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**Disturbing cell phone behavior - a  
psychological perspective.  
Implications for mobile technology  
in tourism**





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**Abstract**

People perceive the use of cell phones as annoying, disturbing, interrupting, impolite, and even as improper behavior in many social situations. This has been explained as a social phenomenon related to norms of social behavior. We argue that a social and cognitive psychological perspective could provide further understanding of the mechanisms involved in this issue. We suggest that disturbance is a complex and multi-dimensional problem, associated with situational, technological and individual factors of the user and the co-located individuals. Several factors are introduced and discussed, including social norms, type of situation, socio-demographics such as age, cell phone ownership and experience, personality, social awareness, cognitive load and attention, task or activity, relevance and predictability of the call, perceived control, listening conditions, speaker volume and the unequal caller/answerer status referred to as "caller hegemony". This is followed by a discussion of disturbance of mobile technology in tourism with examples of how this partly can be solved by using context-aware applications. In the final section we suggest a tentative model illustrating the problems of disturbance of cell phones and other mobile communication, including individual, situational, and technological dimensions.

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## Preface

This report is a result of an activity in the project *Personalization and context-aware applications (PEKKA)* at Telenor R&D, focusing on user-perspectives and social psychological aspects of context-aware applications. A previous version was originally formulated as a proposal for a phd project in psychology. This has been rewritten, focusing on the implications for mobile technology in tourism and adjusted to the format of a Telenor publication.

The report offers insights into issues that should be taken into consideration in Telenor activities towards the travel industries, specifically the MOVE project that is affiliated with PEKKA. MOVE's objective is to develop mobile services based on digital representations of national tourist routes, adding value to the travellers' experiences of the routes' nature, sights, local history, information and other service offers. Focus is both on the tourists, by offering easy access to services, and on the travel industries communicating their service offers. More information on the MOVE project is available on <http://www.moveweb.no>.

## Introduction

People talking in cell phones in public spaces is a common sight in most industrialized countries. There is no doubt that many find cell phones highly useful, and appreciate the flexibility and accessibility they represent. However, the use of cell phones in public spaces may also be experienced as annoying and disturbing, interrupting other activities, and even perceived as improper behavior in many social situations (Haddon, 1998; Wei and Leung, 1999; Katz and Aspden, 1999; Townsend, 2002; Ling, 2002). The problem of cell phone disturbance in public spaces has mainly been treated as a social phenomenon related to norms of social behavior in the various social settings. The general argument being that cell phone usage may challenge the social norms of behavior of the social setting, and/or that specific norms of cell phone usage have yet to be established (Ling, 1998; 2002). Several factors may effect whether a cell phone conversation is to be perceived as disturbing by others, including situational, individual, task related, expectations, perceived control and the relative speaker volume or loudness of the cell phone conversation. The cognitive load on the cell phone user may also be a factor to be considered.

The safety of using cell phones while driving is another aspect of cell phone use of general concern. And there are good reasons to be concerned. It is well documented that using the cell phone while driving distracts the attention of the driver, reduces driving performance and increases the risks for accidents (e.g. Groeger, 2000; Haigney, et al, 2000). The social disturbance of cell phone use in public spaces and the safety hazard of using cell phones while driving may seem unrelated. The former being a social problem related to norms of proper behavior, and the latter a problem of traffic safety related to distracting the attention of the driver.

We suggest that these problems may very well be related. The research on cell phones and driving have documented that cell phone use demands certain cognitive efforts, which again may compete with, disrupt or distract other activities, such as driving. We may assume similar effects of cell phones use on other activities as well, and in this case we are particularly interested in activities related to social interaction. This can be summarised in the following questions:

- Is it possible to find effects of cell phone use on peoples social interaction, parallell to those found on driving performance?
- May the problem of social disturbance of cell phone use be partly explained by these effects?

This cognitive load hypothesis is included in a set of hypotheses about situational, individual and task related factors that may contribute to explain the problem of social disturbance of cell phone conversations. The main focus of the report could be formulated in five questions:

1. Is perceived social disturbance of cell phones related to individual differences (attitudes, experiences, social awareness) of the speaker or of the observer?
2. Is perceived social disturbance of cell phones related to the cognitive load and a diverted attention of the speaker (resulting in a reduced awareness or attention to the local social situation)?
3. Is perceived social disturbance of cell phones task or relevance related (the type of task performed by the observer, or the relevance of the cell phone conversation to the task performed by the observer)?

4. Is perceived social disturbance of cell phones related to expectancy and feeling of control by the observer?
5. Do people tend to speak louder on cell phones than in face-to-face conversations, and can perceived social disturbance be explained simply by the loudness of cell phone conversations?

In the following sections, these questions are discussed separately, and hypotheses for further research are suggested.

Implications for new services based on mobile telecommunication technology in general and particularly related to tourism are discussed. Tourism is among the areas expected to have considerable potential for mobile technologies, and the need for information combined with the high mobility, constant change of the surroundings and new impressions for the tourist, makes tourism a particularly interesting case for discussing implications of social disturbance, diverted attention and cognitive load of information and communication technology.

# 1 Cell phones disturb and distract

Since the mid-nineties, we have witnessed an enormous growth in the use of cell phones. In the US, almost two-thirds (62 percent) of American adults owned a cell phone in 2001 ([www.scarborough.com](http://www.scarborough.com)), and the number of cell phone subscribers (pre-paid and regular) reached 87% of the total Norwegian population by 2003 (Norwegian Post and Telecommunication Authority). Parallell with the growth of users, the rapid technological development of mobile telecommunications has resulted in a wide range of information, communication and transactional services provided via cell phones. Though people use cell phones primarily for speaking and text-messaging (SMS), there is a substantial growth in the use of additional SMS or WAP services such as information services, marketing, buying tickets or products, work related services (mobile office), as well as using the cell phone for online connection of other devices such as lap tops or handheld computers. The high numbers of cell phones in the population combined with the expanding types of use, are indeed indications of the pervasive nature of this technology in our society.

## 1.1 The pervasive cell phone

Cell phones and wireless phones have dramatically changed the way people use telephones. Traditionally, telephone conversations were restricted to take place in relatively fixed locations. The physical telephone line restricted the user's abilities to move around while talking, and telephones were usually located in areas away from and more or less isolated from other activities. Telephone booths and phone boxes were located in designated areas and designed for the purpose of not disturbing and/or being disturbed by others. The location of the telephone in private homes and offices has also been regulated by norms and traditions, balancing the benefits of a central location with the comfort of having the phone conversation away from the noise and disturbance of other activities (Ling & Thrane 2001).

The cell phone has brought telephone conversations out from these designated areas of traditional fixed line telephones, and into the huge variety of social situations and settings people take part in. Today, we see people use cell phones in all kinds of situations, from the most private situations such as in bed and in the bathroom, to public places such as in the streets, on the bus, in shops, restaurants, public theaters, offices, at work as well as leisure, alone as well as together with others.

People often perform cell phone conversations in combination with multiple other activities and simultaneously with other social interactions they participate in locally. Rather than being a one-to-one interaction between the two telephone speakers, mobile phone conversations often involve other persons in the speaker's local context. Whether they are directly or indirectly involved, if this involvement is intended or unintended by the speaker or themselves, whether it has ben accepted and chosen or forced upon by the the speakers, third party individuals are often involved or affected by cell phone conversations. Weilenmann and Larsson give examples of intended, accepted and direct involvement of local others among teenagers, including several local individuals taking turns talking on the phone, reading text messages aloud, and exchanging information between the local group and the remote participants (Weilenmann A & Larsson C 2002).

Not surprisingly, the pervasive nature of mobile telecommunication has social implications and may even cause some problems.

## 1.2 The disturbing cell phone

Social disturbance of cell phones in public places has been the focus of several studies, and Cooper and colleagues have termed the phenomenon “a friction between the mobile users and co-present others” (Cooper, 2002). What exactly are the potential disturbing elements of a cell phone conversation? The co-located persons may feel annoyed by the ringing sound, loud talking, disruption of other activities, confusion of whether the person talks to you or on the phone, a feeling of being forced to eavesdrop, and as an invasion of their personal space (Ling, 1998; 2002; Wei and Leung, 1999; Love, 2001; Murtagh, 2002).

Whether a cell phone conversation is perceived as disturbing or invasive may relate to several factors, both situational (such as the type of situation where it occurs, the space, how crowded it is, noise, and norms related to the situation), individual (such as the experience, attitudes, personality, behavior and sociodemographics of both the cell phone user and the bystander), and task related (the tasks performed by the cell phone user and/or the bystander). People’s expectations and feeling of control (also individual factors, but treated separately in this paper) may further influence the question of disturbance of cell phone conversations. The problem of cell phone disturbance could also be an effect of a cognitive overload on the cell phone user. Managing the two concurrent tasks of interacting on the phone and with the local setting simultaneously can be problematic. The result could be that the phone user may give priority to one of the interactions, and failing to respond and act properly to the other.

Why does it seem to be working only one-way? Given a cognitive load explanation, we should expect that factors in the local situation may disturb the cell phone conversation. We may expect this to be found in situations with high activity level, noise or the speaker performing activities demanding high focus of attention or awareness of the user. Examples could be stressful or intense traffic related situations occurring while the cell phone user is driving the car, or a child caretaker (on the phone) experiencing a critical situation with the child. Such situations may result in the user giving priority to the local situation, and mentally switching off the cell phone conversation, and perhaps followed by an excuse or an explanation (“*excuse me, I had to prevent an accident over here, what did you say?*”). Many cell phone users may recognize such situations, though we haven’t found any systematic documentation of it.

