project or a task participants were working on like: 'administration' or 'Vodafone' ($n = 40$), or aimed at further defining their communicative state like: 'Do not disturb' or 'Drinking coffee' ($n = 20$). In line with the findings reported in Chapter 4, the results have shown that the higher the unavailability level was indicated the more additional indicators were used to strengthen the meaning of that status, for example, participants would indicate their unavailability by using the availability level indication, pressing the three status buttons and also adding a status message like, e.g., 'Don't disturb' at the same time.

A total of 173 communication initiations were recorded during the study (approximately 2 conversations per person a day). 73% of these initiations were commenced when participants' availability was indicated as available; 6% as rather available; 10% as slightly unavailable; 10% as rather unavailable and only 1% as unavailable (see:

Availability level	Initiated communications
Level 1: available	126
Level 2: rather available	11
Level 3: slightly unavailable	17
Level 4: rather unavailable	17
Level 5: unavailable	2
Total	173

Table 5.2: Frequencies showing the relationship between the availability level presented by the recipients and number of communications started by initiators (i.e., sending of a message).

Tab. 5.2). This result indicates that, in general, communicators were willing to initiate communications at an appropriate moment based on the status information presented in the 'buddy list' view and also in the chat box.

It was also found that 30% of the recorded initiations were never responded to (n = 52). This is not a surprising result; similar findings were reported by Nardi et al [116] and also Avrahami and Hudson [10]. Interestingly, no relationship between the lack of response and the availability status could be found. The majority (n = 43) of unanswered communications were initiated when the recipient's status was indicated as available. From that observation a conclusion was drawn that sending a message when the recipient appeared available did not necessarily guarantee receiving a reply. There might have been two reasons for lack of a response: either the message itself did not require a reply (e.g., because it either got outdated or was resolved though a different channel) or that the status indication visible in the system was not up to date and the recipient was, in fact, not able to answer the message. Alternatively, the recipient might have not considered an instant message as an initiation of synchronous communication or might have postponed a response based on reasons unrelated to his or her current availability status. A detailed analysis of the conversations is needed to support further analysis of these observations. Such an analysis was, however, not possible in this study due to the a priori agreement with the company pertaining to the privacy of the logged data.

Finally, 25 events were recorded during which a chat box was opened but no communication was initiated. The majority of these events ($n = 17$) occurred when the recipient's availability status was other than available (for Level 2 – 6 cases, for Level 3 – 6 cases, for Level 4 – 2 cases and for Level 5 – 3 cases). This result hints at the positive impact of the status update in the chat box on increasing awareness regarding the recipient's status at the point of communication initiation. Participants seemed to withdraw from initiating communication after being presented with their

colleague communicative state in the chat box. This observation seems to verify the design rationale behind the proposed mechanisms. A longer study , however, would be necessary to realize a true impact of that design on socially responsible behaviours of communication initiators.

5.5.2 Focus Groups

In the last part of the study, participants shared their opinions regarding setting their availability status and also the extent to which they were aware of their communicators' availability state at the point of communication initiation.

Presenting availability status

Participants appreciated Do^{NT}Bother for allowing them to present their status in three different ways. The threefold way of defining one's status was perceived as providing an acceptable description about one's communicative state and at the same time as a way to disclose limited information about oneself (e.g., by only indicating one's availability level without providing any explanation of that level) or to exaggerate one's status (e.g., by setting the availability level to red and also pressing all status buttons). Different features allowed participants to control the amount of information they wanted to share with their colleagues. In line with findings by Nardi et al [116], also in this study the participants reported to frequently use Do^{NT}Bother to check the status of a person whom they wanted to get in touch with through alternative communication channels (e.g., face-to-face or through the phone).

> 'Do^{NT}Bother , unlike MSN, allows you to quickly tell others how busy you are and also on different levels, so not just only "busy" or "not busy".'

> 'Success of Do^{NT}Bother comparing to MSN is the way it allows me to set my status. You want to give others a correct feeling of what's going on with you. In a face-to-face situation if someone comes and I'm busy I give him a dark look and he should turn around and go away. In Do^{NT}Bother I set a very strong status.'

Consistently with the findings described in Chapter 4, participants most appreciated the possibility to indicate the different availability levels as means to express their communicative state. It allowed them to suggest to their colleagues whether it was a good or a bad moment to start communication but without having to be specific regarding the reasons behind the indicated state. They also repeatedly remarked that the graphical representation and colour coding of availability levels provided them with a quick overview about whom of their colleagues was busy and who was

available. Participants thought that the meaning of green and red colours was exceptionally straightforward and easy to interpret: green meant fully available and red completely unavailable; the remaining levels were seen as allowing for initiating communication but the more unavailable one was indicated the more urgent or important the intended communication subject should have been.

> 'The red and green indications are clear and everything in between is negotiable. If someone has a red status then you should have a really good excuse to bother him.'

The status buttons were also perceived as a quick and effortless way to provide additional information about participants' working context, which was indicated by participants to strengthen the meaning of the availability level participants wanted to present. The message generated by the 'Time Pressure' button was perceived as the most meaningful information about one's situation. Participants explained that the notion of time pressure was relatively straightforward to understand especially in a community, where most people were to some extent knowledgeable about the stage of projects and upcoming deadlines of their colleagues. The message generated by the 'Concentration' button was seen as more difficult to interpret and only appreciated among participants who were adequately aware of the progress in their colleagues work. The message generated by the 'Many Interruptions' button was considered as confusing and therefore the least frequently used. Some participants interpreted the message generated by that button as indicating that one has already experienced many interruptions and therefore did not want to be interrupted anymore. Others thought that it might be better to interrupt right away, because a person was already distracted by others.

> 'It is good to have them (status buttons) because they require really low effort to say: 'I am concentrated' comparing to typing in a message.'

Status messages were seen as an informative means to further explain other status indications: namely the availability level and messages generated by the status buttons. From the perspective of a communication initiator participants frequently mentioned that the status message varied in its notion and had a more significant meaning if they were working on the same project as the colleague they wanted to contact. The message indicating that the recipient was generally unavailable but working on the same project as the initiator was interpreted by team members as 'potentially more available for my team', particularly if the issue at hand was related to the project they were busy with. In such a case, even a strong unavailability indication would be easier to break through especially when the communication subject was, indeed, related to the project they both were working on. In a situation when the message

indicated that one was working on a different project, participants indicated to be more conservative regarding initiating communication. Participants also appreciated the possibility to store status messages in the repository as it saved them the time to type them in over and over again. They typically kept messages indicating the name of the projects they worked on and also messages strengthening the notion of the unavailability status.

Similarly to the study of the LILSYS system [16] it was observed that the status indication would not always stop participants from contacting their colleagues in situations, in which they appeared unavailable. Participants based their decision of whether to interrupt on their knowledge regarding the current task of their co-worker. That knowledge was often supported by the status message stating the project a recipient was presently occupied with. Interestingly, it was also found that a decision whether or not to interrupt someone was based on how trustworthy the status appeared. If the status indication seemed plausible, participants were more likely to respect it. The plausibility of the message could be described as a subjective judgment of the communication initiator whether the status possibly is a true representation of recipient's communicative state. Participants usually assessed the accuracy of the information entered in the system by, e.g., checking whether the status changed over time. They also evaluated recipient's availability status based on their personal subjective knowledge of recipient's whereabouts and workload. Whenever they had doubts regarding its reliability, they would easily discard it and initiate communication.

> 'I find it handy when people set the status using messages so that I know that she is working on project X and she is really unavailable. Then if you are in the same project you know how to behave. I know that she is available for me. So any feature that supports setting the status and also letting people know what they are working on now is great.'

> 'Some colleagues set their status to unavailable from 8 a.m. to 5 p.m. If I check it a few times, I think: "I don't believe that you had so many interruptions already at 8 a.m., you just pressed all button". And I would contact him anyway.'

Finally, participants found it sometimes problematic to keep their status up to date. They reported to remember to set their status in the morning and then would forget to update it during the day. They also remembered to indicate in the system whenever they were busy but would frequently overlook to change the status back to available once a particular task has ended.

> 'If you are busy it isn't a problem to remember to tell others that you are busy but when you are not busy anymore you never change it back.'

Invoking awareness of the recipient's status among communicators

Many participants considered the status update in the chat box as a successful reminder prompting them to either postpone communication or keep it short in situations when the recipient indicated limited availability. Participants felt that the status in the buddy list on its own was insufficient to assume that the communicator was aware of their communicative state. The textual status update was seen as a guarantee that one's status was seen and therefore one can use it as an excuse for delaying or deferring poorly timed communication. The graphical status indication was seen to counterbalance the possible negative impact that communication initiation could have on the recipient.

> 'If someone starts a conversation and gets my status, it is like a reminder: You started talking but I am under time pressure, so you should keep it short. And you can always ask this person to look at your status.'

> 'It was very handy that the chat box got smaller if someone was unavailable. Sometimes you don't really check if he is available, you just want to talk to him. And then you see the chat box getting smaller.'

Surprisingly, participants frequently reported misunderstandings regarding the meaning of sending a message at times when the recipient appeared unavailable. Often when participants sent a message to someone who displayed limited availability for communication they did not intend to compromise her need for solitude. Their goal was, instead, to indicate to the recipient that they would like to communicate with him or her in the near future as, for example, proposed by Romero [141]. At the same time, initiators wanted to leave the initiative to the recipient as when to react to that message. However, while messages received at moments when the recipient was available could be easily deferred for later, those received while one's status was set to unavailable, were often seen as urgent and participants felt inclined to at least read and often also act on them immediately.

> 'If I see that someone is busy, I don't expect an answer right away. I already contacted him and it was enough for me to let him know what my problem is and that I would like a response sometime.'

> 'When my status is set to available and something blinks then I don't care. But when my status is set to unavailable and there is something blinking I think: 'It must be really urgent'. I will answer both, of course, but my curiosity is higher when my status is unavailable and still someone tries to reach me.'

Finally, although they appreciated the status update in the chat box, participants felt that Do^{NT}Bother lacked support for communication breakdowns caused by a change in the communicators' situation that occurred in the middle of the conversation and was often caused by a trigger happening outside the application (e.g., receiving a phone call). Participants needed to be able to quickly put an ongoing IM communication on hold if another situation needed their attention but at the same time they wanted to quickly provide an acceptable excuse explaining why they went into an idle state.

> 'It is important to define who should come back to that conversation because it may end up in a situation that someone is waiting for you and you are waiting for him to continue.'

> 'How many times I wrote: 'Wait a minute, phone'. It is an interruption in my conversation with this person and I want to put him on hold but I also want to tell him that I will be back in few minutes. It is better if somebody knows what is going on. But it is also annoying to have to type in the exact same message over and over again.'

5.6 Discussion

This study investigated ways to achieve mutual awareness of the recipient's availability status in Instant Messaging applications. The results showed that providing the recipient's status in the chat box encouraged participants to respect the communicative state of their colleagues. In line with findings of Begole et al [16], also this study showed that users did not always refrain from initiating communications when their colleagues appeared to be unavailable. Therefore, presenting a textual status update in the chat box guaranteed that to the recipient that his or her communicative state was seen by the initiator. Attaining mutual awareness of the recipient's status provided participants with the opportunity to use it as an excuse to avoid unwanted communication. The graphical representation was seen more as a 'defense mechanism' before the communication was actually initiated as it made the task of typing in the initial message more difficult for the initiator.

