THE UNIVERSITY OF
WAIKATO
Te Whare Wānanga o Waikato

Understanding and Enhancing Customer-Agent-Computer Interaction in Customer Service Settings

Anette Olsson

This thesis is submitted in partial fulfilment of the requirements for the Degree of Doctor of Philosophy in Computer Science at the University Of Waikato

May 2007

ABSTRACT

Providing good customer service is crucial to many commercial organizations. There are different means through which the service can be provided, such as E-commerce, call centres or face-to-face. Although some service is provided through electronic or telephone-based interaction, it is common that the service is provided through human agents. In addition, many customer service interactions also involve a computer, for example, an information system where a travel agent finds suitable flights. This thesis seeks to understand the three channels of customer service interactions between the agent, customer and computer: Customer-Agent-Computer Interaction (CACI).

A set of ethnographic studies were conducted at call centres to gain an initial understanding of CACI and to investigate the customer-computer channel. The findings revealed that CACI is more complicated than traditional CHI, because there is a second person, the customer, involved in the interaction. For example, the agent provides a lot of feedback about the computer to the customer, such as, “I am waiting for the computer”.

Laboratory experiments were conducted to investigate the customer-computer channel by adding non-verbal auditory feedback about the computer directly to the customers. The findings showed only a small insignificant difference in task completion time and subjective satisfaction. There were indications that there was an improvement in flow of communication.

Experiments were conducted to investigate how the two humans interact over two different communication modes: face-to-face and telephone. Findings showed that there was a significantly shorter task completion time via telephone. There was also a difference in style of communication, with face-to-face having more single activities, such as, talking only, while in the telephone condition there were more dual activities, for instance talking while also searching. There was only a small difference in subjective satisfaction.

To investigate if the findings from the laboratory experiment also held in a real situation and to identify potential improvement areas, a series of studies were conducted: observations and interviews at multiple travel agencies, one focus group and a proof of concept study at one travel agency. The findings confirmed the results from the laboratory experiments. A number of potential interface improvements were also identified, such as, a history mechanism and sharing part of the computer screen with the customer at the agent's discretion.

The results from the work in this thesis suggest that telephone interaction, although containing fewer cues, is not necessarily an impoverished mode of communication. Telephone interaction is less time consuming and more task-focused. Further, adding non-verbal auditory feedback did not enhance the interaction. The findings also suggest that customer service CACI is inherently different in nature and that there are additional complications with traditional CHI issues.

ACKNOWLEDGEMENT

First of all I obviously want to express my gratitude for all the help and support I have received from my supervisors (in alphabetical order) Mark Apperley, Matt Jones, Dave Nichols and Mike Twidale. I would not have gotten here without you! Thank you!

I would also like to thank the Computer Science Department for all the support I received throughout my PhD!

I also wish to thank my brother, for reading various papers and reports, for constantly challenging me to finish my PhD before him and for being a great friend! And thank you to my Mum and Dad; without their encouragement and belief in me throughout my life I would not have embarked on this PhD journey.

I had also better thank my friends, because if I don't, they will hassle me for the rest of my life!

I would also like to mention Nick. It is not fair that someone should be taken by cancer at such a young age. But it did teach me how fragile life is, and how important it is to live life fully and be happy!

Last, but certainly not least, I want to thank Geoff, not only for proof-reading the entire thesis, but for being wonderfully helpful when I was stressing about writing this thesis and also for taking over most of the housework while I was writing!

BRIEF TABLE OF CONTENTS

DETAILED TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

1 INTRODUCTION

Providing good customer service is crucial to many commercial organisations. The most common reason a client chooses to take their business elsewhere is because of bad service (Millard, Coe, Gardner, Gower, Hole, and Crowle, 2000). Owing to changes in government regulation, the nature of customer service has changed in many business sectors. For example, since 1990 in New Zealand, there has been deregulation in the electricity supply section which has lead to increased competition, and hence, providing good service and retaining customers has become even more important.

There are different types of organisations that provide customer service as part of their main functionality, such as, travel agencies, banks, insurance companies, supermarkets, call centres, clothes stores, car sales yard etc. In this thesis a subset of customer service is discussed, where there are two human roles, agent and one or more customers, and a computer, and all three of those entities are mutually dependent on each other to complete the task.

The method with which the service is provided varies due to the genre of the organisation; the interaction can be collaborative, for example at a electricity call centre where customer and representative collaborate to identify the old and new addresses, or competitive, for instance, at a car sales yard where the customer wants the lowest price but the sales person wants the highest price, or the collaboration can be both collaborative and competitive. Additionally, the interaction can be static, where specific information such as address details are not flexible, or dynamic, where there are many potentially suitable options, for instance, flight options. Further, different types of service providers prioritise different parts of the customer service. Electricity provider call centres often focus on reducing the time until a call is answered and the time to process a call. The travel industry, on the other hand, often focuses on providing the most enjoyable experience for the customer.

There are different ways to provide customer service, through for example, human agents, electronic computerized agents or telephone-based interfaces such as telephone banking. However, it is most commonly provided through human agents. The service can be provided over various communication channels, such as face-to-face, telephone, email or websites. Historically, a lot of customer service was provided face-to-face, however, increasingly the service is provided via telephone or electronic mediums, such as, email or the Internet. Some organisations, for example, power supply call centres, actively discourage customers to interact face-to-face, while others, for instance, retail industry, predominantly interact with consumers face-to-face.

Another change in the provision of customer service is the addition of computers to the interactions. Before 1990 many agents relied on hardcopy material, telephone communication with experts or their own expertise to complete the client request. However, nowadays computers are often used to support the interaction between the representative and customer. With the introduction of computers vast amounts of information and different options, for instance potentially suitable flights on different dates and with different airlines, are readily available, and with the aid of computers many updates and changes, such as, changing the address for electricity supply, can be made instantly. Since the introduction of computers, there are three entities, the agent, customer and computer, involved in the interaction. The agent mediates between the customer and information system. The customer who wants a service or product has the detailed information needed to complete the task, but is not directly interacting with the computer. Typically only the agent directly interacts with the computer. Further, if the task is being carried out via telephone, the customer is not able to see the computer, and might not even be aware that there is a computer involved in the interaction.

It is good business sense to take into account that software is usable, and it is also law in some countries (EC directive 90/270/EEC, Dix, Finlay, Abowd, and Beale, 1998). Software has to be suitable for the task, easy to use, provide feedback and displays information in a format and pace suitable to the user. Traditional research into usability and computer human interaction (CHI) commonly focuses on one person working in front of one computer. However, many situations require people to collaborate, and it is not unusual that the collaboration involves computers. There has been substantial research into computer supported collaborative work (CSCW), where two or more people collaborate using single or multiple computers. Because there are multiple users in collaborative computing there are additional issues above traditional CHI to consider, for instance, what information is shared or private, and awareness of the activities of other collaborators. There have been frameworks developed for computer supported collaborations, such as the one discussed later in Section 2.2 (for example Figure 12), however, these do not usually take into account the interaction channels between the humans and computer. The next section in this thesis identifies the specific area of research for this thesis as well as defining a framework to facilitate discussion about the interactions.

1.1 Definitions

The research in this thesis was carried out in a setting where a service is provided to a customer through a human agent, such as at a telecommunications or insurance company. Specifically, the setting requires three entities, one or more customers who have approached a business, a representative for the organisation and a computer which the agent interacts with to perform the task. In addition, there is also an inequality between the human roles, where the customer has specific details relating to the task, and the agent has the domain expertise. These types of settings include the interactions at a travel agency or a bank call centre and the communication between representative and client can be either face-to-face or via telephone. However, the scope of this thesis does not include services where the agent does not usually need a computer to solve the task, such as a clothes store. Also, it does not include computer automated customer interaction, such as telephone-based interfaces or E-commerce where there is no human representative.

An additional specification for the context of this thesis is that the research is only concerned with service provision where the customer does not directly interact with the computer. The client has to communicate with the agent who interacts directly with the computer. In some settings the customer can see the computer, while in others they cannot. For example while a consultation is taking place at a travel agency, the customer can see the computer, but when a customer calls a call centre, they are not able to see the computer. For the purpose of this thesis, this interaction, where the customer communicates with an agent who interacts with both the computer and the customer, has been termed Customer-Agent-Computer interaction (CACI).

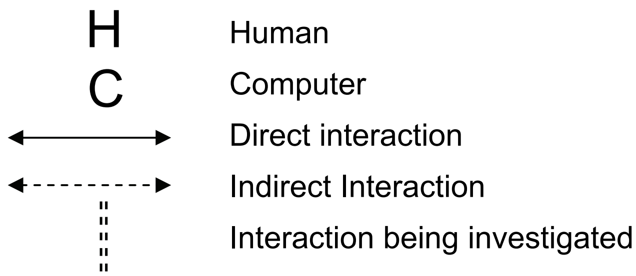


Figure 1. The notations used to describe different interaction channels involving humans and computers

For the purpose of this thesis, a set of notations have been created to represent the different communication channels of computer-human interaction. The elements of the interaction are shown in Figure 1. The letters define the entities and the arrows denote the communication channel. For example, remote email communication is illustrated in Figure 2. The entities, the two humans and two computers are shown through the letters ‘H’ and ‘C’. To illustrate that the interaction is remote, there is no arrow between the two humans. To transfer the information between the two humans, the email is transmitted between the two computers.

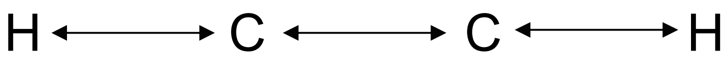


Figure 2. Using the defined notation for describing email communication

In collaborations there is, by definition, more than one human, and they may or may not be in the same role. In the notations, an ‘H’ denotes one or more humans, but they have to be in the same role. For instance, an ‘H’ can represent one or more customers in a travel agency setting, but it cannot symbolize both an agent and a customer. The channels of interactions are represented by an arrow and can be direct or indirect. Direct interaction refers to intentional communication between two entities with no intermediary. An indirect channel refers to unintentional or mediated information being passed between two entities. For example, when a customer calls a call centre and he or she can hear the agent typing on the computer, unintentional information is passed between the customer and computer.

When research has been conducted into an interaction channel, this is noted by a vertical dashed line, for example, Ochsman and Chapanis (1974) investigated human-human communication (see Figure 3).

$$H \longleftrightarrow H$$

Figure 3. Notations illustrating investigations into communication between two human entities

In addition to the notations defined in Figure 1, when the entities refer to these specific roles, a subscript is added to the letter. For example, for the research in this thesis, there are only two roles for the human entities, agent or customer (see Figure 4).

H_a human (specifically agent)

H_c human (specifically customer)

Figure 4. The notation used to describe the human entities including subscript to specifically show the role

In this thesis the channels of communications being investigated are carried out either face-to-face or via telephone. Hence additional notations were added to the channel show the mode of communication (see Figure 5 and Figure 6).

$$H \xleftrightarrow[f]{} H$$

Figure 5. Human-human communication, including notation to show face-to-face interaction

$$H \xleftrightarrow[t]{} H$$

Figure 6. Human-human communication, including notation to show telephone interaction

1.2 Customer-agent-computer interaction

Customer service customer-agent-computer interactions are more complicated than traditional CHI, because there is a second person, the customer, involved in the interaction. Complexities arise because, unlike CHI where there is commonly only one communication channel, in CACI there are multiple interaction channels:

- The customer-computer interaction
- The customer-agent interaction
- The agent-computer interaction

Additionally, CACI is different to CSCW, because in CSCW all the users' are able to interact with a computer and the software has been specifically designed to support collaboration. In CACI, on the other hand, the customer, who is interested in the product or service, is not directly interacting with the computer. The agent on the other hand is interacting with both the customer and the computer, and the computer software has been designed to support the agent's work. Further, the client and representative have different types of information, such as, customers knowing their holiday dates and the agent knowing flight availability, but they also have different representations of the information (Scaife, Halloran, and Rogers, 2002). This can potentially cause problems, as the representative has to interpret and 'repackage' the information from the computer screen to the traveller. The computer software can also have an influence on the discourse between the two humans. For example, at a call centre it is common that the agent will ask the caller for a customer number rather than a name, or a patient judging when to provide information depending on the doctor's interaction with the computer.

Previous investigations into CACI have included directory assistance, doctor's surgery, travel agencies and bank call centre. Some researchers define the agent as a 'surrogate' or 'intermediary' between the computer and agent (Lawrence, Atwood, and Dews, 1994; Lawrence, Atwood, Dews, and Turner, 1995), while others, in contrast, state that the agent is much more than a 'surrogate' and is more of a 'knowledge worker' (Muller, Carr, Ashworth, Diekmann, Wharton, Eickstaedt, and Clonts, 1995). Other studies have investigated the initial interaction that a customer has with travel agencies (Halloran 2002; Scaife, Halloran, and Rogers, 2002) and suggested improving this stage of the task by multiple shared computer screens where the customer and agent sit side-by-side which is different to tradition trave agency interaction where people are sitting facing each other.

The next part of this chapter discusses each of the three interaction channels mentioned at the start of this section.

1.3 Customer-computer interaction

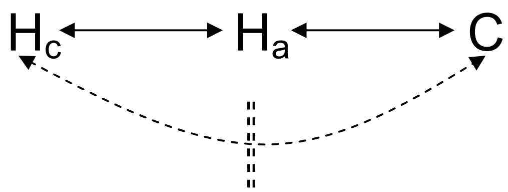


Figure 7. The indirect channel of communication between a customer (H_c) and computer (C)

When a person gets in touch with a customer service organisation, he or she is not directly interacting with a computer. However, there is still an indirect channel between the customer and the computer (see Figure 7). A person contacting an organisation is often aware that there is a computer involved in the interaction. For example, when an individual is co-located with a personal banker he or she can see the computer. Even in a remote setting, such as a call centre, where the person cannot see the computer, they can often hear it, or they are made aware of it by the agent is referring to it. Previous research into a bank call centre has identified the need to display the activity of the agent rather than trying to hide it (Bowers and Martin, 2000).

People visiting a service organisation often modify their behaviour to fit with the agent-computer interaction. For example, when a patient visits a physician, he or she coordinates their interaction with the practitioner depending on the practitioner's interaction with the computer (Greatbatch, Luff, Heath, and Camion, 1993). The doctor-computer interaction can worsen the interaction for the patient, as they can be left waiting or unsure of when to provide information. In co-located interaction, the representative sometimes shares the computer screen with the customer, while in other circumstances they do not. For example, travel agents do not commonly share their computer screen with the client. The physical layout of a typical travel agency is not conducive for sharing the screen and the representation of the information is often too complicated for an untrained eye (Scaife *et al*, 2002).

1.4 Customer-agent interaction

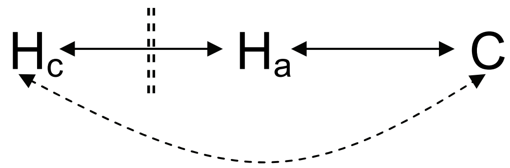


Figure 8. The channel of communication between the customer (H_c) and agent(H_a)

One of the main communication channels in CACI is between the two humans (see Figure 8). They need to collaborate to complete the task as neither can complete it without assistance from the other person. The customer and agent have to establish what the task is and the desired outcome. For example, when a person approaches a travel agency, they must establish the destination, time, price etc. and they also have to confirm whether the customer intends to proceed with that particular agency. Further, the process of arriving at the outcome also needs to be determined. For example, should the task be completed as fast as possible, or is the customer's experience more important?

People communicate via a range of methods, including spoken language, non-speech sounds or body language. Co-located synchronous modes of communication, such as face-to-face, support all the different types of communication, while remotely located modes, for example telephone, only support some of the available channels. Research into communication mode is conflicting, some research suggests there is a difference in, for example, style and content of the communication between face-to-face and telephone interaction (Stephenson, and Dewey, 1981), while others argue that as long as people can communicate verbally there is no significant difference (Ochsman and Chapanis, 1974). Additionally, previous research into human-human communication has not included a computer. Therefore, it is not clear how introducing a computer into the interaction affects human-human communication.

1.5 Agent-computer interaction

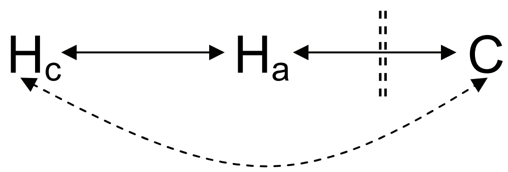


Figure 9. The channel of communication between the agent(H_a) and computer (C)

The last channel relates to the interaction between agent and computer (Figure 9). This might appear to be traditional HCI, but, there is still an additional user involved in the interaction. The agent has to work with the customer, communicate with him or her, and while at the same time interact with the computer. As noted earlier, the customer has a lot of the information that is needed to complete the transaction, even if the agent is the person actually interacting with the computer.

The nature of the task in a customer service setting can be very complicated, and many different options are often considered before a suitable option is found. For example, when finding a suitable holiday destination and date many alternatives are often considered and it is also common that some of the choices are revisited many times before a decision is made. Further, there is often a significant amount of navigation required to complete the task. For example, while a call centre agent completes a person's move from one address to another, he or she has to navigate the computer system, while also obtaining the necessary information from customer. In addition, many call centres strive to reduce the length of customer calls as much possible. Call centres handle many customers each day, and a small time saving can mean a large overall cost saving. Therefore, the agents often endeavour to pre-empt the customer's request by navigating to the anticipated location in the software and hence reduce the time to complete the task.

1.6 Purpose of research

The main objective of this research was to investigate the three communication channels in customer service CACI. There has been research into the individual channels (human-human communication, for example, Ochsman and Chapanis, 1974 and Rutter, *et al*, 1981; customer-computer for example Bowers and Martin, 2000, and Halloran, 2002; and computer-agent Dix *et al*, 1998). However, there are many aspects of the interactions that have not been investigated. The findings from research into human-human communication are unclear, additionally, research into human communication has not been investigated in a customer service setting, nor has it involved a computer in the interaction. Bowers and Martin (2000) argue the importance of 'displaying engagement' to the customer, however, the importance and impact of 'displaying engagement' in a call centres has not been investigated. Previous research (Halloran, 2002; Scaife *et al* 2002) has suggested sharing the entire computer screen would improve the initial stage of a travel booking. However, the literature also highlights the importance of allowing people to maintain both shared and private information (Greenberg *et al*, 1999; Hinckleyss, 2003).

From the previous research areas have been identified that would benefit from further investigation, in particular the objective was to investigate the following questions:

- Would adding auditory feedback to 'display engagement' in a remote telephone interaction improve the indirect communication between customer and computer?
    - Does the mode of communication, co-located face-to-face or remote telephone, have an effect on customer-agent communication in a customer service setting which also includes a computer?
- Would sharing part of the computer screen, at the agent's discretion, enhance the indirect communication between computer and customer in a co-located customer service interaction?
- What are the agent-computer issues in CACI and what are potential computer interface enhancements?

To gain a deeper understanding of the interaction CACI was investigate in different settings; call centre and travel agency.

The approach taken to investigate these questions was to use both qualitative and quantitative methods. The quantitative methods included four controlled laboratory experiments. Two studies were conducted into adding auditory feedback to a call centre simulation. Two experiments were used to investigate human-human communication via telephone or face-to-face in a travel agency setting. For both settings there were both between- and within-subject designs.

Quantitative research is characterized by objectivity, reliability and prediction, while qualitative research seeks to gather evidence relating to *qualities* of live and the participant's perspective, in a natural setting (Burns, 1997; Denzin and Lincoln, 2003). There are advantages and disadvantages with both qualitative and quantitative methods, and the two methods can often be used to complement each other (Patton, 2002; Burns, 1997). The advantages of quantitative methods are in the precision and control, and statistical aggregation (Patton, 2002; Burns, 1997), but disadvantages are that it requires standardized measures which limit the depth and detail of the data (Patton, 2002) and it can produce findings that are artificial and might have little meaning in real life (Burns, 1997). The advantages with qualitative methods are that it allows the researcher to study the issues in depth and detail (Patton, 2002; Burns, 1997). Disadvantages with qualitative research are that it can often be very time-consuming to collect the data and it can be difficult to generalize (Burns, 1997; Patton, 2002). Additionally, the presence of the researcher can have an affect on the participant and it can be difficult to predict what and when events will occur. The researcher also needs to be careful that they do not bias the data (Burns, 1997).

In addition to the laboratory experiments, observations and interviews were conducted at various call centres and travel agencies. Further, at one travel agency a focus group discussion and proof of concept study was conducted.

1.7 The contributions

The main contributions from the research in this thesis are:

- The detailed study, analysis, and development of an understanding of CACI
    - insight into apparent inconsistencies of prior research
    - providing a new perspective on human-human communication when a computer is included in the interaction
    - defining a framework and notation to discuss and compare the channels of communication involved in CACI
- The drawing together of previous research relating to the three different channels of interaction, to form a unified basis for the further development of CACI
- Establishing whether or not telephone-based CACI is impoverished in comparison with face-face interaction, and the study of potential enhancements to telephone interaction and their effectiveness
- In particular, the research has shown that:
    - Adding auditory feedback did not improve CACI in a simple telephone-based task
    - Sharing part of the agent's screen with the customer at the agent's discretion potentially enhances face-to-face CACI

Published papers:

- Steel (aka Olsson) A. (2003). Understanding and Enhancing Call Centre CHHI. *CHI 2003, Doctoral Consortium*
- Steel (aka Olsson) A, Jones, M, Apperley, M. (2002). The Use of Auditory Feedback in Call Centre Computer-Human-Human Interaction. *CHI 2002*.
- Steel (aka Olsson) A., Jones M. & Apperley M. (2001). Auditory feedback in call centre CHHI. *OZCHI 2001*.

1.8 Thesis structure

The following chapter reviews previous literature relating to CSCW, CACI and research relating to the three channels of interaction, between the customer-agent, customer-computer and computer-agent.

In order to gain an initial insight into interactions between the customer, agent and computer, two observational studies were conducted in call centres, which are discussed in Chapter 3.

Chapters 4 and 5 report on two laboratory experiments conducted into adding non-verbal auditory feedback to the interaction at a simulated call centre. It was found that there was only a small insignificant difference in task completion time, flow of communication and subjective satisfaction due to the added auditory feedback. Therefore it was decided to investigate the human-human communication further through two laboratory experiments, described in Chapters 6 and 7. Chapter 8 reports on studies conducted to verify the findings from the human-human communication experiments, in-depth observations and interviews were carried out at a number of travel agencies as well as identifying and examining further areas of enhancement.

The final chapter concludes the contributions of this thesis, discusses the implications and lessons learnt from the methods used and identifies potential future work.

2 LITERATURE REVIEW

As described in the introduction, the research in this thesis is carried out in a customer service setting, where one or more customers communicate with an agent to perform a task, and where the agent is interacting with a computer. There are three channels of communication relevant to the research in this thesis; between customer and agent, customer and computer, and computer and agent. There are many situations where this kind of interaction takes place, such as, at a travel agency, call centre, doctor's clinic, or at a bank. There is an asymmetry between the collaborating partners, such as different goals, knowledge and expertise, and information, relating to the task. In these situations, however, there is also a mutual dependence with the other person in order to successfully complete the task. Further, the interaction can take place over different communication channels, such as, face-to-face, telephone or email. Below are two typical scenarios of the CACI in a customer service setting:

> *Face-to-face scenario*
>
> Joe Lovejoy wants to go on a trip to Cairns over a weekend in June. He has been in contact with a travel agency and has been given a number of brochures to look through. To make a flight and accommodation booking he makes an appointment to go and see the agent face-to-face. He gets a bit frustrated with waiting while the agent is trying to find details on the computer relating to his previous interaction with the agency. Once his details have been found the agent proceeds to find the best flight option. The agent read out many different flight options, but Joe is struggling to remember them all. Instead, the agent prints out some suitable options and they discuss the options over paper. In the end Joe decides on a flight booking. He books the flight now and makes arrangements to come in a pay for the ticket at a later stage, closer to the time of the trip.
>
> *Remotely located collaboration, via telephone*
>
> Mary Storm is moving house and wants to inform her electricity provider of her change of address. While driving, she dials the toll-free number to the power company. The agent asks Mary for her customer

> number, which she does not have as she is in the car. After a bit of searching on the computer, the agent manages to find Mary's details. Mary says to the agent "I am moving from 1 Victoria Street to 23 Queen Street". However, the agent needs to remove her from the old address before adding her to the new address. Mary has to wait while the agent is completing remover her from the old address and while the agent is working on the task, Mary is unsure of what is happening. Once the old address has been removed, Mary has to provide her new address again.

The primary product for many commercial organisations is to offer a service, and hence providing good customer service is essential. In the 'old factories' work was concentrated on the manufacturing floor, while the 'new factories' concentrate on offering services through customer representatives working in front of a computer (Bowers and Martin, 2000). Millard, Coe, Gardner, Gower, Hole, and Crowle (2002) argue that 70% of the customers that terminate their relationship with a business leave because of bad service. Because of the vast number of service interactions and their relationship to important outcomes, such as loyalty, sales and satisfaction, it is essential to understand how to manage service encounters, even in industries that are not traditionally defined as service industries (Bitner, Brown and Muter, 2000). Bradshaw and Brash (2001) define customer relationship management as

> "… a management approach that enables organisations to identify, attract and increase retention of profitable customers, by managing relationships with them."

The call centre is where an organisation, which does not provide face-to-face customer contact, gets an opportunity to understand the clients' needs, and to offer solutions and support to the organisation's product and services (Tanir and Booth, 1999). It is important to ensure that:

- The customer receives quality service
- The service is delivered promptly
- That many customers are served 'at their convenience'

This chapter describes prior work relating to the scenarios described above, in particular research relating to CACI in a customer service setting (Section 2.1) and the three channels of communication. The customer and agent have to collaborate to complete the task and because there is also a computer involved in the interaction, Section 2.2 discusses research into collaborative computing. Although customer service provided through non-human agents is outside of the scope for this thesis, there is still some information relevant to this research, which is described in Section 2.3. Sections 2.4, 2.5 and 2.6 report on research specifically relating to the three interaction channels between the computer-customer, customer-agent and agent-computer. The final section discusses potential research questions identified from the literature.

2.1 CACI in a customer service setting

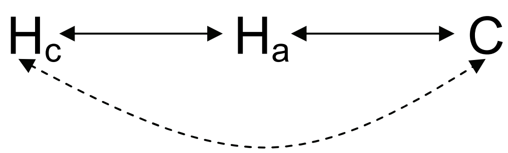


Figure 10. Typical CACI in a customer service situation

This section describes prior work directly relating to CACI (see Figure 10) in a range of customer service settings, for instance, telephone directory assistance, doctors' surgery or travel agencies. Interactive system design is commonly studied as one person interacting with one computer, however, in client service interaction, the agent needs to communicate with the customer while also interacting with the computer (Lawrence, Atwood and Dews, 1994). Further, the customer is trying to accomplish a goal with the computer, such as, book a flight, but is doing so via an organisation's representative. Hence, the agent acts as an interface between the customer and organisation (Randall and Hughes, 1995). The person who approaches a commercial business drives the interaction and decides what information to give the agent, when to provide additional information or when to ask for further assistance. Although the agent has general knowledge of the request, they do not know beforehand the specific details of what the client will ask or how the task will flow. Since the representative is also interacting with a computer, it can be a great source of inconvenience when the client makes an inquiry at an inappropriate time. What might seem like an appropriate time by the customer to ask a question might not be appropriate to the agent, as he or she is busy working with some other part of the request. This common scenario is one which highlights the representatives' pivotal role as an interface between the client and computer.

One common CACI scenario can be found in telephone directory assistance. As mentioned in the introduction (see Section 1.2), Lawrence *et al* (1994) and Lawrence, Atwood, Dews and Turner (1995) suggest that a telephone directory assistance agent is in effect a 'surrogate user' between the customer, with the question, and the computer containing the desired information. The agent has to bridge the 'gulf of execution' (Norman, 1988) between the client's language and the technical terms needed for the computer. The 'surrogate user' needs to obtain information from the customer, translate it into technical terms and search for the listing on the computer, and then translates the technical result back to the customer. This translation from 'social' to 'technical language' is often not trivial (Lawrence *et al,* 1994) and additionally, the agent has to vary the use of social and technical language due to the characteristics of the caller; for example, if the caller was elderly or a child, the operator reverts to a more social interaction.

Social interaction is often time consuming, but directory operators are often required to complete the task as quick as possible (Lawrence *et al,* 1995 and Muller *et al,* 1995). Thus to speed up the task completion, 'technical language' is brief and factual, and is employed with little social talk (Lawrence *et al,* 1995). Conversational turns are short and words were often omitted; for example "In Brooklyn?" instead of "Is that number in Brooklyn?". To encourage a technical as opposed to social communication style, the greeting can be directive and task-oriented, such as "What city, please?". Furthermore, the operators who are better at working in parallel with the two contexts, technical and social, complete the request in a shorter time. The faster operators are able to work with the computer and the customer at the same time, leading to fewer interruptions. The slower operators, on the other hand, work in more of a ‘response mode’, driven by the customer, leading to more interruptions due to the agent typing or waiting for the customer to formulate their next utterance.

An ability of an agent to manipulate the computer system and understand the clients needs has led Muller *et al* (1995) to suggest that a telephone directory assistant is not just a ‘surrogate user’, but is more of a knowledge worker, in contrast with Lawrence *et al* (1994) and Lawrence *et al* (1995). In addition to knowledge of the computer system and an ability to translate between the computer system and customer, the operator also needs:

- Knowledge of the customer’s world, for example, knowledge of unusually spelt locations, such as "Berkeley" being "Buerkle"
- Changes that occurs in the customer’s world, for example, change in name of a government agency
- Knowledge about information that is not stored on the computer database

As well as specific knowledge, the agent also needs further skills, such as, problem solving skills and human-to-human skills, including an ability to collaborate with the customer to refine the queries.

In telephone directory assistance the computer has an influence on the human-human interaction in an audio-only setting, through changing the communication style from social to technical (Lawrence *et al*, 1994), however, technology also has an effect on human-human interaction in a face-to-face setting (Greatbatch, Luff, Heath and Camion, 1993). Patients alter their communication with the doctor depending on the doctor’s interaction with the computer. For example, the patient waits for certain key strokes, such as the return key, or waits until there was a pause in the doctor’s interaction with the computer system, before they would initiate communication. In addition, when the doctor was engaged in computer related activities, such as reading previous notes or finding information, their response to the patient was sometimes delayed or minimal and the patient was sometimes forced to wait, or unsure of when to provide further information. This alteration in behaviour can undermine and disrupt the interpersonal communication between the doctor and the patient (Greatbatch *et al*, 1993). These findings have implications for design of CSCW systems, because the social environment for the system has to be taken into account.

In considering individuals other than the person using the computer, it would be possible to develop systems that support, rather than hinder, the human-human interaction.

Another social environment where computer human-human interaction has been studied is between the customer and agent at travel agencies (Halloran, 2002, Randall and Hughes, 1995, Rodden, Rogers, Halloran and Taylor, 2003, and Scaife, Halloran and Rogers, 2002). One of the main problems in the interaction between the customer and agent is the asymmetry, both in the physical layout of a travel agency and how the information is represented for the two parties. The physical layout at a travel agency makes it difficult for the customer to be part of the collaboration, even if they wanted to (Halloran, 2002, Scaife *et al*, 2002, and Rodden *et al*, 2003). In a typical travel agency situation, the customer and agents sit on either sides of a desk. The agent has access to the information system, while to the customer the agent is the interface to the computer system.

A constraint on effective collaboration can be the difference in information representation. The customer itinerary is often organized chronologically, while for the agent the trip has to be worked on by product category, for instance, flights, tours or accommodation (Halloran, 2002, Scaife *et al*, 2002, and Rodden *et al*, 2003). The information available for the customer, for example brochures or hand written notes, is different to the information the agent has, for example, flight booking systems. Additionally, the information on the computer is tailored for the agent and does not usually account for the additional interaction between representative and client. The interaction between the agent and customer is predominantly verbal as the customer tells the agent what they want and the agent reads out various options, such as, flights. However, due to the complex nature of travel booking, the interaction often becomes complicated, with the customer having to remember many different options. It is common that the agent at this stage prints out a summary of various options and uses the printout as a discussion point (Halloran, 2002).

The issue of physical layout, information representation and agent-customer interaction have been addressed by a novel computer system (Halloran, 2002; Scaife *et al*, 2002; and Rodden *et al*, 2003). The new setup included a different physical layout for the consultation (the participants were sitting side-by-side); three computer screens (one for a map, one for a timeline and budget, and one for brochures) were shared between the agent and traveller, as well as a different graphical layout of the information on the screens. The interfaces spread collaboration over more modalities, for example, shared screens between the customer and agent to remove the necessity for verbal communication of that particular information, which enhances the customer-agent interaction by allowing for a richer and more complex interaction. In addition, there was also extensive work redesigning the interfaces, which is discussed further in Section 2.6.

In summary, the agent in customer-human-human interaction has been labelled as a 'surrogate user' between the computer and the customer. Others suggest that the agent is much more than a surrogate and is more of a 'knowledge worker'. It has also been identified that the two humans, both in face-to-face and telephone interaction, alter their behaviour depending on the interaction with the computer. Additionally, the physical layout of the interaction setting as well as the discrepancy between customer and agent representation of the information can hinder effective collaboration.

2.2 Computer Supported Collaborative Work

A customer and a commercial organisation's agent have to collaborate in order to complete the task. Many aspects of work today, involve people working in collaboration with others, for example, students working on an assignment, a group of software developers brainstorming, or a customer and an agent collaborating to find a suitable flight. Co-operation involves two or more people engaging in some common task through interacting with various tools and products (see Figure 11) and where they communicate to co-ordinate their work (Dix *et al*, 1998). To ensure effective teamwork, both parties are expected to adhere to the rules and norms that guide the interaction (Bardram, 1998). Collaborative work also involves a combination of individual and group activities, where the partners carry out their private tasks while also cooperating with the other team members (Gutwin and Greenberg, 1998). There has been a substantial amount of research into how people collaborate via computers, including how groups work together and how to classify different types of collaboration (for example, Bardram 1998, Grudin 1994, Gutwin and Greenberg, 1998). In 1984 Grief and Cashman (Grudin, 1994) coined the term computer supported collaborative work (CSCW).

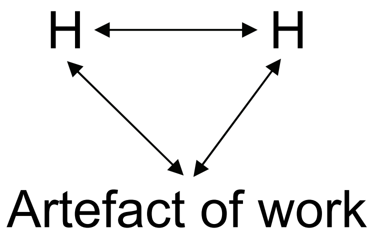


Figure 11. Dix *et al* (1998): Cooperative work framework

CSCW is most commonly defined either by time and location (see Figure 12) or by functionality (Dix *et al*, 1998, and Rodden, 1991). The time/space matrix is the most common classification and splits collaboration into whether the participants are working co-located or remotely, and if they are working synchronously or asynchronously. For example, when two people are communicating via email, it is remote and asynchronous. However, there are problems with the time/space classification. Firstly, there are applications that cross the lines in the matrix, for example, co-authoring tools can be used both co-located and remotely (Rodden, 1991). Secondly, often when designing CSCW software the time/space distinctions are not always important. For example, it does not matter with an email system whether people work synchronously or asynchronously (Dix *et al*, 1998).

	Co-located	Remote
Synchronous	Face-to-face conversation	Telephone
Asynchronous	Post-it note	Email

Figure 12. The time/space matrix of CSCW, with examples of each combination

Another method of classifying CSCW applications is by the function it supports (Dix *et al,* 1998):

- Computer-mediated communication (CMC) – support direct human-human communication, for example, email, video conferencing and virtual collaborative environments (see Figure 2)
- Meeting and decision support systems – support generation and recording of ideas and decisions, for example, a face-to-face meeting room, which has specific computer support for the meetings (see Figure 13)
- Shared applications and artefacts – support sharing the participants work domain, for example, a shared editor for co-authoring documents (see Figure 2)

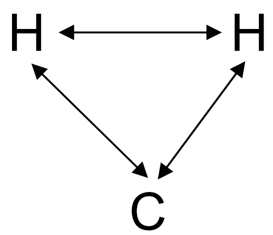


Figure 13. Meeting support system

To support collaborative work, a better understanding of how groups function and evolve is required, as well as understanding of how individuals respond to new technology (Grudin, 1988; Dorohonceanu, Sletterink, and Marsic, 2000; Bardram 1998; Horn, Finholt, Birnholtz, Motwani and Jayaraman, 2004). Introducing large mainframe computer systems into an organisation leads to large scale changes, for example, jobs might be redefined and new jobs created, and specific training is provided (Grudin, 1994). Introduction of smaller computer applications, such as a collaborative computing system, also results in organisational changes but on smaller scale, including how people work collaboratively as well as individually. For example, introduction of electronic scheduling calendar affects how a company manager uses the calendar, but also changes the work duties of their personal assistant, who often is the person who maintains the calendar. In addition, the software affects how meeting scheduling is made with other co-workers (Grudin, 1988). While workers often do not have a choice in adopting a new mainframe system, it is harder to get people to accept smaller applications, such as groupware (Grudin 1994). The company as a whole will not restructure for a smaller application, but social and political factors influencing group work will effect how people collaborate using the new software. An application designed to support group work needs buy-in from the members of the group. Grudin (1994) identifies eight major reasons, of which five relates to the user's workplace, why most CSCW applications fail

- Disparity in work and benefit –
    - some collaborators have increased work, for example, for an electronic scheduling calendar to work, everyone has to maintain their calendar
    - the benefits are not the same for all members
- Critical mass
    - It requires that most people agree to use the tool. Even a small number of refusals can disrupt the entire process, for example, with a communication tool
- Disruption of social processes
    - There might be resistance if the software interferes with subtle and complex group dynamics
- Exception handling
    - The software has to support the way people actually work, not how procedures state they should work
- Unobtrusive accessibility
    - Do not make the overheads of sharing too difficult. Focus on the task of the application as opposed to the collaborative aspects of it

When designing collaborative software, in addition to understanding how groups work, there are issues that require specific attention, such as, group awareness and private versus shared information. Awareness support is about providing remotely located collaborators with similar cues as are afforded in face-to-face communication. These cues help guide the coordination of work and help in assessing who is available for work and who is too busy (Gellersen and Beigl, 1999). Group awareness has been defined as "Consciousness and information of various aspects of the group and its members", but has also been further split into four subcategories (Gross, 1997):

- Informal– informal awareness of who is around
- Social – interest or attention as well as emotional state of collaborative partner
- Group-structural – information about the group itself, as well as the roles and responsibilities of the individual members
- Workspace – information about other participants interaction with shared space and artefacts

In a face-to-face workspace, awareness of the other collaborators' activities is easily maintained due to the physical proximity of the participants (Gutwin and Greenberg, 1998). However, in a situation where people are remotely located, awareness is not as readily available (Gross, 1997; Randall and Hughes, 1995). It has been proposed that to obtain informal awareness cues in remotely located teams, software needs to (Gellersen and Beigl, 1999):

- Track the objects people use, rather than the people themselves
- Introduce awareness into software already in use rather than creating new applications
- Ensure that awareness cues do not monopolize attention or compete for display resources

There is a need for groupware that is powerful and flexible for the individual but that also allows for smooth and efficient group interaction (Gutwin and Greenberg, 1998). In a physically co-located collaboration people often perform individual tasks while also keeping an eye on the activities the other group members are involved in (Gutwin and Greenberg, 1998). When designing a collaborative computer system, both the individual work and shared activity need to be supported. However, there is often a trade-off between the two aspects and designers often focus on either supporting private work, or supporting collaboration (Grudin, 1988, and, Gutwin and Greenberg, 1998).

In summary, it has been argued that a better understanding of how people work collaboratively, including involvements of groups and changes in collaboration due to new computer support, would be beneficial in the design of computer-supported collaborations. Issues, such as group awareness and distinction between shared and private information, which occurs more naturally in co-located collaboration, require careful consideration in computer supported collaboration. In the travel agency scenario, there is a clear distinction between shared and private information; for instance, the computer is private to the agent, while the printout of flight options is shared with Joe Lovejoy. The call centre scenario is an example of lack of awareness, because at one stage Mary Storm is unsure of the agent's activity. In CACI only one person, the agent, has access to the computer and hence differs from traditional CSCW, but as shown in the scenarios, issues such as privacy and awareness are still relevant.

2.3 Customer service provided through a non-human agent

Customer service is often provided through human agents, however, it can be provided through computer software, such as, interface agents or telephone-based interfaces (TBI). Although non-human agents are beyond the scope of this thesis, there is still some previous research that is relevant, in particular relating to interface agents, because some of the issues are similar to those of human agents, and TBIs, because a large part of the research in this thesis is carried out via telephone. This section describes research into customer service provided through these two types of non-human agents, software agents and TBIs.

2.3.1 Interface agents

The term agent commonly refers to a human who is helping or assisting us in achieving a desired task (Lieberman and Selker, 2003). The job of the human agent is to work autonomously towards our goals, increase our productivity and decrease workload, and an interface agent should play a similar role (Lieberman and Selker, 2003). However, inherently when working with agents, computer-based or human, some of the work is delegated, and with this delegation comes potential problems. For example, the risk that the direction were misunderstood, or that the task was not fully completed or completed incorrectly. Additional problems associated with collaborations with an agent are that sometimes collaboration appear slower, due to the extra communication required and the delegation involved.

Lieberman (1997) defines an alternative use of the term agent, described as any computer program considered by the user to be an assistant or helper rather than a tool. The interface agent is a program that interacts with the user but also with the objects on the interface, without explicit instructions from the user. To enable effective collaboration the software agent has to be trustworthy, provide feedback and be instructable (Lieberman and Selker, 2003). The agent observed the user's work and assists them by making suggestions, such as potential actions, while the agent is also directly interacting with the interface.

There are three classes of interface agents (Jennings and Wooldridge, 1996 and 1998; and Jennings, Faratin, Johnson, Norman, O'Brien, and Wiegand, 1996); *gopher agents* - who perform straight-forward tasks based on pre-specified rules; *service performing agents* - who execute a well-defined task at the user's request (involving a higher level of sophistication); and *predictive agents* who volunteer services and information to the user without being explicitly asked. All three types of agents have the following characteristics:

- *Autonomy*: the agents should be able to perform the task mostly without human intervention and have a degree of control of the task.
- *Social ability*: they should be able to interact with other software agents and humans to complete the task.
- *Responsiveness*: agents should have a perception of their environment, such as objects on the interface the human uses, and respond to changes in it.
- *Proactiveness*: they should have goal-oriented behavior and take initiative where appropriate

Interface agents are similar to human agents in that they need to work towards the client's goals, and has to be more than a tool and instead an assistant. Agents, both human and interface, have to be able to work autonomously, have social abilities, be responsive and proactive.

2.3.2 Telephone-Based Interfaces

TBIs are becoming an important means for people to interact with computers, in particular because more and more services are offered via the telephone, such as, banking (Brewster, 1997). Telephones are a convenient way for a user to interact with workstations, partially as it is possible to connect a telephone to a computer but mainly because most people have access to a telephone (Halstead-Nussloch, 1989). However, most people have used a telephone-based information system but few like using them citing that they are frustrating and difficult to use (Resnick and Virzi, 1992, and Yin and Zhai, 2006).

Telephone-based interfaces only have limited input, through the 12-key keypad and speech recognition, and there is no cursor for selecting a specific item, and output, through speech and simple sounds, which can reduce the usability of the interaction (Halstead-Nussloch, 1989, Brewster, 1997). Halstead-Nussloch (1989) developed a set of guidelines for designing telephone-based interfaces. These included suggestions on user input, that is, voice or keypad; system output using synthesised or recorded voice; dialogue design; designing the users' role, choice, control and data entry. When using standard TBI, the user has to listen to long prompts and information, but only a few of the options are of interest, and in the characteristics of auditory information, that is, it is sequential at a fixed pace (Resnick and Virzi, 1992, Yin and Zhai, 2006). It is often hard to know which menu is the correct one, until a lower level in the hierarchy has been reached. One of the most common problems is that the user gets lost in the menu hierarchy (Brewster, 1997). Brewster (1997) conducted an experiment into adding auditory feedback to the interaction. One of the main findings included that Earcons, which are abstract syntactical tones (further discussed in Section 2.4.3), could be used effectively to provide navigational cues in the menu hierarchy.

Improving TBI was taken a step further by Yin and Zhai (2006) in their three experiments into augmenting telephone-based interaction with a visual display. The caller used a cell phone, connected to a loudspeaker, and standard desktop computer with FonePal installed. As the call was connected the visual content of the voice menu was sent via AIM and displayed on the user's computer. Their main findings showed that the interaction was significantly improved by the visual display, with higher subjective satisfaction, improvement in navigation time as well as reduction in errors.

In summary, an agent's (human or interface) job is to collaboratively work toward the user's goal and thus increase productivity and decrease workload. When working with an agent there are potential problems, for example, the task not being fully or correctly completed. Telephones are becoming more common as a tool for interacting with a computer, partially because many services are offered via telephone, and because most people have access to a phone, however, because of limitations in input and output, most people find TBIs frustrating to use. However, complementing a telephone-based interface with a graphical interface or with auditory feedback, can improve the interaction.

2.4 Computer – customer interaction

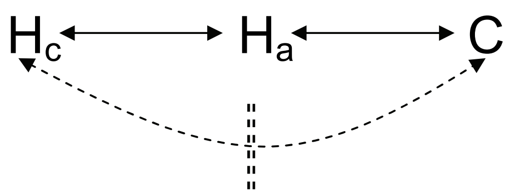


Figure 14. Research relating to the customer – computer channel of communication

This section covers the indirect interaction between the service organisation's computer system and the individual who needs the service (see Figure 14). When a person contacts a customer service provider, they are the person that wants some action performed on the information system, but they are not directly interacting with the computer. For example, in the scenarios described in the introduction of this chapter, Joe Lovejoy wanted to book the flight and accommodation he has chosen, he has to interact with the computer via the agent. In some co-located situation, the agent might share the computer screen with the customer, so he or she can directly see it, however, it is rare that the customer can interact with the computer. In a remote setting, such as in the call centre scenario, the customer cannot see the computer nor interact with it, as the collaboration is taken place via a telephone. Mary Storm cannot see the computer screen and hence does not know that the information system requires the customer number, nor can she tell that the agent is busy trying to locate information on the screen.

The amount of information the customer has about the computer varies depending on the mode of interaction, whether it be provided face-to-face, over the telephone, via email or the Internet, or via fax. For example, in a face-to-face travel agency situation, the traveller can see the agent interacting with the computer. However, if the interaction is carried out over the telephone, as in the call centre scenario, Mary Storm is not able to see the computer, and might not even be aware that there is a computer involved in the interaction.

The following sections cover research into the communication channel between customer and computer in remote interactions, such as those commonly provided through call centres, and in settings where people are collaborating co-located using one shared computer.

2.4.1 CACI at call centres

Bowers and Martin (2000) investigated the interactions between the customer and the agent, and between the agent and the computer at UK bank's call centre. They studied how the bank agents are able to move back and forth between the interaction with the computer and the social interaction with the customer. The study was made through transcripts of telephone recordings from the call centre, observations of operators and listening in on the telephone conversations.

Bowers and Martin (2000) highlighted that it is important to keep in mind three perspectives when designing computer systems for call centres; the customer, the agent and the computer. This is in different to the usual perspectives; the human and computer. Further, they identified a number of issues that are particularly important in call centre interaction:

- Pace of interaction and system responsiveness,
- Information format – the format needs to be designed for ‘effective display’, but also allowing for ‘re-packaging’ and reading out loud
- Display of engagements – explicitly displaying the agent’s engagement with technology which the customer can tune in to
- The design of closing dialogue and session documentation – it is important not to overburden the participants with session-documentation if this makes the closing of the dialogue inelegant or incomplete

Other research has also highlighted the importance of displaying a representative’s engagement to a client. As mentioned in Section 2.1, a patient at a doctor’s clinic coordinates their dialogue with the doctor’s interaction with the computer. Greatbatch *et al* (1993) suggest that this ‘display of disengagement’ should be taken into account when designing systems for these types of scenarios, and suggest auditory icons as a possible solution.

John (1990) used GOMS (Goal, Operators, Methods, and Selection) (Card, Newell and Moran, 1983) analysis to examine telephone assistance operators (TAO) interacting with customer. The aim was to show that GOMS can be a viable technique for a real world system evaluation. The job of the TAO is mostly routine, with little problem solving (John 1990). In call centres, such as telephone operator companies, keeping the time per call as short as possible is essential, even a very small reduction in task completion time can have a large impact. John observed the TAOs and defined their tasks in

- Goals - complete the calls as efficiently as possible
- Operators – operations that need to be performed to complete a the task and the sequence in which they are performed
- Methods - there is only one method, which the TAOs are taught to follow
- Selection - as there is only one method, there is no selection available

The GOMS technique analysis was used to try and predict the performance time of the TAOs. The estimation of call time was then compared with other estimation techniques, for example, previous GOMS analysis, speech generations and video recorded sample calls. John suggests that GOMS promises to be a valuable option for predicting task completion time in an industrial setting.

The work that a call centre agent carries out usually involves a complicated system; including people (agents and clients), computers, switches, phone, faxes etc. It is important to simplify the agents' activity, as well as provide flexibility for the interaction with the client and that the tools take into account the complex communication between the agents, computers and other resources (Anisimov, Kishinski and Miloslavski, 1999). Issues, such as, system responsiveness, information format, and display of engagement (or disengagement) have been identified as important (Bowers and Martin, 2000; Greatbatch *et al*, 1993).

2.4.2 The customer as visually-impaired

When a customer contacts a call centre, they are not able to see the agent's computer screen, and hence are essentially visually-impaired with regard to the computer. The following section reviews research into software for visually-impaired users and how this research can by utilised for CACI.

The majority of computer interfaces today are graphical, usually with a large amount of information on the screen, comprising text and objects (such as windows, buttons and menus). It is clear that the visual properties of the computer interface are an essential part of the interaction between the user and the computer (Edwards, 1988). The graphical interface supports the users' mental model of the computer application, as well as providing the users with a means to interact with the application (Edwards, Mynatt, and Stockton, 1995).

The graphical interface has improved the human computer interaction for the *visual* user, but it has added substantial complications for the visually-impaired user. Information on a graphical interface is often too complicated to be translated into speech (Edwards, 1988). One of the complications is that there is usually a substantial amount of information on a graphical interface, which a sighted person is able to look at it repeatedly, but a visually-impaired user has to remember and recall (Pitt and Edwards, 1996). Despite the complications, there are ways for the visually-impaired user to interact with visual interfaces, usually with the aid of screen readers. Screen readers are software applications that collect information about the objects on the interface and the application's behaviour and translate it into a non-visual format, usually auditory or Braille (Mynatt and Weber, 1994).

It is often the case that non-sighted users work on computers together with sighted users. To allow for effective collaboration, it is therefore important that they have a similar mental model of the computer system. However, it has been argued that screen readers convey the graphical screen, not the semantic interface and that they do not usually support the non-sighted users' in attaining a mental model of the computer system (Edwards *et al*, 1995, and Mynatt and Weber, 1994). While the graphical interface supports visual users' mental models, many screen readers only provide information about the objects the user can interact with (Edwards *et al*, 1995). For example, many graphical objects, such as minimize and maximize buttons, on the visual interface would not be of any use to a non-visual user, because they are only artefacts of the graphical interface (Mynatt and Weber, 1994). The power of graphical interfaces is in their symbolic as opposed to their visual representation (Mynatt and Weber, 1994). When creating an auditory interface based on a graphical interface, it is important to translate the characteristics about the objects, such as, type and attributes, and the operations the object supports, not the *visual* method of performing actions (Edwards *et* al, 1995). An object's characteristics can be conveyed through speech and non-speech cues, examples of non-speech cues to graphical interface objects can be: text-entry field - old-fashioned typewriter; buttons - chain-pulling light switch and menus - a set of buttons with varying range of pitch.

Studies have shown that both sighted and non-sighted participants are able to carry out the tasks on an auditory interface (Edwards, 1988; Mynatt and Weber, 1994; and Edwards and Mynatt, 1994). However, a number of problems have been identified, such as, high mental workload caused by having to remember and recall a lot of spatial information (Edwards, 1988) and frustration in identifying cues (Mynatt and Weber, 1994). In a visual interface the cues are presented constantly and the users can rely more on recognition, while in an auditory interface the user has to remember the cues. Auditory interfaces for visually-impaired users rely almost solely on computerised speech output, (Pitt and Edward, 1996) and speech has fixed duration and the person has to keep the information in memory as he or she is processing the information. Speech is therefore slow to use and also demanding on memory. Adding non-speech as well as speech cues will aid the visually-impaired user in remembering and recalling the interface. Non-speech auditory feedback, for example a warning beep, occupies less space in short-term memory than speech and is faster to process. Pitt and Edward (1996) conducted an experiment where participants were asked to play the spelling game Hangman using only auditory feedback, predominantly speech. They found that amount of speech information needed to be kept to a minimum, and that the order the information was presented made a difference. Further, the participants suggested that adding non-speech auditory feedback would be useful for, for example, immediate feedback into the success and failure of the entered letter. These findings suggest that using speech in combination with non-speech auditory feedback provides the best solution for both sighted and visually-impaired users.

The majority of graphical interfaces contain large amount of information that is difficult to translate into an auditory interface. Many interfaces for visually-impaired users rely mostly on speech output, but some research found that non-speech sounds can be used effectively in conjunction with speech. Mynatt and Weber (1994) suggest that creating an interface for visual-disabled users is just a way of 'retargeting' a visual interface. They also suggest that it is possible to 'retarget' graphical to other 'disabled' users, such as people interacting with computer interface via a telephone and hence is in a 'disabled' situation. The next section further discusses auditory feedback and how it can be used to enhance interfaces for disadvantages users.

2.4.3 Auditory feedback

In the everyday world people rely on a combination of senses to obtain information about the world, for example, vision, smell, hearing, taste etc. Our different senses are good at providing different kinds of information about the world. Hearing and vision are complementary in attaining information about the world, without the ability to hear many events would go unnoticed (Gaver, 1986; Gaver, 1989; Gaver, 1993; and Edwards 1989).

Sounds have different characteristics to vision, they exist in time, that is, they have a noticeable beginning and an end, and are often transient, and hence both the beginning and end can be experienced. Visual objects, on the other hand, usually exist in space, that is, they tend to persist over longer time and their creation and destruction are not usually witnessed (Gaver, 1989). Visual objects usually exist in a limited space, you have to look in a certain direction to get information from them, while sounds can be heard from many directions. Therefore vision is good for relatively constant information (Blattner, Sumikawa and Greenberg, 1989; Gaver, 1989; Gaver, 1993; and Gaver, 1993b), while sounds are most useful for grabbing someone's attention while performing some other task (Brewster, Wright and Edwards, 1992).

As well as being suitable to use in conjunction with other senses, such as vision, hearing has its own advantages. Hearing is used to obtain information about objects in our surroundings and also in what environment the objects exist. For example, as a car is approaching, you can hear if it is a small car or a large truck (from the sound the object makes), how fast it is approaching (from the change of sounds in the environment), and that the road is a gravel road (from the sounds that are produced by the environment) (Gaver, 1993b). Additionally, auditory output comes in two different forms, speech and non-speech, and both can be used in conjunction with each other without interference (Brewster, Raty and Kortekangas, 1996). For example, while you are talking to a friend, you are still able to hear the phone ringing. It is possible to maintain the conversation, while attending to the other sound, that is, noticing that there is an incoming call and moving towards the telephone to answer it.

Another advantage with auditory feedback is that people are aware of it, without paying conscious attention to it. People can hear sound in the background, but forgetting about it while working on a different task (Conversy, 1998). For example, as you are having a conversation with a friend, you can hear the microwave buzzing in the background. There is no need to pay any attention to the buzzing, nor does it interfere with your conversation, however, attention is drawn to a change in the sound (Conversy, 1998, and Dix *et al*, 1998), for example, as the microwave has finished and the buzzing ceases, you become aware of the change in the sound. The change in the background sound is therefore useful as a reminder or a notification.

There are also potential disadvantages with auditory feedback. If the sound is too loud or interfering, it can be intrusive, for instance, it is often hard to maintain a conversation at a nightclub. Another disadvantage is when the sound is interfering with another activity; if someone is talking on the phone and other people are talking in the background, the background talk can be intruding on the telephone conversation. It is the inherent characteristics of sounds that provide both advantages and disadvantages for its use in communication, however, there benefits and detriments inherent in vision as well.

Since we rely on a combination of senses in the world, it seems reasonable to also rely on a combination of senses for computer interfaces. However, most computer interfaces rely almost solely on visual cues. Despite the advantages of using auditory feedback in conjunction with visual input, it is under-utilised in computer interfaces (Brewster, Wright and Edwards, 1993) and is usually restricted to a beep or click to notify the user that something is wrong. As mentioned before, it has also been used to some extent where it is not possible to rely on visual information, for example, software for the visually-impaired or telephone interfaces.

Auditory feedback is often studied with regards to the perceptual dimensions and attributes, rather than the experience that people have with the sounds (Gaver, 1993b) and this can make a difference in the creation of auditory interfaces. Gaver (1993b) found that people are usually very good at identifying what objects have created a sound and in what environment. For example, people can often identify someone walking on a staircase, and also in what direction, up or down.

Previous research has investigated adding auditory feedback to a computer interface, for example, sonically enhanced scrollbars (Brewster, 1998), progress bar with associated auditory cues (Crease and Brewster, 1998), associating certain commands with audio cues (Jones and Furner, 1989), and mapping objects, windows and trashcan events to sounds (Gaver, 1989). Studies have shown that adding auditory feedback to the interface leads to an improvement in, for example, reduced mental demand (Brewster, 1998), increased usability (Crease and Brewster, 1998), and increased user satisfaction and flexibility (Gaver, 1989). The added auditory feedback allowed the users to continue working on other tasks while also monitoring the progress on a different task (Crease and Brewster, 1998). Gaver (1989) argue that the increased subjective satisfaction was evident from the participants' reports that they missed the sounds when they were removed. He states "Once accustomed to the SonicFinder, using the quiet Finder is comparable to wearing earplugs in everyday life". Other studies have shown an increased annoyance (Jones and Furner, 1989), but, it has been argued that perceived annoyance is a personal preference and not necessarily a good indication of usefulness of the auditory feedback (Brewster, 1998; and Jones and Furner, 1989).

As identified by research, sound and vision are complimentary senses in everyday life, but despite this, sound has been underutilised in computer interfaces. However, studies have shown that adding auditory feedback to a graphical interface can lead to a reduction in mental demand, increased usability and increased subjective satisfaction. The next two sections cover research into two forms of auditory feedback used in computer interfaces, *auditory icons* and *Earcons*.

Auditory icons

Auditory icons are the auditory equivalent to visual graphical icons and are audio representations mapped to computer events and objects (Gaver, 1993; Gaver, Smith and O'Shea, 1991). They are based on everyday sounds and can provide users with a natural and intuitive auditory representation of objects on a computer interface (Mynatt, 1994), but they can also provide the user with additional information about the object, such as the number of items in a menu. *Auditory icons* provide information about the object making the sound, dimensions of the object, and information about the object's environment (Gaver, 1986, and Gaver, 1989). For example, a text file arriving in the mail has a paper sound to show that it is a text file, and as the file is large, it has a weighty sound, and with a special characteristic to show that it is coming in the mail. As the mail window is currently not the active window, the sound is muffled. The echo sounds like a large empty room, to show that the computer load is fairly low. From this example a lot of information is conveyed through a single sound (Gaver, 1986). Mynatt (1994) argues that in designing auditory icon there are a number of factors to keep in mind:

- The user has to be able to recognize the sound
- Does the sound map to the users' conception of the icon?
- Intensity, length and bandwidth
- User preference

Further, the icons must also be unique with regards to the other icons, as otherwise the user might not be able to differentiate between them. There are different levels of mapping data to an auditory icon and there are three main dimensions (Gaver, 1986; Gaver, 1989):

- Symbolic: relying on social learned convention (for example, applause for approval).
- Nomic: depending on the physical situation (for example, hiss for snake)
- Metaphorical: similarities between the object and the environment (for example, mailbox sound for arriving email)

The nomic mappings are more directly linked with actual events and are therefore easier to learn (Gaver, 1986). However, in other situations the symbolic or metaphorical mappings would be better, because the users are more familiar with the particular sound.

There are different methods for creating auditory icons, 'sampling', that is, recording the sound, or 'synthesizing', creating an artificial sound. Sampling allows for more realistic sounds than synthesizing, however it can still be hard to record sounds that realistically and naturally represents the object (Gaver, 1993). Further, it is often the case that the tool used to record the sound has an influence on the resulting auditory icon.

In summary, auditory icons are based on everyday sounds and can provide a natural and intuitive way to represent graphical interface object. There are two methods for creating auditory icons, sampling and synthesizing.

Earcons

While *auditory icons* are based on everyday sounds, *Earcons* are abstract syntactic tones. *Earcon*s are compositions of sounds that vary in rhythm, pitch, timbre, register and dynamics (Blattner *et al*, 1989, Brewster *et al,* 1993). The building blocks can be single or groups of pitches; by combining a succession of pitches a rhythmic and tonal pattern, also called a motive, is created, which functions as an individual and recognizable *Earcon* (Blattner *et al*, 1989). *Earcon*s should be long enough to convey the message, and the optimal length of an *Earcon* is 2-3 notes.

There are different complexities and combinations of *Earcon*s (Blattner *et al,* 1989). One-element *Earcon*s, which are a single note or a motive, are most suitable for representing simple, basic or commonly occurring entities, such as key clicks or selection mechanism. *Earcons* can also be combined to produce more complex auditory messages (Brewster *et al*, 1992), so-called 'compound *Earcon*s', that are created by placing two or more audio elements in succession. Further, *Earcon*s can also be grouped into families and hierarchies, for each level in the hierarchy one attribute, either, rhythm, pitch, timbre, dynamics or register, is modified.

The usefulness and usability of *Earcon*s have been studied extensively (for example, Brewster *et al* 1992; Brewster, 1998; Brewster *et al*, 1996; McGooking and Brewster, 2004; and Vargas and Anderson, 2003) and have been shown to be useful in a range of settings such as, a Paint application (Brewster *et al*, 1992), provide navigational cues in a menu hierarchy (Brewster, 1998; Brewster *et* al, 1996; and Vargas and Anderson, 2003). Brewster *et al* (1992) conducted two experiments to investigate the effectiveness of *Earcons*. The first experiment was conducted to compare unstructured sounds, with simple structured sounds (simple *Earcons*) and complex structured sounds (compound *Earcons*) and the sounds used were made up of timbre, rhythm and pitch. For the first phase, each family, for example Paint application and a Paint file, shared the same timbre. Each type shared the same rhythm, for example all the applications had the same rhythm. Items that were in the same family and type were separated by pitch. For the second phase, each menu had a designated timbre. The items in the menus were separated by rhythm, pitch and intensity. The main findings were that the compound *Earcons* provided the best way of presenting information. They can also be used to provide absolute information about events. Further, Brewster *et al* (1992) argue that the *Earcons* can be recognised individually as well as in relation to other *Earcons*.

Studies into the usefulness of *Earcon*s in providing navigational cues in a menu hierarchy suggests that people are able to recognise and recall *Earcon*s and also recognise the place in the hierarchy they represent despite only short training (Brewster, 1998; and Brewster *et al*, 1996). The participants were also able to identify where in the hierarchy the unknown *Earcons* belonged (Brewster, 1996). The various levels and nodes in the hierarchy had different sounds to distinguish them, with the top level of the hierarchy had a neutral *Earcons*. For the second level in the hierarchy, each family has a separate timbre, register and spatial location. In the third level rhythm was used to distinguish the various nodes and for the fourth level, tempo was used. The studies also included investigating if the relatively low quality of sound over the telephone had an effect on the use of *Earcons.* Brewster (1998) found that the *Earcons* provided an effective way for the participants to tell where they were in a telephone menu hierarchy and reduced the risk of the participants getting lost in the menu navigation.