Why a cell phone conversation disturbs the local situation more than the situation disturbs the cell phone conversation, could perhaps be explained by some characteristics of the cell phone technology. The alarming calling sound of the phone may demand higher or more focus of attention to the phone rather than to the local setting. Another aspect relates to what Hopper (Hopper 1992) refers as “caller hegemony”; the asymmetric relationship between the caller and the answerer. The ringing sound, the “caller hegemony” and the social norm of answering an incoming call are all factors related to the telephone technology (not specifically for cell phones) contributing to the problem of cell phone disturbance. The sound quality produced in the cell phone receiver and how loud people tend to speak on the cell phone may also be relevant. We may speculate whether people tend to speak louder on cell phones than in face-to-face conversations, and loud speaking may certainly increase the risk of disturbing others. While very quiet speaking could be done in many face-to-face settings, the microphone and loudspeaker quality of the cell phones may fail to support the low signals of quiet speaking. Listening problems may further demand the user to direct attention to the phone and concentrate to hear what is said on the phone. These and similar characteristics of the telephone may force the user to give priority to the cell phone conversation. The result may be a reduced attention to and awareness of features of the co-located social interaction and situation, which again could lead to increased risk of disturbing.

### 1.3 Attention and driving performance

Cell phones and driving is an area of particular concern in the public, the media and by traffic authorities. It is well documented that the use of cell phones while driving is a risk factor in traffic safety. Cell phone conversation distracts the driver's attention, increase reaction time, reduce visual field attention, reduce driving performance and increase the risk for accidents (Alm & Nilsson 1995, Barkana et al 2004, Consiglio et al 2003, Garcia-Larrea et al 2001, Haigney 2001, Haigney et al 2000, Hancock et al 2003, Liu 2003, Patten et al 2004, Strayer & Johnston 2001, Strayer et al 2003). Early studies focused on the fact that cell phones usually were handheld, and traffic authorities in many European countries (including Norway) and several states in the US have banned the use of handheld cell phones while driving, allowing only mounted or so called hands-free cell phones.

More recent studies (Barkana et al 2004, Consiglio et al 2003, Garcia-Larrea et al 2001, Patten et al 2004, Strayer & Johnston 2001, Strayer et al 2003) have documented that hands-free cell phones may have the same negative effect on driving performance as handheld cell phones. These studies included testing any effect of other similar activities, though similar strong effects were not found on listening to radio or book on tape, or merely holding the phone. Strayer and colleagues found that the reduced attention was not related to the effect of merely looking at the cell phone and away from the road while driving, as would be the case with manually operating the phone. Controlling for visual sensory focus by using eye-tracking technology, they found that reaction to and memory of visual inputs while driving was reduced even in cases where the subjects looked directly at the objects (e.g. a traffic sign) (Strayer et al 2003).

These results indicate an effect on a cognitive level above the sensory (vision) level. The reduced attention could not be explained as a result of an overload on the visual sensory system, but on the cognitive processing of these inputs. It is the cell phone conversation that divert the attention. Though a handsfree set with voice dialing may reduce the problems of looking away from the road while picking up the phone, while finger dialing or looking up a name in the directory, a handsfree set does not solve the problem of cell phone effects on driving performance.

The reduced perceptual attention to visual information while driving is referred to by Strayer et al as "inattention blindness". They conclude that cell phone use disrupts driving performance by diverting attention to an engaging cognitive context other than the one immediately associated with driving (Strayer & Johnston 2001, Strayer et al 2003). These findings are particularly interesting because they give clear evidence that cell phone conversations take a significant amount of cognitive resources and focus of attention by the user, and that cell phone use may reduce the performance of other activities performed simultaneously.

These findings may have implications for the use of cell phones in other situations as well. Obviously, we may expect that performance of tasks or activities demanding certain degree of attention or concentration would be affected by simultaneous use of a cell phone. However, these effects of cell phone use should be considered in the wide range of activities and situations where people use their cell phones. Rather than looking into the effects of cell phone use in relation to specific tasks or activities, we will focus on social situations in general, and particularly the problem of social disturbance in public situations. Drawing on the research on cell phones and driving, we ask whether cell phone disturbance could be explained in terms of a cognitive and psychological perspective.

## 2 Why cell phone conversations disturb

Cell phone conversations are sometimes perceived by observers as disturbing, and this may be understood in terms of social norms of proper behavior in the given situation (Ling 1997, Wei & Leung 1999). However, to better understand the phenomenon, several questions regarding how, why, when and by who cell phone conversations may disturb need to be answered. In this section we will discuss some of the potential factors we may expect to have an impact on whether cell phone conversations are perceived as disturbing or not. These include situation characteristics, individual differences on various factors such as socio-demographics, cell phone experience, cell phone ownership, personality, social awareness and self-monitoring, cognitive load, task, relevance, uncertainty, predictability, perceived control, listening problems and speaker volume.

### 2.1 The situation

Peoples' perceptions of cell phone conversations as disturbing depend on the situation in which they occur (Humphreys 2004, Ling 1997, Ling 2002, Palen L et al 2001, Wei & Leung 1999). Restaurants and cafes are topping the list of settings or situations where people find cell phone use most irritating, followed by in class, at school, in the library, at airports or train stations, in hospitals and in churches (Wei and Leung, 1999). The use of such public places are typically regulated by norms of what is considered proper social behavior, and it has been suggested that the use of cell phones may challenge these situation specific norms, as well as blurring the boundaries between the private and the public by introducing private conversations into public places (Ling, 1998; Wei and Leung, 1999; Cooper, 2000).

Aknowledging these problems, norms of proper cell phone behavior and explicit rules of cell phone usage have been suggested. These have been communicated through "No cell phones" - signs on the walls and in information leaflets (program, menu, a.o.) by owners of various public places, such as buses, trains, restaurants, in offices, concert halls, theaters and cinemas. Cell phone etiquette has also been suggested by phone manufacturers and network operator companies in the instruction/manual booklet of the cell phone, in commercials and on their websites. Legislations have also been suggested (e.g. in New York in 2002), prohibiting the use of mobile phones in "places of public performance," such as movie theatres, art galleries and libraries, making an exception for emergency phone calls. (Batista 2002).

### 2.2 Individual differences

The disturbance of cell phones may also depend on individual factors, both on the cell phone users and the bystander. While some phone users seem to find it unproblematic to take cell phone calls in almost any situation, others seem to have more or less explicit or elaborate "rules" for how and where they use cell phones. A similar variation is expected to be found among the observers; while some people seem to never be annoyed or disturbed by cell phone use in any situations, others may perceive almost any situation involving cell phones as disturbing. Thus we may expect individual variations in the threshold for perceiving cell phones as disturbing.

Individual differences in attitudes and perceptions towards the use of cell phones in social situations could be associated with socio-demographic variables, experience with cell phones, personality, and variations in the individuals' awareness or orientation of self,

others and the situation (self awareness/self-monitoring, social awareness and situational awareness).

### 2.2.1 Socio-demographics

Peoples' attitudes, adoption, use of and satisfaction with information technology such as Internet, are associated with socio-demographic variables, such as gender (Thompson & Vivien 2000, Thompson 2001, Weiser 2000), age (Zhang 2002), education and work (Zhang 2002) and culture (Lee 2002). The use of cell phones and attitudes towards cell phones are associated with similar socio-demographic dimensions (Skog 2002, Ling 1998, Ling 2001a, Leung & Wei 1999, Vishwanath & Goldhaber 2003, Ling 1999).

The age dimension may serve as an example. Teenagers have been the early adopters of cell phones, and their extensive use of cell phones (particularly text messaging) for social networking has been the focus of several studies (Aoki & Downes 2003, Davie et al 2004, Ling 2000, Ling 2001b, Pedersen 2004, Skog 2002, Virpi & Jussi 2004, Weilenmann A & Larsson C 2002).

There is reason to believe that attitudes towards other people's use may be associated with own use of cell phones. Given the extensive use of cell phones by teenagers (Davie et al 2004, Ling 2001b, Ling 2001a), and the differences between teenagers and other age groups both in frequency and type of use (Pedersen 2004, Skog 2002, Virpi & Jussi 2004, Weilenmann A & Larsson C 2002, Aoki & Downes 2003, Ling 1999, Ling 2000, Ling & Yttri 2002), we may expect to find age differences in both attitudes towards other peoples' cell phone use, and in their threshold for perceiving other people's cell phone use as disturbing. A claim that could be tested is whether there is a lower tendency among young people to feel disturbed by other people's cell phone use, compared to older people. We could also ask if young people are less worried than elder people that their cell phone might disturb others.

### 2.2.2 Cell phone experience and ownership

People's own experience with cell phones and their own status as cell phone user/non-user may also effect their perceptions of cell phone conversations in public places. Wei and Leung (Wei & Leung 1999) reported user versus non-user differences in perceptions of cell phones in public places. As compared with users, non-users had a stronger tendency to think that use of cell phones in public places made them lose private time and space. Non-users were also more likely to feel suspended, dismissed and left hanging when cell phones interrupted conversations, and more likely to feel annoyed when ringing made every cell phone user check their own set.

The experience with cell phones may also have an effect on cell phone disturbance. Palen and colleagues (Palen L et al 2001) found that people modified their attitudes and opinions towards cell phone use in public places over the first two weeks period from the time they purchased their first cell phone, and after four to six weeks many had completely changed their attitude:

*In spite of clearly articulated feelings about improper uses of mobile phones initially, subjects very quickly began to modify these perceptions after gaining personal experience. By the second interview about two weeks after acquisition some subjects began to temper and qualify their opinions about use of phones in public places. In particular, many who thought they would never talk and drive also admitted to doing so. ( ..... ) Four to six weeks after acquisition nearly all subjects who had concerns about how they would be perceived by other people no longer cared what others thought. (Palen L et al 2001)*

### 2.2.3 Personality

Personality has been suggested to have an impact on whether people experience the use of cell phones in public space as disturbing. Love and Kewley (Love Steve & Kewley J 2003) studied personality differences in people's attitudes towards cell phone use in public place, using the Eysenck Personality questionnaire (Eysenck, 1978) - a self-report personality inventory which assumes the three basic personality dimensions of extraversion versus introversion, neuroticism versus stability and psychoticism versus socialization. While people with high scores on the extraversion may be characterized as sociable and carefree, low scorers are more withdrawn, serious, moralistic, and tend to enjoy being alone (introversion). People with high scores on the neuroticism tend to be worried and moody, while people low on neuroticism often can be characterized as stable, less emotional, and not very anxious. People high on the third dimension – psychoticism – tend to have low empathy, to be hostile, insensitive or disengaged from society, while people with low score on this dimension tend to be sociable, emphatic and sensitive (socialization). These descriptions are highly superficial to the original theory, but may give readers not familiar with the theory a brief idea of the personality dimensions used in the study by Love and Kewley.

