To
fellow survivors
"we are strong"
and to
Eevi Saarisalo, my grandmother
"kaimalle, jolta sisu, mistä väitöskirja".

Practices of Collaboration in Writing and Their Support

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D.Phil. thesis

December 1994

I hereby declare that this thesis has not been submitted, either in the same or different form, to this or any other university for a degree.

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SUMMARY

This thesis documents practices in distributed coauthoring groups which are not consistent with certain assumptions evident in the literature on collaborative writing systems. Instead of the carrying out of tidy agreements, salient features were flexibility and context sensitivity with which information and situations were interpreted. How the coauthors arrived at decisions about appropriate courses of action, was inseparable.

To expand, there is little understanding of how distributed writing groups manage their collaboration and what kinds of support are most useful. However, an understanding of group writing in context is an essential basis for designing coauthoring support systems. This should include an appreciation of the dynamics within writing groups and of the process of collaborative writing itself.

This thesis presents work on what is collaborative writing, looking at what work distributed coauthors engage in to manage their joint writing. Two preliminary studies and a survey are presented, leading up to the main empirical work: field studies of three distributed collaborative writing groups in academia. The writing process is shown to evolve over time, constantly adapting to changing circumstances. Systematic planning was not in evidence as a major organising tool. Instead, the coauthors offered and made use of a range of information in deciding on appropriate next steps. Their subsequent use of this information to make appropriate *ad hoc* decisions in new circumstances, appears to be essential to achieve flexibility and coordination. Two concepts, *informed opportunism* and *documenting changes*, are proposed to capture the insights gained.

Design implications for support tools for distributed collaborative writing are identified. In particular, the issues of task relevance examined in the empirical studies, lead to the argument that a too narrow task focus in the conceptualisation of collaborative work may be detrimental to providing adequate 'support'.

ACKNOWLEDGMENTS

First and foremost, I am extremely grateful for the time and effort of the participants in all the studies. Particularly, however, the participants in the case studies deserve a big thank you. Despite my best efforts they were inevitably inconvenienced by my intrusion into their work, but continued to contribute significant amounts of time.

There are people who, through the example of their own work, and unexpected interest in mine, provided vital affirmation at crucial points that what I was trying was worth doing. These include Phil Agre, Judith Barlow, Liz Beaty, Wendy Mackay, Yvonne Rogers, Leigh Star, and Anselm Strauss. Hearing about Ilona Posner's work was an early source of encouragement to continue. Friendly arguments with Victoria Bellotti were immensely important in helping me clarify what I was trying to do. Piercing questions have come especially from Charles Wood, who taught me a new level of academic critique, and from Julian Budd.

I am immensely grateful to friends and family who have provided vital support throughout my work and in times of difficulty. To mention but a few, particularly solid have been my parents and Elaine. Steve V. has been a close friend and steady support for many years, while Abs demanded I keep my feet on the non-academic ground. Paul D. has provided invaluable help and support throughout the D.Phil. work, and was there at the end of the phone when I most needed someone. Rachel H. convinced me I was worth something when I needed persuading. Ronald walked with me past a few more milestones on the long road to healing. Arantza, Judy, Paulo, and others have laughed and cried with me and provided everyday closeness to keep me sane towards the end, whereas Charles was there in the early years.

In writing the thesis, I am grateful in particular for the commitment of Yvonne Rogers, whose inspired suggestions of issues to develop further have been invaluable, and that of Julian Budd, who time and again prompted me to keep going. Lydia Plowman, Steve Viller, and Joe Wood have gone through the whole thesis, filling the pages with comments, and Lars Breivik, Steve Easterbrook, and Mike Sharples have read parts. All provided useful comments. Remaining mistakes, ambiguities, and too long sentences are all my responsibility. Others, who have contributed more indirectly by commenting on previous writing, include: Victoria Bellotti, Matthew Chalmers, Paul Dourish, Radka Dvorak, Ronald Lemmen, Leigh Star, Charles Wood,

and anonymous reviewers. Charles Wood and Toby Champion have for years acted as stand-in manuals for Word for Windows, while Joanna Brook's competence at fixing bad PostScript ensured the figures in chapter 7 could be printed. Arantza Etxeberria checked references for me, and Paulo Da Silva Costa helped collate the appendices.