In summary, in everyday life people rely on a combination of senses because the different senses serve different purposes; vision tends to persist over time and can be viewed repeatedly, while sound often is transient and suitable for drawing your attention to something. Computer interfaces, though, tend to rely predominantly on vision, but, verbal and non-verbal auditory feedback has been used successfully with software for visually-impaired users and for telephone based interaction. There are two main types of computer auditory feedback, *auditory icons*, which are the auditory equivalent to visual icons, and *earcons*, which are abstract syntactical tones.

2.4.4 Sharing a Computer Screen

The previous sections describe research relating to customer service interaction in a remote setting, while this section focuses on research relating to customer-computer interaction in co-located settings. How well people communicate depends on the amount of presented information, such as, proximity cues (including, body language, eye gaze, and facial expression), shared computer screen and hardcopy documents, as well as a distinction between private and public.

One context for co-located collaboration is when learning about a new computer application. Many people prefer to learn in a social context, by approaching a colleague and asking their assistance, as opposed to using online help or hardcopy manuals (Twidale, 2005). Often the help is provided at the learner’s or the helper’s computer and both people are working on the same computer (Over The Shoulder Learning, OTSL). In OTSL the help provided by the colleague is not limited to one application, rather the help extends over several programs as well as rules and norms in the workplace not directly related to the computer.

Other research has investigated whether a shared display has effect on group participation. DiMicco *et al* (2004) conducted a study where they used a group participation display for a group to monitor how much each participant contributed. Their hypothesis was that the display would lead to over-contributors decreasing their contributions, and under-contributors would increase their contributions. The tasks were group-decision tasks where there was no 'right' answer; selecting a student for undergraduate program and location of 24-hour convenience store. They found that the display of participation did lead to a reduction in the contribution of over-contributors, but no increase by under-contributors. There was no difference in contribution of critical information and hence the group participation display did not have the expected outcome.

When people collaborate in a face-to-face setting without computers, it is not unusual that a large table is the shared work area. In addition, for small group collaboration people prefer to sit around a table rather than shoulder-to-shoulder as this means making eye-contact is easier and provides easier awareness of the other collaborators (Wang and Blevis, 2004; Kruger *et al*, 2002). The way people distinguish between shared and private information is usually done without any restrictions or specific rules. The level of privacy can change during the collaboration and this is signalled by a document being moved between the private and shared space. The orientation of the document also signals the privacy level, if a document is located right in front of and oriented towards a particular person it usually signals a private document (Wang and Blevis, 2004; Kruger *et al*, 2002), while if a document is turned towards someone else, it usually means that it is being shared with that person (Shen *et al,* 2003). In co-located collaboration, in absence of computers, distinction between shared and private documents occurs naturally.

When collaborating via a computer, a decision has to be made regarding how much to share; do the participants want to share all their items, so called WYSIWIS (what you see is what I see), or are all items private. Many groupware applications do not support people distinguishing between their private and shared artefacts, nor does it support an easy seamless transition between them (Greenberg *et al*, 1999; and Shen *et al,* 2003). Different systems have been designed to support the sharing of private versus public documents in a collaborative co-located setting. Shen *et al* designed an interactive flat table top display, where the location on the space shows the document as private – not visible to anyone else, personal – visible but not readable or editable by anyone else, and public – readable and editable to anyone. Greenberg *et al,* in contrast, used a PDA, PC and public single display groupware (see Figure 15). The collaborators can create notes on their individual PDA and if they choose to make it public, it will automatically be displayed on the display groupware. The users can also create shared documents on the public display, and any notes that are contained on both systems are automatically synchronized. People can also continue to work on the document in-between meetings and bring the notes to the next meeting. Another co-located collaborative system was designed by Hinckleyss (2003), where tablet PCs were equipped with a tilt sensor, touch sensor, proximity sensor and light sensor. Face-to-face users initiate collaboration by physically bumping together two tablet computers and hence establishing a shared workspace. The tablet computers have both a private and shared work area, which allows the collaborators to choose what they want to share with the other user. A user can also use their hand to quickly 'shield' an area from the other collaborator.

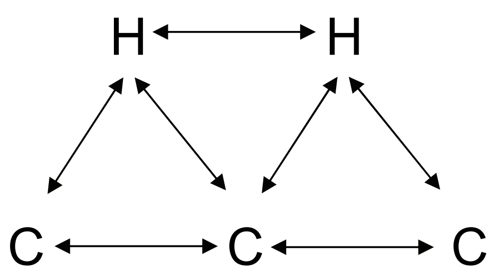


Figure 15. The interaction with a shared display and individual personal computers; there is interaction between the two humans and between the computers, but no interaction with the other person's personal computer.

Horizontal surfaces are natural for people sitting face-to-face and collaborating (Shen *et al,* 2003; Kruger *et al*, 2002). Physical tables naturally support collaboration on a shared work space, and, they can be enhanced through computer augmented displays (Kruger *et al,* 2002). However, Single Display Groupware (SDG) is often vertical displays which have limitations in comparison to physical tables, in for example:

- People can reach anywhere on the table, as opposed to a vertical display where people have to move around each other to reach the display
- People tend to *sit* around a table, which is usually more comfortable and stable for a longer period of time, while on a vertical display people tend to be standing
- Seating arrangements lets people decide how close they want to work with someone, side-by-side, face-to-face, opposite corners, while vertical displays only allow for side-by-side
- Orientation of documents allow for organisation of private versus shared resources, where this is not possible in a vertical display
- People can place objects on a table, while not on a vertical display
- People can easily share objects around the table

Another collaborative situation is when multiple co-located people work on a single display with multiple devices (Stewart *et al*, 1999; Stewart, Raybourn, Bederson, Druin, 1998; Tse, Histon, Stacey and Greenberg, 2004). Although CSCW is a thriving field and is focusing on supporting remote collaboration, but there is a need for further effort to support people that are co-present and sharing one computer (Stewart *et al*, 1998). There has been software developed to enable people to collaborate remotely, however, most personal computers are not conducive for cooperation between several co-located users. The space around a computer tends to be limited, where people have to encroach on other users' personal space, but, even though standard personal computers are not suitable for group work, people manage through viewing the screen shoulder-to-shoulder and taking turns doing input. If the computer supported multiple people working on one computer, the collaboration would be enhanced (Tse *et al*, 2004; Stewart *et al*, 1999). There are many potential domains where people collaborate co-located (Stewart *et al*, 1999):

- Creative domains such as writing, drawing or programming
- Learning domains where multiple users explore new information
- Instruction domains where one more experienced user is teaching another
- Sales Domains where a sales person and customer can both be engaged in the process of finding the best option

When multiple people are collaborating using one personal computer there are usually only limited input devices (Stewart *et al* 1999, Tse *et al,* 2004). One solution is SDG where multiple people can interact with the system simultaneously over a common display, each collaborator has their own input device, and the system distinguished between the different input devices. Even though the collaborators in effect now have 'virtual hands' and can reach any area of the collaborative space, they tend to not interfere with each other. People partitioned their workspace based on, for example, the task and seating arrangements (Tse *et al,* 2004). Stewart *et al* conducted a study to investigate what collaborative benefits elementary school children would receive when using SDG for a story-creation application. They did a comparative study with normal computer interaction and interacting via SDG. Their main findings include that the children that did not use SDG:

- Tried to point at the screen to manipulate objects
- Users fought over control of input device
- The communication was less collaborative, with participants who were not in control of input device issuing orders to the one that was
- Frustration over unequal participation in the task

In contrast, the problems with the single input device condition disappeared for the children using SDG. Further, the children that used SDG:

- Had more fun
- Had enhanced curiosity and exploration
- Helped each other find things

2.4.5 Summary

This section has discussed the indirect channel of communication between the customer and computer. Although a customer is not directly interacting with the computer, there is still a channel of communication between the entities. It is still important to consider the role of the customer when designing the interface through, for example, explicitly displaying the agent's activity or taking into account that the agent might need to read information on the interface out loud.

In everyday life people rely on a combination of senses, such as, vision and hearing, but sounds have been underutilised in computer interfaces. However, non-verbal auditory feedback has been shown to be effective in supplementing speech in software for visually-impaired users and to complement telephone-based interfaces.

In a face-to-face situation, the customer can see the computer and see the work the agent is doing on the computer. Work by Halloran (2002), suggests that sharing the computer interface with the customer improves travel agency interactions. In many face-to-face settings people collaborate on a physical table and research suggests that SDG can be used to enhance co-located collaboration.

2.5 Customer – agent interaction

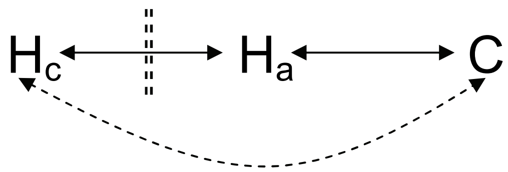


Figure 16. Research relating to the agent – customer channel of communication

The previous section covered the indirect interaction between customer and computer and this section covers research relating to the second channel; the communication between the two humans (see Figure 16). In the scenarios, this refers to the communication between the customers, Joe Lovejoy or Mary Storm, and the agent, in both face-to-face and telephone modes of interaction.

Human-to-human communication is often complex and it can be ambiguous and error-prone (Balint, 1996), and additionally, humans only have a limited amount of cognitive resources (Walker, 1994). When solving problems, communicating with other humans is only one of the activities that require cognitive resources. Communication has to share the available resources with other activities, such as making inferences, retrieval from long term memory and interacting with other artefacts. There are different formats of communication depending on the setting and the artefacts in that setting (Lawrence *et al,* 1994; Ten Have, 1991; Greatbatch *et al*, 1993), for example, as mentioned in Section 2.1, a telephone directory assistant has to translate between the social language of the customer and the technical language of the computer. Another example of difference in communication format is the asymmetric communication between a patient and a doctor, due to the computer system (described in Section 2.1) but also due to the different background and goal of the collaborators (Greatbatch *et al*, 1993; Ten Have, 1991). When a patient visits a doctor, it is the patient's, not the doctor's, health that is under review and there is a difference in the methods the two people use to approach the task (Ten Have, 1991). The patient reports on their illness, answers the doctor's questions and accepts (or choose not to accept) the physician's recommendation. The doctor, on the other hand, listens, investigates and diagnoses. However, the asymmetry is not always consistent; at times the doctor-patient communication is like a normal informal conversation, while at other times formal and asymmetrical, and the participants move between the formal and informal modes during a consultation.

Due to the ambiguous and error-prone nature of human-human communication, Balint (1996) argues that there can be a case for explicitly adding a computer to human-human communication because this can increase reliability, correctness and exactness. However, with this increased precision in information comes a more rigid and mechanized format of human-to-human communication. In certain situations, for example business and financial administration, where correctness and exactness is important the inclusion of a computer would be worth considering.

Human communication can take place over a range of different modes, such as face-to-face, video-mediated communication, computer-mediated communication, telephone or email. There are both advantages and disadvantages with face-to-face communication (Nardi and Whittaker, 2001); one advantage is that it supports sustaining a social relationship which is required to enable remotely located collaboration. But there are also disadvantages with face-to-face communication; it requires effort, it can be disruptive and costly, since people, by definition, have to be at the same location. Some research suggests that as long as people are able to communicate verbally having visual contact does not make much difference (for example, Chapanis, Ochsman, Parrish, and Weeks, 1972; Ochsman and Chapanis, 1974; and Gale, 1991). An impoverished communication mode, such as telephone, might not necessarily lead to a less satisfactory outcome or process of communication. Other research, in contrast, suggests that there is a difference in outcome, style and content between audio-only and face-to-face communication (for example, Short, Williams and Christie, 1976; Suchman, 1987; and Rutter, Stephenson and Dewey, 1981). The next two sections discuss research relating to the contrasting findings into whether audio-only is as good as face-to-face communication.

2.5.1 Verbal-only communication as good as face-to-face communication

In the early 70's a series of studies were carried out by Chapanis *et al* to investigate the communication between humans in collaborative problem solving tasks (Chapanis *et al*, 1972; Chapanis and Overby, 1974; Ochsman *et al*, 1974). The purpose of the studies was to investigate how a range of different modes of communication (for example, face-to-face, audio-only, hand-written) affected the human-to-human communication. There was a significantly shorter task completion time for the audio modes, where the participants were able to communicate verbally, than the hard copy modes, where the participants communicated in written form only. There was a shorter average time for the communication-rich, including visual and voice communication, in comparison to the voice-only mode, but this difference was not statistically significant. As long as the participants were able to talk, the lack of visual communication did not make any significant difference.

Chapanis *et al* (1972) and Ochsman and Chapanis (1974) also collected 'activity sampling', which involves an observer noting down every fifth second what activity the participants were involved in. The activity categories were:

Single activities

- Sending only
- Sending pause
- Receiving only
- Searching only
- Handling parts
- Making notes
- Waiting

Dual activities

- Sending and searching
- Sending and handling
- Sending and making notes
- Receiving and searching
- Receiving and handling
- Handling and making notes
- Searching and making notes

There was a difference in task-completion time and activity sampling between the hard-copy modes and voice modes, however, there was only a small difference between the modes containing voice communication. The most common activities for both the voice modes (communication rich and voice only) were 'searching only', 'sending and searching', 'receiving and searching', and 'handling parts'. Based on their findings, Ochsman and Chapanis (1974) state that "there is no evidence the addition of a video channel has any significant effect on communication times or on communication behaviour" and that "the telephone is an extremely effective communication device".

More recent studies comparing face-to-face communication with audio-only and audio with video communication via computers also suggest that there is only a small difference in task completion time (Gale, 1991; Masoodian and Apperley, 1995; Masoodian, Apperley and Fredrikson, 1995). However, including a visual link in the communication gives people a higher feeling of 'social presence', potentially resulting in people spending more time on social activities, rather than working on the task at hand (Gale, 1991).

2.5.2 Difference in outcome, style and content due to audio-only mode

The findings from the studies mentioned in the previous section suggest that as long as people can communicate verbally, adding visual contact does not improve task-completion time, outcome or alter participants' activities. In contrast, Short *et al* (1976) argue that despite the evidence that telecommunication does not have an effect on the outcome of task solving, there are indications that the medium of communication has an effect on the *process* of arriving at the outcome, such as, audio-only is less personalized than face-to-face communication. Additionally, some research found only a small difference in performance, but people preferred to communicate face-to-face (Masoodian and Apperley, 1995; Masoodian *et al*, 1995; Fletcher and Major, 2006) and that people reported a higher enjoyment when working face-to-face (Crede and Sniezek, 2003). Further, participants also report on diminished performance and teamwork in audio-only communication (Fletcher and Major, 2006). In contrast, it has been suggested that when people are communicating over a poorer quality channel they are able to focus more on the task and get less distracted by social talk, but are still as satisfied with the outcome (Matarazzo and Sellen, 2000).

Teams that were co-located are more productive than the remote teams and they also get the job done in a shorter amount of time (Olson, Teasley, Covi and Olson, 2002). Co-location, including visibility, mobility and other affordances, has a positive effect on collaboration through easier initiation of conversation, awareness of changes etc. (Kraut, *et al*, 2002). Teams that are co-present have access to all the artefacts, ready access to communication with other team members, an awareness of what the others were doing, and an ability to listen in on other members' conversation for later use (Olson *et al*, 2002). On the other hand, physical co-presence has disadvantages, for example, the obvious fact the people have to be in the same place at the same time, which can be inconvenient and costly, and, sometimes opportunistic co-located communication can cause undesired interruptions (Kraut *et al*, 2002), and there can also be a lack of privacy (Olson *et al*, 2002).

As well as investigations into productivity of co-located and remote teams, research suggests that face-to-face and telephone interactions are different in content, style and outcome (Rutter and Stephenson, 1977, Rutter, Stephenson and Dewey, 1981; Stephenson, Ayling and Rutter, 1976; Doherty-Sneddon *et* al, 1997; O'Malley *et al*, 1996; Green and Williges, 1995). Audio-only interactions are more task-oriented, depersonalized, and less spontaneous than face-to-face interaction (Rutter *et al,* 1981; Kraut, Fussel, Brennan and Siegel, 2002). Further, there is a difference in style of communication; in face-to-face there are more speech overlaps and shorter pauses, on the other hand in audio-only, the speech acts tend to have longer durations and with fewer conversational turns, more pauses and less simultaneous speech (Matarazzo and Sellen, 2000). When people perform a task in an audio-only setting, they need to communicate more to complete the task than people do in a face-to-face setting and there is more discussion about the procedure, more discussion about the outcome, and less introduction of irrelevant information (Doherty-Sneddon *et* al, 1997; Rutter *et al,* 1981), and they are more confident in their decision and a re more likely to improve on it (Crede and Sniezek, 2003). Additionally, people need to communicate less in a face-to-face condition to confirm that there is a mutual understanding and this difference could be because the visual channel provides feedback of the other person's level of understanding (Doherty-Sneddon *et* al, 1997; O'Malley, Langton, Anderson, Doherty-Sneddon and Bruce, 1996; Anderson, Newlands, Mullin, Fleming, Doherty-Sneddon and Van der Velden, 1996).

Visual cues help people communicate more spontaneously and allow for more interruptions (Rutter and Stephenson, 1977). The number of cues decreases as a mode becomes less rich, for example, face-to-face has both visual communication and physical presence, while audio-only has neither. Rutter *et al* (1981) argue that it is the total reduction in cues as opposed to any specific cue that caused the difference between the communication modes. In an audio-only situation, people can pick up non-verbal cues that are not accessible in a text-only context. Despite being easier to collaborate while co-located, people do still collaborate when remotely located, and people adapt to the mode, for instance, in instant messaging there are emoticons and common abbreviations (LOL – laugh out loud, IMHO – in my humble opinion) to provide some cues that would otherwise be unavailable (Kraut, *et al*, 2002).

2.5.3 Summary

Human-to-human communication is complex and the style varies depending on the social context, other demands on cognitive resources and the mode of communication. There are contrasting views on whether audio-only communication mode is as good as face-to-face communication. Some previous research suggests that as long as people are able to communicate verbally, there is no significant difference in task outcome, completion time or activity sampling. Other research, in contrast, suggests that although there is no difference in *outcome*, there is a difference in the communication *process* where audio-only interaction is more task-oriented, different in style, and less spontaneous. Because of the absence of visual cues, the process of arriving at the outcome is different, since people have to talk more about the process and ensure a mutual understanding.

2.6 Computer – agent interaction

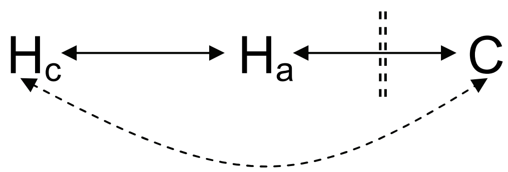


Figure 17. Research relating to the agent-computer channel of communication

The final channel of interaction in CACI is between the agent and computer (see Figure 17). Even though the interaction is between the computer and agent, and this might appear to be traditional HCI, there is still a customer involved in the interaction which makes the interaction more complex. For example, in the scenarios described earlier, the computer system did not fully support the interaction between Joe Lovejoy and the agent regarding the various flight options, and therefore discussion were made over a printout of the options. In Mary Storm's example, the order in which Mary was giving the old and new address to the agent was different than the format on the computer system requires. In a customer service setting, the agent has to work with the customer, communicate with him or her, and translate information from the computer screen to the customer and vice-versa. As mentioned earlier, the customer has the information that is needed to complete the transaction, even if the agent is the person actually interacting with the computer. It is important to take the perspective of the customer into consideration when designing computer systems for customer service settings, such as call centres (Bowers and Martin, 2002).

Technology can complicate the way the agent interacts with the customer, but ideally the computer system should be invisible for the interactions with the customer (Randall and Hughes, 1995). Although the agent has a computer interface to the information required to perform the task, the customer does not and to the customer the agent is the interface (Halloran, 2002). Fuller (1996) suggests that there is a need for further guidelines to enable CHI to co-exist with human-computer-human interaction and one way of developing guidelines is to investigate social cognition in human communication. It has been found that users that rely on electronic media often developed misperceptions about the person they were communicating with. The difference between email-only and face-to-face could be due to technology limiting the communicational-cues, such as body language or tone of voice, between the humans.

Because technology can affect how the agent communicates with the customer, it presents extra challenges over traditional HCI. It is important to consider *how* the users interact with the computer system. The predominant ways of computer-human interaction, for example direct-manipulation, might not be the most suitable way for supporting human-human communication whilst also interacting with computers (Fuller, 1996). When designing interaction techniques, such as screen changes and key sequence, it is important to consider how it can be used in combination with interactions with the other person, that is, the customer (Bowers and Martin, 2002).

In addition to the challenges relating to interface manipulation, there are also extra considerations with information presentation. The interface has to be able to present large amount of complex information, present the right information at right time, provide suitable navigation that does not interfere with agent-customer communication, and provide a coherent, efficient and effective method for getting the information to the customer (Millard*,* Hole and Crowle, 1997). Additionally, the information needs to be formatted for effective display as well as supporting the agent in re-packaging and reading out loud to the customer. Further, it is important that the session documentation (such as, notes relating to the task) does not interfere with the closing of the session (Bowers and Martin, 2002).

There are many examples of contexts, for instance travel agencies, medical consultations and construction sites, where inclusion of a customer has an impact on the agent-computer interaction. The following three paragraphs cover research conducted into those three contexts. Rodden *et al* (2003), Scaife *et al* (2002) and Halloran (2002) conducted ethnographical observations at travel agencies and two main issues in the initial travel booking stage were identified, physical and information representation asymmetry (also discussed in Section 2.4.4). To address these asymmetries, a novel travel booking system including three screens (one for map, one for timeline and budget, and one for brochures) where the customer and agent were sitting side-by-side in-front of the screens, was created. The interactive planner was linked to a brochures database, and as a certain hotel was dragged onto the map, the relevant brochure was brought up on the screen. The customer and agent could see the cost and availability of, for example certain hotels, and allowed experimentation of different alternatives with the cost being automatically updated on the timeline and budget screen. The information required in the initial booking stage was visual as opposed to the form-based user interface, and was intended to reduce asymmetry between agent and customer information representation, and to be easy to understand and shared by both users. The information display was a combination of the two peoples' representation, that is, the agent's traditional tools and the chronological order in which a customer plans a trip. The users interacted with the interface via direct manipulation. They tested their interface and novel layout in a travel trade show and found that the customer and agent were able to create complex itineraries in a relatively short time. They also found that both the agents and customer enjoyed the process.

Another setting where CACI has an impact on the user-computer interaction is in medical consultation. For the medical consultant the mobility of paper is crucial for work and communication (Luff and Heath, 1998). The record can be moved to different practitioners, but also manipulated for different purposes in a medical consultation. The paper can be seen just by the doctor, being used as a shared artefact to talk over, placed in the background so as to not interfere or it can be taken apart and put together again in a different way. Luff *et al* argue that computer systems do not support this micro-mobility and that it is difficult for the doctor to maintain interaction with the patient while reading or entering information into a computer system.

The third CACI situation where the human-computer channel of interaction has been investigated was at a construction site. In the construction site a paper allocation sheet is used to record what jobs have been done, what time has been spent on and any problems that arose (Luff and Heath, 1998). Several people, gang leader, foreman and administrative staff, in different places, on site in the gang, collected by foreman and in the site hut, use the sheet. Observations were made as a new technological version of the paper allocation sheets was introduced. Although the electronic system that was supposed to aid in mobile collaboration, it ended up impeding the collaboration. Rather than the transparency of the paper version, the mobile computer became topic of conversation and would impede the discussion about possible problems. The foreman ended up collecting the information in a note book (or even on the old allocation sheets) and then entering the data into the computer. The new system which was supposed to enable more mobile collaborative work ended up making the users less mobile, less able to monitor the work and less able to engage in activities on the site. Luff and Heath argue that to design a good mobile collaborative tool it is important to consider what activity people engage in with other people and what artefacts they use.

To summarise, when a customer approaches a service provider, the agent is the interface to the business' computer system. The computer interface needs to support this situation and enable the agent to interact with the customer as well as the computer system. When designing a computer interface for a customer service situation it is important to take into account the social setting, including the people's activities, collaborators' different representation of information, and where the computer will be used.

2.7 Potential research questions emerging from literature

This section describes the gaps or unclear findings from previous work, and identifies potential research. From previous research (for example, Lawrence *et al*, 1994; Lawrence *et al*, 1995); Muller *et al*, 1995) it is not clear if the role of the agent is as a 'surrogate user' who simply mediates between the customer and computer, or if he or she is more of a 'knowledge worker' with additional information and skill needed to complete the task. Possible research arising from this would be to clarify what the role of the agent is in customer service CACI. The next three sections discussed potential research to the three channels of communication.

Human (customer) – computer interaction

In CSCW research the importance of awareness has been identified. In a co-located collaboration there are many visual cues that provide awareness about, for example, who is present, who is currently busy working and what they are working on, what people are paying attention to (Gellersen and Beigl, 1999; Gross, 1997; Gutwin and Greenberg, 1998; Randall and Hughes, 1995). However, in audio-only interactions, such as at a call centre, those cues are not as readily available, but it could still be beneficial to provide a customer with awareness of the agent's activity (Bowers and Marin, 2000). This would give the customer an indication and awareness about what action the agent is engaged in and therefore act as a cue as to when to initiate or withhold information.

Bowers and Martin's (2000), and Greatbatch *et al's* (1993) findings about the need to display the agent's engagement (or disengagement) were based on naturalistic observations in a bank and doctor's clinic, but there has not been any controlled laboratory investigations into the importance of displaying engagement. Potential research questions are to investigate display of engagement in different settings, such as power company call centre, and in a controlled laboratory experiment, and different ways of providing the awareness. Additionally, possible research also includes interviews with agents and their customers to obtain information on their perceived need for display of engagement.

In a call centre setting, the customer is visually-impaired with regard to computer. The customer relies on a speech interface, the agent, to translate the interface. Auditory feedback has been used effectively with software for visually-impaired users and it has also been used effectively in telephone-based interfaces (Mynatt and Weber, 1994; Edwards and Mynatt, 1994; Edwards, 1988). *Auditory icons* and *Earcons* can provide both visually-impaired and sighted users with a natural and intuitive auditory representation of objects on a computer interface (Mynatt, 1994; Brewster *et al* 1992; Vargas and Anderson, 2003) and it has also been shown that auditory feedback can be used in telephone-based interfaces (Brewster, 1998; and Brewster *et al*, 1996). Since, auditory feedback has been used in combination with speech and also in menus over the telephone, potential investigations include the possibility of providing a customer in CACI with awareness of the agent's activity through the use of auditory feedback.

Human (agent) – human (customer) interaction

Rutter *et al* (1981) suggest that as communication moves from face-to-face interaction towards audio-only it becomes more cueless. They describe the communication modes on a continuum, where the quality degrades as the mode becomes more impoverished. Chapanis and Overby (1972) and Ochsman and Chapanis (1974) on the other hand argue that as long as people can communicate verbally, visual interaction is not essential. Clearly there are discrepancies in previous research relating to the effect of mode on communication. Potential research includes attempting to clarify this unclear result. Additionally, previous research has not investigated human-to-human communication in a customer service setting when there is also a computer involved.

Ten Have (1991) argues that there is an asymmetry between doctor and patient, which raised the questions;

- Is there asymmetry between customer and agent in a customer service setting?
- Does this asymmetry effect the communication between the two people?
- Does the asymmetry need to be taking into account in the design of computer interfaces for CACI?

Human (agent) – computer interaction

Studies by for example, Rodden *et al* (2003) and Scaife *et al* (2002), investigated CACI in a travel agency, but those studies mainly focused on the initial stage of a travel booking and they focused on the face-to-face interaction sharing the entire screen with the customer during the entire interaction. As mentioned by Rodden *et al* (2003), much of the information given to a customer is different from the information the agents have. Some of the information might not be of any use to the customer. Therefore, is sharing the entire screen the best option, or would part sharing be a preferred option? In contrast, Greenberg *et al* (1999) argue the importance of separating shared and private information. There are number of research questions arising from this:

- Do the same findings hold at all stages of a travel booking?
- Do the findings hold if the customer and agent are remotely located?
- Do the agents want to share all information on the screen, such as commission and various options?
- Is there a need to distinguish between private and shared information?

In summary, many potential research areas were identified based on previous research. To gain an initial understanding of customer service CACI and to narrow down potential research questions, it was decided to conduct naturalistic observational studies in customer service settings. The next chapter in this thesis describes two observational studies conducted across four call centres.

3 OBSERVING CACI IN CALL CENTRES

In order to gain an initial insight into the interactions that take place in a customer service setting between the customer, agent and computer, two observational studies were conducted at utility provider and telecommunications call centres.

A call centre agent interacts with a personal computer, however, there are extra complications because the agent also has to interact with the customer. Additionally, as the interaction is carried out via telephone, the customer is not able to see the agent's work with the computer (see Figure 7). The agent has to alter his or her work with the computer as they, for example, wait for the customer to provide information or while trying to establish the customer's specific request. The customer has information that is specific to their request, for example their customer number or new address, while, the agent has got expert knowledge of the industry and the computer system, and skills, such as human-human communication. In this three-way interaction neither the agent, nor the customer, nor the computer can complete the task without interaction with the others.

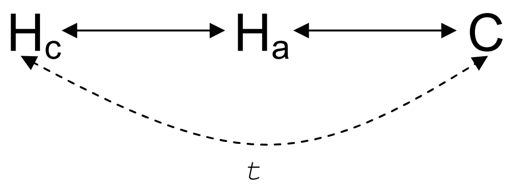


Figure 18. Interactions that take place between customer (H_c), agent (H_a) and computer (C) via telephone (*t*), in a call centre setting

As mentioned in Section 2.4.1, Bowers and Martin (2000) investigated the interactions between the customer and the agent, and between the agent and the computer at a UK bank's call centre. In designing computer systems for call centres, it is important to keep in mind three perspectives, the customer, agent and computer. Bowers and Martin (2000) identified these issues to be of particularly importance to this kind of interaction:

- Pace of interaction and system responsiveness,
- Information format,
- Display of engagements,
- The design of closing dialogue,
- System documentation.

Other previous research suggests that a call centre agent is a 'surrogate user' between the customer and computer (Lawrence *et al,* 1994; Lawrence *et al,* 1995), while others argue that the agent is more of a 'knowledge worker' (Muller *et al*, 1995). Lawrence *et al* (1994) and Lawrence *et al* (1995) studied the interaction between a caller and operator in telephone directory assistance. They suggest that the agent is in effect a 'surrogate user' between the customer, with the enquiry, and the computer, containing the desired information. The assistants need to coordinate social and technical interactions, and they have to translate between the social language, used in communication with the client, and the technical terms needed for the computer. This translation from social to technical language is often not trivial. In contrast with Lawrence *et al* 1994) and Lawrence *et al* (1995), Muller *et al* (1995) argue that the directory assistance operator is more than a 'surrogate' and has expert knowledge, about the computer and the context of the query, needed to find the correct answer, as well as, problem solving skills and human-to-human communication skills.

Technical communication is more brief and factual than social communication. Because call centres are concerned with reducing call time with a customer (Lawrence *et al,* 1995, Muller *et al,* 1995, John, 1990) technical communication is often encouraged. In addition, the operators that are able to work in parallel between the social and technical language commonly complete the task quicker (Lawrence *et al*, 1994, Lawrence *et al,* 1995).

This chapter describes studies carried out to investigate CACI in a utility provider and telecommunications call centre setting. The aim was to gain a general understanding of the interactions that take place, as well as identifying issues specific to this interaction. In addition, the objective was to conduct further studies on an issue that was identified as being important and could benefit from further investigations.

The aim was also to clarify the unclear findings from previous research about the role of the agent as a 'surrogate user' or a 'knowledge worker'.

The possible settings for the observations were restricted by privacy regulations (Privacy Commissioner, 1993) in New Zealand. For example, it was not possible to observe interactions at banks or WINZ (the New Zealand government unemployment benefit department), as the customer details in these cases contain sensitive private information. Two business domains were identified as viable for observations, utility providers and telecommunications. Another advantage with utility and telecommunication industries is that they routinely monitor all incoming and outgoing calls. Customers are made aware that their call will be recorded and that other people might be observing the conversation.

There were two stages to these observations; study 1 was conducted to gain a general understanding of the interactions as well as identifying issues specific to CACI. Study 2 focused on the issues of awareness and feedback between the agent, computer and customer. This included situations when the agent directly referred to the computer, or when the customer directly asked for awareness, for example, the customer asking if their address details had been updated on the computer. Further focus was placed on the activity of the customer, agent and computer at the times where the agent would make the customer aware of the computer.

Section 3.1 describes the observational setting for both studies 1 and study 2, including the characteristics of the four call centres as well as the computer system they use. Details of study 1 are described in Section 3.2, including the method in Section 3.2.1 and the findings in Section 3.2.2. Study 2 is described in Section 3.3, with the method described in Section 3.3.1 and the findings are reported on in Section 3.3.2. In Section 3.4 the results from the studies are discussed.

3.1 Observational setting

Four call centres in total were observed; three utility providers and one telecommunication company (see Table 1). To ensure a broad understanding the call centres were different in set-up and activity. For study 1, three call centres were observed; utility 1 and 2, and the telecommunication company. All the call centres were located in New Zealand, but in different geographical regions, and the language spoken was English. Utility 1 was a division of an electricity and natural gas company, while utility 2 was an independent company which serviced three different electricity providers. The call centre was split into three divisions, one for each power provider, and each section was physically separated at the call centre office. The different power providers had slightly different rules, provided slightly different services and had different computer systems. The agents usually worked for only one of the divisions. Additionally, the staff-members were further split into working with calls relating to commercial or private customers. However, the agents did sometimes work in other sections than their speciality. Consequently, the agents were also specialized for a particular power provider and specialized in a particular service area. In utility 1, in contrast, the staff were not specialized and dealt with any type of call. However, as the call centre was part of the utility supply company, they only worked with that provider.

The telecommunications call centre was a division of the company. As with utility 2 the agents were assigned to certain areas, such as home telephone, mobile phone or Internet. However, within that section they worked on any customer queries. In addition to finding a solution to the problem, they were also expected to attempt to sell extra services to the customer.

For study two, one call centre was observed, utility 3, who was dedicated to one electricity provider but covered a much larger geographical area and larger population base than utility 1. However, as with utility 2, the agents were specialized in certain areas and generally only handle calls within their speciality.

Table 1. Details of call centres observed

Call Centre type	How they service the industry	Service provided	How the work was assigned to the different agents
Utility 1	Call centre a division of the power providing company	Electricity and gas	The agents worked with different sections of the customer service
Tele-communication	Three aspects of the telecommunication industry, home phone, mobile phone and internet, but within the same company	Tele-communication services	Assigned to a particular sector, such as home phone, but work with all aspects within that area
Utility 2	Independent company servicing three different power providers	Electricity	Assigned to particular provider and business sector
Utility 3	Independent company, servicing one specific power provider	Electricity	Mostly assigned to a particular business sector, but do work in other sectors when needed

3.1.1 Details about the call centre software

Each call centres had different software interfaces as well as interaction methods (Table 2). Utility 1 had a sequential text-based interface. The agent had to use the keyboard for the interaction and there was no direct manipulation, that is, point-and-click interaction with a mouse. For changing screens or performing an action keyboard shortcuts were used, see selected region at the bottom of Figure 19.

Table 2. Characteristics of the software used by the call centres studied

Call Centre type	Software interface	Input
Utility 1	Text-based only	Only keyboard
Telecommunication	Text-based, graphical interface and database form-based interface	Depending on the interface; keyboard, or mouse, or combination
Utility 2	Graphical interface	Predominantly mouse
Utility 3	Graphical interface	Predominantly mouse, but some keyboard

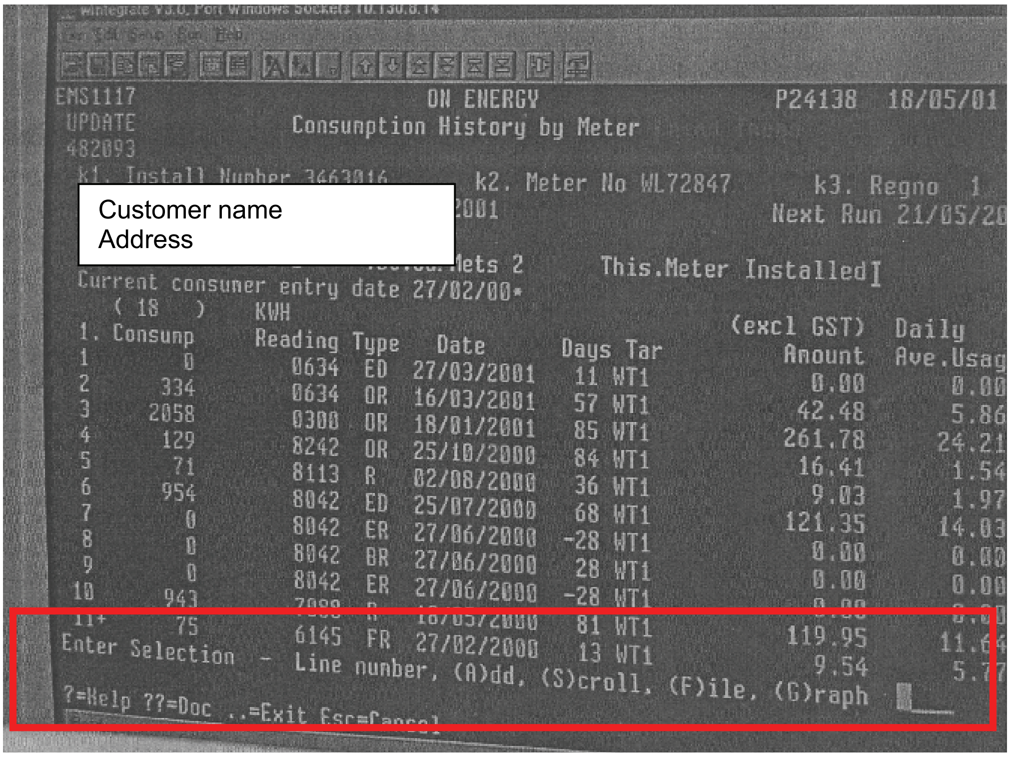


Figure 19. Example screen shot of computer interface for consumption by meter for utility 1, highlighting keyboard interaction for navigating to another screen

The telecommunication company had separate interfaces for different types of interaction. For searching and viewing details about a customer, a predominantly direct-manipulation point-and-click interface was used. As a call came in, the details telephone number and details relating to that customer were automatically displayed on the interface (a drawn example of the computer screen is shown in Figure 22). There were only very few situations where the agent would use keyboard input, for instance, if the details were not correct because the customer had called from a different phone number than their own. However, once a customer's details had been found, a completely separate interface had to be used for editing. This second interface was strictly keyboard-based, and only sequential navigation was supported, using the "Tab" key to move to the next field.

Utility 2 had a strictly point-and-click interface. The keyboard was used only when entering text, such as typing new customer details for searching (see Figure 20).

Utility 3 used a mostly direct manipulation interface, through point-and-click mouse interaction. However, there was some opportunity for using keyboard input and shortcut commands.

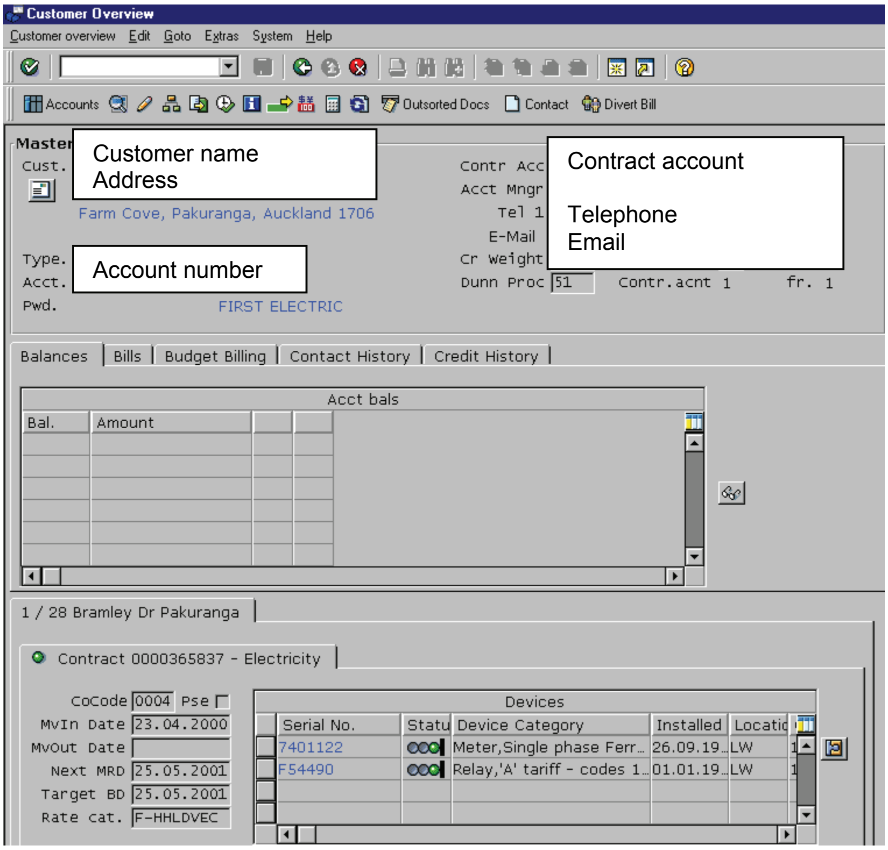


Figure 20. Example screen shot for overview interface for Utility 2; predominantly a point and click interface

3.2 Study 1 – general observation

The first observations were made to obtain an insight into the interaction between the customer, the agent and the computer at a call centre. The aim was to gain a general understanding of the interaction and to gain an understanding on issues where CACI differ from traditional CHI. The intention was also to identify areas that would benefit from further investigation.

3.2.1 Method

Three of the four call centres mentioned earlier were observed in study 1, utility 1 and 2, and the telecommunication company. The sessions with each call centre lasted between two to five hours, however, for utility 1, there were two sessions. There were 16 hours of observations in total and a total of 136 calls were observed (see Table 3). The number of the sessions depended on the call centres ability to provide suitable agents and how busy those agents were. For each call centre, 3-6 different agents were observed. Observations were made of both male and female agents, from 20 to 40 years old. The level of experience ranged from inexperienced call centre agents to very experienced (see Table 4). In addition, at each call centre a one hour interview was conducted with call centre staff managers.

Table 3. The number of agents, length of observations and number of calls for each call centre

Call centre	Agents	Hours	Calls
Utility 1 (session 1)	2	3	27
Utility 1 (session 2)	4	4	43
Telecommunication	3	3	20
Utility 2	5	5	46

Table 4. Breakdown of level of experience of the observed call centre agents

Call centre	Inexperienced agents	Moderately Experienced agents	Very experienced
Utility 1 (session 1)	1		1
Utility 1 (session 2)	1	2	1
Telecommunication	1	1	1
Utility 2	2	1	2

Because of the observations being made of real call centre interaction, there was a risk of a sensitive situation arising, for example, an irate or difficult customer, the agent feeling under pressure, or containing commercially-sensitive information. In case such a situation arose, a discontinuation signal had been agreed on between the observer and the agent, and the observer would leave the desk. However, this did not occur and all calls were observed in their entirety.

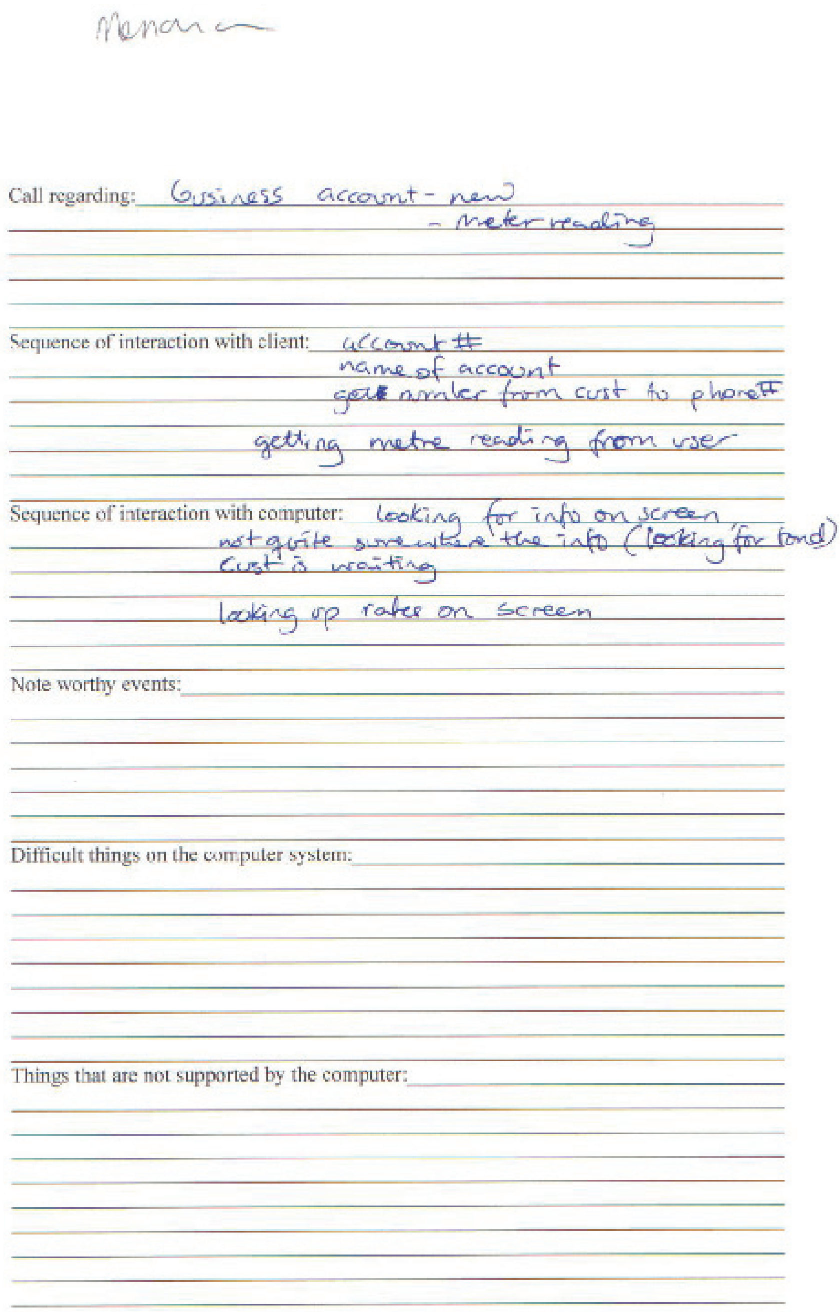
The agents' work with the customer and computer was observed, and additionally, the telephone conversation was listened-in on via an additional telephone headset. The study was unstructured and unobtrusive, that is, there was no influence or interference with the normal communication between the agent and customer. When time permitted, in-between phone calls, discussions were held relating to issues that had arisen during the conversation with the customer or issues relating specifically to the interaction with the computer. The observer would take notes during the calls, as well as in-between the calls. At the end of a session with an agent, he or she was given an opportunity to look at the notes. This was done to give the agents an opportunity to ascertain the accuracy of the annotations and also to remove any information they did not want included. The notes were also used as a reminder for the agent of what had taken place during the call and therefore enable supplementary discussion.

General interviews were made with each agent at the completion of their session. They were asked if they thought the computer system supported the interaction and what aspects did or did not support the interaction. Enquiries were also made into what they would like to change and how they would like it to change.

There were practical constraints on the ability to record the observations and interviews. Because of privacy regulations and commercial sensitivity, it was not possible to audio or tape record the observations or interviews, or to record take any software logs. The call centres also would not allow any photos to be taken. The researcher had to rely on handwritten notes. Before the observations took place, note-sheets were made to aid note taking during the observations. The sheets included an area for drawing pictures of the computer interface (see Figure 22) and the physical layout of the call centre. The sheet also had categories for making notes including:

- Call regarding
- Noteworthy events
- Difficult situations on the computer system
- Items that are not supported by the computer

A separate sheet was used for each call (see Figure 21). After the observations, the sheets were used for analysing and categorising the observations.


Menara

Call regarding: business account - new
- meter reading

Sequence of interaction with client: account #
name of account
gets number from cust to phone#
getting metre reading from user

Sequence of interaction with computer: looking for info on screen
not quite sure where the info (looking for fond)
cust is waiting
looking up rates on screen

Note worthy events:

Difficult things on the computer system:

Things that are not supported by the computer:

Figure 21. The note sheet for one call where the customer is moving premises and also requesting a final reading

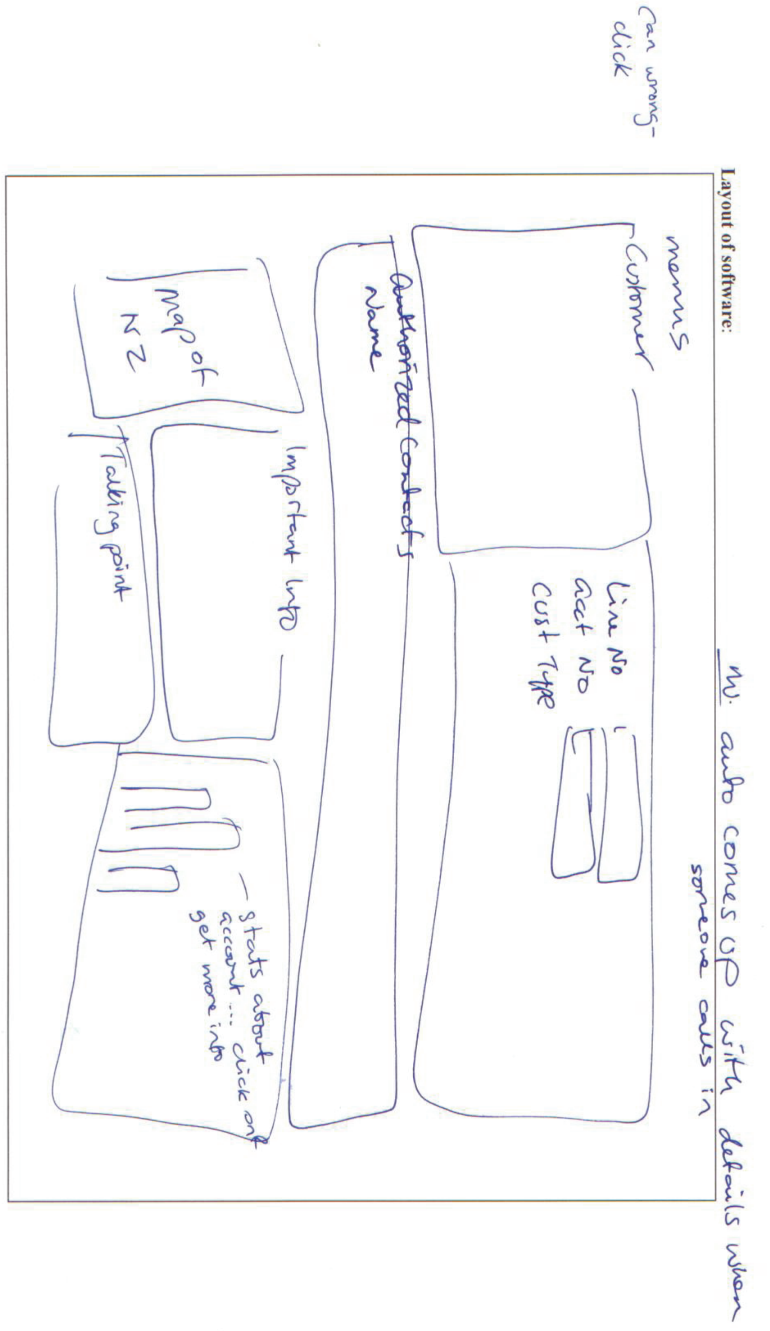


Figure 22. The sheet used for drawing pictures of the computer interface, including a drawing from the telecommunications company.

3.2.2 Findings

This section discusses the general observations that were made as well as issues that were identified.

Interviews with call centre managers

During the interviews with the utility call centre managers, three important issues were identified, that is, customer satisfaction, high staff-turnover and reducing call times. For the utility companies, the average task completion time was about 1 minute. Because the centres handle hundreds and sometimes thousands of calls every day, even a small reduction in time meant a larger overall saving.

The average duration an agent would remain an employee at any of the observed call centres was less than 18 months. Further, new call centre agents had to be given extensive training before starting their work as an agent. The average training before being able to take calls was 3-4 weeks. However, it often took agents an additional 2-3 months before they were fully proficient in the work required, including the computer system. The additional time it takes for a new agent to deal with each call increases overheads for the call centre.

The call centre managers also stated that it was very important that the customer received what they perceive to be good service. The agents were instructed to smile despite the communication being over the telephone because "*the customer can hear that you are smiling and think that they are getting better service*". Additionally, part of that service was to process the customer's request as quickly as possible and which included informing the customer that the agent was in fact working on the task by providing verbal feedback in situations where there was a silence. It was call centre policy to try and ensure that the customer was aware that their request was being processed. However, as the customer is not able to see the agent's work, the awareness has to be provided verbally. This issue is covered further below in Section 3.3.

Many tasks at a call centre are very similar and the most common tasks relate to customer's account, signing up a new customer or moving premises (see Figure 23).

Call Work Code	Call Work Code Name	ACD Calls	ACD Time	ACW Time	Avg ACD Time	Avg ACW Time
Totals		1582	83:50:41	29:58:38	3:11	1:08
50	On A/c Balance	158	7:55:22	:40:27	3:01	:15
51	On Credit Control	309	17:07:35	5:40:29	3:20	1:06
52	On New Cust	196	12:08:55	1:10:04	3:43	:21
53	On Move Address	19	1:19:13	:03:52	4:10	:12
54	On Final Reads	76	3:51:52	:24:04	3:03	:19
55	On Gas Fault	15	:23:21	:15:30	1:33	1:02
56	On Electric Fault	10	:28:17	:04:39	2:50	:28
57	On Missing Payment	5	:14:01	:00:00	2:48	:00
58	On Payment Mthd Enq	150	6:10:39	:52:13	2:28	:21
59	On Payment Receipt	40	1:08:56	:06:23	1:43	:10
60	On Switching Enq	8	:31:03	2:18:18	3:53	17:17
61	On Bill Format Enq	29	1:40:13	:00:00	3:27	:00
62	On All other Enqs	278	17:03:21	13:55:18	3:41	3:00
63	On Cust Reading	37	2:08:05	:00:17	3:28	:00
64	On Interim Gas Enq	14	:50:29	:08:53	3:36	:38
65	On Emerg Line Wrong	8	:09:31	:04:10	1:11	:31
66	On Business Call	36	1:43:06	:11:14	2:52	:19
67	On Tariff Enquiries	2	:06:52	:00:00	3:26	:00
68	On Transferred Call	77	1:50:09	1:27:25	1:26	1:08
69	On Rebranding	1	:07:25	:00:00	7:25	:00
70	On Tariff Price Chge	13	:40:11	:03:11	3:05	:15
71	On Get it On Promo	3	:02:55	:00:00	:58	:00
73	On ChCh Office Calls	16	:55:49	:02:46	3:29	:10
80	Bus A/c Balance	4	:08:47	:00:00	2:12	:00
81	Bus Emergency	1	:00:30	:00:00	:30	:00
82	Bus Gen Bill Enq	26	2:06:36	1:10:10	4:52	2:42
84	Bus Final and Set up	9	:43:11	:00:00	4:48	:00
85	Bus Switching	1	:06:37	:00:00	6:37	:00
86	Bus Credit Control	6	:26:58	:08:34	4:30	1:26
87	Bus Propane	2	:00:26	:00:00	:13	:00
88	Bus Transferred Call	25	1:23:47	1:06:18	3:21	2:39
89	Bus All Other Enq's	7	:14:46	:04:23	2:07	:38
90	Bus Emerg line wrong	1	:01:41	:00:00	1:41	:00

Figure 23. Statistics of nature of calls over one day from utility 1

General observations

It was observed that the ability to find the correct information on the computer was difficult for newer agents. There was a continued learning curve to become proficient with the computer system although they were already dealing with live customer calls. It was particularly difficult at the call centres that had a text-based interface as the agents were required to remember the commands. However, the direct manipulation interfaces also posed problems for the newer agents, as it was still difficult to find the correct information and once found, it did not seem to be obvious how to utilize it correctly. It was also observed that the newer agents relied on the computer to find all information, and they were not always successful, while the more experienced agents had more extensive domain knowledge in addition to the information available on the computer.

All call centres kept notes on the computer of the interactions with the customers. The comments were made manually by the agents at the end of the call with the customer. Often the agent would write them while they had already started attending to the next call. There were no guidelines to how the notes should be made. Some agent wrote extensive notes, while others maintained brief cryptic notes. The extent of the notes also depended on how busy they were.

It was observed that some well-known CHI issues are also important to CACI, however, CACI adds complexity to these issues, due to the impact of the second person, the customer. The next part of this chapter discusses three areas of CHI; ease of navigation, responsiveness of the computer system and feedback.

Navigation

Being able to navigate an interface with ease is known to be important to human computer interaction. However, in CACI there are additional complications because the agent must navigate the computer system and serve the customer at the same time. It was observed at all the call centres that as a new phone conversation was initiated, the staff member would navigate between the potential screens. As the agent was talking to the customer, they were bringing up the screen that was most relevant to the conversation at that point, even if they did not actually need to use that particular screen. This behaviour did not seem to be due to the agent being lost, but rather that they were trying to predict what screen they would need to satisfy the customer next request. During the interviews the agent stated that if they already had the correct page loaded, they could respond to the customer’s request faster and more accurately. This behaviour of trying to pre-empt what screen would be needed, seemed to continue to some extent throughout the entire conversation, but was the most prominent during the initiation of the conversation.

Table 5. Ease of navigation for experienced and inexperienced agents for the different call centres in study one

Call Centre	Inexperience agent	Experienced agents
Utility 1	Difficult for inexperienced	Ease and fast for experienced
Utility 2	Easier for inexperienced agents	Easier for experienced agents
Telecommunication	Relatively difficult - different software for different tasks	Shortcuts made it somewhat easier for experience agents

There were differences in the navigation depending on the software type and interface, and the level of experience of the agent (see Table 5). It was observed that the inexperienced agents in utility 1 sometimes had to ask the customer to wait as they were trying to remember a command, or find certain information, for example *"can you wait a minute, I am just trying to find the information about consumption"*. Many of the agents, even the experienced ones, had a piece of paper glued to the side of the monitor with all the commands (see Figure 24). However, once the agents were proficient in remembering the commands, they could quickly navigate between the screens, with virtually no delay for the customer.

F1	Cus/Con
F2	Account Balance
F3	Customer paid arrears, Receipt:
F4	Credit agreement:
F5	CR processed - Account Sent
F6	Customer requested account copy dated
F7	If agreement broke discon - cust advised
F8	Courtesy Call
F9	Advised ECO was best plan
F10	Advised ECO was not best plan
F11	Customer rung,
F12	Called cust re ep review, spoke to
Shift F1	Application Fee
Shift F2	$100 Bond
Shift F3	$150 Bond
Shift F4	$200 Bond
Shift F5	NOK
Shift F6	Winz paying ...
Shift F7	Disconnection fee
Shift F8	Reconnection Fee
Shift F9	Landlord Details
Shift F10	No Credit call
Shift F11	Credit call agreement ...
Shift F12	Left message for cust re ep review
Control F1	Requested Tenancy
Control F2	Mail GNA
Control F3	Winz rang for cust info
Control F4	Speaking authority added
Control F5	Received letter from cust
Control F6	Sent 7 day response letter
Control F7	Sent cust a response letter
Control F8	Next bill due to be sent
Control F9	Have sent the customer
Control F10	Referred the cust to plumber/electrician
Control F11	Cust rang IR account
Alt F1	Deleted postal address
Alt F2	Added postal address
Alt F3	Problem getting access for read
Alt F4	Refund requested for $
Alt F5	IR suppression requested
Alt F6	IR suppression removed
Alt F7	Refund not understood
Alt F8	High A/C, have recommended
Alt F9	EP/DD Problem
Alt F10	Customer req bank a/c info
Alt F11	Credit Check Fee
Alt F12	Asked if know new tennants - advised no

Figure 24. The list of shortcut commands that the agents at Utility 1 had attached to the side of their monitor.

With the graphical interfaces, in contrast, there were fewer observations of the agent having to ask the customer to wait due to being lost in the navigation or struggling to find the correct command.

However, because the interface was graphical it was slower to draw on the screen and hence, there were more occurrences where the agents had to tell the customer to wait as the agent was waiting for the system to bring up the desired page. For example *"I am sorry it is taking so long, the computer is just so slow"*. The telecommunication company's graphical interface allowed both direct manipulations via a mouse and keyboard shortcuts. This allowed the experienced agents to navigate the screens faster. However, adding the shortcut commands did not improve the speed of drawing the graphical interfaces and therefore there were still situations where the agent had to wait while the screen was being drawn.

Many of the customer requests only required the agent to access a small part of that customer's information, and there was no need to enter or alter any information, for example when the customer enquiry was *"why is my bill so high?"* or *"when is my next bill due?"*. Even for a seemingly simple request such as these there was often a significant amount of navigation required involving several different screens. Often the customer seemed to expect the agent to respond to the request in a very short time. However, only one of the call centres, the telecommunications company, computer systems supported this, through a good overview of the customer information. Much of the information for a customer was available from the first screen, and there was a lot of the additional information available through one mouse click. This seemed to reduce the amount of navigation and also seemed to reduce the delay in response to the customer as the agent did not have to look through large amount of information on different screens.

Responsiveness of the computer system

As well as being able to interact with a computer interface with ease, it is also important that the computer system responds quickly. This aspect seemed to be very important in call centres. There were many occurrences where the agent would complain to the customer about the system being slow *"I am sorry about the wait, but the computer is slow at bring up the screen"*, or "*we are having problems with the computers being slow today*". Further, most of the agents stated that they would like a faster response from the computer. One agent said *"it is always frustrating waiting for the computer, but it is much worse when you know the customer is waiting as well"*.

It was observed that for the experienced agents the strict keyboard interface was faster (see Table 6). This was in part because the experience agent were very fast at navigating the screens, but also due to the interfaces having fewer graphical aspects, such as diagrams, pictures and colours. Therefore, as the agent was navigating the screens were brought up faster. One agent in particular was very experienced, and knew many of the shortcuts and frequently used them. The navigation was very fast and there were rarely any delays. However, for the inexperienced agents the time spent trying to remember or look up the shortcut slowed down their interaction with the system.

The slowest system was the telecommunications call centre with the mixed interface. There were quite a few graphical aspects to the system, which at times were slow to draw. However, there were more delays due to repetition of work. Even though the agent had, for example, customer information on one screen, if they wanted to add a product they had to use a different interface. There was no integration between the different sections of the system and the agent had to search for the customer details again.

Table 6. Speed of the computer system for the different call centres in study one

Call Centre type	Speed
Utility 1	Slow for inexperienced agents, very fast for experienced agents
Utility 2	Delays at times, due to graphical parts being slow to display
Telecommunication	Delays, both due to computer being slow at drawing screen, as well as having to repeat input already done on other screens

Feedback

One recognised issue in human computer interaction is feedback, as it is important that the computer system communicates its state to the user. This is often done via progress bars, moving icons (for example an hour glass) or a warning sound when something is wrong. During the observations, it was noted that the agents seemed to get frustrated when they did not get almost immediate feedback from the computer and in particular if they were not sure what was going on. Several times it was observed that the agents would sub-vocalize swear words, or make faces at the computer. Many agents stated that they felt frustrated when they were not sure of the state of the computer and that they felt extra pressure as they knew that the customer was waiting. For example *"we are supposed to complete the calls as quick as possible and our call times are being monitored, and it [the delay in response by computer] adds to the stress"*.