Love and Kewley (Love & Kewley J 2003) used scenario ratings of how comfortable individuals would feel in social situations with cell phone conversation, and found that individuals with high scores on extraversion reported to be more comfortable in situations where cell phones were being used, than did people high on introversion. These findings are in line with what could be expected, and could be explained as an effect of extrovert people being more comfortable in social situations in general, compared to introverts. This is indeed one of the defining characteristics of the extrovert and introvert personality dimensions. Introverts are more sensitive to social situations, and the cell phone conversation may perhaps increase this sensitivity. Extroverts may feel more comfortable with cell phone conversations in social situations, simply because they are more comfortable with social situations in general.

Love and Kewley (Love & Kewley J 2003) also found that individuals high on neuroticism reported to be more comfortable in situations with cell phone conversations than people low on neuroticism. This seems to be a counter-intuitive finding. We would expect that people high on neuroticism, characterised as worried and moody, would be less comfortable than those more stable, less emotional and less anxious (Stability – low neuroticism). However, further studies are necessary to explain these findings.

Love and Kewley (Love & Kewley J 2003) focused on the personality of the listener/bystander. We may also expect that the personality of the phone user may have an effect. A plausible hypothesis could be that extrovert phone users may feel more comfortable using the cell phone in social situations, because they generally are less worried of disturbing others. This could have a negative effect on how comfortable listener/bystanders feel. We could also expect that introverts phone users, being more worried and withdrawn and less comfortable in social situations, display a more careful and quiet way of using the cell phone in public places. And this could have a positive effect on how comfortable the bystanders/listeners are with that situation.

The findings by Love and Kewley (Love & Kewley J 2003) indicates that there indeed are personality differences in how people perceive the use of cell phones in social situations. However, to our knowledge Love and Kewleys is the only study on personality and social reactions to cell phones.

## 2.2.4 Social awareness and self-monitoring

People may differ in their concerns of other people's needs and how other people feel and react in a situation. For example how much they consider the impact of own behavior on other people, and their awareness of how other people may differ from themselves in how they perceive the situation.

This could be associated with classic concepts of decentration and egocentrism by the developmental psychologist Piaget. In his classic studies of cognitive development, Piaget noted the pre-school child's tendency to limit the focus of attention toward a single aspect of an object or a task in a situation, which he referred to as centration. For the child to be able to grasp the complexity of the task (and we may add the problem or situation), the child needs to decentering attention from this single object or task and consider multiple aspects and alternative perspectives. Piaget also observed children's tendency to base their understanding of the situation purely from their own perspective, failing to acknowledge that others may have a different perspective (referred to as egocentrism).

Egocentrism and decentration are concepts referring to cognitive development in early childhood, and as such they may have a limited value in understanding adult behavior. However, cognitive development should be understood as an ongoing life-long process, and the egocentrism and decentration as tendencies all of us have. Understanding and considering the perspectives of self and others in real life situations, implies a certain balance between a more or less focus on self, and a more or less focus on the others (Berk 2003)

Rather than claiming that disturbing cell phone users are immature, we may suggest that people's awareness of others may vary, and that this perhaps partly could explain the problems of cell phone disturbance. Social awareness addresses individual variations in people's ability and/or willingness to take others perspective, to pay attention to and consider other people's needs relative to ones own. People vary in their social awareness, and we may certainly expect a higher risk for disturbing others when the cell phone user has a high focus on own perspective and low focus on others.

The problem of cell phone disturbance could perhaps also be explained in terms of social intelligence. We may adopt the working definition suggested by Silvera and colleagues (Silvera et al 2001), as "the ability to understand other people and how they will react to different social situations"(p. 314). They identified social awareness as one of three major factors of social intelligence.

A related concept is self-monitoring, introduced by Mark Snyder in 1974 (Gangestad & Snyder 2000), referring to how much people *monitor* – observe, regulate and control – the image of themselves that they display to others in public. Snyder's theory of self-monitoring differentiate between high and low self-monitors:

*Some people, out of a concern for the situational appropriateness of their expressive self-presentation, have come to monitor their expressive behavior and accordingly regulate their self-presentation for the sake of desired public appearances. Thus, the behavior of these high self-monitors may be highly responsive to social and interpersonal cues of situationally appropriate performances. By contrast, other people, those who (relatively speaking) do not engage in expressive control, have not acquired the same concern for the situational appropriateness of their expressive behavior. For these low self-monitors, expressive behaviors are not controlled by deliberate attempts to appear situationally appropriate; instead, their expressive behavior functionally reflects their own inner attitudes, emotions, and dispositions.*

(Gangestad & Snyder 2000)

Differences in social or situational awareness and self monitoring may be reflected in different strategies for using cell phones in public spaces and situations involving other people. We may expect that people with high social awareness and/or high self-monitors may be more concerned about any disturbance they might produce by their cell phone use, than low social awareness and/or low self-monitoring.

### **2.3 Expectations and predictability**

People's expectations and perceived predictability in a situation may effect how they perceive and experience situations and events. Situations with low predictability may increase stress and negative emotional reactions (Lazarus & Folkman 1984). Cell phones may cause more negative reactions in situations where people have low expectations of a cell phone conversation to happen. The situations where cell phones are most disturbing (such as restaurants, theatres), could be situations where people have low expectations for cell phone conversations to occur. If the social norm of being quiet works successfully, it may contribute to a reduced frequency of cell phone conversation in these situations. Thus, the low expectations could relate to the social norm and/or an actual low frequency. However, this has to be verified empirically.

People build expectations on prior experiences and knowledge of similar situations. Social norms may serve both as regulators of behavior and as a source of information about the specific type of situation. The norm of being quiet informs us how to behave in the situation, but may also serve as an indicator for what kind of behavior or events we may expect to see in the situation. We know we should not talk loud in a theatre, and we don't expect others to do so either. We don't expect incoming phone-calls in meetings, in restaurants or theaters. If it happens, we may be surprised, because it is not expected.

The phone owner often seems to be just as surprised as the other people around him or her, indicating that she/he also has a low expectancy of a cell phone call in these situations (Murtagh 2002). Phone owner's behavior when the phone rings in these situations may indicate a certain embarrassment (Murtagh 2002). This is consistent with the finding of Wei and Leung (Wei & Leung 1999) that cell phone users agreed with non-users on the situations where they felt cell phone use was experienced as disturbing.

People sometimes try to avoid the surprise and negative reactions of an incoming call by announcing that there might be one (e.g. during the meeting), and perhaps explaining the need for answering it and the importance of the call. Another strategy for reducing disturbing effects of incoming phone calls is to adjust the cell phone to silent or vibration signal. However, reducing the disturbing ringing sound don't solve the potential disturbance of answering the phone and talking on the phone, neither does it prepare the other people for a cell phone conversation to occur.

### **2.4 Perceived control**

Several of the public places where people find cell phone conversations to be disturbing are characterised by limited options for escaping from or shielding oneself from the cell phone conversation. The feeling of being forced to eavesdrop and not being able to escape from the cell phone conversation in public places such as on public transportation (Humphreys 2004, Ling 1997, Wei & Leung 1999) indicates a perceived lack of control in the situation. Perceived control is low in situations where people find that their own actions have limited or no effect on the situation, or where few options to change the situation are available. Low predictability may also contribute to low feeling of control, both associated with stress and negative affect (Lazarus & Folkman 1984).

## 2.5 Cognitive load

We may also speculate whether cell phone disturbance could be explained as a result of a cognitive “overload” for the cell phone user. George Miller (Miller G 1956) was among the early proponents of the idea of limited cognitive capacity. Miller’s focus was mainly on the memory capacity, documenting the limits of information processing and memory.

According to the theory of limited cognitive capacity (Kahneman Daniel 1973) each of the activities the individual is engaged in, demands certain cognitive efforts. The human cognitive capacity has certain limitations, and a combination of activities may potentially overload the available cognitive capacity. This is not limited to memory capacity, but may also include other cognitive processes such as attention and information processing. Similar limitations are documented in a series of early studies on selective and divided attention (Broadbent 1982, Deutsch & Deutsch 1963).

Later studies have suggested more elaborated views on attention capacity, differentiating between controlled and automatic processes, where automatic processes demand less cognitive resources than controlled processes, and that the cognitive load of multiple tasks is not additive (Schneider & Shiffrin 1977). This explains how we are able to perform multiple tasks simultaneously. Tasks that are well trained and based on automatic processes, may more easily be combined with other tasks, and demand less cognitive efforts than new or less trained tasks.

Driving involves a set of highly automatic tasks for the experienced driver, and may to a certain extent be combined with other activities. However, research on cell phone and driving (see previous chapter) indicates that people may be too optimistic about their ability to combine driving with other tasks. Cell phone conversation, as well as other tasks such as changing the music CD, adjusting the radio, drinking coffee, talking with passengers, all demand certain cognitive efforts. These activities could interrupt or compete with the cognitive processes related to driving.