I have had two supervisors: in my first year, at the University of Liverpool's Department of Computer Science, Roy Rada, and since then, at the School of Cognitive and Computing Sciences at the University of Sussex, Mike Sharples. I am grateful to Roy for encouraging me to stick with my guns and choose a thesis topic I was really interested in, and to Mike for introducing me to research (and researchers!) on Computers and Writing, for help in preparing the survey and the case studies, for helpful advice on presentations, and, not least, for being sympathetic and patient when personal difficulties became overwhelming.

Financially, the thesis work was supported by a doctoral grant from the then Norwegian Research Council for Scientific and Industrial Research, by a loan from the Norwegian State Educational Loan Fund, by an Overseas Research Student Award for part fees, and by Rank Xerox Cambridge EuroPARC's Student Internship program.

Finally, in the below I have tried to make evident the web of influences on my work. However, innumerable discussions have been had, ideas shared, papers read, *etc.*, which are not mentioned. I cannot recall, let alone cite, all sources of influence and inspiration, so let this be my collective thank you.

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CHAPTER 1. INTRODUCTION TO THESIS

1.1. Collaborative writing in academia and its computer support

The rapid development of communications technology is making it easier than ever before for many people to communicate across large distances. In academia, some find it beneficial or necessary to work with colleagues who are elsewhere, and to collaborate on documents with them. Thus, it is increasingly likely that coauthors of a document are distributed over a wide area and use telecommunications technology in their communication and management of the writing activity. Computers connected over national and international networks could potentially help such work significantly. Hence, it is useful to understand what kinds of computers and software tools might be helpful to collaborative writing.

Some such tools are being built. However, it is unclear just how well many of them support the work that collaborating authors actually do. This thesis addresses this problem by presenting studies of collaborative writing among academics which focus on the process of writing together over distance. These are studies of collaboration among authors as part of their ordinary work. The starting point for this enquiry is how the process is experienced by the coauthors themselves, broadening out to the work they perform in organising and coordinating their writing when they are in separate places.

Interest in understanding collaborative writing come from many perspectives. At one extreme, writers like Bruffee, 1983, argue that writing and reading are inherently collaborative acts, even when performed by an individual on their own. Another extreme, in one sense, is to address only the cases in which people observably are simultaneously making changes to the same document. One example is ShrEdit (McGuffin and Olson, 1992), a prototype collaborative writing system designed for testing the use of writing technology when coauthors are editing a document at the same time. As yet, however, guidance from basic research for the development of collaborative writing systems is limited, partly because of the limited amounts of such research, and partly because of the limited transfer of understanding from basic research on collaborative writing to the development of computer systems. This thesis addresses both of

these issues: it presents some basic research on collaborative writing, and takes the findings some of the way towards system design recommendations.

In terms of basic research, this thesis presents studies on what is collaborative writing, looking at what work distributed coauthors engage in to manage their joint writing. Two preliminary studies and a survey lead to the main empirical work: a field study of three distributed collaborative writing groups in academia. From the experiences of the earlier studies, in which the framework proposed proved too limited, three key questions are eventually arrived at (see section 1.4 below) which form the basis for a second analysis of the field studies. The new open-ended analysis shows the writing process to have evolved over time, constantly adapting to changing circumstances, and that systematic planning was not in evidence as a major organising tool. Instead, the coauthors offered and made use of a range of information in deciding on appropriate next steps. Their subsequent use of this information to make appropriate *ad hoc* decisions in new circumstances, appears to be essential to achieve flexibility and coordination. The two concepts of *informed opportunism* and *documenting changes* are proposed as tools for conceptualising the process of collaborative writing in light of these studies.