The study results further revealed that leveraging mutual awareness of each other's communicative state is not only important during communication initiation but during the entire communicative process. Participants, for example, indicated that they missed a lightweight way to indicate to each other communication breakdowns, especially if the breakdown is caused by external factors (e.g., a visitor or a phone-call). A current work-around was to quickly send an explanatory message like: 'I am on the phone' and then leave the conversation. However, such a method was perceived

neither efficient (participants kept on typing similar messages every so often) nor lightweight (typing in a message required time and was often inconvenient). Therefore, participants indicated that they would have liked to have lightweight means to indicate the reasons behind pausing communication. One possible solution would be to support users in creation of a list of 'delay' messages; a sort of an 'excuse repository', from which typical responses could be easily and efficiently retrieved. Such messages should, however, be personalized rather than system-generated. For example, Romero [143] proposed the *drag&drop* mechanism similar to the status repository concept proposed in the current study. A recipient could create a set of standard reactions and use them to respond to a instant message by a simple drag-and-drop action. However, the evaluation showed that the system users were not likely to use that mechanism. Therefore, a further design effort is necessary to propose a mechanism which is considered as sufficiently lightweight and also purposeful by the users of Instant Messaging applications.

Another way to ascertain mutual awareness communication systems should support communicators in managing their expectations as when a response to a message can be expected. On the one hand, it is desirable that the initiator has the possibility to indicate how urgently the recipient should react to the particular message. On the other hand, recipients should have the possibility to indicate to the initiator when it is feasible to expect a response. Such systems could also support people in indicating who of the communicators should be responsible for communication re-initiation and when the right moment for that re-initiation is. For example, the system could indicate to the initiator that recipient's status changed to available. An example of such a mechanism was proposed by Romero [143, 142]. She designed a tangible device enabling communicators to indicate a reception of a instant message and also to notify the initiator when the response might be expected. It would be also interesting to expand the proposed functionality by enabling initiators to indicate whether a response is at all expected or not. Such a solution would, however, need to be critically assessed as whether it does not introduce another level of information processing rather than minimize the current level of information overload.

I can see that while the general idea of adding mechanisms to attain mutual awareness may seem to burden the Instant Messaging users with additional effort when initiating communication, it should not be dismissed as these mechanisms bring benefits to the ways mediated communication unfolds. Such mechanisms, when well integrated in systems supporting mediated communication, are likely to provide social benefits to communicators like, for example, helping to formulate rules regarding when communication is desirable and when it is unwanted.

5.7 Conclusions

The study described in this chapter empirically investigated ways to attain mutual awareness of recipient's availability for communication in Instant Messaging systems. For that purpose a prototype of an Instant Messaging system named Do^{NT}Bother was tested. The analysis of the results showed that providing status indication during communication initiation influenced participants to show more respect towards the communicative state of their colleagues comparing to similar situations when the availability status was visible only in the 'buddy list' view. Moreover, this study showed that mutual awareness should be maintained not only in the phase of communication initiation but also during the entire communication. These findings confirm the importance of supporting reciprocal awareness that was already discussed by Erickson and Kellogg [51]. By ascertaining that all systems users know what information is shared among them people are likely to become more sensitive to the communicative needs of others and act in a way that is socially salient.

6

Conclusions

Abstract

As discussed in Chapter 1, communication is the basic tool for sharing information in the modern world [97, 116]. People are provided with various channels to communicate from typically synchronous (e.g., face-to-face or phone) to inherently asynchronous (e.g., email). Any such communication is built upon a set of subtle indications of people's intentions towards getting involved in a conversational activity with another person [31, 25, 95, 115]. Unfortunately, most of the present communication tools are, in their nature, partially or fully devoid from such cues [51]. It does not, however, mean that people need to remain socially blind in the digital world. To change the current situation, such systems need to begin conveying social signals that are informative and meaningful for the interacting parties. They also have to support the attainment of mutual awareness regarding these signals as a way to develop and maintain common ground between communicators. Finally, such systems should make people aware that they can be held accountable for their inappropriate actions. This is why communication technologies that augment social mechanisms might prove to be the optimal approach to control, regulate and encourage adequate social behaviour in the digital domain [150]. In My view, the Social Translucence framework [51] provides a convincing basis to inform the design of such social mechanisms in systems supporting mediated communication and collaboration. This thesis investigated the value of the Social Translucence framework as means to design systems supporting communication in a digital domain. In this chapter I summarize the research conducted in the course of this PhD, highlight its main findings and discuss possible directions for future research.

6.1 Introduction

Prior works indicated the necessity of considering the context within which communication occurs to improve availability management [17, 56, 39, 159, 172] but did little to explicate the social rules that guide people's communicative behaviours in the digital domain. I argued that the next improvement regarding the ability for people to interact with each other in the digital world with grace and cohesion could be achieved through leveraging their social abilities. The research described in this thesis aimed to operationalize the Social Translucence framework [51] as means to inform the design of mechanisms presenting social cues in mediated settings. The Social Translucence framework was initially applied to inform the design for situations in which one wanted to obtain entry into ongoing communications and communicators could modulate their actions to avoid (or not) involvement of others. This thesis argued that the framework could also be successful in describing how social cues are exchanged in one-to-one mediated communication.

Following the reasoning of Erickson and Kellogg [51] I aimed at investigating whether attaining visibility and awareness leads to the increase of social behaviours based on the conjoint understanding regarding the possibility to be held accountable for one's actions. Providing visibility and awareness of socially significant information in the system should allow for defining new social norms in mediated settings. Accountability was, in this thesis, seen as an implicit basis for creation of such social norms. More specifically, the goals of this research were:

- to understand what elements of face-to-face communication negotiation could be translated into a mediated setting so that they lead to a better assessment of the communicative needs of the recipient and the initiator.

- to investigate what information should be shared between communicators so that a successful level of visibility regarding their availability for communication is attained.

- to investigate ways of attaining mutual awareness regarding the availability state of communicators in mediated communication as means of forming a foundation for accountability based on the mutual knowledge of each other's actions and behaviours in the system.

In this chapter I first summarize the contributions of this research. Then, I discuss the applicability of the Social Translucence framework as an approach for designing systems supporting mediated communication. I end with concluding remarks.

6.1.1 Thesis recapitulation

In order to address the aforementioned research goals I executed three empirical studies conducted in a real world context, followed by a laboratory experiment. Then, I conducted two *research-through-design* studies aiming at operationalizing the results gathered from the empirical research.

Chapter 2 proposed a posit that one's availability for communication is a dynamic state that is conjointly shaped by both the recipient and the initiator [132, 141] and that this negotiation process can be mapped onto the information needs of both communicators. More specifically, it suggested that the availability of the communication recipient can be influenced by factors such as the nature of the communication subject, the anticipated communication duration and social proximity between communicators. Any combination of these factors affects the recipient's initial availability status and change it into an interactive or an interpassive modus [93]. Based on these results I argued that, to successfully communicate, both actors need to be presented with relevant information that enables them to assess the potential impact of communication on another person. For the initiator, it means being presented with the possible negative impact of communication initiation on the recipient's ongoing task. For the recipient, it means realizing the urgency and importance level of the communication subject and also the time-demand required for that communication. I also saw that organizational, hierarchical and personal relationships have a vast impact on the recipient's decision regarding the communication outcome. However, the relative impact of social proximity on that decision differs depending on the communication medium selected by the initiator. For example, it has a vast impact on the decision how to proceed with communication in a face-to-face setting but appears to be far less influential in email communication. The obtained results showed that communication negotiation is a complex and also tacit process and that it is difficult to predict the impact of different factors defining this process on its final outcome. The results further revealed the value of providing, next to the availability status, other indicators pertaining to the context of communication (like the urgency and the importance of its subject) as a way to leverage social behaviours among communicators.

Chapter 3 further evaluated the influence of social proximity on communicators' content and time-related interruption behaviours in a laboratory experiment. Social proximity was used as an independent variable and defined in terms of a joint incentive versus a relationship that was solely dependent on social reciprocity. The results indicated that people, in their interruption behaviours, are motivated by social reciprocity and, therefore, are likely to act in a socially salient way to (i) achieve an optimal result of their own task and (ii) to maintain a social relationship with their partner.

This experiment also showed that social proximity cannot be defined only through an organizational dependency between communicators. I saw that social reciprocity encouraged people to act in a social way, while, the absence of social reciprocity led to triggering individualistic behaviours aiming at optimizing personal results. The experiment confirmed the theoretical assumptions of the Social Translucence framework [51] regarding the importance of attaining a sufficient level of visibility of one's availability status as a way to create the feeling of a 'collaborative spirit' between the actors. I saw that, in order to leverage socially responsible behaviours communicators need to be provided with indications regarding each other's communicative state in a way that is abstract yet informative enough to take a correct decision whether to initiate communication or not. The experiment also showed the need of leveraging accountability for one's actions, which could be achieved by representing social costs pertaining to inappropriate behaviours.

Chapter 4 described the first research-through-design study exploring the implications of the Social Translucence framework for designing mechanisms supporting attainment of visibility regarding one's communicative state. I aimed to understand what social cues about availability are perceived as sufficiently expressive by the recipient, and also easily understood and correctly interpreted by the initiator. I also wanted to test if there is a need to provide additional mechanisms, for example, mechanisms supporting mutual awareness, or whether provision of successful social cues could alone become foundation for new social rules in mediated settings. I saw that, to improve visibility, systems should present people's availability status in a contextualized yet abstract manner. A contextualized status was perceived as more informative compared to the generic availability information. The abstract, graphical representation of the status that was entirely dedicated to announce one's availability reduced people's privacy concerns. I also saw that visibility itself was not enough to leverage socially salient behaviours of communicators as it did not sufficiently supported gaining awareness of whether one's availability status was actually seen by the initiator.

Chapter 5 presented the second research-through-design study that explored ways to attain mutual awareness of the recipient's availability status. The results showed that ascertaining such awareness during communication initiation encouraged communicators to respect the communicative state of their colleagues comparing to the situation when the availability status was visible only in the 'buddy list' view. The main advantage of the textual status update was its equal visibility to both the recipient and the initiator, which provided participants with the opportunity to use it as an excuse to avoid an unwanted communication. The graphical representation was seen more as a 'defense mechanism' before the communication was actually initiated as it made the initiator's task of typing in the initial message more difficult. I also observed

that attaining mutual awareness of each other's communicative state was not only important during communication initiation but throughout the communicative process, like, for example, during communication breakdowns caused by external factors such as a phone-call. The results pointed at the importance of providing a lightweight way to indicate to each other communication breakdowns, especially if the breakdown is caused by external factors. Communication systems should also support managing communicators' expectations as when a response can be expected. They also need to support people in indicating who should be responsible for communication re-initiation and when the right moment for that re-initiation is.