We suggest that the problems of cell phone conversations producing social disturbance could be explained by similar mechanism. The parallel activities of taking part in a cell phone conversation simultaneously with other social activities, may represent a potential cognitive overload on the individual. The result may be that the phone user directs the focus of attention and awareness to the phone conversation, downplaying focus of attention or awareness to what happens in the local context. This could increase the risk for disturbing others.

## 2.6 The task people are engaged in

We may expect that people’s experience of cell phone conversations as disturbing or invasive may depend on the task or activity performed by the cell phone user or by the bystander/observer. To our knowledge, there have not been reported any studies looking explicitly on task related factors on cell phone disturbance.

However, some situations often imply certain kinds of activities, and the tasks or activities that take place in these situations often define the situations. Cell phone disturbance in the situation may relate to the specific tasks or activities people take part in. The low threshold for cell phone disturbance in cinemas, theatres and music concerts may serve as an example. Cell phone conversations, as well as other sound producing activities, are not compatible with the main task and activity of most people in these situations; namely listening. The norm of being quiet is thus highly functional and task related. Loud talking or making sounds in these settings has never been accepted, and using cell phones are just one of many ways people may interfere with the listening activity in these situations. As far as a

cell phone conversation is a sound producing activity, it may be experienced as disturbing in any situation where people are engaged in tasks or activities that involve listening.

Similarly, the study by Wei and Leung (Wei & Leung 1999) reported that people find cell phone conversations disturbing when they are engaged in a joint activity with the cell phone user. Their interaction is disrupted by the cell phone ringing and by the cell phone user answering the call. Disruption of the ongoing interaction is also a reason people give for cell phone disturbance in meetings. This may indicate a high risk for cell phone conversations to be experienced as disturbing when people are engaged in a mutual interactive or cooperative activity with others.

We may also expect cell phone conversations to be experienced as more disturbing when people are engaged in difficult or complex tasks, tasks demanding high concentration, or when people are under time pressure. A line of research in cognitive psychology since the early 1950s has documented limitations of human cognitive capacity. People's capacity and performance on several cognitive dimensions such as memory, attention and reaction time on various tasks are reduced when engaged in dual or multiple activities, or introduced to complex situations involving multiple stimuli (Broadbent 1982, Kahneman Daniel 1973, Miller G 1956).

Limitations in cognitive capacity, and effects of cognitive (over)-load by multiple stimuli or tasks on human performance have been an important research topic in ergonomics and human factors. Several studies have identified the effects of various additional tasks or stimuli such as cell phone use on car driving performance (see prior section). We may expect similar effects of cell phone use (or other concurrent activities) on other non-driving tasks as well, including the variety of social interactions people take part in. The dual tasks of interacting and participating in a local social interaction and managing a concurrent cell phone conversation may represent a kind of overload for the phone user. This may reduce the phone user's attention to and awareness of certain features or nuances in the local social interaction. Whether the cell phone conversation is experienced as disturbing or not, may depend partly on the task the phone user and other person(s) are engaged in and their interaction.

## **2.7 Relevance and contextual information**

The relevance of the cell phone conversation to the task or activity people are engaged in may be another factor in the question of cell phone disturbance. Examples of a relevant cell phone conversation in a meeting could be that the cell phone user calls another person to check out or resolve a question raised during the meeting. Another example could be an incoming call to someone at a meeting to inform the group of something concerning their task. A highly relevant cell phone conversation may thus be perceived as useful, necessary and not at all disturbing, while a non-relevant conversation may be perceived as interrupting or disturbing.

Defining what is relevant in each situation could vary between the individuals involved, and people may differ in their understandings of how to balance the cost of being disturbed with the benefits of being informed. This is the classic problem faced by secretary deciding whether or not to forward a telephone call to a person at a meeting. Deciding about relevance builds on a necessary knowledge of the meeting as well as knowledge of the incoming call. A secretary serves as a "gate keeper", deciding whether or not to forward the call to the target person. In an ideal situation, the secretary's decision is based on an optimal combination of the prior knowledge of the activities taking place (e.g. task and availability of the individuals at the meeting) with the new information about the incoming call. (This ideal situation assumes that the secretary holds the necessary information, which

may often not be the case. However, the “secretary” may serve as a useful analogy of an optimal position holding knowledge of both the caller and the target for the call).

Calling directly to a cell phone offers no context information to the caller about the activities of the other (the target), and only limited information to the target/answerer about the caller. Caller may be identified by the caller-ID shown on the cell phone display. However, this only identifies the number of the incoming phone and the name of the owner of that number. The caller may also disable caller-ID functionality, not revealing the number s/he is calling from. However, none of the two parties have any direct information about the topic, activity or agenda of the other. As a result, both the caller and the answerer have limited access to information needed to solve the question of relevance. The respective decisions by the caller and answerer whether to call or not and whether to accept the call or not is thus based on very limited information.

Telenor R&D has addressed the issue of awareness and information about caller and answerer/callee activities related to distributed team-work in previous projects, including the NETTO-project ([www.tft.tele.no/netto](http://www.tft.tele.no/netto)), (Akselsen et al., 1997a), (Akselsen et al., 1997b), (Munch-Ellingsen et al., 1998), (Stenvold, Grav and Bergvik, 1999), (Ejdemo, Akselsen, Grav, 2003). An application providing context information on a handheld computer (PalmPilot) was described and discussed by Munch-Ellingsen and colleagues (Munch-Ellingsen et al., 1998). Schmidt and colleagues have also addressed this problem and suggested a solution using WAP technology to provide the caller with context information about the target person when initiating the call (Schmidt et al 2000).

Providing information of a user’s activities, location and context may have implications on privacy issues and trust (Levijoki 2000). These problems could be avoided to a certain degree by providing high technological security, ensuring explicit and informed consent by the user, enabling the user control and options to manipulate the system manually, as well as providing an easy way to disable the system at any time.

Providing information of the context and activities of others may also have implications for social relationships. Introna (1997) suggests a thought experiment to help clarify the impact of a loss of privacy on social relationships by proposing a world of absolute transparency:

*Imagine a world where there is a comprehensive and complete lack of privacy, complete and immediate access, complete and immediate knowledge, complete and constant observation of every individual. There would be no privacy thoughts and no private places ... What will there be to exclusively share since everything is always already known to every ‘other’? It seems that in the transparent world notions such as getting to know someone, or being intimate with someone, or sharing yourself with someone just fade into obscurity ... From this thought experiment it is clear that all social relationships, relationships of collaboration or of competition, require at least some level of privacy.*

(Introna and Whitley, 1997: 487 - 488)

This thought experiment also shed some light on the possible limits of the provision of awareness information in teamwork. There is a limit for how much should be provided and the consequences of breaking this limit might be that the links between team members get weaker.

However, a major challenge in teamwork and collaborative work is information management and how to share information in an effective way. Teams are often co-located, and this makes it easy to share information among team members. Kraut and colleagues (Kraut et al, 1990) found in a series of studies that people made use of contextual information of the colleagues activities and whereabouts, and that important information sharing took place at spontaneous meetings at the coffee machine or at the copy machine.

Open area office has been expected to increase the frequency of such spontaneous meetings, and support collaboration and sharing of information. A challenge working in such settings is to differentiate between useful information and disturbance. Observing a colleague talking on the phone may provide useful information to the rest of the team members, but may also disturb the same people. The balance between sharing and disturbing could be problematic in open area offices. Talking on the phone or with the colleague next to you may indeed disturb other people in the room. However, being too careful not to disturb others may reduce communication between colleagues. Rather than stimulating to communication and information sharing, co-location thus may also run the risk of reducing contact and communication among colleagues. However, in some situations, such as in co-located teams, listening to other people's conversations may be a highly valuable and acceptable way of updating and sharing information in the group.

## 2.8 Listening problems and speaker volume

Low sound quality in the cell phone may cause problems for the phone user to hear and understand the other person on the line. The sound quality is critical in situations with a high (external) noise or sound level. A phone call is characterized by the two parties located on different local settings. The two physical settings may have different background noise, resulting in different listening conditions for the persons located at the respective settings. People have to adjust their speaking volume both to their own local setting and to the other part's setting and listening conditions. The result could be that people tend to speak louder in cell phones than in face-to-face conversations.

This could be explained as a compensational strategy for the difficulties of hearing. In a face-to-face situation with external noise or other sound related problems it would be regarded as a highly functional strategy, because the two parties share the same listening conditions and experience the same listening problems. In phone conversations this strategy may produce problems and disturbance in the local settings of the phone user.

We suggest that there is such a relation between listening problems and speaking volume, formulated in the two following hypothesis: Listening problems in cell phones lead to a tendency to increase own speaking volume. A tendency of increased speaking volume in cell phone conversations (due to listening problems) increases the risk of disturbing co-located persons.

## 2.9 Caller hegemony

Telephone technology produces an asynchrone relationship and an imbalance in the roles of the caller and the answerer, causing extra problems for the answerer. Hopper (Hopper 1992) refers to this phenomenon as a "caller hegemony". The caller determines the start of interaction and the answerer must respond. The caller "acts" and the answerer must "react". This imbalance is also indicated in the opening of the telephone call. The answerer is expected to start speaking without knowing who's calling and why. This asymmetric relationship is also maintained by the social norm of giving a calling phone high priority; the norm is to answer an incoming phone (Hopper 1992, Humphreys 2004).

Answering a call involves an uncertainty of the relevance of the call to the present tasks or activities, and runs a risk of disrupting or disturbing present activities. The uncertainty is a result of the limited information to the answerer about the caller and the purpose of the call, as well as limited context information to the caller about the answerer.

The “caller hegemony”, the norm of answering incoming calls, limited context information and the alarming and intrusive nature of the ringing sound<sup>1</sup> may together put a pressure on the cell phone user to answer the phone, even if s/he may run the risk of disturbing someone.

