Chapter 10. Advanced Topic: CSCW

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Context

The purpose of this unit is to explore the important, evolving area of Computer Support of Collaborative Work (CSCW). Most work involves people working together. Increasingly, interactive computer systems are being used to support such shared activity. This unit discusses a wide range of system and considers how they may enhance business practice. Just as 'traditional' interactive systems

design needs to be informed by cognitive psychology, developers of CSCW systems need to be aware of the potential social and work-practice impacts when these systems are introduced. You will consider some of these users-centred issues.

Objectives

At the end of this unit you will be able to:

- Explain the meaning of CSCW;
- Classify CSCW systems in terms of the broad ways they are used (e.g., remote vs. local use and synchronous vs. asynchronous use).;
- Describe a range of CSCW tools and explain their significance to business.;
- Discuss the role of sociology and group-working research to CSCW;
- Discuss several social and work-practice impacts of CSCW and suggest ways of solving potential problems.

Unit Outline

In this unit we are concerned with computer supported collaborative work (CSCW)– broadly a set of concerns related to computer support for activities in which more than one person is involved. Within previous units you have focused on the design process (units 2,3 & 6), the user (units 4,5 & 7) and defining the human computer interaction (units 8 & 9). Within CSCW there is the added complexity of the human-to-human interaction, which is important, as well as how technically mediating the process affects the interaction. Specifically this unit will review the background to CSCW as a separate yet related field within human computer interaction (HCI). To understand CSCW applications and design it is important to be able to define the different ways these systems are used and how this helps categorise the array of CSCW specific tools and applications. Finally the social impacts of cooperative work on CSCW and how the technology effects social interactions are established.

Introduction to CSCW

First of all we need to understand why CSCW has become such a crucial field of study within interactive systems.

With changes in business organisations and world economics there has been a move towards global markets that are multinational and multilingual organisations. Rising organisational costs have also driven increases in the degree of strategic co-operations and opportunistic alliances.

Both of these factors have produced an increased need for businesses to communicate and collaborate both locally and remotely.

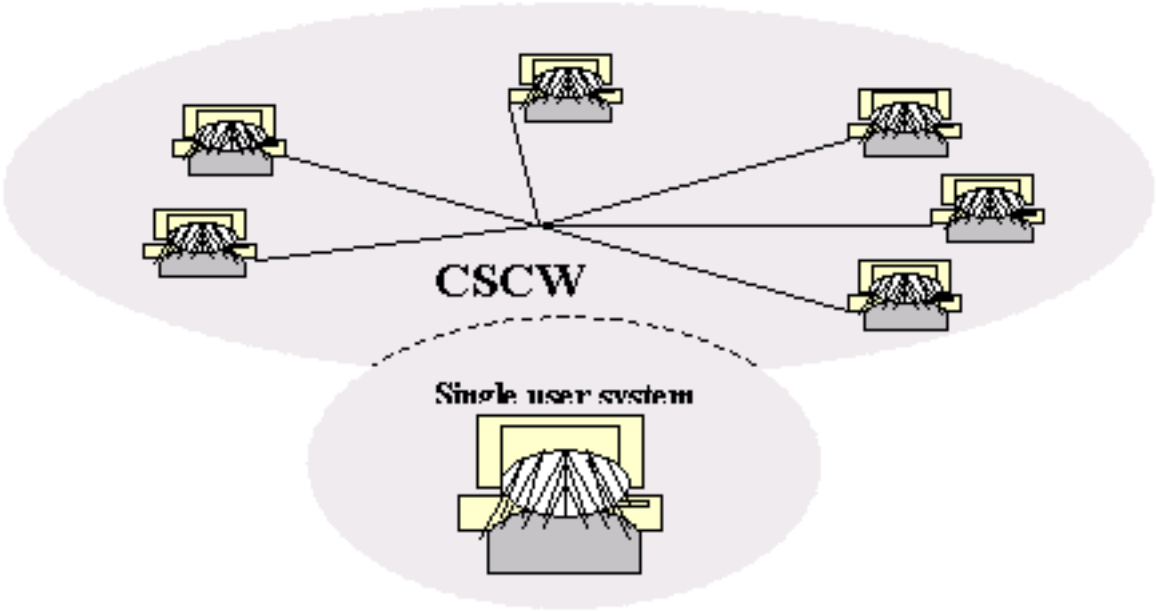
Over the last two decades computer technology has evolved a worldwide infrastructure.

There has been an international increase in networking capabilities producing more potential for applications and tools characterised by the information superhighway. A spread of connectivity has created what has been termed the global village. Finally a merging of technologies has occurred between telephony, television and computing.