It was also observed that feedback was communicated between the customer and agent. Three situations were identified that were relating to feedback

- The agent providing customer with direct feedback about the computer, for example *"I am just waiting for the computer*":
- The customer asking for direct feedback about the computer, for example *"have you found my address yet"*
- The customer providing information at a time when the agent could not use it, due to lack of awareness of the computer, for example *"Customer: I have bought a new TV. Agent: uhm, hang on, I am looking at your consumptions and trying to see if there is anything unusual there. "*

The most common occurrence was the agent communicating feedback to the customer. There were many occurrences where the agent would provide verbal feedback of the computer state, for example:

- *"I am trying to find information on the computer"* or
- *"I have to enter your final reading date first"*.

If the agent was, for example, working on a task that was time consuming, they would often give the customer verbal feedback about the delay. Some agents told the observer that they informed the customer about the state of the computer to let them know that they were still working with their request. For instance, *"there is a lot of information I have to enter to remove you from your old house, but I am getting through it (smile)"*. Further, they also felt that longer silences were often perceived by the customer as inactivity on the agent's part. It was also observed that at the end of a call, the agent sometimes told another agent about lack of computer feedback, for example *"I just don't know what the computer was doing, and I had to tell the customer that I will call them back"*. In addition, the call centre manager stated that it was call centre policy to make sure that the caller was aware that the agent was working on their task.

The type of verbal feedback the agent communicated to the customer seemed to depend on the type of software. For the text-only interfaces, it was more common that the agent had to ask the customer to wait, as they were trying to find some information or command. In contrast, with the direct manipulation interfaces, there were more occasions were the agent would inform the customer about the state of the computer, for example, *"I won't be a second, I am just waiting for the computer screen to come up"*.

3.2.3 Summary

All the call centres were concerned with reducing the time to complete a call. It was also found that all call centres had a high staff-turnover. It usually took the agents approximately 3-4 months before they were proficient in handling calls. Therefore, learnability of software was very important as it could reduce the time taken for an agent was able to handle calls with sufficient speed. Three well-known CHI issues, navigation, responsiveness of computer system and feedback, were also important to CACI, but are more complicated due to the involvement of the customer. For example, feedback needs to be communicated to both the agent and the customer. It was observed that the agent provided verbal feedback about the computer system to the customer. The issue of feedback was identified as having additional complications and Bowers and Martin (2002) identified the need to 'display of engagement' to the customer. It was therefore decided to conduct further observations in a call centre and focus on the issue of feedback.

3.3 Study 2 – focus on auditory feedback

During study 1 it was identified that the issue of feedback had addition complications in CACI. It was observed that the agent would give the customer verbal feedback about the state of the computer system, for example "*can you wait [with providing the new address], I am trying to find your old address first"*. In addition, the call centre managers also stated that it was very important that the customer received good service, and part of that service was to make sure the customer was aware that their request was being processed as fast as possible. All the call centres visited during the first study, instructed their agents to keep the customer informed about the interaction taking place between the agent and computer.

The importance of ‘display of engagement’ has been identified as important in previous research (Bowers and Martin, 2000). However, they did not identify how or when the agents displayed engagement.

To investigate the issue of feedback further, another observational study was conducted. The aim was to investigate the verbal feedback communicated between the agent and the customer, the type of feedback that was communicated and the situations in which the feedback was given. The issues of interest were:

- How did the agent communicate feedback to the customer?
- When did lack of feedback adversely affect the interaction?
- In what situations did the customer give information at an inappropriate time due to lack of awareness of computer?
- Identify how feedback could be improved

3.3.1 Method

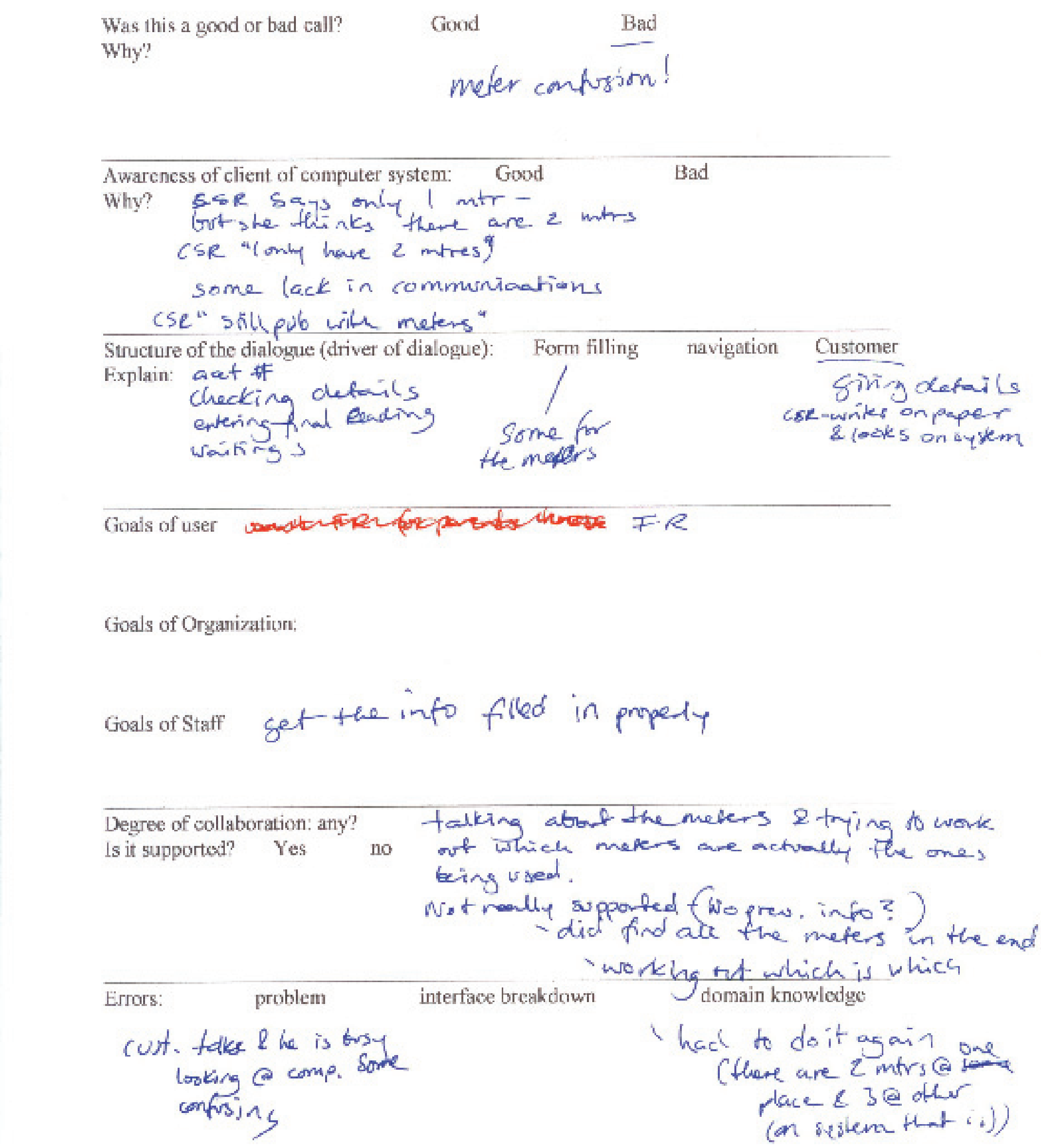
To gain broader findings, a call centre, utility 3, that was not included in the original study was observed. Three agents were observed and the session with each agent lasted between one and two hours. There were five and a half hours of observations and 47 calls in total. There were one male and two female agents aged between 20 and 40 years old. The agents had a varying level of experience with call centre work.

The study was conducted through observing the interaction between customer, computer and agent, and listening in on the telephone calls received at the call centre via an added headset. There was no interaction between the observer, and customer or agent during the calls. When time permitted, interviews were made in-between calls. At the end of each session with each agent, contextual interviews specific to the communication of feedback were performed.

During the observations attention was paid to:

- Direct communication of activity from the agent to the customer
- When customer asked for feedback
- Times that the customer provided information when the agent was busy performing a task and was therefore not able to utilize the information
- The type of feedback the agent was communicating
- What activity the agent was involved in as they gave the feedback
- Identifying situations that could benefit from non-verbal feedback
- Identifying what kind of non-verbal feedback might be useful

As with the first observational study, it was not possible to audio or video record the observations or interviews, or to take photos. Prior to the observations note sheets had been prepared. The observations were categorised to allow for easier recording and analysis. An example the note-sheet is shown in Figure 25 and Figure 26.



Was this a good or bad call? Good Bad
Why?
meter confusion!

Awareness of client of computer system: Good Bad
Why? CSR says only 1 mtr – but she thinks there are 2 mtrs
CSR "I only have 2 mtres"
some lack in communications
CSR "still prob with meters"

Structure of the dialogue (driver of dialogue): Form filling navigation Customer
Explain: acct #
checking details
entering final Reading
waiting
Some for the meters
giving details
CSR-writes on paper & looks on system

Goals of user ~~[illegible]~~ F.R

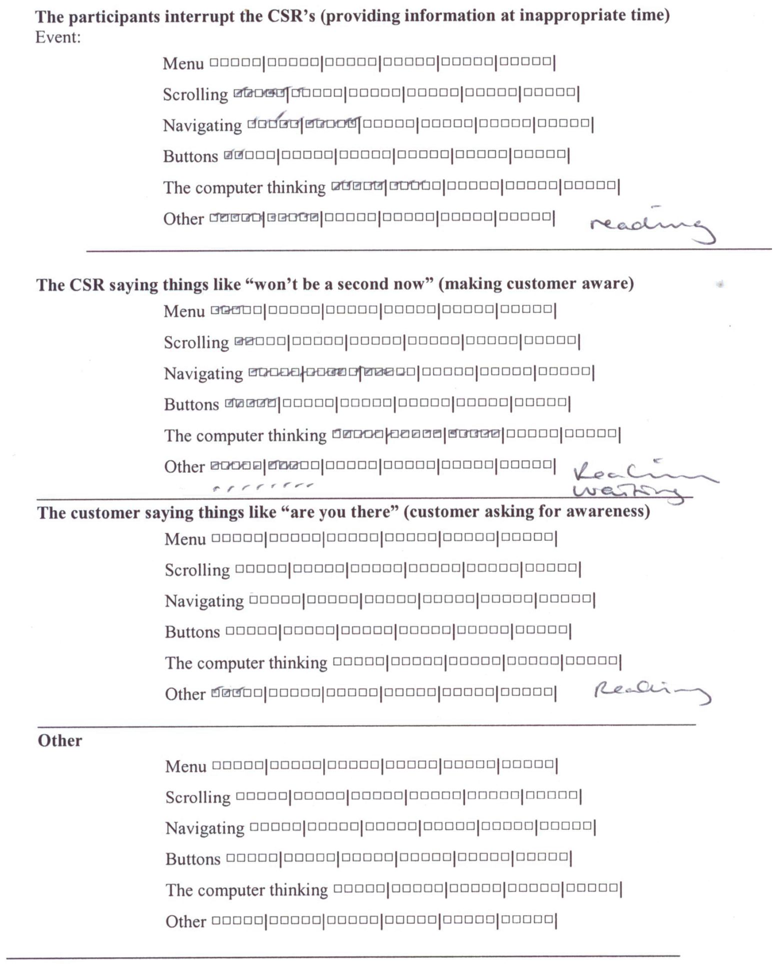
Goals of Organization:

Goals of Staff get the info filled in properly

Degree of collaboration: any? talking about the meters & trying to work out which meters are actually the ones being used.
Is it supported? Yes no
Not really supported (No prev. info?)
- did find all the meters in the end
- working out which is which

Errors: problem interface breakdown domain knowledge
cust. talks & he is busy looking @ comp. Some confusing
- had to do it again (there are 2 mtrs @ one place & 3 @ other (on system that is))

Figure 25. First part of the note sheets for auditory feedback observations



The participants interrupt the CSR's (providing information at inappropriate time)
Event:

Menu
Scrolling
Navigating
Buttons
The computer thinking
Other reading

The CSR saying things like "won't be a second now" (making customer aware)

Menu
Scrolling
Navigating
Buttons
The computer thinking
Other Reading waiting

The customer saying things like "are you there" (customer asking for awareness)

Menu
Scrolling
Navigating
Buttons
The computer thinking
Other Reading

Other

Menu
Scrolling
Navigating
Buttons
The computer thinking
Other

Figure 26. Second part of the note sheets for auditory feedback observations

3.3.2 Findings

The results from the study are split into three sections:

- when the agent gave direct feedback
- when the customer asked for feedback
- when the customer gave information at an inappropriate time due to lack of feedback.

In addition, for each of those sections, it was also identified what activity the agent was engaged in as the feedback was communicated or the customer provided information at an inappropriate time.

The agent providing feedback

The most frequently occurring form of feedback was the agent providing direct feedback to the customer about the computer system, for example, *"I am waiting for the computer to bring up the screen"*. Some customer requests (or part thereof) took a while for the agent to complete on the computer. For example, it was sometimes difficult for the agent to find the customer's new address, but, while the agent was searching, there was often not much more additional information needed from the customer. However, the agents were encouraged to limit the frequency and length of silences, because the customer might perceive silences as inactivity by the agent. The most common way for the agent to limit silences were by continuously verbally updating the customer what they were working on. All the observed agents provided verbal feedback to the customer. There were many examples where the agent would give the customer verbal feedback about their activity. For example:

- *"I am trying to find that street"*
- *"I am waiting for the computer to search for your details"*
- *"My computer seems to have gone to sleep"*
- *"My computer has crashed"*
- *"I am looking through a menu to find the information"*
- *"I don't know what is wrong with the computer today, it just seems to be very slow"*
- *"I am looking through the pages trying to find anything that could have caused your bill to get so high"*

During the interviews the agents stated that they wanted the customer to know that they were still there and still working on their task. One agent said *"I don't think that the customer would wait long before they got concerned about my activity or that they might have lost the phone connection"*. All the agents stated that they did not like the silences, as the customer might perceive that they were not doing their job properly.

It was observed in both in study 1 and study 2, that many of the agents typed with force on the keys. During the interviews the agents were asked about this. They replied that if they typed hard then the customer might be able to hear the typing, and would therefore know that the agent was engaged in some activity.

It was identified that the agent would provide more feedback during certain activities. It tended to be activities where the agent needed to work on a request and there was no need for further input from the customer. In particular the agent would communicate feedback when:

- They were typing. As mentioned before the agents typed hard on the keys to make sure that the customer could hear that they were doing something. However, they still communicated verbal feedback
- They were busy trying to find information on the computer. This included both entering and searching for a particular person or address, or searching through pages to find a certain information
- They were waiting for the computer. This included both waiting for a new page to load as well as waiting while the computer was saving, searching, drawing etc.

The customer asking for feedback

The second type of feedback was when the customer would directly ask for feedback about the computer system or about the agents work with the computer system. This feedback included questions such as *"can you find the address [on the computer screen]?"*. As mentioned earlier, keeping the caller informed that their request is being processed is company policy. Despite this and the agents' attempt at providing feedback, there were still occasions where the client would directly ask for direct feedback. Examples where the customer asked for awareness include:

- *"Has that information been updated now"*
- *"Can you please read out to me what you have entered, I just want to make sure it is correct"*
- *"Can you find my contact details? Do you want my phone number instead?"*
- *"Are you still there?"*
- *"Are you ready for my new address now?"*

It was observed that there were more occurrences where the customer would ask for awareness with the less experienced representative. The cognitive effort required by an unexperienced agent in processing the request, for example, navigating the site or trying to find the correct details, was of sufficient magnitude that they did not present verbal feedback to the customer. This led to longer silences during which the customer would ask for feedback.

In the interviews the agents stated that they did not think it took long before the customer got concerned over if their request was being processed. The agents said that they could hear the customer, for example move or sigh, after only a very short silence and they estimated that the client would start to become concerned after less than two seconds. In such situations, the more experienced agents would give the customer verbal feedback to reassure them. However, faced with a difficult task, or in the case of an inexperienced representative, these signals were not always noticed, and the customer's growing concern was not addressed. The agents also stated that the worst circumstance was when the customer would ask *"are you still there?"*. In those situations the caller was clearly very concerned about whether their request was being processed or even if the call was still active.

Activities that cause a higher cognitive load on the agent seemed to cause more of this type of feedback. It seemed to occur in circumstances where the agent had actively placed all their effort into completing the task. The specific observations included when the agent:

- had to review large amount of information, or many different pages, to find the pertinent information
- had to enter large amounts of information into the computer
- was not sure how to complete the task and really focused on solving the problem
- was not sure where to find the required information

The customer gave information at the inappropriate time due to lack of feedback

The final observation regarding feedback occurred when the customer would provide information at an inappropriate time due to lack of feedback. This happened when the customer was not aware of the state of the computer system, or the order and format needed for the required information. An example scenario would be, to change the address for electricity supply, the agent initially needed to find the customer's details, remove the old address and then add the new address. However, most people would provide the information in a different order, saying for instance "*I am moving from address 1 to address 2 on such a date*". When customers called the call centre they would give one address, wait a short while and then give the new address. However, the agent would not be ready for the new information, as they had not finished finding and removing the old address. Occurrences like the scenario above were fairly common. There is no way for the customer to know when to provide information or to have any understanding of the computer software.

There were several examples when the customer would provide information at the inappropriate times. In these circumstances the agent would either have to stop the activity they were currently involved in and make a note of the new information, or had to ask the customer to wait and provide the information at a later stage. Here are some examples of when this was observed:

- The agent was removing the old address and the customer provided the new one. The agent stopped her current work and made a note on paper of the new address. She then used this information later.
- The agent was trying to find a customer's details, and the customer provided their new address. The agent had to pause their current task and ask the customer to provide the new address later.
- The agent was trying to find information about why a bill was high. The customer also asked when the bill was due. The agent had to stop the current task and look for the details on due date, she then had to reassume the previous task.

During the interviews the agents stated that it was disruptive when the customer would provide information at the wrong time. For example one agent said: "*this customer kept asking me if this new appliance [fridge] or that [fan] would have increased the bill, this was really distracting because I was trying to look through the consumption history to find anything that seemed odd*". This meant that the agent had to stop what they were currently doing and hence had to pick up the work again. When they had to stop and start a task it slowed down the overall time taken to process the request. They also stated for example *"when this [the customer interrupts] happens it makes my job more difficult, in particular as call time is so important here [at the call centres]*". The agents also made statements like "*[I think* *that] the customer got impatient with waiting, and provided more information to try and speed things up, however, this had the opposite effect as I had to stop what I was doing".*

Overall this type of feedback was fairly common. In many cases, however, the experienced agent handled it with only a small delay, while, there was a larger effect with the newer agents. The more experienced representatives seemed to be able to continue working on the task at hand while still asking the customer to provide the information later. Sometimes the really experienced agent was able to continue working on the task, take in the new information and utilize it later when needed. Usually, there was some delay in the task completion time due to the customer providing information at a time when the agent could not use it.

The activities when the customer provided information at inappropriate times tended to be during more time consuming tasks, for example while the agent was searching for some information, or when the perceived task order was different for the customer and agent, such as, when the customer wanted to report moving premises.

3.3.3 Summary

In the second study it was observed that there is a lot of feedback being communicated between the agent and customer about the computer system. In particular there were many occurrences where the agent would directly provide the customer awareness of their activity with the computer. For example, "*I am looking through a menu to find that information*", or "*won't be a moment now, the computer is busy*". In particular the agent would communicate feedback to the customer when the computer was slow or there seemed to be a pause in the interaction between the two humans. In the interviews with the agents they stated that they wanted the customer to know that they were still there and still working on their task.

Despite the agent working hard to make sure the customer was aware of their activity, there were still occurrences of where the customer asked for direct feedback. This seemed to occur more with the unexperienced agents. For example "*are you still there?*", "*do you want my new address now*?". In particular this would occur when the agent was preoccupied with a task on the computer that had a high cognitive load.

There were also situations where the customer would provide information at inappropriate situations. These included the customer giving their new address while the agent was busy trying to find their old address or giving their name while the agent needed their customer number. This disrupted the agents' work, as they had to pause the current task, deal with the customer's additional information, and then resume working on the original task.

3.4 Discussion

This chapter reports on two observational studies conducted at call centres to gain a better understanding of the interaction between the customer, agent and computer at call centres. The first study was conducted to get a general understanding of the interaction, while the second study focused on feedback between the customer and agent regarding the computer system. It was observed that many traditional HCI issues also apply to call centre CACI. However, there are additional considerations to be made with some issues, such as navigation, speed of system and feedback, which is consistent with Bowers and Martin's (2000) findings. The second study focused on feedback about the computer by the agent to the customer. It was observed that there were many situations where feedback was verbally communicated between the agent and customer; in particular the agent provided a lot of verbal feedback to the customer.

To ensure a more generalizable result four different call centres were visited, in different industries, power providers and telecommunication. Agents of different gender, age and experience were observed. Due to practical constraints, it was not possible to audio or video record the observations and interviews.

The findings from these studies suggest that the call centre agent is more than a 'surrogate' user, which is in contrast to Lawrence *et al* (1994) and Lawrence *et al's* (1995) findings but consistent with Muller *et al's* (1995) findings. Three of the four call centre has staff specialised in certain aspects of the work. At utility 2, who services three different electricity providers, the staff were divided between those providers In addition, it was observed that the experienced agents were able to reply to questions without consulting the computer, and sometimes reply to a question where the information was not available on the computer.

One implication with the findings is that it is important to take into consideration that there is partnership between the customer and agent in the call centre interaction. It was observed that navigation, speed and feedback were very important. The agents spend a lot of time navigating between screens to pre-empt which screen would be needed to satisfy the customer's request. This has potential implications for call centre software design. The findings suggest that its important to take into account how the agent might navigate to satisfy most common tasks, as well as making sure the navigation is fast, when designing call centre software. Further, the findings also suggest taking into account the layout and graphical display of the information to reduce the navigation required and increase the responsiveness of the interface.

There were also extra considerations needed with feedback, since both the agent and the customer need awareness about the computer. The customer might not need to have specific feedback from the computer, but still needs to be aware of the agent-computer work. The issue of feedback seemed to be more important as the customer could not see what the agent was doing, or even if they were doing anything at all. It was also observed that the agents type with considerable force on the keys, and when asked about this, they stated that they did it so that the customer could hear them working. The amount of verbal feedback provided to the customer about the state of the computer suggests that he or she does need awareness of the computer. The call centre managers stated that the agents were encouraged to keep the customers informed about the work he or she was doing. This was to make sure that customer perceived that they received good and efficient service from the call centre.

As well as paying attention to the feedback provided, attention was also paid to the task the agent were performing and what activity on the computer they were engaged in (see Table 7 and Table 8).

Table 7. The main situations where feedback impacted on the interaction were when the agent was:	**Table 8. The main activities the agents were engaged in were:**
• waiting for the computer • busy entering information • engaged in some cognitive task, such as working out why a bill was high, including searching through substantial amount of information • not sure how to solve a task, and had to focus all their attention on the task at hand • busy working on a time consuming task	• navigating between screens • typing • searching through a large amount of information on the screen • waiting for the computer

From the observations directions for potential work were identified; 1) There are additional complications with navigation and it would be useful to study navigation further. 2) Comparing different interfaces, for example graphical or text based, investigating task completion time and subjective satisfaction.

Another possibility for future work would be to investigate the issue of feedback between the computer and customer. It was identified that the agents provided frequent verbal feedback to the customer. One possible enhancement could be allowing the computer to communicate some of the feedback that the agents provide. Much of the verbal feedback communicated could be done via non-speech computer feedback, for example, giving the customer awareness that the agent was typing, or waiting for the computer. To investigate this further, a controlled laboratory study was planned. The next chapter reports on a study into the use of non-speech auditory feedback in call centre CACI.

4 THE EFFECT OF AUDITORY FEEDBACK ON CALL CENTRE CACI – EXPERIMENT 1

The previous chapter reported on observations into CACI conducted at a number of call centres. It was observed that the agents provided verbal feedback about the computer system to the customer. This chapter describes an experiment conducted into the indirect interaction between a computer and the customer through a service-providing organisation (see Figure 27). The customer is the person that wants some action performed on the organisation's computer system, however, he or she is not directly interacting with the computer. Additionally, when the interaction is carried out over a telephone, the customer is not able to see the computer. This chapter reports on an experiment conducted into the use of non-verbal auditory feedback to improve the interaction between the organisations computer and the customer.

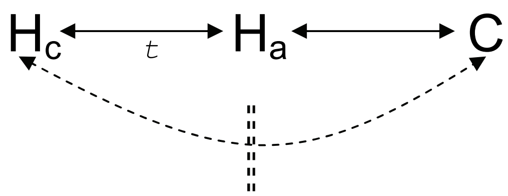


Figure 27. The indirect channel of communication between a customer (H_c) and computer (C)

During the observational studies described in Chapter 3, it was identified that awareness is more complicated in call centre CACI than in traditional CHI. The feedback about the state of the computer has to be communicated to both customer and agent. As the client was not directly interacting with the computer, the service representative often informed the customer about the computer system, for example, by telling him or her that transactions had been completed or that they were waiting for the computer to finish the current task. It was also observed that many of the agents pressed down hard on the computer keys when typing. When asked, they stated that they did this to let the customer know they were still engaged in working on their task.

Despite the growing importance of call centres, little has been published that is directly relevant to the human-human-computer interaction that takes place. Lawrence *et al* (1994) and Lawrence *et al* (1995) studied the interaction between caller and operator in telephone directory assistance. The inclusion of a computer in caller-operator communication is different than standard human-to-human communication, because the agent has to translate and coordinate between the customer and computer and has to bridge the gap between the 'technical computer language' and the 'social language' of human-human communication. For example, the agent asking the customer "business or residence" provides the customer with information about the agent's technical context.

In face-to-face interactions there are many interactional cues other than speech, such as, body language, non-speech words and eye glances, which help the collaborators assess who is busy and who is available to work (Gellersen and Beigl, 1999; Gutwin and Greenberg, 1998). However, in remote collaboration awareness is not as readily available (Gross, 1997; Randall and Hughes, 1995). Bowers and Martin (2000) conducted preliminary research at a UK bank call centre, and identified a number of important issues in call centre CACI, for example with 'display of engagement', which refers to showing the activity taking place between the agent and computer to the customer. However, they did not offer any further detail on how to provide a display of engagement. Greatbatch *et al* (1993) observed the interaction between doctor, computer and patient. The patient would wait with initiation conversation until the physician had finished their interaction with the computer. Greatbatch *et al* refer to this as doctor's 'display of disengagement' with the computer, and propose that 'display of engagement' should be taken into account when designing software for CACI.

It is often complicated to translate a graphical interface into an auditory dialogue (Edwards, 1988). Despite these complications, there are ways for the visually-impaired user to interact with visual interfaces, usually with the aid of screen readers or Braille (Mynatt and Weber, 1994). Pitt and Edward (1996) argue that auditory interfaces rely almost solely on speech output, but, it has been shown that non-speech auditory feedback can be used effectively to complement interfaces for visually-impaired user (Gaver, 1986) and telephone based interfaces (Brewster, 1998). *Auditory icons* and *earcons* can provide both visually-impaired and sighted users with a natural and intuitive auditory representation of objects on a computer interface (Mynatt, 1994, and Brewster, 1998).

Customers in call centre CACI cannot see the computer screen and could therefore be considered visually-impaired with regard to the computer system. In call centre interaction, the customer does not need to know all the information about the computer interface but, as the observational studies indicated, there are still many times when the agent conveys information about the interface to the customer. Based on previous research into software for the visually-impaired (for instance Edwards, 1988) and auditory feedback in computer interfaces (for example Brewster *et al*, 1993; or Gaver, 1989), and the observational studies at call centres, it was decided to conduct an experiment into adding non-verbal auditory feedback to the interaction at a simulated call centre. Previous research suggests that GOMS can be used to predicting task completion time in a call centre setting (John, 1990). However, to obtain a more complete picture and collect more detailed data, it was decided to conduct an experiment. The aim of the experiment was to investigate if adding auditory feedback to the interaction would have an effect on CACI. The hypotheses for the experiment were that the addition of auditory feedback in a call centre interaction would lead to:

- Shorter task completion time
- Improved flow of calls
- Improved customer satisfaction

The next section describes which activities auditory feedback was added to and the form of that feedback. Section 4.2 describes the method of the experiment, while the results are described in 4.3 and these are then discussed in Section 4.4.

4.1 Auditory feedback design

During the second observational study (see Section 3.3) three aspects were identified relating to feedback:

- The agent communicating feedback to the customer
- The customer asking for feedback about the computer
- There were an adverse effect in the interaction due to lack of feedback about the computer to the customer

For the remainder of this chapter 'communicating feedback' refers to all three scenarios.

During the observations, situations and events where the agent or customer communicated auditory feedback were identified, the activities that the agent was most commonly engaged in were when:

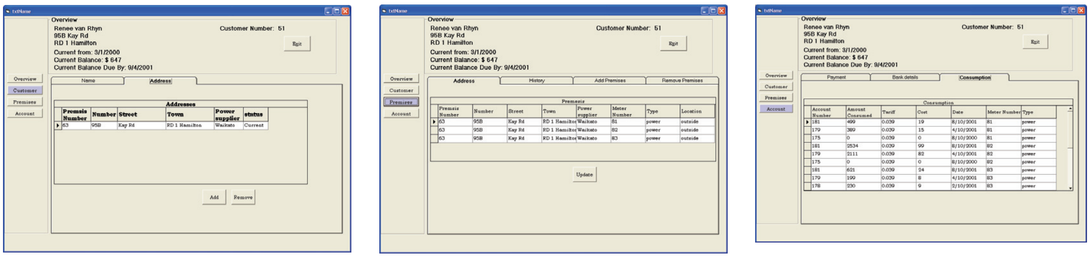
- While the agent
  - was typing
  - was searching through information
  - was waiting for the computer
  - was not sure how to complete the task
- There was a discrepancy in the perceived order of task between customer and agent
- The task the agent was engaged in would take time to complete

To cover as many of these activities as possible, it was decided to add auditory feedback to the following computer events:

- Typing
- Navigating – when the agent moved between different 'pages' or tabs on the computer software
- When the computer was busy – when the agent was waiting for information to be brought up on the computer screen

It was also decided to add auditory feedback to the complexity of information on the screen, not including navigational objects, such as command buttons. Some screens only have a graph or a small amount of information on the screen, while some screens have many pages of information that the agent had to search through to find the correct piece of information. The amount of information on the screen was divided into three levels (see Figure 28):

- Low – up to 10 items, for example cells in data grids and text-boxes, the agent had to search through
- Medium – between 10-20 items the agent had to search through
- High – more than 20 items the agent had to search through



(a) low level (b) medium level (c) high level (including scrolling)

Figure 28. Examples illustrating the three different levels of information on the screen

The type of feedback added to the events was based on previous research into auditory feedback. There are two types of auditory feedback, auditory icons (for example Gaver, 1989) and *earcons* (for example Brewster *et al*, 1993), that have been found to be effective in improving interactions for visually-impaired and sighted users. Auditory icons are designed to symbolise an actual activity or object, for example, a *typing* auditory icon to symbolize the agent typing on the keyboard, the same way that graphical icons resemble a real thing, such as a picture of a trash can. *Earcons*, on the other hand, are abstract syntactical tunes, and are not intended to imitate a real sound. They change their characteristics, such as pitch and timbre, to show the user some change in state on the computer system.

For this experiment both auditory icons and *earcon*s were chosen as auditory feedback. For typing (event 1), navigation (event 2) and busy computer (event 3) activities auditory icons were used as there are actual sounds to symbolise these activities. An *earcon* was used to show the complexity of information on the screen, because there was no obvious auditory icon. The auditory icons were created through sampling and the *earcons* were synthesised. Gaver (1993) suggests that sampling makes a more realistic sound, however, it can still be difficult to produce sounds that accurately represent the activity.

Typing:

For the *typing* activity, the auditory icon chosen was one resembling the sound of someone typing on a computer keyboard (see Figure 29). The length of this icon was 0.03 seconds and each time the agent pressed a key on the keyboard the auditory icon was played. However, if the user was typing quickly the icon was just played continuously while he or she continued to type, but stopped as soon as the agent stopped typing. There was no lag in the playing of the icon and it was used to represent typing activity rather than specific keystrokes.

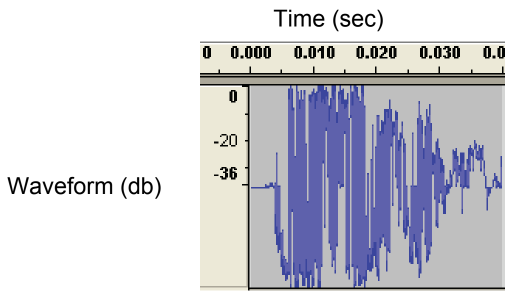


Figure 29. Visual representation of the typing auditory icon

Navigation:

To symbolize the agent navigating through the different pages on the computer system, a sound representing the shuffling of paper was used as an auditory icon. The intent was to symbolize someone flicking through pages in a magazine (see Figure 30). This icon, a single sound with a fixed length of 0.33 seconds, was added to all situations where the agent *navigated*, such as moving between screens or between fields in a screen, or opening a new page.

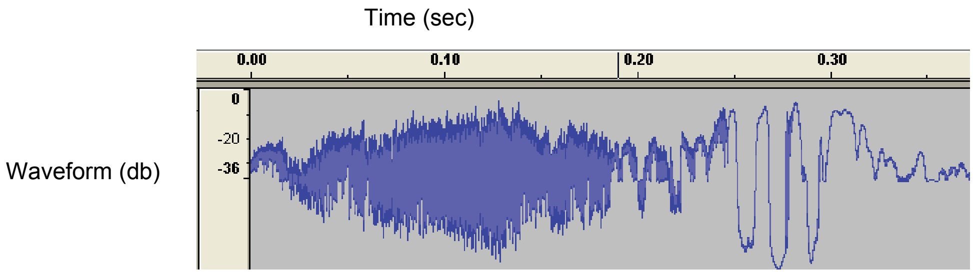


Figure 30. Visual representation of the navigation icon

Busy computer:

An auditory icon was also used to signal computer busy periods. However, it was harder to find an intuitive icon that the customers would recognise without training. Several different auditory icons were sampled, for example, clock ticking (three different versions), timer (one oven-type timer and one exercise timer) and egg timer (three different versions). Informal tests were made with nine people to choose the most appropriate sound. The test included asking the participants to state what they thought would be a suitable auditory icon to show a busy computer. Following that, different auditory icons were played to the participants. The decision was to use one of the egg timer ticking sounds, which was the most preferred by the participants (see Figure 31). The length of the example shown in Figure 31 is 3.36 seconds, however, the icon would play the entire time the computer was busy.

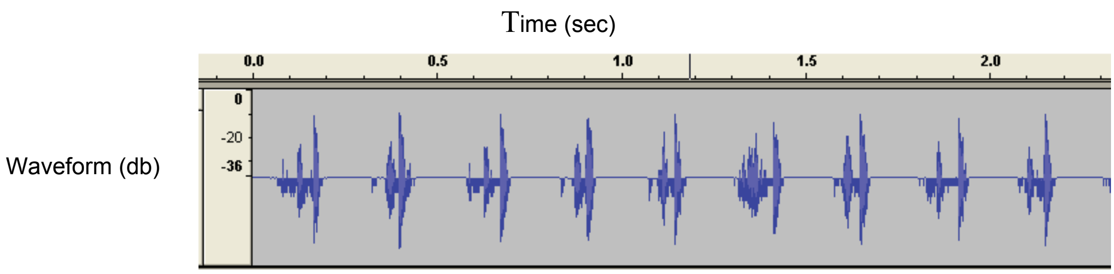


Figure 31. Visual representation of the "busy computer" auditory icon

Amount of information on screen:

Earcons were used to represent the more abstract concept of the level of information on the screen, since there is no obvious real sound that can be associated with this parameter. In addition, the auditory feedback also needed to be easily modifiable to show the different amount of information. The *earcon* used was a short tune played when the agent arrived at a new page. The tune changed in pitch and speed depending on the level of information on the screen. There were three versions of the *earcon*;

- Low level of information on the screen – a slow low pitch tune (see Figure 32).
- Medium level of information – slightly faster tune with broader pitch range (see Figure 33).
- High level of information on the screen – faster tune with a wide pitch range (see Figure 34).

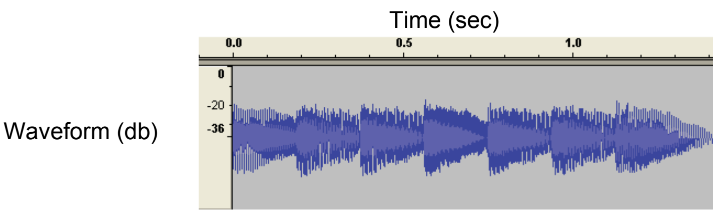


Figure 32. Visual representation of the "low level of information"-*earcon*

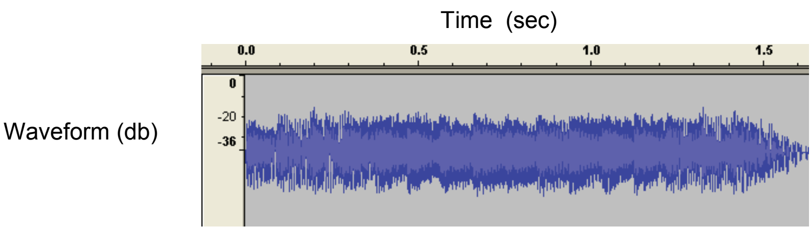


Figure 33. Visual representation of the "medium level of information"-*earcon*

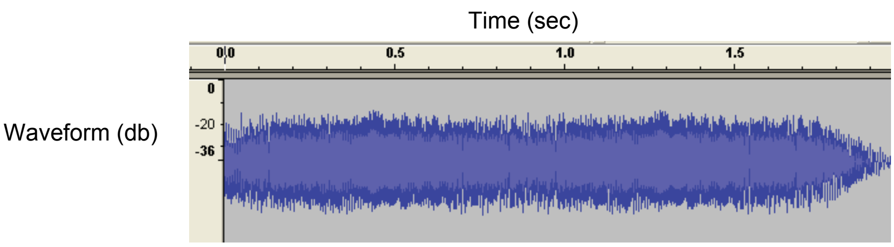


Figure 34. Visual representation of the "high level of information"-*earcon*

4.2 Method

This section describes the method used for the experiment, including the number, selection and assignment of participants, the data collected and the procedure. The experiment was a controlled between-subject laboratory experiment, carried out in a simulated power company call centre setting. There were two conditions for this experiment, auditory feedback and non-auditory feedback.

4.2.1 Participants

There were 21 sessions in total. Ten participants performed the task in the auditory feedback condition and 11 participants performed the task in the non-auditory feedback condition. The participants were randomly assigned to a condition.

The participants were recruited through posters and advertisements in local magazines. Everyone who expressed an interest in participating was selected, that is, there were no particular recruitment criteria. There were nine male and 12 female participants and the age of the participants varied from 18-74 years. All of these participants were given the role of customer in the experiment.

The Agent

To work as agents in a power company call centre, a certain amount of training is required. Although the agent for this experiment did not need to be able to do all the potential work in a call centre, she still needed some training on the software and interaction with the customer. To control the experiment as much as possible, one agent was recruited and employed to act as agent for all sessions. The agent was given initial training, including becoming familiar with all parts of the software, and taking calls in a call centre setting. The training sessions lasted for five hours in total.

4.2.2 Task

Careful considerations were made in the selection of tasks and activities. Care had to be taken to ensure that the activities were practical and realistic, but also that the agent could provide a reasonable solution to the customer despite her lack of call centre training. The participants also had to be able to understand and complete the activities.

Call centres keep statistics regarding calls, for example length of calls, how long customers have to wait before calls are answered and the type of customer request. To make the experiment as realistic as possible, statistics regarding the frequency of customer requests from two call centres (utility 1 and 2) were used as a basis for the choice of activities. Using the considerations mentioned in the previous paragraph and the frequency statistics from call centres the chosen activities were:

- Call the power company call centre, notify them of a change of address and to have the power account finalized at the old place and connected to a new residence
- Enquire why a bill was higher than expected and how to pay after the due date

Appendix A contains a full version of the task and activities.

The specific details for each individual participant had to be altered to reduce any learning-effects on the part of the agent. To make the task more realistic and more natural to the participants, they were asked to provide their own details, so that their actual names and addresses were used on the simulated power bill and in the database. 20 participants provided their actual details, but none of the identifying details were used for the analysis or in any written material. One person did not provide their own details and so for this participant fake details were used.

The order that the activities were given to the participants was balanced. 11 participants were given the change of address activity first, while the other 11 participants were given the bill enquiry activity first. However, both tasks were provided on one piece of paper, see Appendix A. The participants could complete both activities during one phone call, or make multiple phone calls.

4.2.3 Experimental design

This experiment was a between-subjects experiment, where the participants performed one task either with or without added non-verbal auditory feedback condition. To simplify the exposition, for the remainder of this chapter the "with added non-verbal auditory feedback" - condition will be referred to as the *enhanced* condition, while the "without added non-verbal auditory feedback"- condition will be referred to as the *basic* condition.

As the experimental sessions with the customers progressed, the agent, despite her very limited experience, became more familiar with the software and in dealing with customer enquiries. To ensure that the agent's practice and learning did not affect the result the order of the conditions and the order of the tasks was alternated. The auditory feedback was added to every second session and 50% of the participants were given task A first, while 50% were given Task B first.

Table 9. Sample of the order of the conditions and tasks for four participants

	First task	Condition
Participant 1	A	*Enhanced*
Participant 2	A	*Basic*
Participant 3	B	*Enhanced*
Participant 4	B	*Basic*

4.2.4 Data collection

Three sets of data were collected for this experiment, task completion time and event categories were collected from the video, audio and computer screen recordings, and qualitative data was collected via a post-task questionnaire.

Task completion time was collected by timing when the participant established a phone connection with the agent until the participant ended the call.

Event categorisation

The second type of quantitative data collected was a measure of the flow of conversation. This was collected via categorizing events into different types of verbal feedback communicated between the agent and customer, and also the impact of a lack of feedback. During the naturalistic call centre studies it was observed that auditory feedback impacted on the interaction in three main ways (see Section 3.3). The events were grouped based on these identified categories:

- When the agent provided the customer with direct awareness of the computer system, for example,
    - I am just updating the information
    - I am waiting for the computer
    - I am trying to find that information
- When the customer asked for direct feedback regarding the computer system, for example:
    - Have you entered the new details?
    - Can you find the address?
    - Can you find why the bill is high?
- When the customer provided information at inappropriate times and the agent was not able to use the information. The agent had to stop the activity she was engaged in to deal with new information, for example,
    - As the agent was searching for the old address, the customer provided the new address
    - As the agent was typing in the new details, the customer provided the moving date
    - As the agent was trying to establish why the bill was high, the customer asked about alternative payments

The video-audio recordings of the sessions were analysed manually. The events categorisation involved collecting how many times an event in each category occurred during the entirety of the phone conversation. This included recording all the occurrences of the events and at what time during the call they took place.

The event categorisation also included the activity the agent was performing as the events occurred, and it was noted if there was auditory feedback added to the agent's activity as the events occurred. For example, if the agent gave the customer direct feedback by telling them that she was typing, it was noted that she was typing and whether the typing activity was enhanced by added auditory feedback.

Questionnaire

Post-task questionnaires allowed the participants to rate their experience and also comment on their rating. The questions were a Likert-style seven-point scale, with general questions as well as those specific to the auditory feedback. All participants were given identical questionnaires, regardless of experimental condition. The non-auditory feedback participants were also given questions regarding auditory feedback. The full questionnaire is shown in Appendix A.

The general questions were grouped into two agree-disagree and two never-often questions (for example see Figure 35). There were also three agree-disagree rating questions specific to auditory feedback.

Questionnaire

Please describe your general impression of the conversation:

Please state if you agree with the following statements:

1. I found the conversation satisfying. Please tick the appropriate box

Strongly disagree — Neither agree nor disagree — Strongly agree

2. Please explain your answer

3. I found that the conversation flowed well. Please tick the appropriate box

Strongly disagree — Neither agree nor disagree — Strongly agree

4. Please explain your answer

5. How often did you interrupt the call centre staff member? Please tick the appropriate box

Never — Neither often nor seldom — Very often

Figure 35. Part of the post-task questionnaire for auditory feedback study 1

For one of the agree-disagree questions, specific to auditory feedback, “The sound was helpful”, there was also an additional question: “What were the sounds helpful for?”. The participants were given a number of options to choose from (see Figure 36).

Please state if you agree with the following statements:

The sounds were helpful

Strongly agree — Neither agree nor disagree — Strongly disagree

If the sounds were helpful, were they helpful for: (Tick as many as you want)

Telling me when the call centre staff member was busy []
Informing me when the best time to provide information was []
Giving me feedback about what was going on at the call centre []
Other [] Please
Explain:______________________________________

Figure 36. Example of question where the participants were asked to choose from a list of options regarding auditory feedback

4.2.5 Materials

The agent used simulated power company call centre software (see Figure 37, Figure 38 and Figure 39). The software was developed specifically for this experiment, using Microsoft Visual Basic 6.0. It was based on actual power company software, but only contained part of the functionality. The reason for limiting functionality was because all aspects of a standard call centre software were not needed for this experiment. However, the software did have enough functionality to support the most common tasks performed in a power company call centre. For an example of the interface for the *moving premises* task see Figure 38 and for an example of the *power consumption* task see Figure 39.

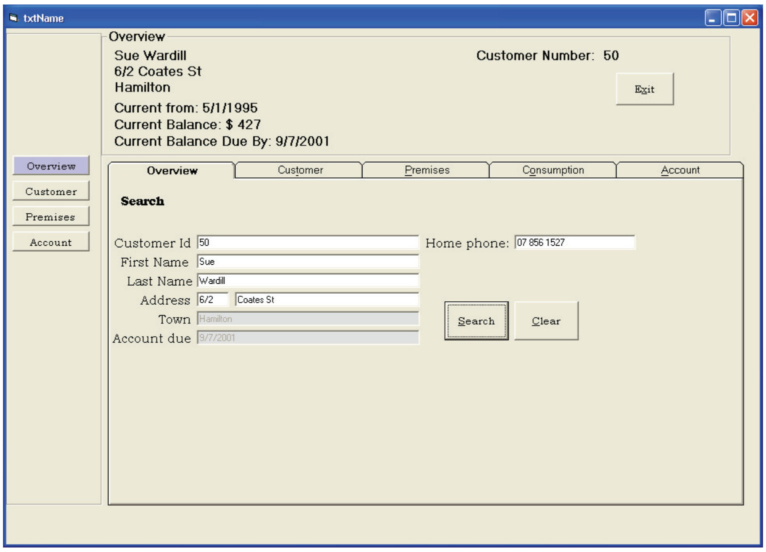


Figure 37. Example of the overview page of the simulated power company call centre software

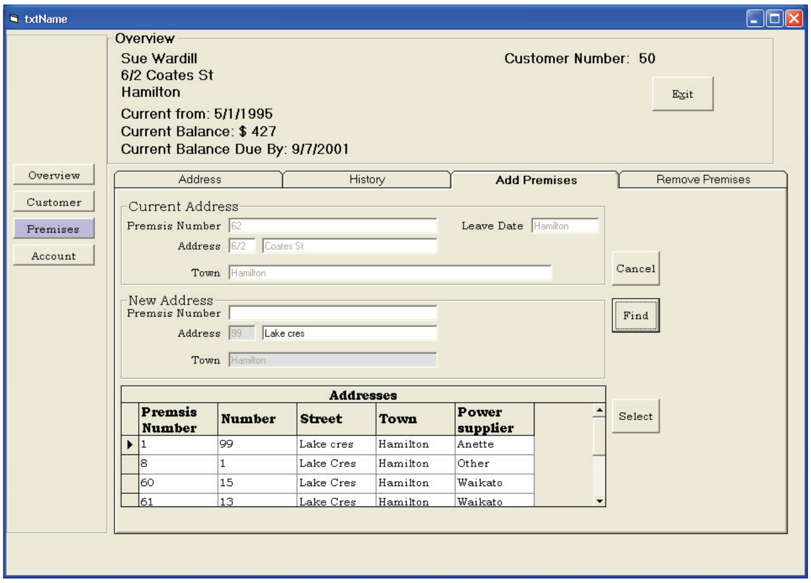


Figure 38. Example showing the "add premises to a customer account"-component

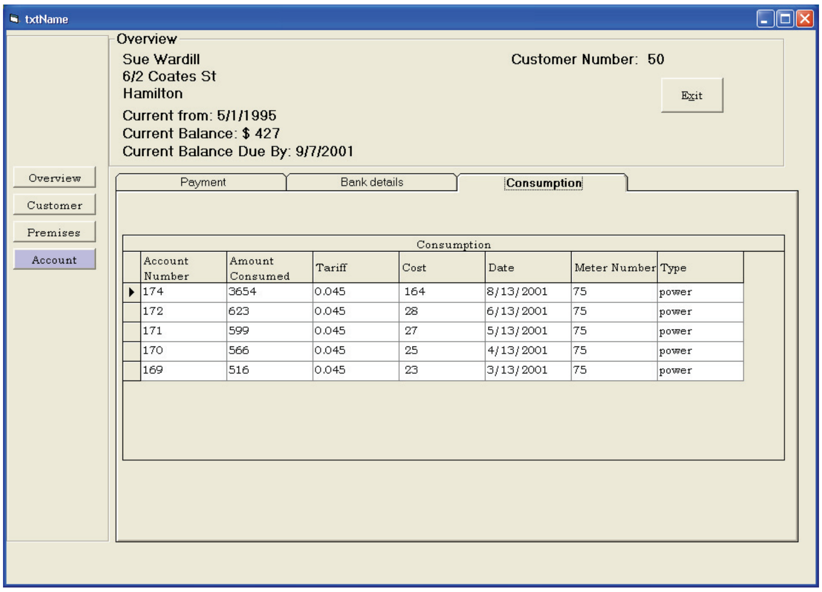


Figure 39. Example showing the power consumption per meter, including cost

The agent used a hands-free telephone and the customer used a standard handheld telephone. The auditory feedback was played through a microphone which was physically connected to the headset. Both the agent and customer were able to hear the auditory feedback.

Each session was recorded with 4-way video output. Video recordings were made of the agent face, the computer screen, and the customer's face and upper body (see Figure 40). Audio recordings of the conversation between the agent and customer were also made.

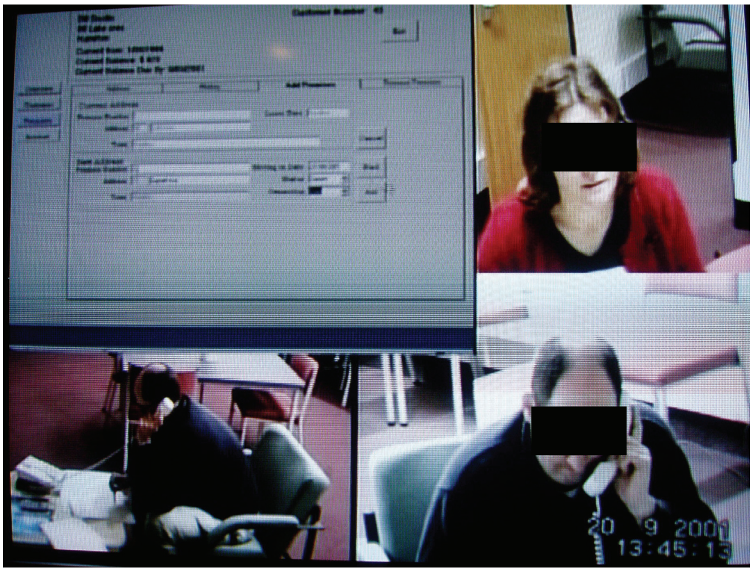


Figure 40. Example of the video recording of the experimental sessions.

4.2.6 Procedure

On arrival, the participants were given instructions regarding the experiment. These instructions included information about the procedure and the participants' rights, as part of the ethical consent procedure. The participants were told that the experiment was aimed at investigating interaction in a call centre. However, there was no information stating that the experiment was aimed at investigating auditory feedback. The experimenter was present as the participants were given the information. After the initial information and ethical consent procedure, the participants were given further written information, including basic instructions on completing the task, a simulated power bill, the tasks and post-task questionnaire. Both the tasks were given on the same piece of paper. To ensure that all the participants got exactly the same information, no further individual oral instructions were given. After the participant had been given the written information the experimenter left the room and did not return until the participant had finished filling out the questionnaire.

There were no instructions for the agent, other than the information she received during the training sessions.

4.3 Results

There were three sets of data collected: task completion time, event logging and subjective satisfaction from the questionnaires. This section describes the results from each of those sets of data.

4.3.1 Task completion time

Descriptive statistics were calculated for the task completion time (see Table 10). Mean and maximum were higher for the *basic* than the *enhanced* condition and there was a higher variance in the *basic* condition. The standard deviation was almost twice as high for the *basic* condition (188 seconds) than for the *enhanced* condition (92 seconds) (see Figure 41).

Table 10. Descriptive statistics of task completion times (in seconds)

	Basic N = 11	***Enhanced*** N = 10
Mean	402	378
Standard deviation	183	92
Median	380	382
Minimum	128	196
Maximum	801	564

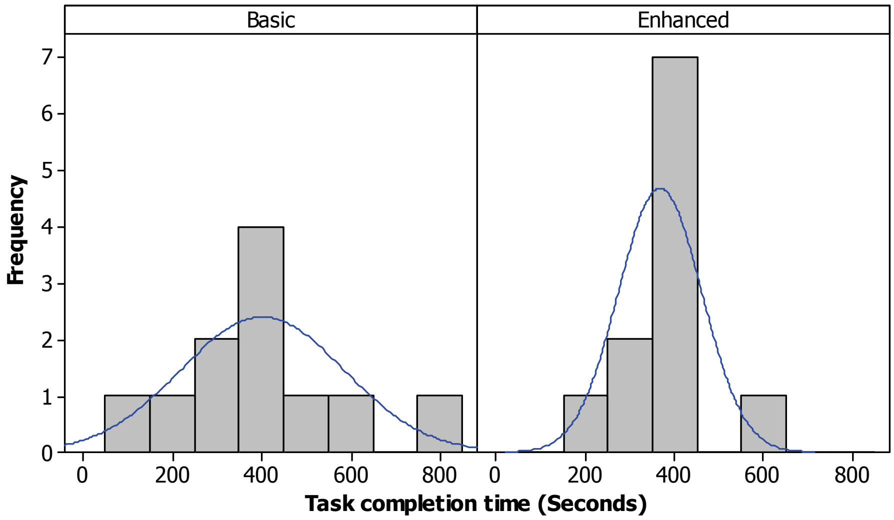


Figure 41. Histogram, with normal distribution curve, of completion time by condition

The significance of the difference between means was tested using a two sample t-test with unequal variance. This test was used as the data was approximately normally distributed and there was an unequal variance between the samples (Bluman, 2001). The difference between the two conditions was not statistically significant (two sample t-test unequal variance, DF = 15, p=0.70).

The task completion time for each individual participant in both conditions is shown in Figure 42. Five of the six longest completion times were from participants in the *basic* condition. There was a much smaller variance for the *enhanced* condition, where most of the participants had a completion time between 300 and 400 seconds.

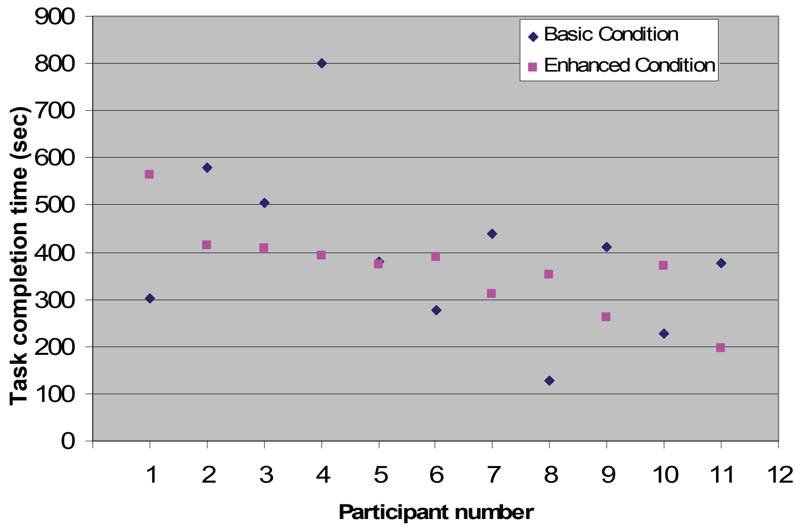


Figure 42. Task completion time for each individual participant in both experimental conditions

Standard deviation and Figure 42 suggested that there were potential outliers in the dataset. It was decided to identify outliers as participants outside two standard deviations. They were removed and the remaining data re-analysed. There were two participants outside two standard deviations, participant one in the *enhanced* condition (801 seconds), and participant four in the *basic* condition (564 seconds). Removing the outlier only had a small impact on the result (see Table 11). There was still no significant difference between the conditions (two sample t-test unequal variance, DF = 12, p=0.78). Additional graphs relating to the outliers can be found in Appendix B.

Table 11. Descriptive statistics of task completion times (in seconds) without outliers (outside 2 standard deviations)

	Basic **N = 10**	***Enhanced*** **N = 9**
Mean	372	357
Standard deviation	138	68
Median	380	375
Minimum	128	196
Maximum	578	415

4.3.2 Events categorisation

The second data set collected was events organized into three categories:

- When the agent provided the customer with direct awareness of what she was doing
- When the customer asked for awareness of what the agent was doing
- When the customer provided information at inappropriate times and the agent was not able to utilize the information

To clarify and simplify discussion of the events, for the remainder of this chapter shorthand labels are used for the three event-types. The first event, "when the agent provide feedback to the customer" will be referred to as *offer,* "the customer asking for awareness" will be referred to as *request* and "the customer providing information at inappropriate time" will be *inappropriate timing.*

The mean, median, maximum and minimum number of occurrences of each event was calculated (see Table 12). On average, there were more occurrences in each category for the *basic* condition. In particular, there were on average two occurrences of event *inappropriate timing* in the *basic* condition while only 0.7 in the *enhanced* condition. For all the event categories, the standard deviation was higher for the *basic* condition.

Table 12. Descriptive statistics of the occurrences of events in the three categories

	Basic N = 11			*Enhanced* N= 10		
	Offer	*Request*	*Inappropriate timing*	*Offer*	*Request*	*Inappropriate timing*
Mean	7.18	1.09	2.00	6.70	0.80	0.70
Standard Deviation	2.48	1.51	1.18	2.36	0.92	0.95
Median	7.00	0.00	2.00	6.50	0.50	0.50
Max	13.00	4.00	4.00	12.00	2.00	3.00
Min	5.00	0.00	0.00	4.00	0.00	0.00

To further investigate individual differences the total number of events for each participant was plotted (see Figure 43 and Figure 44). For the *basic* condition 10 of 11 participants had at least one occurrence of *inappropriate timing* event. However, in the *enhanced* condition, only six of 10 participants had any instances of *inappropriate timing* event.

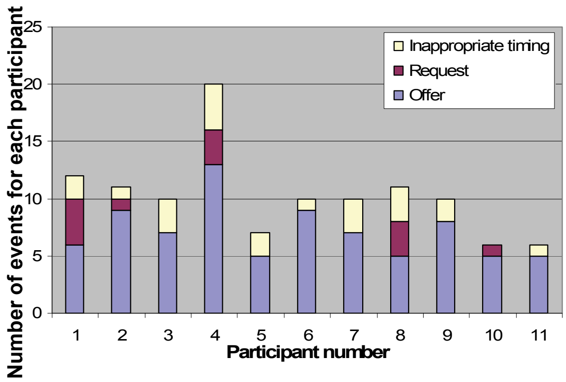


Figure 43. Total number of events for each individual participant in the *basic* condition

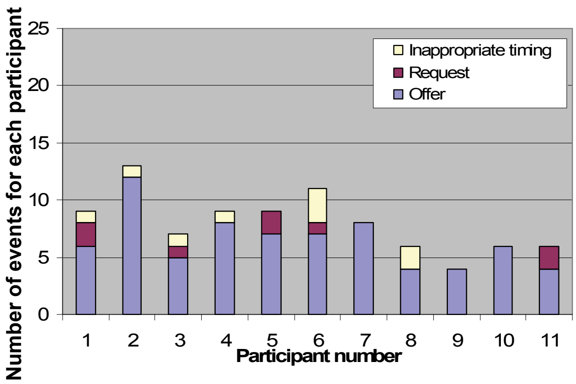


Figure 44. Total number of events for each individual participant, in the *enhanced* condition

As the data was independent and categorical, statistical significance was calculated by comparing observed data with data that would be expected to obtain, using a Chi-Squared test (Bluman, 2001). The difference between the conditions was not statistically significant (Likelihood Ratio Chi-square, DF = 2, p = 0.082) at a cut off point of α=0.05. However, it is common practise in statistics to use a cut off point of α = 0.1 for Chi-Squared tests (for example Bluman, 2001), in this case the difference between the conditions would be statistically significant.

The Chi-Squared test also gives an indication of which category contributed to the p-value and how large the contribution was. The row "Chi Squared contribution" in Table 13 indicated which group contributed the most to the p-value. Both the *basic* and the *enhanced* condition demonstrated large values for the *inappropriate timing* category, 1.60 and 2.21 respectively. The "% Row"-row shows that the *basic* condition contributed twice as much to the p-value than did the *enhanced* condition (see Table 13).

Table 13. Chi-Squared values for all event categories

	***Basic* N = 11**			***Enhanced* N = 10**		
	Offer	*Request*	*Inappropriate timing*	*Offer*	*Request*	*Inappropriate timing*
Chi Square Contribution	0.03	0.01	1.60	0.05	0.02	2.21
% Row	69.91	10.62	19.47	81.71	9.76	8.54

Inappropriate information provision by the customer

Because of the difference between the conditions for the *inappropriate timing* event, further analyses were made into the activity the agent was engaged in when the participants provided information at inappropriate times and if the activity had added auditory feedback.

There were three main types of activities the agent was engaged in when the customer provided information at inappropriate times, typing, navigation and searching through information. For both conditions, the most frequent activity that the agent was engaged in was typing (see Table 14).

Table 14. The activity that the agent was engaged in as the customer provided information at inappropriate time

	Basic **N = 11**			***Enhanced*** **N = 10**		
	Typing	Navigating	Searching through information	Typing	Navigating	Searching through information
Total	13	4	3	6	3	1
Mean	1.18	0.36	0.27	0.55	0.27	0.09
Standard Deviation	0.87	0.50	0.47	0.93	0.47	0.30

4.3.3 Questionnaire

The questionnaire was separated into two sections: general and auditory feedback-specific questions.

General rating questions

Mean and standard deviation were calculated for general rating questions (see Table 15). Overall, there was a very similar rating between the conditions with the mean rating slightly more favourable for the *basic* condition (4.27) than the *enhanced* condition (4.12).

Table 15. Descriptive summaries for the subjective rating

	***Basic* N = 11**		***Enhanced* N = 10**	
	Mean	Standard Deviation	Mean	Standard Deviation
The conversation was satisfactory	5.73	1.10	5.58	1.31
Flow of the conversation was good	5.91	0.83	5.33	1.30
How often did you interrupt the agent	3.18	1.40	2.75	1.42
How often did you have to wait because the staff member was busy	3.64	1.69	3.67	1.56

The data was ordinal, normal distribution could not be assumed and was collected from two independent samples, and therefore statistical significance was calculated using a Mann-Whitney U test (Bhattacharyya, and Johnson, 1977). There was no statistically significant difference between the two conditions for any of the questions (see Table 16).