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<sup>1</sup> *Though some of the wide range of ringing sounds available on cell phones may be described as more pleasant or less intrusive than others, the purpose of a ringing sound will always be to direct the attention of the owner to the fact that someone is calling them. The ringing signal is supposed to be intrusive to the cell phone user.*

### 3 Some hypothesis of cell phone disturbance

Cell phone conversations in public places seem to be more likely to be experienced as disturbing by observers than face-to-face conversations between co-located people in public places. However, the disturbance may relate to several factors, including social norms, situational factors, cognitive load, individual factors/personality of the user as well as the non-user, the task or activity of the user/non-user, the task or situational relevance of the phone call, the non-user’s feeling of uncertainty, predictability and perceived control, the listening conditions, the speaker volume as well as the unequal caller/answerer relationship of telephone conversations referred to as “caller hegemony”.

In this section we propose a set of hypotheses based on the discussion given in the previous section.

#### 3.1 Inattention blindness in social situations

We suggest that the concept of “inattention blindness” (Strayer et al, 2001) could be successfully applied to other situations as well, such as the problem of social disturbance of cell phone use in public places. The argument is that cell phone use in social situations may result in an overload of cognitive resources (such as attention) because of the need for simultaneously interacting with the two parallel social contexts. The respective local interaction and remote interaction demand certain attention and cognitive efforts of the person. Due to the cognitive load and the “caller hegemony”, the cell phone user may have problems paying the necessary attention to and awareness of the local situation, and thereby fail to respond properly to it. The cell phone conversation makes the user “blind” to cues and details of communicative behavior of the co-located individuals as well as other relevant features of the social situation. In sum, the social disturbance of cell phones may be a result of the cell phone user’s “inattention blindness” to aspects of the local situation, due to a cognitive overload on the cell phone user.

We propose the following inattention blindness hypothesis:

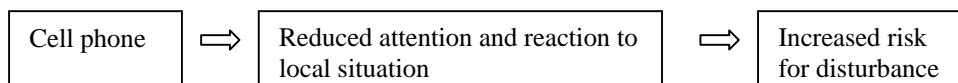
Compared to face-to-face conversations, cell phone conversations reduce the cell phone user’s attention to the local situation, and this may increase the risk for observers experiencing the cell phone conversation as disturbing.

This is broken into the following sub-hypothesis:

Cell phone conversations reduce the cell phone user’s attention to aspects in the local social situation, compared to face-to-face conversation.

Cell phone conversations reduce the cell phone user’s reaction to and responding to changes and events in the local social situation, compared to face-to-face conversations.

Reduced attention, reaction and responding to changes and events in the local situation increase the risk for disturbing others.



### 3.2 Social awareness, self monitoring and cell phone strategies

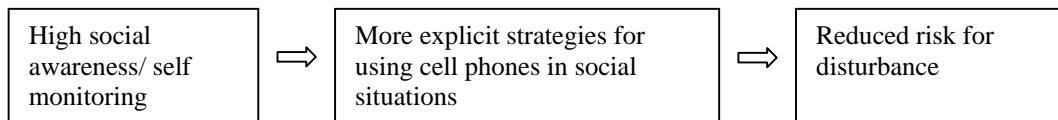
#### Social awareness hypothesis:

- a) Individuals scoring high on social awareness tend to have more explicit and elaborated strategies for using cell phones in social situations, than individuals scoring low on the respective scales.

Individuals scoring high on social awareness have a lower risk for disturbing others by their cell phone use, compared to individuals low on social awareness.

#### Self-monitoring hypothesis:

- a) High self-monitoring individuals tend to have more explicit and elaborated strategies for using cell phones in social situations, than low self-monitoring individuals.
- b) High self-monitoring individuals have a lower risk for disturbing others by their cell phone use, compared to low self-monitoring individuals.

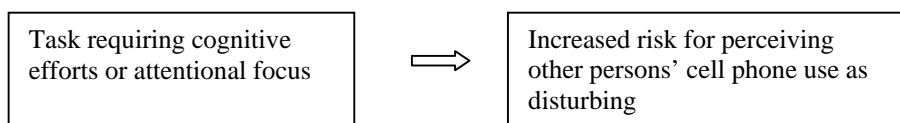


### 3.3 Task and relevance

We expect that the type of task observers perform while the cell phone conversation they observe takes place, may influence whether the cell phone conversation is experienced as disturbing or not. Tasks demanding relatively high focus of attention is expected to increase the likelihood of experiencing it as disturbing. We further expect that the relevance of the cell phone conversation also may have an impact on whether the cell phone conversation is experienced as disturbing, with conversations of low relevance as more likely of being experienced as disturbing than conversations of high relevance.

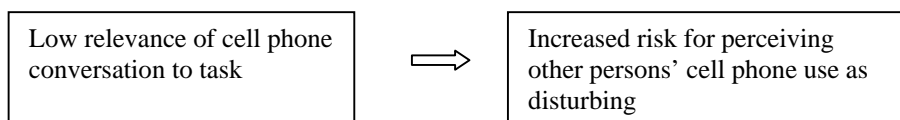
#### Task hypothesis:

Cell phone conversations are more likely to be perceived as disturbing in situations where the observer/non-user takes part in tasks demanding certain focus of attention and cognitive efforts, compared to more easy and automated tasks



#### Relevance hypothesis:

Cell phone conversations are more likely to be perceived as disturbing if the observer/non-user considers the cell phone conversation to have low relevance to his/her task or the situation.

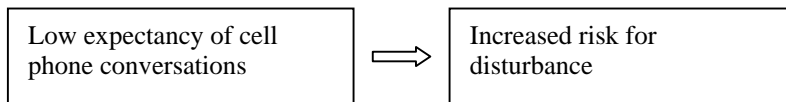


### 3.4 Expectancy and control

People's expectations of a cell phone conversation to occur may influence whether the cell phone conversation is experienced as disturbing or not. A low expectancy of cell phone conversations may increase the negative experience of it when it occurs. Being prepared for and expecting a cell phone conversation may reduce the risk for experiencing a cell phone conversation as disturbing.

#### Expectancy hypothesis:

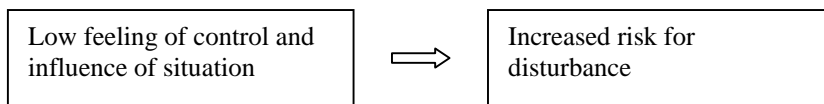
- a) Cell phone conversations are more likely to be perceived as disturbing in situations where people have low expectancy of a cell phone conversation to occur, versus situations with high expectancy.



Perceived control and influence over the situation may have a similar impact. Situations where people have low perceived control may increase the risk for negative reactions to cell phone conversations.

#### Control hypothesis:

- a) Cell phone conversations are more likely to be perceived as disturbing in situations where people have low feeling of control and influence over the situation, compared to high feeling of control and influence.

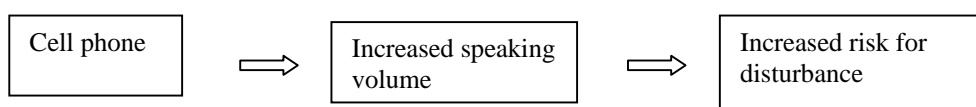


### 3.5 Speaker volume and listening problems

Further, we suggest that cell phones may attract other (observing) people's focus of attention, more than other comparable activities such as conversations between co-located individuals. A critical attention demanding feature may be the sound of the ringing, or that people tend to speak at a higher volume in cell phones than in face-to-face conversations. Such a volume difference could be explained as some kind of compensation strategy related to acoustic problems and difficulties of hearing the other part of the conversation, and the higher volume of the speaker may be experienced as disturbing by observers.

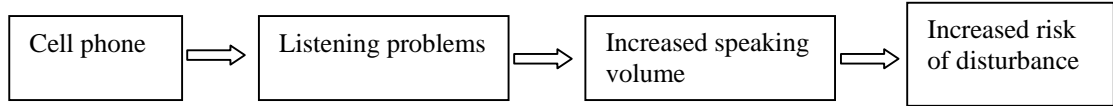
#### Speaker volume hypotheses:

- a) People tend to speak at a higher volume on cell phones than in face-to-face conversation.
- b) Cell phone disturbance is related to the higher volume of the speaker



#### Compensation for listening problems hypothesis:

- a) Cell phone users tend to increase own voice when experiencing listening problems.
- b) There is an increased risk for disturbance when the cell phone user is experiencing listening problems.



### 3.6 Multiple factors

Some of the multiple factors explaining the social disturbance of cell phones are listed in the following table. The list is only a first effort to suggest some of the factors we may expect to have an effect on the problem social disturbance of cell phones. Further work and studies may expand the list by adding new factors and categories.

<b>The cell phone user</b>	<b>Technology</b>	<b>Task requirements (both user and co-located person)</b>	<b>Co-located person</b>	<b>Situation</b>
Socio-demographics (age, gender, experience, a.o.)	User interface	Cognitive efforts	Socio-demographics (age, gender, experience, a.o.)	Physical space (crowded vs spacious, indoor vs outdoor)
Social awareness	Attention demanding	Focused attention	Cell phone ownership	Dedicated to certain activities
Self-monitoring	Sound or visual	Phone call's relevance to task	Expectations	Norms of behavior
Strategies for using cell phones in social situations	Listening problems and speaker volume due to technology		Feeling of control	External noise (listening problem and speaker volume)
Attitudes towards cell phone use in social situations	Adjusting to situation (context aware)		Attitudes towards cell phone use in social situations	

## 4 Implications for mobile technology in tourism

Since the mid 1990s we have seen a rapid development of cell phone technology, as well as in handheld and mobile information and communication technology in general.

Telecommunication and computer technology have merged, and today we are offered handheld devices combining these technologies. These new developments represent a high potential for a wide range of services delivered to people's cell phones or handheld devices.