6.2 Contributions

Erickson and Kellogg [51] defined the Social Translucence framework to facilitate a new approach for designing communication systems that make social information visible. My research goal was to operationalize this framework by (i) gaining knowledge about the information needs of communicators and (ii) designing and evaluating examples of mechanisms enabling a system to become socially translucent. By achieving these goals I hoped to inform the design of future tools supporting mediated communication that leverage social skills of people. I saw that the Social Translucence framework successfully serves as a guideline to inform the design of tools supporting social behaviours in mediated communication. Although I only addressed a small part of the communication process, I hope that the value of this framework will be recognized and used to inspire the design of new systems supporting communication and collaboration in mediated settings. I believe that the Social Translucence framework is a promising way to think about supporting computer-aided human-human interaction in the digital domain. In summary, the major contributions of the work presented in this thesis state that:

- Availability has a dynamic nature that is defined by factors such as the nature of the communication subject, the anticipated communication duration and social proximity between communicators. All these factors conjointly determine the communication outcome. The relative impact of them depends on the communication channel selected by the initiator. These factors should be seen as social cues which once made visible in the system are likely to support people in acting in a socially responsible manner.
- Communicators who share the same incentive are more likely to act in a socially responsible manner when communicating with each other. Communicators whose motivation is only based on social reciprocity are likely to act in a socially salient manner as a way to maintain the relationship with each other and also to increase their chances for a positive outcome of the communicative act.

- The recipients should be given the opportunity to indicate an appropriate moment for communication initiation. It should be achieved in terms of providing status indication that allows for contextualizing one's communicative state with minimal level of effort required. By a contextualized status indication, I refer to an indication that represents one's availability level and also provides an explanation regarding the reasons for indicating that particular level. Contextualized status indication is likely to allow co-workers not only to see that their colleagues are unavailable but also to understand why they are unavailable. An abstract, graphical status representation that is entirely dedicated to announce availability seems to leave sufficient space to achieve a desired level of ambiguity regarding how people present themselves to others and at the same time is not considered as privacy threatening.

- For systems supporting mediated communication to be successful, it is insufficient to only provide social cues about the availability status. It is crucial for such a system to leverage mutual, reciprocical awareness of that status by, for example, providing people with information about who is consulting their status and who is not. Displaying such information is likely to enable communicators to be more confident in holding each other accountable for untimely communications. The mutual awareness of the recipient's availability status could be achieved by presenting that status as a part of an ongoing communication rather than in a separate view (e.g., in the buddy list). In such a way an equal visibility of that status to both the recipient and the initiator is guaranteed.

- Mutual awareness needs to be maintained not only during communication initiation but also throughout the entire communication. To achieve that, systems need to support the initiator to indicate the time frame for answering messages in situations when the recipient is not instantaneously able to engage in a conversation. They should also support indicating communication breakdowns, especially, if they are caused by a reason occurring outside the application domain (e.g., pausing an Instant Messaging communication because of another communication initiated through the phone).

6.3 Implications for HCI practice

This research aimed at showing that the Social Translucence framework could be seen as guideline for different designs aiming at leveraging social skills of people that current design approaches do not succeed to achieve. As discussed in Chapter 1, many current solutions seem to be too rigid in their functionality to enable its users to apply the rules of social interaction to efficiently and effectively negotiate their

communicative contracts [16, 56, 159]. These solutions also fail to see the vitality of negotiating one's interactions as a way to create one's self-representation in the system [66, 22]. The Social Translucence framework shows that interaction between the actors could be seen as a social game; a skill that allows them to arrive at a certain place. On the other hand attaining too high level of Social Translucence could discourage users from interacting through a certain system. For example, displaying information regarding who and how often viewed one's availability status may seem too much as people may not want to appear desperate to contact each other. By implementing such a mechanism, the actors may begin to avoid checking each other status and through that loose the social advantage provided by the system.

6.3.1 Semi-automatic means to attain visibility

The results presented in this thesis showed that, although people appreciate the possibility to manually control their availability status, they often forget to keep it up to date. Therefore, I would like to argue that, to provide a reliable and informative status indication, it is necessary to merge the manual and automatic status adaptation techniques. This could, for example, be achieved by combining qualities of an agenda with the status message functionality of Instant Messaging applications. The calendar might be a right place to plan future appointments, but it rarely happens that one goes back there to fine-tune one's current activities. A more natural place to do so would be, for example, an Instant Messaging application. There, one could edit the current status (derived from his or her calendar). These changes could then be fed back to the calendar, which could adequately adjust other entries. In such a way the main advantages of the automatic and manual systems for indicating one's availability status could be combined to create a lightweight mechanism to support keeping one's status up to date and providing an additional advantage of offering a way to update calendar entries whenever necessary.

6.3.2 Initiator's needs for visibility

My early results also stated that attaining visibility of the recipient's communicative state is insufficient due to the fact that such a state is of a dynamic nature and is influenced by factors such as the nature of the communication subject, the anticipated communication duration and social proximity between communicators. In this thesis, I did not address this particular aspect of visibility. This aspect was, nonetheless, investigated through a number of master student projects. Although the results of these projects are not sufficiently rigorous, I could draw the following assumption that could be tested by the future research. I believe that, for any communication system to become socially translucent, there is a need to present information regard-

ing the needs of the initiator as only on that basis a true communication negotiation can begin. An example of such a solution was proposed by Hsieh et al [84] show the importance of addressing this issue. The evaluation of their *time* and *no popup tags* showed their value as lightweight means to coordinate the intended pace of Instant Messaging communications. I agree with the authors that message tagging is likely to facilitate different activities occurring in Instant Messaging systems. I, however, think that such tags should not only be provided for the communication initiators but also for the recipients. I also think that there is a need for more refined mechanisms to present communicative needs of the initiator. I also believe that once the initiator is requested to state his or her needs, they may become more conscious and therefore more considerate regarding the balance between their and the recipient's communicative state.

6.3.3 Ambiguity in status representation

Begole et al [17] experimented with visualizations of daily rhythms by mining the content of people's calendars. However, participants expressed concerns pertaining to privacy of their data. This is why it is crucial to allow users for defining the granularity with which their status is presented to others [174, 21]. Supporting ambiguity and deception is, in fact, admitting that availability is not an objective state of one person but a collaborative negotiation act that aims at assessing each other's communicative intentions and at the same time embedding the self-representations techniques into the dialogical structure of the interaction [77, 6, 173]. I think that leaving room for ambiguity in presenting one's communicative state is a crucial element for a success of any technological solution aiming at supporting mediated communication as it enables to distinguish between one's actual state of availability and awareness of that status among others [21]. In such a way people are provided with means to effectively manage their 'professional face' [66].

6.3.4 Continuous awareness

The study described in Chapter 5 pointed at an important issue regarding the fact that mutual awareness of people's actions in the digital domain needs to be maintained not only during communication initiation but also throughout the communication process. Romero [143] proposed an *one-click* mechanism which could serve as the means to maintain such mutual awareness. The mechanism allows the recipient to indicate that the recipient recognized the intent to communicate but was not able to react immediately by simply clicking on the message. In such a way the recipient minimized initiator's uncertainty regarding whether or not the message has been noticed, without compromising his or her need to postpone answering. It also sup-

ported ambiguity regarding the moment of resuming communication as it does not force the recipient to define the timeframe for returning to the paused conversation. In such a way Romero enabled the users of her system to attain mutual awareness as a prerequisite of their explicit grounding actions. In My view, however, mechanisms supporting mutual awareness need to be automatically embedded into the communicative exchange (like the mechanisms proposed in Chapter 5). Only then both communicators have the guarantee that the other party was notified about a given update. In consequence, an automatic way to attain mutual awareness creates the ground for accountability without inducing social tension between communicators (as discussed in Chapter 3). Future design research in this field should investigate other mechanisms supporting mutual awareness and investigate the extent to which they could leverage social behaviours in mediated communication.

6.3.5 Explication of accountability

The study reported in Chapter 4 pointed at the need for communication systems to provide explicit mechanisms allowing communicators to hold each other accountable for inappropriate behaviours. This observation contradicts the assumptions of the Social Translucence framework [51] which state that accountability is, in fact, an implicit process of rules and norms creation. I, however, argue that it may be interesting to experiment with some explicit accountability mechanisms or a priori rules that promote accountability to see whether they could provide additional benefits for communicators which were not initially envisioned by Erickson and Kellogg.

For example, Grudin and Horvitz [72] proposed a concept of an *optimistic access control* that could be seen as one way to explicate accountability for inappropriate user actions in a mediated setting. In the context of mediated communication, the optimistic access control could assume that anyone is able to initiate communication as long as the communicators act in a socially salient way. Once a certain person behaves inappropriately, the rules behind accepting his or her communication requests may change. For example, such a person could be presented with the status indication that presents higher level of unavailability and which, in fact, aims at increasing the threshold for communication initiation. To certain extent such mechanisms are proposed by many websites dealing either with bookings or an exchange of second-hand goods. On such sites, the purchaser has a possibility to provide a rating regarding the concluded transaction. On some sites, also the contractor is enabled to express his or her opinion regarding the transaction. If the contractor collects a large number of positive reviews, he or she is more likely to be considered for future transactions. Negative reviews, on the other hand, tend to discourage people to do business with an untrustworthy provider and, in the extreme case, the provider might be even banned from the possibility to do business on that particular site.

Another way to explicitly support accountability could be achieved through providing an aggregated assessment regarding social behaviours of members of a mediated setting. A concept similar to the *Round-Robin signature* could be provided for that purpose [120]. The Round-Robin signature enables group members to share comments without having to assume individual responsibility for the provided statement. Each group member can post a comment and ask for support of it. When a sufficient number of supporters is gathered, the system reveals both the comment and the names of the supporters. A similar solution could be proposed to evaluate people's communicative behaviours. Once a number of people notes that a group member acts in a socially dubious manner, they could use such a system (i) to verify whether their observation is shared by others and (ii) to indicate to that group member what the problem with his or her communicative attitude is. Lack of anonymity in presenting such a comment is likely to invoke a feeling of accountability also for those who comment on one's behaviour and in such a way secure that the comment would be phrased in an acceptable manner.

6.3.6 Testing theory in design

It is a difficult attempt to operationalize a theoretical framework in design. While theories are in their nature generic, the designs are specific. Each system is likely to require a dedicated set of guidelines that help it to become socially translucent. In this work I addressed some of the design aspects applicable for Instant Messaging tools. These guidelines may be less accurate for other communication systems such as phones or social networks. Nonetheless, it does not imply that Social Translucence could not provide guidance for designing mechanisms leveraging social behaviours in other tools supporting mediated communication. Below I present exemplary scenarios that show possibilities to incorporate the constructs of the framework: visibility, awareness and accountability into different communication means.

6.3.7 Social Translucence and face-to-face communication

Although face-to-face is not an example of mediated communication per se, it could be supported by a system. In many offices, the way to address Social Translucence is achieved simply by installing windows and/or semi-transparent doors, which allow the initiators to peek through and assess the state of the recipient (as envisioned by Erickson and Kellogg in their example of the translucent door). I could also envision the following scenario to achieve Social Translucence when mediating face-to-face communication that is based on the work of Cheverst et al [29].

> A group of co-workers is located in three-person offices. Each person can indicate his or her availability status (possibly using a tool support-

ing other communication means, like e.g., an Instant Messaging application). This status is presented on the door to their office in such a way that whoever approaches it cannot miss that information. Thus, the office inhabitants are ensured that every visitor entering their workspace is aware of the status of the person he or she wants to talk to and also of the status of the other people occupying the same office.