Table 16. P-values for each question using Mann-Whitney U test to compare *enhance* and *basic* conditions

	p-value
The conversation was satisfactory?	0.863
Flow of conversation?	0.151
How often did you interrupt the agent?	0.401
How often did you have to wait because the staff member was busy?	0.748
The sounds were helpful?	0.175
The sounds increased satisfaction?	0.71
The sounds were annoying?	0.295

Questions specific to auditory feedback

Eleven participants did not receive any additional auditory feedback, nevertheless nine of those participants answered the questions relating to auditory feedback. Mean and standard deviation were calculated for the questions relating to sounds (Table 17). There was a small difference between the conditions, with the rating being slightly more favorable for the *basic* condition.

Table 17. Mean and standard deviation for questions relating to auditory feedback

	***Basic* N = 11**		***Enhanced* N = 10**	
	Mean	Standard Deviation	Mean	Standard Deviation
The sounds were helpful	4.33	1.00	3.67	1.97
The sounds increased satisfaction	3.78	1.64	3.50	1.98
The sounds were annoying	3.33	1.66	4.33	2.10

The participants also made comments on their rating. For the rating on annoyance of auditory feedback, there were more negative comments from the *enhanced* condition. Three participants commented that 'the tune' (the *earcon*s) was annoying or distracting. Additional details about the comments can be found in Appendix B.

The participants were asked if the auditory feedback was helpful and if so for what. They were given four categories to choose from:

- Information about when the agent was busy
- Information about when to provide information
- Giving feedback about what was happening
- Other

Overall, there were more selections of auditory feedback being helpful in the *basic* condition (see Table 18). The most frequent selection was that the auditory feedback was helpful for telling when the agent was busy. However, the mean number of times the participants selected an option as being helpful was one for all questions and both conditions.

Table 18. Descriptive summaries of how the participants reported auditory feedback was helpful

	***Basic* N = 11**			***Enhanced* N = 10**		
	Information about when agent was busy	Information about when to provide information	Giving feedback about what was happening	Information about when agent was busy	Information about when to provide information	Giving feedback about what was happening
Total	7	5	3	6	2	4
Mean	1	1	1	1	1	1
Standard Deviation	0	0	0	0	0	0

The participants were also asked about the sounds, if any, they heard during the interaction. Participants in the *basic* condition mostly stated that they could hear keyboard typing or buzzing from the phone line. In contrast, the participants in the *enhanced* condition reported hearing larger variety of auditory feedback (see Table 19).

Table 19. Total and average number of different types of auditory feedback the participants reported hearing

	Basic N = 11		*Enhanced* N = 10	
	Total	Mean	Total	Mean
Added auditory feedback				
Tune	0	0.00	10	0.83
Paper flicking	0	0.00	1	0.08
Ticking	0	0.00	4	0.33
Keyboard typing	7	0.78	10	0.83
Naturally occurring feedback				
Buzzing	5	0.56	7	0.58
Beeping	0	0.00	1	0.08
Traffic	0	0.00	2	0.17
Other	3	0.33	4	0.33

4.4 Discussion

There were three hypotheses for this experiment:

The hypothesis that adding auditory feedback would lead to:

- a shorter task completion time was supported but was not statistically significant
    - The task completion time was shorter for the *enhanced* condition, but the difference was not statistically significant.
    - Five of the six longest completion times were from participants in the *basic* condition.
    - There was a much smaller variance for the *enhanced* condition.
- an improved flow of the conversation was supported
    - The *basic* condition had more occurrences of each event category.
    - For the *inappropriate timing* event there were significantly more occurrences in the *basic* condition. This finding is consistent with Bowers and Martin (2000) in regards to the importance of *display of*

    engagement and suggests that non-verbal auditory feedback can provide the customer with information about the agent's engagement with technology.
  - The result that the agent provided information about the computer to the customer is consistent with Lawrence *et al* (1994) finding that the operator is communicating the technical context to the customer.
- improved customer satisfaction was not supported
  - For all questions in the questionnaire there was only a very small difference between the conditions.
  - The *enhanced* condition had slightly lower overall subjective satisfaction. This finding was not consistent with Brewster's (1998) finding that participants prefer the auditory feedback condition.

The task completion time was longer for the *basic* condition and it was found that the participants in the *basic* condition provided information at inappropriate times more frequently. It is possible that the reduction in the number of times the participant provided information at inappropriate times had an effect on the task completion time. This is potentially valuable, as many call centres strive to shorten the time of each call.

In the observational studies it was noted that the agents provided a large amount of verbal feedback to the customer. This observation was supported in this experiment, as the agent provided verbal feedback to the customer despite the added auditory feedback to the e*nhanced* condition. However, there was only a small difference in her behaviour between the conditions. She provided direct awareness information to the customer slightly more times in the *basic* condition. This difference was not statistically significant, and, because there was only one agent for all the participants, this result could be due to the agent's personality, not a result of the added auditory feedback. Further, the conditions were altered to reduce learning effects, leaving open the possibility that the agent was unable to adjust to the added auditory feedback condition. If all sessions had added auditory feedback it is possible that she would have adjusted her behaviour as the customers were given information through the non-verbal feedback.

There was a difference in the customers' behaviour, primarily how often they provided information at inappropriate times. It is possible that the auditory feedback gave the customer awareness of the agent's activity and hence knew when to provide further information. Additional findings showed that the most common activity the agent was engaged in when the customer provided information at inappropriate time was typing, which is an activity that had added auditory feedback. The participants in the *basic* condition provided information twice as often as the participants in the *enhanced* condition while the agent was typing. Additionally, the participants in the *enhanced* condition had a lower rating than did the participants in the *basic* condition for the question "how often did you interrupt the agent". Participants in both conditions commented that the auditory feedback was helpful, in particular it was helpful for telling when to provide further information. This is also consistent with the finding relating to flow, as this suggests that the participants found auditory feedback helpful in offering a cue to when it was an appropriate time to provide additional information.

The results from this experiment did not support the hypothesis that the auditory feedback would improve the customer's satisfaction of the call. The participants in the *basic* condition rated the conversation as slightly more satisfactory, however this difference was not significant. There were more people in the *enhanced* condition that commented on the sounds being distracting and annoying and there were slightly more comments from participants in the *enhanced* condition that the sounds were distracting. This was not compatible with Brewster's (1997) results. He found that the participants did not find the auditory feedback annoying or distracting. This incompatibility in results could be due to several reasons, for example that auditory feedback is not good for call centre interaction. The choice of sounds might not have represented the computer activities as well as they could have. It is possible also that it was the particular auditory feedback in this experiment that was distracting, and that other less intrusive sounds would have led to a different result.

From this study several areas of potential future work were identified. For example, would adding auditory feedback have a greater effect on the customer satisfaction, task completion time and flow of communication if the agent was instructed not to providing information, such as, "I am updating that information now"? Additional investigations include if the lack of difference in subjective satisfaction was due to individual preference and would there be a difference in a within-subject study asking participants to compare with and without added auditory feedback.

It is possible that the tasks in this study were not complicated enough to improve from adding auditory feedback and because this was a simulated situation, the participants might not have a vested interest in the extent to which the task had been completed. Future research includes creating a higher vested interest for the customer by, for example, paying participants based on the outcome.

Other potential studies include investigating the participants' perception of the auditory feedback, including what they represent and what they sounded like, to ensure that it accurately represented the correct activity on the computer. In this experiment care was taken in designing the auditory feedback, however, it is possible that improvements could be made to the choice of the specific auditory icons and *earcon*s. In particular three participants commented that the *earcon*s were annoying or distracting.

In summary, there were indications that the first two hypotheses were supported. The non-auditory feedback condition had shorter task completion time (not statistically significant) and there was a difference between the conditions in progress and flow, where the non-auditory feedback condition had more occurrences of each event. For the event *inappropriate timing* there were significantly fewer occurrences for the auditory feedback condition. The agent provided a lot of verbal feedback, despite the added non-verbal auditory feedback. However, there was only a very small difference in subjective satisfaction. However, even though the participants in the *enhanced* condition reported that the auditory feedback did not increase satisfaction and that it somewhat increased annoyance, they did provide less information at inappropriate times. The fact that the agent was already providing lots of awareness information to the customer could have had an effect on how much the customer was asking for direct awareness.

The next chapter describes an experiment carried out to address some of the potential work identified in this chapter. To investigate if there would be a larger difference between the conditions if the agent was instructed not to provide verbal auditory feedback, another experiment was conducted. This study was a within-subject design to enable individual comparison between the conditions. To improve the quality of the auditory feedback, a sound-effects designer was employed to create the auditory feedback.

5 THE EFFECT OF AUDITORY FEEDBACK FOR CALL CENTRE CACI – EXPERIMENT 2

The previous chapter reported on an experiment exploring adding auditory feedback to call centre CACI. There were some promising indications, but they were inconclusive. There was a reduction in task completion time for the *enhanced* condition, however, this was not statistically significant. The indications were that the auditory feedback had some effect on the customers' behaviour, as the customer's in the *enhanced* condition provided information at inappropriate times less often. But, the added auditory feedback did not appear to have an effect on subjective satisfaction, and, in the *enhanced* condition there were more occurrences of participants stating that the auditory feedback was annoying or distracting. In contrast, there was no change in the agent's behaviour, as she provided verbal information about the computer in both the *basic* and *enhanced* conditions, even when there had been auditory feedback added. This chapter reports on a second experiment investigating the indirect interaction between a service providing computer and customer (see Figure 27). However, to attempt to clarify the findings from the previous experiment, the current experiment was a within-subject experiment with restrictions about what verbal feedback the agent provided to the customer about the computer.

As mentioned in Chapter 4, previous research into CACI has suggested that it is important to display the agent's engagement with the computer (Bowers and Martin (2000); Greatbatch *et al*, 1993). Further, auditory feedback has been shown to be useful in providing awareness and interaction cues in software for visually-impaired users (Mynatt, 1994, and Brewster, 1998) and it has also been found that auditory feedback can be used effectively over the telephone (Brewster, 1998). During the observations at call centres (see Chapter 3) it was found that reducing task completion times, and increasing customer satisfaction is a goal for many call centres. Providing verbal auditory feedback potentially increases task completion time as it distracts the agent from the task they are working on and also increases the complication of the dialogue between the service representative and customer.

The aim of this second experiment was to investigate if the addition of auditory feedback has an effect on call centre CACI, when the agent was instructed to refrain from provide verbal feedback about the computer to the customer, unless specifically asked. The experiment described in this chapter is a replica of the previous study. However, there were some modifications to the auditory feedback as well as the method, and these are discussed further below (Sections 5.1 and 5.2).

As with the previous chapter to simplify the exposition, the "with added non-verbal auditory feedback"-condition will be referred to as the *enhanced* condition. However, because the agent was not providing verbal feedback, the "without added non-verbal auditory feedback"-condition will be referred to as the *restricted* condition.

The hypotheses were the same as for the preceding experiment:

- The task completion time will be shorter for the *enhanced* conditions than for the *restricted* condition
- There will be an improved flow of calls for the *enhanced* condition than the *restricted* condition
- There will be a higher subjective satisfaction for the *enhanced* than the *restricted* condition

The next section describes the design of the auditory feedback, and is then followed by the experimental method. The results are reported and discussed in Sections 5.3 and 5.4.

5.1 Auditory feedback design

Auditory feedback was added to the same activities as in the initial experiment (Chapter 4), typing, navigating and when computer was busy, but also to show the level of information on the screen. During auditory feedback experiment 1 all but one participant answered the questions regarding auditory feedback, including the participants in the non-auditory feedback condition. There were more participants in the *enhanced* than the *basic* condition who stated that sounds were annoying and distracting, and, more participants in the *basic* condition stated that auditory feedback were helpful. This finding suggests that the choice of auditory feedback needed improving. To ensure that the chosen feedback was a more realistic representation of the computer activities a professional sound-effects designer was employed. The typing, navigation (Figure 45) and busy-computer (Figure 46) auditory icons used in this experiment were similar and followed the same criteria the ones used for auditory feedback study 1.

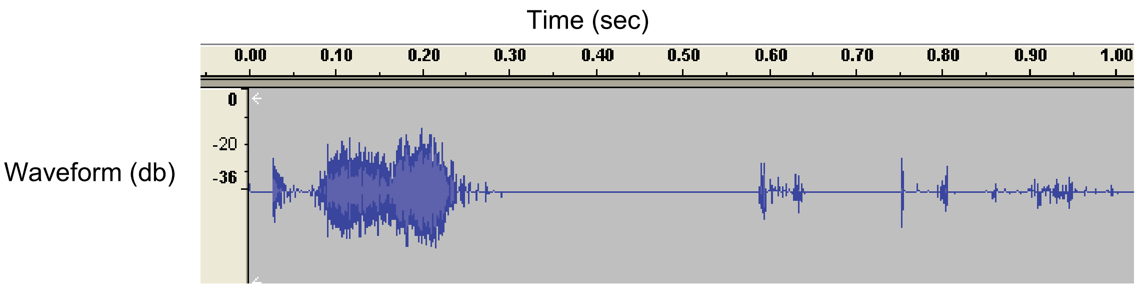


Figure 45. Visual representation of the navigation auditory icon used in auditory feedback study 2

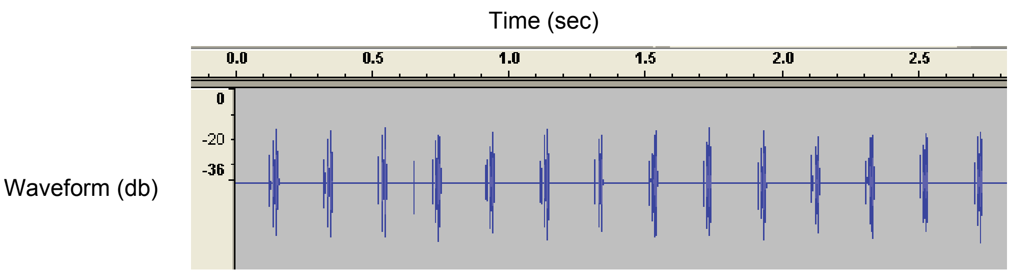


Figure 46. Visual representation of the *busy-computer* auditory icon used in auditory feedback study 2

Because participants in the previous study commented that the *earcons* were annoying or distracting, it was decided to change this auditory feedback. Instead of showing the amount of information on the screen with an *earcon*, it was decided to show complexity of information by adding an auditory icon to any scrolling activity the agent was doing (see Figure 47). The call centre software was adapted such that the scrolling icon was continually played as the agent was scrolling and stopped as soon as the agent stopped scrolling.

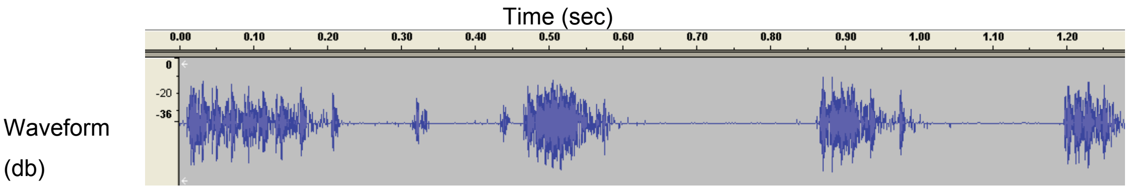


Figure 47. Visual representation of the scrolling auditory icon used in auditory feedback study 2

5.2 Method

This section explains the method used for this study, including participants, experimental design, procedure and data collection.

5.2.1 Participants

There were 20 participants in total, 14 female and six male. They were recruited via posters and email lists (via the University of Waikato Usability Laboratory). The participants' ages varied from 17-50 years, with a majority (75%) being less than 30 years old. All of the participants were university students. Everyone who expressed an interest participated in the experiment.

The agent

As with auditory feedback study 1, there was an agent required for this experiment. The agent was a software tester employed by the software provider. It was necessary that the agent had a reasonable knowledge of the system because it was commercially used utility providing call centre software.

Another difference to the prior study was that the agent was instructed not to provide any feedback to the customer about the state of the system. She was specifically instructed not to:

- Provide information about what the computer is doing, for example “I am waiting for the computer to open that page”, unless she was specifically asked. If specifically asked, she is only allowed to answer that specific question, but not provide any further information.
- Interfere when the customer was providing information at inappropriate times. For example, if the customer started providing details for the new premises while the agent was still working on the old premises, the agent was not allowed to provide any feedback. Once she had finished with the task, she had to ask for the new address details again.
- Stop working even if the customer was trying to interrupt the current task.

5.2.2 Task

Each participant was asked to perform two tasks, one in each condition. As for experiment 1, care was taken in selecting the tasks. The tasks had to be realistic, yet simple enough for a non-professional agent to solve. However, the second task was changed because of the complexity of enquiring about a bill on the software used for this experiment. The second task was:

Task B – flatmate task

> “Your name is Joe Bloggs and your address is 4 Another street. You need to call Waikato energy on 5116 and add your flatmates name to your power account. Your flatmates name is Rob Robson.”

Unlike the previous study, the participants were given the information pertaining to a single call.

5.2.3 Experimental design

In contrast with the previous study, this was a within-subject experiment; all the participants did one task in the auditory feedback condition and one task in the non-auditory feedback condition. 50% of the participants had the auditory feedback added to the first task they performed, while the other 50% had the auditory feedback added to the second task. The participants were randomly assigned to the condition order. As with the first experiment, the task order and condition order was altered (see Table 20).

Table 20. Sample order of the conditions and tasks for four participants

	Condition	First task	Condition	Second task	Condition
Participant 1	Auditory feedback first task	A	*Enhanced*	B	*Restricted*
Participant 2	Auditory feedback second task	A	*Restricted*	B	*Enhanced*
Participant 3	Auditory feedback first task	B	*Enhanced*	A	*Restriction*
Participant 4	Auditory feedback second task	B	*Restricted*	A	*Enhanced*

5.2.4 Data collection

The data collected was the same as for auditory feedback study 1, task completion time, event categorisation (*offer, request, inappropriate timing*) and questionnaire (although this had been modified).

To allow for comparison between auditory feedback experiment 1 and auditory feedback experiment 2, occurrences of the *offer* event were collected. However, as the agent had been informed not to provide any verbal feedback, it was not expected that there would be any occurrences of this event.

Questionnaire

In contrast with the earlier investigation, the participants were asked to fill out a questionnaire after each task regarding their experience with the interaction. The questionnaire had been slightly modified from the one used in auditory feedback study 1. The questionnaires were identical irrespective of whether it was an auditory feedback or non-auditory feedback task. The questionnaire included questions about the participant's general satisfaction with the call, as well as questions specific to auditory feedback. For all the questions the participants were asked to rate on a seven-point Likert scale. The questions were split into:

- *General rating* – five questions asking the participants to rate their agreement with a certain statement, with 1 being the least favorable rating (see Figure 48)
- *Length rating* – two questions asking the participants to rate their agreement with a certain statement regarding the length of the call, with 1 being the shorter, 4 being as expected and 7 being longer (see Figure 49)
- *Yes-no questions* – three questions asking the participants to answer "yes" or "no" to a question followed by a rating on how strong their answer was (see Figure 50)

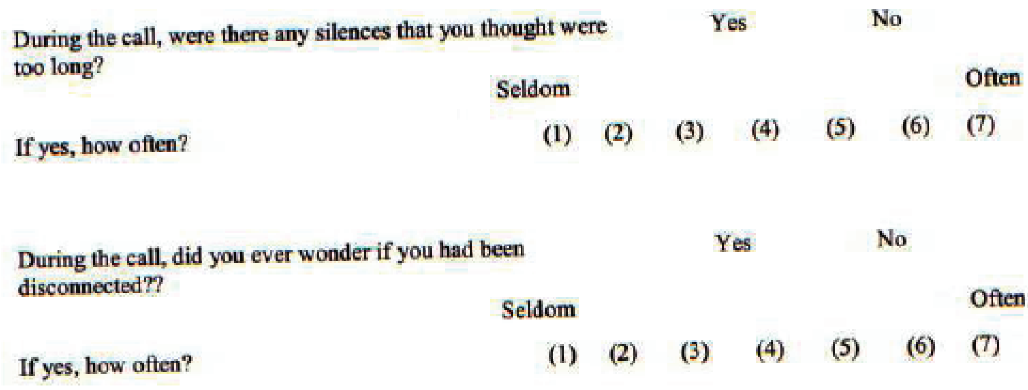
(Please circle your choice)

Rate how well you were able to complete the task Comment	Didn't complete the task at all (1)	(2)	(3)	(4)	(5)	(6)	Fully completed the task (7)
Rate how satisfying the conversation was Comment	Not at all satisfying (1)	(2)	(3)	(4)	(5)	(6)	Very satisfying (7)
Rate how well the conversation flowed Comment	Didn't flow well at all (1)	(2)	(3)	(4)	(5)	(6)	Flowed very well (7)

Figure 48. Example of rating question with 1 being the least favorable rating

Was the length of the call Comment	Too short (1)	(2)	(3)	Just right (4)	(5)	(6)	Too long (7)

Figure 49. Example of a length rating question



During the call, were there any silences that you thought were too long? Yes No

	Seldom						Often
If yes, how often?	(1)	(2)	(3)	(4)	(5)	(6)	(7)

During the call, did you ever wonder if you had been disconnected?? Yes No

	Seldom						Often
If yes, how often?	(1)	(2)	(3)	(4)	(5)	(6)	(7)

Figure 50. Example of yes-no question including the rating of the yes answer

There were also questions specific to auditory feedback. These questions also asked the participants to rate their answer on a 7-point Likert scale. The complete questionnaire can be found in Appendix C.

5.2.5 Materials

Location

The experiment was held in the Usability Laboratory at the University of Waikato; using the single user room and the group user room (see Figure 51). The agent was located in the single user room and the participant in the group user room. The participants were greeted in the group user room and did not see the agent or the single user room.

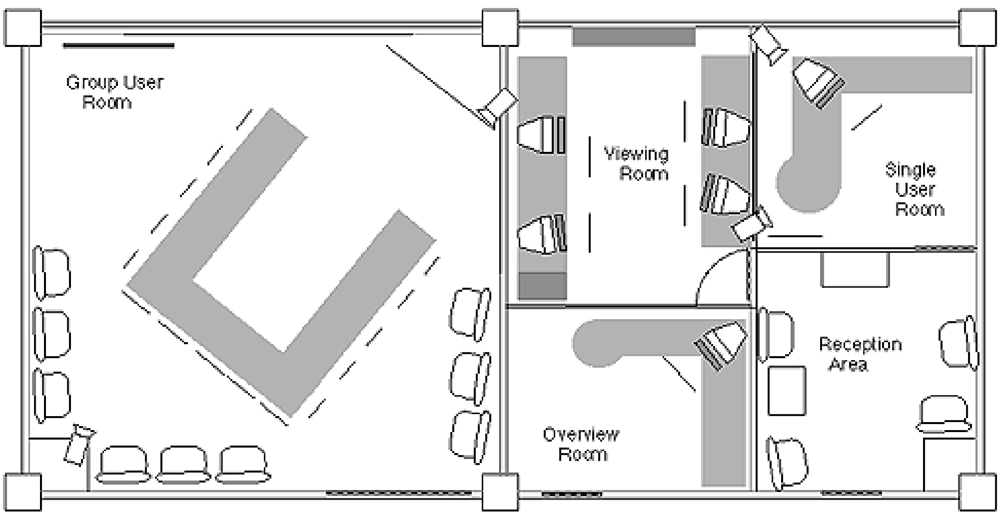


Figure 51. Layout of the usability laboratory where the auditory feedback experiment 2 was conducted

The agent used a PC and a hands-free telephone and the customer used a standard handheld telephone. There was also a microphone connected to the computer and attached to the agent's telephone to communicate the auditory feedback. Both the agent and customer could hear the auditory feedback.

Software

In contrast with auditory feedback study 1, the agent used power company call centre software (see Figure 52 and Figure 53). The reasons for using real software were to make the study more realistic and obtain a higher external validity. The software is used in a number of actual power company call centres mostly in the United States and Australia.

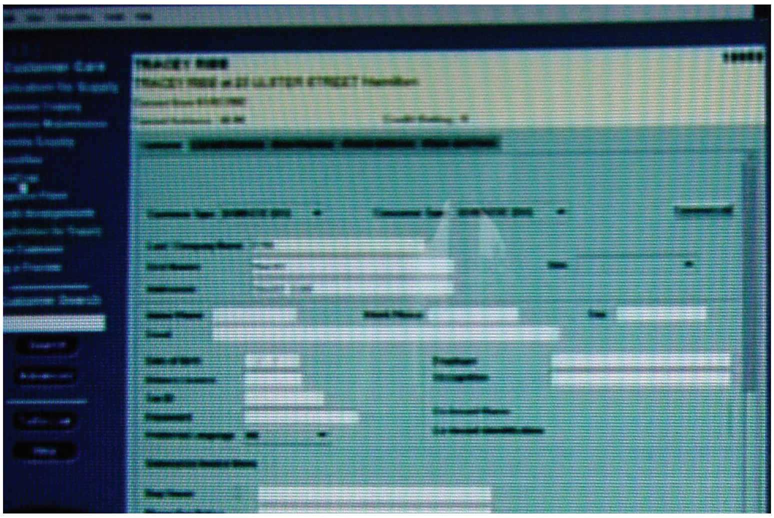


Figure 52. Example screen of customer details of power company call centre software used (blurred to protect customer data)

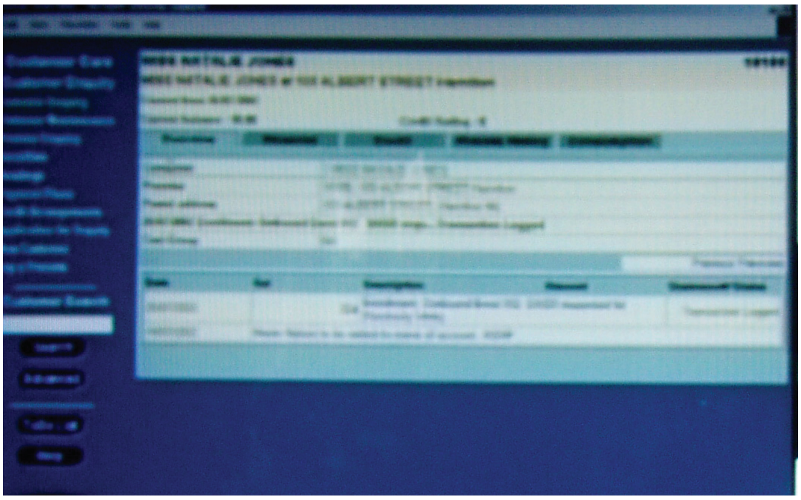


Figure 53. Example screen consumption history of power company call centre software used (blurred to protect customer data)

Each session was recorded with 4-way video output; visual recordings of the customer, the agent and the computer screen (see Figure 54), and auditory recordings of the conversation.

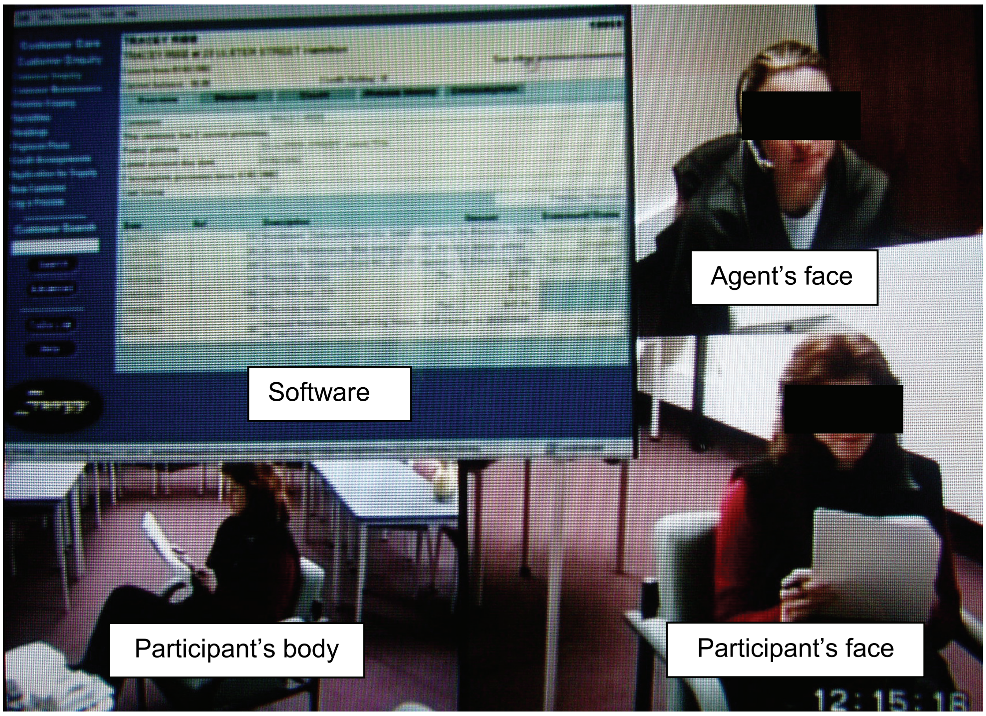


Figure 54. Example of visual recording of the software, the participants face and body, and the agents face

5.2.6 Procedure

The procedure for the sessions was the same as for the previous experiment, except in the performance of the tasks:

- The participant performed the first task
- A post-task questionnaire was filled out
- The participant performed the second task
- A second post task questionnaire fill out

There were no instructions given to the agent, other than initial training, and the restrictions relating to her providing verbal auditory feedback.

5.3 Results

This section describes the results from the experiment. There were three sets of data collected for this experiment, task completion time, event categorisation and subjective satisfaction.

5.3.1 Task completion time

Descriptive statistics were calculated for task completion time (see Table 21). There was only a small difference in task completion time between the conditions. The mean and median completion times were slightly longer for the enhanced condition (Table 21) and there was only a small difference in standard deviation between the conditions (see Figure 55).

Table 21. Descriptive statistics, in seconds, comparing enhanced with restricted conditions

	Enhanced	*Restricted*
Mean	132.28	121.06
Standard deviation	61.72	56.13
Median	117.00	110.00
Maximum	332.00	307.00
Minimum	75.00	60.00

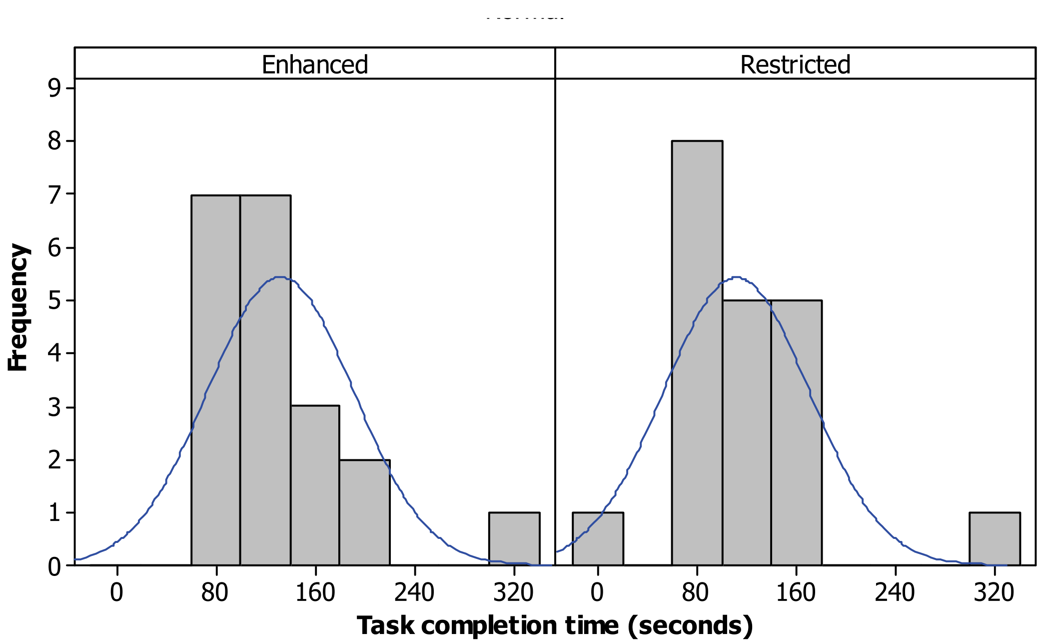


Figure 55. Histogram, including distribution, of task completion time

The completion time for all participants for both tasks was plotted (see Figure 56). Overall there did not appear to be any difference, either between the conditions or due to task order. Most participants took between 50 and 200 seconds to complete the task, irrespective of condition or task. Since the second task sometimes had longer and sometimes shorter completion time, there did not appear to be any learning effect. For both conditions, the task completion time was longer for the move task (mean completion time in seconds; *enhanced*-flatmate 116, *enhanced*-move 147, *restricted*-flatmate 96, *restricted*-move 126). Additional details about the effect of the task can be found in Appendix D.

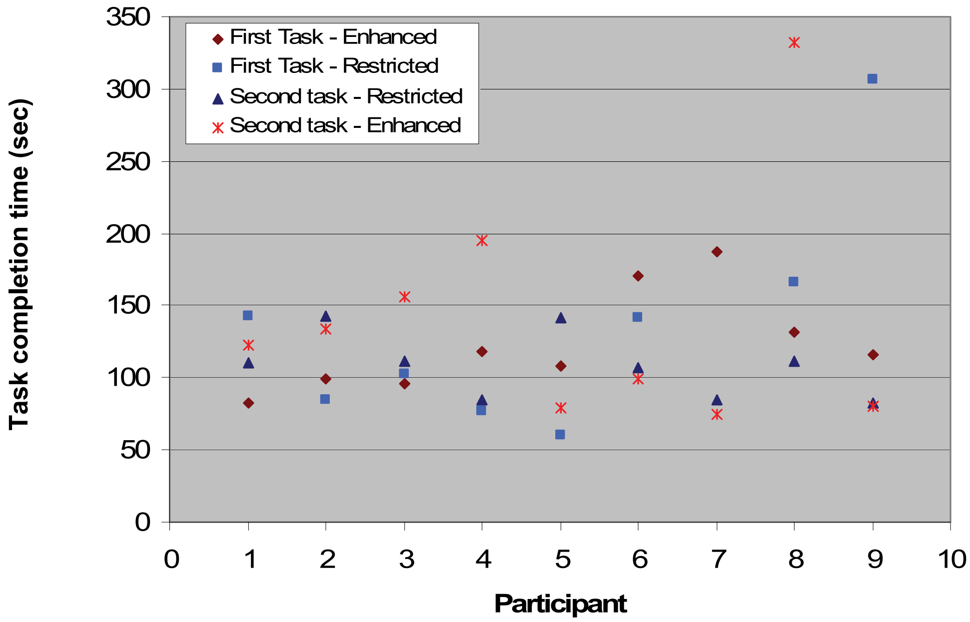


Figure 56. Total task completion time (seconds) for both task for all participants

Figure 56 suggests that there were two possible outliers in the data set, participant eight (second task – *enhanced*) and participant nine (first task – *restricted*). It was decided to identify outlier as task completion times outside 2 standard deviations (249 seconds for *enhanced* condition and 225 seconds for *restricted* condition). Removing outliers did not alter the difference between the conditions (Table 22). The *restricted* condition still has a shorter mean task completion time.

Table 22. Descriptive statistics comparing *enhanced* with *restricted* conditions, removing outliers

	Enhanced	*Restricted*
Mean	121.84	106.89
Standard deviation	36.04	29.32
Median	116.00	104.50
Max	195	166
Min	75	60

As the data was reasonably normally distributed (see Figure 55) and the data was continuous, a paired t-test was used to calculate statistical significance (Bluman, 2001). The difference was not statistically significant (paired t-test, DF = 19, p = 0.81).

5.3.2 Event categorisation

The second type of data collected was three event categories: *offer, request* and *inappropriate timing.*

Descriptive statistics were calculated for the number of events in each category (see Table 23). There was higher total and mean number of events in the restricted condition. However, for both conditions there were few occurrences of events, with only five for the *restricted* condition and three in the *enhanced* condition.

Table 23. Descriptive statistics of occurrences of events for both conditions

	***Enhanced* N = 18**			***Restricted* N = 18**		
	Offer	*Request*	*Inappropriate timing*	*Offer*	*Request*	*Inappropriate timing*
Sum	0	1	2	0	2	4
Mean	0.00	0.04	0.07	0.00	0.10	0.19
Standard deviation	0.00	0.22	0.30	0.00	0.44	0.40

Individual differences were also investigated and most participants did not have any event in any category (see Figure 57). Only five participants had any events at all. Further, three of those five participants had events in both the *enhanced* and *restricted* conditions. Participant 18 when performing the task *enhanced* condition, twice asked "*are you still there*?".

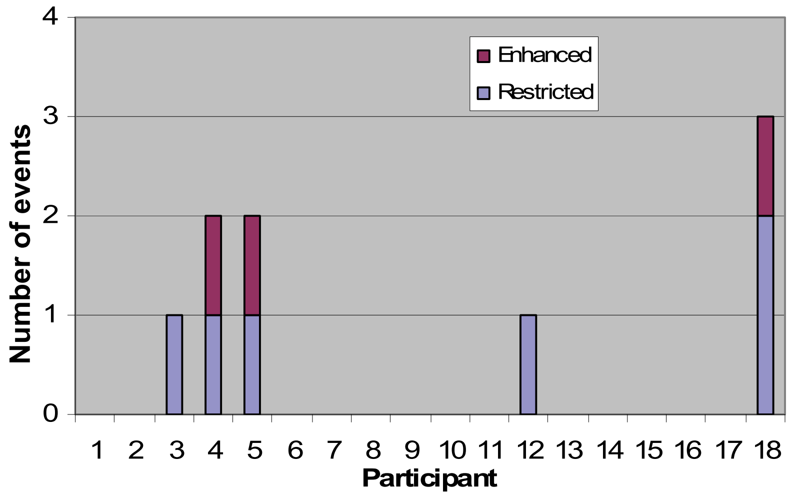


Figure 57. Occurrences of events for each participant comparing both conditions

5.3.3 Questionnaire

This section describes the results from the questionnaire. There were three types of questions:

- *General rating* - Rating a certain statement, with 1 being the least favorable and 7 the most favorable
- *Length rating* - Rate agreement with a certain statement regarding the length of the call, with 1 being the shorter than expected, 4 being as expected and 7 being longer than expected
- *Yes-no questions* - Yes-no answer followed by a rating

Descriptive statistics were calculated for the general rating questions. Overall there was only a small difference between the two conditions, with a mean rating of 5.6 for the *enhanced* condition and 5.5 for the *restricted* condition. The mean rating was similar for all questions (see Table 24). The effect of the tasks was also calculated, but there was little difference due to the task. The details can be found in Appendix D.

Table 24. Descriptive statistics of general rating questions

	How well did you complete the task?	How satisfied were you with the interaction	How well did the conversation flow?	How often did you interrupt the agent?	How aware were you of the agent's activity?
			***Enhanced* condition**		
Mean	6.94	5.11	4.72	6.78	4.44
Stdev	0.24	1.71	1.87	0.73	1.92
Median	7	5	5	7	4.5
Max	7	7	7	7	7
Min	6	1	1	4	1
			***Restricted* condition**		
Mean	6.94	5.06	4.89	6.67	4.06
Stdev	0.24	1.43	1.94	0.84	2.13
Median	7	5	5.5	7	3.5
Max	7	7	7	7	7
Min	6	2	1	4	1

For the questions relating to the length of the call, there was a similar rating for both conditions (Table 25) with the rating being close to middle, in other words: "just right".

Table 25. Descriptive statistics for the questions relating to lengths of call

	Was the length of call shorter than expected, as expected, longer than expected?	Was the length of call too short, just right, too long?
	Enhanced condition	*Enhanced condition*
Mean	3.61	4.39
Standard deviation	1.82	0.92
Median	3	4
Max	7	7
Min	1	3
	Restricted condition	*Restricted condition*
Mean	3.56	4.44
Standard deviation	1.42	0.70
Median	3.5	4
Max	7	6
Min	1	4

For the yes-no questions the ratings were similar for both conditions (see Figure 58). In both conditions, 12 participants thought that there were silences that were too long and most participants reported hearing non-speech sounds.

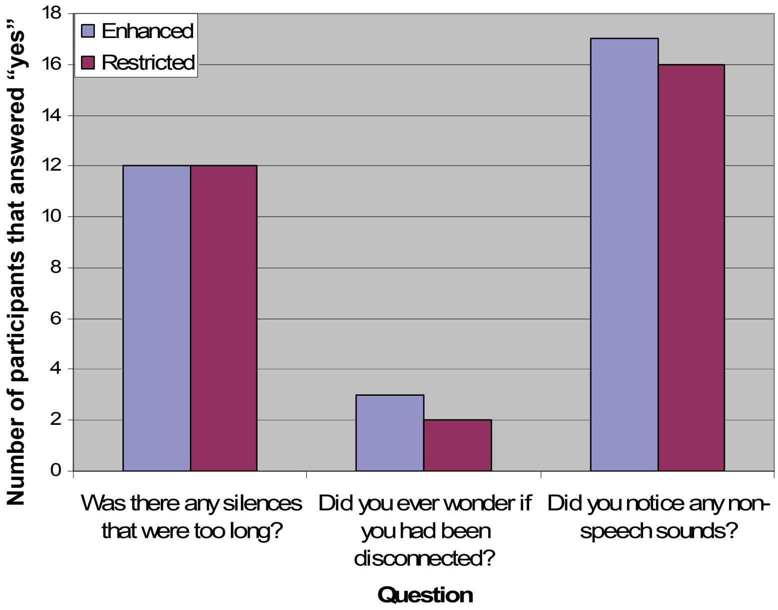


Figure 58. Total number of participants that answered yes to the questions

Questions relating to auditory feedback

Most participants (16 for *restricted* and 17 for *enhanced*) reported hearing non-speech sounds. Descriptive statistics were calculated for the general rating questions (see Table 26). The overall mean for the auditory feedback being useful was slightly more favourable for the *restricted* (3.95) than the *enhanced* condition (3.17). For most questions the rating was more favourable for the *restricted* condition, except for the question "given me feedback" (see Figure 59).

Table 26. Descriptive statistics for questions relating to auditory feedback

	Telling when agent was busy	Telling me when to provide information	Giving me feedback	Other
Mean	3.47	2.27	3.75	3.00
Standard deviation	1.68	1.16	1.73	2.83
Median	4	2	3	3
Max	7	5	7	5
Min	1	1	1	1
Mean	5.33	2.82	3.57	4.33
Standard deviation	1.87	1.25	2.03	3.06
Median	6	3	4	5
Max	7	4	7	7
Min	1	1	1	1

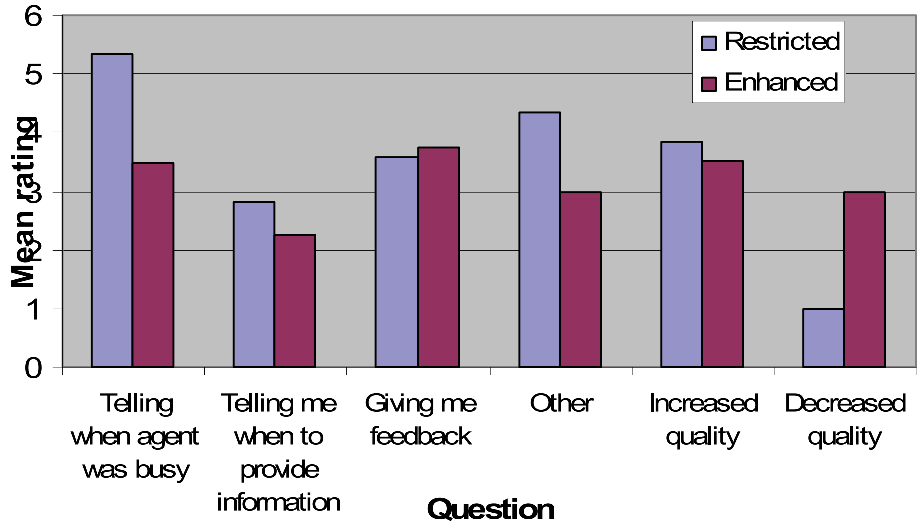


Figure 59. Mean rating for questions relating to auditory feedback

5.4 Discussion

There were three hypotheses for this experiment; the hypothesis that adding auditory feedback would:

- reduce task completion time was not supported
  - The mean task completion time was very similar for both conditions, for the *enhanced* condition it was 132 seconds and for the *restricted* condition was 117 seconds.
  - The mean task completion time was shorter for the *restricted* condition, but the difference was not statistically significant.
- improve flow of calls was not supported
  - most participants had no occurrences in either *request* or *inappropriate timing*, irrespective of the condition
  - There were a total of six events, two *request* and four *inappropriate timing,* in the *restricted* condition and three, one *request* and two *inappropriate timing,* in the *enhanced* condition.
- improve subjective satisfaction was not supported:
  - There was only a very small difference in the questionnaire ratings between the conditions, with a 5.6 mean for the *enhanced* and 5.5 for the *restricted* condition.
  - The participants in the *enhanced* condition had higher rating on the questions "did you wonder if you had been disconnected" than did the non-auditory feedback condition.
  - In both conditions, twelve participants thought that there were silences that were too long.

The findings relating to task completion time and event categorisation were not consistent with the findings from auditory feedback study 1 (see Chapter 4) and were also not consistent with previous research discussed in Chapter 2 suggesting that it is important to display the agent's engagement with the computer to the customer (Bowers and Martin, 2000). In this study most participants did not provide any events, irrespective of the condition, which is not consistent with auditory feedback study 1, where there was a significant difference in the number of *inappropriate timing* event between the conditions. However, the findings relating to subjective satisfaction were consistent with the previous study, where there was only a very small difference between the conditions. These findings suggest that restricting the amount of feedback the agent is allowed to provide might not be a good solution for reducing time and improving subjective satisfaction, and that the verbal feedback the agent provides is sufficient and does not require enhancement.

Overall there were very few occurrences of any event and the participants that provided any occurrences of the events did so in both conditions. This suggests that the result was due to individual differences and not due to the auditory feedback. It is also possible that since the agent did not provide any verbal feedback and therefore might not have been perceived as friendly, the participants might have felt discouraged from asking for awareness. One participant did ask "*are you still there*?" when performing the task *enhanced* condition, but, in the question "did you ever wonder if you had been disconnected*"* this participant stated 'no' for both conditions.

The questions relating to the customers' awareness of the agent's activity ("how aware were you of the agent's activity" and "did you even wonder if you had been disconnected") had unexpected findings. The expectation was that the auditory feedback would increase the customer's awareness of the agent's activity and would provide the participants with more information about the interaction between the agent and computer and hence lead to the customer being less inclined to think that they had been disconnected. However, in this experiment, the participants in the *restricted* condition had a more favourable mean rating on this question. Further, there were more occurrences of participants thinking that they had been disconnected in the *enhanced* condition, but the difference was small (three people in the *enhanced* condition and two in the *restricted*). There did not seem to be a correlation between lower ratings on awareness and number of events a participant had.

The issue of the quality of the auditory feedback from the auditory feedback experiment 1 was addressed by having a professional sound-effect designer create the sounds. Although the sounds chosen accurately represented the activity when played straight from the computer, they did not as accurately represent the activity when played through the telephone, as the low quality audio channel slightly altered the auditory feedback. In addition, there was a potential confounding variable because the participants could hear non-verbal auditory feedback even in the *restricted* condition. The participants were able to hear the agent typing and pressing mouse buttons.

Even though it was found in the call centre observations (Chapter 3) the agents provided auditory feedback, the findings from these two studies suggest that adding auditory feedback does not improve CACI at a utility company call centre. In addition, in auditory feedback study 1 the agent provided verbal feedback despite the added non-verbal feedback. There could be many reasons for this:

- Personal preference
- The agent needs to use the non-verbal feedback for a length of time to get used to it, and also have confidence that the added feedback provides the customer with sufficiently awareness
- The reason for the verbal feedback might have a different purpose than providing awareness, it might be communicated
    - To fill the gap of a silence rather than, or in addition to, providing awareness
    - For social purposes, such that the customer perceive that they receive good service

The lack of improvement because of the auditory feedback condition might also be because the reduction of cues in telephone interaction does not have a negative affect on the person to person interaction. The finding raises the question: Is there a difference in how people communicate via telephone or face-to-face, where more awareness cues are available?

In summary, the expectations prior to conducting this study were that adding auditory feedback would improve interaction time, flow and subjective satisfaction. The results from auditory feedback study 1 indicated that adding auditory feedback increased the flow of interaction, and, it was observed at call centres that agents provide verbal feedback to the customer. It has also been suggested in previous research that it is important to display the agent's activity to the customer. However, the findings from this study are not consistent with either of those findings; the *restricted* condition had a slightly shorter task completion time, the *enhanced* condition had slightly fewer events. In contract, the finding relating to subjective satisfaction was consistent with the result from auditory feedback study 1, where there was only a very small difference between the conditions.

To assess why the expectations for this experiment were not met, further studies into the communication between the two human in CACI, the customer and agent, would be beneficial. It has been argued that in a call centre setting, where the customer cannot see the computer, it is important to display engagement of the agent (Bowers and Martin, 2000), but this study did not support their finding. Therefore, future work includes investigating how a ‘cueless’ communication mode (Rutter *et al,* 1981), such as telephone, differs from face-to-face interaction. The next chapter describes a study investigating the human-human channel of CACI, comparing telephone and face-to-face communication. The study was conducted in a simulated travel agency setting, which is a more complicated setting than at a utility provider.

6 HUMAN-HUMAN COMMUNICATION FACE-TO-FACE OR OVER TELEPHONE

The previous two chapters described studies into enhancing CACI at a call centre by adding auditory feedback. It was expected that the added auditory feedback would improve task completion time, flow of interaction and subjective satisfaction. However, it did not have the expected effect, and therefore it was decided to further investigate the communication channel between the customer and agent. This chapter reports on a laboratory experiment conducted to investigate if communication mode, face-to-face versus telephone, has an effect on how people communicate in a customer service setting when there is a computer involved in the interaction. The research focused on the communication between the two human entities, agent and customer, in CACI (see Figure 60).

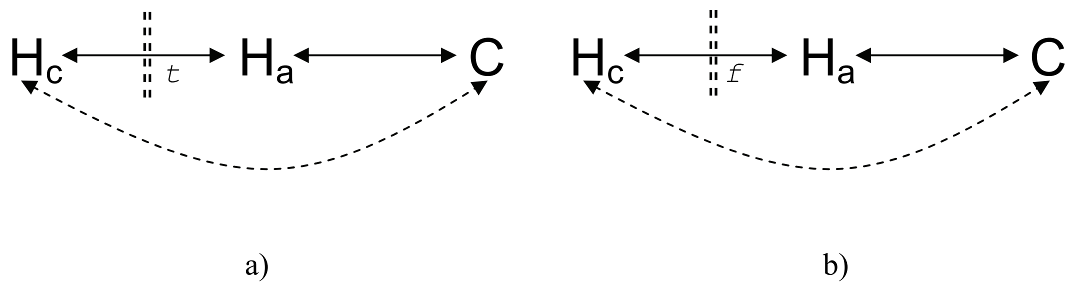


Figure 60. Comparing human (H_c)-human (H_a) interaction over two different communication modes a) telephone ($_t$) and b) face-to-face ($_f$)

The background for this experiment includes both the two studies described in Chapters 3 and 4 and previous research into human-human communication. For the two studies into adding auditory feedback to address the communication channel between the computer and customer part of CACI (shown in Figure 27), a simulated call centre setting was used and the participants communicated via telephone to solve common utility provider tasks. The intent was to provide the customer with direct information about the computer, as he or she could not see or interact with the computer. The purpose was also to support the agent by providing auditory information about the state of the computer directly to the customer therefore reducing how much verbal feedback he or she had to provide. From auditory feedback study 1 there were indications that the added auditory feedback enhanced the interaction, by improving task completion time and flow of interaction. However, in the second more constrained experiment there was only a very small non-significant difference in task completion time, flow of interaction and subjective satisfaction between the conditions.

Some research suggests that as long as people can communicate verbally, adding visual communication does not improve the interaction (Chapanis *et al*, 1972, Ochsman and Chapanis, 1974, and Gale, 1991) (see Section 2.5.1). Chapanis *et al* and Ochsman and Chapanis conducted a series of studies investigating communication modes, involving two people collaboratively solving a task, with one person being an 'ideal computer' and the other person the 'computer user'. An impoverished communication mode, such as telephone, might not necessarily lead to a less satisfactory outcome or process of communication.

Other research, in contrast, suggests that there is a difference in outcome, style and content between audio-only and face-to-face communication (Short *et al*, 1976, Suchman, 1987, and Rutter *et al*, 1981) (see Section 2.5.2). Audio-only interactions are more task-oriented, depersonalized, less spontaneous, and end in a different outcome, and additionally audio-only interaction has fewer interactional cues, such as body language or the activity of the other collaborator. Face-to-face communication style has more speech overlaps (people speaking at the same time) and a shorter pause, while audio-only has longer speech acts and fewer conversational turns, more pauses and less overlaps (Matarazzo and Sellen, 2000). Additionally, it has also been suggested that people preferred face-to-face interactions (Masoodian and Apperley, 1995; Masoodian *et al,* 1995; Fletcher and Major, 2006).

There is substantial amount of research into how people collaborate via computers (for example, Grudin, 1988 and Gutwin and Greenberg, 1988), and the focus has been on how to make the electronic collaboration easier, but not on how people actually communicate. It has been suggested that there is a need for further understanding on how groups work together and how individuals and groups work with technology (Grudin 1988).

Previous research into human-human communication appears to be inconclusive, and also, in those studies the participants did not have access to computers. On the other hand, in the collaborative computing studies, both humans have access to a computer, and there is normally some amount of shared information via the computer screen. Therefore, CACI differs from both human-human communication studies and collaborative computing studies. Unlike human-human communication studies, there is a computer involved in the interaction. In contrast with collaborative computing, the people are not communicating via a computer, and, there is no sharing of the information via a computer and only one of the users has access to it.

Based on experiments carried out into the use of auditory feedback in CACI (Chapters 4 and 5) and the inconsistent findings from previous research, for example Ochsman and Chapanis (1974) and Rutter *et al* (1981) it was decided to conduct an experiment investigating communication modes in customer service CACI. The experiment was based on Ochsman and Chapanis' (1974) work and a similar design was used. The aim was to investigate the differences in human-human communication in CACI comparing face-to-face and telephone modes where there is a computer involved in the interaction. The hypotheses were:

- There will be a difference in task completion time between face-to-face and audio-only conditions
- There will be a difference in style and content conditions between the face-to-face and audio-only condition
- There will be a difference in subjective satisfaction between face-to-face and audio-only condition

The next section describes the method, while Section 6.2 reports on the findings of the experiment and those are discussed in Section 6.3.

6.1 Method

This section describes the method for the experiment, including, participants, agents and customers, task and the criteria for selecting the tasks. The section also describes the experimental setting and the procedure. The experiment was a between-subject study, where each participant pair performed one task either face-to-face or via telephone.

6.1.1 Participants

In each session there were two participants, one person was randomly assigned the role of agent and the other the role of customer. There were 19 participant pairs in total, nine in the face-to-face condition, and 10 in the telephone condition. Due to technical recording problems there was an imbalance in the number of participants between the experimental conditions. Participants were recruited via posters and email lists. There was a spread of people with different ages, gender, culture and educational level (see Table 27).

Table 27. Descriptive characteristics of participants

Age		Gender		Educational level	
<20	2	Female	9	No tertiary education	3
20-30	13	Male	10	Currently studying	5
30-40	2			Diploma	2
40-50	2			Bachelor or higher	9
50<	0				

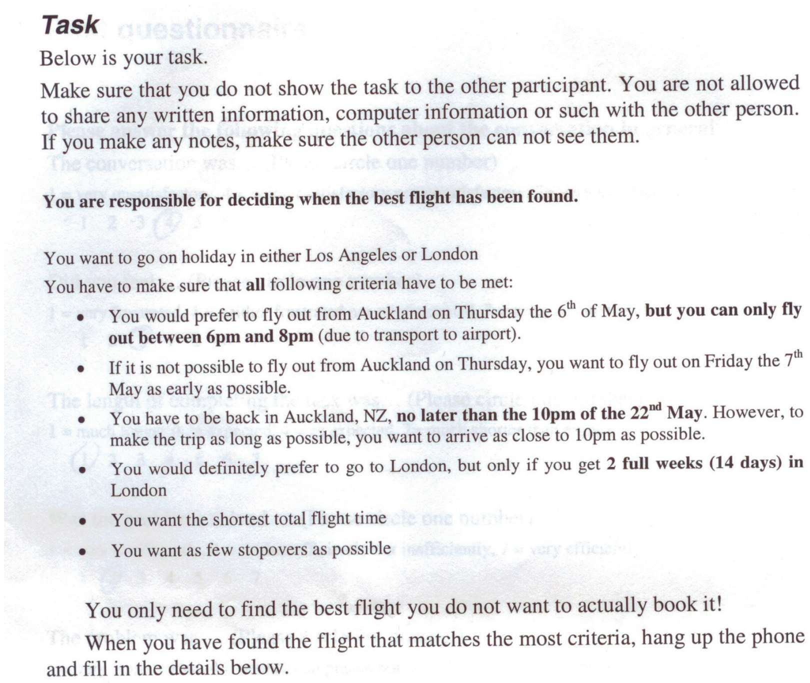
6.1.2 Tasks

Previous research by Ochsman and Chapanis (1974) investigated differences between face-to-face and audio-only conditions. They used a number of criteria for selecting their tasks, because this study was a replication of those studies, a similar task selection process was used. Based on Ochsman and Chapanis' work, the following criteria were used for this study:

- The problem was practical and real
- The problem did not require any special skill or knowledge for the participating "actors"
- Both participants needed to collaborate and communicate to be able to solve the task.

Additional to Ochsman and Chapanis' criteria, for this study it was important that the tasks were not too short to ensure that enough communication data could be collected.

The task selected was a flight booking task (see Figure 61). The customer had a range of criteria for the flight booking and the agent had to find a flight that best fulfilled these criteria. These criteria included the departure date and time, and the destination.



Task

Below is your task.

Make sure that you do not show the task to the other participant. You are not allowed to share any written information, computer information or such with the other person. If you make any notes, make sure the other person can not see them.

You are responsible for deciding when the best flight has been found.

You want to go on holiday in either Los Angeles or London

You have to make sure that **all** following criteria have to be met:

- You would prefer to fly out from Auckland on Thursday the 6^{th} of May, **but you can only fly out between 6pm and 8pm** (due to transport to airport).
- If it is not possible to fly out from Auckland on Thursday, you want to fly out on Friday the 7^{th} May as early as possible.
- You have to be back in Auckland, NZ, **no later than the 10pm of the 22^{nd} May**. However, to make the trip as long as possible, you want to arrive as close to 10pm as possible.
- You would definitely prefer to go to London, but only if you get **2 full weeks (14 days) in** London
- You want the shortest total flight time
- You want as few stopovers as possible

You only need to find the best flight you do not want to actually book it!

When you have found the flight that matches the most criteria, hang up the phone and fill in the details below.

Figure 61. The task given to the participant in the role of customer in human-human communication experiment 1

The customer was given the responsibility to decide when the task was completed, which was based on Ochsman and Chapanis (1974) studies where their seeker decided when the task was finished.

The agent and customer were given separate instructions. The instructions included all the information needed to perform the task, but also restrictions (see Appendix E); It was strongly emphasized that the participants were only allowed to communicate verbally and they were not allowed to share any notes, computer screen or other resources.

The instructions for the agent included information about the websites, and also restrictions on what could be done. For example, "the customer has to use the same airline in both directions".

All the materials given to the participants are in Appendix E.

6.1.3 Data Collection

A range of data was collected for this study:

- Task completion time
- Number of correctly selected flight details
- Activity sampling
- Duration of utterances of time in conversation
- Subjective satisfaction questionnaire data

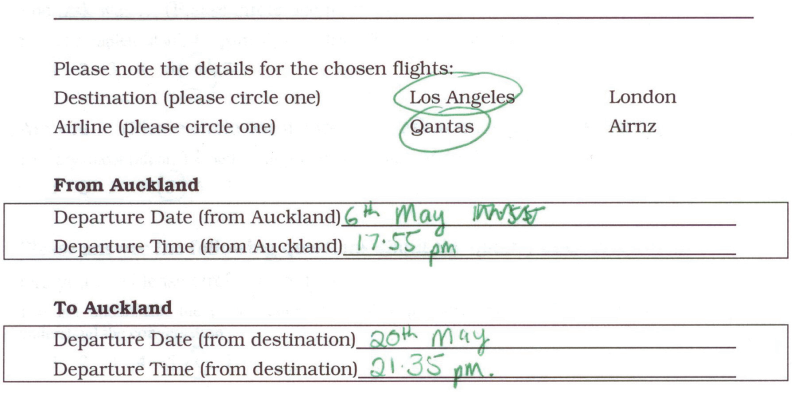
The selection of data collection was based on previous research by Ochsman and Chapanis (1974) into human-human communication, namely, task completion time and activity sampling. However, since other research (for example, Rutter et al, 1981) suggests that face-to-face communication results in a different outcome and a different communication style, selected flight details (outcome) and utterances data was also collected. Since it has also been argued that people prefer face-to-face communication (Masoodian *et al*, 1995; Fletcher and Major, 2006) it was decided to also collect subjective satisfaction.

Task completion time

The task completion timing started when the participants initiated the conversation and finished when the customer stated that the task was completed. In the telephone condition, the timing started as the customer established a telephone connection with the agent, and ended as the customer hung up the phone.

Selected flight details

At the end of the session the customer was asked to state the outcome of the interaction (see Figure 62). The task had been set up such that there was only one correct option for each question. The number of correct options was counted, with five meaning that they were all correct and zero meaning none of the details were correct.



Please note the details for the chosen flights:

Destination (please circle one) Los Angeles London

Airline (please circle one) Qantas Airnz

From Auckland

Departure Date (from Auckland) 6th May

Departure Time (from Auckland) 17·55 pm

To Auckland

Departure Date (from destination) 20th May

Departure Time (from destination) 21·35 pm.

Figure 62. The form for the customer to complete at the end of the session about the flight options

Activity sampling

An activity sampling method was used to collect qualitative information about the interaction. The activity sampling technique was replicated from Chapanis *et al* (1972) studies into human-human communication (see Section 2.5.1). The activity the participants were engaged in was recorded every fifth second. The categories used were based on the work by Chapanis *et al* (1972), who had refined them extensively. The criteria for selection the tasks were:

- They had to be as exhaustive as possible, while not too many to manage
- They had to be precisely defined to attain reliable and valid results

Not all categories used by Chapanis *et al* (1972) were relevant to this experiment, for example 'handling parts' as there were no physical parts that the participants needed to handle to complete the tasks. Additionally, Chapanis *et al* used both single and dual categories, for example, just listening or listening and searching, which was replicated for this experiment. Based on their work, 12 categories were used in this experiment to classify the activities (see Table 28 for the single activities and Table 29 for dual activities).