There are high expectations to the potential for commercial services in mobile telecommunications, and a wide range of services has been offered. Mobile technology services may be grouped into information, communication and transaction services and any combination of these. Most mobile services today are based on the simple text messaging (SMS) technology, available in all GSM cell phones. However, limitations of the SMS on the amount of information per message as well as the text-only interface, have led to the introduction of alternative technologies such as WAP (wireless application protocol). There are also high expectations to the next generation cell phone infrastructure, such as the UMTS, offering higher bandwidth than the regular GSM. In sum, these developments indicate highly advanced services delivered on mobile telecommunication in the near future.

Rather than having plain conversations or sending simple text messages, cell phone users will have a broad range of information and communication services available in their cell phone. These new developments in mobile telecommunication may have important implications for the question of cognitive load and potential social disturbance of telecommunication technologies. We may expect problems of information overload similar to what has been the case with the Internet, but now the user has to deal with these problems outside the quiet office or home, and in the wide range of situations where s/he brings (and uses) the technology. This may increase the user challenges of handling the dual task of local and remote interaction, increase the risk for overloading the user capacity and increase the risk for disturbing other people in the local setting.

### 4.1 Mobile technology in tourism

Tourism is expected to have a high potential for services offered via mobile telecommunication technologies. High mobility combined with high need for information makes mobile information and communication technology well suited for tourism.

Furthermore, both the tourist and the tourist industry are facing the challenges of having relevant and updated information available to the right person, at the right time and in the right place.

Various mobile information and communication services for tourism have been developed, ranging from simple text or audio-based information services to advanced multimedia and context-sensitive services (Abowd et al 1997, Cheverst et al 2000a, Grav & Bergvik 2002, Klante P et al 2004, Simcock T et al 2003, Woodruff A et al 2001). Examples of simple services are audio-guides provided via regular cell phones, such as *The Guided Tours of London* offered by HandheldHistory ([www.handheldhistory.com](http://www.handheldhistory.com)). The user dials a telephone number, and responds to a menu of options by pressing the respective digits on the cell phone. The user listens to taped stories over the phone, and may pause, stop, rewind and fast forward or jump to another story by using the dialer on the cell phone. Other examples of simple services are the wide range of downloadable services available for handheld computers or pocket PCs such as PalmPilot ([www.palmpilot.com/](http://www.palmpilot.com/)) and HP iPAQ

([www.hp.com](http://www.hp.com)). These include maps, information of concerts, cinema, theaters and other events, games and entertainment, dining and a wide range of other services. These services are mainly general and fixed information the user can download to the handheld device and use as some kind of an electronic guidebook.

More advanced tourist guides are utilising context information to increase relevance (Abowd et al 1997, Cheverst et al 2000a, Grav & Bergvik 2002, Klante P et al 2004, Simcock T et al 2003). Location or positioning is a basic feature of many context aware applications. Location awareness means that the application somehow is aware of the current location and uses this information to present, retrieve or filter the information appropriate to this position (Butz 2004). However, location is only one of several aspects of the context. Dey and Abowd (Dey & Abowd 2000) define context as:

*Any information that can be used to characterize the situation of an entity. An entity is a person, place, or object that is considered relevant to the interaction between a user and an application, including the user and applications themselves.*

They further define context-awareness as:

*A system is context-aware if it uses context to provide relevant information and/or services to the user, where relevancy depends on the user's task.*

An example of a context-aware system used in tourism is GUIDE (Cheverst et al 2000b). This is a web-based system enabling visitors to the city of Lancaster to interact with an information model that represents the city via a hand-held and context-aware tourist guide. The basic service of the system is to offer the tourists walking around in Lancaster city information relevant to the area s/he is located (e.g. when moving towards the church, information of the church is provided on the handheld computer screen). For more details on the GUIDE project, see <http://cosmos.kaist.ac.kr/salab/project/dms/GUIDE.html>

Inspired by the GUIDE system, a context-aware digital guide based on information of physical availability for diasabled (GAID) was developed for the city of Tromsø in Norway (Grav & Bergvik 2002). GAID was based on GSM infrastructure, collecting location information from the GSM antenna and communicating with a server combining information of the user profile and contextual information of the specific location. The server held information of restaurants, cafes, shops, commercial and public services in the city centre of Tromsø, including details of the physical conditions critical for availability of disabled persons. The user asked for a type of service (e.g. restaurant, cafe, hotel, different kind of shops a.o.), and was provided information of relevant services in the area near the user's location, listing first those who best met the user needs and preferences. The project focus was on the needs of disabled persons, but the basic principles in GAID are generic and could be used in a general service for other purposes and other groups of users as well.

## 4.2 The social and collaborative nature of tourism

Tourist's need for information is high, and the majority of tourist technologies are supporting the need for information. Examples of information sources are the traditional guidebooks, maps, information leaflets and commercial handouts, timetables (for trains, buses), billboards and road signs. Tourist services based on mobile technologies are also highly information oriented, increasing the relevance of the information to the context of the user.

Knowledge of tourist activities and strategies is critical in developing successful services. Detailed studies of tourist activities have documented the highly social and collaborative nature of tourism (Brown 2003b, Cheverst et al 2000b, Woodruff A et al 2001). Tourists interact and collaborate with many others, including fellow travellers, other tourists,

personnel in shops, restaurants, transportation and tourist services, local residents and others they meet. The use of information sources is also highly social and collaborative. Brown and Chalmers (Brown 2003a) demonstrated how tourist activities related to seeking information, making decisions (about what to do, when and how to do it and how to get there), orientation and navigation as well as experiencing and enjoying attractions are all highly collaborative and social in nature. The use of information artefacts such as a guidebook and a map are often performed as a joint activity of several persons, and used as a basis for discussing and negotiating decisions (Brown 2003a). Several sources of information such as maps and guidebooks are also used in combination, with a certain division of labour between fellow travellers.

Tourists use other tourists as important sources of information. They often exchange information about sites they have visited, share experiences and give recommendations and advice to other tourists. Brown and colleagues (Brown B & Chalmers M 2003) found that advice from other tourists was given even greater value than information given by guidebooks or tourist information staff.

Another highly social and collaborative activity of tourists travelling together, is co-ordination of activities when the group temporarily splits up and needs to get together again, or just managing the group and the various needs and preferences among the group members. This is relevant not only for organised and large groups, but also for smaller groups down to two or three people such as a small family. Parents spend considerable time “shepherding” children around museums (Brown 2003a).

How tourists use cameras and regular cell phones may serve as illustrations of tourism as a social phenomenon. Cameras and photography in tourism have been the focus of several studies (Albers & James 1988, Chalfen 1979, Cohen et al 1992, Markwell 1997), and Brown and colleagues suggest that the camera is the most successful tourist technology, designed to “take the visit back home” (Brown 2003a). Photography and film recorded by the tourist are ways of documenting the visit for oneself as well as for communicating the experience with friends back home. Postcards and souvenirs have similar functions. The extensive use of cameras at tourist sites suggests that these ways of documenting and communicating the experience are highly valued by tourists. We also see tourists using cell phones when visiting attractions and sharing their experience with friends on the phone.

In sum, the social and communicative nature of the tourist experience is also reflected in tourists’ use of technologies such as cameras, guidebooks, maps and cell phones.

### **4.3 Disturbing tourism technology**

The problem of social disturbance of cell phones in social situations may very well apply to tourist settings and situations related to tourist activities. Tourist attractions such as museums, theatres, opera buildings, churches, cemeteries and monuments may be settings associated with a certain quietness and respect. Respect perhaps for the historical or religious importance of the site, for other people’s need for thinking and reflecting or merely to be able to hear and see a performing event taking place.

It is likely that the use of cell phones may be considered improper in such settings, and experienced as disturbing by other people. In some settings such as religious sites open for tourists, it may be considered improper to use cameras as well. (However, restrictions on camera use are often related to the effect of camera flash on paintings, disturbing the actors/musicians or commercial interests such as copyrights.) Though we don’t know any studies on the problem, we may have found other people’s use of cameras on sites such as churches, museums and theatres as disturbing and annoying. Part of the problem could be that camera users direct their attention more to the camera and how to get an optimal

picture, and less to the social situation in which they are part of. Following this line of argument, the problems of disturbing cameras and cell phones in tourist settings could be explained by similar mechanisms. Introducing advanced mobile technologies in tourist as well as non-tourist settings could increase the risk of social disturbance.

#### **4.3.1 Cognitive load and attention**

The combination of high storage capacities and access to service providers and computer databases through a wireless network connection represent a unique potential for providing tourist information services on mobile technologies. However, the amount of information available to the user may represent an information overload parallel to what we see on the Internet. Reducing the amount of information or supporting the user in finding relevant information are some of the major challenges in developing successful information services for tourism as well as other purposes. Strategies may include reducing the amount by filtering or sorting information, increasing information relevance to the individual and the situation, for example by using profiles (personalizing) and/or context-awareness (Dey & Abowd 2000). Other strategies are improving the tools for direct manipulations, such as searching and navigating (Schneiderman B 1993). Optimal design of such technologies may reduce the problem of information overload and increase the usability of mobile technologies. However, supporting the user moving around in a continuously changing context, is a highly complex and dynamic task, with a high risk of performing inadequate adjustments or malfunctioning.

The multimedia capacity of mobile technologies may represent another challenge for the user. While guidebooks and maps made of paper are quiet and “frozen” representations, multimedia technologies may offer audio or video representations. An example of an audio-based technology popular in museums and other tourist sites, is the audio guide. This is usually a kind of tape recorder and a headset, offering the visitor a recorded talk about the exhibit. A problem with the audio guides is that they may cause a kind of social isolation, reducing the visitor’s social interaction with other co-visitors (Woodruff A et al 2001). Digital guides based on both graphic and audio interfaces tend to direct the visitor’s focus of attention towards the technology and the information, and away from the objects of the exhibit and the social and physical context (Woodruff A et al 2001). Evidence from the studies of cell phone and driving performance, has proved the attention demanding nature of cell phone communication. Advanced mobile technology combining mediated communication capabilities with information services similar to digital guides may occupy a significant amount of attention resources of the user. Cognitive overload and diverted or distracted attention may ruin the experience of the tourist and disturb co-visitors.