Through such a mechanism both the visibility of one's status and the awareness of that status is ensured. The additional benefit of such a system stems from the fact that the initiator is not only aware of the possible damage to the solitude of the intended recipient but also to that of the other office inhabitants (as the information of other office occupants is also clearly visible). In such a way, new social rules might be created that consider not only a one-to-one communicative act but also include the definition of socially appropriate behaviours in the context of people's coexistence in one physical space.

6.3.8 Social Translucence and phone communication

In phone communication, it is particularly important to enable an exchange of cues indicating whether communication will be accepted and how it could proceed prior to its actual initiation. Aoki and Woodruff [6] indirectly addressed some aspects of Social Translucence through the phone. They saw communication negotiation as a story-telling activity in which accounting for each other's actions is a continuous process. They proposed a concept of a *lease* that substantiates the way people could reciprocate their communicative behaviours and protect themselves from undesired communication by not renewing an expired contract with another person. A lease is, in fact, a voucher for initiating communication with another person for a specified period of time. Once a lease expires, one can decide whether or not to extend it for a particular person. Aoki and Woodruff see leases as 'a technical means of capturing expressions of ongoing reciprocal interest between entities'.

Another concept supporting attainment of mutual awareness in phone communication was proposed by Wiberg and Whittaker [172]. They suggested that the initiator should first indicate a need for phone communication, define its subject and propose a timeframe for that communication. By being provided with that information, the recipient should be able to compare his or her availability with the needs of the initiator and decide upon the most convenient moment to establish communication. If the initiator does not agree with that proposal, he or she could keep on negotiating the communicative contract until the agreement is reached. Such a proposal attempts to assure the symmetry in control over the communicative exchange by applying the Social Translucence constructs, namely visibility and awareness. Visi-

bility is expressed through the exchange of the cues regarding the reasons for communication before the communicative act is, actually, committed. Mutual awareness is partially attained through enabling lightweight negotiation regarding the time-frame for communication initiation, which, once agreed upon, could be seen as a communicative contract defining both the intermediate as well as future communications between the actors.

6.3.9 Social Translucence and email communication

As email is an asynchronous channel, one might say that the notion of Social Translucence is not applicable. I, however, argue otherwise and propose the following scenario to show its advantages for that communication channel.

> A group of people works on a project that has a number of sub-projects with a different number of them involved. As many things need to be shared, there is a lot of email communication going back and forth. Whenever a person writes a message that starts a new thread, he or she can apply relevant tags to it. Such a shared tag is, in fact, a one-word indication regarding the content of the message that is placed next to the subject line. Once the recipient(s) receives the message, the tags assigned by the initiator are proposed by the system as the default tags for that email. These tags are then propagated to all existing instances of the message. If a message has a tag the recipient considers as inappropriate, he or she can delete or edit it. These edits are then propagated to all instances of the message and made visible (e.g., by using a strikethrough text). Such an edited or deleted tag could have a link to a 'discussion page', where team members could resolve the issue about its meaning*.

Such interactive tagging could be seen as providing unique social cues to an email to increase the visibility of the focus of that message. The possibility of editing and deleting tags could be seen as an instantiation of mutual awareness. It guarantees that all interested parties receive a clear indication what message is potentially interesting to them. Finally, knowing that every tag is propagated to everyone is likely to encourage care in tag choice, which could be seen as creation of social rules based on the possibility to be held accountable for abusing the tagging system. I could also envision that an email client could learn about the usage patterns of different tags and propose the appropriate selection of them to the users as a way to reduce the additional workload pertaining to tag selection.

*The design of the shared tags has been conducted during an internship of the author of this thesis at Google Labs in Zurich, Switzerland. Due to the non-disclosure agreement, the design cannot be reported in this thesis in more detail

6.3.10 Social Translucence and social networks

Recent years brought about new ways of communicating in the digital world. New channels such as social-network applications (e.g., Facebook) or microblogging (e.g., Twitter) gain more and more popularity. Moreover, there are systems created that combine previously independent communicative means (e.g., Microsoft Office Communicator, Gmail or Google Wave). These developments imply changes in users' attitudes towards mediated communication. Firstly, with the maturing of communication technologies, so mature their users. For example, recently there have been rumours on the Internet that Facebook is enabling the access to the data of their subscribers to third party advertisers without permission. Facebook users used Facebook to inform others about a potential privacy violation on Facebook by over and over positing the following message as a status update item:

> 'Facebook has agreed to let third party advertisers use your posted pictures without your permission. Click on settings. Select Privacy. Then select 'Newsfeeds' and 'Wall'. Next select the tab that reads Facebook Ads. In the drop down box, select 'no one'. Then save your changes.'

In such a way a socially salient cue was made visible in the system for all its users to become aware of a potential privacy threat. With the increase of the mutual awareness of that threat among Facebook users, the company needed to quickly react by posting an adequate explanation regarding that potential threat. In such a way, accountability for an improper action of Facebook was attained. Moreover, it became clear that a social network could easily become a powerful means to share social cues and to ensure a quick attainment of mutual awareness regarding these cues. This could be perceived as an ultimate case of Social Translucence in the digital world.

Twitter is another example of an emerging communication medium that offers a low-effort means to provide updates about one's whereabouts that recently became popular also in corporate environments. It can be seen as a channel, where Social Translucence is attained automatically – as everyone sees what is being posted, it requires a certain level of consideration in what is being written. For example, in one situation a person posted a twit which could have been considered as inappropriate. Immediately, there was a reaction from the colleagues to delete it. I believe that this is an example of formation of new social rules based on the fact that one is held accountable for one's writings.

The expansion of communication channels also promises to make provision of social cues more salient. A person setting his or her status in one medium might, in the future, be able to propagate that status to other channels. An email with a request for additional work sent when the recipient indicated an incoming deadline might be more likely left unanswered on the basis of mutual awareness of that status.

However, existence of a larger set of communication means also implies danger of an increased information overload and saturation of some channels. It may also cause problems regarding inability to control what information is being shared with whom.

6.3.11 Cultural implications for design

The research described in this thesis was conducted in a country, which is a representative of a western-world. I am aware that different cultures may encourage different communication attitudes and norms. For example, Perlow and Weeks [130] showed the extent to which the feeling of reciprocity varied among Indian and American engineers. While Indian co-workers saw the act of helping each other as a way to expand one's own knowledge, the Americans perceived it as an exchange of favours and kept track of who was helping whom. Correspondingly, I envision that there will be differences in attaining Social Translucence for different cultures and environments, which is going to be explicated through different use of the offered mechanisms. Nonetheless, I believe that the fundamental notion of the framework pointing at the importance of presenting social cues in mediated settings remains applicable regardless of the cultural background of the system users.

6.4 Implications for HCI research

6.4.1 Methodological evolution in HCI

As described in Chapter 6, the focus in the Human-Computer Interaction (HCI) field shifted from user-orientation to design-orientation during the years of this research work [20, 35]. Emotions, values and culture became important elements to consider for the development of the next generation technologies. Cockton [35] said: *'the elements of user experience comprise design and human elements that interact to create and maintain feelings and beliefs, as well as enabling actions within digital environments and in the social and physical world'*. I believe that the focus of this research that aimed at leveraging social skills of people as means to regulate their interactions in mediated settings could be an addition to this new line of HCI research. I also see the need to expand this research from focusing purely on the communication process to including the design aspects of communication systems such as materials, features and qualities that make a specific technological solution worthwhile [34]. As shown by Romero [141] the physical representation of mechanisms supporting attainment of mutual awareness enables assessment of social cues using peripheral awareness, and in such a way lowers the potential disruptive effect of these cues.

6.4.2 Selection of methods

Throughout the research described in this thesis I applied a variety of research methodologies to test the validity of the Social Translucence framework as a guideline for the design of communication systems that aim at leveraging socially salient behaviours. I used both quantitative and qualitative methods frequently applied in this field before such as: laboratory experiments, Contextual Inquiry, interactions logging, open interviews and Focus Groups. I have also employed a method that is only recently gaining attention in the CSCW domain, namely Repertory Grid Technique. Based on My experiences, I argue that in order to inform design it is not sufficient to just test some design alternatives, it is important to apply methodologies that are sensitive to capture design implications. I would like to suggest that the method used on the study described in Chapter 4 (Repertory Grid Technique – RGT) shows to be more sensitive in eliciting data that could inform the design space for future technological solutions comparing to the more traditional interview techniques applied in other studies described in this thesis. I believe that RGT shows great capability to capture more design-relevant data and also enables the researcher to capture heterogeneous aspects on the design space for new technological solutions. However, the large imitation of the RGT pertains to the need of obtaining a number of technological artifacts, which then could be grouped in triads. In future work, I would like to verify this observation and also look for low-effort means to produce various design artifacts, which could then be used for evaluation using Repertory Grid Technique.

6.4.3 Study context

By studying communication behaviours in the laboratory (Chapter 3), I was able to effectively control for the influence of the context, within which the interactions were taking place. However, communication behaviours are situated in the picture bigger to that imitated in the lab [63] and reflect interpersonal relationships as largely influencing the way people act [69, 70]. Erickson and Kellogg [51] argued that systems attempting to leverage social processes should be studied in real-world settings. According to them, only in the real situation an actual social dependence between communicators is created, which, in turn, could begin to serve as the basis for creation of new social rules. However, setting up studies in real world renders problems. The most pertinent one is related to the difficulty of developing prototypes to the point when they could successfully replace commercial products. In the study described in Chapter 5, the main reason for many employees to withdraw from participation in the study was that the Do^{NT}Bother system was not as well developed as, e.g., MSN. Therefore, many potential users decided against putting the effort to switch to a new system. Consequently, only 1/3 of the initial group of participants decided to join the study, which limited the generalizability of the study results.

Studying communication systems in academia (and especially in researcher's own group) helps to overcome the problem of participation. In the study reported in Chapter 4, I could see that the overall involvement of participants was much higher comparing to that displayed by participants of the study described in Chapter 5. It could be explained by reciprocity between the researcher and his or her colleagues. Moreover, in academia researchers tend display highly inquisitive nature, therefore, they are be more inclined to persist with the study even if it causes some inconvenience. One may question the representativeness of the obtained results comparing to the cases where the researcher is an independent observer rather that a member of the group under investigation. A similar approach has been accepted in the CHI and CSCW community since its early days [47, 2]. I see the risk of a possible bias in setting up a study in one's working environment. I tried to deal with this issue by inviting participants who, although related to the author of this thesis, were in no way professionally related to her (except from one case). Moreover, I explicitly stated that the systems under evaluation are only means to conduct research and not final products and in such a way I hoped to encourage participants to express their true rather than socially-biased opinions regarding their experiences with the proposed solutions.

6.5 Concluding remarks

This thesis argued for a research approach that supports people in socially responsible interaction in the digital world by leveraging aspects such as: visibility, awareness and accountability, the three constructs proposed by the Social Translucence framework. It is through such an approach that people could be empowered to use their natural social sensitivity to guide their mediated interactions, on the one hand, and be enabled to control their interactive borders, on the other. The work presented in this dissertation is the first step towards realizing such an approach.

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Appendices

A

Data collected in the observational study of the administrative assistants reported in Chapter 2

Table A.1: Raw observational data collected during the study regarding the interruption handling practices of administrative assistants.