All of these factors have led to the increased potential for computing technology to aid collaborative working.

However, despite widespread accessibility of computer networking technologies and the reliance of many organisations on successful cooperative activities the historical focus within HCI (see unit 1) has

limited the support provided by automated tools for the creation of single user independent systems. Since many people work in groups on cooperative tasks CSCW has sought to address these needs.



It is important to understand how CSCW systems differ from other interactive systems. Designers must understand the nature of cooperative tasks in order to design appropriate technology for the cooperative work setting. A set of questions must, therefore, be answered if appropriate CSCW systems and software are to be designed:

How do we define group work? How can computer systems and software that support group working be developed? What are the impacts of technology on group working?

To answer these questions CSCW involves inter-disciplinary researchers including psychology, sociology, organisational theory and anthropology.

A note on terminology

It is important to understand that CSCW is a wide-ranging term which encompasses not only the technology / software but its users and their physical and social environment. Groupware, however, is a term often referred to within CSCW as related to the technology and software used for computer supported group-working.

Review Question 1

Explain why CSCW systems have grown in their importance over recent years?

Answer at the end of the chapter.

Review Question 2

Why has the development of applications to support cooperative working been slower than other areas of computer support?

Answer at the end of the chapter.

Review Question 3

What are the three specific aspects of CSCW systems that must be understood to design appropriate applications and tools

Answer at the end of the chapter.

How CSCW is used

When designing computer supported collaborative work systems and applications it is important to understand how they will be used and for what types of tasks. However there has been much controversy over this issue, as conceptualisation of the field should not artificially or inadvertently preclude specific types of cooperative work. Characterising how these systems are used should therefore allow for the rich diversity of forms of cooperative work.

Who uses CSCW systems

It is important to note that CSCW systems have a varied set of collaborating users that will impact on what systems are required and how the systems are used. Collaborating users may have different:

- Goals
- Equality of status,
- Feelings of comradeship
- Organisational alliances
- Heuristics and conceptual frameworks

It is important to understand that whilst some groups do have a closed and predetermined character, such as project teams, others are formed and disbanded spontaneously when the need arises. This distinction has been termed the difference between formal and informal groups (Preece, 1995). CSCW systems are increasingly being developed to support informal group collaborations as they are recognised as an important characteristic of the work scenario.

The geographical location of the user

The geographical distribution of group members is an important aspect of group interaction. Cooperative systems are often classified as either local, with group members co-located in the same environment or remote with members at different locations. This divide is concerned as much with the accessibility of users to each other than their physical proximity. Computer support for these interactions has traditionally considered the case of remote asynchronous (at different times) group working. However, more recent research has aimed to support synchronous (at the same time) face-to-face meetings.

A note on terminology

The term ‘co-located’ is often referred to instead of ‘local’ to emphasise this logical division. The term local used in this context should not be confusion with the distinction between remote and local communication systems.

The form of interaction

The most commonly used classification for the mode of interaction is between asynchronous (occurring at different times) and synchronous (occurring at the same time) working (Preece et al, 1995; Dix, 1998) . These two forms of interaction are important in distinguishing computer support for different tasks. Synchronous cooperation is ideal for creative problem solving, as it often requires immediate input from each group member (i.e. to bounce ideas off of). In contrast, rigid tasks often have a previously formulated strategy whereby group members take on a particular role and work in an asynchronous manner.

Interactions between the form of interaction (synchronous, asynchronous) and the location of the user (local, remote) are often used to define different modes of interaction for CSCW systems. This approach is probably often used because it easily relates to CSCW applications and tools. However as the types of interactions supported by CSCW systems become ever more complex this matrix type approach becomes inadequate.

	Synchronous	*Asynchronous*
Local	Same time Same place	Different time Same place
Remote	Same time Different place	Different time Different place