Searching for information, navigating in menus, watching or listening to multimedia presentations, and communicating with others on a handheld device, all represent highly attention demanding activities. A major challenge when introducing advanced mobile multimedia technology in tourism is to manage the problems of attention and cognitive load on the user.

#### **4.3.2 Social and situational awareness**

The examples of social disturbance of cell phones in social situations, and cameras in tourism are indications of the potential risk for producing social disturbance when introducing advanced mobile technologies in tourism. The attention of the user may be drawn towards the technology, and away from the attractions or the social context. Increased complexity of the device may increase the need for focusing the attention towards the technology. The user has to balance the needs of managing the technology and managing the context. As discussed in relation to disturbance of cell phones (see chapter 3),

individuals differ significantly in their motivation or capacity for balancing the awareness of self versus others, and self versus situation. Individual differences in social awareness may be more visible in some of the classic tourist settings we have referred to, such as museums, churches and theatres. The norms of being quiet and not disturbing others appeal to the individual's understanding, motivation and abilities to pay attention to and respect other persons needs.

Differences in how technology is used and how the use is perceived may also be explained in terms of cultural differences in norms of behavior and sensitivity to other people's behavior. This is highly relevant in tourism, because of the intercultural meeting between tourist from various cultural backgrounds and the local people. The tourist's awareness and motivation for adjusting to the local norms include the use of technological devices.

Challenges in developing mobile technologies in tourism include understanding individual and cultural variations in behavior and norms of behavior, and the implications for using technology in various tourist as well as non-tourist settings.

#### **4.4 Context-awareness and user-technology-context interaction**

Understanding the use of technology must include the interaction between the user, the technology and the context. The use of cell phones, cameras and other technological devices in museums, churches and theatres could be explained in terms of the interaction between individual or user-related factors (such as social awareness), the technology (such as the information, design and interface), and situational factors (such as the social norms and physical structures).

The problem of attention and cognitive load is not only a question of design and interface, but also how this is affected by situational and individual variations. Some people may find the technology convenient and effective to use, while others find it difficult and ineffective. Further, the same person may find it easy to use in one setting, but difficult in another. Flexibility for adjusting the interface according to individual differences and situational variation may be an effective way of solving the problem. Voice-interface of cell phones in cars is an example of adjusting the interface according to the situational and task-related variations. Another example would be a context-aware application "broadcasting" to every cell phone or device a suggestion to adjust ringing to "silent" mood, or even adjust all devices directly.

Context-aware tourist applications such as *Cyberguide* at Georgia Institute of Technology (Abowd et al 1997), *GUIDE* in Lancaster (Cheverst et al 2000a) and *GAID* in Tromsø (Grav & Bergvik 2002) are examples of technologies using information of the context to provide the user with relevant information related to his or her situation. Context-aware application is a promising solution to some of the challenges of mobile information and communication technology. However, there are some general problems with context-aware applications as well, and we will conclude this paper by drawing attention to some of them.

##### **4.4.1 Context, position and direction**

Context-aware applications are often based on a location aware system, and tend to give information about objects or points of interests (POI) in the near surrounding of the user. This could be highly effective and useful, and increase the information relevance, because it is likely that the user wants and needs information about the POIs near her/him. However, some tourist sites (such as churches and landmarks) could be traced from a distance, and this would not be supported by simple location-aware applications. A parallel problem could be found inside a building such as a museum or a church. The user may see objects from a distance, and consider taking a closer look. A simple location-aware application

would not give information about the object until s/he has moved up toward it. This problem was discussed by Cheverst and colleagues related to a prior version of the GUIDE (Cheverst et al 2001). The prior version of GUIDE employed an over-determination to simplify the user's task. They addressed the issue as a specialisation of the fundamental design trade-off between prescription and freedom/flexibility. They solved this problem in the following version of GUIDE by providing the user with the additional options of manually selecting the information. The problem could also partly be solved by some kind of direction awareness system, sensitive to the direction the user was facing. However, a direction-aware system would have problems identifying if the user is interested in a nearby or a distant object in that direction.

#### 4.4.2 The social context

Another problem of context-aware applications is that they often fail to include the social context. While the location and the physical or other fixed features of a context are easy to define, the social activities of a situation is much more difficult to define and trace. Though a situation or setting to a certain degree can be defined by the physical structure, such as the rooms in a building, the activities and the people in the area may be even more important signifiers for identifying the situation.

Many physical settings are used for multiple purposes and activities, and the corresponding norms of social behaviour may vary among them. A concert or a theatre play may be held in a museum, in a church, in a playground, a sports stadium or in a park. A religious mass could be held in a non-church setting. A conference workshop or a meeting could be held in a restaurant setting. This may cause a temporal change of the norms from those associated with the original purpose of the setting, to those associated with a theatre. Identifying the setting according to the original purpose of the place may be inappropriate to the situation with a theatre. Thus, at one point in time it may be highly functional and accepted to use an advanced digital guide or a cell phone, while in the next it would not, even in the same physical settings.

The time dimension combined with an agenda of scheduled events could be used as contextual information in a context-aware application, and this could provide the user and the device with the necessary information to make proper adjustments prior to and at the setting. However, this would only account for pre-scheduled events. Ad hoc and unplanned events or activities would not be registered and adjusted to. The user may usually be able to adjust the device manually, such as setting the cell phone on "silent" or deactivating video or audio and using a text/graphic interface only. The advantage of a dynamic context-aware application is that these and similar adjustments can be performed automatically by the system. Manually adjustments may require that the user makes these adjustments before entering the setting. It would be too late to adjust the cell phone to "silent" when someone is calling.

Context is social because other people are involved. Deciding if and how to use a technology in a given situation should include considerations of other people in the context, and if they may be involved or disturbed by it. "People-awareness" applications have been developed for the purpose of co-ordination and finding people with mutual interests (Cheverst et al 2001). Another purpose could perhaps be to "warn" and adjust the system to an increased risk of disturbing others in the area, due to their individual preferences or high sensitivity for disturbing activities or technologies. My cell phone could "broadcast" my preferences for not being disturbed to other devices nearby, suggesting adjustments to the ringing sound or interface to be used.

User preferences and context-related information could also be communicated to those trying to call this user. A general problem with the adjustments available on cell phones

(such as silent mood, ringing sounds, forwarded calls) is that its effect is limited to the device, and not communicated to others.

As discussed previously, providing the caller with some information of the context of the target person would enable the caller to decide whether to proceed and make the call, or to call again later when the other person is in another situation and perhaps more available for a phone conversation. The application suggested by Schmidt and colleagues (Schmidt et al 2000) and our own work on context-awareness (Munch-Ellingsen et al, 1998) are examples of efforts made to solve this problem.

A system providing contextual information of other persons would raise some privacy issues, and may even run the risk of producing more disturbance than it reduced. However, it may illustrate how the social context follows a person or a group of persons as they move around in and out of various physical surroundings. Further, it may illustrate how elements of the social context could be represented and communicated to others.

## 5 Conclusion

The use of cell phones is sometimes perceived as annoying, disturbing, interrupting, impolite, and even as improper behavior in many social situations (Haddon, 1998; Wei and Leung, 1999; Katz and Aspden, 1999; Townsend, 2002; Ling, 2002). This has been explained as a social phenomenon related to norms of social behavior. The main argument in this paper has been that a social and cognitive psychological perspective could provide further understanding of the mechanisms involved in this issue. A set of hypotheses have been suggested, and implications for mobile communication services applied in tourism have been discussed. In this final section we suggest a tentative model for understanding the problems of disturbance of cell phones and other mobile communication, including individual, situational, and technological dimensions.

### 5.1 Towards a model

We suggest that the problem of social disturbance of cell phones as well as other mobile communication is the result of an interaction of individual, situational and technological factors, described as a four-step model.

#### 5.1.1 The User

In the first step we focus on variations among the individual cell phone users, differentiating between a high versus low willingness to disturb. The term “willingness to disturb” may not be a good one, and could be misleading by implying an intention to disturb. Though we cannot rule out the possibility that someone actually might use the phone to intentionally disturb others, this is not the focus here. Alternatively this dimension could be reversed and phrased as low versus high on social awareness or worriedness to disturb. The purpose is to include a dimension of individual variations of the phone users that might be associated with disturbance. In this first effort of building a model, the term willingness to disturb is a pragmatic choice.

This step takes into account that some people seem more worried while others are less worried about disturbing others. Individual factors we may expect to be associated with this worriedness include socio-demographic such as age, gender, education, work, social and cultural background, technological experience and cell phone experience, personality style (such as extraversion versus introversion), social and situational awareness, self-monitoring as well as expectations and feeling of control in the situation. The combined set of individual factors result in differences in people’s attitudes and concerns about the effect of their own behaviours (including their use of technology) upon other people, their awareness of self versus others, and the social situation they take part in.