No	Adressee	Importance of the interruptor	Prupose of the interruption	Importance of interruption for interruptor	Importance of interruption for assistant	How quickly should the interruption be handled?	Task of assistant at the moment of interruption	Availability of assistant	Interruption outcome
1	assistant	the same level	mixed	Important	Not so important	whenever	talking to another person	Rather unavailable	Postponed
2	assistant	the same level	professional	Important	Rather unimportant	next hours	working on the computer	Available	diverted
3	assistant	the same level	professional	Important	Rather unimportant	next hours	talking on phone	Rather unavailable	diverted
4	assistant	the same level	professional	Important	Not so important	today	talking to another person	Not so available	Postponed
5	assistant	the same level	mixed	Important	Not so important	today	working on the computer	Not so available	Immediately handled
6	assistant	the same level	professional	Important	Not so important	today	talking to another person	Very available	Postponed
7	assistant	the same level	professional	Important	Unimportant	today	working on the computer	Available	diverted
8	assistant	the same level	professional	Very important	Not so important	today	talking to another person	Not so available	Immediately handled
9	assistant	the same level	professional	Very important	Unimportant	immidiately	talking to another person	Rather unavailable	Immediately handled
10	assistant	important	professional	Very important	Very important	this week	working on the computer	Available	Postponed
11	manager	less important	professional	Very important	Important	immidiately	absent	Very available	Postponed
12	assistant	the same level	professional	Important	Rather unimportant	today	working on the computer	Available	Immediately handled
13	assistant	very important	professional	Very important	Important	next hours	talking on phone	Not so available	Immediately handled
14	assistant	important	professional	Very important	Not so important	immidiately	working on the computer	Available	diverted
15	assistant	less important	social	Unimportant	Unimportant	immidiately	working on the computer	Available	Immediately handled

No	Adressee	Importance of the interruptor	Prupose of the interruption	Importance of interruption for interruptor	Importance of interruption for assistant	How quickly should the interruption be handled?	Task of assistant at the moment of interruption	Availability of assistant	Interruption outcome
16	assistant	very important	professional	Very important	Very important	immidiately	working on the computer	Very available	Immediately handled
17	assistant	the same level	professional	Important	Not so important	immidiately	working on the computer	Available	diverted
18	assistant	the same level	professional	Very important	Important	immidiately	talking to another person	Available	Immediately handled
19	assistant	the same level	professional	Very important	Not so important	immidiately	working on the computer	Very available	Immediately handled
20	assistant	the same level	professional	Important	Not so important	whenever	working on the computer	Available	Postponed
21	assistant	very important	social	Important	Very important	immidiately	working on the computer	Very available	Immediately handled
22	assistant	the same level	mixed	Important	Important	whenever	working on the computer	Available	diverted
23	assistant	less important	professional	Very important	Important	next hours	talking to another person	Not so available	Immediately handled
24	assistant	less important	mixed	Very important	Important	this week	working on the computer	Very available	Immediately handled
25	assistant	important	professional	Important	Important	immidiately	talking to another person	Not so available	Immediately handled
26	assistant	important	professional	Important	Important	today	working on the computer	Not so available	Immediately handled
27	assistant	the same level	mixed	Very important	Important	immidiately	talking on phone	Rather unavailable	diverted
28	assistant	the same level	professional	Important	Important	next hours	talking on phone	Not so available	Immediately handled
29	manager	important	professional	Important	Important	this week	talking to another person	Very available	Postponed
30	assistant	the same level	mixed	Unimportant	Rather unimportant	immidiately	working on the computer	Unavailable	Immediately handled
31	assistant	very important	professional	Very important	Very important	immidiately	working on the computer	Available	Immediately handled
32	assistant	important	professional	Important	Important	immidiately	working on the computer	Unavailable	Immediately handled
33	assistant	the same level	professional	Not so important	Important	today	working on the computer	Very available	diverted

No	Adressee	Importance of the interruptor	Prupose of the interruption	Importance of interruption for interruptor	Importance of interruption for assistant	How quickly should the interruption be handled?	Task of assistant at the moment of interruption	Availability of assistant	Interruption outcome
34	assistant	important	professional	Very important	Not so important	immidiately	working on the computer	Available	Immediately handled
35	assistant	the same level	professional	Not so important	Not so important	today	working on the computer	Available	diverted
36	manager	important	professional	Very important	Not so important	immidiately	absent	Unavailable	Postponed
37	assistant	the same level	professional	Very important	Very important	next hours	working on the computer	Very available	Immediately handled
38	assistant	very important	professional	Very important	Important	immidiately	working on the computer	Very available	Immediately handled
39	assistant	the same level	professional	Important	Rather unimportant	immidiately	working on the computer	Available	diverted
40	assistant	the same level	professional	Not so important	Important	this week	working on the computer	Available	diverted
41	assistant	the same level	mixed	Important	Not so important	next hours	working on the computer	Available	diverted
42	assistant	the same level	social	Important	Rather unimportant	whenever	working on the computer	Available	Immediately handled
43	assistant	very important	professional	Important	Very important	immidiately	working on the computer	Available	Immediately handled
44	assistant	the same level	professional	Not so important	Important	today	talking on phone	Not so available	Immediately handled
45	assistant	the same level	professional	Very important	Very important	immidiately	working on the computer	Available	Immediately handled
46	manager	very important	social	Unimportant	Rather unimportant	immidiately	talking to another person	Not so available	Immediately handled
47	assistant	important	professional	Very important	Important	this week	talking to another person	Not so available	Postponed
48	assistant	the same level	professional	Not so important	Rather unimportant	immidiately	talking to another person	Not so available	diverted

B

Data collected in the interview study of the knowledge workers reported in Chapter 2

Table B.1: Reported motivations of the interruptors regarding their decision whether to continue with initiating communication or not and the frequencies regarding how often each motivation was mentioned in the study.

Reported motivations	No
Decision to *continue* with the interruption	
When the interruptor has a feeling that the interruption subject requires personal attention of or is very relevant to the interruptee (e.g., informing the interruptee that his or her project received additional funding)	12
When the interruptor and the interruptee are engaged in a lengthy mail exchange that seems to bring no solution and the interruptor wants to discuss the problem in a more efficient way	12
When the interruption subject requires very little time from the interruptee (e.g., requiring about a perosn who is absent)	12
When the interruptor seeks a break or intends to socialize with the interruptee	12
When the interruptor searches for an honest opinion in a sensitive matter or is bothered about some incident (e.g., discussing with the manager why he or she wants to stop the project the interruptor is involved in)	9
When the interruptor wants to remind the interruptee about the responsibilities the he or she has towards the interruptor (e.g., reminding about a meeting)	7
When it is visible that the interruptee has already been interrupted by others (e.g., when others form a line outside or inside the interruptee's office)	6

When the interruptor wants the interruptee to dedicate time for him or her (e.g., to participate in the workshop the interruptor organizes or give a presentation).	5
When the interruptor thinks that the interruptee should take an immediate decision regarding an issue which is the subject to the interruption	4
When the interruptor wants to reformulate a negative reaction that the interruptee might feel offended by (e.g., when the interruptor refused via e-mail to get involved in organizing a social event for the group; an activity the interruptee is responsible for)	4
When the interruptee is alone at the office, so there is no danger of disturbing his or her roommate(s) when initiating the interruption	4
When the interruptee is clearly taking a break (e.g., drinking coffee)	4
When the interruptor looks for a quick and efficient exchange of opinions with the interuptee	3
When the interruptor wants to obtain a physical object (e.g., a book)	1
When the interruptor needs to travel a long distance to reach the interruptee	1
Decision to *postpone* the interruption	
When the interruptee is in a meeting, in an agitated discussion, surrounded by others or on the phone	12
When the interruptee explicitly indicates that the moment of the interruption was poorly chosen	10
When the interruptor recognizes that the interruptee is occupied and the interruption subject itself has a low urgency or importance	6
When the interruptor prefers to return at time when the interruptee can dedicate sufficient time to deal with the interruption subject	3
When the interruptee looks upset or irritated	1
When the interruptor comes only to assess the interruptee's occupancy level but the interruption itself can be handled at any other time	1

Table B.2: Reported motivations of the interruptees regarding their decision whether to handle immediately, postpone or reject interruption and the frequencies regarding how often each motivation was mentioned in the study.

Reported motivations	No
Decision to *handle immediately* the interruption	
When the interruptee recognizes the urgency of the problem after initial explanation of the problem given by the interruptor	10
When the interruptee feels that there is enough time to finish his or her own tasks or evaluates that he or she can still change plans for the day	10

When the interruptee assesses that time needed to handle the interruption is rather short (e.g., about 5 minutes)	9
When the interruptee expects that the interruptor wants to fix a social situation that has happened prior to the interruption (e.g. an argument)	7
When the interruptor holds a higher position in the organization comparing to the interruptee or is recognized as an expert in the field the interruptee works on	5
When the interruptee has an affinity with the interruption subject because of personal interests or professional responsibilities	3
When the interruptee realizes that he or she has overlooked professional obligations towards the interruptor (e.g., when the interruptee has forgotten about an appointment he or she had scheduled with the interruptor)	3
When the interruptor addresses the interruptee as an expert and brings an interesting question related to the domain the interruptee works on	3
When the interruption subject seems easy enough to be handled immediately (e.g. if the interruptor needs a certain document the interruptee has stored on his/her computer)	3
When the interruptee is either just starting the day, between the tasks or bored	3
When the interruptor comes with a professional issue during a social conversation like when the interruptee socializes with his or her colleagues at the coffee corner	2
When the interruptee knows that the interruptor is in a difficult personal or professional situation	2
When the interruptee realizes that he or she has nothing planned for the present moment	1
Decision to *postpone* the interruption	
When the interruptee feels that his or her task requires high concentration level or does not want to loose the inspiration in it	12
When the interruptee needs time to finish his or her own task	12
When the interruptee is under stress becasue of working on a high priority task for a long time	12
When the interruptee needs additional time to finish his or her primary task	12
When the interruptee thinks that the interruptor should rethink the subject of the interruption	8
When the interruptee sees that he or she has time to help the interruptor later in the day	8
When the interruptee has a feeling that the problem will work out by itself	8
When the interruptee wants to verify the importance of the interruption subject (e.g., assuming that the interruptor will return if the issue is really important)	3

When the interruptee has another appointment planned at a short notice or needs to prepare for an approaching meeting	3
When the interruptee can include the problem into the plans of for the following day (e.g., by scheduling a meeting with the interruptee)	2
When the interruptee cannot solve the problem immediately and needs time to prepare the correct answer	1
When the interruptee decides that the interruptor should spend more time analyzing the interruption subject (e.g., if the interruptor is unable to clearly specify his or her expectations towards the interruptee)	1
When the interruptee is in a negative emotional state due to personal reasons	1
Decision to *reject* the interruption	
When the interruptor behaves in an impolite or an insensitive way when initiating the interruption	12
When the interruptor disturbs a meeting or a professional conversation with another person	12
When the interruptor comes too often or brings the same problems over an over again	8
When the interruptor refuses to understand why the interruptee has no time and attempts to apply social pressure on the interruptee	7
When the interruptee has a feeling that the problem will work out by itself and doesn't want to invest time and effort into dealing with it	5
When the interruptee thinks that another person should be taking care of providing support in certain tasks (e.g., an office assistant might be more proficient in explaining how to fill in the forms for traveling expenses)	5
When the interruptee perceives that the interruptor has him or herself created a problem and demands that the interruptee deals with it (e.g., if the interruptor delayed a task in the project and wants the interruptee to finish it)	1
When the interruption subject is of no interest to the interruptee and at the same time he or she is busy with own tasks	1
When the interruptee wants to discourage the interruptor from coming again	1

C

Trivia questions used for the Quiz Game described in Chapter 3.