Table 28. Single activity used to classify the participants' activities

Category	Description
Send only	The only activity the participants is engaged in is talking to the other person
Sending pause	A pause while the participant was in the process of talking
Receive only	The only activity the person is engaged in is listening
Search only	Looking through own information
Making notes	
Waiting	Waiting only, that is no other activity, e.g. listening, talking searching
Other	

Table 29. Dual activity used to classify the participants' activities

Category	Description
Sending and searching	Talking and looking
Sending and making notes	Talking and making note
Receiving and sending	Listening and talking
Receiving and searching	Listening and search
Receiving and making notes	Listing and making notes
Searching and making notes	

Speech utterances pattern

Data about speech utterances, such as duration, place in communication, which person made the utterance, was collected, based on Rutter and Stephenson's (1977) experiment. Each time a participant started an utterance and when the participant stopped the utterance was recorded. An utterance was defined as a continuous string of speech, irrespective of whether this was a complete sentence or part sentence (see Figure 63). There could be an overlap in utterances, when the participants talked at the same time. Examples of utterance included:

- 'I am trying to find a flight with Qantas now' or
- 'I am just trying'

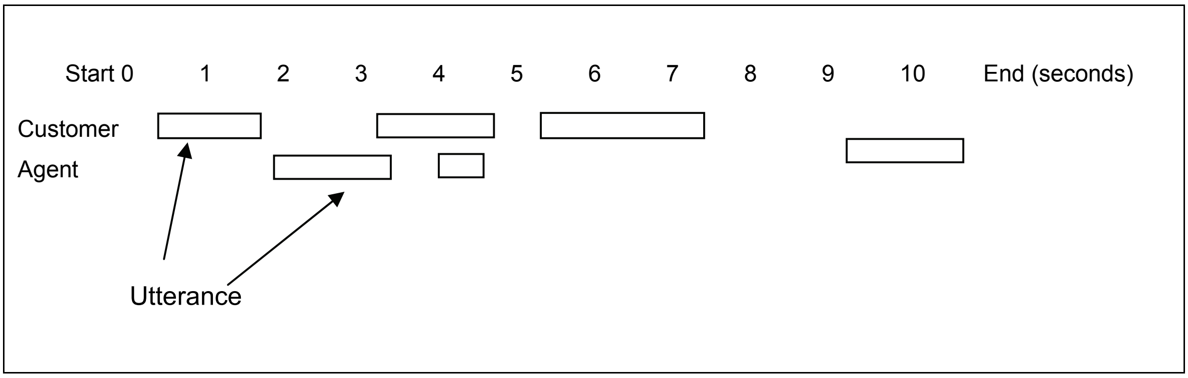


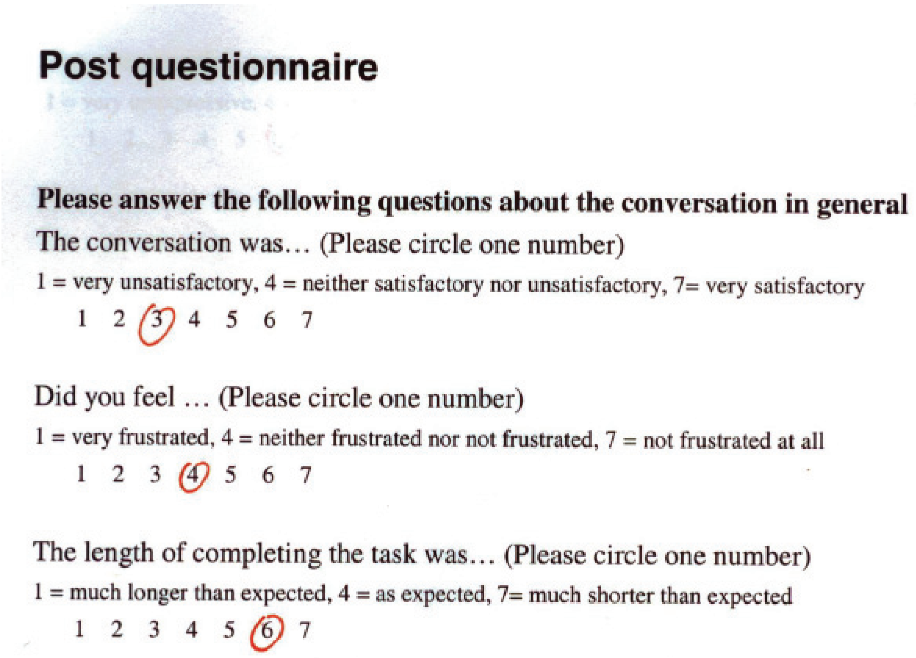
Figure 63. Visual description of data collection for duration of speech utterances and time in conversation utterance took place

The speech utterance data contained two subsets:

- Duration of utterances; it was recorded when the utterance started and finished. The length of that utterance was calculated. For example:
    - The utterance "I am looking for a flight at the moment, you wanted a flight to London right?", has a duration of about 2 seconds
    - If the participant stopped half-way through a sentence, the part sentence was noted as an utterance, for instance, "there are so many flights here, um", was noted as an utterance (of about 1 second)
- The time in the conversation where the utterance took place. The middle point of the utterance was calculated using the start and end of the utterance and was rounded to the nearest whole second. For example, in Figure 63, the customer's first utterance would be recorded at occurring at 1 second.

Subjective satisfaction

Subjective satisfaction was collected via a post-task questionnaire. The participants were asked to fill out a questionnaire after the completion of the task. The questionnaire included questions such as the level of frustration, satisfaction, understanding etc. and was similar to the one used by Masoodian *et al* (1995). All questions were on a 7 point Likert scale, with 1 being the least favourable rating and 7 being the most favourable rating. An example of a question is shown in Figure 64. All the material in the questionnaire is shown in Appendix E.


Post questionnaire

Please answer the following questions about the conversation in general

The conversation was… (Please circle one number)

1 = very unsatisfactory, 4 = neither satisfactory nor unsatisfactory, 7= very satisfactory

1 2 3 4 5 6 7

Did you feel … (Please circle one number)

1 = very frustrated, 4 = neither frustrated nor not frustrated, 7 = not frustrated at all

1 2 3 4 5 6 7

The length of completing the task was… (Please circle one number)

1 = much longer than expected, 4 = as expected, 7= much shorter than expected

1 2 3 4 5 6 7

Figure 64. Example completed post-task questionnaire questions

6.1.4 Materials

Location:

The experiment was held in the Usability laboratory at the University of Waikato; including both the single user room and the group user room (see Figure 51 in Chapter 4). For the face-to-face condition both participants were located in the single user room, with the customer sitting on the opposite side of a table. The customer was not able to see the computer screen. For the telephone condition the agent was located in the single user room and the customer in the group user room. They were communicating via telephone.

Hardware:

For the telephone condition a hands-free telephone was used by the agent and a standard telephone by the customer. For the face-to-face condition there was no added communication hardware.

For both conditions, the agent used a standard desktop PC.

Software:

The agent used AirNZ's, www.airnz.co.nz (see Figure 65 and Figure 66) and Qantas', www.qantas.co.nz, (see Figure 67 and Figure 68) online booking sites.

Figure 65. Screen shot showing the search page for the AirNZ website at the time of the study

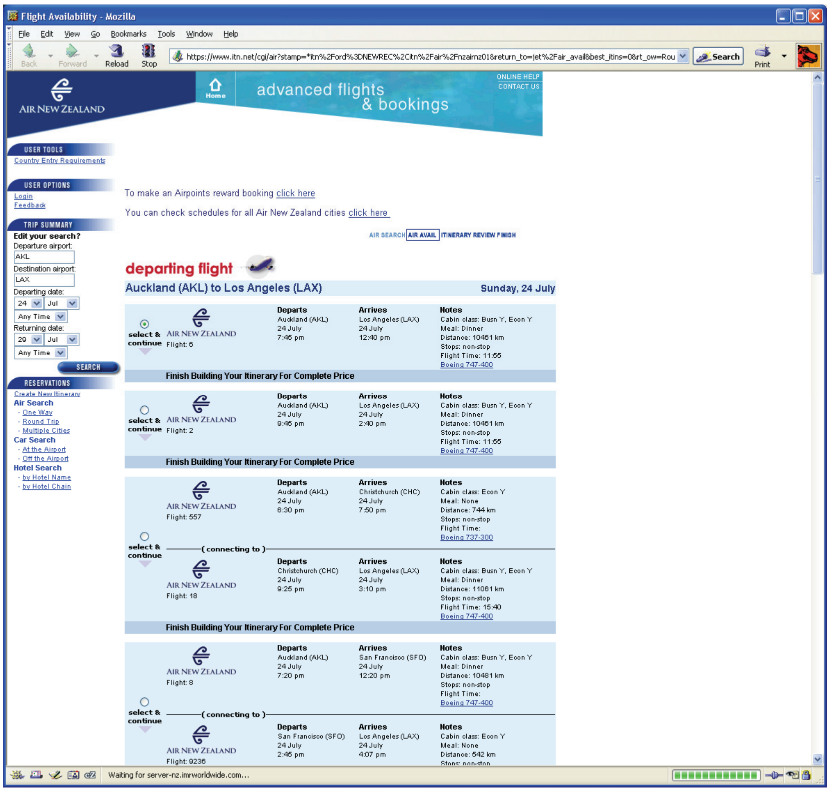


Figure 66. Screen shot of an example search and the resulting flight options on the AirNZ website during the time of the study

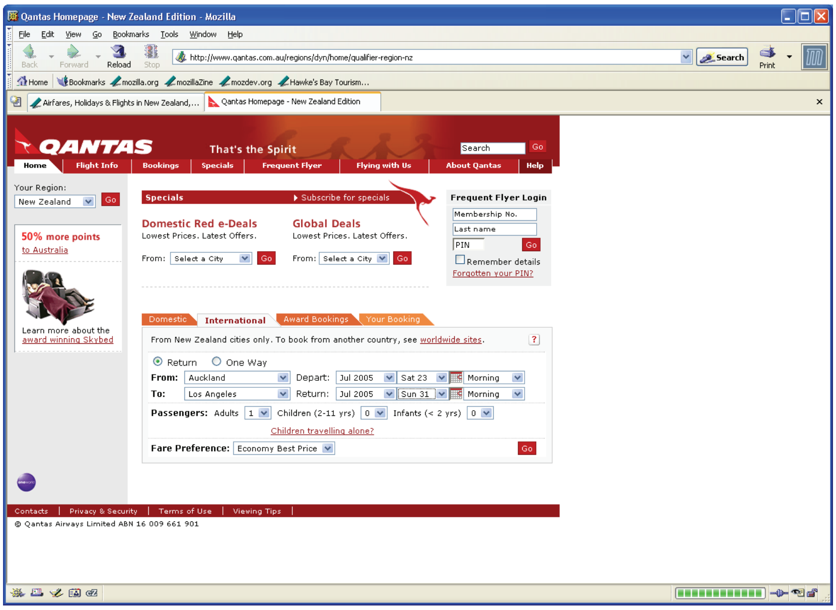


Figure 67. Screen shot of the search page for Qantas website during the time of the study

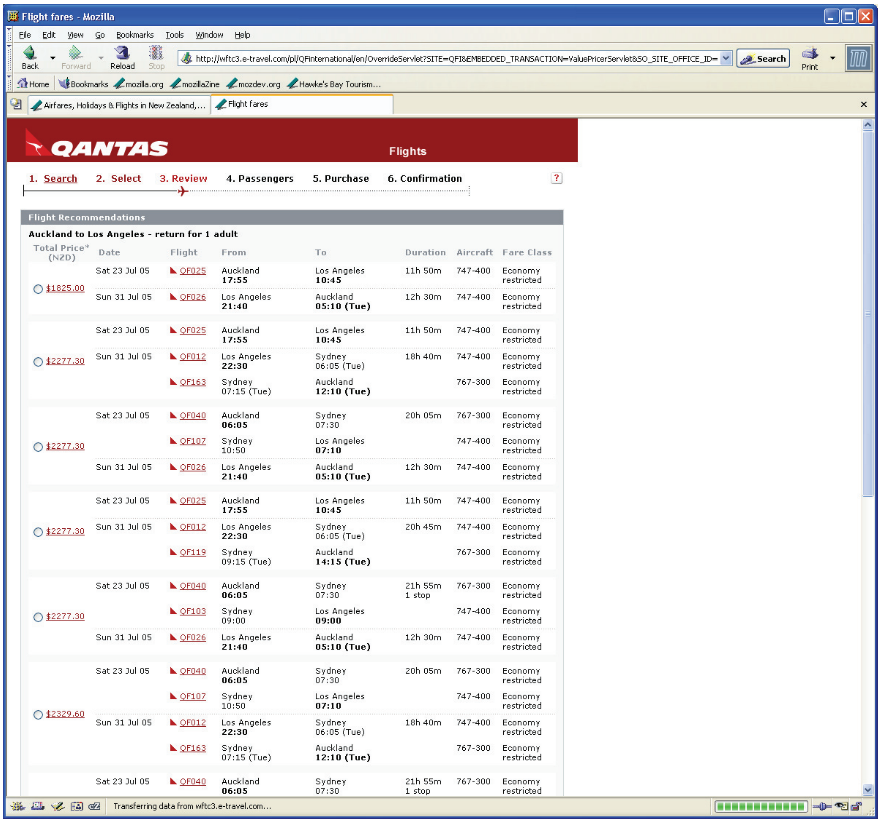


Figure 68. Screen shot of an example search and the resulting flight options on the Qantas website during the time of the study

All sessions were both visual and audio recorded. The visual recordings contained the customer, the agent and the computer screen (see Figure 69 for telephone and Figure 70 for face-to-face). The auditory recording contained both the customer and the agent.

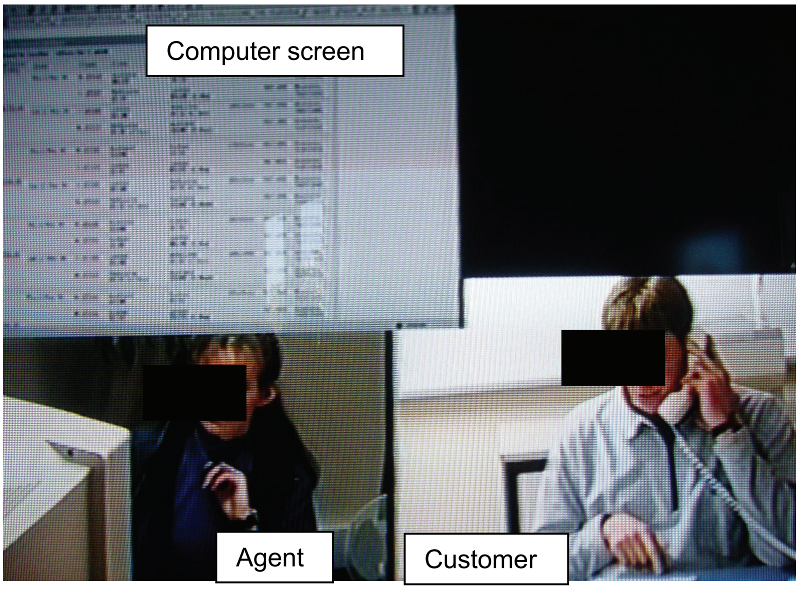


Figure 69. Example of visual recoding for telephone condition

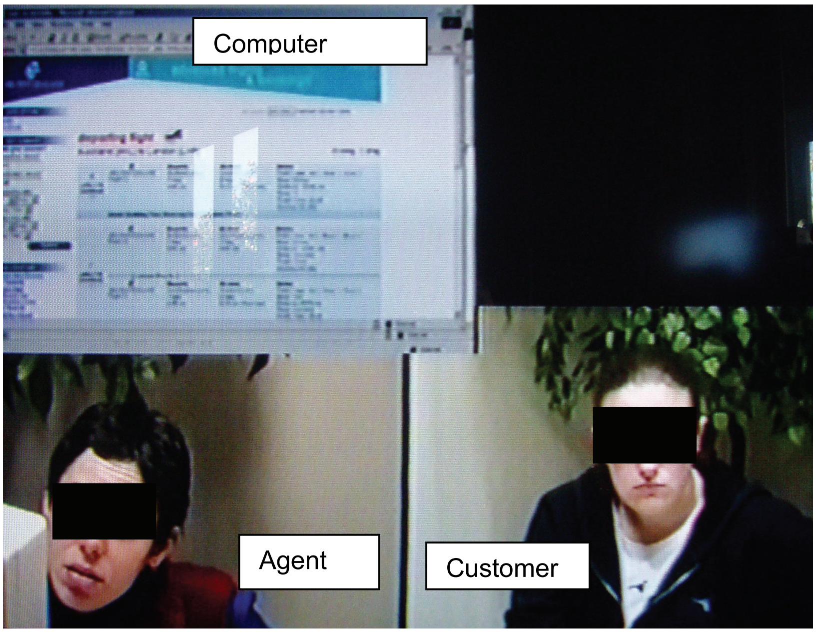


Figure 70. Example of visual recording in the face-to-face condition

6.1.5 Procedure

Prior to the participating in the study, the participants were asked a few questions, such as age and experience with online booking. For a list of the questions, see Appendix E. The procedure for each session was:

- Participant who is assigned the job of agent is greeted by researcher
- The agent was given a short training session on the websites, as well as five minutes to familiarize themselves with the sites
- The other participant, the customer, arrives
- The procedure was simultaneously explained to both participants, followed the ethical consent procedure, which included information that the study was about on communication
- The participants were given written instructions
- The participants performed the task
- The participants filled out a questionnaire

For both conditions the participants were only allowed to communicate verbally. They were not allowed to share any notes, written or typed, nor were they allowed to share the computer screen.

6.2 Results

There was a range of data collected: task completion time, outcome, speech utterances over time in conversation, activity sampling and subjective satisfaction. This section covers each of the collected data sets.

6.2.1 Task Completion Time

As each task was carried out in pairs, only one time for each pair was calculated. The mean task completion time for the telephone condition was 1148 seconds, while it was 1937 seconds for the face-to-face condition (see Table 30). However, the standard deviation was larger for the telephone condition (655seconds) than the face-to-face condition (457 seconds).

Table 30. Descriptive statistics of task completion time

	Face-to-face N = 9	Telephone N = 10
Mean	1937	1148
Standard deviation	457	655
Median	1770	900
Maximum	2575	2250
Minimum	1455	525

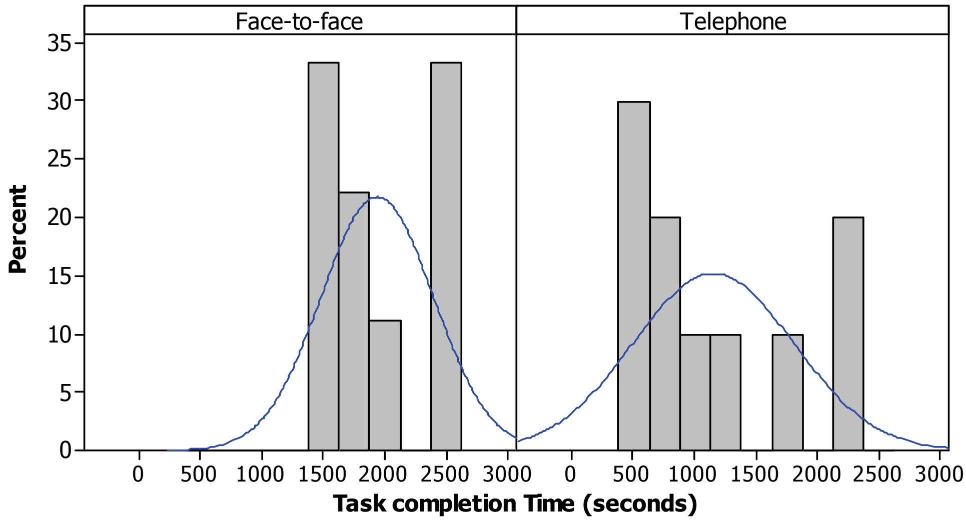


Figure 71. Frequency distribution histogram with normal distribution curve, of task completion time

The task completion time data was continuous but not normally distributed (see Figure 71), consequently a Wilcoxon Rank-Sum test was used for calculating statistical significance (Bhattacharyya and Johnson, 1977). Under the null hypothesis of equal distributions, we expect that the ranks 1 to 19 would be equally distributed between the two groups. However for this experiment they were not; the sum of the ranks was 120 for the face-to-face condition and 70 for the telephone condition. The probability of obtaining a rank sum of 119 or greater on a sample of 19 is less than 0.009. Since this was a two-sided test, the p-value had to be multiplied by two to get an upper bound for the p-value of the test. Hence the difference between the conditions was statistically significant (Wilcoxon Rank-Sum, N=19, p-value = 0.018). The details about the ranking can be found in Appendix F.

Most of the face-to-face pairs had longer task completion times than the pairs in the telephone condition. Seven of the 10 participant pairs in the telephone condition had shorter task completion times than any participant in the face-to-face condition (see Figure 72).

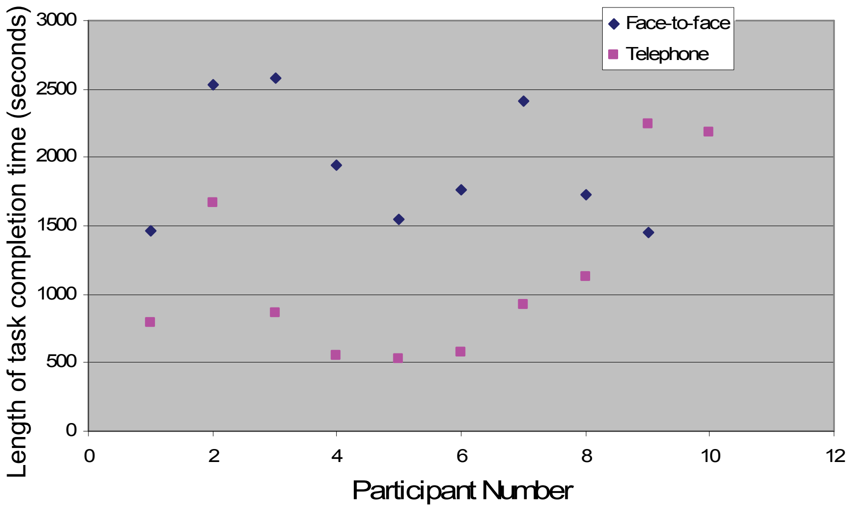


Figure 72. The total task completion time for each participant pair in both conditions

6.2.2 Outcome

At the end of each session, the customer participants were asked to provide the details that they deemed best fitted the criteria. The participants were asked about destination, departure time and date, and return date and time. They were then given a score between 1 and 5 (1 – one correctly fulfilled criterion, 5- five correctly fulfilled criteria).

Descriptive statistics were calculated, shown in Table 31, and there was only a small difference between the two conditions. Overall, the face-to-face condition had a slightly higher mean number of correctly selected criteria. The difference was very small though with the mean for face-to-face 4.1 and for telephone 3.7.

Table 31. Descriptive statistics for the correctly selected flight details

	Face-to-face	Telephone
Mean	4.11	3.70
Standard deviation	0.93	1.06
Median	4.0	3.5

Further analysis was made into the outcome for each participant pair and there was a larger individual difference in the telephone condition (see Figure 73 and Figure 74). There were five pairs in the telephone condition that only had a 2 or 3 score and 5 pairs that had a 4 or 5. In contrast, for the face-to-face condition, six pairs had a score of 4 or 5, while only three pairs had a score of 3.

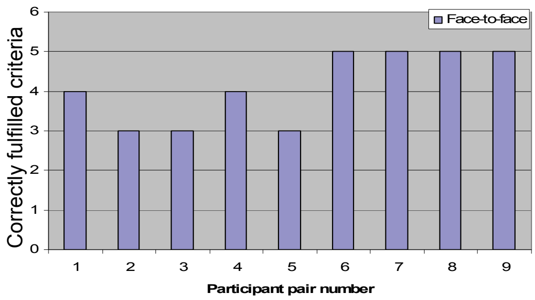


Figure 73. Correctly fulfilled criteria for each participant pair in face-to-face condition

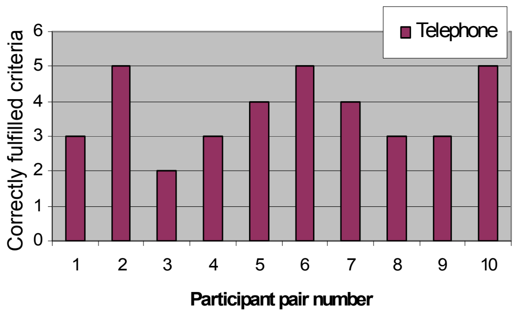


Figure 74. Correctly fulfilled criteria for each participant pair in telephone condition

6.2.3 Activity sampling

As described in the method section, the activity sampling was taken every five seconds of the entire conversation. Descriptive statistics were calculated for activity sampling (see Table 32). As the task completion time was longer for the face-to-face condition, the data was normalized. Overall the face-to-face condition had more occurrences of single activities, while the telephone condition had more occurrences of dual activities (see Table 33).

Table 32. Descriptive statistics of single and combined activities for both conditions

	Face to face N = 9		Telephone N = 10	
	Single	Combined	Single	Combined
Mean	34.25	24.59	15.72	19.93
Standard deviation	51.8	36.31	38.43	34.51
Median	10	6	1.5	3

Table 33. Normalized data (over task completion time) descriptive statistics of single and combined activities for both conditions

	Face to face N = 9		Telephone N = 10	
	Single	Combined	Single	Combined
Mean	0.08	0.06	0.06	0.09
Standard deviation	0.12	0.09	0.11	0.13
Median	0.02	0.01	0.00	0.01

For all the single activity categories, the face-to-face condition had a higher count (see Figure 75). In contrast, for all dual activities, the telephone condition had a higher count. Some categories contributed more to the overall difference. For example, in the face-to-face condition 'Just Listen' had a high count, while in the telephone condition 'Talk and Search' had a high count.

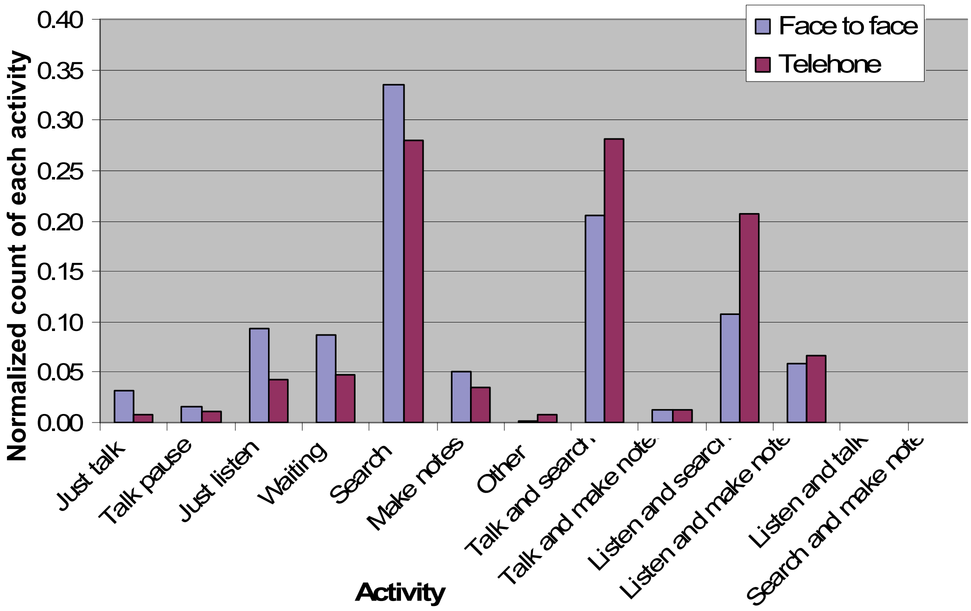


Figure 75. Normalized count of each activity for both conditions

As the data was categorical a Chi-Squared test was used to calculate the statistical significance of the activity sampling (Bluman, 2001). The Chi-Squared test if the proportions of observations for each activity category were the same for both conditions. The result for the activity sampling was statistically significant, with a p-value very close to zero (Chi-Squared, N = 19, p = 0.000). A Chi-Squared test also indicates which categories contributed to the p-value. The main contributing categories were 'Listen and Search', 'Just Listen' and 'Just Talk', where both conditions contributed (see Table 34). The telephone condition had a lower than expected (based on the Chi-Squared calculation) observed count for all the single activities, while the face-to-face condition had a higher than expected observed count for all single activities. In contrast, for the dual activities, the face-to-face condition had a lower than expected count on four of five categories, while the telephone condition had a higher than expected count on four of five categories.

Table 34. Main contributors to the statistically significant difference in activity sampling

	Observed Count		Expected count		Chi contribution	
	Face-to-face	Telephone	Face-to-face	Telephone	Face-to-face	Telephone
Just talk	243	47	175	115	26.53	40.36
Talk pause	102	41	86	57	2.88	4.39
Just listen	668	201	524	345	39.53	60.21
Waiting	649	295	569	375	11.16	17.05
Search	2303	1405	2236	1473	2.00	3.12
Make notes	343	186	319	210	1.80	2.77
Other	8	26	21	14	7.63	11.56
Talk and search	1425	1198	1582	1042	15.55	23.40
Talk and make notes	89	53	86	56	0.13	0.21
Listen and search	754	880	985	649	54.34	82.20
Listen and make notes	388	257	389	256	0.00	0.00
Listen and talk	0	0	0	0	0.00	0.00
Search and make notes	0	3	2	1	1.81	2.74

The data suggests that the participant role had an impact on the results (see Table 35). For the face-to-face condition the customer had a higher mean count in single activities than dual, while the agent had a similar mean for both single and dual activities. In contrast, for the telephone condition, the agent had a higher mean count for dual activities while the telephone customer had a similar mean count for both single and dual. However, the median value shows a slightly different picture, where the telephone agent had a very low median count for both single and dual activities. The customer, on the other hand, had a higher median in dual activities. A Chi-Squared test was used to calculate statistical significance. The result was statistically significant, with a p-value close to 0 (Chi-Squared, $N = 38$, $p = 0.000$). The details about the contribution of each category including role can be found in Appendix F.

Table 35. Descriptive statistics of activities including role of participant

	Face-to-face				Telephone			
	Customer		Agent		Customer		Agent	
	Single	Dual	Single	Dual	Single	Dual	Single	Dual
Mean	38.41	19.76	30.10	29.43	17.04	18.38	14.40	21.47
Standard deviation	39.89	23.56	61.51	45.37	30.15	25.71	45.41	41.67
Median	24.00	13.50	5.00	0.50	3.00	11.50	1.00	0.00

6.2.4 Speech utterances over time in conversation

The second set of data was utterances over time in the conversation.

Duration of utterances

Descriptive statistics about the duration of each individual utterance was calculated (see Table 36). The mean duration of utterances was longer for the telephone condition, 3.30 seconds versus 2.81 for the face-to-face condition. There was a large standard deviation for both conditions. For both conditions the majority of utterances were of short duration, less than three seconds (see Figure 76). Additionally there was only a small difference between the roles, and further details can be found in Appendix F.

Table 36. Descriptive statistics of duration of utterances (in seconds)

	Face-to-face N = 9	Telephone N = 10
Mean	2.81	3.30
Standard Deviation	4.00	4.56
Median	2	2
Maximum	60	38
Minimum	0	0

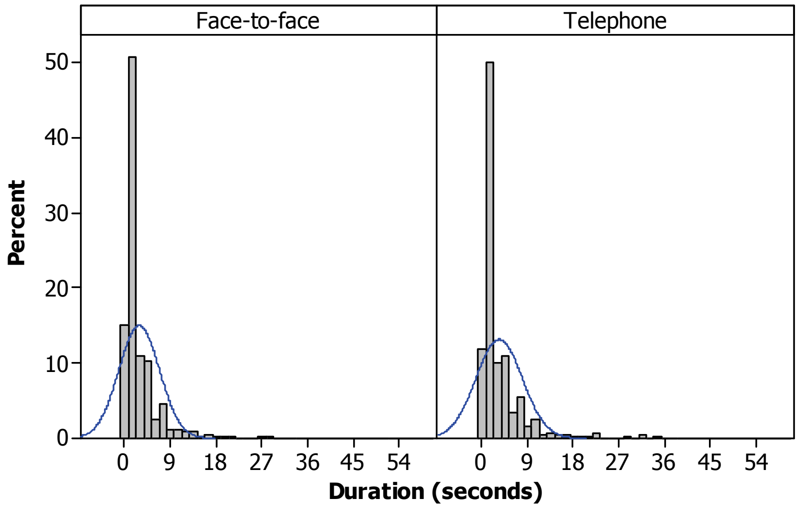


Figure 76. Histogram and normal distribution curve of the distribution of duration of utterances

Count of utterances

Data was collected regarding the number of utterances. The data was normalized by dividing the number of utterances for each participant by the task completion time for that participant (see Table 37). There was no difference in normalized number of utterances between the conditions.

Table 37. Descriptive statistics of the number of utterances normalized over task completion time

	Face-to-face N = 6	Telephone N = 7
Mean	0.16	0.16
Standard Deviation	0.02	0.03
Median	0.15	0.15
Maximum	0.18	0.23
Minimum	0.13	0.12

Comparing duration and number of utterances

A comparison was made of the duration of utterances against the number of utterances. For each participant the duration of utterances and the average number of utterances was calculated and plotted (see Figure 77). The telephone condition had more data points in the upper left corner, that is, utterances of longer duration and lower frequency. In contrast, the face-to-face condition had more data points in the lower right corner, that is, higher number of utterances but utterances of shorter duration. There was no significant difference contributed by the role (see Appendix F).

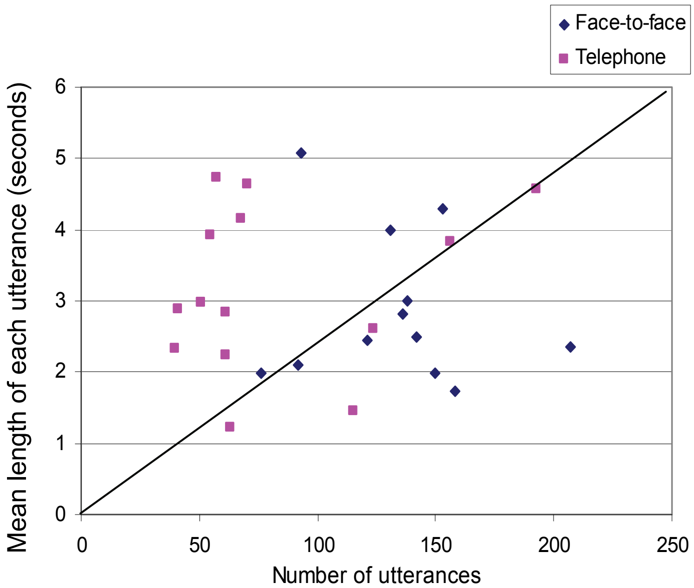


Figure 77. Average length of utterances against the number of utterances for each condition

Figure 77 suggests that there was a difference between the conditions in the length of utterances against number of utterances. However, due to the relatively small number of participants it was decided to also calculate the mean of a moving window to understand the data better (Panis and Verheyen, 1995; Friedrich, Siegert, Peinke, Luck, Siefert, Lindemann, Raethjen, Deuschl and Pfister). This involves taking a portion of the length of the conversation and calculating the mean for that portion. The portion is then moved along the timeline (see Figure 78).

The window length and movement increments were progressively lengthened until it was possible to see any trends in the data. The window was 0.2 seconds and it was shifted 0.05 seconds each movement.

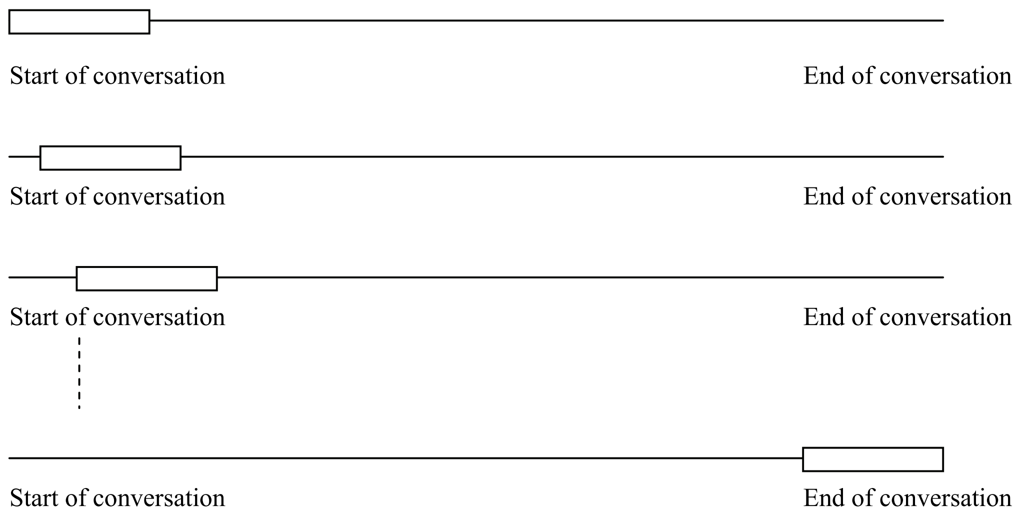


Figure 78. Visual representation of moving window placement

The mean number of utterances and duration during each window was calculated. For each session there were 46 windows and example graphs of the mean count and mean duration for the face-to-face condition for seven windows can be found in Figure 79 and Figure 80 respectively. The two graphs were then combined to produce a scatter plot of the mean count of utterance against the mean duration of utterance for that window (see Figure 81). This graph is then combined with the equivalent windows for the telephone condition (see Figure 82).

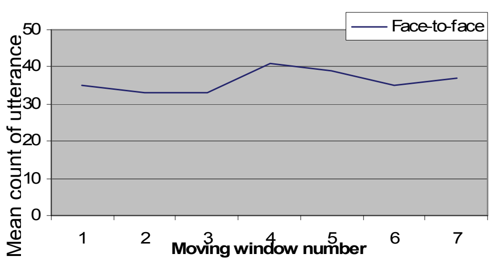


Figure 79. Number of utterance for seven windows in the moving window analysis

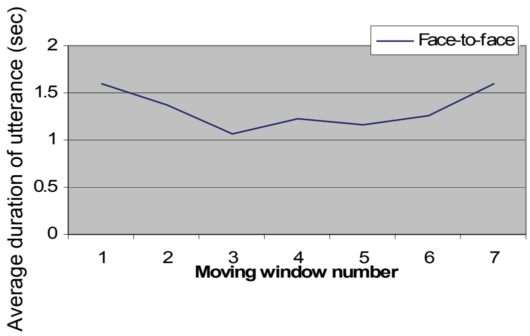


Figure 80. Average duration of utterance for seven windows in the moving window analysis

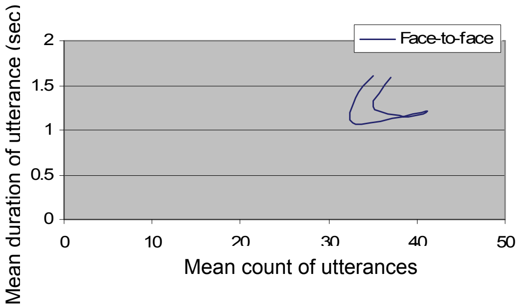


Figure 81. Mean count of utterance against duration of utterance for seven windows in the face-to-face condition

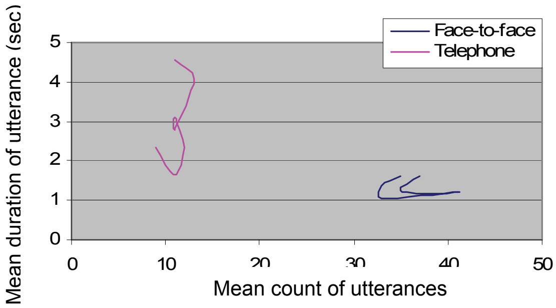


Figure 82. Mean count of utterances against duration of utterances for seven windows in both face-to-face and telephone

The mean, based on the moving window analysis, number of utterances against duration for all participants in both conditions was plotted (see Figure 83). The pattern was the same as for the overall mean (see Figure 77). There appeared to be a difference between the conditions, with the telephone condition being more focused in the upper left corner, which means that the speech utterances were of long duration but low count of utterances. The face-to-face condition, in contrast, was more focused in the lower right corner, with a high count of speech utterances, but the utterances were of short duration.

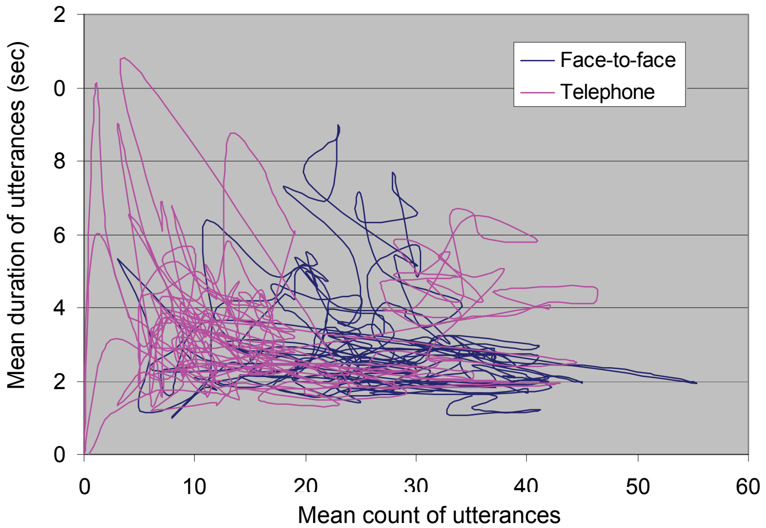


Figure 83. Mean duration of the utterances against the mean count of utterances in a 0.2 second window

As there was a difference between the conditions but it was somewhat difficult to see any definite trends in Figure 83, the moving window mean number against duration for each individual participant pair was also plotted (see Figure 84 and Figure 85). For the face-to-face condition, three of six participant pairs had the majority of their interaction in the lower right corner. For the telephone condition, six of the seven participant pairs had the majority of their interaction in the upper left corner.

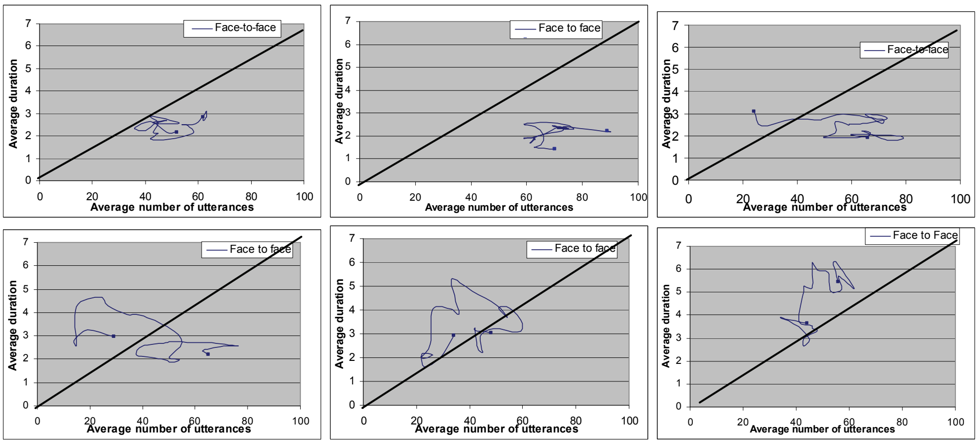


Figure 84. The individual plot for 0.2 second moving window mean duration and mean number of utterances for face-to-face condition

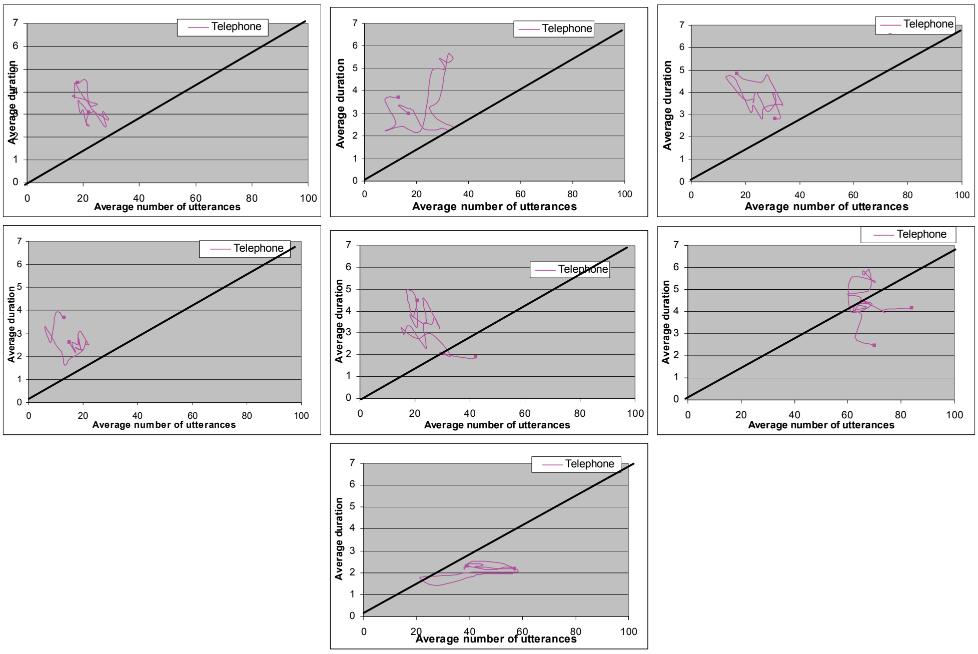


Figure 85. The individual plot for 0.2 second moving window mean duration and mean number of utterances for telephone condition

6.2.5 Subjective satisfaction

There was only a small difference in the questionnaire response between the conditions. The overall mean rating for the face-to-face condition was 4.16 and for the telephone condition it was 4.67. Standard deviation, median, maximum and minimum values were all very similar between the conditions (see Table 38).

Table 38. Descriptive statistics of questionnaire ratings by condition

	Face-to-face	Telephone
Mean	4.16	4.67
Standard deviation	1.74	1.63
Median	4	5
Maximum	7	7
Minimum	1	1

There were small differences between the conditions for individual questions (see Figure 86). For most of the questions, the telephone condition had a more favourable rating. In particular, the ratings for satisfaction of conversation, level of frustration, task complication and task completion were more favourable for the telephone condition. For understanding the conversation and for 'the expressiveness of the conversation' the face-to-face condition had a slightly more favourable rating.

Statistical significance was calculated using a Mann-Whitney U test, as the data was continuous and normal distribution could not be assumed, and it was collected from two independent samples (Bhattacharyya and Johnson, 1977). There was only a significant difference between the conditions for question 3 ("Was the length of completing the task as expected?"), but none of the other questions showed a significant difference (see Table 39).

Table 39. Statistical significance results for each question

Question	P-value
The conversation was satisfactory?	0.765
Did you feel frustrated?	0.097
Was the length of completing the task as expected?	0.005
Was the problems solved efficiently?	0.067
Was the problem complicated?	0.065
Did you complete the task?	0.197
Are you confident the task was completed as you expected?	0.295
Did you understand the conversation?	0.807
The conversation was concise?	0.127
The conversation was expressive?	0.978

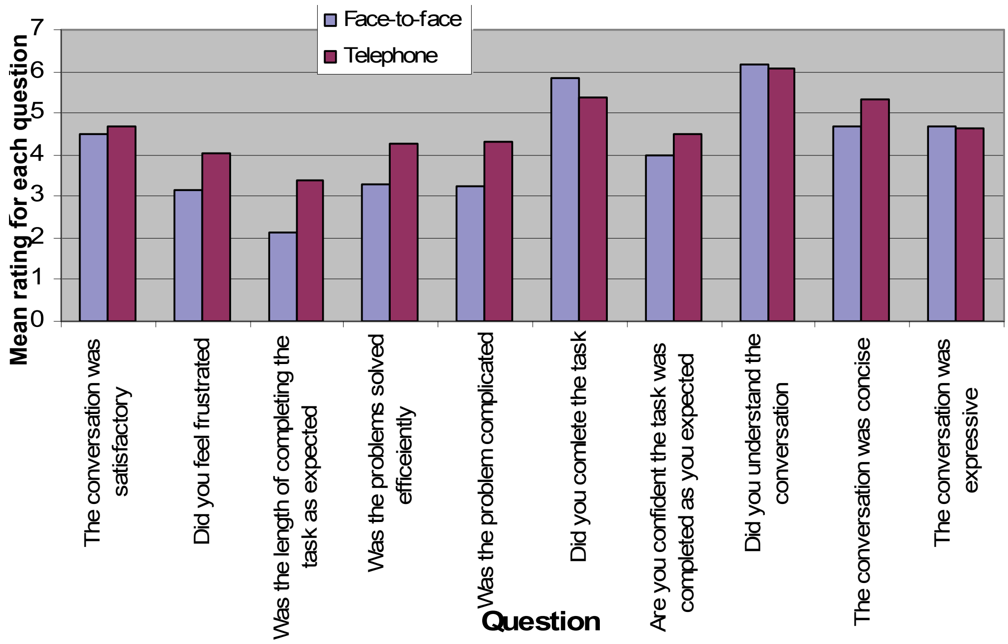


Figure 86. Mean rating by each condition for all questions

6.3 Discussion

There were three hypotheses for this experiment:

- The hypothesis that there would be a difference in task completion time between face-to-face and audio-only condition was supported
  - On average the face-to-face condition had a significantly longer completion time than the telephone condition
  - Most people in the telephone condition had shorter task completion times than any of the participants in the face-to-face condition
- The hypothesis that there would be a difference in style and content conditions between the face-to-face and audio-only condition hypothesis was supported:
  - There was a statistically significant result in the activity sampling, in contrast with Chapanis *et al's* (1972) work. The participants in the face-to-face condition spent more time in single activities, such as 'just talk' and 'just listen', while in the telephone condition they spent more time in dual activities, such as 'talk and searching' and 'listen and search'.
  - The duration of utterances were slightly longer for the face-to-face condition, which was consistent with Rutter and Stephenson's (1977) findings
  - The number of utterances was slightly higher for the telephone condition, which was also consistent with Rutter and Stephenson's (1977) results
  - The face-to-face condition had a high count of utterances that were short in duration, while the telephone condition contained fewer number utterances but they were longer in duration, which is consistent with Matarazzo and Sellen's (2000) work.

- The hypothesis that there would be a difference in subjective satisfaction between face-to-face and audio-only condition was not supported:
    - There was only a small difference in subjective satisfaction between the face-to-face and telephone conditions
    - For seven of the 10 questions, the subjective rating was more favorable for the telephone condition
    - The rating for the question relating to satisfaction of conversation was slightly more favorable for the telephone condition, which contrasts with previous research (Masoodian and Apperley, 1991)

The findings from this experiment have added to the understanding of human-human communication in CACI in a travel agency setting. As mentioned in the introduction of this thesis, providing good customer service is crucial to many organisations and it is becoming more common that this service is provided through call centres. The results from this study favours call centres and replicates the result that Rutter *et al* found, that face-to-face communication is more time-consuming and less efficient, but with no significant difference in subjective satisfaction or outcome. It is possible that the higher number of single activities for the face-to-face condition, while the higher number of dual activities for telephone would contribute to the shorter task completion time for the telephone condition. In the face-to-face condition, the participants would stop working on the current task and look at the other participant while he or she was talking. In the telephone condition, in contrast, people kept working on the task while also talking or listening to the other participant. It is also possible the difference in style of communication contributed to the short task completion time. The face-to-face condition appeared to be more interactive, with participants predominantly communicating through a high count of utterances that were of short duration. In contrast, in the telephone condition the participants were less likely to interrupt the other participant which led to the longer, but fewer, utterances, which is consistent with Matarazzo and Sellen's (2000) findings. In the face-to-face condition the participants asked for more clarifications, sought confirmation that the other person had understood and also offered more confirmation of understanding. In addition, the subjective ratings for the questions relating to task complication and completion were more favourable for the telephone condition.

During the analysis the researcher noted that that the telephone condition was more task-oriented and that the people in the face-to-face condition spent more time talking about non-task related topics. This is consistent with the findings by Rutter *et al* (1981) and Gale (1991). Gale (1991) suggests that the participants would spend more time talking about social topics in a richer communication mode. In this study, the participants in the face-to-face condition seemed to spend more time explaining why the criteria had to be met (although this was not specified in the task). The participants were not given a reason for the time restraints, however they made up reasons. For example, "*I can't make it to the airport until 6pm as I have a business conference in Auckland*". They also spent time on other non-task related communication, for example by saying "*it must be really boring for you to wait while I am looking on the computer*". In addition, for the subjective satisfaction questions relating to understanding the conversation, and also for 'the expressiveness of the conversation' the face-to-face condition had a more favourable rating.

There were some threats to generalisability in this study because some of the constraints, the inexperience of the agent and the restriction on information sharing, were not realistic. In most CACI one person is an experienced user of the computer system and also trained in communicating with a customer. Further, a call centre agent has often had customer service training, including training on what to say and also how to interact with the customer. For example, in call centres, agents are often told to smile, even though the customer cannot see them (see Section 3.2.2). In this experiment neither of the participants were experts. The agent in this experiment did not have any customer service training and only very short training on the websites. However, to improve control in the experiment, it was decided that the short training was an acceptable compromise. It was not possible to find enough trained travel agents to participate in the experiment. If the role of agent was the same person for all sessions there would have been other threats, such as learnability and individual differences. Further, the fact that neither participant was trained might have mitigated any differences between the conditions.

The experimental constraints could also have had an effect on the results. As mentioned before the participants were only allowed to communicate verbally and were not allowed to share any written or electronic information. This constraint was added to control the experiment and make sure that the two conditions were comparable. However, in a real situation the participants would be able to share written information, as well as sometimes being able to share the computer screen. In the face-to-face condition, being able to share written information might have led to a reduction in time, due to the customer looking at a paper itinerary while the agent searched for additional options.

There are many options for future work arising from this study, for example, comparing more modes of communication or investigating human – human communication in a different setting. More and more customer service is being carried out electronically, for example internet banking, email and chat programs. It would be interesting to compare face-to-face and telephone, with instant electronic communication (such as, a chat program or instant messaging). The setting for this study was task-oriented and non-emotional, and involved booking a flight, however, other types of customer service are more emotional, for example, if a person is consulting a doctor. It is possible that there would be a larger difference in subjective satisfaction between the conditions in a more emotional task.

In the face-to-face condition people stopped what they were doing to concentrate fully on the other participant, and spent more time in single activities, such as ‘just talking’. This halting of activity could have an effect on the task completion time, as participants were engaged in single activities. It is possible that there would be additional time while they picked up the task again. Bowers and Martin (2000) argue that it is important to consider ‘information format’ and ‘pace of interaction’ in designing software for call centres and it is important to take into account that information might need to be re-packed and read out loud. However, based on the results from this study, there seems to be a need to consider how information is displayed in face-to-face interactions as well. Potential work could investigate how people pick up their work again after the pause and how to display the information to assist this *resumption* of this work.

In this study, there was only a small difference in subjective satisfaction, with the telephone condition having a slightly more favourable rating. However, this study was a between-subject study and hence this difference could be due to individual preferences. Future work includes replicating this study using a within-participants design to assess participants' preference when forced to make a choice.

Further future work includes investigating if the findings from this study also hold in a more realistic setting, for example, conducting naturalistic observation and interviews to investigate if telephone communication is more task-oriented and less time-consuming than face-to-face interaction.

Through this experiment a better understanding of human-human communication in CACI has been achieved, and it appears that the mode has an effect on communication. The participants in the face-to-face condition took longer to complete the tasks and they spent more time in single activities, such as just talking. In contrast, there was no difference in the subjective satisfaction between the two conditions. There are two studies following on from this laboratory experiment. The next chapter discusses a second experiment into human-human communication. Because the study described in this chapter was a between-subject study and there was an unexpected finding regarding subjective satisfaction, it was decided to conduct a within-subject study that focused on subjective satisfaction, including asking participants to compare the two conditions. Chapter 8 reports on a naturalistic study at a number of travel agencies. This study includes observations, interviews and focus group discussions. The aim of this study was to investigate if the findings from the experiment in this chapter also applied in a natural customer service setting.

7 SUBJECTIVE SATISFACTION IN HUMAN-HUMAN COMMUNICATION: FACE-TO-FACE OR VIA TELEPHONE

This chapter reports on a second experiment into the human-human communication channel in CACI (see Figure 60, in Chapter 6). In the human-human communication between-subject experiment discussed in the previous chapter, there was only a small difference in subjective satisfaction between the face-to-face and telephone conditions. This finding is not consistent with previous research, which found that participants preferred face-to-face interaction (Masoodian and Apperley's, 1995; Masoodian *et al*, 1995; Fletcher and Major, 2006). To further investigate if there is a difference in subjective satisfaction in a customer service CACI a within-subject experiment was conducted.

The previous chapter reports on a between-subject study comparing human-human communication over two different modes, face-to-face and telephone. The aim was to investigate if there was a difference in outcome, style and content, and subjective satisfaction. It was found that there was a difference in outcome, and style and content, but there was a small, insignificant difference in subjective satisfaction. However, the study was between-subject, hence each participant only performed a task in one condition. It is possible that there would be a difference if the participants compared the two conditions in a similar task and were asked to make a choice.

As mentioned in Chapter 6, there appears to be an unclear finding from previous research into human-human communication. Some research suggests that audio-only communication is as good as face-to-face (for example Ochsman and Chapanis, 1974) while other research suggests that there is a difference in communication due to the modes (for example Rutter *et al*, 1981). Masoodian and Apperley (1995) and Fletcher and Major (2006) found that participants preferred face-to-face interaction over audio-only communication. It has also been suggested that people engage more in social talk when communicating face-to-face and focus less on the task, but they are still as satisfied with the outcome (Matarazzo and Sellen, 2000).

In the previous experiment it was expected that the participants would rate the face-to-face condition higher, however, this expectation was not met, and since the findings were inconsistent with previous research, an experiment was conducted to further investigate if there is a difference in subjective satisfaction between face-to-face and telephone communication in customer service CACI. This study was a replica of the experiment discussed in Chapter 6, however some modifications had been made, such as the change from a between-subject to within-subject design. The changes to the method are described in Section 7.1. The hypothesis was that there would be a higher subjective satisfaction in the face-to-face than the telephone communication mode.

The remainder of this chapter reports on the experiment carried out. The method, in particular the sections where there are deviations from the previous human – human experiment, including participants, design, materials, data collection and procedure, is described in Section 7.1. The results are reported in Section 7.2 and discussed in Section 7.3.

7.1 Method

This section describes the method used for the experiment. This was a within-subject design, where all participants performed one task face-to-face and one over the telephone.

7.1.1 Participants

As with the human-human communication study 1 (see Chapter 6), there were two people in each session, one agent and one customer. There were 16 participants, eight females and eight males, their cultures included European, New Zealander, Asian and Indian, with ages varying from 18 to 45.

7.1.2 Experimental design

Unlike the previous experiment (Chapter 6), this was a within-subject experiment, all the participants did one task face-to-face and one task over the telephone. Four of the participant pairs performed the face-to-face task first, while four pairs did the telephone task first. The participants were randomly assigned to condition order.

To limit any learning-effects there were two different tasks. To reduce any risk of bias due to task order, the order of the tasks was altered, 50% of the participants did task A first, while 50% did task B first. The conditions were also alternated (see Table 40).

Table 40. The order of the conditions and tasks for four participant pairs

	First task	Condition	Second task	Condition
Participant pair 1	A	Face-to-face	B	Telephone
Participant pair 2	A	Telephone	B	Face-to-face
Participant pair 3	B	Face-to-face	A	Telephone
Participant pair 4	B	Telephone	A	Face-to-face

7.1.3 Tasks

The tasks were based on the same criteria as the tasks in the previous chapter (see Section 6.1.2):

- The problem was practical and real
- The problem did not require any special skill or knowledge
- Both participants needed to collaborate and communicate to be able to solve the task

However, because this study was a within-subject study two tasks were needed. Care was taken to ensure that the tasks were based on the same criteria and were comparable, in expected task completion time and complexity. The customer had a number of criteria required for the flight booking and the agent had to find a flight that best fulfilled these criteria. The criteria included departure date and time, and destination. The customer was given the responsibility to decide when the task was completed. The two tasks are shown in Figure 87 and Figure 88:

You are responsible for deciding when the best flight has been found.

You want to go on holiday in either Los Angeles or London

You have to make sure that **all** following criteria have to be met:

- You would prefer to fly out from Auckland on Thursday the 7th of September, **but you can only fly out between 6pm (18.00 hours) and 8pm (20.00 hours), on that day** (due to transport to airport).
- If it is not possible to fly out from Auckland on Thursday, you want to fly out on Friday the 8th September as early as possible.
- You have to be back in Auckland, NZ, **no later than the 10pm of Friday the 22nd** September. However, to make the trip as long as possible, you want to arrive as close to 10pm as possible.
- You would definitely prefer to go to London, but only if you get **2 full weeks (14 days) in** London

You only need to find the best flight you do not want to actually book it!

When you have found the flight that matches the most criteria, please state loud and clear "I have found the best flight" and fill in the details below.

Figure 87. The instructions given to the customer in for task A

You want to go on holiday in either Bangkok or Frankfurt

You have to make sure that **all** following criteria have to be met:

- You would prefer to fly out from Auckland on **Friday 11th August**.
- You have to be back in Auckland, NZ, on the **Sunday 27th August**.
- You would definitely prefer to go to Frankfurt, but only if the total **flight** price is **less than** $1700. If the flight price is more expensive than that you want to fly to Bangkok. You still do not want to pay more than $1700 for flight price
- You want the shortest possible flight time. However, price is more important

You only need to find the best flight you do not want to actually book it!

When you have found the flight that matches the most criteria, please state loud and clear "I have found the best flight" and fill in the details below.

You need to phone 6590 to find the most suitable flight

Figure 88. The instructions given to the customer in for task B

The agent and customer were given separate instructions for the tasks. The instructions included all the information needed to perform the task, but also restrictions. As with human-human communication study 1 (see Chapter 6), it was emphasized that the participants were only allowed to communicate verbally and that they were not allowed to share any notes, or turn around the computer screen.

The instructions for the agent included information about the websites, and also restrictions on task solutions, for example, "the customer has to use the same airline in both directions".

For a full reference of the material given to the participants, see Appendix G.

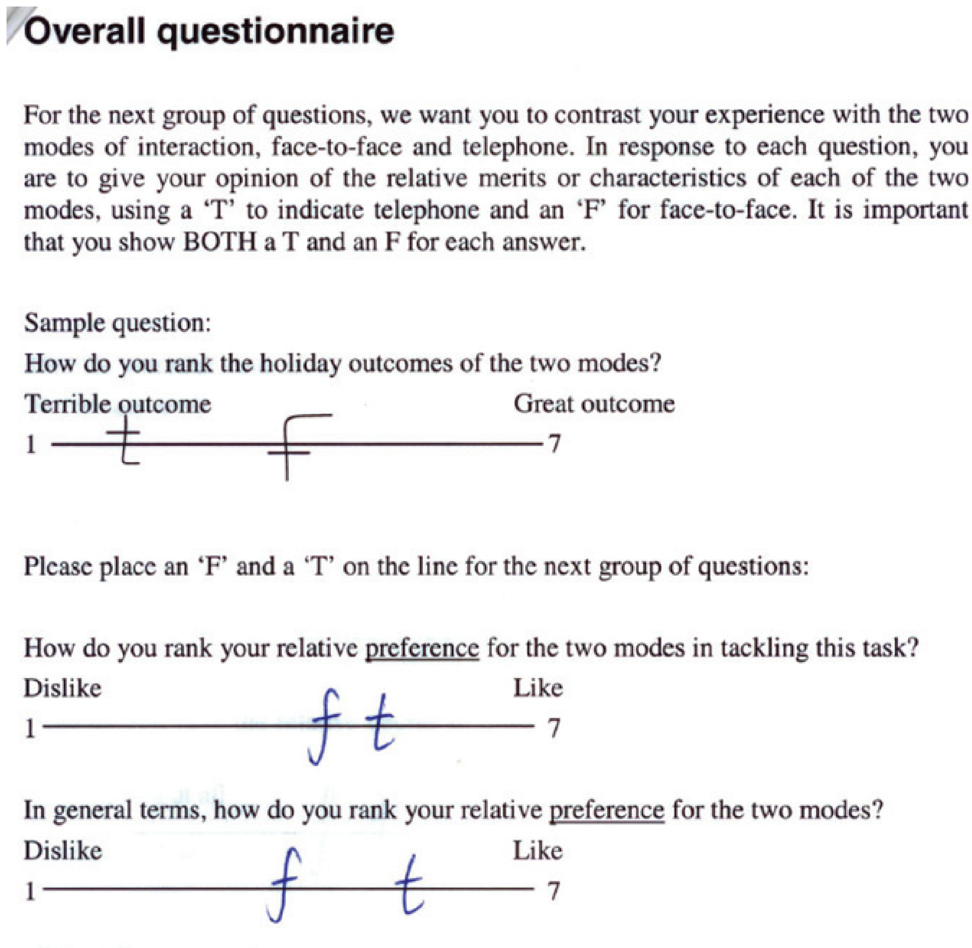
7.1.4 Data Collection

Unlike human-human communication study 1, only subjective satisfaction through questionnaires was collected for this experiment, where the participants were asked to fill out a post task questionnaire after each task. The questionnaire after each task was identical to the one used in Chapter 6 (see Appendix G), which was similar to the one used by Masoodian and Apperley (1995).