#### 5.1.2 The co-located other

The second step includes the co-located person, and his/hers relative sensitivity to other people’s cell phone behavior. This could be understood as a certain individual threshold for perceiving the use of cell phones in certain situations as disturbing and irritating. Cell phone disturbance could then be explained as a match or mismatch between the individual preferences or characteristics of the two persons. The cell phone user may vary on the willingness to disturb, and the other person varying on the sensitivity to be disturbed. This could be illustrated by a simple two-by-two table:

		Co-located person's sensitivity to be disturbed	
		High	Low
Cell phone user's willingness to disturb	High	A	B
	Low	C	D

Figure 1: Willingness versus sensitivity to disturbance

A cell phone user with a high willingness to disturb and a co-located person who is highly sensitive to be disturbed (the High-high combination A) would be the combination representing the highest risk for cell phone disturbance. The combinations B and C would have mediate risks, while the meeting between a cell phone user with low willingness to disturb and co-located persons with low sensitivity to be disturbed (the low-low combination D), would have the lowest risk for cell phone use to be perceived as disturbing.

### 5.1.3 The situation

In the third step, situational factors assumed to be associated with cell phone disturbance are identified, and the model differentiates between situations of high versus low sensitivity for cell phone use to be perceived as problematic.

We have cited several studies documenting that cell phone disturbance is associated with situational factors, with some types of situations having a higher risk for cell phone use to be perceived as disturbing. Theatres, cinemas, restaurants and public transportations are among the situations where people report a higher sensitivity for other people's use of cell phones. The activities and tasks people perform or are engaged in could be treated as separate dimensions, but are included in the situational category, because we understand a situation as defined and constructed partly by the activities people are engaged in. The same argument holds for the social and relational factors among people at a certain time and in a certain place.

		Co-located person's sensitivity to be disturbed			
		High		Low	
Situation sensitive for disturbance	→	High	Low	High	Low
Cell phone user's willingness to disturb	High	A1	A2	B1	B2
	Low	C1	C2	D1	D2

Figure 2: Willingness and sensitivity to disturbance in high versus low sensitive situations

The combinations of user willingness to disturb, and other persons' sensitivity to be disturbed in high and low sensitive situations are illustrated in figure 2. Cell phone users' high versus low willingness to disturb are represented by the two rows. Co-located persons' high versus low sensitivity to be disturbed, further divided into high versus low sensitive situations, are represented in the columns.

The highest risk for disturbance is found in the combinations of a high willingness to disturb (user), a high sensitivity to be disturbed (co-located person), in a situation characterized as highly sensitive for disturbance (A1), while the lowest risk for disturbance would be the triple-low combination (D2).

However, sometimes the situation may override individual sensitivity. In a highly sensitive situation such as theatre or cinema performance, and a religious ceremony such as a funeral, most people would perceive cell phone use as disturbing. If the user fails to acknowledge or respect the high sensitivity of these situations, there is a high risk for disturbing others by using the cell phone, even if people present are low-sensitive to be disturbed by cell phones (B1). Individual sensitivity may also override the situational dimension. For some people, other people's use of cell phones is perceived as disturbing in any kind of situations, even in low-sensitive situations, and even if the user makes efforts not to disturb others (C2).

#### **5.1.4 The technology**

In the final step technological factors are considered, and technology factors assumed to be associated with cell phone disturbance are identified. The model differentiates between technology with high versus low risk for disturbance.

Examples of technological factors we may assume would contribute to increase the risk for disturbance could be an interface or communication modality producing sounds, such as the ringing sound, or audio based alarms, warnings, or reminder signals, a speech-recognition interface or a regular phone conversation. For example, the use of text messages is a quiet activity and may reduce the risk, while the sound of talking on the phone may increase the risk for disturbing others in a given situation.

Similarly, we have suggested that listening difficulties (due to low quality sound production by the device) may result in a tendency to increase own speaking volume, and thereby increase the risk of disturbing others.

Another factor we have discussed in this paper is the amount of cognitive efforts or focused attention necessary for the user to operate or make use of the technology. The studies of cell phone use and driving have illustrated the problem of diverting the cognitive efforts between several tasks, and how cell phone use may reduce driving performance. A similar problem could be expected in a social context. If a high amount of cognitive resources or a highly focused attention towards the technology is needed, it could reduce the cognitive resources available for other tasks, such as the situation, activities, events and people in the physical surroundings. High cognitive demands by the technology thus could increase the risk for ignoring or failing to adapt to what happens in the local social situation, which again could result in disturbing others.

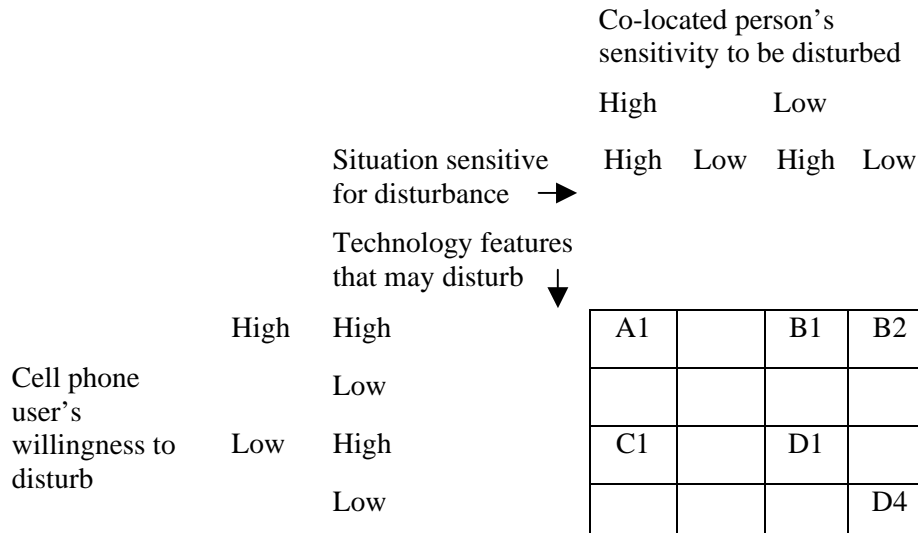


Figure 3: Willingness and sensitivity to disturbance in high versus low sensitive situations when using high versus low disturbing technology

Figure 3 illustrates the model including individual differences of user and co-located person, technology and situation. High versus low user willingness to disturb (individual differences of users) and technology characteristics expected to be high versus low disturbing is shown in the rows. Sensitivity of co-located person and sensitivity of situation is shown in the columns. The highest risk for disturbance is also in this figure found in A1, the combination of a user with high willingness to disturb, using a highly disturbing technology, in a sensitive situation including sensitive co-located individuals. The lowest risk is found in the D4 combination.

However, a highly disturbing technology used by someone not worried of disturbing others, may cause disturbance in low sensitive situations even if others are low-sensitive B2. This could explain why cell phone conversations sometimes are disturbing others in open public areas such as on the platform waiting for a train. The situation or the co-located others may not be particularly sensitive, but the technology characteristics of the cell phone may be highly disturbing. As discussed earlier, the listening conditions may be difficult and the user may speak louder than in regular face-to-face conversations.

This tentative model may illustrate the need for adjusting technology to variations in the situation. Ideally, a user interface should adjust to low-disturbing when entering a highly sensitive situation. People often do this manually, e.g. by switching the phone to “silent mode”. This could also be provided automatically by context-awareness. Adjusting technology to the situation may prove useful and reduce the risk of disturbance.

However, to understand the problem of social disturbance of cell phone technology, we must include individual factors of both the user and the other co-located individuals. Our model have suggested a way to do this.

The model suggested here is certainly highly tentative and rudimentary, and should not be understood as a complete model. More than a model, it is a first effort to illustrate the dimensions we may assume to be associated with social disturbance of cell phones.

## 5.2 Summary

The problem of social disturbance of cell phones is complex and multi-dimensional, including both individual, situational and technological factors. The main focus of this report has been to introduce and discuss individual factors, and particularly cognitive and psychological factors we may assume to be associated with the problem of social disturbance of cell phones. Several factors have been suggested and discussed, including situational factors, individual differences on various factors such as socio-demographics, cell phone experience, cell phone ownership, personality, social awareness and self-monitoring, cognitive load, task, relevance, uncertainty, predictability, perceived control, listening problems and speaker volume. A set of hypotheses has been made, suggesting how each of the factors may be associated with the problem.

Though the documented problems of social disturbance is related to traditional conversations on cell phones, the problems may have relevance for use of other types of technologies and more advanced mobile technologies.

The final section of the paper addressed the problem of social disturbance in relation to mobile technologies in tourism. Tourism is expected to have a high potential for services offered via mobile telecommunication technologies. High mobility combined with high need for information makes mobile information and communication technology well suited for tourism. The focus has been on the social nature of tourism and tourist activities. A major challenge for the tourist is the diverting or shifting attention between the source of information, the attraction, and the social context including other people. Various technological solutions based on context-awareness have been discussed. Finally, a tentative model illustrating the multi-dimensional problem of cell phone disturbance is suggested.

There are very few studies of the social psychological and cognitive aspects of the social disturbance of mobile telecommunication. In this report we have suggested several factors we assume to be associated with the problem, and formulated a set of hypotheses. Further research testing these as well as other hypotheses in this area may increase our understanding of the problem of cell phone disturbance.

Successful use of mobile technology must build on a necessary knowledge of how the user interacts with the context. Understanding the user challenges of managing handheld telecommunication in real life situations is vital in producing successful and non-invasive mobile telecommunication services. Knowledge of cognitive, social and psychological factors associated with the social disturbance of regular cell phone conversation may provide important input to the design of new mobile communication services, and contribute to avoid negative social consequences of new technologies.

## Significance for Telenor

By new telecommunication technologies, various kinds of information are made accessible on handheld mobile devices, relevant and specific to the surroundings, as well as to the interests and preferences of the individual user. This has been the focus of a series of research projects by Telenor R&D in Tromsø. Experiences from the projects have increased the understanding of the huge challenges the user has to face when operating mobile communications technology in dynamic real life settings, and simultaneously maintaining social interaction with other people in the situations. A better understanding of the social and cognitive processes and mechanisms involved in cell phone use in social situations is a key issue for succeeding in developing and delivering information, communication and transaction services on mobile telecommunications.

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