In the two rounds of the Quiz Game two sets of trivia questions were used. Each set contained 10 questions requiring participants to list six specific items. Participants had 1 minute to answer each question. After one minute elapsed a new question appeared. Participants could not return to previous questions at any point in the game. The task progression was calcutated by counting the number of items a participant entered per question.

C.1 Quiz I

1. List six European countries
2. List six islands in the world
3. List six wild animals
4. List six surnames of world famous painters
5. List six names of contemporary pop bands
6. List six names of nicknames of characters from the movie 'Star Wars'
7. List six hardware elements of the computer
8. List six vegetables
9. List six world famous buildings
10. List six Olympic disciplines

C.2 Quiz II

1. List six European capitals
2. List six US states
3. List six domestic animals
4. List six surnames of world famous composers

5. List six Oscar winning actors
6. List six names of characters from the movie 'Lord of the Rings'
7. List six software programs
8. List six names of flowers
9. List six seas or oceans
10. List six summer Olympic disciplines

D

Articles used in the Word Guessing Game described in Chapter 3.

In the two rounds of the Word Guessing Game two sets of trivia articles were used.

- One World, Two Civilizations by *Ryszard Kapuscinski* published in New Perspectives Quaterly 3(1), 1986
- Coutry of Longitudinal Essences by *Isabel Allende* published in My Invented Country, Harper Collins, 2003

The following two sections contain both articles. Each article is divided into a number of paragraphs. Within each paragraph four words are removed. For the missing words a number of related words was proposed (the correct word for each set of related words is highlighted).

Participants in the game were asked to read the consecutive paragraphs and fill in the missing words into a form placed next to that article. Unlike in the Quiz Game, there was no time limit assigned to reading each paragraph. Nonetheless, once moving to the following paragraph participants could not return to the previous one any more.

D.1 One World, Two Civilizations by *Ryszard Kapuscinski*

As a foreign correspondent for the Polish Press Agency, Ryszard Kapuscinski covered civil wars and revolutions in Latin America, Africa and the .....[2 pt] East for twenty years.

In times of crisis the importance of the .....[3 pt] is minimized because of the tension caused by big forces. Big forces involve the interests of the whole. Big forces mean a big mass and a big mass means the removal of the individual. It means the neglect, the non-importance, of the individual. Through manipulation and mass organization the individual becomes only .....[4 pt] of the big social forces, without a name and without hope. This has been the danger of the 20th Century. In a country with internal calm, in a stable society, there is a feeling that the space ahead is open. There is hope. One can pronounce his hopes and express himself because he's an individual. That's not true in a situation of crisis and .....[5 pt]. In a large demonstration, or in a large crowd, a person sees that he doesn't count. He is lost completely. He sees that his spirit has no meaning. He is a machine to march, to move, to fight.

- far / *middle*
- person / human being / *individual*
- a component / *an element* / a factor / an aspect
- unsteadiness / wavering / *instability* /flux / volatility

Crisis is always represented by crowds. In a crisis there are such important things involved that no one pays attention to the individual. History is always bigger and more important than individuals. History is the .....[2 pt], but not as Marx said, 'created according to man's will'. Rather, people are always faced with a situation where they don't know what they're creating. This is the .....[3 pt] of history. Crisis means everyone is dissatisfied - that's why there is tension. Everybody's unhappy. And if we are unhappy as a social force, then our private unhappiness is .....[4 pt] in this big social unhappiness. Our personal unhappiness exists, but becomes unimportant. Nobody pays attention. In the martial law period in Poland, this has troubled me. I have felt myself living the crisis, thinking, "how unimportant are my own problems when facing the big drama of history." I felt that it is unworthy to voice my own questions, my own troubles. It seemed .....[5 pt].

- *master* / creator
- irony / contradiction / *paradox*
- *dissolved* / melted / dispersed / vanished
- inapt / improper / unsuitable / *inappropriate* / unfitting

The more space history takes for itself, the less there is for the individual. This .....[2 pt] situation is the reality for the great masses of the Third World. There are millions of people dying of hunger but we are unable to mention a single name. We are .....[3 pt] the tragedy of mass anonymous death. The great problem of the .....[4 pt] Western societies - what New Perspectives has called the problem of the self-absorbed individual, not the absorption of the individual by history - doesn't have this destructive force. These modern problems don't kill the .....[5 pt] capacities of a society. The crisis created by history, however, is very destructive. It paralyzes society. The society doesn't create anything except hatred and violence and death.

- *anonymous* / unidentified
- tracking / trailing / *tracing*
- superior / *advanced* / highly developed / sophisticated
- inventive / productive / resourceful / original / *creative*

This difference is resulting in the creation of two different civilizations in the world. The question is not just one of quantity in terms of living standards, but of quality - of imagination, creativity and .....[2 pt]. That is the tremendous difference. If a person travels in the world today, he sees that he not only goes from a less developed country to a more developed country, or a poor region to a more .....[3 pt] one, but from one civilization to another! The contact between these civilizations is not growing. Rather, the .....[4 pt] is becoming

more pronounced. Despite forty years of decolonization and attempts at development we remain unable to find a way to .....[5 pt] this division, to make the North and South more equal. The gap will be greater at the beginning of the next century than at the beginning of this century.

- *dynamism* / vitality
- *prosperous* / wealthy / thriving
- disparity /*gap* / difference / inequality
- lessen / minimize / reduce / decrease / *shrink*

When I first went to Africa thirty years ago, I could find some modern agriculture, infrastructure and .....[2 pt]. There was more or less .....[3 pt] with Europe that had been destroyed by war and was then undeveloped. When one travels now, the difference is absolutely incredible. A lot of what was left from colonialism in Africa has deteriorated. Not many new things have been built. In the meantime, Europe has developed to .....[4 pt] level, not to speak of America. Instead of becoming more equal, everything has become more unequal. History has caused this paralysis in the Third World. Only big anonymous forces move things. It is a heavy .....[5 pt] that handicaps development. Everything has been decided in the past.

- healthcare / *medicine*
- comparable / *a parallel* / similar
- a vast / a gigantic / a massive / *an enormous*
- load / weight / problem / *burden* / liability

Societies with an historical .....[2 pt] are directed toward the past. All their energies, their feelings, their passions are dedicated to the discussion of history, to the meaning of history. They Eve in the realm of .....[3 pt] and founding lineages. They are unable to speak about the future because the future doesn't arouse the same passion in them as their history. They arc all historical people, born and living in the history of great fights, divisions and conflicts. They are like a war veteran. All he wants to talk about when he gets older is living that big experience of the war which carried such a .....[4 pt] emotion that he was never able to forget about it. So, this is the problem of historical societies, which all Third World nations are. They must live deeply in history; this is how they identify themselves. If they lose their history, they lose their identity. Then they will cease to exist. It is a question of survival. The historical societies are trapped in a tragedy. To forget about history would mean to forget about themselves a biological and psychological impossibility. Yet, to create a new value, a society has to have .....[5 pt] mind that will enable it to concentrate on doing something directed at the future.

- mindset / *mentality*
- myths / tales / *legends*
- profound / *deep* / intense / grave

- *a clean* / pure / wholesome / an unadulterated / an untainted

America, by contrast, is a .....[2 pt] nation. It has no problem with history. The American mentality is open to the future. As a young society it can be creative with no burden of history keeping it down, holding its leg, tying its hands, and, especially, pressing in on its mind. The danger for America, and the danger for the whole world, is that American development is so dynamic and creative that, by the beginning of the next century, it will be a completely .....[3 pt] world on this same planet. Everyday, America is producing more and more .....[4 pt] of a completely new civilization which is further and further from the civilization of the rest of the world. The civilization of the computer is untransferrable to the Third World where it can't be absorbed. The position and rule of dynamic America and the paralysis of historical societies - this is the big problem for the future of mankind. Unlike the .....[5 pt] we all held twenty years ago, the world is not converging, but spreading apart like the galaxies. This is the world we will have at the end of the 20th Century.

- fortunate / *lucky*
- changed / *different* / other
- factors / facets / *elements* / constituents
- *vision* / foresight / prediction / forethought / calculation

After the Second World War there was a great .....[2 pt] of consciousness in the Third World countries. For Africa and Asia particularly, the war proved that the master countries, like Britain or France, could be beaten. Also, the centers of power in the world .....[3 pt] from Germany, Japan and the French and British empires to the United States and the Soviet Union - countries that were not traditional colonial powers. These developments convinced the young nationalists in the Third World that they could achieve independence. The fight for independence had three stages. First came the national liberation movements, especially in the largest Asian countries.

India .....[4 pt] independence in 1947 and China in 1949. This period ended with the Bandung Conference in 1955, where the first political philosophy of the Third World, "nonalignment," was born. This philosophy was promoted by the great and colorful figures of the 1950s - Nehru Of India, Nasser of Egypt, Sukarno of Indonesia. The second stage, in the 1960s, was characterized by great optimism. It was the period when decolonization spread rapidly with the nonalignment philosophy as its guide. In 1964, fourteen African countries achieved independence. In the third stage, from the decade of the 1970s into the present, the great optimism which had accompanied the birth of nations began to be dashed. The .....[5 pt] that national independence automatically meant economic independence and cultural independence proved to be a utopian and completely unrealistic conception.

- *awakening* / arousing
- moved / altered / *shifted*
- gained / acquired / achieved / *obtained*
- faith / confidence / certainty / *belief* / trust

The present situation is rather pessimistic for the Third World countries, and there are no visible signs of improvement. For any of these nations to gain economic independence, given the general condition of the world market and level of technological development, is practically impossible.

Having spent many .....[2 pt] in the Third World, I am coming to the fatalistic conclusion that the structure of the world - the economic division of the world between developed and undeveloped nations - was already .....[3 pt] in the 18th and 19th centuries. With very few exceptions - Japan most notably - it is difficult to find a country that was undeveloped in the 19th Century that is developed today. 'Colonialism' was not only .....[4 pt] used in propaganda, but a very real system which created lasting structures which are seemingly impossible to .....[5 pt]. The tempo of change is very, very slow. It is always centuries before a society advances.

- *decades* / years
- determined / resolved / *decided*
- tag / *label* / mark / stamp
- *surpass* / beat / outdo / exceed / overcome

As we enter the 21st Century with the globe divided into the two great blocs of a developed and underdeveloped world, we see a fourth stage, opened by the Iranian revolution, which has .....[2 pt] as a consequence of the optimistic efforts for development. The technocratic character of modern values and the industrial plans of the optimistic period ignored the .....[3 pt] dimension of historical societies - the ethical and religious values of tradition. For example, the .....[4 pt] importation of technology into Iran was perceived by Iranians as a humiliation for a people with such a long, traditional culture. Because they were not able to learn the technology, they felt ashamed. This humiliation caused a very strong reaction. The Iranians nearly destroyed the sugar factories built by European specialists because they felt such fury at not being able to understand the technology. Because it was something foreign, they felt the technology was built-in to .....[5 pt] them. The change was so rapid that they were unable to accept it in such a short period of time. They refused because they felt it threatened the most elemental part of their society. The great Iranian masses that followed Khomeini found the grand economic plans, inefficient in terms of leading them to Heaven, to Paradise. As a result, even more emphasis was placed on older values. People defended themselves by hiding in these old values. The old traditions and the old religion were the only shelter available to them. The emotional and religious movements we see in reaction today are only the beginning. The Iranian Revolution opened a new period in Third World countries - the period of cultural decolonization and Cultural Revolution.