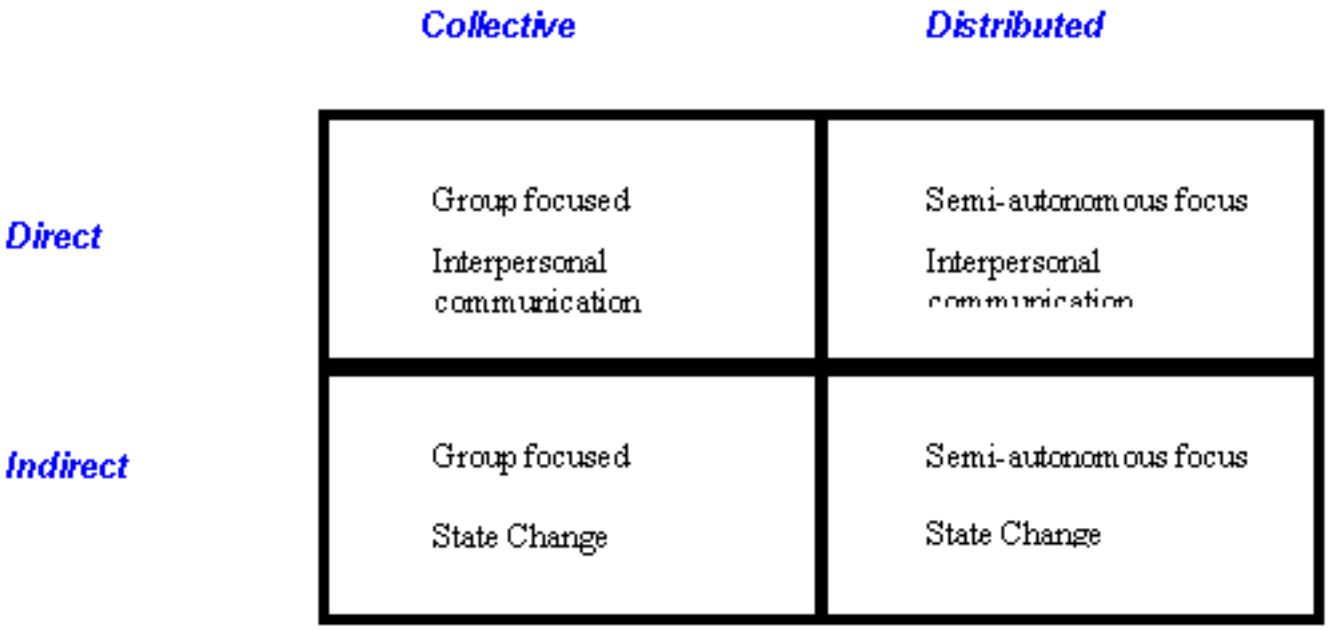
Group working has been further categorised in a number of different ways. The group work and thus the decision making process can be conducted:

- collectively, whereby the group has focused strategies
- distributed across the group whereby decisions are made by an ensemble of semi-autonomous workers planning and acting on their own strategies.

Furthermore, cooperative working may be conducted:

indirectly, mediated and guided by the changing state of the process; or directly mediated and guided by direct interpersonal communication.

Interactions between these 4 dimensions can be used to analyse collaborative tasks in more depth. These positions indicate what type of support is required from the technology and potential problems.



Review Question 4

How would you define a group that has a scheduled, pre-set agenda?

Answer at the end of the chapter.

Review Question 5

Consider the task of ‘writing a co-authored book’ and the task of ‘brain-storming an advertisement campaign’, which task would require synchronous or asynchronous cooperation to be completed most efficiently.

Answer at the end of the chapter.

Review Question 6

A group focused collaborative exercise which is guided by changes in the task can be defined as a direct collective collaboration (True / False)

Answer at the end of the chapter.

CSCW tools and applications

The number and variety of CSCW tools and applications (often known as groupware) is quickly growing as are the number of ways to classify them. The following three categories are a simplification of various authors’ groupings (Baecker, 1993; Preece, 1995; Dix, 1998) :-

Computer mediated communication:

- Email and bulletin boards, structured message systems
- Videoconferences / desktop video conferencing / multicasting
- Virtual collaborative environments

Meeting support:

- Augmentation tools

- Meeting rooms

Decision support systems and tools

- Shared work surfaces, PC’s and window systems
- Shared editors and co-authoring systems
- Shared diaries, active badges

Computer mediated communication

Computer mediated communication is the main research focus and the most used form of CSCW (Baecker, 1993; Keisler, 1997). Email and bulletin boards are the simplest and yet most successful asynchronous CSCW systems (although there are synchronous variations). The growth of distributed organisations has been attributed, in part, to email as an effective form of computer mediated communication. This communication medium has led to the emergence of on-line communities with their own specific HCI and social interaction problems e.g. information overload, lack of recipient feedback, inappropriate informality etc.

The history of videoconferencing has developed in parallel with advances in the technology (Baecker, 1993). Listing them in chronological order multimedia communication started first with close-caption TV (CCTV) with dedicated lines transmitting (synchronous) video directly to participants. Video conferencing began with the transmission of group images from one room to another via a common monitor. Multimedia communication really came into its own with the advent of desktop videoconferencing. Users sit in front of their computer and communicate in real time (synchronously) via a microphone, camera and (often) a digital workspace. This configuration is often referred to as a picture-in-a-picture (PIP) setup or CuSeeMe. The communication can take place on a point-to point basis or can involve many individuals and sites.