Because this was a within-subject study it was possible to ask the participants to compare the two conditions, and hence at the end of both sessions, the participants were also asked to complete a comparative questionnaire, which was similar to the one used by Masoodian and Apperley (1995). There were 11 questions addressing issues such as frustration level, satisfaction and efficiency (for example see Figure 89). The participants were asked to rate their relative preference for each communication mode. Two data sets were collected from the comparative questionnaire:

- Which condition had the highest ranking
- A number between 1 and 7 was assigned to the two conditions depending on the location on a ranking line. In Figure 89, for the 'relative preference'-question, the participant's response would have been recorded a five for the 't'-rating and a 4.5 for the 'f'-rating. Numbers were superimposed, with the aid of a transparency, on the questionnaire to obtain the number (see Figure 90)

The distance between the two conditions on the ranking line was calculated, in the example shown in Figure 89, for the last question the difference would be two (approximately six minus four). To simplify discussion for the remainder of this thesis, the distance between the placed where the participants had place the 't' and 'f' will be referred to as *ranking distance.*


Overall questionnaire

For the next group of questions, we want you to contrast your experience with the two modes of interaction, face-to-face and telephone. In response to each question, you are to give your opinion of the relative merits or characteristics of each of the two modes, using a 'T' to indicate telephone and an 'F' for face-to-face. It is important that you show BOTH a T and an F for each answer.

Sample question:

How do you rank the holiday outcomes of the two modes?

Terrible outcome — Great outcome

1 — t — f — 7

Please place an 'F' and a 'T' on the line for the next group of questions:

How do you rank your relative preference for the two modes in tackling this task?

Dislike — Like

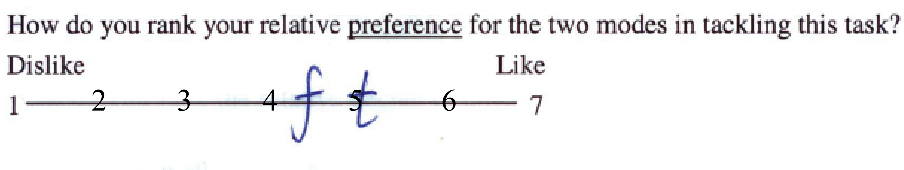
1 — f t — 7

In general terms, how do you rank your relative preference for the two modes?

Dislike — Like

1 — f — t — 7

Figure 89. Example comparative questionnaire question


How do you rank your relative preference for the two modes in tackling this task?

Dislike — Like

1 — 2 — 3 — 4 f 5 t — 6 — 7

Figure 90. Example of numbers superimposed on the ranking from the questionnaire

7.1.5 Materials

As with human-human communication study 1, the experiment was conducted in the Usability laboratory at the University of Waikato; including both the single user room and group user room and the same hardware was used.

7.1.6 Software:

The agent used the AirNZ and Qantas online booking sites. There had been some cosmetic changes to the website from the first experiment, however, the task flow of the sites were still the same (see Figure 91 and Figure 92).

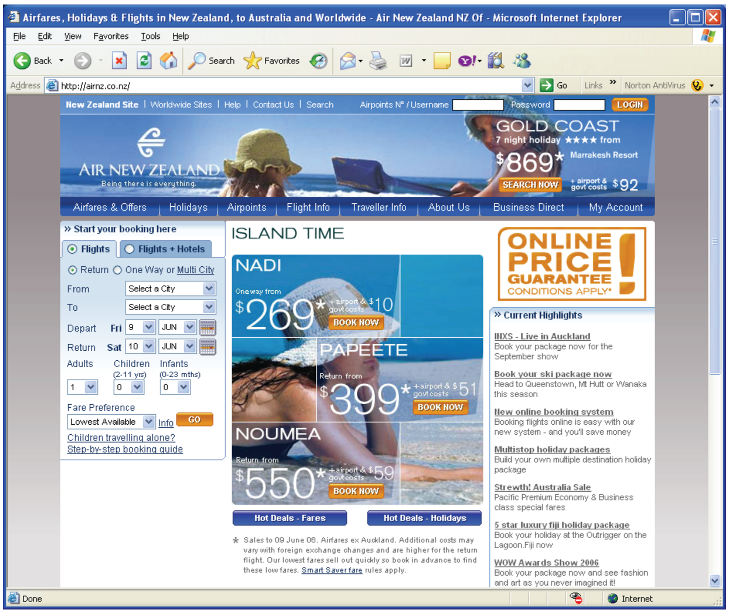


Figure 91. Screen shot of the search page for the AirNZ website

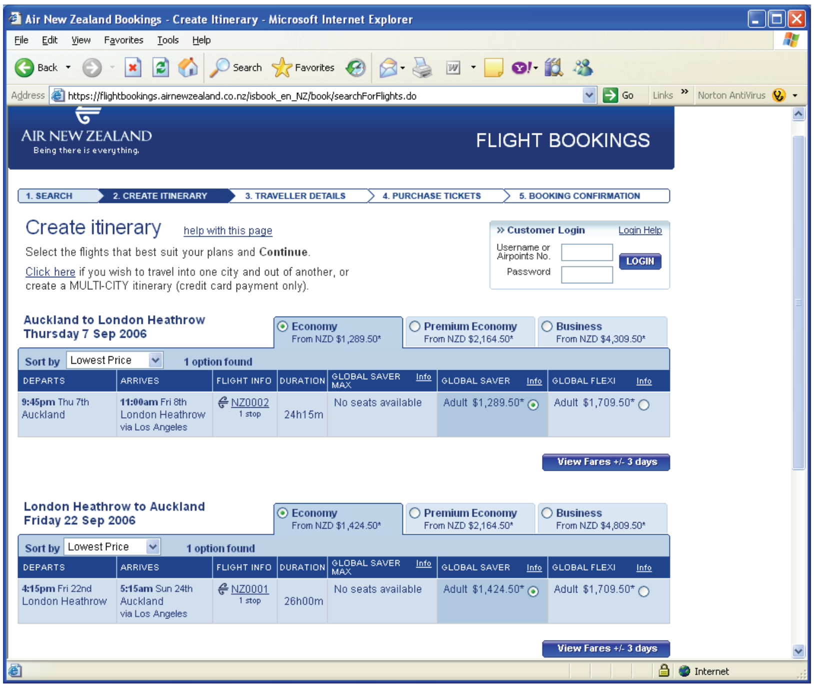


Figure 92. Screen shot of the fights resulting from the search on AirNZ website

All sessions were recorded, and contained the customer and the agent, and the auditory recordings.

7.1.7 Procedure

All participant pairs were greeted together. Hence, even when the participants performed the telephone task first, they had met prior to performing the task. This decision was made as otherwise there would be a larger difference in the established rapport between the participants depending on whether they performed the telephone task or face-to-face task first.

The procedure for each session was:

- Both participants were greeted
- The procedure was simultaneously explained to both participants, followed the ethical consent procedure, which included information that the study was the topic of communication
- Participants performed a task in one condition, followed by completion of a post-task questionnaire
- Participants performed a task in second condition followed by completion of a post-task questionnaire
- Participants completed comparative questionnaire

7.2 Result

Subjective satisfaction data was collected through questionnaires. There were two types of questionnaires: post-task questionnaires after each task, and a comparative questionnaire. The remainder of this chapter describes these sets of data.

7.2.1 Post-task questionnaires

Descriptive statistics for the post-task questionnaire ratings were calculated. There was only a small difference between the conditions (see Table 41) with the mean and median rating being slightly more favorable for the face-to-face condition. The variance was similar for both conditions.

Table 41. Descriptive statistics on subjective ratings from the post-task questionnaire

	Face-to-face	Telephone
Mean	5.39	5.14
Standard deviation	0.93	0.98
Median	5.55	5.30
Max	6.80	6.90
Min	3.30	2.90

The mean rating for each question was also calculated (Table 42). For most questions the rating was slightly more favorable for the face-to-face condition. However, the difference was only small.

Table 42. Mean rating for each question in the post-task questionnaire for both conditions

	Face-to-face	Telephone	Difference
Satisfaction	5.67	5.63	0.04
Frustration	5.38	5.22	0.16
Expected length	3.92	3.91	0.01
Efficiency	4.39	4.41	0.02
Complicated	5.56	5.40	0.16
Completion	6.83	6.54	0.29
Confidence in completion	6.21	6.07	0.13
Understood	6.64	6.38	0.26
Conciseness	5.70	5.32	0.38
Expressiveness	4.73	4.42	0.31

The mean rating for all questions and each participant and condition was calculated (see Table 43). Participants were sorted based on the condition they performed first. Hence participants with odd numbers performed the task in the face-to-face condition first, while participants with even numbers performed the task in the telephone condition first. Five participants rated the telephone condition higher and nine participants rating the face-to-face condition higher. However, for eight of the participants there was only a small difference in the mean overall rating.

Table 43. Mean subjective rating for each participant in each condition

Session	Role	Face-to-face	Telephone	Difference
1	Agent	5.5	5.5	0.0
1	Customer	5.0	5.1	-0.1
2	Agent	4.5	4.3	0.2
2	Customer	5.9	6.9	-1.0
3	Agent	5.6	5.3	0.3
3	Customer	5.6	5.8	-0.2
4	Agent	6.6	6.1	0.5
4	Customer	6.0	6.0	0.0
5	Agent	4.4	5.5	-1.1
5	Customer	3.3	2.9	0.4
6	Agent	5.5	3.8	1.7
6	Customer	6.8	5.9	0.9
7	Agent	4.2	4.9	-0.7
7	Customer	6.3	5.3	1.0
8	Agent	5.9	4.4	1.5
8	Customer	5.2	4.6	0.6

7.2.2 Comparative questionnaire

The final questionnaire asked the participants to compare the two conditions. The higher-rated condition for each question and participant was collected and counted. For example, if the participant had rated as shown in the 'relative preference'-question in Figure 89 one 't' would have been counted.

More participants ranked the face-to-face condition as more favorable, Table 44. The face-to-face condition was ranked higher 102 times as opposed to 68 for the telephone condition.

Table 44. Descriptive statistics of the number of times each condition was ranked higher

	Face-to-face	Telephone
Mean	6.38	4.25
Standard deviation	4.01	3.68
Median	7.00	3.50

There appeared to be large individual differences (see Table 45). Five participants had ranked face-to-face higher over 75% of the time, while three participants had ranked the telephone condition higher 75% of the time. Four participants had ranked face-to-face higher for all the questions and 1 participant had ranked telephone higher for all questions. Only two participants had ranked the conditions higher equally often (customer 5 and 7).

Table 45. Percentage of times each participants selected 'F' or 'T' as the higher ranking

Session	Role	Face-to-face	Telephone
1	Agent	100	0
1	Customer	0	100
2	Agent	18	82
2	Customer	9	91
3	Agent	64	36
3	Customer	91	9
4	Agent	64	27
4	Customer	0	55
5	Agent	73	27
5	Customer	45	55
6	Agent	100	0
6	Customer	100	0
7	Agent	36	64
7	Customer	55	45
8	Agent	100	0
8	Customer	73	27

The number of times each condition was ranked higher for each question was also calculated (see Table 46). For most of the questions the face-to-face condition had greater number of higher rank than the telephone and the only question where telephone had a greater number of higher ranks was for "efficiency".

Table 46. Number of higher ranks for each individual question

Question	Face-to-face	Telephone
Preference	11	5
Satisfaction	10	5
Frustration	10	6
Efficiency	7	9
Effectiveness	8	8
Ease of solving	8	7
Completion	9	6
Being at ease	9	6
Understanding	10	5
Engagement	9	6

As well as analysing which condition the participants had ranked higher, the *ranking distance* was also examined. Numbers ranging from 1 to 7 were superimposed on the questionnaire the participants had filled out (see Figure 89). The number closest to where the participants had placed the 'f' and the 't' was noted down and descriptive statistics were calculated, in the 'relative preference-question in Figure 89 the 't' would be noted as a five and the 'f' as a four.

There was only a small difference between the conditions with the mean *ranking distance* being slightly more favorable for the face-to-face condition (see Table 47). For most participants there was only a small difference in mean *ranking distance* (see Table 48). For 14 of the 16 participants the *ranking distance* was less than two.

Table 47. Descriptive statistics of the *ranking distance* for the comparative questionnaire

	Face-to-face	Telephone
Mean	5.28	4.70
Standard deviation	0.97	1.17
Median	5.66	5.20

Table 48. Mean *ranking distance* for each participant for each condition

Session	Role	Face-to-face	Telephone	Difference
1	Agent	5.14	3.77	1.36
1	Customer	4.36	5.23	0.86
2	Agent	3.36	5.27	1.91
2	Customer	4.91	5.82	0.91
3	Agent	6.27	5.36	0.91
3	Customer	5.55	5.18	0.36
4	Agent	5.80	5.30	0.50
4	Customer	5.83	6.50	0.67
5	Agent	5.77	5.73	0.05
5	Customer	3.18	2.27	0.91
6	Agent	6.18	2.91	3.27
6	Customer	6.45	4.59	1.86
7	Agent	4.73	5.00	0.27
7	Customer	5.82	5.23	0.59
8	Agent	5.77	3.50	2.27
8	Customer	5.27	3.50	1.77

For most of the individual questions, the *ranking distance* was slightly more favourable for the face-to-face condition (see Figure 93). The only question that had a higher mean *ranking distance* for the telephone condition was the completion level.

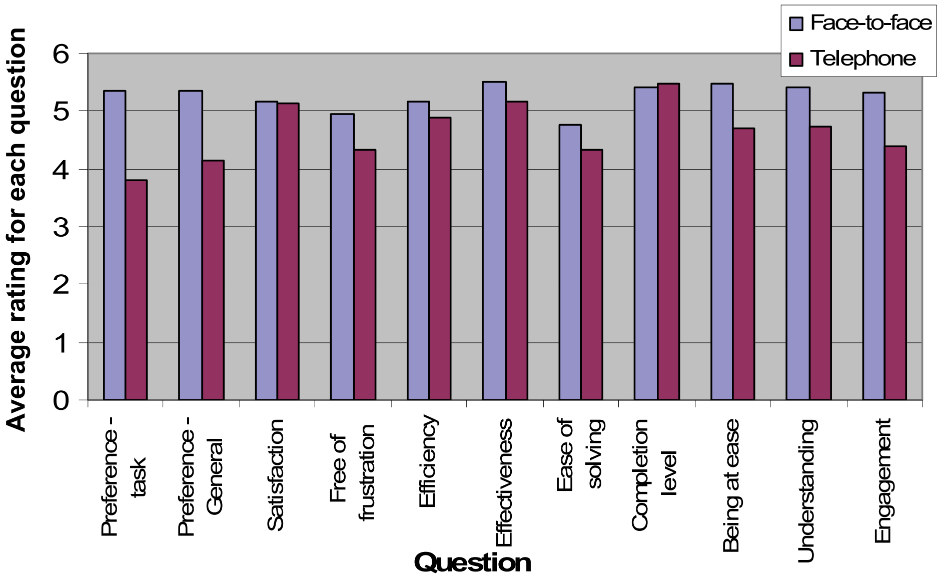


Figure 93. Mean *ranking distance* for each individual question

7.3 Discussion

The hypothesis for this experiment was that there would be a higher subjective satisfaction for the face-to-face than the telephone condition. For the post-task questionnaires there was only a small difference between the conditions, with the face-to-face condition having a slightly higher mean rating on the post-task questionnaire. For all questions the difference in the mean rating between the conditions was less than 0.4, and there was only a small difference for each individual participant, with 11 having less than 1.0 point difference in rating between the conditions. For the comparative questionnaire the participants had ranked the face-to-face condition better more often (6.38 versus 4.25). However, there was only a small difference in the mean *ranking distance* between the two conditions, 5.28 for face-to-face versus 4.70 for the telephone. These findings are consistent with the human-human communication study 1 (see Chapter 6), but inconsistent with other research (for example, Masoodian and Apperley, 1995).

When the participants were forced to compare the two conditions, there was a difference in the ranking between the conditions. But the difference appeared to be due to individual preference, where the participants would either rank face-to-face or telephone higher for most or all of the questions asked. Five participants ranked the face-to-face higher for over 75% of the questions and three participants ranked the telephone condition higher for over 75% of the questions. In contrast, the analysis into the mean *ranking distance* showed only a small difference. For ten participants there was less than one difference in the *ranking distance*. When investigating both the highest ranked condition and the *ranking distance* between them, there were also large individual differences, where some participants had ranked one condition higher most of the time, but there was only a small difference in the *ranking distance*. For example customer 1 had ranked telephone higher for all questions, but there was only a 0.9 difference in the mean *ranking distance*. In contrast, other participants had a large difference between the *ranking distance* means. For example, agent six had ranked face-to-face higher for all questions and the difference between the *ranking distance* of the two conditions was 3.3.

There are several potential reasons why the hypothesis was not supported. The people in this study did not have a vested interest in the outcome and this could have affected their lack of preference of communication modes. As the participants did not have a personal interest in the outcome, the inability to establish the accuracy of the outcome might not affect subjective satisfaction. As this study was conducted in a simulated setting, it is also possible that participants settled for an option that was only average as opposed to an option that fully satisfied all the requirements, and this could have simplified the task and hence had an effect on subjective satisfaction. It is also possible that the nature and complexity of the task was solved equally sufficiently by either face-to-face or via the telephone. Further, it is possible that the restrictions in information-sharing reduced some of the advantages of being face-to-face. With the growth of call centres and other business transactions taking part via telephone, it is possible that people are used to conducting their business via telephone. This might also have had led to the lack of difference between the conditions.

The findings from this experiment suggest a number of areas for future work. The current experiment was a controlled laboratory study, and there was no reward for the participants depending on the outcome of the tasks. Possible future studies include investigating whether the mode of communication has an effect on subjective satisfaction in either a real situation or in a situation where the participants had a vested interest.

It is also possible that the type of setting affected the result and the findings might have been different in a more emotional task, such as visiting a doctor, or a more complicated task, such as booking an extensive trip around the world. Future work includes investigating if the nature of the task has an impact on the mode of communication.

The aim of this study was to clarify the finding from the human-human communication study 1 (Chapter 6). The results from this study agree with those findings confirming only a small difference in subjective satisfaction with the face-to-face condition being slightly more favorable than the telephone condition. The difference in the mean rating of the post-task questionnaires between the conditions was smaller for the study described in this chapter. In the previous study (Chapter 6) it was found that telephone communication is more task-focused and efficient. It is possible that people are equally satisfied with telephone as face-to-face, even though telephone interaction is more task-focused, with less small-talk and a less interactive style of communication.

Both the current study and human-human communication study 1 (Chapter 6) were laboratory studies where the participants did not have a personal interest in the outcome of the task. The next chapter in this thesis reports on a naturalistic study conducted at travel agencies to investigate if the findings from human-human communication study 1 and the current study also hold in a real world situation.

8 STUDIES OF CACI IN A RANGE OF TRAVEL AGENCIES

The two previous chapters, Chapter 6 and 7, report on laboratory experiments investigating human-human communication in CACI (see Figure 60) in a travel agency setting. Chapter 6 reported on a between-subject study, where 50% of the participants interacted face-to-face, while the others interacted via telephone. Chapter 7 describes a second simulated travel agency study, which was a within-subject study where the participants performed one task face-to-face and one over the telephone. The findings from these studies included that there was a difference in communication style due to mode and that the telephone mode was more task-oriented, however, there was only a small difference in outcome and subjective satisfaction. This chapter presents a set of studies conducted at a number of travel agencies. There were two main aims; to investigate if the findings from the laboratory studies also hold in a naturalistic setting, and to identify areas that would potentially enhance the agent-computer channel of communication (see Figure 94).

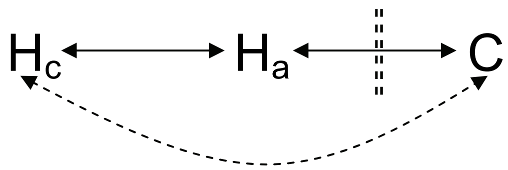


Figure 94. Repetition of Figure 9; Investigations into the agent(H_a) – computer channel of communication

In the study described in Chapter 6 the participants performed a flight booking task and the findings from this experiment included:

- Participants in the face-to-face condition were engaged in more single activities, such as just talking. In contrast, in the telephone condition, people were mainly engaged in dual activities, such as talking and reading
- The telephone condition was more task-oriented
- There was a difference in communication style due to the medium; face-to-face communication was more interactive with higher number of utterances that were of short duration, while the telephone interaction had longer, but a fewer number of utterances
- There was only a small difference in outcome and subjective satisfaction between the conditions

In Chapter 7 a second study investigating human-human communication focusing on subjective satisfaction was reported. These confirmed the findings described the study in Chapter 6, that the communication mode does not appear to have an effect on subjective satisfaction.

When people collaborate co-located, with an absence of computers, distinguishing between shared and private documents occurs naturally through the orientation, for instance, facing towards the owner signals private and facing towards the other users signals shared, and location of those documents, for example, in the user's drawer, in-front of user or in the middle of table (Wang and Blevis, 2004; Kruger *et al*, 2002). In contrast, in collaborative computing shared versus private documents have to be explicitly incorporated in the software (Greenberg *et al*, 1999; Hinckleyss, 2003).

Ethnographic studies in travel agencies focused on finding methods for improving the interaction between a computer, agent and customer in face-to-face interaction (Rodden *et al,* 2002; Scaife *et al*, 2002). Scaife *et al* (2003) describes an extensive ethnographic study at travel agencies, including observations, video-taping and interviews. They focused on how the customer and agent interacted physically face-to-face, for example, how they shared information or talked to each other, and how the information was represented, for example in brochures, on paper or on the computer. During their observations they noted that the agent only rarely shared the computer screen with the customer. Scaife *et al* (2002) argue that sometimes there was a good reason for the lack of sharing, because some information is private to the agent (for instance, the agent's commission), but sometimes it was due to the information being too complicated for the untrained eye, in tables and codes, which would be very difficult for a customer to understand. They found that the main problem was the asymmetry between the customer and agent, both with regard to the physical layouts of the travel agents' workspace and in the information representation. Based on their findings they developed a novel system, which included a different physical layout (the participants were sitting side-by-side), three screens that both customer and agent could see, as well as a different information layout on the screens (see Figure 95).

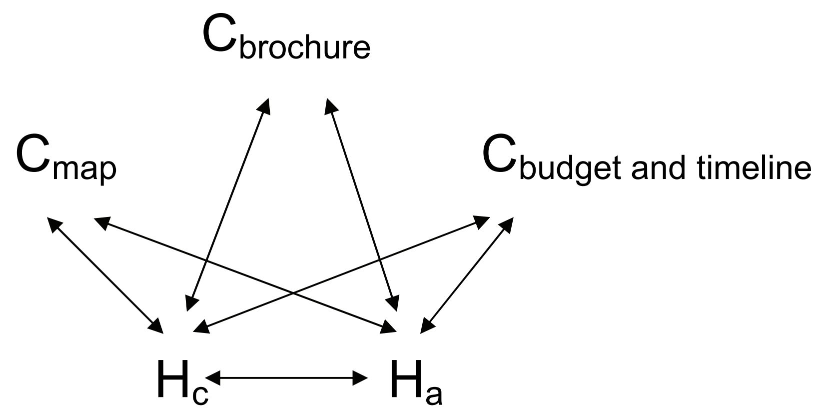


Figure 95. Visual representation of the physical layout of Rodden *et al's* (2003) novel system for CACI in a travel agency

Halloran (2002) and Scaife *et al* (2002) conducted ethnographical observational studies at a travel agency, investigated how information was accessed, configured, and used during customer-agent consultations. They suggest that there were three stages in travel agency transactions; approach stage, development stage and the closure stage, and that the 'approach stage' was very critical, as this was where the relationship between the agent and customer was established. The two parties collaborate with different goals, but which were mutually dependent. There is an asymmetry between the information available for the customer, for example, brochures, and the information available to the agent, such as the computer system. This could lead to misunderstandings or problems when planning a trip. They also found that the difference in information representation could constrain effective collaboration. Additionally, the physical layout between the customer and agent at a traditional travel agency does not help the interaction between the customer and agent. The system described by Halloran (2002) had a different physical layout, where the agent and customer were sitting side by side and the information was displayed for both the customer and agent (Figure 95). There was also extensive work into the graphical representation of the interfaces. The screen on the left (C_{map}) was an interactive planner where the itinerary was formed. As changes were made on left screen (C_{map}), relevant information from the online brochure was shown in the middle screen ($C_{brochure}$). The right screen ($C_{budget\ and\ timeline}$) shows the timeline and budget for the itinerary that was developed on the left screen (C_{map}), and as changes were made the results were automatically updated on the $C_{budget\ and\ timeline}$ screen.

The studies discussed in this chapter are different from these previous research, in that the aim is to look at both face-to-face and telephone interaction, and to consider all stages of a travel booking. The intent of the studies reported in this chapter, was also to investigate if the findings from the laboratory studies (see chapters 6 and 7) hold in a real setting. There was also an interest to get a general better understanding of the computer-human interactions that take place in all stages of travel agency transactions. The aim of the research in this chapter was to:

- Investigate the validity of the finding from the laboratory study in a realistic travel agency setting, such as
  - Communication style; face-to-face spent more time in single activities, while the telephone condition spent more time in dual activities
  - Content of communication; people talk more about non-task related topics while face-to-face
- Investigate if the constraints from the laboratory study would make a difference in a realistic setting
- Investigate the general characteristics of CACI in a real travel agency
- Identify potential areas of enhancements to the computer agent communication channel

There were four stages to the study:

- Observations of CACI in a travel agency
- Interviews with agents
- Focus group interviews with experienced agents regarding potential enhancements
- Observations focusing on potential enhancements

Section 8.1 describes the observational studies conducted at four different travel agencies and Section 8.2 reports on follow-up in-depth interviews. In Section 8.3 the focus group discussion potential enhancements that were identified during observations and interviews are described. To further investigate one of those enhancements a proof of concept study was conducted which is reported in Section 8.4.

8.1 Observations and contextual interviews

The initial observational study was carried out at four travel agencies. The aim was to investigate whether any of the findings from the laboratory experiment would also apply in a natural setting. The intent was also to get a general understanding of the interactions that take place between computer and agent, including the impact that the customer has on that interaction, at travel agencies.

8.1.1 Method

For this study observations were performed at four travel agencies in different locations with different target markets (see Table 49). The physical settings, such as size and layout, also varied in between the different agencies (see Table 51).

Table 49. The agencies where observations were made

Travel agency number	Location	Focus	Agents observed	Time spent
1	City centre	Private, low budget holiday	3	6 hours
2	University	Private, personal travel	3	6 hours
3	Suburb	Private, holiday and personal travel	4	6 hours
4	Suburb	Business travel	4	5 hours

In total, 14 agents were observed over 29 hours (see Table 50). At each travel agency three or four agents were observed. Both male and female agents were observed and ages varied from 21 to 53 years old. The observed agents had levels of different experience and expertise.

Table 50. Breakdown of the level of experience of each observed travel agent

Travel agency number	Inexperienced agents	Moderately Experienced agents	Very experienced
1	1	1	1
2	1	1	1
3	2	1	1
4	1	2	1

Table 51. Description of the physical setting of the travel agencies

Travel agency number	Location	Setting
1	City centre	A long desk where 4 agents could work, and also one desk separately. In face-to-face interaction, the customer sat on the opposite side of the desk. The agents could accept payment at their desk, but had to leave their desk to get printouts. Each agent had a PC and a telephone in their workspace. Brochures were located on the walls behind the agents. There was no designated waiting area. There was very little free physical space in the agency that was not filled with desks and chairs.
2	University	The agency had four separate desks with one agent working at each, with a PC and a telephone. For face-to-face consultations, the customer sat on the opposite side of the desk. The agents had to leave their desk to accept payment or collect printouts. There was a small waiting area where the brochures were also located. The office was reasonably spacious with only four desks.
3	Suburb	There were approximately 20-30 desks. Many of the desks were joined with other desks, while some stood alone. There was one agent with a PC and telephone at each desk and in face-to-face communication the customer sat on the opposite side of the desk. The agents had to leave the desk to take payment or collect printouts. There was a designated reception and waiting area, where the brochures were located. The reception area was relatively small and there was no free space, and the remainder of the agency was almost entirely filled with desks and chairs.
4	Suburb	There were approximately 20-30 desks that were mostly joined together in groups of four. The agents did not interact with customers at their desks. If a customer came in to the agency, the agent communicated with them in the reception area. There were no waiting area and no brochures available for customers because customers were discouraged from interacting with the agents face-to-face.

For the face-to-face consultations the customer and agent were observed, as well as any interaction with the computer. For telephone communication, observations were made of the agent's interaction with the computer and any other artefacts, as well as listening-in on the agent-customer conversation via an added headset.

The study was unstructured and controlled by the incoming customer requests. Observations were made of the usual work of the agent as well as the interaction between the customer, agent and computer. The research was non-intrusive, the researcher did not directly influence the normal interaction between the agent, customer and computer.

Because the observations took place at real travel agencies there was a possibility of a sensitive situation arising, such as an unhappy customer or the customer becoming uncomfortable with being observed. To minimize any stress of discomfort by the customer or agent, an observations discontinuation signal had been agreed on between the researcher and the agent prior to the session. If a sensitive situation arose the agent would give the signal, and the observer would leave the table. However, no situation occurred where the observer was signalled to leave.

The main methods used for this study were:

- Observing
    - The communication between customer and agent
    - The use of artefacts
    - how the conversation and artefacts interweave
- Interviewing
- Taking notes

Due to privacy regulations and commercial sensitivity, it was not possible to audio or video record the observations and it was not possible to take photos of the workplace. The researcher had to rely on handwritten notes. Prior to the study, note-sheets had been developed to simplify recording of the observations. The note-sheets incorporated tick-boxes as well as an area for comments (see Figure 96).

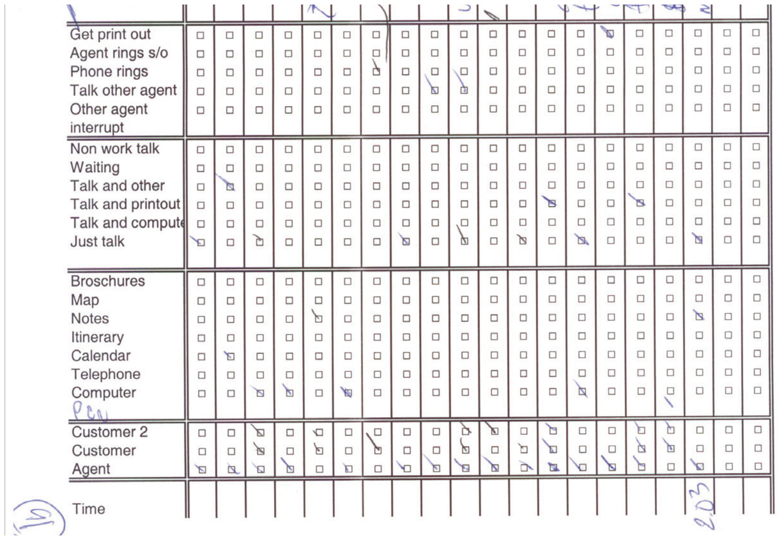


Figure 96. The note-sheet used for the observations at travel agencies

At the end of each session, when time permitted, the agents were interviewed. The enquiries aimed at discussing issues that arose during the interaction with that specific customer. General interviews were at the end of a session with an agent. Due to the unstructured nature of the interviews, there was not a predefined note-sheets and hence the observer wrote down the answers on separate paper.

Data collection included:

- Do the findings from the lab study hold in a realistic situation?
- Do the agent and customer engage more in single versus dual activities?
- Does the customer make more small talk face-to-face?
- Do the constraints from the laboratory study make a difference in a real situation?
- General observations

8.1.2 Findings

It was observed that customers interacted with the agencies more than once for a single trip booking. The amount of contact varied between the different agencies (Table 52). As identified by Halloran (2002) there are different stages to the trip booking:

- Quote
- Booking
- Pay deposit
- Pay full
- Pick up ticket

Table 52. Number of times of contact with customers for a single trip

Travel agency number	Location	Focus	Number of times of contact
1	City centre	Private, low budget holiday	4-5
2	University	Private, personal travel	5-7
3	Suburb	Private, holiday and personal travel	7-10
4	Suburb	Business travel	3-5

The asymmetry between customer and agent discussed by Rodden *et al* (2003) and Scaife *et al* (2002) was also observed in this study. In all the travel agencies the customer sat on the opposite side of the desk to the agent (see Table 51), which does not lend itself to sharing the agent's main information source, namely the computer. In contrast, the main information source for the customer was brochures and verbal communication from the agent.

There are different genres of travel, including, commercial travel, for example business trips, and private trips, such as holidays. There seemed to be a difference in how people interacted depending on the nature of the trip as well as the type of travel agency. The commercial travel agencies deal more with people on the telephone as opposed to face-to-face. They also seem to spend less time making small talk and concentrating on being efficient. The trips seemed to be more fixed, that is, the customer knows exactly when and where they want to go and there is very little room for alternatives.

The holiday travel agencies on the other hand seem to interact more face-to-face. There also seemed to be more emphasis on making small talk. A further difference between the genres is that personal holidays are often dynamic and the details and requirement changes as the trip is being booked. It is not unusual for a customer to ask an agent something like: “I would like to go on a holiday to a warm tropical island sometime in June”. The uncertainty and changeable nature of the task often leads to several communications with the agency, and work being done both synchronously and asynchronously.

Travellers usually rely on a combination of communication modes. In the interview at the end of the sessions, it was identified that for most agencies the customer came in for face-to-face communication at some stage and it was rare that all communication was done via telephone or email. There was also a difference in how people made the initial contact with the agencies, and what medium they choose to use (Table 53).

Table 53. Most common way for a customer to approach to the travel agency

Travel agency number	Approach method
1	Face-to-face - Drop by as they are walking past
2	Face-to-face - Drop in as they are at campus anyway
3	Telephone contact with appointment to see agent
4	Mostly telephone based conversation

Do the findings from the lab study hold in a realistic situation?

From the observations it was suggested that the laboratory finding relating to dual and single activities depending on communication mode also held in a realistic situation. When the customer and agent interacted face-to-face it appeared that they spent more time in single activities, such as just looking, just waiting, or just searching. The agent often focused all their attention on the customer while they were talking. In contrast, while communicating via telephone the agents seemed to spend time in dual activities. The organisation representative worked on other tasks while talking to the customer. As they were gathering requirements from the customer, for example, they started searching for the most suitable travel arrangements and some agents were even working on another customer’s task, while talking to the new customer.

The finding that the telephone is more task-oriented also appeared to be the case in a real travel agency setting. There seemed to be more non-work related talk in the face-to-face condition, while the telephone condition was more focused on the task. While interacting face-to-face the customer often shared information about their trip that did not add necessary information for the purchasing of the trip. For example, "*my wife recently died, so I thought it was time I visited my daughter*". It was also observed that the agents in face-to-face interaction sometimes shared their own experiences with the customers, such as "*I have flown with Singapore [airways} and they are very prompt with the food*", even though this did not directly help the process of finding a trip. In the interviews some agents said that they sometimes feel like counsellors and felt that, mostly when communicating face-to-face, they had to talk to the customers about non-work related topics. Additionally, they stated that they sometimes felt that the customer came in to the agency mostly to chat, rather than work at the task at hand. Sometimes the customer was just excited about the trip, and wanted someone share it with. In contrast, there was only a small amount of social talk in the telephone interaction, with very little added unnecessary information, and at no stage was it observed that the agents shared any personal anecdotes.

Do the constraints from the laboratory study make a difference in a realistic situation?

A constraint of the laboratory study described in Chapters 6 and 7 was that the participants were only allowed to communicate verbally. They were not allowed to share paper, the computer screen or other artefacts. One aim of the observational study was to investigate how, and if, people use other forms of communication, such as sharing paper or computer screen or pointing.

Harper and Sellen (2001) suggest that although the 'paperless office' was predicted, computers appear to have increased the used of paper, which was observed in this study as there was substantial use of paper in the interaction between customer and agent. Paper was used as a communication tool with customer. While in discussion to find the most suitable travel option paper was used for making notes about different flight, reading and discussing different options, keeping track of details of a customer's booking etc. Most of these tasks could have been done on the computer, such as reading information and making notes. However, the agents often choose to do the work on paper instead. They printed out some flight information, and then used the printout to work with the customer to find the best option, while simultaneously checking details on computer. They also commonly wrote down the new details they found on the computer on the piece of paper. This observation is consistent with, for example, Rodden *et al* (2002) finding that there is an asymmetry between the customer's information, such as brochures, and the agent's, mainly the computer screen, information representation.

Paper was also used as a tool when the customer was not present. The more experienced agents were able to keep mental records of the information, while the more inexperienced ones would print out and read a lot of the information. The newer agents used paper to ensure that all necessary work had been done. They printed different kinds of information, for example:

- Rules, such as certain ticket restriction rules, rental car rules, insurance rules
- Customer details, for instance various options for the planned trip
- Information and documents the customer needed, such as itinerary, booking details

An interesting observation was that despite the extensive use of paper, some agents were reluctant to write down quotes to customers, in particular early in the quote stage. In the interviews the agents stated, that the reason for this was that many customers approach several travel agencies before deciding which to use. If a traveller approaches an agency with a written quote from a different agency, some travel organisations will match the quote and the initial agent would lose the sale.

As well as the extensive use of paper, it was also observed that the agents relied on other physical artefacts as opposed to their electronic equivalent. In particular they made extensive use of physical calculators and calendars. At no point during the observations did any agent use the electronic calculator or calendar.

General observations

The travel industry is inherently complicated, in contrast with, for example, power company queries. There are a number of potential travel options, which are not static but changing depending on, for example, available flights, destinations and ability for the customer to take time off work. In power call centres the information pertaining to the task are static, for example, “I am moving from address 1 to address 2”. While in travel setting the detailed information might not be as static, for example, “I want to fly to Europe over Christmas”. Further, travel agencies book a number of services and products for a customer in addition to the flight booking. Their service include flight bookings, accommodation booking, rental cars, tickets to shows, package deals etc. Many of these services are not actually handled by the agency, but the travel organisation acts as an intermediary between the customer and the service providers. It has been suggested that an agent in a service providing organisation is an ‘intermediary’ between the customer and computer (Lawrence, Atwood, and Dews, 1994, and Lawrence, Atwood, Dews, and Turner, 1995), however, in this situation, it appears that the agent is a ‘surrogate’ between customer and other wholesale providers.

There is often a form of negotiation between the agent and customer to ascertain the best date, airline and destination. As the customer approaches the agency they have an idea of where and when they want to travel. Sometimes these ideas are fairly specific, for example, I want to travel to the Gold Coast in Australia on Labour weekend. However, sometimes the requirements are very vague, for example, I want to go on holiday sometime in June to a warm resort somewhere not too far from NZ. Even for a specific request there are a number of options to consider. However, for a vague request, there are a large number of options to consider, such as the destination and date, but also price, airline, accommodation, weather at the location around the date etc. As the agent and customer talk about different options, they negotiate on details, such as price and accommodation options, during which time the agent is also establishing the customer’s detailed preference, for instance, an all-inclusive tourist location versus an adventure trip. During this negotiation, the agent has to look at many different flight options, both with regard to the different airlines, and the dates and destinations.

It can also be hard for the travel agent to establish what the customer actually wants, especially as the customer might not even know themselves. Many agents said that they felt unappreciated by customers (and sometimes the company) about how much work there is involved in finding a satisfactory option. There is a lot of work relating to finding a suitable trip, only to find out that it was not what the customer actually wanted. It was observed that the agent would often obtain the required information from the customer, and then ask them to come back at a later stage due to the amount of work needed to work on the options. This happens even when the customer has come in to talk to the agent.

It was also observed that the agents leave the communication with the customer, to enquire about some detail with another representative. This could be because the other agent has also dealt with the customer, or because the other person has some information relating to the current customer's trip.

Breakdowns

During the observations there were only two breakdowns. One involved a customer not realizing that she had to pay ticket in full before a certain date. The customer had not done so, and the ticket therefore ended up being more expensive. It was a fairly significant increase, which was due to changes in petrol taxes the airlines charged.

In this situation the customer claimed that she had not been told that she had to pay before a certain date. However, the agent who handled the customer initially had made notes on the computer stating that she had informed the customer, and that the customer said that she was coming in on the following Monday. This was a situation where having made computer notes was very useful for the travel agency.

The other breakdown was with a "difficult customer". The customer had booked a musical via the travel agency. However, he also bought tickets to the same musical over the internet. In the end he did not want the ones from the travel agency as they were more expensive. However, the agency had already purchased the tickets through an outside company and they were not refundable. However, despite asking the agent to purchase the tickets, the customer refused to pay for them. Due to the relationship the agent has with the ticket wholesale company, they agreed to take the tickets back and sold them on. The agent in this circumstance was asked why this customer was considered difficult. The reply was that he kept changing his mind, and did not realise all the work the agent had to do for all the different bookings. She added that the customer was difficult because he didn't seem to appreciate the work she was doing. She also stated that he would argue over every detail. The agent had dealt with the customer before and made sure she made careful notes of any conversations, she also printed out all electronic interaction and information.

Interface design

As mentioned earlier, customers often communicate with a travel agency several times before a final purchase is made. However, there did not appear to be much support for the agent to revisit previous work done with a customer. All travel agencies relied on the agents making notes about the customer and their proposed trip. One agency used electronic notes. They said that it was a great facility, and would work really well if everyone used it, however, this was not the case. The notes had to be made separately, there was no automatic notes made from the booking software. The other agencies relied on paper notes. One agency kept a very extensive hardcopy folder about each customer and their trip, while another agency was more sparse and informal with their note making.

As mentioned before, there were often many alternatives considered before a customer and agent found an option that best satisfies the customer's needs. It was common that the customer would say, for example, "*can we look at the one [flight option] you talked about 2 or 3 options ago again*". However, the software did not appear to support the need for viewing and revisiting different options. There did not seem to be any history mechanism, saving or highlight facilities. To revisit a previous alternative the agents then had to either scroll through a sequential list of options with no obvious separator, or try to remember the criteria and redo the search. Many agents printed out potential options and used them as a point of reference for discussion with the customer. Once the number of alternatives had been narrowed down, the agent would again search for the options.

It did not seem like the computer system supported organising information on the screen to help search for a many different flight options, nor to support the interaction with the customer. The main interface that the agents use is a blue screen with white text in capitals which caused problems:

- It is hard to read (the screen was entirely in capital letters)
- Hard to find previous queries
- There is only a scrolling mechanism for finding previous queries
- There is no easy-to-understand history mechanism
- There is no easy way to show multiple alternative flight options
- Each flight option has to be searched individually

The agencies often tried to assign one agent to a customer. This was partly because there did not seem to be an easy way for another agent to take over the work on a certain customer, and in part because the agent had established a rapport with the customer. Often there had been communication between the customer and the initial agent that had not been noted down.

8.1.3 Summary

General observations were that the travel industry is complicated and dynamic, as the customer might not be fully aware of what they want. This is in contrast with, for example, the power industry where the task is simpler and the detailed customer information are static. Further, customers often get in contact with a travel agency several times before a task is completed. However, there did not seem to be much software support for revisiting previous work with a customer again. There did not seem to be any history or saving facilities.

From the observations it appeared that the findings from the laboratory study also hold in a realistic setting. When people were interacting face-to-face they spent more time in single activities, while interacting via a telephone they were engaged in more dual activities. It also appeared that the communication was more task-oriented over the telephone, and included more small-talk while interacting face-to-face.

It was also observed that the constraint from the laboratory study was not realistic. The agents heavily relied on paper, for example, in discussion with customer, keeping track of bookings or for reading rules. The agents also used paper as a basis for communication with the customer, as a point of reference while finding the optimal flight.

8.2 In-depth interviews

To gain a better understanding of the use of communication mode and style, artefacts and use of information, in-depth interviews were conducted with eight travel agents.

8.2.1 Method

Interviews were conducted at three of the four agencies where the observations had been conducted. The fourth observed agency was too busy to allow time for in-depth interviews. The agencies where interviews were conducted are listed in Table 54.

Table 54. List of agencies where interviews were conducted.

Travel agency number	Location	Focus	Number of interviewed agents
2	University	Private, personal travel	2
3	Suburb	Private, holiday and personal travel	3
4	Suburb	Business travel	3

Agents of different experience and expertise were chosen for the interviews (Table 55). The number of years of experience in the travel industry ranged from 6 months to over 30 years. Some of the agents had worked in a variety of areas in the travel industry while others only had limited experience. The agents were also in different positions in the agencies, from junior agent to company manager.

Table 55. Breakdown of the level of experience of each interviewed travel agent

Travel agency number	Inexperienced agents	Moderately Experienced agents	Very experienced
2	1		1
3	1	1	1
4	1	1	1

To cover the issues that had arisen from the observations, four categories of questions were asked:

- How does the medium, face-to-face, telephone and email, affect the communication?
- How much of the communication is work-related? Is there a difference in the amount of non-task related communication depending on mode?
- How do they use physical artefacts versus electronic artefacts, including paper, calculators and calendar?
- How do the agents receive, remember and use information?

The interviews were semi-structured. There were a set of questions (see Appendix H), however, the agents were encouraged to expand on any information or issue. The interviews were tape-recorded and at the end of all sessions, the recordings were transcribed.

8.2.2 Findings

Mode of communication

The agents were asked questions about the use of the different medium of communication. All of the agencies reported relying on a range of modes, such as, telephone, face-to-face, email and fax, for customer communication. However, the extent of each medium appeared to depend on the genre of the agency (see Table 56). Both the private travel agencies use all modes for communication, while the business agency relied much less on face-to-face than did the other agencies.

Table 56. Frequency of each medium used for communication with customer

Travel agency number	Location	Face-to-face	Telephone	Email
2	University	33%	33%	33%
3	Suburb	33%	33%	33%
4	Suburb	10%	45%	45%

Different modes of communication were suitable for different stages of the travel booking process. For the private travel agencies face-to-face seemed to be used initially. During this stage, the customer was often given hardcopy information, such as initial quotes and brochures, and the detailed requirement of the travel was established. During the intermediate stages of the process, information was usually passed back and forth between the agent and customer via email or telephone discussion. However, it was common that customers would come in again for further face-to-face discussion. The agents stated that email was particularly useful for sending larger amount of specific information, such as flight details or various accommodation options. For the business agency, there seemed to be a larger focus on email and telephone, and telephone was particularly used for the initial stages, and thereafter predominantly email.

The agents also stated that the difference modes of communication each had advantages and disadvantages. Telephone and email were more suitable for simpler, less complicated travel booking. In contrast, for more complicated travel purchases face-to-face was more suitable in establishing the requirements. For larger travel plans, face-to-face was often preferred because it is more personal, for example, one agent said that "*face-to-face interaction is more personal and more exciting for the customer*" (Agency 1, agent 3) and another stated that "*the minute the customer walks in, should be the start of their holiday*" (Agency 2, agent 1).

Communication style

In the laboratory experiment, the findings suggested that the telephone condition was more task-focused, while there was more non-task related communication in the face-to-face condition. During the interviews, the agents were asked about communication style, how much of the conversation was task-specific and how the medium influenced the dialogue.

The agents stated that non-task related communication was more prominent in face-to-face interaction, and virtually non-existent in email interaction. Some small-talk took place in telephone communication, but not as much as face-to-face. One agent said that he would purposely ignore attempts at non-task related communication via email. If the customer, for example, asked how his day was going, he ignored it and continued with the job at hand.

There seemed to be a difference in how much non-task related communication the agents claimed to make, even within the same agency. Some agents said that they liked small talk and that up to 40% of the communication was non-task related communication. Another agent stated that "*even communication that appeared to be non-task related, was actually work related*" (Agency 2, agent 2). Through chatting to the customer about non-task related topics, they were actually gathering further information that would ultimately help the agent plan the trip for the customer. Some agents suggested that non-work related communication added to the customers' overall experience of their holidays. One agent stated "*the minute the customer walks in, should be the start of their holiday*" (Agency 1, agent 2). Another said "*if the customer didn't want personal touch, that is, chit chat, they would use a computer*" (Agency 2, agent 2). Sometimes the agents used non-task related communication to avoid silence, in particular while waiting for the computer. One agent said that she hated silences while the customer was just sitting there waiting and she would make small-talk even though this slowed down her work on the computer.

The private travel agencies seemed to encourage non-task related communication. They argue that it is important to build a relationship with the customer, and part of doing that is non-task related communication. To maintain this relationship, the private travel agencies also prefer to keep the customer with the same agent. For the business agency, on the other hand, there was only a small amount of non-task related communication. They argued that their customers would think they were inefficient and unprofessional if they wasted time with non-task related communication. However, they did also state that once a rapport had been established with a client some small-talk took place.

Artefacts

During the observations it was noted that many of the agents relied on the physical version of artefacts, such as paper documents, calculators and calendar, rather than the electronic versions. In particular it was noted that the agents relied heavily on paper-based artefacts. They printed out information that was available on the screen for their own reading, printed out alternative itineraries for the clients as well as printing out some electronic communication with customers. This was done despite the fact that the information was readily available on the computer. The private travel agencies seemed to rely on paper more than the business agency.

During the interviews the agents were asked why they used paper in discussions with the customers. The agents provided the following answers:

- "*Because it [paper] is real*" (Agency 3, agent 1)
- A focus point to talk over
    - "*Point of talking about"* (Agency 2, agent 2)
    - *"Can tweak the details on paper, talk over it, check on computer, make notes on paper, then book the actual flight details"* (agency 1, agent 1)
- *"Easier to read than on the computer"* (agency 3, agent 1)
- *"Can't use the computer, as the customer would not be able to understand what's on the screen"* (Agency 1, agent 3)
- *"Make sure that all things have been covered"* (Agency 3, agent 1)

For the business agency, they said that they would like to move away from using paper. However, one agent stated that "*the travel industry is still very 'paper hungry'* (Agency 3, agent 1)". He also said that there are advantages of paper, such as that "*the satisfaction you get from being able to physically chuck it in the bin when you are done*" (Agency 3, agent 1).

It was observed that the agents only very rarely turn the computer screen around and share it with the customer. During the interviews the agents were asked why they did not share the screen, but rather printed the information out on paper. The agents said that it was too hard for the customer to make sense of the information on the screen and the agent felt that they would waste time explaining the content. The other reason was that they did not want to share all of the information on the computer screen, such as the agent's commission or options that they did not want to pursue.

It seemed that most of the agents use a physical calculator as opposed to the calculator on the computer. When asked, common reasons were:

- *"it is more convenient"* (Agency 2, agent 2)
- *"more used to it"* (Agency 1, agent 2)
- *"don't want the customer to see the screen (commissions and stuff)"* (Agency 1, agent 3)
- *"it is easier to show the customer the calculator"* (Agency 2, agent 1)
- *"some cultures are used to using the calculator"* (Agency 1, agent 2)
- *"physical objects are more portable, for example, [to] take to the EFTPOS machine"*

Another reason mentioned for using a physical calculator, was because the price stated on the computer screen for a certain booking, was not actually the price the customer would pay. The price on the screen is the wholesale price, but in addition there are taxes etc. to be added, and the travel agent's commission.

For the private travel agencies, it was observed that the agents predominantly used a physical calendar, as opposed to the one on computer. The reasons the agents gave for this, were for example:

- "*point of reference to talk over with customer*" (Agency 2, agent 1)
- "*doesn't clutter up the screen*" (Agency 2, agent 1
- "*habit*" (Agency 3, agent 3)

One agent in the business travel agency was the exception; he relied almost completely on the electronic calendar, but still used a physical calculator.

Information

During the observations it was noted that agents in a travel agency receive, use and have to remember, significant amounts of information such as, flight options, specials, new rules or changes to tax. During the interviews the agents were asked questions about the levels of information as well as strategies for working with the information.

The travel agents have to draw on a large pool of information, on top of all the standard information, such as flight prices, airlines, destinations, hotels etcetera, there is also new information arriving all the time, including specials, flight changes, taxes, change in regulations, package deals, etc. Information comes through a variety of channels, such as, email, letters, faxes, telephone or magazines. The frequency of the arrival of new information varies from weekly to several times per day. The information comes from a variety of sources, for example, wholesalers, airlines, and also different people in the agency, both on a local level and from the head office. To further complicate the work of a travel agent, it is not uncommon that a certain piece of information arrives multiple times from different sources.

In the interviews the agents were asked how they remember all this information. Individual agents had different strategies for remembering the information, such as physical folders, organized email folders or checking with other agents. However, many of them said that mostly that they just had to memorise, which was particularly hard for the newer agents. Most agents stated that generally they are not able to remember all the new information. Even when they were able to remember that there was some new information, they found it hard to find specific details about the information. One agency tried to ease the agents' information load by assigning certain agents to particular travel areas, for example, European travel or resort-type holidays near New Zealand.

During the observations and interviews it was noticed that the travel industry is very dynamic. The nature of the interaction between the agent and customer becomes much more of a negotiation, which often leads to a lot of information being passed between the representative and traveller, and, many customers have contact with the agency multiple times for a single trip. However, it is not always possible for them to talk to the same agent, and this can lead to some re-sharing of information, and previous discussions being repeated. During the interviews, the agents were asked about taking over a customer, and how they found out what information had already been passed between the previous agent and customer.

It seemed that each agency has some mechanism in place to keep a record of the information passed between customers and agents. One agency had a computer note system, where the agent filled out the details, while another had physical paper folder system, where the agents could put written notes or print-outs. However, none of the travel agencies had an automated system for storing information. It was observed that agents often did the search again, rather than trying to find the relevant notes. In the interviews, the agents stated that entering and finding information into the note system was often more time consuming then simply performing the search again. One agent stated "*if it is a fairly simple search, it is quicker to just do the search again rather than waste time making notes*". Further, many agents said that they kept the information stored in their head, as opposed to in the note systems. In particular, the more experienced agents were less likely to make or keep notes. However, most of the agents agreed that it would be a lot easier to take over a customer if there were more notes made, but, the overhead in making the notes seemed to outweigh the benefits.

8.2.3 Summary

All of the agencies seemed to rely on a range of modes for customer communication. Different medium seemed to serve different purposes, depending on how complicated or emotional the task was, the genre of the travel, that is, business or private, or the stage of the travel booking. For the private holiday agencies, face-to-face was used initially, and then telephone or email for fine-tuning the booking, usually followed by some further face-to-face interaction. The business travel agency relied more on email or telephone for most of the booking stages.

The private travel agencies seemed to encourage non-task related communication, to build a relationship with the customer and improve the overall travel experience for the customer. However, agents stated that what appeared to be non-task related communication was actually a means for the agent to gather more information from the customer, and hence the communication was indirectly work-related. Non-task related communication was most prominent in the richer communication channel, that is, face-to-face, while virtually non-existent in email. The agents said that they sometimes felt obliged to make small talk, in particular while waiting for the computer.

The reasons for printing out information, as opposed to using the softcopy version, were to use as a reference point for discussion with customer, keep records of the interaction or because it was easier to read. The agents stated that they virtually never share the computer screen with the customer. One reason is that it is too complicated for the customer to understand and another is that they do not want to share all the information with the customer.

It was observed that most customers have contact with the agency multiple times and the agencies had some mechanism for maintaining a record of the interactions, such as computer note system or physical paper folder system. However, neither of these systems automatically stored information, nor was there an easy way of ascertaining what interactions had already taken place.

8.3 Focus group follow-up

As noted earlier, there were two main reasons for the study with travel agencies; investigating the external validity of the laboratory experiment findings and identifying potential enhancement. In the observations and interviews a number of areas were identified as potential enhancements to CACI:

- Facility for sharing computer information with customer; it was identified during the observations and interviews that information was shared using paper, and not via sharing of the computer screen
- History mechanism for the current interaction with customer; it was found that the only way to revisit a previous option was through scrolling a sequential list
- History mechanism to attain information about a customer previous engagement with the agency; it was found that there were only manually stored notes from previous encounters with the customer. There was no automated system
- Alternative views for displaying the large amount of information available to the agents; the agents often have to look at a large number of different flight options, however, the information is shown in a sequential list

To discuss the validity of the enhancements, focus groups were held with experienced travel agents. The intention was to discuss the different areas, identify one for further work and generate ideas for enhancing that area. Further, the intention was also to get input on how the areas could be enhanced and what possible constraints there were. To ensure that the agents had sufficient knowledge of the travel industry to be able to discuss and identify improvements and constraints only experienced agents were recruited for the focus group.

8.3.1 Method

The focus group was held at one agency, which was selected because it was a large agency with a long history, but also because it dealt with both private and business travel. The focus group consisted of four senior experienced travel agents with an average of 15 years experience in the travel industry. All agents were in management roles, ranging from agency director to team leader.

The discussions were semi-structured and covered the following topics:

- Reporting on findings from interviews and observations
- Discussing each finding
- Selecting one potential enhancement for further investigation
- Planning proof of concept investigation

Notes were made of the focus groups and as the discussion took place drawings were made of the potential enhancements.

8.3.2 Findings

Overall the agents could see the reason for the situations having been observed as needing improvement. They considered that all the areas were sensible and could see the point of improving on either of them. Potential improvements included:

- Graphical visualisation of different options with current customer, for example a different layout with facility for the agent to select different ways of grouping information (see Figure 97 and Figure 98)
- Easier navigational path to previous searches, for example a menu to select queries relating to for example a certain flight or location (see Figure 99)
- Automated storing of work at the end of a session, including different options that were looked at, how these had changed over time, summary of information, such as location, dates and airlines.
- Sharing part of the screen as a point of reference with customer, as opposed to using paper for point of reference. However, with the limitation that only the part of the screen the agent chooses would be shared.

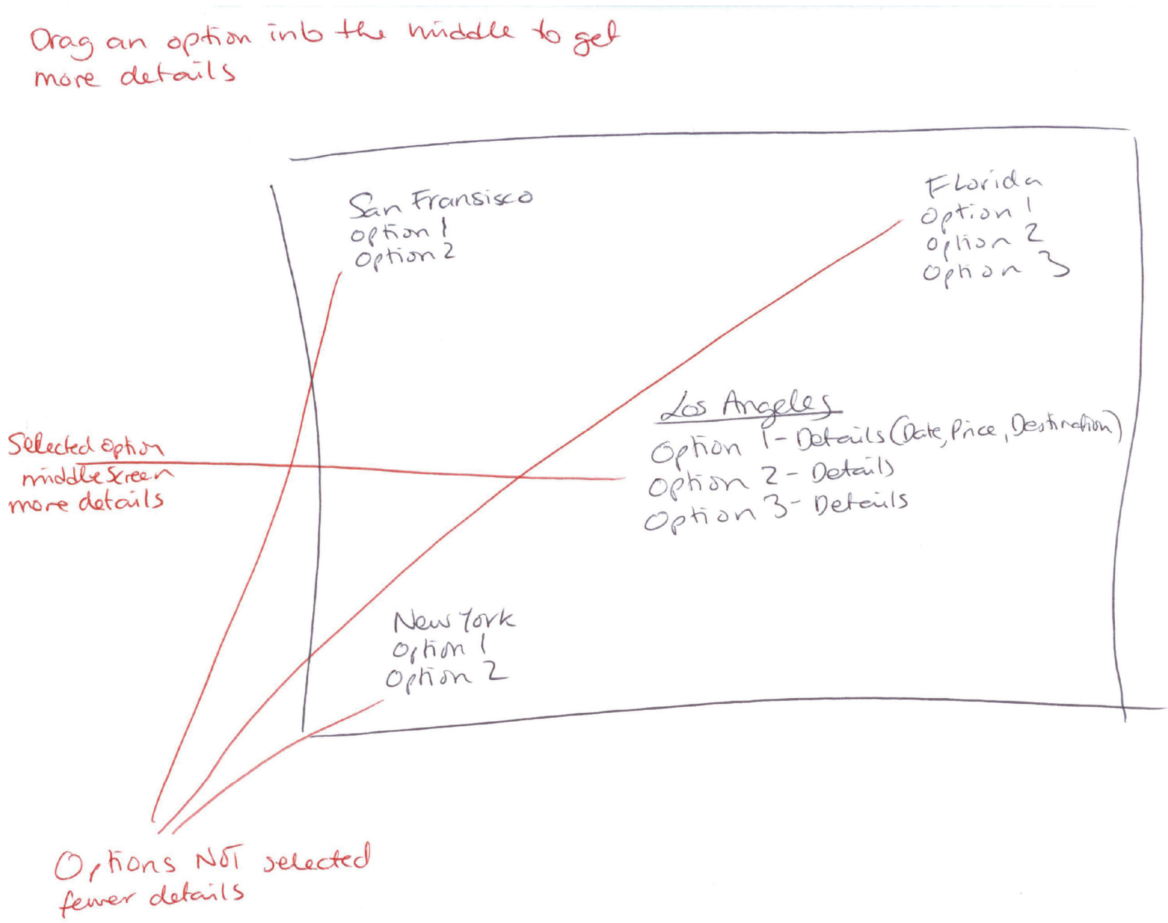


Figure 97. Drawing made during the focus group discussion about one potential enhancement; different way of arranging information by travel locations on the travel agency screen

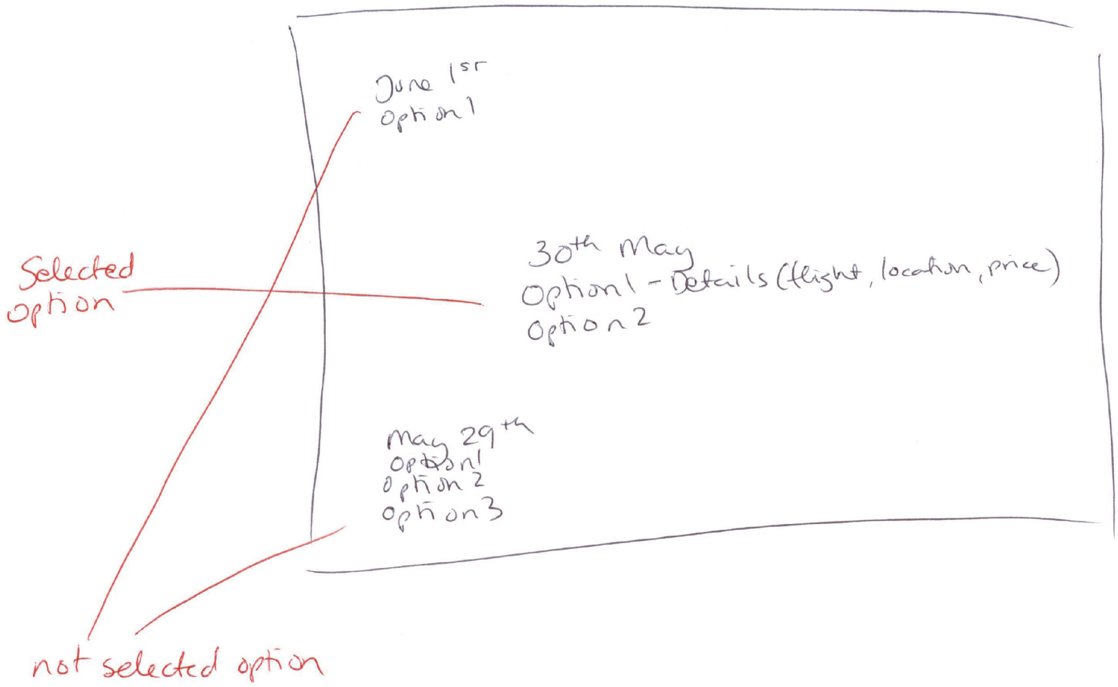


Figure 98. Drawing made during the focus group discussion about one potential enhancement; alternative way of arranging information by different travel dates on the travel agency screen

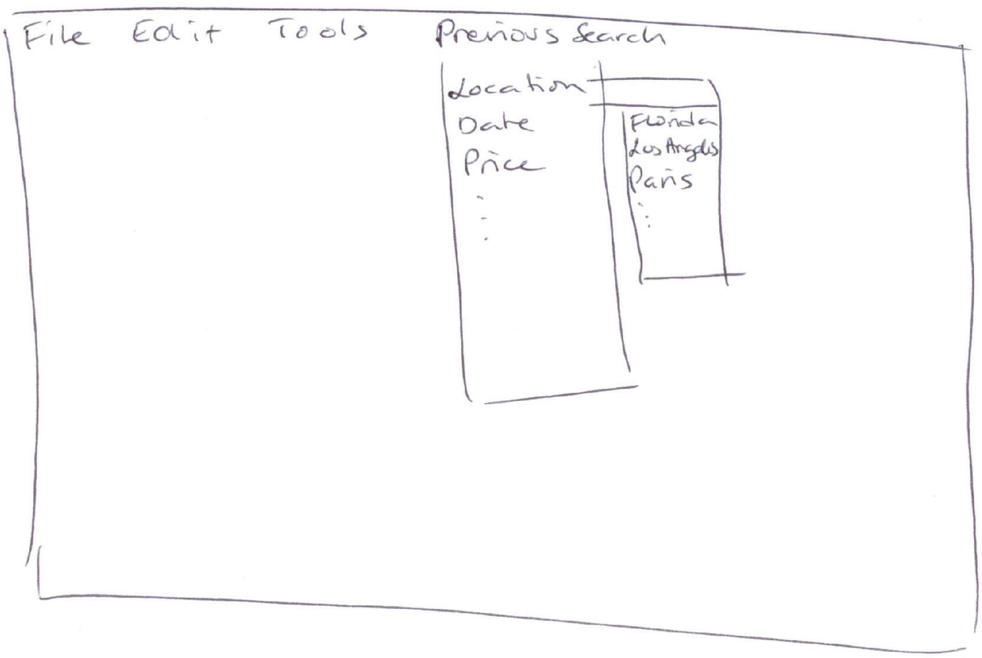


Figure 99. Drawing made during the focus group discussion about one potential enhancement; selecting previous search options through menus

The area that inspired the most excitement with the focus group was the sharing the screen and it was decided to discuss it in real detail. The agents in the focus group had not realised that the screen was not actually being shared in communication with the customer. Further, the travel agency was also attempting to waste less paper in the office. However, they also agreed with the interviewed agents; that neither should the all screens be shared nor all the information on the individual screens. The travel agent had to be able to choose what to share, and when to share at all. Further, in the focus group discussions, they did not think that it would be good if a customer had any input facility for the computer, as the computer systems are too complicated and it could potentially cause serious problems. They only wanted to share specific areas of the screen, at the agent's discretion, as a reference and discussion point when the agents felt it would be useful.