- occured / *emerged*
- vital / *crucial* / important
- quick / fast / hurried / *rapid*
- *dominate* / rule / control / dictate / limit

D.1. One World, Two Civilizations by *Ryszard Kapuscinski*

New forces are trying to find their way in the .....[2 pt] world. They are trying to define their own ideologies, their own way of expression. This new ideology is not creative, but defensive. The classic expression, which is the slogan of the future of the Third World, was formulated by the Ayatollah Khomeini. His slogan is "Not East, or West, Only the Islamic Republic." In this slogan we have practically all philosophies of the nationalistic, religious leaders. It is neither East - in terms of the Soviet Union or West - in terms of America - but only the Islamic Republic. Islamic means religious and republic means bureaucracy. The .....[3 pt] of religious ideology and bureaucracy is a living force in the societies of the Third World today (...)

The historical societies of the Third World accept certain .....[4 pt] of modernism which can somehow be coordinated with the old values - the wristwatch, the radio, the car. But we can't find an example of what will pave the way from the traditional structure of historical and even tribal societies, to developed, democratic Western types of society. There is no country which has taken the road not just to America, but even to Dutch society or Swiss society. And, without this development, none of these societies is able to absorb modernization as something that will change their everyday lives. Rather, the common man of the Third World countries will treat modernism, on the grand scale, as a threatening force for two reasons. First, since the state sees modernism as important in these countries, the government builds big projects which have nothing to do with the life of the .....[5 pt] man. These projects only serve to strengthen local bureaucratic powers. Second, modernism comes in the form of armaments which, in internal policy, are used by the government to suppress the society. So, thinking in terms of credit and machines is a completely wrong idea of development, especially when the education level of many nations, especially in Africa, is lower now than twenty years ago. That route doesn't work. Only a change in the thinking, in the imagination of these societies will work. And for that there are no practical answers, only theoretical ones. Some say socialism. Some say democracy.

- *contemporary* / modern
- *combination* / amalgamation / mixture
- accomplishments / attainments / *achievements* / triumphs
- ordinary / regular / *common* / normal / mundane

But, in the realities of these Third World societies, the theoretical answers have little .....[2 pt]. Democracy or socialism are just words and intentions used demagogically. They produce no practical results. Whether of the left or the right, these ideologies have been unable, during this second half of the 20th Century, to surmount the blockades set in place by both colonialism and tradition. These limits were .....[3 pt] in Iran with the Shah, then with Bani-Sadr, the first president of the revolution's original left-leaning stage. The limits are also clear in such places as Ethiopia, Somalia, Togo and elsewhere in Africa. These nations switch from left to right and back, but nothing changes except their foreign policy positions. The need is to find an internal solution to change society, to make a revolution of the mind, of behavior, attitude and organization. These societies are so completely ignorant of organization that to change that alone would .....[4 pt] an enormous revolution. It is an inherent characteristic of an oligarchy that it creates a large class of bureaucrats, military and police who all

stand to lose their vested interests in any transfer of power, democratic or otherwise. So, they stubbornly resist. It is very difficult to change power in a democratic way in countries without democratic traditions. In the 1960s, Europe had many military dictatorships - Greece, Portugal, Spain. However, those countries had European democratic traditions, so they were able to return to democracy. But, when there is no democratic .....[5 pt] to return to, the mechanism of permanent authoritarian power tends to be re-established.

The Iranian revolution was a clear example of this. It started out as a pro-democratic revolution and ended as a religious dictatorship. Nigeria is another good example. Two years ago, it tried to return to civilian rule and failed. The military rules there once again. These countries are moving in a vicious cycle set in motion a long, long time before us.

- *meaning* / connotation
- obvious / evident / *apparent*
- need / *require* / necessitate / demand
- knowledge / practice / familiarity / *experience* / understanding

It is difficult to expect liberal democrats to .....[2 pt] power in places like the Philippines even if they have attained it. They are unable to offer any immediate answers to the problems of a society like the Philippines. They cannot satisfy the revolution of growing expectations based in .....[3 pt] everyday needs and the promises to satisfy them. In a situation of poverty, there will always be confrontation and unrest. Even the few democratic societies of the Third World, like India which was born out of British liberal traditions, are forced to use the military to calm down situations instead of resolving the problems of society. That is beyond their reach.

If we look at it in perspective, the period of these oligarchies is coming to an end. There are very few now. The big names are gone - the Somozas, Papa Doc, Trujillo, Idi Amin and Marcos. And in each case, the rule is either directly in the hands of military groups without .....[4 pt] leaders, or it is in the hands of bureaucrats representing the interest of their own group. The democratic trend in Latin America is not very new. If we take into account the history of countries like Argentina, we see the characteristics of so many Latin regimes: .....[5 pt] change between military and civilian rule. This change is something which, historically, has happened every four or eight years for more than one-hundred years with the exception of Chile, where there was civilian rule for a very long time and now military rule for a very long time.

- preserve / *maintain*
- instant / constant / *immediate*
- significant / central / chief / *important*
- cyclic / intervallic / *periodic* / recurrent

With the swing toward civilian government, the military seems to have exhausted its possibilities at this stage of Latin American history. But this is temporary. None of these governments - civilian or military - are able to resolve the problems of the country. With the enormous debt problem now, they are in a very difficult economic situation, although things

have always been difficult economically. The debt problem will surely lead to a new stage of social unrest. Democratization is a temporary phenomenon since the economic difficulties are a growing phenomenon. Maybe I'm wrong, but historical experience has to be the guide. In Latin America, the army is practically another political party dressed in uniform. They are never too far from power. They can't long resist the temptation to come back to power. And this has proved an easy road in Latin America.

D.2 Country of Longitudinal Essences by *Isabel Allende*

Let's begin at the beginning, with Chile, that remote land that few people can locate on the map because it's as far as you can go without falling off the .....[2 pt]. Why don't we sell Chile and buy something closer to Paris? One of our .....[3 pt] once asked. No one passes by casually, however lost he may be, although many visitors decide to stay forever, ...[4 pt] of the land and the people. Chile lies at the .....[5 pt] of all roads, a lance to the south of the south of America, four thousand three hundred kilometers of hills, valleys, lakes, and sea.

- earth / *planet*
- scholars / thinkers / *intellectuals*
- mesmerized / *enamored* / charmed / fascinated
- fringe / side / *end* / edge / tip

This .....[2 pt] country is like an island, separated on the north from the rest of the continent by the Atacama Desert -the driest in the world, its inhabitants like to say, although that must not be true, because in springtime parts of that lunar rubble tend to be covered with a .....[3 pt] of flowers, like a wondrous painting by Monet. To the east rises the cordillera of the Andes, a .....[4 pt] mass of rock and eternal snows, and to the west the abrupt coastline of the Pacific Ocean. Below, to the south, lie the solitudes of Antarctica. This nation of .....[5 pt] topography and diverse climates, studded with capricious obstacles and shaken by the sighs of hundreds of volcanoes, a geological miracle between the heights of the cordillera and the depths of the sea, is unified top to tail by the obstinate sense of nationhood of its inhabitants.

- *elongated* / stretched
- blanket / *mantle* / veil
- impressive / dreadful / *formidable* / extraordinary
- spectacular / striking / remarkable / sensational / *dramatic*

We Chileans still feel our bond with the soil, like the campesinos we once were. Most of us dream of .....[2 pt] a piece of land, if for nothing more than to plant a few worm-eaten heads of lettuce. Our most important newspaper, El Mercurio, publishes a weekly agricultural .....[3 pt] that informs the public in general of the latest insignificant pest found on the potatoes or about the best forage for improving milk production. Its readers, who are planted in asphalt and concrete, read it voraciously, even though they have never seen a live cow.

Appendix D. Articles used in the Word Guessing Game described in Chapter 3.

In the broadest terms, it can be said that my long and narrow homeland can be broken up into four very .....[4 pt] regions. The country is divided into provinces with beautiful names, but the military, who may have had difficulty memorizing them, added numbers for identification purposes. I refuse to use them because a nation of poets cannot have a map dotted with numbers, like some mathematical delirium. So let's talk about the four .....[5 pt] regions, beginning with the norte grande, the "big north" that occupies a fourth of the country; inhospitable and rough, guarded by high mountains, it hides in its entrails an inexhaustible treasure of minerals.

- having / *owning*
- appendage / *supplement* / addition
- *different* / diverse / distinctive / singular
- big / sizeable / huge / *large* / great

I traveled to the north when I was a child, and I've never forgotten it, though a half-century has gone by since then. Later in my life I had the .....[2 pt] to cross the Atacama Desert .....[3 pt] times, and although those were extraordinary experiences, my first recollections are still the strongest. In my memory, Antofagasta, which in Quechua means 'town of the great salt lands', is not the modern city of today but a .....[4 pt], out-of-date port that smelled like iodine and was dotted with fishing boats, gulls, and pelicans. In the nineteenth century it rose from the desert like a mirage, thanks to the industry producing nitrates, which for several decades were one of Chile's .....[5 pt] exports. Later, when synthetic nitrate was invented, the port was kept busy exporting copper, but as the nitrate companies began to close down, one after another, the pampa became strewn with ghost towns. Those two words: 'ghost town' gave wings to my imagination on that first trip.

- *opportunity* / possibility
- numerous / a number of / *a couple of*
- gloomy / *miserable* / depressed / sad
- primary / major / *principal* / foremost / main

I recall that my family and I, loaded with bundles, climbed onto a train that traveled at a .....[2 pt] pace through the inclement Atacama Desert toward Bolivia. Sun, baked rocks, kilometers and kilometers of ghostly .....[3 pt], from time to time an abandoned cemetery, ruined buildings of adobe and wood. It was a dry heat where not even flies survived. Thirst was unquenchable. We drank water by the gallon, sucked oranges, and had a hard time .....[4 pt] ourselves from the dust, which crept into every cranny. Our lips were so chapped they bled, our ears hurt, we were dehydrated. At night a cold hard as glass fell over us, while the moon lighted the landscape with a blue splendor. Many years later I would return to the north of Chile to visit Chuquicamata, the largest open-pit copper mine in the world, an immense amphitheater where thousands of earth-colored men, working like ants, rip the mineral from stone. The train .....[5 pt] to a height of more than four thousand meters and the temperature descended to the point where water froze in our glasses. We passed the silent salt mine of Uyuni, a white sea of salt where no bird flies, and others where we saw

elegant flamingos. They were brush strokes of pink among salt crystals glittering like precious stones.