With the introduction of media spaces, distributed users access one another, like videoconferencing systems, via video and audio links. However, media spaces not only support explicit, intentional interactions and shared artefacts but also informal interactions and awareness. These informal communications (colleague presence, activity and availability awareness, and unplanned interactions) have been identified as critical to effective group work. Awareness technologies have evolved to allow distributed workers awareness of their co-workers and of their potential for collaboration. These technologies invariably use video images as the main data source for awareness although there are audio only awareness tools.

Internet-based videoconferencing has been regularly used since the early 1990’s . However, the first major enhancement to Internet videoconferencing has been the advent of multicasting. A Unicast connection transmits data on a point-to-point basis whilst a Multicast connection allows for data to be transmitted to multiple recipients. During multicasting the network replicates (at the routers) the packets transmitted. The replicated packets can be sent to as many recipients as have requested the data and are members of the multicast group. In multicast conferencing, audio and video are sent in different streams. Desktop conferencing facilities on computer workstations, can use a combination of multicast conferencing tools.

Virtual reality is a computer-based application which allows human-computer and human-human interactivity through a sensory environment called the virtual world which is dynamically controlled by the user’s actions. Virtual environments rely heavily on the notion of immersion both physically and cognitively. Keyboard and monitor input devices allow a user to be partially immersed whilst head mounted displays produce total-immersion in the environment. A user is cognitively immersed in the environment when they feel immersed in the action.

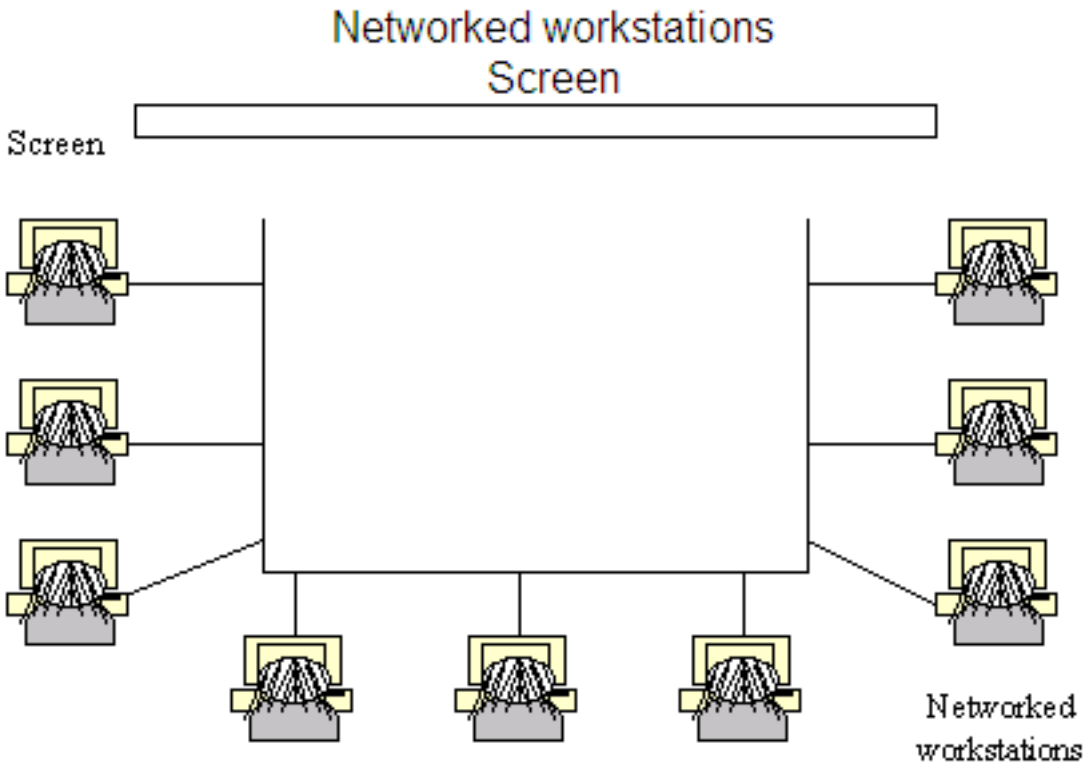
Collaborative virtual environments provide remotely located users with the ability to collaborate via real interactions in a shared artificial environment. Virtual reality communication environments have been argued to provide a natural, intuitive environment for communication with the added benefit of removing some of the social taboos from social interactions. Virtual reality animated actors called avatars aid the user in their interaction with others in the virtual reality environment making it seem

more natural in two ways. Firstly, avatars can represent the user within the environment - a user relates and collaborates with other users via their avatars. Secondly, an avatar can represent a software agent with the actor's behaviour defined by that agent.