In the focus group, the researcher also presented the previous research carried out by Rodden *et al* (2002), where they designed a novel computer system for travel agency CACI. However, the agents in this focus group did not agree with the findings of previous research for several reasons, they:

- do not have the space in the office for such a set up
- did not want to share all the information on the screen, but still wanted the agent to have access to the information that was not shared
- wanted the agent to be able to choose what to share and what not to share

In addition, the focus group also had other constraints about the physical setup as well as the sharing of information:

- the agency only limited amount of physical space on the agents' desks and in the office, hence the solution had to be relatively small physically
- the agent had to keep the full use of the computer including all the facilities usually available, for example email and flight booking system, and be able to work without sharing (sometimes agents work on different customers tasks, even when working with a current customer)
- any enhancement had to fit in with their existing systems

8.3.3 Summary

From the focus group discussions with four travel agents, it was found that all the identified enhancement areas were appropriate and promising. In the focus group, the area that was identified as the most promising was the sharing of part of the computer screen. However, the discussions also identified constraints with the sharing of the screen, in contrast with previous research (Rodden *et al.*, 2003), which were:

- That only part of the screen was to be shared
- Up to agent to decide when and what to share
- Had to fit with current system
- It should not take up too much additional space

8.4 Proof of concept of sharing part of the agent's screen with the customer

Previous researchers suggest (for example Rodden *et al* 2003) that there is an asymmetry between the representation of information between the customer (for example, brochures) and the agent (computer screen), and that the difference in representation could constrain the interaction between customer and agent (Scaife *et al,* 2002). Based on previous research, and observations, interviews and focus groups at travel agencies, an area that could be enhanced was identified, namely with sharing part of the screen. However, in contrast with the previous research, the travel agency did not want to share the screen at all times, and they did not want to share all the information on the screen. They wanted a mechanism of selecting what to share and when to share it. To further investigate the feasibility of the enhancement, an initial proof of concept observational study was made. The study was carried out to investigate:

- if there was information that the agents would like to share
- what information they would like to and would not like to share
- if the agents thought that it would be useful to be able to share

8.4.1 Method

There were observations with five different agents, with travel agency experience level ranging from less than one year to over 30 years (see Table 57). Each agent was observed between one and two hours.

Table 57. Breakdown of the level of experience of each observed travel agent for proof of concept study

Travel agency number	Number of interviewed agents	Inexperienced agents	Moderately Experienced agents	Very experienced
3	5	2	1	2

The observations were carried out as the agents were interacting with the customers and the same discontinuity signal was used. Prior to the sessions, the customers had been informed about the study and had given consent. However, unlike the initial observations (see Section 8.1), these ones were not unobtrusive. As the agent was interacting with the customer, they would stop the work with customer, to discuss with the observer what specifically on the screen at that time they would like to share, and what parts of the screen they would like to share. For the parts of the screen the agent did not want to share, they made a note about it and discussed with the observer after the completion of the session. It was not possible to take photos, or to video or audio record the interaction, because of privacy regulations and risk of displaying commercially sensitive material. However, when agent noted screens they would have liked to share or would not like to share, a screenshot was taken of the actual computer screen the agents were using (for example, Figure 100). These screenshots were saved onto a Word document.

After the completion of each session the agent and observer discussed what the agents wanted to share and why they wanted to share that information. As well as what the agents did not want to share and why they did not want to share.

8.4.2 Findings

Travel agency software is often complicated, and this is one reason why the agents do not normally share the screen with the customers. However, the agents said that if they could remove some of the information that made it complicated or show different part of the screen while working on different tasks, it would be useful to share the screen with the customer.

The agents also suggested that it would be useful to be able to share the screen if there were several different options the customer could choose from and if it was displayed in a way such that the customer could understand it easily, for example, accommodation option (*area to share* in Figure 100). From the same screen though, the agent did not want to include all the information, such as the gross price of the accommodation, as the customer would be able to work out the agent's commission (for example, see *area not to share (sensitive information)* Figure 100). Further, there was also information on the screen that the agent did not want to share as it did not add any useful information to the customer and sharing the information would only complicate the interaction (see *area not to share (did not add useful information)* Figure 100).

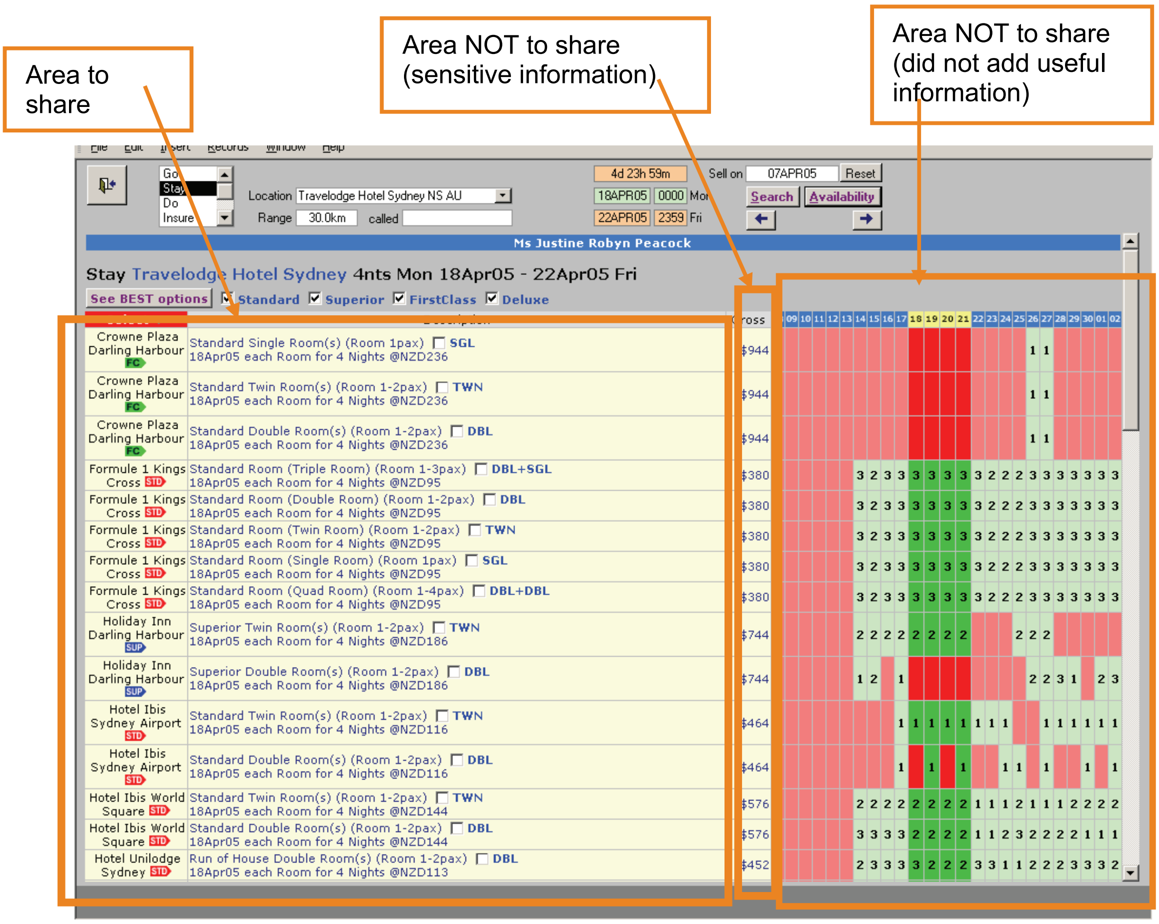


Figure 100. Screenshot of travel agency page including notes on areas the agent wanted and did not want to share

Another situation where the agent wanted to share the screen with the customer was when there was a lot of information that the customer needed to read, such as conditions of flights or insurance (Figure 101). However, often there are different stages in the interaction with the customer, while all the information is on one screen. The agents stated that if they could show only the parts of the screen that pertained to the current stage of the task it would be useful to share. For example, as the agent is arranging insurance for the customer, they would initially show only the part of the screen where the customer had to make choices (see *Area to be shared while choosing options* Figure 101). Once the choices had been made, the agent would then show only the conditions part for the customer to read (see *area to be shared while discussing conditions* Figure 101).

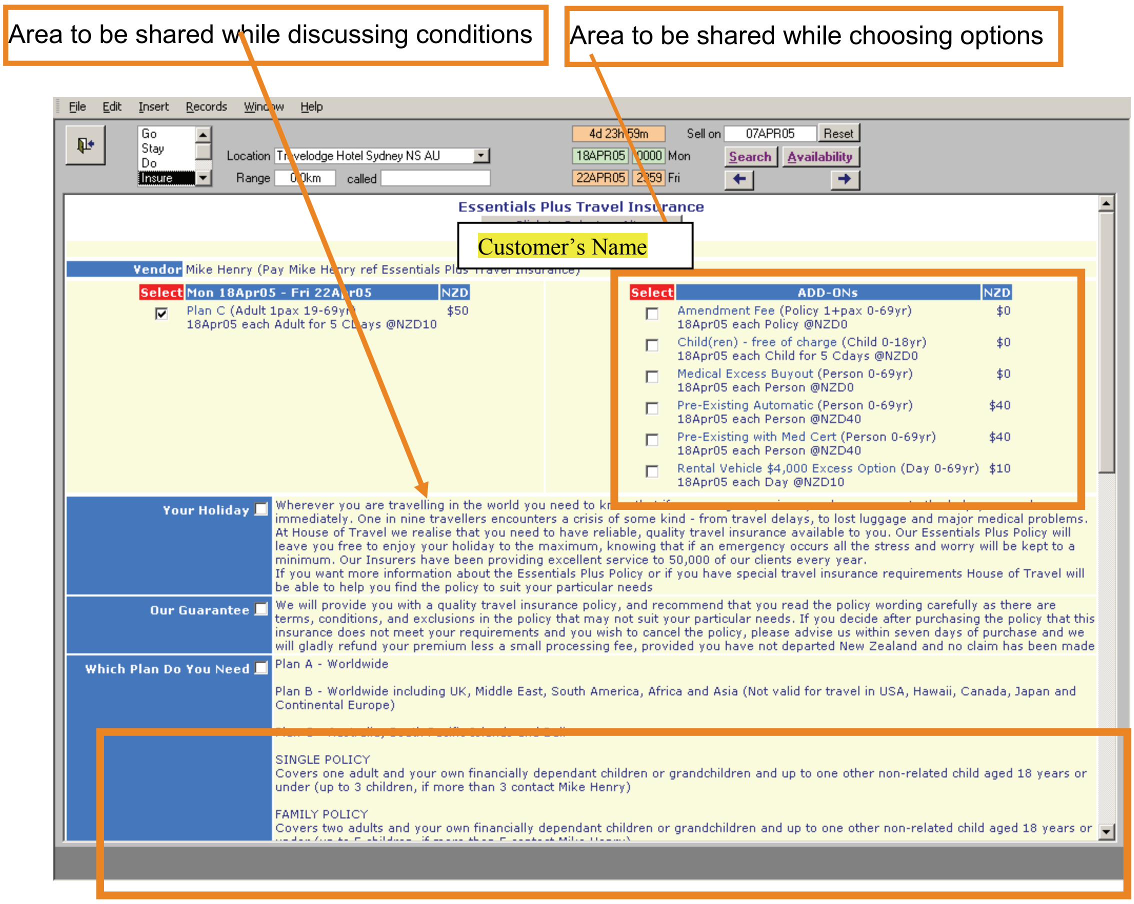


Figure 101. Screen shot of screen and notes about what the agent wanted to share

There were also screens that the agents did not want to share at all. Some software is very complicated and would require a lot of explanation by the agent. Hence, the agents stated that they would rather not share at all. It would take more time to explain the screen than it would be to read out the options (see Figure 102). Additionally, sometimes there were options available that the agents did not want to pursue. This could be due to a difficult wholesaler, known problems with a certain hotel, or pending price changes. The agent preferred not show these options, rather than having to explain why they were not suitable options.

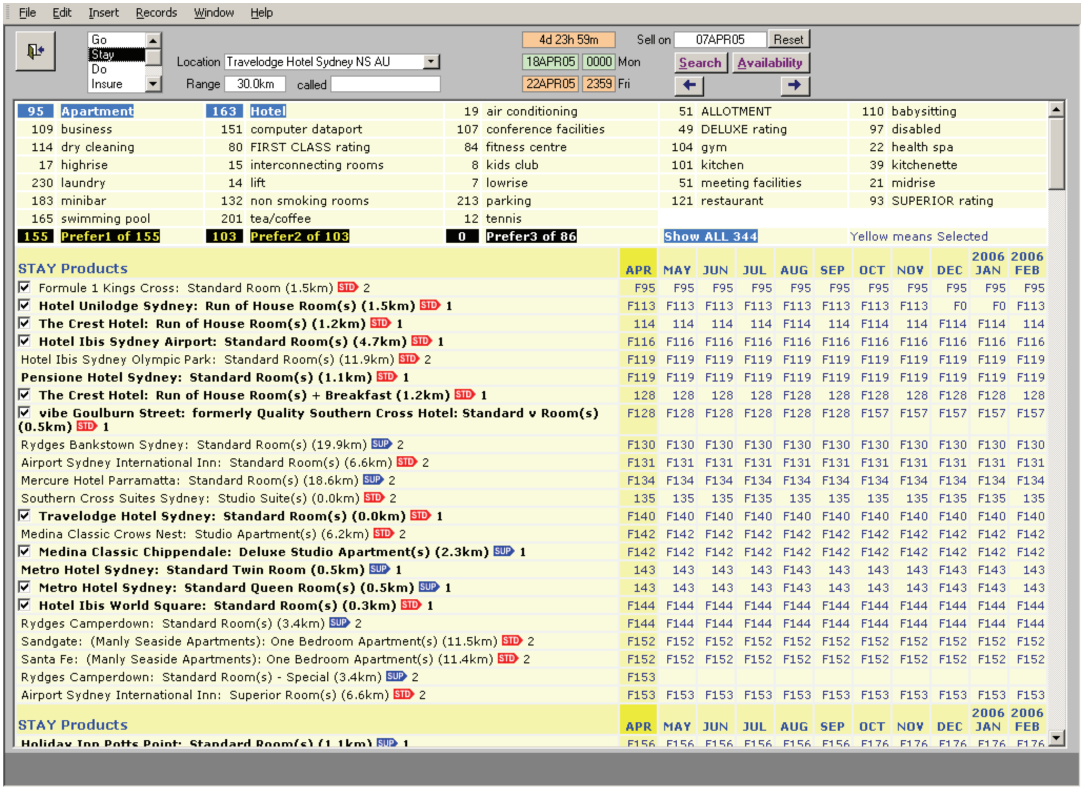


Figure 102. Screen that the agent did not want to share due to the complexity of the information on the screen

8.4.3 Summary

Overall there were indications that sharing the screen would enhance the interaction between computer, human (agent) and human (customer) in a travel agency. There were situations where the agents wanted to share information on the screen with the customer, however, most of the time they did not want to share the entire screen. The parts they did not want to share were when the information on the screen was too complicated for the customer to understand, or when the screen contained sensitive information, such as details about commission or options the agent did not want to pursue.

8.5 Discussion

This chapter reports on a series studies, including observations, interviews, focus group and a proof of concept study, carried out at travel agencies, and the findings were:

- General findings included that there are different genres of customer service provision depending on if:
  - the customer's detailed information relating to the task is static or dynamic
  - complex or simple task
  - if it is an emotional as opposed to mundane task
  - the number of times a customer contacts the organisation
- Travel agents largely rely on hardcopy or physical artefacts, as opposed to electronic artefacts, such as, calendars or calculators
- Findings from the laboratory study appeared to hold in a naturalistic situation:
  - There were more single activities face-to-face while more dual activities via the telephone
  - Telephone was more task-oriented and contained less small talk than face-to-face
  - Subjective preference depends on more than communication mode, such complexity of task and stage of travel booking
- The constraint in the laboratory studies might have contributed to the lack of difference in outcome between the conditions and the longer task-completion time for face-to-face condition
- A number of enhancement areas were identified:
  - History mechanism for current interaction with customer
  - Electronic, potentially automatic, note making system for sessions with customer
  - Different layout of the large number of options
  - Facility for sharing part of the screen with the customer at the agent's discretion
- Sharing part of the screen appears to be a feasible enhancement

In some situations the information the customer has that is needed to complete the task is static while in other situations it is dynamic. At power company call centres the information is static, for example, when moving from one address to another. In the travel industry, on the other hand, the details pertaining to the task, such as date, destination or airline, can be dynamic, for example, the customer might not have decided when or where they want to travel, just that they want to go on a winter holiday.

Another difference in customer service genres is that people usually only get in touch with a power company once to change address, but engage with a travel agency many times for a single trip purchase. It was observed that all the agencies had some note system, either on paper or on the computer, but they all relied on manual notes explicitly created by the agent. In the interviews it was said that the accuracy and extent of the notes was entirely up to the agent. Experienced agents, in particular, tended to rely on mental storage of information rather than written notes. This often made it difficult for a different agent to take up work with a customer. In the focus group a possible enhancement was identified; the possibility of automatic notes being made at the closure of the session, including storing information such as destinations and dates considered or accommodation options. This is consistent with Bowers and Martin (2000) who suggest that it is important to consider dialogue closing and session documentation in designing software for CACI.

The findings from the human-human communication study discussed in Chapter 6 suggested that there was a difference in the style of communication depending on the mode, where people engage more in single activities and there are more non-work related communication face-to-face than via telephone. From the observations and interviews it appears that this is also the case in a real travel agency situation, which is also consistent with previous research suggesting that face-to-face and telephone communication vary in style and content (Rutter *et al*, 1981). During this series of studies at travel agencies, it was observed that in face-to-face communication the agents were engaged in more single activities, such as, just listening as the customer presented their requirements. In contrast, when interacting via the telephone the agent engaged in more dual activities, for example, it was observed that the agents would start searching for a flight on the computer while also listening and talking to the customer over the telephone. It was also observed that telephone interaction was more task-oriented, with less non-task related communication. During the interviews some agents stated that they were encouraged to make small-talk, partially as it enriches the customer's process of buying the travel but also as a means to reduce periods of silence while the agent was busy on the computer. One agent said that the customer's holiday experience should start as they enter the travel agency. The business travel agents, on the other hand, said that small talk was not encouraged. They said that the customer would think that they were wasting time and being unprofessional if they spent time on small talk.

In the human-human communication studies (see Chapters 6 and 7) there was only a small difference in subjective satisfaction between the two communication modes. However, previous research suggests that people prefer face-to-face interaction (Masoodian and Apperley, 1995; Masoodian *et al,* 1995; Fletcher and Major, 2006). Based on the observations and interviews it was found that subjective preference depended on more than the mode of communication, for example, complexity of travel, stage of travel purchase and individual preference of the customer. The agents stated that for complex tasks or tasks that were emotional to the customer, face-to-face is preferred, while for relatively simple tasks, telephone was favoured. One agent said that "*face-to-face interaction is more personal and more exciting for the customer*". Further, often face-to-face was chosen in the early stages, while telephone was used for follow-up and updates. At the business travel agency it was observed that there was only very little face-to-face interaction. In the interviews the agents commented that telephone and email were the preferred communication modes, and that their customers did not want to waste time actually visiting the agency.

These findings relating to human-human communication from both the current chapter and Chapters 6 and 7 suggest that customer satisfaction is balanced by both effectiveness and 'social-ness'. If you lower effectiveness but increase social interaction, you end up with roughly the same level of customer satisfaction.

During the observations it was found that the agents share a lot of paper with the customer. In the human-human communication studies (see Chapters 6 and 7) the participants were not allowed to share paper, which could have had an impact on the findings. It is possible that the longer task completion time for the face-to-face condition was in part because the customer and agent did not share paper and hence could not work in parallel on separate tasks. Additionally, the participants were not able to discuss and fine-tune the options over paper, as they would in a real situation, which could have had an effect on the lack of difference in the outcome between the modes.

A number of potential enhancement areas were identified during the observations and interviews, and these were further discussed in a focus group. It is common that during the interaction with a customer, the agent investigates one option and then move on to other options, only to return to the previous search at a later stage. However, there is currently no easy mechanism for returning to a previous option. The searches are displayed in a sequential list of text in capital letters with no obvious separator between the options. In the focus group this issue was discussed and alternatives were suggested, such as different graphical layout of the information or a clear menu option for selecting a previous option.

During the observations it was noted that the agents virtually never shared the computer screen (it only happened once). In the interviews the agent explained that there were two main reasons why they did not want to share; some information on the screen was private, such as the agent's commission, and often the screens were too complicated for the customer to understand, which is consistent with Scaife *et al's* (2002) findings. Based on the observations and interviews, as well as the focus group experienced travel agents, and, previous research into shared computer screens (for example Scaife *et al,* 2002), and, the importance of awareness and separation of private versus public information (Greenberg *et al*, 1999; Hinckleyss, 2003), it was decided to investigate the option of a sharing screen facility further. In the observations at call centres (see Chapter 3) and auditory feedback study 1 (see Chapter 4) it was found that the agents provide a lot of verbal feedback to the customer about the computer. A sharing facility could also reduce how much verbal feedback was required, which potentially could be used both face-to-face and over the telephone in combination with a shared interface via the Internet.

Through the focus group discussion, constraints to the sharing facility were identified, it had to:

- fit into the current physical work-space which at most of the agencies was very limited (see Section 8.1.1)
- have a facility for the agent to separate private versus public information, which is in accordance with Greenberg *et al*'s (1999) suggestions

An initial proof of concept study was made into whether the agents would share the screen and if so, what they would share. The findings suggested that the agents saw the value of sharing the computer screen, however findings also reinforced the result from the interviews; that the agents only wanted to share part of the screen. They would like to share parts of the screen that contained, for example, different options for the customer to consider or when there was information that the customer needed to read, such as terms and regulations. Additionally, there were parts of the screen the agent would not share, for example information pertaining to commission or options that the agent did not want to pursue, where the ability to select what section of the screen to share with the customer was attractive.

These findings relating to sharing the computer screen suggest that the novel system designed by Scaife *et al* (2002) and Rodden *et al* (2002) might not be the best solution. Scaife *et al* (2002) stated "there are also good reasons why some information should only be available to agents (e.g. the amount of commission they are earning)", however, their system included three screens that were *completely* shared with the customer. They did not provide any methods for the agent to not disclose a particular option to the customer, nor could the agent see what their commission on the sale would be.

In these studies, it was not possible to interview the customers, due to the agency regulations. However, it would be beneficial to also interview the customers regarding, for example, their opinion about different communication medium and non-work related talk.

Other potential future work includes further investigation of sharing the computer screen. Because this study was a proof of concept study and the agents did not have an actual screen sharing facility, there are many future avenues to pursue, such as implementing a sharing facility and testing it in a real or laboratory setting. It would also be of interest to investigate customers' opinion on a sharing facility.

This chapter has confirmed the findings from the human-human communication laboratory experiment (see Chapter 6), and the studies in this chapter have also investigated the computer-agent channel and identified potential enhancements to the computer interface. The next chapter in this thesis describes the overall conclusion as well as discussion methods and future work.

9 CONCLUSION

The overall goal of this research was to advance the understanding of the interaction that takes place in a customer service setting, via telephone or face-to-face, between the customer, agent and computer. Specifically, the aim was to gain an insight into the three channels of the interaction, that is, between the customer-agent, customer-computer and agent-computer, and to identify and investigate possible enhancements to the computer interface supporting CACI.

Bowers and Martin (2000) conducted preliminary research at a UK bank call centre and suggest that there is a need to consider technology from the customers' perspective. It is important to 'display engagement', which refers to providing the customer with direct awareness of the agents interaction with the computer. As a call centre customer is visually disabled with respect to the computer, 'display of engagement' has to be provided through an auditory channel. Hearing is useful at providing information about changes in the environment, without the ability to hear many events would go unnoticed (Gaver, 1989, and Brewster, 1998). Mynatt and Weber (1994) found auditory feedback effective in improving interactions for visually-impaired and typical users.

There are contrasting findings relating to the effect mode has on human-human communication. Rutter *et al* (1981) suggest that there is a difference in content, style and outcome between a rich communication mode, face-to-face, and an impoverished communication mode, audio-only. In contrast, Ochsman and Chapanis (1974) argue that there is only a small difference in task completion time and activity sampling between face-to-face and audio-only. An impoverished communication mode might not necessarily lead to a less satisfactory outcome or process of communication.

Ethnographic studies in travel agencies focused on how the customer and agent interacted physically face-to-face (for example, Scaife *et al,* 2002; Rodden *et al*, 2003). They found that the main problem was the asymmetry between the customer and agent, both in the physical layouts of the travel agents workspace and in the information representation. Based on their findings they developed a novel system, changing both physical layout and the computer interface.

From previous research, areas were identified where further investigation would be beneficial. The conflicting findings relating to effect of mode in human-human communication research by, for instance, Rutter *et al* (1981) and Ochsman and Chapanis (1974) identified a need for further investigations. Further, there is nothing in the literature that compares face-to-face and telephone communication in customer service CACI. Bowers and Martin's (2000) findings were based on naturalistic observations, but there have not been any investigations of the importance of the display of engagement in a controlled laboratory setting. Studies by Rodden *et al* (2003) and Scaife *et al* (2002), investigated CACI in a travel agency. However, they investigated only face-to-face interaction. They focused on the initial stage of travel booking and not the other later stages, nor did they focus on issues arising from the customer revisits with a travel agency. Additionally, although these previous research areas are all relating to CACI, they have not previously been integrated. Hence, there is a need to bring together the different types of research into CACI.

From these previous research works, research questions arose:

1. In customer service CACI does the communication mode, face-to-face or telephone, have an effect on outcome and process of communication?
2. Would displaying engagement by adding auditory feedback enhance customer service CACI?
3. Would sharing the computer screen with the customer enhance customer service CACI?
4. How do interface design issues for CACI in a customer service setting differ from traditional CHI and how could the interface supporting CACI be enhanced?

To investigate these research questions a range of methods were used. To gain knowledge on CACI in a real setting, naturalistic observations and interviews were held in power companies, a telecommunication company and travel agencies. To test specific aspects of CACI, four controlled laboratory studies were conducted. The laboratory studies included participants performing tasks as well as answering questionnaires on their experience of the task. As many different methods were used for this PhD, the details are described in more detail in Section 9.5.

The findings from the laboratory studies are restricted due to the experimental design and constraints. Because the tasks had to be able to be completed in one session, as opposed to a real situation where the customer might be in touch with the service provider multiple times, the tasks needed to be limited in complexity. Additionally, due to the nature of experiments and because there was no explicit incentive (for example, payment for outcome) the participants had a low vested interest in the outcome.

This research has found that issues such as navigation, feedback, awareness and history are more complex in CACI than in traditional CHI because of the inclusion of the customer. For example, feedback is a well-known CHI consideration, however, with CACI, feedback has to be communicated to the customer as well as the agent. It was found that there are a range of types of CACI settings, where in some situations there is very little variation in the tasks and the customer only contacts the organisation once, while in others the task is more variable and many encounters are needed.

There were three main areas of investigation; the customer-computer interaction (Figure 103a), the customer-agent interaction (Figure 103b), and the agent-computer interaction (Figure 103c). The findings and contributions relating to each of these areas will be discussed below.

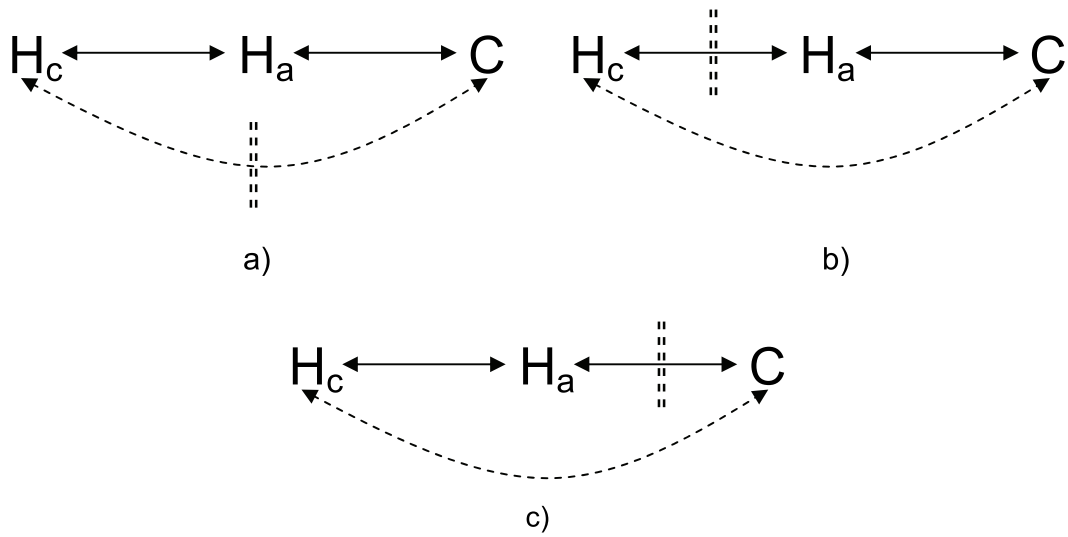


Figure 103. Investigation into the three channels of communication; a) customer (H_c) – computer channel b) customer (H_c) – agent (H_a) c) agent (H_a) – computer

One contribution from this research was the observation that call centre agents provide a lot of verbal feedback about the computer to the customer and that the customer asked for feedback regarding the computer. This finding has not previously been reported in literature. Bowers and Martin (2000) did report on the importance of 'display of engagement' in telephone banking, but in a call centre setting enhancing the interaction with auditory feedback only provided a small enhancement in task completion time, flow of communication or subjective satisfaction. It was also found in both call centres and travel agencies that sometimes the aim of communicating the computer state was *not* to share the state of the computer, but to avoid a silence or communicate the 'state' of the agent, to let the customer know that the agent was engaged in work.

Findings from research into human-human communication is inconsistent, where some researchers (for example Chapanis *et al*, 1972) argue that there is no significant difference between co-located and audio-only communication, while other (for example Rutter *et al*, 1981) suggest that there is a difference in style and outcome between face-to-face and audio-only communication. The research in this thesis has shown that for simpler tasks or if the customer has a lower vested interest, a less-rich communication mode, telephone, is more efficient and task-oriented than face-to-face. It also does not have a lower subjective satisfaction for the customer or agent, and does not necessarily lead to a negative outcome or process of arriving at the outcome. But the findings also suggest that in a more emotional or complex task there might be a difference in style and subjective satisfaction due to the communication mode.

A number of potential alternative enhancements to the computer interface used for CACI have been identified, sharing screen (enhancing customer-computer interaction, Figure 103a), history mechanisms (enhancing agent-computer, Figure 103c) and alternative ways for graphical layout of the flight options (enhancing agent-computer, Figure 103c). Further investigations showed that sharing part of the screen, where the agent decided what to share and what not to share, has potential as an enhancement to the computer interface.

It was found that customer service interaction differs in the nature of the transactions. The task at a power company call centres is static, that is, the task criteria do not change. For example, a customer might call to inform the power company of a change of address. The task at a travel agencies, on the other hand, is dynamic, there are, potentially, many suitable options. For instance, a customer wants to go on a one to two week holiday somewhere warm sometime in July. Additionally, most of the time a customer will only get in touch with a power company once about a particular task. For travel agencies, on the other hand, customers are often in contact many times for a single trip booking. Another difference between the genres is that power companies try to process the customer task as rapidly as possible, while the focus in a travel agency is to create as pleasurable experience for the customer as possible.

9.1 Computer - Human (customer) interaction

In the observations at call centres (Chapter 3) it was found that there was frequent communication about the state of the computer. The agents regularly provided verbal feedback about the computer state to the customer, for example "*I am trying to find your details*", and the customer asked for feedback about the computer state, for example "*have you found my address yet*?". There were also situations where the customer would provide information at inappropriate times due to lack of feedback. For example, providing their new address before the agent had removed the old one.

Two studies were conducted to investigate enhancing the computer-customer channel of communication with auditory feedback (Chapters 4 and 5). The auditory feedback was added to the most common activities, identified in the call centre observations (Chapter 3), that the agents were engaged in as feedback was communicated; typing, when the agent busy trying to find information on the computer, when the agent was waiting for the computer. The result from the studies showed that adding auditory feedback did not appear to have an effect on the interaction (Chapters 4 and 5). There was a small statistically insignificant difference in task completion time. There was a reduction in the number of times the customer would provide information at inappropriate times when there had been auditory feedback added to the interaction (Chapter 4). However this was not replicated in the constrained between-subject study (see Chapter 5). There was only a small difference in subjective satisfaction (see Sections 4.3.3 and 5.3.3). There were some interesting findings from the questionnaire though. For the question "how aware were you of the agent's activity", the participants had rated a higher awareness in the non-auditory feedback condition.

During the observations and interviews (Chapter 8) it was shown that travel agents did not share the computer screen. There were several reasons stated why the screen was not shared, such as, sensitive information or screen was too complicated. In a focus group and proof of concept study (Chapter 8) a facility for sharing part of the screen at the agent's discretion was explored further. The situations where the agent wanted to share part of the screen were when there many options for the customer to consider (such as different hotel options) or when there was large amount of information the customer needed to read (insurance rules). Sometimes they wanted to share a part of the screen at different stages of the task. However, they did not want to share the screen when information was private (such as commission), there was information that was unnecessary for the customer to read, or when the screen was too complicated for the customer to understand.

9.2 Human (customer) – human (agent) communication

The results of investigations into customer-agent interaction (see Figure 8) showed that telephone communication is more efficient and less time-consuming than face-to-face communication (see Chapters 6 and 8) and the task completion time was significantly shorter for the telephone communication (Chapter 6). People engage in multiple activities over the telephone, for example, reading information while also talking. In contrast, when communicating face-to-face people often discontinue the task they are working on to focus their entire attention on the other person (Chapters 6 and 8). It was found that while communicating over the telephone, agents sometimes work on tasks that were not even related to the current customer (see Chapters 3 and 8). Via the telephone one person would talk for longer, without interruptions from the other person, but while interacting face-to-face people would talk for shorter periods of time with more turn-taking from the other person. These findings are consistent with Rutter *et al* (1981) who argue that face-to-face interaction is more time-consuming and less efficient than telephone interaction.

The results from the laboratory studies (Sections 6.2.5 and 7.2) investigating human-human communication of different modes showed that there was only a small difference in the subjective preference, such as satisfaction, frustration and confidence in completion. However, the interviewed travel agents stated that for tasks where the customer had a larger vested interest, or for a more complicated task, a richer communication mode of face-to-face is preferred (Chapter 8).

From the ethnographic studies at travel agencies (see Chapter 8) it was found that a different mode of communication was used for different types of task. There are situations where face-to-face communication is preferred, such as when there was a need to establish rapport and confidence, or when a lot of information needs to be shared and understood by both parties. However, when for example, clarification or sharing only a small amount of information is needed, the telephone was preferred. If precise information needs to be shared and agreed on, email is the preferred mode.

9.3 Human (customer) – human (agent) communication

The results of investigations into customer-agent interaction (see Figure 8) showed that telephone communication is more efficient and less time-consuming than face-to-face communication (see Chapters 6 and 8) and the task completion time was significantly shorter for the telephone communication (Chapter 6). People engage in multiple activities over the telephone, for example, reading information while also talking. In contrast, when communicating face-to-face people often discontinue the task they are working on to focus their entire attention on the other person (Chapters 6 and 8). It was found that while communicating over the telephone, agents sometimes work on tasks that were not even related to the current customer (see Chapters 3 and 8). Via the telephone one person would talk for longer, without interruptions from the other person, but while interacting face-to-face people would talk for shorter periods of time with more turn-taking from the other person. These findings are consistent with Rutter *et al* (1981) who argue that face-to-face interaction is more time-consuming and less efficient than telephone interaction.

The results from the laboratory studies (Chapters 6 and 7) investigating human-human communication of different modes showed that there was only a small difference in the subjective preference, such as satisfaction, frustration and confidence in completion. However, the findings from the interviews at travel agency suggest that for tasks where the customer had a larger vested interest, or for a more complicated task, a richer communication mode of face-to-face is preferred (Chapter 8).

From the ethnographic studies at travel agencies (see Chapter 8) it was found that a different mode of communication was used for different types of task. There are situations where face-to-face communication is preferred, such as when there was a need to establish rapport and confidence, or when a lot of information needs to be shared and understood by both parties. However, when for example, clarification or sharing only a small amount of information is needed, the telephone was preferred. If precise information needs to be shared and agreed on, email is the preferred mode.

9.4 Computer - human (agent) interaction

It was found that the traditional CHI issue of navigation had additional considerations in CACI (Chapters 3 and 8). However, the considerations are dependent on the nature of the interaction. For power company call centres, speed of solving the customer task is essential (Chapter 3). Hence, ease and speed of navigation is very important. Sometimes the speed of the navigation came at the expense of learn-ability. It was found that as soon as a customer interaction was initiated, the agent would move between the screens while they were ascertaining what the customer wanted. It appeared that this behaviour was to speed up the customer request by pre-empting what screen would be needed.

For travel agencies (Chapter 8) it was found that the customer and agent often re-visit previously discussed options. For example, "*no I don't like that option, could we look at that 6.45pm option again*?". However, the only available history mechanism was scrolling through the information about previous searches. The agent would often repeat the search or discuss the different options on paper. There was also no way of displaying multiple options at the same time, or displaying the options by some common criteria, such as location or date. During the focus group discussions, a range of potential improvements were identified; graphical grouping and layout of options, easy navigation to previous searches, automated storing of options, preferably sorted by, for example, location or date.

In all of the customer service companies observed, notes were made about the interaction with the customer (Chapters 3 and 8). However, for the most part those notes had to be manually added by the agents. The extent and the comprehensiveness of the notes were up to the agent. In particular, the experienced agents often made fewer notes (Chapter 8) than less experienced agents. This often caused problems when less experienced agents tried to pick up the customer task.

It was also observed that the speed of the computer system was very important (Chapters 3 and 8). There were many occurrences where the agent would complain to the customer about the system being slow and most of the agents stated that they would like a faster response from the computer. One agents stated "*it is always frustrating waiting for the computer, but it is much worse when you know the customer is waiting as well*". Some agents felt obliged to make small talk with the customer as they were waiting for the computer system, in particular when interacting face-to-face (Chapter 8).

9.5 Methods

This research problem has many aspects, including three separate entities, two human roles and a computer, and a setting that varies greatly due to the genre of the organisation, and hence multiple methods were needed to gain a broad understanding. To gain a more generalisable result there were two different settings for the studies, travel agencies and call centres (power and telecommunications companies). The methods for the particular interaction, customer-agent, customer-computer or agent-computer, were chosen based on the nature of the specific research questions for that channel. To obtain both general and specific findings, ethnographic and laboratory methods were used for each research question. The list below describes the methods used for each research question mentioned in the introduction of this chapter:

1. Ethnographic studies, observations and interviews, at call centres, followed by two laboratory studies, in a call centre setting.
2. Two laboratory experiments, in a travel agency situation, followed by ethnographic studies, observations and interviews, at travel agencies
3. Ethnographic study including, observations, interviews, focus group and proof of concept study, at travel agencies
4. Both the ethnographic studies at call centres and travel agencies, as well as, laboratory experiments auditory feedback 1 and auditory feedback 2

All the studies are connected as they followed a line of investigation. The findings in the previous study lead to the specific research question and method for the following one.

Because there has only been a small amount of previous research into customer service CACI, the initial ethnographic study was appropriate for obtaining a general and initial understand of the CACI as well as identifying areas for further investigation. During these studies at call centres, auditory feedback was identified as a potential area for further investigations, which led to the refinement of research question 1 and controlled laboratory experiments were conducted. The intent of the study was to obtain detailed findings relating to auditory feedback in a call centre and hence the ethnographic study setting was replicated as close as possible. Through the use of a laboratory experiment, controlled specific data about auditory feedback in CACI was collected, which would not have been uncovered in a real-world study.

To investigate research question 2, two laboratory experiments were conducted. The first was based on Ochsman and Chapanis's (1974) work, with similar task-criteria and data collection. However, to gain broader findings and due to the extensive recording facilities, additional data was collected. The setting also had to be altered somewhat to include a computer. The second study was based on, and refined from the findings of, the first human-human communication study, but with altered experimental design and focusing on one of the data set. By conducting laboratory experiments detailed data was collected on many aspects of human-to-human communication, including, activities, outcome and process. Following those laboratory experiments, an ethnographic study at travel agencies was used to validate the laboratory findings and obtain richer real world information about human-human communication.

Because of the many aspects and settings of CACI, to examine how the computer interfaces are used in a real CACI setting and identify areas of potential improvements to the computer interface, ethnographic studies were conducted. However, laboratory experiments were also used to investigate one enhancement, auditory feedback, in more detail and to investigate the customer-agent communication channel.

There are trade-offs between laboratory studies and naturalistic studies. In a laboratory study it is easy to control the conditions and variables. For example, in auditory feedback study 2 (see Chapter 5), it was decided to remove the variable of the agent providing verbal feedback to the customer. This was done simply by telling the agent that she was not allowed to provide feedback. However, there are also problems with laboratory studies, for instance, because of the unnatural setting, it can be difficult to generalise the results and as the customer requests are only simulated, and the customer does not have a vested interest in the outcome. This could influence for example subjective satisfaction and how selective they are with ranking the best solution to the task.

There are advantages and disadvantages with all the methods. There are considerations to be made with laboratory experiments, for example, there were trade-offs with using one or multiple agents, and with using simplified simulated or actual software. There are also trade-offs with the experimental technique, such as within or between subject design. The human-human communication subjective satisfaction study was a within-subject design and an advantage is that the participants were explicitly asked to compare the conditions. However, there are also disadvantages in using a within-subject design, since the participants are performing two tasks, it is likely that there will be some learning effects or that the two participants establish a relationship, positive or negative, which can affect the second task. The advantages with between-subject studies are that there is less risk of confounding variables. However, as the participants only perform tasks in one condition, there is a risk that any result, or lack of result, is due to individual differences and preferences, not due to the experimental conditions. For example, there were indications in the first auditory feedback study that there was an enhancement in task completion time and the event logging between the conditions.

Naturalistic studies have more external validity as they are set in a real setting, where the customer and agent have a real interest in the process and outcome of the task. However, it can be hard, and sometimes impossible, to control variables and make sure that conditions and tasks are similar and comparable. In the observational studies at travel agencies communication mode was investigated. However, it was not possible to control whether the customer interaction was face-to-face or via telephone. It was also not possible to control the complexity of the task and it can be hard to record the observations, for example, it was not possible to video or audio record the interactions in the call centre observations. The difficulty is partly because the call centres have strict privacy rules, but also as it is technically difficult to record a telephone conversation. In particular it is very difficult to video record the customer as they were not present in the call centre.

Using different methods for investigating the different communication channels has strengthened some of the findings. Both the laboratory experiment and travel agency observations showed that there was a difference in style of communication between face-to-face and telephone. In both settings it was found that the agent and customer engaged in single activities face-to-face while engaging in dual activities over the telephone. At the call centre studies it was observed that agents worked on the computer as they were talking to the customer.

In both the laboratory study (auditory feedback study 1) and at call centre observations the agents provided a lot of verbal feedback to the customer, and in observations and interviews at call centres it was discovered that the agents would type hard on the keyboard to provide auditory feedback to the customer. However, in the laboratory studies (auditory feedback study 1 and 2) findings there did not appear to be any enhancement due to added auditory feedback.

By using multiple methods, the findings from this work are more robust. If there had only been one method used it is possible that some findings would have been missed or misinterpreted. For example, in the call centre studies it appeared that adding non-verbal would enhance CACI, however, this was not supported in the laboratory experiments. Additionally, it would not have been possible to draw as generalised conclusions if it was only based on ethnographic studies *or* laboratory experiments.

9.6 Future work

Communication via the telephone was found to be more task-oriented, less time-consuming and with no reduction in subjective satisfaction. These results were found in a simulated travel agency study and, observations and interviews at travel agencies. Travel agency interaction, although at times complicated and emotional, is not as emotionally charged as for example consulting a doctor about a serious illness. Future work from these findings includes comparing communication modes in a situation that is more emotional. In the observational and interview studies conducted, only the agent was interviewed. Due to travel agency and call centre regulations, it was not possible to interview the customers. Future research could explore the customers' perception of the difference due to the mode of communication, and subjective satisfaction, in a real setting where the customer had an actual vested interest in the outcome. Potential future work also includes testing different modes of communication in a laboratory setting but attempting to increase the participants' interest. For example, paying the participants based on the outcome could increase their vested interest.

It is not unusual that part of a companies' customer service is conducted over the internet or via email. During the studies at travel agencies it was observed that the agency relied on email interaction, as well as telephone and face-to-face. In the laboratory studies exploring differences in mode of communication, only face-to-face and telephone was investigated. Potential future work includes exploring other modes of communication, and possible combinations of modes. For example, it would be interesting to investigate if a shared computer interface (for example web interface) while interacting via telephone would make a difference to the interaction.

In the power company call centre laboratory study it was found that adding auditory feedback did not enhance the CACI. Further, in the human-human communication studies, it was found that telephone interaction was not an impoverished mode. However, it would be of interest to investigate if adding auditory feedback would make a difference in a different type of task in a different domain, for example, in a complicated problem solving task. Further, future work also includes investigating if adding auditory feedback would enhance interaction if the agent or customer were given training about the auditory feedback.

Travel agents do not often share their computer screens with the customer. The reasons for this were that they did not want to share sensitive information, or the information was considered too complicated for the customer. From discussions with travel agents and a proof of concept study it was indicated that enabling the agent to share part of the screen and being able to choose when and what to share, would be a valuable enhancement. From this finding there is a range of potential future work identified, including implementing the sharing screen facility and exploring in both ethnographic and laboratory experiments the effect on sales, options visited, subjective preference of both the customer and agents, and task completion time. Other potential work involves examining how the sharing facility would be implemented; does the software automatically elicit the information to be shared and does the agent explicitly state what to share, and does the start and finish of sharing start automatically or explicitly performed by the agent? It would also be possible to incorporate the findings by Scaife *et al* (2002) into the multiple screens, but, for example, with the addition of a private screen for the agent, and with the ability for the agent to choose which options are available on the shared screen.

A range of potential enhancements to the computer-human interaction part of CACI were identified, graphical grouping and layout by, for example location or date, history mechanism and automatic notes. There are potential for future work from these findings, including, investigating if a different grouping and layout would be an enhancement, and how the information is best grouped and displayed. It would also be beneficial to investigate different history mechanisms and how they can best be represented and displayed.

9.7 Finally

This thesis has investigated three channels of interaction, agent-computer, customer-agent and agent-computer, in a customer service setting where each entity is mutually dependent on the others.

Telephone is more task-focused and more efficient than face-to-face, which does not appear to lead to a change in outcome or subjective satisfaction in simple or mundane tasks. Additionally, feedback and awareness are more complex in CACI than traditional CHI. Sharing specific part of the screen has been identified as one potential enhancement in a co-located setting, while in a remote setting, non-verbal auditory feedback did not appear to enhance CACI.

Therefore, when designing computer systems to support customer service CACI, it is important to, not only explicitly include support for the customer-agent communication, but also consider the genre of the service, and the complexity and emotional status of the task.

10 References

Anisimov N., Kishinski K & Miloslavski A. (1999). Formal Model, Language and Tools for Designing Agent's Scenarios in Call Center Systems. In *Proceedings of the Thirty-second Annual Hawaii International Conference on System Sciences*, (pp. 8-17). Washington, DC, USA:IEEE Computer Society.

Anderson A. H., Newlands A., Mullin J., Fleming A. M., Doherty-Sneddon G. & Van der Velden J. (1996). Impact of Video-Mediated Communication on Simulated Service Encounters. *Interacting with Computers, 8*(2), 193-206.

Balint L. (1996). Computer-Mediated Interpersonal Communication: The HCHI Approach. In D. L. Day & D. K. Kovacs (Eds.)*, Computers, Communication & Mental Models* (28-35). Bristol, PA, USA: Taylor & Francis, Inc.

Bardram J. (1998). Designing for the Dynamics of Cooperative Work Activities. In *Proceedings of the 1998 ACM Conference on Computer Supported Cooperative Work (CSCW '98),* (pp. 89-98). New York, NY, USA: ACM Press.

Bhattacharyya G. K., & Johnson R. A. (1977). *Statistical Concepts and Methods.* New York, USA: John Wiley and Sons.

Bitner M. J, Brown S. W., & Meuter M. L. (2000). Technology Infusing in Service Encounters. *Journal of the Academy of Marketing Science, 28*(1), 138-149.

Blattner M., Sumikawa, D., & Greenberg, R. (1989). Earcons and icons: Their structure and Common Design Principles. *Human Computer Interaction, 4*(1), 11-44.

Bluman A. G. (2001). *Elementary statistics: a Step by Step Approach (4th ed)*. New York, USA:McGraw-Hill Companies Inc.

Bowers J., & Martin, D. (2000). Machinery in the New Factories: Interaction and Technology in a Banks Telephone Call Centre. In *Proceedings On The ACM 2000 Conference On Computer Supported Cooperative Work (CSCW '98),* (pp 49-58). New York, NY, USA: ACM Press.

Bradshaw D. & Brash, C. (2001). Managing Customer Relationships in the E-Business World: How to Personalise Computer Relationships for Increased Profitability. *International Journal of Retail and Distribution Management*. *29*(29), 520-529.

Brewster S. A. (1997). Navigating Telephone-Based Interfaces with Earcons. In H. W. Thimbleby, B O'Conaill, & P. Thomas (Eds), *Proceedings of HCI on People and Computers XII*, Bristol, UK, 39-56.

Brewster S. A. (1998). Using Non-Speech Sounds to Provide Navigation Cues. *ACM Transactions on Computer-Human Interaction*, *5*(3), 224-259.

Brewster S. A., Raty V. P., & Kortekangas A. (1996). Enhancing Scanning Input with Non-Speech Sounds. In *Proceedings of the Second Annual ACM conference on Assistive Technologies*, (pp. 10-14). New York, NY, USA: ACM Press

Brewster S. A., Wright P. C. & Edwards A. D. N. (1992). A Detailed Investigation into the Effectiveness of Earcons. In G. Kramer (Ed.), *Auditory Display: Sonification, Audification and Auditory Interfaces* (471-498). Santa Fe Institute, Santa Fe, USA: Addison-Wesley.

Brewster S. A., Wright P. C & Edwards A. D. N (1993). An Evaluation of Earcons for Use in Auditory Human-Computer Interfaces. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI'93),* (pp. 222-227). New York, NY, USA: ACM Press.

Burns R. B. (1997). *Introduction to research method (3rd ed)*. Melbourne, Australia:Addison Wesley Longman Australia ltd.

Card S. K., Newell A. & Moran T. P. (1983). *The Psychology of Human-Computer Interaction*. Mahwah, NJ, USA: Lawrence Erlbaum Associates, Inc.

Chapanis A., Ochman R. B., Parrish R. N. & Weeks G. D. (1972). Studies in Interactive Communication: I. The Effect of Four Communication Modes on the Behavior of Teams During Cooperative Problem Solving. *Human Factors*, *14*(6), 487-509.

Chapanis A., & Overby C. M. (1974). Studies in Interactive Communication: III. Effect of Similar and Dissimilar Communications Channels and Two Interchange Options on Team Problem Solving. *Perceptual and Motor Skills*, *38*, 343-374.

Conversy S. (1998). Wind and Wave Auditory Icons for Monitoring Continuous Processes. In *Proceedings of the Conference on CHI 98 Summary: Human Factors In Computing Systems (CHI'98),* (pp. 351-352). New York, NY, USA: ACM Press.

Crease M. & Brewster S. A. (1998). Making Progress with Sounds: The Design and Evaluation of an Audio Progress Bar. *International Conference on Auditory Display, November 1-4, University of Glasgow,*

http://www.dcs.gla.ac.uk/publications/paperdetails.cfm?id=5282

Crede M. & Sniezek J. A. (2003). Group Judgment Processes and Outcomes in Video-Conferencing versus Face-To-Face. *International Journal of Human-Computer Studies*, *59*(6), 875-897.

Denzin K. N. & Lincoln Y. S. (2003). The discipline and Practice of Qualitative Research.: In N.K. Denzin, Y. S Lincoln (Eds), *Handbook of Qualitative Research 2nd ed*. CA, USA: Sage Publications, Inc.

DiMicco J. M., Pandolfo A., & Bender W. (2004). Influencing Group Participation with a Shared Display. In *Proceedings of the 2004 ACM Conference on Computer Supported Cooperative Work (CSCW'04),* (pp. 614-623). New York, NY, USA: ACM Press.

Dix A., Finlay J., Abowd G. & Beale R. (1998). *Human-Computer Interaction 2nd Edition*. Glasgow, UK: Pearson Education Ltd.

Doherty-Sneddon G., Anderson A., O'Malley C., Langton S., Garrod S. & Bruce V (1997). Face-To-Face Mediated Communication: A Comparison of Dialogue Structure and Task Performance. *Journal of Experimental Psychology: Applied*, *3*(2), 105-125.

Dorohonceanu B., Sletterink B., & Marsic I. (2000). A Novel User Interface for Group Collaboration. *Proceedings of the 33rd Hawaii International Conference on System Sciences*, (pp. 1024). Washington, DC, USA:IEEE Computer Society.

Edwards A. D. N. (1988). The Design of Auditory Interfaces for Visually Disabled Users. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, Washington USA, (pp. 83-88). New York, NY: ACM Press.

Edwards A. D. N. (1989). Soundtrack: An Auditory Interface for Blind Users. *ACM SIGCHI Bulletin 21*(1)*,* 124.

Edwards W. K., Mynatt E., & Stockton K. (1995). Access to Graphical Interfaces for Blind Users. *Interactions, 2*(1), 54-67.

Edwards W. K., & Mynatt D. E. (1994). An Architecture for Transforming Graphical Interfaces. In *Proceedings of the 7th Annual ACM Symposium on User Interface Software and Technology*, (pp. 39-47). New York, NY, USA: ACM Press.

Eseryel D., Ganesan R., & Edmonds G. S. (2002). Review of Computer-Supported Collaborative Work Systems. *Educational Technology & Society*, 5(2), 130-136.

Fletcher T. D. & Major D. A. (2006). The Effect of Communication Modality on Performance and Elf-Rating of Teamwork Components. *Journal of Computer-Mediated Communication, 11*(2), 557-576.

Friedrich R., Siegert S., Peinke J., Luck St., Siefert M., Lindemann M., Raethjen J., Deuschl G., Pfister, G. (2000). Extracting Model Equations from Experimental Data. *Physics Letters A*, *271*(3), 217-222.

Fuller R. (1996). Human-Computer-Human Interaction: How Computers Affect Interpersonal Communication. In D. L. Day & D. K. Kovacs (Eds.)*, Computers, Communication & Mental Models* (28-35). Bristol, PA, USA: Taylor & Francis, Inc.

Gale S. (1991). Adding Audio and Video to an Office Environment. *Studies in Computer Supported Cooperative Work: Theory, Practices and Design*. Amsterdam, The Netherlands: North-Holland Publishing Co.

Ganesan, R., Edmonds, G. S., & Spector, J. M. (2001). The Changing Nature of Instructional Design for Networked Learning. In C. Jones & C. Steeples (Eds.). *Networked Learning in Higher Education* (93-109). Berlin: Springer-Verlag.

Gaver W. W. (1986). Auditory Icons: Using Sound in Computer Interfaces. *Human-Computer Interaction, 2*(2), 167-177.

Gaver W. W. (1989). The SonicFinder: an Interface that Uses Auditory Icons. *Human-Computer Interaction*, *4*(1), 67-94.

Gaver W. W. (1993). Synthesizing Auditory Icons. In *Proceedings on Human Factors in Computing Systems,* (pp. 228-235). New York, NY, USA: ACM Press.

Gaver W. W. (1993b). What Do We Hear? An Ecological Approach to Auditory Source Perception. *Ecological Psychology*, *5*(1), 1-29.

Gaver, W. W., Smith R. B. & O'Shea T. (1991). Effective Sounds in Complex Systems: The Arkola Simulation. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems: Reaching Through Technology (CHI'91),* (pp. 85-90). New York, NY, USA: ACM Press.

Gellersen H.-W. & Beigl M. (1999). Ambient Telepresence: Colleague Awareness in Smart Environments. In *Proceedings of Managing Interactions in Smart Environments,* Ireland, December, 80-88.

Greatbatch D., Luff ., Heath C. & Camion P. (1993). Interpersonal Communication and Human Computer Interaction, an Examination of the Use of Computers in Medical Consultations. *Interacting With Computers, 5*(2), 193-216.

Green C. & Williges R. C. (1995). Evaluation of Alternative Media Used With a Groupware Editor in a Simulated Telecommunications Environment. *Human Factors, 37(*2), 283-289.

Greenberg S. & Boyle M. (1998). *Moving Between Personal Devices and Public Displays.* Technical Report 98/630/21, Department of Computer science, University of Calgary, Canada.

Greenberg, S., Boyle, M. and LaBerge, J. (1999). PDAs and Shared Public Displays: Making Personal Information Public, and Public Information Personal. *Personal Technologies, 3*(1/2), 55-64.

Gross T. (1997). Towards Flexible Support for Cooperation: Group Awareness in Shared Workspaces. In *Proceedings of the 8th International Workshop on Database and Expert Systems Applications*. (pp. 406). Washington, DC, USA:IEEE Computer Society.

Grudin J. (1988). Why CSCW Applications Fail: Problems in the Design and Evaluation of Organizational Interfaces. In *Proceedings of the 1988 ACM Conference on Computer-supported Cooperative Work (CSCW'88),* (pp. 85-93). New York, NY, USA: ACM Press.

Grudin (1994). Computer-Supporter Cooperative Work: History and Focus. *Computer, 27*(5), 19-26.

Gutwin C. & Greenberg S. (1998). Design for Individual, Design for Groups: Tradeoffs Between Power and Workspace Awareness. In *Proceedings of the ACM Conference on Computer Supported Cooperative Work (CSCW'98),* (pp. 207-216). New York, NY, USA: ACM Press.

Halloran, J. (2002). Putting it all Together: Information Visualizations, Display Arrangements, and Sales Transactions. In *New Review of Information Networking, 8,* 3-31.

Halstead-Nussloch R. (1989). The Design of Phone-Based Interfaces for Consumers. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems: Wings for the Mind (CHI'89),* (pp. 347-352). New York, NY, USA: ACM Press.

Harper R. & Sellen A. J. (2001). *The Myth of the Paperless Office*. Massachusetts, USA:MIT press.

Hinckleyss K (2003). Distributed and Local Sensing Techniques for Face-to-Face Collaboration. In *Proceedings of the 5th International Conference on Multimodal Interfaces*, (pp. 81-84). New York, NY, USA: ACM Press.

Horn, D. B., Finholt, T. A., Birnholtz, J. P., Motwani, D. & Jayaraman, S. (2004). Six Degrees of Jonathan Grudin: A Social Network Analysis of the Evolution and Impact of CSCW Research. In *Proceedings of the 2004 ACM Conference on Computer Supported Cooperative Work*, (pp. 582-591). New York, NY, USA: ACM Press.

Jennings, N. R., Faratin, P., Johnson, M. J., Norman, T. J., O'Brien, P. and Wiegand, M. E. (1996). Agent-based Business Process Management. *International Journal of Cooperative Information Systems*, *5* (2&3), 105-130.

Jennings N. R. & Wooldridge M (1996). Software Agents. *IEEE Review, 42*(1), 17-21.

Jennings N. & Wooldridge M. (1998). Applications of Intelligent Agents. In Nicholas R. Jennings and Michael J. Wooldridge (Eds.), *Agent Technology Foundations, Applications, and Markets*. Secaucus, NJ, USA: Springer-Verlag.

John B. E (1990). Extension of GOMS Analyses to Expert Performance Requiring Perception of Dynamic Visual and Auditory Information. In *Proceedings of the*

SIGCHI Conference on Human Factors in Computing Systems: Empowering People, (pp. 107-116). New York, NY, USA: ACM Press.

Jones S.D & Furner S.M (1989). The Construction of Audio Icons and Information Cues for Human Computer Dialogues. In T. Megaw (Ed.), *Contemporary Ergonomics: Proceedings of the Ergonomics Society's 1989 Annual Conference*. Reading, MA, USA: Addison-Wesley.