- snail's / *turtle's*
- *solitude* / loneliness / isolation
- protecting / taking care of / shielding / *defending*
- went / climbed / *ascended* / rose / soared

The so-called norte chico, or "little north," which some do not classify as an actual region, ...[2 pt] the dry north from the fertile central zone. Here lies the valley of Elqui, one of the spiritual centers of the Earth, said to be magical. The .....[3 pt] forces of Elqui attract pilgrims who come there to make contact with the cosmic energy of the universe, and many stay on to live in esoteric communities. Meditation, Eastern religions, gurus of various stripes, there's something of everything in Elqui. It's like a little corner of California. It is also from Elqui that our pisco comes, liquor made from the muscatel grape: transparent, virtuous, and .....[4 pt] as the angelic force that emanates from the land. Pisco is the prime ingredient of the pisco sour, our sweet and treacherous national drink, which must be drunk with confidence, though the second glass has a kick that can floor the most valiant among us. We usurped the name of this liquor, without a moment's hesitation, from the city of Pisco, in Peru. If any wine with bubbles can be called champagne, even though the authentic libation comes only from Champagne, France, I suppose our pisco, too, can .....[5 pt] a name from another nation. The norte chico is also home to La Silla, one of the most important observatories in the world, because the air there is so clear that no star-either dead or yet to be born-escapes the eye of its gigantic telescope. Apropos of the observatory, someone who has worked there for three decades told me that the most renowned astronomers in the world wait years for their turn to scour the universe. I commented that it must be stupendous to work with scientists whose eyes are always on infinity and who live detached from earthly miseries, but he informed me that it is just the opposite: astronomers are as petty as poets. He says they fight over jam at breakfast. The human condition never fails to amaze.

- separates / *divides*
- strange / unexplained / *mysterious*
- placid / peaceful / tranquil / *serene*
- apt / fitting / proper / *appropriate* / suitable

The valle central is the .....[2 pt] area of the country, a land of grapes and apples, where industries are clustered and a third of the population lives in the capital city. Santiago was founded in 1541 by Pedro de Valdivia. After .....[3 pt] for months through the dry north, it seemed to him that he'd reached the Garden of Eden. In Chile everything is centralized in the capital, despite the efforts of various governments that over the span of half a century have tried to .....[4 pt] power among the provinces. If it doesn't happen in Santiago, it may as well not happen at all, although life in the rest of the country is a thousand times .....[5 pt] and more pleasant.

- *most prosperous* / richest
- *walking* / hiking / traveling
- *distribute* / split / divide / spread
- more serene / *calmer* / stiller / quieter / relaxed

The zona sur, the southern zone, begins at Puerto Montt, at 40 degrees latitude south, an enchanted region of forests, lakes, rivers, and volcanoes. Rain and more rain .....[2 pt] the tangled vegetation of the cool forests where our native trees rise tall, ancients of thousand-year growth now threatened by the timber industry. Moving south, the traveler crosses pampas .....[3 pt] by furious winds, then the country strings out into a rosary of unpopulated islands and milky fogs, a labyrinth of fjords, islets, canals, and water on all sides. The last city on the continent is Punta Arenas, wind-bitten, harsh, and proud; a high, ...[4 pt] land of blizzards.

Being so far from everything gives us Chileans an insular mentality, and the majestic beauty of the land makes us take on airs. We believe we are the center of the world-in our view, Greenwich should have been set in Santiago and we turn our backs on Latin America, always .....[5 pt] ourselves instead to Europe. We are very self-centered: the rest of the universe exists only to consume our wines and produce soccer teams we can beat.

- *nourishes* / feeds
- whipped / belted / *lashed*
- inhospitable / *barren* / desolated / infertile
- *comparing* / associating / contrasting / matching / relating

My advice to the .....[2 pt] is not to question the marvels he hears about my country, its wine, and its women, because the foreigner is not allowed to criticize-for that we have more than fifteen million .....[3 pt] who do that all the time. If Marco Polo had descended on our coasts after thirty years of adventuring through Asia, the first thing he would have been told is that our empanadas are much more .....[4 pt] than anything in the cuisine of the Celestial Empire. (Ah, that's another of our characteristics: we make statements without any basis, but in a tone of such certainty that no one doubts us). I confess that I, too, suffer from that chilling chauvinism. The first time I visited San Francisco, and there before my eyes were those gentle golden hills, the majesty of forests, and the green mirror of the bay, my only comment was that it looked a lot like the coast of Chile. Later I learned that the sweetest fruit, the most delicate wines, and the finest fish are imported from Chile .....[5 pt].

- traveler / *visitor*
- nation / citizens / *natives*
- *delicious* / enjoyable / delightful / tasty
- Unsurprisingly / *Naturally* / Obviously / Logically / Of course

To see my country with the heart, one must read Pablo Neruda, the national poet who in his .....[2 pt] immortalized the imposing landscapes, the aromas and dawns, the .....[3

pt] rain and dignified poverty, the stoicism and the hospitality of Chile. That is the land of my nostalgia, the one I invoke in my solitude, the one that .....[4 pt] as a backdrop in so many of my stories, the one that comes to me in my dreams. There are other faces of Chile, of course: the materialistic and arrogant face, the face of the tiger that spends its life counting its stripes and cleaning its whiskers; another, depressed, crisscrossed by the brutal scars of the past; one that shows a .....[5 pt] face to tourists and bankers; and the one that with resignation awaits the next geological or political cataclysm. Chile has a little of everything.

- poems / *verses*
- *tenacious* / persistent / obstinate
- looks / emerges / materializes / *appears*
- merry / joyful / *smiling* / cheery / happy

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Executive Summary

Communication is for people a salient way to exchange information and to maintain interpersonal relationships. However, for communication to be successful both the initiator and the recipient need to constantly ground their communicative needs. Such a process is predominantly guided by a set of social rules that are shared between the communicators. The joint agreement upon these rules is often implicitly attained in face-to-face encounters where other reference points besides the content of the conversation (such as gestures, mimics and elements in the environment) help to ground each other's communicative expectations. This is, however, not the case in the digital domain. Current tools supporting mediated communication tend to fulfill functional requirements enabling communication to occur but otherwise are blind to social signals people so effectively produce in the physical domain. The most profound problem of such tools is that they do not address the asymmetry in control over a communicative exchange and fail to help communicators to provide sufficient social cues about their communicative state.

Thus far two approaches were proposed to address that blindness: reachability management that aims at automatically finding an appropriate moment to initiate communication based the cues gathered from one's environment. The problem with that approach pertains to the level of informativness and reliability of an automatic status indication. An alternative approach: interpersonal privacy negotiation, addresses the influence of both communicators on shaping the decision regarding communication initiation. This approach, however, misses out on the aspect regarding developing of social rules in communication that pertains to the achievement of accountability for one's actions based on the mutual awareness of each other's activities and behaviours. This thesis proposes a third approach to address the aspect of communication negotiation in mediated settings which aimed at leveraging social behaviours of communicators through attaining sufficient level of visibility regarding one's availability state and also by ensuring the mutual awareness regarding that status at the point of communication initiation. This approach is based on the Social Translucence framework proposed by Thomas Erickson and Wendy Kellogg.

First, the factors shaping communication negotiation were examined and the relative impact of these factors that depends on the nature of the communication channel was investigated. The initial results were then tested in a laboratory setting, where we attempted to understand the interplay between the social relationship and the different system behaviours. Next, in two research-through-design studies, the applicability of the Social Translucence framework to design mechanisms supporting social behaviours in Instant Messaging applications was investigated. I chose for that particular communication channel as the test-bed as it offers a highly observable continuum between synchronous and asynchronous types of communication.

The contribution of this research to the field of Human-Computer Interaction lays in the provision of a higher understanding regarding the importance of enabling formation of new rules that stimulate social behaviours in the digital world that are based on the joint understanding of being able to hold one accountable for an inappropriate behaviour. This thesis advances previous work by empirically confirming the importance to support the development and maintenance of social rules in mediated communication that can be achieved through making socially significant information about one's availability status visible in the system and also by ensuring the mutual awareness of that status among communicators. Results indicate that, although it is crucial to ground the joint understanding of each other's communicative state at the point of communication initiation, it is equally important to provide mechanisms to maintain that common understanding throughout the entire communication process. Only then communicators are able to develop new rules that leverage their social behaviours.

Short Curriculum Vitae

Agnieszka Matysiak Szóstek was born in 1974 in Kielce, Poland. Her early scientific interests evolved around the domain of linguistics, which she studied at Warsaw University in Poland. During her studies she was awarded a governmental scholarship provided to 15 best Polish students and visited the Institute for Greek and Latin Languages at the University of Copenhagen, Denmark. After graduating with the highest grade, she moved to The Netherlands to enter a two-year postgraduate program of User System Interaction at Eindhoven University of Technology. She graduated in 2002 and then chose to pursue professional career as an industrial researcher. She began working as a member of scientific staff at Oce Technologies in The Netherlands. In the course of her work she became involved in the Smart Surroundings project funded by the Ministry of Economic Affairs of The Netherlands (Contract no. 03060). Her role in the project resulted in the offer of a PhD position that would be fully sponsored by Smart Surroundings. She started her PhD in 2005 at the Industrial Design department of Eindhoven University of Technology in The Netherlands. In the course of her PhD she was invited to present her work at various research institutions both in The Netherlands and in other European countries. Her visit to Switzerland resulted in an invitation to join Google labs in Zurich and conduct research on the subject of email overload. She arrived in Switzerland in September 2008 and spent 5 months working on ways to address the problem of email overload in Gmail.

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Agnieszka Matysiak Szóstek, Panos Markopoulos and Berry Eggen. The nature of availability. To be published in the special issue of The Ergonomics Open Journal, Bentham Open (2010)

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The years of conducting the PhD were for me like the trip to Madagascar to research the coral reef, which I went on just before coming to the university. First, we got excited about a new adventure and could not wait for it to start. Once we arrived on the island, we realized that the way to the destination was long, unknown and full of adventures. We had to survive a 16-hour trip on a local mini-van filled up with 15 other people, a crash with a bus and drowning in the sands. Before being entitled to start doing the research we needed to distinguish among 150 species of fish that did not look that much different from each other. Then we spent long hours in the sea, regardless of its condition, counting the fish and measuring the coral. We were virtually cut off the rest of the world and dependent only on each other. Some days were great, some were less. But I never regretted living through this experience. Likewise, I never regretted coming back to the academia and learning how to do research.

There are so many people whom I would like to thank for their help and support in these last four years. Having you around me made these years to forever stay in my memory as fantastic time full of exiting challenges and a steep learning curve.

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> 'It is possible to fail in many ways...while to succeed is possible only in one way.' *Aristotle*

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> 'There is an evil tendency underlying all our technology - the tendency to do what is reasonable even when it isn't any good.' *Robert Pirsig*

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> 'The important thing in science is not so much to obtain new facts as to discover new ways of thinking about them.' *Sir William Bragg*

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> 'Part of the secret of success in life is to eat what you like and let the food fight it out inside.' *Mark Twain*

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> 'Most people are other people. Their thoughts are someone else's opinions, their lives a mimicry, their passions a quotation.' *Oscar Wilde*

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> 'Every portrait that is painted with feeling is a portrait of the artist, not of the sitter.' ('Każdy portret namalowany z uczuciem jest portretem artysty a nie osoby widocznej na obrazie.') *Oscar Wilde*

Mamo, dziękuję Ci za to, że mnie nauczyłaś jak być ambitną, konsekwentną i niezależną. Mam nadzieję, że dziś jesteś ze mnie dumna!

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