Meeting support systems

Meeting support applications and tools have emerged as a form of support for local synchronous meetings rather than with computer mediated communication, which has traditionally been primarily a support for remote synchronous & asynchronous collaborations (Preece, 1995; Keisler, 1997; Dix, 1998).

Meeting room systems often take the form of a meeting room furnished with a large screen video projector and a number of computer workstation / terminals.



Most of these systems focus on improving decision-making by groups rather than individuals. The large screen and all the participants' screens show the same image and this tool is often used as an electronic whiteboard easily accessible by all the group members.

Argumentation tools support and document multiparty arguments and negotiations. Many argumentation tools have been developed to support system designers in the decision making process. Tools that support argumentation often have a hypertext type format which allows designers to work simultaneously (synchronously) although they are often used asynchronously by local group members.

Co-authoring and shared applications

The aim of co-authoring systems is to support the collaboration necessary between co-authors in producing a document. The general mode of interaction for these systems is asynchronous cooperation with each user working as a semi-autonomous individual on a portion of the document. Many of these systems use a hypertext model. The text forms the basis of the interaction with linked networks of data (usually text or graphics) connected to this basic structure. Shared editors, in contrast to co-authoring

systems, work synchronously with text or graphics. Specific problems occur with this synchronous mode of interaction.

Shared diaries and calendars are often used for CSCW purposes. This idea has been taken further with active badges which track the whereabouts of users within a building and then relay the information back to a shared diary system. The accessibility of the resultant information has many social impacts that are becoming more evident especially with reference to privacy issues (see the next section)

Shared workspaces and window systems are examples of synchronous collaboration applications.

An important aspect of these shared applications is the notion of floor control – who has control over the application at any one time. There is either a social protocol in force or technical mechanisms imposed by the system which work on a first-come / first-served or turn-taking basis.

Activity 1 – Classifying applications 1

Identify some different tools & applications that would support each of the four classifications of group cooperation described according to geographic location and mode of cooperation i.e. remote synchronous, remote asynchronous, local synchronous, local asynchronous

A discussion on this activity can be found at the end of the chapter.

Activity 2 - Classifying applications 2

Can you think of different tools & applications that would support each of the four classifications for mode of group cooperation i.e. Direct collective, Indirect collective, Direct distributive, Indirect distributive

A discussion on this activity can be found at the end of the chapter.

Social interaction issues

There are an abundance of social issues which impact on the design of CSCW applications (Grudin, 1990). These extend through 3 main levels with an extensive variety of resulting issues:

- Communication: Verbal (e.g. language, intonation, tone, pauses) and non-verbal (e.g. body language such as gestures, eye contact) communications.
- Environmental and task factors: Factors associated with the specific environmental and task situation.
- Social, organisational and cultural norms: Norms associated with social groups, organisations, geographical and cultural boundaries.

To understand group collaboration at all these levels we must understand that social interaction is reliant on accepted norms of behaviour.

Mental models

Throughout our lives we develop mental models (internalised mental representations) of the world and our interactions. These representations play a central role in our understanding of the world, enabling us to predict and interact with it. You may have a mental model of a restaurant; what is expected to be found (e.g. plates, food, tables, cutlery), to occur (e.g. ordering food, eating food, paying for that food) and how you should behave there (e.g. etiquette - table manners, tipping etc). Mental models are not purely cognitive as they develop within cultures where learning them is part of our assimilation and socialisation. These mental models are, therefore, affected by previous experiences that are often embedded within cultural contexts (e.g. US tipping culture, Greek plate throwing etc). This means that mental models are not scientifically based but instead incomplete, unstable and often superstitiously based.

In order for us to communicate with others it is important that there is a joint understanding with reference to our mental models. There are, therefore, socially determined mental models that we construct for both verbal (conversation, intonation, pauses) and non-verbal (e.g. body-language, eye contact) communications. Specific communication environments and tasks affect these mental models as well as the relevant social, organisational and cultural norms.

Social cues

We all assume that in many situations we know the codes of practice (have mental models) of what is acceptable and unacceptable behaviour (e.g. acceptable to clap at the end of a theatre performance but not at the end of a funeral service). However, these codes vary within different cultures and these cultures can vary between organisations, cities or countries. These differences in social codes can relate strongly to many collaboration systems as they cross many organisational, country and cultural boundaries. In the real world moving between different cultures can be difficult but the human ability to adapt enables many of us travelling between different cultures to learn what is acceptable or unacceptable from others within that culture. What is of vital importance, therefore, is for us to receive accurate feedback of what is acceptable and unacceptable within that culture for that specific environment and task. Social cues of norms & pressures are investigated to produce informed knowledge of these acceptable and unacceptable behaviours.