Karsenty L (1997). Effects of the Amount of Shared Information on Communication Efficiency in Side by Side and Remote Help Dialogues. In *Proceedings of the Fifth European Conference on Computer Supported Cooperative Work,* (pp. 49-64). Dordrecht, The Netherlands: Kluwer Academic Publishers.

Kraut R. E., Fussel S. R., Brennan S. E. & Siegel J. (2002). Understanding Effects of Proximity on Collaboration: Implications for Technologies to Support Remote Collaborative Work. In P. Hinds and S. Kiesler (Eds), *Distributed Work. New Ways of Working Across Distance Using Technology* (137-162).Cambridge, MA, USA: MIT Press.

Kruger R., Carpendale S. & Greenberg S. (2002). Collaborating over Physical and Electronic Tables. *ACM CSCW '2002 Conference on Computer Supported Cooperative Work*, New Orleans, Louisiana, USA. November.

Lawrence D., Atwood M.E. & Dews S. (1994). Surrogate Users: Mediating Between Social and Technical Interaction. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems: Celebrating Interdependence (CHI'94)*, (pp. 399-404). New York, NY, USA: ACM Press.

Lawrence D., Atwood M.E., Dews S. & Turner T. (1995). Social Interaction in the Use and Design of a Workstation: Two Contexts of Interaction. In P. Thomas (Ed.), *The Social and Interactional Dimensions of Human Computer Interfaces*. Cambridge, UK: Cambridge University Press.

Lieberman H and Selker T (2003). Agents for the User Interface. In J. Bradshaw (Ed.), *Handbook of Agent Technology*. MIT Press.

Lieberman H. (1997). Autonomous Interface Agents. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI'97)*, (pp. 67-74). New York, NY, USA: ACM Press.

Luff P. & Heath C. (1998) Mobility in Collaboration. In *Proceedings of the 1998 ACM Conference on Computer Supported Cooperative Work (CSCW'98)*, (pp. 305-314). New York, NY, USA: ACM Press.

Masoodian M., & Apperley M. (1995). User Perceptions of Human-To-Human Communication Modes in CSCW Environments. In *Proceedings of ED-MEDIA '95, World Conference on Educational Multimedia and Hypermedia*, (pp. 430-435). Chesapeake, VA, USA:AACE.

Masoodian, M., Apperley, M., and Frederikson, L. (1995). Video Support for Shared Work-Space Interaction: An Empirical Study. *Interacting with Computers 7*(3), 237-253.

Matarazzo G. & Sellen A. (2000). The Value of Video in Work at a Distance: Addition or Distraction? *Behaviour and Information Technology, 19*(5), 339-348.

McGooking D. K. & Brewster S. A. (2004). Understanding Concurrent Earcons: Applying Auditory Scene Analysis Principles to Concurrent Earcon Recognition. *ACM Transactions on Applied Perception (TAP), 1*(2), 130-155.

Millard N., Coe T., Gardner M., Gower A., Hole L. & Crowle S. (2000). The Future of Customer Contact. *BT Technology Journal*, *18*(1), 51-52.

Millard N., Hole L. & Crowle S. (1997). From Command to Control: Interface Design for Customer Handling Systems. In *Proceedings of the IFIP TC13 International Conference on Human-Computer Interaction*, (pp. 294-300). London, UK, UK:Chapman & Hall, Ltd.

Muller M. J., Carr R., Ashworth C, Diekmann B., Wharton C., Eickstaedt C., & Clonts J. (1995). Telephone Operators as Knowledge Workers: Consultants Who Meet Customer Needs. In *Proceedings of the SIGCHI Conference on Human Factors in Computing System (CHI'95)s*, (pp. 130-137). New York, NY, USA: ACM Press/Addison-Wesley Publishing Co

Mynatt E.D. & Weber G (1994). Nonvisual Presentation of Graphical User Interfaces: Contrasting Two Approaches. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems: Celebrating Interdependence (CHI'94)*, (pp. 166-172). New York, NY, USA: ACM Press.

Mynatt E.D. (1994). Designing with Auditory Icons: How Well Do We Identify Auditory Cues? In *Proceedings Of the SIGCHI Conference on Human Factors in Computing Systems (CHI'94),* (pp. 269-270). New York, NY, USA: ACM Press.

Nardi, B and Whittaker, S. (2001). The Place of Face-To-Face Interaction in Distributed Work. In P. Hinds and S. Kiesler (Eds), *Distributed Work. New ways of Working Across Distance Using Technology*. Massachusetts, USA:MIT Press.

Norman D. (1988). *The Psychology of Everyday Things*. New York, USA: BasicBooks, Inc.

O'Malley C., Langton S., Anderson A., Doherty-Sneddon G. & Bruce V. (1996). Comparison of Face-to-Face and Video-Mediated Interaction. *Interacting with Computers*, *8*(2), 177-192.

Ochsman R. B. & Chapanis A. (1974). The Effect of 10 Communication Modes on the Behavior of Teams During Cooperative Problems Solving. *International Journal of Man-Machine Studies, 6*(5), 579-619.

Olson J. S., Teasley S., Covi L. & Olson G. (2002). The (Currently) Unique Advantages of Collocated Work. In P. Hinds and S. Kiesler (Eds), *Distributed work. New Ways of Working Across Distance Using Technology*. Massachusetts, USA: MIT Press.

Panis L. I. & Verheyen R. F. (1995). On the Use of Split Moving Window Analysis for Boundary Detection in Ordered Dataseries from Benthic Communities. *Aquatic Ecology, 29*(1), 49-53.

Patton, M., Q. (2002). *Qualitative Research and Evaluation Methods*. California, USA: Sage Publications, Inc.

Pitt I. & Edwards A. (1996) Improving the Usability of Speech-Based Interfaces for Blind Users. In *Proceedings of The Second Annual ACM Conference On Assistive Technologies*, (pp. 124-130). New York, NY, USA: ACM Press.

Privacy Commissioner (1993). *The Privacy Act and Codes*. Retrieved September 7th, 2006, from http://www.privacy.org.nz/privacy-act/

Randall D. & Hughes J. A. (1995). Sociology, CSCW and Working with Customers. In Thomas (Ed), *The Social and Interactional Dimensions of Human-Computer Interfaces*. New York, USA: Cambridge University Press.

Resnick P. & Virzi R. A. (1992). Skip and Scan: Cleaning up Telephone Interfaces. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, (pp. 419-426). New York, NY, USA: ACM Press.

Rodden T. (1991). A Survey of CSCW Systems. *Interacting with Computers, 3*(3), 319-353.

Rodden T., Rogers Y., Halloran J. & Taylor I. (2003). Designing Novel Interactional Workspaces to Support Face to Face Consultations. In *Proceedings of the Conference on Human Factors in Computing Systems (CHI'03)*, (pp. 57-64). New York, NY, USA: ACM Press.

Rutter D. R. & Stephenson G. M. (1977). The Role of Visual Communication in Synchronizing Conversation. *European Journal of Social Psychology. 7*(1), 29-37.

Rutter D. R., Stephenson G. M. & Dewey M. E. (1981). Visual Communication and the Content and Style of Conversation. *British Journal of Social Psychology, 20*(1), 41-52.

Scaife, M., Halloran, J., & Rogers, Y. (2002). Let's Work Together: Supporting Two-Party Collaborations with New Forms of Shared Interactive Representations. In *Proceedings of COOP'2002*. Nice, France. August, 123-138. Amsterdam, Holland:IOS Press.

Shen C., Everitt K. & Ryall K. (2003). UbiTable: Impromptu Face-to-Face Collaboration on Horizontal Interactive Surfaces. In *Proceedings of the Fifth International Conference on Ubiquitous Computing*, (pp. 218-288). Berlin, Germany:Springer-Verlag

Short J., Williams E. & Christie B. (1976). *The Social Psychology of Telecommunications*. New York, USA:John Wiley & Sons, Ltd.

Steel A. (2003). Understanding and Enhancing Call Centre CHHI. In Proc *CHI '03 extended abstracts on Human factors in computing systems, SESSION: Doctoral Consortium Submissions,* (pp. 690-691). New York, NY, USA: ACM Press.

Steel A, Jones, M, Apperley, M. (2002). The Use of Auditory Feedback in Call Centre Computer-Human-Human Interaction, (pp. 68-69). In *CHI '02 Extended Abstracts on Human Factors in Computing Systems*. New York, NY, USA: ACM Press.

Steel A., Jones M. & Apperley M. (2001). Auditory feedback in call centre CHHI. (142-147) In *Proc OZCHI 2001: Usability and Usefulness for Knowledge Economies,* Perth, Western Australia.

Stephenson G. M., Ayling K. & Rutter D. R. (1976). The Role of Visual Communication in Social Exchange. *British Journal of Social and Clinical Psychology, 15*(2), 113-120.

Stewart J., Bederson B.B. & Druin A. (1999). Single Display Groupware: A Model for Co-Present Collaboration. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems: The CHI is the Limit (CHI'99)*, (pp. 286-293). New York, NY, USA: ACM Press.

Stewart J., Raybourn E. M., Bederson B. & Druin A. (1998). When Two Hands Are Better Than One: Enhancing Collaboration Using Single Display Groupware. In *Proceedings Conference Summary on Human Factors in Computing Systems (CHI'98)*, (pp. 287-288). New York, NY, USA: ACM Press.

Suchman L. A. (1987). *Plans and Situated Actions: The Problem of Human--Machine Communication.* New York, USA: Cambridge University Press.

Tanir O., & Booth R. (1999). Call Centre Simulation in Bell Canada. In *Proceedings of the 31st Conference on Winter Simulation: Simulation---A Bridge to the Future,* (pp. 1640-1647). New York, NY, USA: ACM Press.

Ten Have P. (1991). Talk and Institution: a Reconsideration of the Asymmetry of Doctor-Patient Interaction. In D. Boden & D. H. Zimmerman (Eds), *Talk and Social Structure: Studies in Ethnomethodology and Conversation Analysis*. Cambridge, UK: Polity Press.

Tse E., Histon J., Stacey D S., & Greenberg S. (2004). Avoiding Interference: How People Use Spatial Separation and Partitioning in SDG Workspaces. In *Proceedings of the 2004 ACM Conference on Computer Supported Cooperative Work (CSCW'04)*, (pp. 252-261). New York, NY, USA: ACM Press.

Twidale M. B (2005). Over the Shoulder Learning: Supporting Brief Informal Learning. *Computer Supported Collaborative Work, 14*(6), 505-547.

Vaus D. A. (1991). *Surveys in Social Science Research.* 3rd edition. London, England: University College press.

Vargas M. L. M. & Anderson S. (2003). Combining Speech and Earcons to Assist Menu Navigation. In *Proceedings of the 2003 International Conference on Auditory Display,* Boston, MA, USA. 6-9 July, 38-41.

Walker M. A. (1994). Experimentally Evaluating Communicative Strategies: The Effect of the Task. In *Proceedings of the Twelfth National Conference on Artificial Intelligence (vol. 1),* (pp. 86-93). Menlo Park, CA, USA: American Association for Artificial Intelligence.

Wang H., & Blevis E. (2004). Concepts that Support Collocated Collaborative Work Inspired by the Specific Context of Industrial Designers. In *Proceedings of the 2004 ACM Conference on Computer Supported Cooperative Work (CSCW'04)*, (pp. 546-549). New York, NY, USA: ACM Press.

Wilson K., Roe B., & Wright L. (1998). Telephone or Face-to-face Interviews: A Decision Made on the Basis of a Pilot Study. *International Journal of Nursing Studies, 35*(6), 314-321.

Yin M., & Zhai S. (2006). The Benefits of Augmenting Telephone Voice Menu Navigation with Visual Browsing and Search. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI'06), (*pp. 319-328). New York, NY, USA: ACM Press.

Appendix A. Auditory feedback study 1 Workbook

This appendix shows the workbook that was given to the participants in auditory feedback study 1 (see Chapter 4). It includes instructions, tasks, additional information needed and the questionnaires.

The Use of Auditory Feedback In Call Centre Computer-Human-Human Interaction

Participant Workbook

Session Number: **Date and Time:**

Sequence:

Sub task A; (1) Sub tasks B: (2)

Introduction

This study is aimed to investigate if the use of auditory feedback improves the interaction that takes place at a call centre.

I would like to stress at this point, that it is the auditory feedback that is being evaluated, not you! The session will be videotaped and there will also be an observer for the sessions.

You will be asked to perform a set of tasks. When you have finished these I will ask you to complete a questionnaire about your experience of the tasks. I will then discuss with you any issues or difficulties you had, as well as anything else you wish to comment about with regard to the tool.

I would also like to point out that you have the right to refuse to perform any task and to leave the study at any time that you choose.

Research Participant's Bill of Rights

The University of Waikato Department of Computer Science

The following is a list of your rights if you participate in a research project in the Department of Computer Science at the University of Waikato.

As a research participant, you have the right:

- To be treated with respect and dignity in every phase of the research.
- To be fully and clearly informed of all aspects of the research prior to becoming involved in it.
- To enter into clear, informed, and written agreement with the researcher prior to becoming involved in the activity. You should sense NO pressure, explicit or otherwise, to sign this contract.
- To choose explicitly whether or not you will become involved in the research under the clearly stated provision that refusal to participate or the choice to withdraw during the activity can be made at any time without penalty to you.
- To be treated with honesty, integrity, openness, and straightforwardness in all phases of the research, including a guarantee that you will not unknowingly be deceived during the course of the research.
- To receive something in return for you time and energy.
- To demand proof that an independent and competent ethical review of human rights and protections associated with the research has been successfully completed.
- To demand complete personal confidentiality and privacy in any reports of the research unless you have explicitly negotiated otherwise.
- To expect that your personal welfare is protected and promoted in all phases of the research, including knowing that no harm will come to you.
- To be informed of the results of the research study in a language you understand.
- To be offered an range of research studies or experiences from which to select, if the research is part of fulfilling your educational or employment goals.

The contents of this bill were prepared by the University of Calgary who examined all of the relevant Ethical Standards from the Canadian Psychological Association's Code of Ethics for Psychologists, 1991 and rewrote these to be of relevance to research participants.

A description of the CPA Ethical Code and the CPA Ethical Standards relevant to each of these rights is available on-line if you would like to examine it. The complete CPA Ethical Code can be found in Canadian Psychological Association *"Companion manual for the Canadian Code of Ethics for Psychologists"* (1992).

Research Consent Form

The University of Waikato Department of Computer Science

This consent form, a copy of which has been given to you, is only part of the process of informed consent. It should give you the basic idea of what the research is about and what your participation will involve. If you would like more detail about something mentioned here, or information not included here, please ask. Please take the time to read this form carefully and to understand any accompanying information.

Research Project Title

The Use Of Auditory Feedback In Call Centre Computer-Human-Human Interaction

Researcher

Mrs. Anette Steel (BSocSc)

Experiment Purpose

The purpose of the experiment is to investigate if the use of auditory feedback improves the interation that takes place at a call centre.

Participant Recruitment and Selection

As any person is a potential call centre customer, there are no particular demographics required for the participants. To try and get a representative sample of participants, a random process of selection will be used. The recruitment of participants will be through posters or similar.

Procedure

You will be asked to perform a few task regarding questions about a power bill. You will be given a bill and a telephone.

After the tasks you will be asked to fill out the questionnaire about your experience of the tasks.

Data Collection

We are measuring general satisfaction and progress of calls.

Confidentiality

Confidentiality and participant anonymity will be strictly maintained. All information gathered will be used for statistical analysis only and no names or other identifying characteristics will be stated in the final or any other reports.

Likelihood of Discomfort

There is no likelihood of discomfort or risk associated with participation.

Finding out about Results

The finding will be made available only after agreement of Peace software. Some of the data might be available in a short form without any confidential information.

Agreement

Your signature on this form indicates that you have understood to your satisfaction the information regarding participation in the research project and agree to participate as a participant. In no way does this waive you legal rights nor release the investigators, sponsors, or involved institutions from their legal and professional responsibilities. You are free to not answer specific items or questions in interviews or on questionnaires. You are free to withdraw from the study at any time without penalty. Your continued participation should be as informed as your initial consent, so you should feel free to ask for clarification or new information throughout your participation. If you have further questions concerning matters related to this research, please contact the researcher.

__________________________ __________________

Participant Date

__________________________ __________________

Investigator/Witness Date

A copy of this consent form has been given to you to keep for your records and reference.

Instructions

The next page in this workbook contains a power bill. In this room you will find a telephone. For the tasks that you perform, all you need is the bill and the telephone. The telephone number you need to call is on the phone bill.

Bill

WAIKATO ENERGY

Waikato Energy
1 Energy Rd
Free phone: 5116
Account Number 242

Energy account – Actual reading

Please have this ready when you call us for enquiries

Customer Number: 66

Your energy usage at a glance

Electricity usage until 3 September	$175
Total energy	$175

See on other side for full details on usage

Current charges due by 28 September 2001

Total to pay **$218**

Tariff and usage information

Electricity information

5a Ford St

Meter 103

	Energy	Charge	Line	Charges	
Reading	Rate	Amount	Rate	Amount	Total
3891	0.045	175	0.10021	43.27	218.27

Total energy charges -- $218

Payment received since your last bill. Thank you

28 July -- $133

Task 1

You are moving from 1 Home Street Hamilton, to 45 Away Street Hamilton.

Task 2

You have been sent a power bill. The total is a bit high and you want to know why. If it has been billed correctly, you need to set it up so that you can pay it a bit later on, as you cannot pay for the bill before the due date.

Questionnaire

1. Please describe your general impression of the conversation:

Please state if you agree with the following statements:

2. I found the conversation satisfying. Please tick the appropriate box

Strongly disagree			Neither agree nor disagree			Strongly agree

3. Please explain your answer

4. I found that the conversation flowed well. Please tick the appropriate box

Strongly disagree			Neither agree nor disagree			Strongly agree

5. Please explain your answer

6. How often did you interrupt the call centre staff member? Please tick the appropriate box

Never			Neither often nor seldom			Very often

7. How often did you have to wait, while the call centre staff member was busy? Please tick the appropriate box

Never			Neither often nor seldom			Very often

8. Did you notice any sounds other than speech? Please tick the appropriate box

Yes	No	Not sure

If yes, what were they? (Tick as many as you want)

A tune	[]
Background buzzing	[]
Beeping	[]
Clicking	[]
Flicking	[]
Ticking	[]
Traffic	[]
Other	[] What were they?________________________

____

If you heard the following sounds what do you think the sounds represent?

A tune ____

Background buzzing ________________________________

Clicking____

Flicking____

Ticking____

Please state if you agree with the following statements:

The sounds were helpful

Strongly agree — Neither agree nor disagree — Strongly disagree

If the sounds were helpful, were they helpful for: (Tick as many as you want)

Telling me when the call centre staff member was busy	[]
Informing me when the best time to provide information was	[]
Giving me feedback about what was going on at the call centre	[]
Other	[]

Please Explain:____

____

The sounds increased my satisfaction of the call

Strongly agree — Neither agree nor disagree — Strongly disagree

Please explain

I found the sounds annoying

Strongly agree — Neither agree nor disagree — Strongly disagree

Please explain

Thank you for your time and effort in participating in this experiment

Appendix B. Additional results from auditory feedback study 1

This appendix shows additional results from auditory feedback study 1 (see Chapter 4).

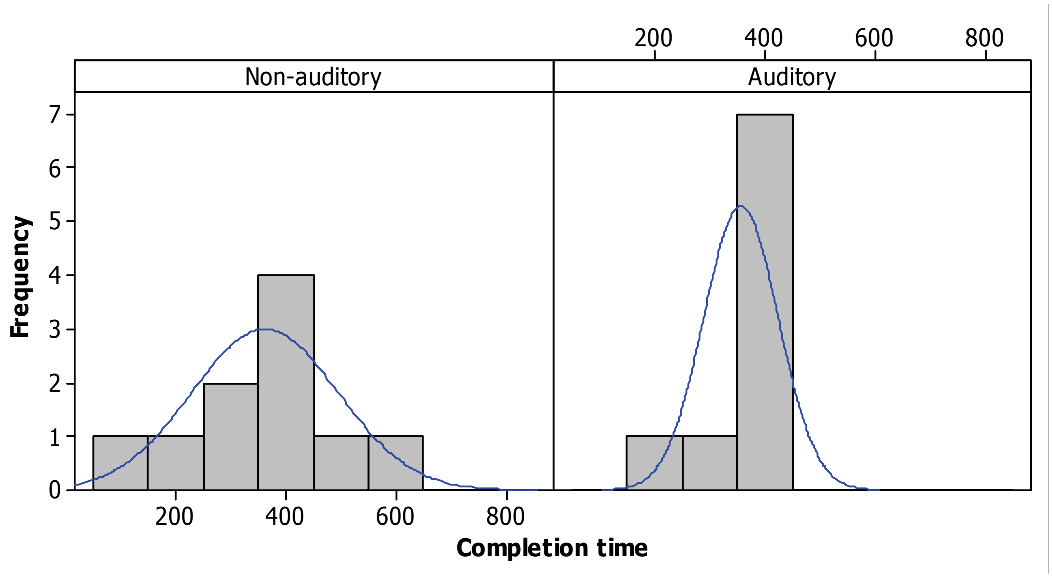


Figure 104. Histogram, with normal curve, of completion time by condition, without outliers

Table 58. Comments participants made about if the auditory feedback made the interaction more satisfying

	Knew something was happening'	Easier to wait	Knew something had been done	Helpful
Non-Auditory feedback	5	1	1	0
Auditory feedback	5	0	1	1

Table 59. Comments made by the participant about if the auditory feedback was annoying

	Distracting	Annoying	Non useful	Unprofessional	Reduced concentration	Hindered conversation
Non-Auditory feedback	1	2	1	0	0	0
Auditory feedback	2	0	0	1	1	2

Appendix C. Auditory feedback study 2 Workbook

This appendix shows the workbook given to the participants in auditory feedback study 2 (see Chapter 5). This includes instructions, tasks and questionnaires.

Introduction

This study is aimed to investigate the interaction that takes place at a call centre.

At this point I would like to point out that it is call centre transaction that is being evaluated, not you! The session will be recorded and observed.

You will be asked to perform a set of tasks. When you have finished each task, I will ask you to complete a questionnaire about your experience. At the end of the entire session, I might discuss with you any issues or difficulties you had, as well as anything else you wish to comment about with regard to the interaction.

You have the right to refuse to perform any task and to leave the study at any time that you choose.

Research Participant's Bill of Rights

The University of Waikato Department of Computer Science

The following is a list of your rights if you participate in a research project in the Department of Computer Science at the University of Waikato.

As a research participant, you have the right:

- To be treated with respect and dignity in every phase of the research.
- To be fully and clearly informed of all aspects of the research prior to becoming involved in it.
- To enter into clear, informed, and written agreement with the researcher prior to becoming involved in the activity. You should sense NO pressure, explicit or otherwise, to sign this contract.
- To choose explicitly whether or not you will become involved in the research under the clearly stated provision that refusal to participate or the choice to withdraw during the activity can be made at any time without penalty to you.
- To be treated with honesty, integrity, openness, and straightforwardness in all phases of the research, including a guarantee that you will not unknowingly be deceived during the course of the research.
- To receive something in return for your time and energy.
- To demand proof that an independent and competent ethical review of human rights and protections associated with the research has been successfully completed.
- To demand complete personal confidentiality and privacy in any reports of the research unless you have explicitly negotiated otherwise.
- To expect that your personal welfare is protected and promoted in all phases of the research, including knowing that no harm will come to you.
- To be informed of the results of the research study in a language you understand.
- To be offered a range of research studies or experiences from which to select, if the research is part of fulfilling your educational or employment goals.

The contents of this bill were prepared by the University of Calgary who examined all of the relevant Ethical Standards from the Canadian Psychological Association's Code of Ethics for Psychologists, 1991 and rewrote these to be of relevance to research participants.

A description of the CPA Ethical Code and the CPA Ethical Standards relevant to each of these rights is available on-line if you would like to examine it. The complete CPA Ethical Code can be found in Canadian Psychological Association *"Companion manual for the Canadian Code of Ethics for Psychologists"* (1992).

Research Consent Form

The University of Waikato Department of Computer Science

This consent form, a copy of which has been given to you, is only part of the process of informed consent. It should give you the basic idea of what the research is about and what your participation will involve. If you would like more detail about something mentioned here, or information not included here, please ask. Please take the time to read this form carefully and to understand any accompanying information.

Research Project Title

Call Centre Computer-Human-Human Interaction

Researcher

Anette Steel (BSocSc, PgDipSc), Department of Computer Science at the University of Waikato

Research Purpose

The purpose of the research is to investigate transactions at a call centre.

Procedure

You will be asked to perform a task regarding questions about a power account.

After the tasks you will be asked to fill out the questionnaire about your experience of the tasks.

The session will take approximately 30 minutes in total.

Data Collection

We are measuring timing, general satisfaction and progress of calls.

Confidentiality

Confidentiality and participant anonymity will be strictly maintained. All information gathered will be used for statistical analysis only and no names or other identifying characteristics will be stated in the final or any other reports. The personal details used for the study will not mentioned in final or any other reports.

The sessions will be recorded. The recordings will not be seen by anyone except for the researcher and Usability Laboratory staff.

Likelihood of Discomfort

There is no likelihood of discomfort or risk associated with participation.

Finding out about Results

The findings will be made available after the end of the study.

Agreement

Your signature on this form indicates that you have understood to your satisfaction the information regarding participation in the research project and agree to participate as a participant. In no way does this waive you legal rights nor release the investigators, sponsors, or involved institutions from their legal and professional responsibilities. You are free to not answer specific items or questions in interviews or on questionnaires. You are free to withdraw from the study at any time without penalty. Your continued participation should be as informed as your initial consent, so you should feel free to ask for clarification or new information throughout your participation. If you have further questions concerning matters related to this research, please contact the researcher.

Participant | Date

Investigator/Witness | Date

A copy of this consent form has been given to you to keep for your records and reference.

Questionnaire

1. How old are you? (Please circle your choice)

Less than 20	21-30	31-40	41-50	51-60	Older than 61

2. Gender (Please circle your choice)

   Male Female

3. What is your ethnical background?

   New Zealand Maori []
   New Zealand European []
   Australasian []
   European []
   Asian []
   American []
   African []
   Other, please state:_____________________

4. Is English your first language Yes No

5. Approximately how often do you phone a call centre (by call centre we are referring to when you talk to a person representing say a power company, telephone company, travel agent etc. over the phone, to get more information about a product or service) (Please circle your choice)

Less than once per year	2-3 times per year	Every 2-3 months	Once per month	2-3 per month	Once per week	More than once per week

Tasks A

You are moving from 2 Dawson, Street Hamilton, to 4 Hogan Street Hamilton. You are moving on the 15 September 2001. You need to call the energy company and let them know your change of address.

<u>Answer the following questions based on the telephone call you just made</u>

Please describe your general impression of the interaction:

(Please circle your choice)

	Didn't complete the task at all						Fully completed the task
Rate how well you were able to complete the task	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Comment							

	Not at all satisfying						Very satisfying
Rate how satisfying the conversation was	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Comment							

	Didn't flow well at all						Flowed very well
Rate how well the conversation flowed	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Comment							

	Very often						Never
Rate how often you interrupted the agent	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Comment							

	Not at all aware						Very aware
Rate how aware you were of what the agent was doing	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Comment							

	Shorter than expected			As expected			Longer than expected
Was the length the call	(1)	(2)	(3)	(4)	(5)	(6)	(7)

Comment

	Too short			Just right			Too long
Was the length of the call	(1)	(2)	(3)	(4)	(5)	(6)	(7)

Comment

During the call, were there any silences that you thought were too long? Yes No

	Seldom						Often
If yes, how often?	(1)	(2)	(3)	(4)	(5)	(6)	(7)

During the call, did you ever wonder if you had been disconnected?? Yes No

	Seldom						Often
If yes, how often?	(1)	(2)	(3)	(4)	(5)	(6)	(7)

Did you notice any non-speech sounds? (Please circle your choice)

Yes	No
Please continue on next page	Please continue with the next task

Rate what the sounds were useful for (Please circle your choice)

	Not at all useful						Very useful
Telling me when the call centre staff member was busy	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Informing me when the best time to provide information was	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Giving me feedback about what was going on at the call centre	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Other, Please state: ______ And rate	(1)	(2)	(3)	(4)	(5)	(6)	(7)

Did the sounds increase or decrease the quality of your experience with the interaction? (Please Circle your choice)	Increased the quality	Decreased the quality	No change in quality

	Increased a little						Increased a lot
If it increased, how much did it increase?	(1)	(2)	(3)	(4)	(5)	(6)	(7)

	Decreased a little						Decreased a lot
If it decreased, how much did it decrease?	(1)	(2)	(3)	(4)	(5)	(6)	(7)

Thank you, please continue with the next task.

Task B

You have been sent a power bill (see the next page for the bill). The total is higher than you expected and you want to know why.

Answer the following questions based on the telephone call you just made

Please describe your general impression of the interaction:

(Please circle your choice)

	Didn't complete the task at all						Fully completed the task
Rate how well you were able to complete the task	(1)	(2)	(3)	(4)	(5)	(6)	(7)

Comment

	Not at all satisfying						Very satisfying
Rate how satisfying the conversation was	(1)	(2)	(3)	(4)	(5)	(6)	(7)

Comment

	Didn't flow well at all						Flowed very well
Rate how well the conversation flowed	(1)	(2)	(3)	(4)	(5)	(6)	(7)

Comment

	Very often						Never
Rate how often you interrupted the agent	(1)	(2)	(3)	(4)	(5)	(6)	(7)

Comment

	Not at all aware						Very aware
Rate how aware you were of what the agent was doing	(1)	(2)	(3)	(4)	(5)	(6)	(7)

Comment

	Shorter than expected			As expected			Longer than expected
Was the length the call	(1)	(2)	(3)	(4)	(5)	(6)	(7)

Comment

	Too short			Just right			Too long
Was the length of the call	(1)	(2)	(3)	(4)	(5)	(6)	(7)

Comment

During the call, were there any silences that you thought were too long? Yes No

	Seldom						Often
If yes, how often?	(1)	(2)	(3)	(4)	(5)	(6)	(7)

During the call, did you ever wonder if you had been disconnected?? Yes No

	Seldom						Often
If yes, how often?	(1)	(2)	(3)	(4)	(5)	(6)	(7)

Did you notice any non-speech sounds? (Please circle your choice)

Yes	No
Please continue on next page	Thank you for your time and effort in participating in this study!

Rate what the sounds were useful for (Please circle your choice)

	Not at all useful						Very useful
Telling me when the call centre staff member was busy	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Informing me when the best time to provide information was	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Giving me feedback about what was going on at the call centre	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Other, Please state: ____________ And rate	(1)	(2)	(3)	(4)	(5)	(6)	(7)

Did the sounds increase or decrease the quality of your experience with the interaction? (Please Circle your choice)	Increased the quality	Decreased the quality	No change in quality

	Increased a little						Increased a lot
If it increased, how much did it increase?	(1)	(2)	(3)	(4)	(5)	(6)	(7)

	Decreased a little						Decreased a lot
If it decreased, how much did it decrease?	(1)	(2)	(3)	(4)	(5)	(6)	(7)

Thank you for your time and effort in participating in this study!

Appendix D. Additional results from auditory feedback study 2

This appendix displays additional results from auditory feedback study 2 (see Chapter 5).

Table 60. Mean completion time due to task order and condition

	Auditory feedback		No auditory feedback	
	Mean	St dev	Mean	St dev
First task	122.40	32.69	129.89	75.25
Second task	142.30	77.28	142.00	22.58

Table 61. Mean completion time due to task

	Auditory feedback		No auditory feedback	
	Mean	St dev	Mean	St dev
Move task	147.80	28.75	140.67	70.48
Flatmate task	116.90	76.83	96.50	19.91

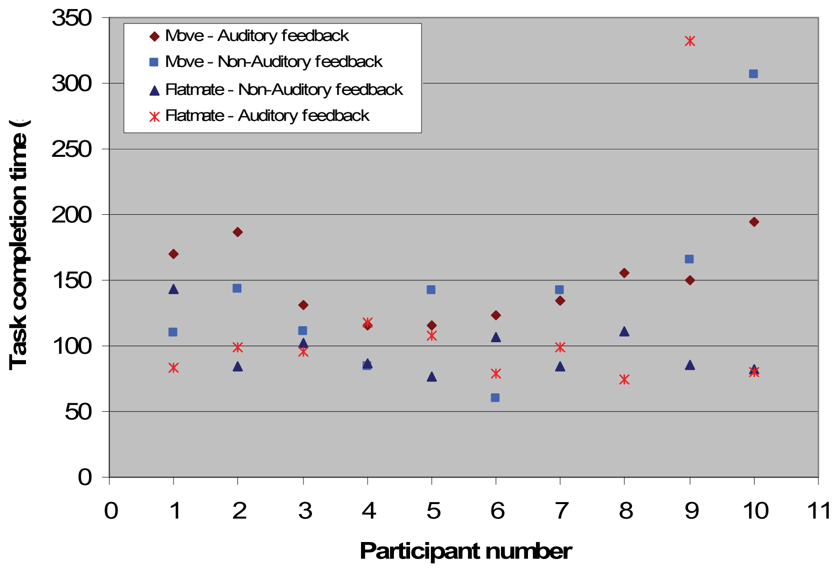


Figure 105. Task completion time for each individual participants, including task

Table 62. Completion time, in seconds, taking into account the tasks and condition.

	Auditory feedback		Non auditory feedback	
	Flatmate	Move	Flatmate	Move
Sum	1169	1478	965	1266
Mean	116.90	147.80	96.50	126.60
Standard deviation	76.83	28.75	19.91	79.97
Median	97.50	142.00	86.50	126.50
Max	332	195	143	307
Min	75	116	77	0

Table 63. Descriptive statistics of general rating questions, taking task into account

	How well did you complete the task?	How satisfied were you with the interaction	How well did the conversation flow?	How often did you interrupt the agent?	How aware were you of the agent's activity?
	Flatmate	Flatmate	Flatmate	Flatmate	Flatmate
Mean	6.90	5.10	5.05	6.70	4.80
Stdev	0.31	1.62	1.79	0.80	1.85
Median	7.00	5.00	5.50	7.00	5.00
Max	7.00	7.00	7.00	7.00	7.00
Min	6.00	2.00	1.00	4.00	2.00
	Move	Move	Move	Move	Move
Mean	6.90	4.85	4.40	6.50	3.55
Stdev	0.31	1.60	1.93	1.10	1.96
Median	7.00	5.00	5.00	7.00	3.00
Max	7.00	7.00	7.00	7.00	7.00
Min	6.00	1.00	1.00	4.00	1.00

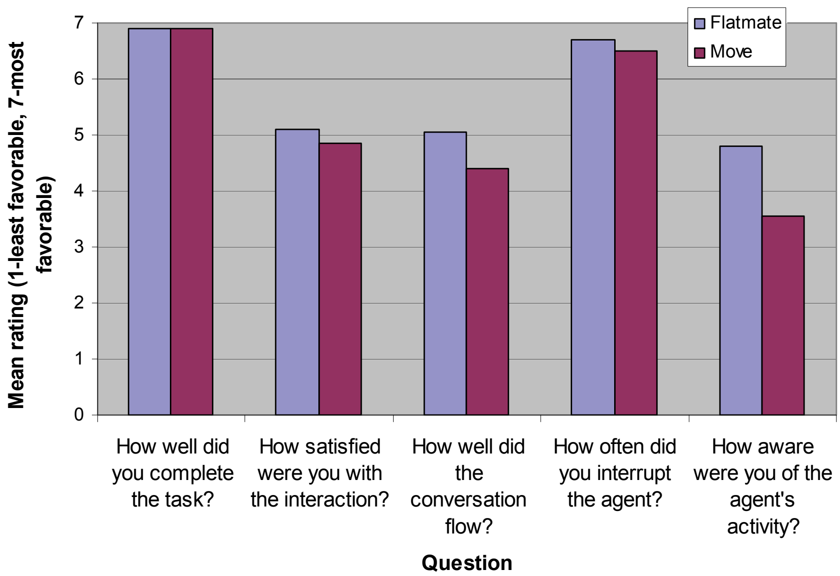


Figure 106. The mean rating taking into account task, where 1 is the least favorable rating and 7 is the most favorable.

	Was the length of call shorter than expected, as expected, longer than expected?	Was the length of call too short, just right, too long?
	Flatmate	Flatmate
Mean	2.85	4.00
Stdev	1.31	0.73
Median	3.00	4.00
Max	7.00	6.00
Min	1.00	2.00
	Move	Move
Mean	4.45	4.85
Stdev	1.61	0.99
Median	4.50	5.00
Max	7.00	7.00
Min	1.00	4.00

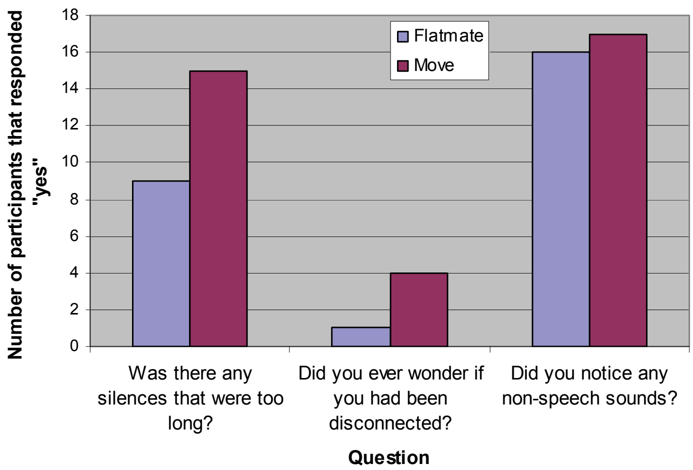


Figure 107. Total number of times participants answered "yes" when tasks were taking into account

Appendix E. Participant material: human-human communication study 1

This appendix contains the materials given to the agent and customer for human-human communication study 1 (see Chapter 6), including instructions to both agent and customer participants, tasks and questionnaires.

Instructions for both participants

The purpose of this study is to compare human communication in a customer service situation.

At this point I would like to point out that it is call centre transaction that is being evaluated, not you!

All your interactions will be recorded, both video and audio. All recordings will be strictly confidential, and my supervisors and I are the only people who will see it. The data collected will be anonymous and confidential.

You will be asked to perform a task. When you have finished task, I will ask you to complete a questionnaire about your experience. It is really important that you collaborate to arrive at the best result. Finding the most suitable flight is much more important than the time it takes.
You have the right to refuse to perform any task and to leave the study at any time that you choose.

Instructions for the "Agent"

You role is to be a travel agent.

Here are some guidelines:

Here are some guidelines:

- You need to use the online flight booking websites www.airnz.co.nz and www.qantas.co.nz to find the flights. **It is important that you use both websites to find the best option!**
- You only have to find the most suitable flight, do not try to actually book the flight!
- The customer has to use the same airline in both directions.
- It is very important that you find the best flight that most satisfies all the other participants needs.
- It is the other participant who decides when the best option has been found.
- You only have to find the most suitable flight, do not try to actually book the flight! However, to get at the price on www.airnz.co.nz you have to choose flights and go one step further. You can do this without actually booking the flight.
- All communication with the other participant has to be verbal only! You are **not** allowed to show the other participant the computer screen, hand written notes, print outs or similar. If you make any notes, make sure the other person cannot see them.

Instruction to customer

Below is your task.

Make sure that you do not show the task to the other participant. You are not allowed to share any written information, computer information or such with the other person. If you make any notes, make sure the other person cannot see them.

You are responsible for deciding when the best flight has been found.

You want to go on holiday in either Los Angeles or London

You have to make sure that **all** following criteria have to be met:

- You would prefer to fly out from Auckland on Thursday the 6^{th} of May, **but you can only fly out between 6pm and 8pm** (due to transport to airport).
- If it is not possible to fly out from Auckland on Thursday, you want to fly out on Friday the 7^{th} May as early as possible.
- You have to be back in Auckland, NZ, **no later than the 10pm of the 22^{nd} May**. However, to make the trip as long as possible, you want to arrive as close to 10pm as possible.
- You would definitely prefer to go to London, but only if you get **2 full weeks (14 days) in** London
- You want the shortest total flight time
- You want as few stopovers as possible

You only need to find the best flight you do not want to actually book it!

When you have found the flight that matches the most criteria, please state loud and clear "I have found the best flight" and fill in the details below.

Please note the details for the chosen flights:

Destination (please circle one)	Los Angeles	London
Airline (please circle one)	Qantas	Airnz

From Auckland

Departure Date (from Auckland)______________________________

Departure Time (from Auckland)______________________________

To Auckland

Departure Date (from destination)______________________________

Departure Time (from destination)______________________________

Please answer the following questions about the conversation in general

The conversation was… (Please circle one number)

1 = very unsatisfactory, 4 = neither satisfactory nor unsatisfactory, 7= very satisfactory

1 2 3 4 5 6 7

Did you feel … (Please circle one number)

1 = very frustrated, 4 = neither frustrated nor not frustrated, 7 = not frustrated at all

1 2 3 4 5 6 7

The length of completing the task was… (Please circle one number)

1 = much longer than expected, 4 = as expected, 7= much shorter than expected

1 2 3 4 5 6 7

Was the problems solved … (Please circle one number)

1 = very inefficiently, 4 = neither efficiently nor inefficiently, 7 = very efficiently

1 2 3 4 5 6 7

The problem was … (Please circle one number)

1 = very complicated, 4 = neither complicate nor straight forward, 7 = very straight forward

1 2 3 4 5 6 7

The task was … (Please circle one number)

1 = not complete at all, 4 = partially completed, 7 = fully completed

1 2 3 4 5 6 7

Are you … (Please circle one number) the task was completed as you expected?

1 = very unconfident, 4 = neither unconfident nor unconfident, 7 = very confident

1 2 3 4 5 6 7

Please answer the following questions about the quality of conversation

Did you … (Please circle one number)

1 = not understand the conversation at all, 4 = partially understand the conversation, 7 = fully understand the conversation

1 2 3 4 5 6 7

The conversation was … (Please circle one number)

1 = not concise at all, 4 = partially concise, 7 = very concise.

1 2 3 4 5 6 7

The conversation was … (Please circle one number)

1 = very unexpressive, 4 = neither unexpressive nor expressive, 7 = very expressive

1 2 3 4 5 6 7

Pre task questionnaire

1. How old are you? (choose 1 option)

<20 20-30 30-40 40-50 >50

2. Gender: (choose 1 option) Male female

3. What is your educational background? (choose 1 option)

No tertiary education Diploma or similar Bachelor Higher than Bachelor

4. How often do you travel? (choose 1 option)

Never Rarely Sometimes Fairly often Very often

5. When was the last time you called a call centre, such as Power Company, telecom, travel agent? (choose 1 option)

Last week last month within last 6 months in the last year more than a year ago

6. When was the last time you went in to a customer service, such as bank, insurance company? (choose 1 option)

Last week last month within last 6 months in the last year more than a year ago

7. Have you ever used online flight booking? If so, how much? (choose 1 option)

All the time Quite often A few times Once

8. If you have used online flight booking, who have you used?

Appendix F. Additional results for human-human experiment 1

This appendix shows additional results from the human-human communication study 1 (see Chapter 6).

Table 64. Ranks of times for both conditions

Condition	Time (sec)	Rank
Telephone	105	1
Telephone	111	2
Telephone	116	3
Telephone	159	4
Telephone	174	5
Telephone	186	6
Telephone	226	7
Face to face	291	8
Face to face	293	9
Face to face	309	10
Telephone	333	11
Face to face	345	12
Face to face	354	13
Face to face	388	14
Telephone	437	15
Telephone	450	16
Face to face	483	17
Face to face	507	18
Face to face	515	19

Table 65. Chi contribution including role

	Face-to-face		Telephone	
	Agent	Customer	Agent	Customer
Just talk	0.63	65.28	46.20	4.77
Talk pause	33.34	11.35	1.11	16.12
Just listen	105.08	366.65	147.52	1.39
Waiting	208.40	367.30	162.33	47.72
Search	182.45	131.95	40.08	77.73
Make notes	113.34	157.46	67.23	34.24
Other	3.81	3.81	5.79	5.79
Talk and search	43.07	146.96	183.59	44.83
Talk and make notes	37.00	43.55	15.93	11.25
Listen and search	12.86	195.94	29.95	54.18
Listen and make notes	124.21	122.74	78.18	79.56
Listen and talk	0.00	0.00	0.00	0.00
Search and make notes	0.90	0.90	0.60	9.71

Table 66. Descriptive statistics for duration of utterance for both conditions and role

	Face-to-face N = 6		Telephone N = 7	
	Agent	Customer	Agent	Customer
Mean	2.67	2.62	3.65	2.91
Standard Deviation	3.64	4.45	4.26	4.86
Median	2	1	2	1
Maximum	33	60	38	35
Minimum	0	0	0	0

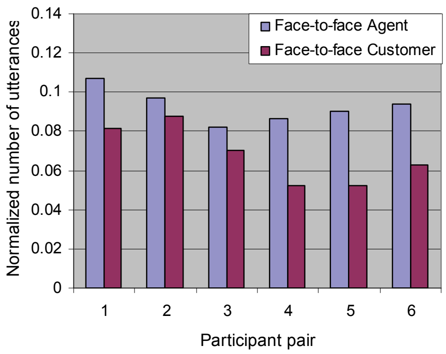


Figure 108. Mean number of utterances for each participant in the face-to-face condition

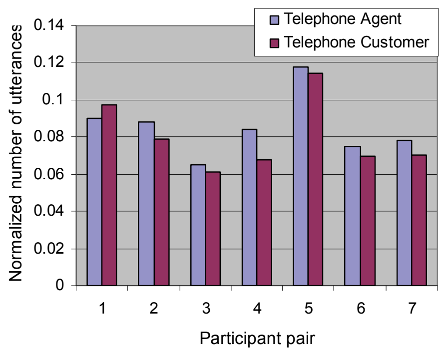


Figure 109. Mean number of utterances for each participant in the telephone condition

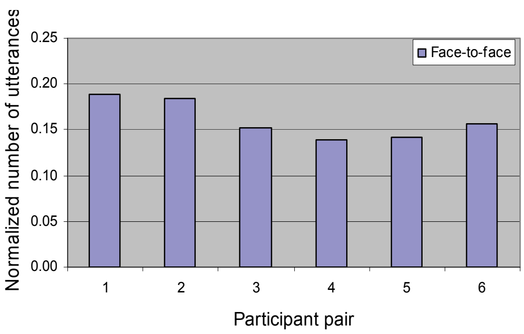


Figure 110. Mean number of utterances for each participant pair in the face-to-face condition

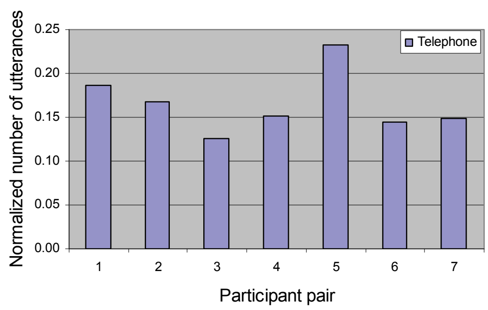


Figure 111. Mean number of utterances for each participant pair in the telephone condition

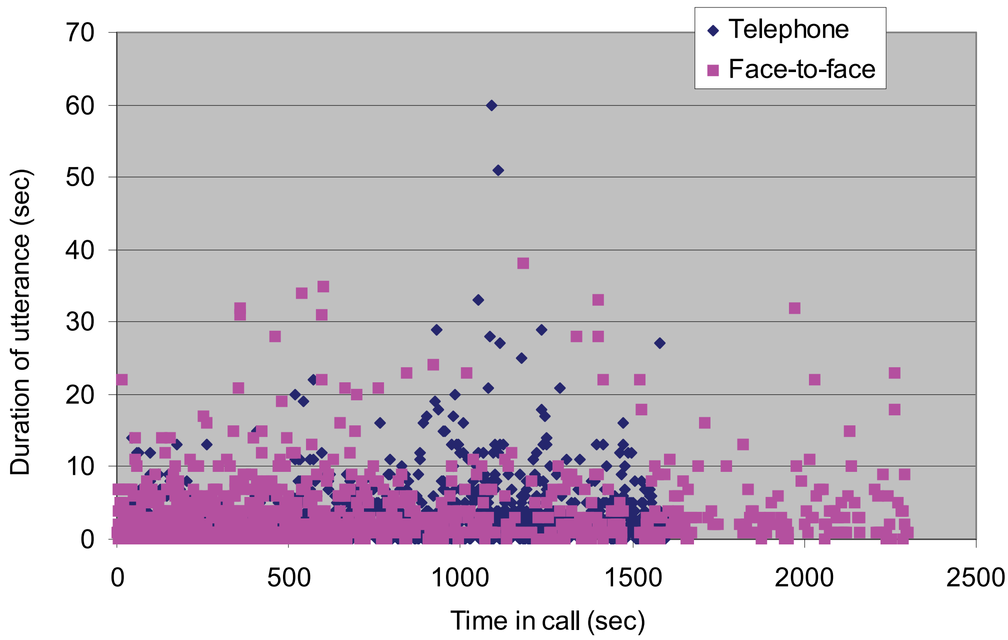


Figure 112. Scatter plot for all utterances for both conditions and roles

Appendix G. Participant material: human-human communication study 2

This appendix contains the instructions to the agent and customer for human-human communication study 1 (see Chapter 7), including instructions to both agent and customer participants, tasks and questionnaires.

Instructions to the agent

You role is to be a travel agent.

Here are some guidelines:

- You need to use the online flight booking websites www.airnz.co.nz and www.qantas.co.nz to find the flights. **It is important that you use both websites to find the best option!**
- You only have to find the most suitable flight, do not try to actually book the flight!
- The customer has to use the same airline in both directions.
- It is very important that you find the best flight that most satisfies all the customer's needs.
- It is the customer's who decides when the best option has been found.
- You only have to find the most suitable flight, do not try to actually book the flight! However, to get at the price on www.airnz.co.nz you have to choose flights and go one step further. You can do this without actually booking the flight.
- All communication with the customer has to be verbal only! You are **not** allowed to show the customer the computer screen, hand written notes, print outs or similar. If you make any notes, make sure the customer cannot see them.

Material given to the customer

Instructions

Below is your task.

Make sure that you do not show the task to the agent. You are not allowed to share any written information, computer information or such with the agent. If you make any notes, make sure the agent cannot see them.

You are responsible for deciding when the best flight has been found.

You want to go on holiday in either Bangkok or Frankfurt

You have to make sure that **all** following criteria have to be met:

- You would prefer to fly out from Auckland on **Friday 11th August**.
- You have to be back in Auckland, NZ, on the **Sunday 27th August**.
- You would definitely prefer to go to Frankfurt, but only if the total **flight** price is **less than** $1700. If the flight price is more expensive than that you want to fly to Bangkok. You still do not want to pay more than $1700 for flight price
- You want the shortest possible flight time. However, price is more important

You only need to find the best flight you do not want to actually book it!

When you have found the flight that matches the most criteria, please state loud and clear "I have found the best flight" and fill in the details below.

Please note the details for the chosen flights:

Destination (please circle one) Bangkok Frankfurt

Airline (please circle one) Qantas Airnz

Departure flight, From Auckland

Departure **Date** (from Auckland)______________________________
Departure **Time** (from Auckland)______________________________

Return flight, To Auckland

Departure **Date** (from destination)____________________________
Departure **Time** (from destination)____________________________

Please answer the following questions about the conversation in general

The conversation was… (Please circle one number)

1 = very unsatisfactory, 4 = neither satisfactory nor unsatisfactory, 7= very satisfactory

1 2 3 4 5 6 7

Did you feel … (Please circle one number)

1 = very frustrated, 4 = neither frustrated nor not frustrated, 7 = not frustrated at all

1 2 3 4 5 6 7

The length of completing the task was… (Please circle one number)

1 = much longer than expected, 4 = as expected, 7= much shorter than expected

1 2 3 4 5 6 7

Was the problems solved … (Please circle one number)

1 = very inefficiently, 4 = neither efficiently nor inefficiently, 7 = very efficiently

1 2 3 4 5 6 7

The problem was … (Please circle one number)

1 = very complicated, 4 = neither complicate nor straight forward, 7 = very straight forward

1 2 3 4 5 6 7

The task was … (Please circle one number)

1 = not complete at all, 4 = partially completed, 7 = fully completed

1 2 3 4 5 6 7

Are you … (Please circle one number) the task was completed as you expected?

1 = very unconfident, 4 = neither unconfident nor unconfident, 7 = very confident

1 2 3 4 5 6 7

Please answer the following questions about the quality of conversation

Did you … (Please circle one number)

1 = not understand the conversation at all, 4 = partially understand the conversation, 7 = fully understand the conversation

1 2 3 4 5 6 7

The conversation was … (Please circle one number)

1 = not concise at all, 4 = partially concise, 7 = very concise.

1 2 3 4 5 6 7

The conversation was … (Please circle one number)

1 = very unexpressive, 4 = neither unexpressive nor expressive, 7 = very expressive

1 2 3 4 5 6 7

You are responsible for deciding when the best flight has been found.

You want to go on holiday in either Los Angeles or London

You have to make sure that **all** following criteria have to be met:

- You would prefer to fly out from Auckland on Thursday the 7th of September, **but you can only fly out between 6pm (18.00 hours) and 8pm (20.00 hours), on that day** (due to transport to airport).
- If it is not possible to fly out from Auckland on Thursday, you want to fly out on Friday the 8th September as early as possible.
- You have to be back in Auckland, NZ, **no later than the 10pm of Friday the 22nd** September. However, to make the trip as long as possible, you want to arrive as close to 10pm as possible.
- You would definitely prefer to go to London, but only if you get **2 full weeks (14 days) in** London

You only need to find the best flight you do not want to actually book it!

When you have found the flight that matches the most criteria, please state loud and clear "I have found the best flight" and fill in the details below.

Please note the details for the chosen flights:

Destination (please circle one) Los Angeles London

Airline (please circle one) Qantas Airnz

Departure flight, From Auckland

Departure **Date** (from Auckland)________________________________
Departure **Time** (from Auckland)________________________________

Return flight, To Auckland

Departure **Date** (from destination)______________________________
Departure **Time** (from destination)______________________________

Please answer the following questions about the conversation in general

The conversation was… (Please circle one number)

1 = very unsatisfactory, 4 = neither satisfactory nor unsatisfactory, 7= very satisfactory

1 2 3 4 5 6 7

Did you feel … (Please circle one number)

1 = very frustrated, 4 = neither frustrated nor not frustrated, 7 = not frustrated at all

1 2 3 4 5 6 7

The length of completing the task was… (Please circle one number)

1 = much longer than expected, 4 = as expected, 7= much shorter than expected

1 2 3 4 5 6 7

Was the problems solved … (Please circle one number)

1 = very inefficiently, 4 = neither efficiently nor inefficiently, 7 = very efficiently

1 2 3 4 5 6 7

The problem was … (Please circle one number)

1 = very complicated, 4 = neither complicate nor straight forward, 7 = very straight forward

1 2 3 4 5 6 7

The task was … (Please circle one number)

1 = not complete at all, 4 = partially completed, 7 = fully completed

1 2 3 4 5 6 7

Are you … (Please circle one number) the task was completed as you expected?

1 = very unconfident, 4 = neither unconfident nor unconfident, 7 = very confident

1 2 3 4 5 6 7

Please answer the following questions about the quality of conversation

Did you … (Please circle one number)

1 = not understand the conversation at all, 4 = partially understand the conversation, 7 = fully understand the conversation

1 2 3 4 5 6 7

The conversation was … (Please circle one number)

1 = not concise at all, 4 = partially concise, 7 = very concise.

1 2 3 4 5 6 7

The conversation was … (Please circle one number)

1 = very unexpressive, 4 = neither unexpressive nor expressive, 7 = very expressive

1 2 3 4 5 6 7

Overall questionnaire

For the next group of questions, we want you to contrast your experience with the two modes of interaction, face-to-face and telephone. In response to each question, you are to give your opinion of the relative merits or characteristics of each of the two modes, using a ‘T’ to indicate telephone and an ‘F’ for face-to-face. It is important that you show BOTH a T and an F for each answer.

Sample question:

How do you rank the holiday outcomes of the two modes?

Terrible outcome   Great outcome

1 ____ t ____ f ____ 7

Please place an ‘F’ and a ‘T’ on the line for the next group of questions:

How do you rank your relative <u>preference</u> for the two modes in tackling this task?

Dislike   Like

1 ________________________ 7

In general terms, how do you rank your relative <u>preference</u> for the two modes?

Dislike   Like

1 ________________________ 7

How do you rank your relative <u>satisfaction</u> with the two modes?

Unsatisfactory   Satisfactory

1 ________________________ 7

How do you rank your relative <u>frustration</u> using the two modes?

Frustrating   Free of frustration

1 ________________________ 7

How do you rank the relative <u>efficiency</u> of the two modes?

Inefficient   Very efficient

1 ________________________ 7

How do you rank the relative <u>effectiveness</u> of the two modes?

Ineffective   Very effective

1 ________________________ 7

How do you rank the relative <u>ease of solving</u> the task in the two modes?

Hard Easy

1 ———————————————— 7

How do you rank your relative <u>sense of having completed</u> the task for the two modes?

Far from completed Totally completed

1 ———————————————— 7

How do you rank your relative <u>feeling of being at ease</u> with the two modes?

Not at ease at all Very at ease

1 ———————————————— 7

How do you rank your relative <u>understanding</u> of what the other person was telling you or asking you for the two modes?

Hard to understand Easily understood

1 ———————————————— 7

How do you rank the relative <u>degree of engagement</u> in the conversation for the two modes?

Not engaged at all Intimately engaged

1 ———————————————— 7

What differences did you perceive between the two modes?

____
____
____
____
____
____
____

What differences did you notice in conversation style between the two modes?

____
____
____
____
____

Appendix H. Interview questions for travel agency study

This appendix contains the interview questions for the agent in the travel agency studies (see Chapter 8).

General information:

1. Think of your last 3 customers, how many times were you in contact with them?
   Customer 1
   Customer 2
   Customer 3

Remember info:

2. How do you get new information, such as new taxes or specials?
3. How do you remember new information, such as new taxes, or specials?
4. If you have to take over a customer from another agent, how do you find out information about that customer?
5. How do you remember information about a particular customer?

Medium:

6. Think of your last 3 customers, how much of the contact was

1.	% face to face	% telephone	% email
2.	% face to face	% telephone	% email
3.	% face to face	% telephone	% email

7. Which medium do you prefer? Telephone, face to face, email, other? Why?
8. Are different mediums more suitable for different stages or different tasks?

Communication style:

9. Think about your last 3 customer, how much of the communication was travel related, and how much is 'small talk'?
10. On telephone contact, how much of the communication with the customer is travel related, and how much is 'small talk'?
11. With face to face contact, how much of the communication with the customer is travel related, and how much is 'small talk'?
12. With email contact, how much of the communication with the customer is travel related, and how much is 'small talk'?
13. Does the travel agency encourage you to make small talk, or to finish talking to the customer as quick as possible?
14. How important do you think that small talk is to make the customer feel satisfied with the service?

Artefacts:

15. Do you use paper when you talk to customer? Why? Please give as many reasons as you can think of.
16. In your opinion, do you think that the customer prefer to get paper copies of details? Why or why not?
17. Do you prefer physical artefacts, eg calculator, calendar, or electronic, eg calculator on computer? Why? Please give as many reasons as you can think of.

If there is time:

18. What is the worst thing about working with the computer?
19. What is the best thing about working with the computer
20. What training did you do before starting as a travel agent? Eg, courses, in-house training, observing, apprentice, etc?

Appendix I. Consent forms in proof of concept study

This appendix contains the ethical consent forms for the proof of concept study (see Chapter 8).

Agent's Research Consent Form

The University of Waikato Department of Computer Science

This consent form, a copy of which has been given to you, is only part of the process of informed consent. It should give you the basic idea of what the research is about and what your participation will involve. If you would like more detailed information, or information not included here, please ask. Please take the time to read this form carefully and to understand any accompanying information.

Research Project Title

Contextual enquiry of information sharing between customer, agent and computer at Calder and Lawson Travel

Researcher

Anette Olsson (BSocSc, PgDipSc), Department of Computer Science at the University of Waikato

Location

Calder and Lawson travel

Research Purpose

The purpose of the research is to investigate how the travel agent currently shares information with the customer, and how this sharing could take place if a different electronic sharing facility was available

Procedure

During your interaction with the customer, I will observe. Further, I will ask you to describe to me what you share, and what you would have shared if you had a different electronic facility. I will ask you to print out information that you share with the customer. At the end of the session I will go through this information further with you.

Data Collection

What and how the agent share information with the customer

Confidentiality

Confidentiality and participant anonymity will be strictly maintained. All information gathered will be used for statistical analysis only and no names or other identifying characteristics will be stated in the final or any other reports. No potentially negative information will be past on to the company, or anyone else. If there is information that you do not wish to include in the study, please tell me and I will remove it from all records.

The sessions will be audio recorded. The recordings will not be available to anyone except for me and potentially my University supervisors.

Likelihood of Discomfort

There is no likelihood of discomfort or risk associated with participation.

Finding out about Results

The findings will be made available after the end of the study. To get the finding, contact the researcher Anette Olsson on email acs9@cs.waikato.ac.nz, phone 07 838 44 66 ext 6729 or

Anette Olsson,
Computer Science department,
University of Waikato,
Private bag 3105,
Hamilton

Agreement

Your signature on this form indicates that you have understood to your satisfaction the information regarding participation in the research project and agree to participate as a participant. In no way does this waive you legal rights nor release the investigators, sponsors, or involved institutions from their legal and professional responsibilities. You are free to not answer specific items or questions in interviews or on questionnaires. You are free to withdraw from the study at any time without penalty. Your continued participation should be as informed as your initial consent, so you should feel free to ask for clarification or new information throughout your participation. If you have further questions concerning matters related to this research, please contact the researcher.

____________________________ ____________________

Participant Date

____________________________ ____________________

Investigator/Witness Date

Customer's Research Consent Form

The University of Waikato Department of Computer Science

This consent form, a copy of which has been given to you, is only part of the process of informed consent. It should give you the basic idea of what the research is about and what your participation will involve. If you would like more detailed information, or information not included here, please ask. Please take the time to read this form carefully and to understand any accompanying information.

Research Project Title

Contextual enquiry of information sharing between customer, agent and computer at Calder and Lawson Travel

Researcher

Anette Olsson (BSocSc, PgDipSc), Department of Computer Science at the University of Waikato

Research Purpose

The purpose of the research is to investigate how the travel agent currently shares information with the customer, and how this sharing could take place if a different electronic sharing facility was available

Procedure

During your interaction with the travel agent, I will observe. At times I will ask the agent to describe what information he or she is sharing.

Confidentiality

Confidentiality and participant anonymity will be strictly maintained. All information gathered will be used for statistical analysis only and no names or other identifying characteristics will be stated in the final or any other reports. If there is information that you do not wish to include in the study, please tell me and I will remove it from all records.

The sessions will be audio recorded. The recordings will not be available to anyone except for me and potentially my University supervisors.

Finding out about Results

The findings will be made available after the end of the study. To get the finding, contact the researcher Anette Olsson on email acs9@cs.waikato.ac.nz, phone 07 838 44 66 ext 6729 or

Anette Olsson,
Computer Science department,
University of Waikato,
Private bag 3105,
Hamilton

Agreement

Your signature on this form indicates that you have understood to your satisfaction the information regarding participation in the research project and agree to participate as a participant. In no way does this waive you legal rights nor release the investigators, sponsors, or involved institutions from their legal and professional responsibilities. You are free to not answer specific items or questions in interviews or on questionnaires. You are free to withdraw from the study at any time without penalty. Your continued participation should be as informed as your initial consent, so you should feel free to ask for clarification or new information throughout your participation. If you have further questions concerning matters related to this research, please contact the researcher.

Participant	Date
Investigator/Witness	Date