Every perception we have and every action we take is embedded within our experiences and understanding of the social world around us. Yet, social interaction is complex and, although researched for centuries, much of the reasoning behind our social behaviours still eludes us. It is not surprising then, that computer-mediated interactions often develop into a simplification of the real world. However, because users equate mediated life with real life, computer mediated interactions often trigger a wealth of socially determined responses, whether the system designers expected them to occur or not. Within CSCW systems real world metaphors are often used to assist and shape interactions. However, it must be understood that many everyday assumptions we make to help us navigate our everyday life are not supported and are inaccurate within CSCW systems.

The Internet, in particular, covers all continents and thus many cultures and yet it can isolate us from the very social cues that allow us to adapt our behaviours accordingly. Within the virtual world there are often no clear communities with cues from others of what is acceptable or unacceptable behaviour. Many collaborative and communication environments are designed around replicating real world spaces through spatial metaphors. However, these replications often do not produce the socially constructed understanding of place we require for mediating our interactions. Ultimately, many cues can be relayed within a virtual format but much is often missed. Worse than a lack of cues, however, is the presentation of inaccurate cues. If we have an inaccurate mental model of a communication environment we are likely to predict inaccurately its behaviour or act inappropriately.

Activity 3 – Verbal and non-verbal cues

Identify within a conversation some verbal cues and non-verbal cues we use to identify if someone is bored, angry or confused.

A discussion on this activity can be found at the end of the chapter.

Activity 4 - Cultural cues

Identify some variations between two different cultures for verbal and non-verbal cues

A discussion on this activity can be found at the end of the chapter.

CSCW impacts on social interaction

People need social cues about the type of situation in which they find themselves and the type of behaviour with which they should respond. We also use social cues to assess those with whom we are interacting and how they perceive us. CSCW systems and applications vary in the level of contextual

cues provided that enable users to appropriately frame their interactive behaviour. Many of the cues that are provided distort the resultant interaction. The three levels of social interaction issues previously mentioned (communication, environment / task factors and social, organisational and cultural norms) are used to assess the type of misconceptions that can arise out of distorted or non-existent CSCW system cues.

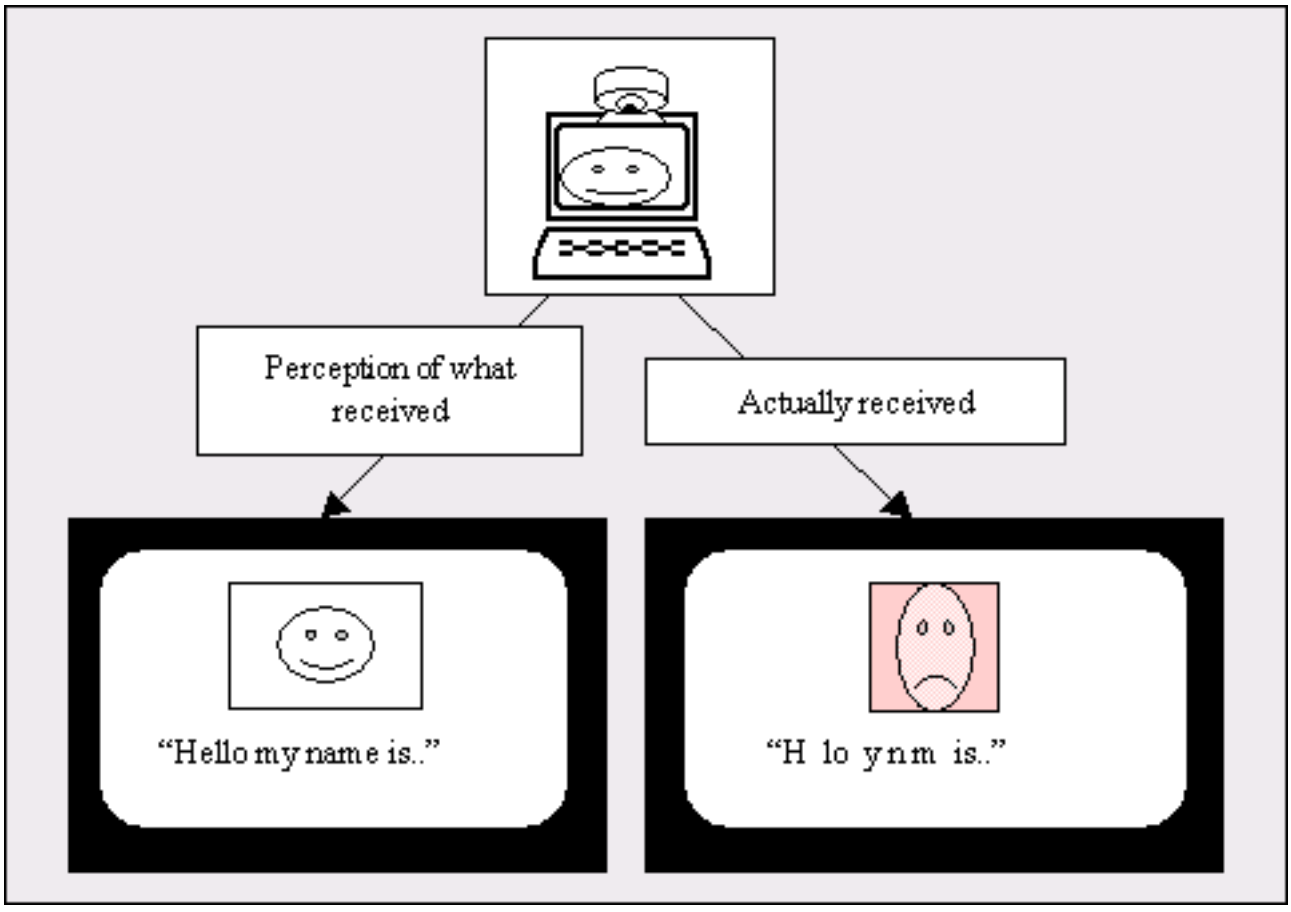
Communication

Non-verbal communication

Image quality, camera angles or lost data during transmission (due to packet loss) may result in a perception of the user that they regard as inaccurate. Distorted images can make people look bored, angry or upset when this is not the case. A lack of feedback to those releasing the data about how it looks when received may also produce inaccurate assumptions about the interaction.

Verbal communication

Due to information being lost when communicating, users can get a distorted perception of the interaction and the people they are interacting with. Audio loss can slow down the conversations and increase misinterpretations about the task.



Environmental and task factors

Temporal contexts

When interacting across temporal contexts as with asynchronous interactions the situational context (environment, conditions) may change during the task. This then means that some users may misinterpret the task they are collaborating on.

Task awareness

Lack of feedback in some CSCW systems, in synchronous interactions, can cause task state changes to go unnoticed or misinterpreted. This can cause a lack of task continuity for some of the users.

Integrating tools and work procedures

Collaboration becomes cumbersome when new tools have to be learned or used (causing data format translation problems) for the same task in collaborative mode from the ones used in non-collaborative mode (Schneiderman, 1998).

Social, organisational and cultural norms

Collaborators may not share the same assumptions and beliefs. Cultures can be national, geographical, ethnic, social, educational, and organisational.

Security and privacy

CSCW system design should ensure users awareness of interaction accessibility. There can be problems when users accidentally drift from private to public space/directory/conference, or if then are not aware what others can do with their data.

Cultural norms

A publicly transmitted interaction that implies, by contextual cues, to people from one culture that it is private but implies to someone from another culture that this is a public interaction is likely to lead to an invasion of the former users' privacy.

Activity 5 – Unsupported non-verbal cues

Identify a non-verbal communication cue that could cause problems if not supported by a CSCW system. How would it cause problems?

Designing CSCW systems

Cooperation between individuals, groups and organisations is still increasing so the demand for Groupware/CSCW systems is likely to increase. It is therefore, vital that the design of these systems supports rather than impedes collaborative work (Grudin, 1990). To this end CSCW system designers must try to understand:

1. Multiple users and their social interaction

2. Collaborative work

Designing for multiple users and their social interactions

Multiple users increase the importance of users' involvement in requirements capture and design. This can be done through user centred design procedures (see units 7, 8 and 9) and there are various other methodologies that allow for capturing the complexities involved in social interactions (participatory design, ethnography and grounded theory - a social science methodology recently applied by some CSCW researchers)

When designing CSCW systems it is important to understand the multiple roles that users have in the interaction and therefore not to design for users as one body e.g.

When designing CSCW systems it is important to understand the multiple roles that users have in the interaction and therefore not to design for users as one body e.g.

Feedback is an important element in CSCW system design. Ultimately there is a need for accurate contextualisation of data for all parties. The more appropriate social interaction feedback parties receive, the easier it will be to appropriately support social interactions e.g.

In the real world standing too close to someone or staring at them for too long would result in disapproving looks, coughs, sighs etc. A lack of the facial and body cues that we take for granted in real world situations can produce an isolating and inhibiting situation for a user.

Designing for collaborative work

Designing for collaborative work increases the importance of understanding all aspects of the collaborative task and potential state changes.

Keep it simple to start with, let users evaluate the system early on, and give them time and opportunity to learn how to use the system before using it for real tasks.

Integrate CSCW application with other tools users employ e.g. Make sure data from users tools can be easily incorporated into shared applications and vice versa - there is no greater waste of time than having to re-create or transform data.

Ensure interoperability with other users/systems/organizations.

Collaborative working carries overheads (time, cost, coordination, communication) as well as potential benefits (resource sharing, improved quality, cultural diversity). The trade-offs that users are prepared to make against these overheads must be understood. It is important to understand whether or not your CSCW system has lost the major benefit that could be traded off against what is considered minor inconveniences.

Activity 6 - CSCW application assessment

Review a CSCW application and identify if the system does not support required:

- Communication cues
- Environmental and task factors
- Social, organisational and cultural norms.

Review Question 7

Describe an interaction problem that may be caused by group members working asynchronously

Answer at the end of the chapter.

Review Question 8

Scenario: An office worker goes to his single occupant office after work to change for a squash match. Later he is told by a colleague that they liked the colour of his underpants which they saw on their monitor via the organisational awareness technology system.

Why did this scenario occur?

Answer at the end of the chapter.

Discussion Topics

Discussion 1

Discuss in which circumstances computer support for collaborative work is inappropriate and how you would make sure that CSCW is appropriate?

Comments on this discussion topic can be found at the end of the chapter.

Discussion 2

Discuss how Internet multimedia communication collaborations (video conferencing, virtual reality) may cause problems with social interactions between cultures.

Comments on this discussion topic can be found at the end of the chapter.

Answers and Discussions

Answer to Review Question 1

As international economies have risen in their importance so has the importance of international collaboration. The costs of international travel in time, money and physical exhaustion compares unfavourably with the alternative of installing and using CSCW tools and applications

Answer to Review Question 2

Previous concentration by disciplines such as HCI on one user one application support has hindered the development of multiple user applications and tools.

Answer to Review Question 3

Defining the group work which requires support Detailing which aspects of group working the CSCW system & software support Identifying what potential obstacles the technology may impose on group working.

Answer to Review Question 4

A formal group

Answer to Review Question 5

The rigid specific sub-task assigned project of writing a co-authored book requires group members to be able to work in a staggered manner working, for portions of their time, alone and non-collaboratively. An asynchronous application would therefore support these work practices. A brain-storming task, however, requires group members to respond immediately to collaborative participants and requires a synchronous application to support this form of cooperation.

Answer to Review Question 6

FALSE: This would be classified as a collective indirect (not direct) collaboration as the collaboration is mediated by the task changes and not the group members in direct interpersonal communication.

Answer to Review Question 7

The task may change without some members being aware of it and thus these group members may be working on something already discarded as unimportant by the rest of the group.

Answer to Review Question 8

A lack of system feedback to the user that the system was still on, what other users could see made the office worker feel secure in his physical surroundings that the situation was private when it was not.

Discussion on Activity 1

In identifying the tools and applications it may help to fill in a table (below is what Dix, et al. 1998 describe as a time and space matrix). Below are some examples of the tasks to be supported by the tools and applications.

	Synchronous	*Asynchronous*
Local	Board Meeting	Design team working on an application design
Remote	Job Interview with someone from abroad	Watching a conference session from abroad the next day

Discussion on Activity 2

In identifying the tools and applications it may help to fill in a table (below is what Dix, et al. 1998 describe as a time and space matrix). Below are some examples of the tasks to be supported by the tools and applications.

	Collective	*Distributed*
Direct	Application design	Writing a paper
Indirect	Brain storming	Interest group discussions

Discussion on Activity 3

To help identify these cues consider:

- With verbal cues it will help to think of intonation, tones, flow of the conversation
- With non-verbal cues it will help to think of body language, eye contact, actions

Discussion on Activity 4

To help identify these cues consider differences between cultures for:

- With verbal cues it will help to think of intonation, tones, flow of the conversation
- With non-verbal cues it will help to think of body language, eye contact, actions

Comments on Discussion 1

It is important to understand that technology is not appropriate for all situations and in some contexts may impede effective real-world interactions. It has recently been argued that people teleworking need to have occasional face-to-face meetings to ‘stay in touch’ with what is going on. Many of the reasons behind this need for real-world meetings relates to social interaction issues of trust, relationships etc.

Comments on Discussion 2

Within different cultures variations in social norms (e.g. privacy requirements, communication norms) can cause problems with communications. Interpersonal distance has been found to dictate the intensity of a response: faces in a close-up are scrutinised and attended to more often than those in the background. Yet, between cultures the personal space required for comfortable interactions varies. How would you allow for the right distance, in an application, to increase attention levels yet allow for variations in personal space?