1.2. Purpose of thesis

This thesis makes a contribution towards understanding the role of context in the coauthoring process. Implications for system design of taking the perspective that context is important are considered. A basic tenet is that an improved understanding of the process of academic coauthoring can lead to the design of better systems to support collaborative writing over distance. The thesis attempts to contribute to the good design of computer systems for distributed collaborative writing in two ways.

> First, by the additional insight gained on the organisation of work from the empirical studies conducted.
>
> Second, by adding to the argument for an approach to the design and development of computer systems which is willing to question fundamental tenets of computer system development as conventionally done (such as rationalist assumptions about 'support'), which takes into consideration existing work in relevant social sciences, and which builds on understanding gained from studies of the use of existing technologies.

The former is done in this thesis through the reporting of empirical findings. The latter is done through making evident within the thesis my path through which an initial concern for system

design lead to qualitative empirical studies, and through demonstrating that findings from such studies can contribute to system design.

An aim of this thesis is thus to show that the integral 'messiness' of the 'real world' can be studied, and, significantly, that focusing on such issues can make a substantial contribution to the research field of Human-Computer Interaction (HCI). This is achieved through the example of the last study in this thesis, a field study. The study does not start with a fixed focus; instead, the focus is allowed to emerge from the study. In doing so, results are obtained which, I argue, are useful for computer system designers.

In this thesis a particular view is taken on collaborative writing; one of many possible, but one which has not been fully addressed in the literature surveyed. This is to focus on the work of distributed coauthoring (*i.e.* writing together over distance), examining how activity is organised between the coauthors and in relation to their environment. In particular, I make the argument that, in the conceptualisation of collaborative work, exclusive attention to a stylised notion of the 'task' at hand is too narrow to capture important aspects of collaboration, and is detrimental to providing appropriate 'support'. An example is seeing the coordination of effort in a collaborative writing project as simply the carrying out of agreed plans. Furthermore, I argue that such thinking has influenced much of the development of collaborative writing systems in the field of Computer Supported Cooperative Work (CSCW).

This thesis examines the nature of collaborative writing—and, ultimately, collaborative work—as evidenced in studies conducted of coauthors at work. No comparison is made with the single person case, and no assessment of the extent to which issues raised may apply to individual authoring as well. Instead, the focus is to present evidence of practices of coauthoring which provide counter examples to certain assumptions evident in the literature about how such collaborative work is organised. The thesis can not, of course, be an exhaustive account or definitive discussion of the issues raised. Rather, it should be seen as a pointer to an area which has not been treated adequately in the literature so far. For example, although an argument is made for the relevance to system design of studying the use of existing technology, the focus of the thesis is on the competence of coauthors in their use of whatever technologies are available to them, and what this reveals about the way in which their work is organised. Other issues, such as the shortcomings of these technologies, are treated as and when relevant to this, rather than as a separate concern. Also, this thesis does not resolve the problem of how to incorporate the issues raised into computer system design, although some initial suggestions are made. Finally, I do not address pedagogical issues, although much research on collaborative writing comes from interest in the teaching of writing.

1.2.1. Approach

The thesis potentially has a number of audiences, including practitioners of collaborative writing and sociologists of science. Primarily, however, it is an attempt to 'bridge the gap' of understanding which I argue exists between many with a computer systems development background and those with a psychology, social sciences, or writing research background. In this case the area of study is collaborative writing, but my efforts are intended to add to those of others, contributing to a more general *rapprochement*. To be useful and understandable to all constituencies, there are explanations included at a level which, I hope, will prove comprehensible to all. I am aware of walking a tightrope in the thesis between, on the one hand, becoming 'jack of all trades but master of none', and, on the other (and to my mind, more gravely), to assume familiarity on the part of the reader with specialist concepts of diverse fields. To what extent I have succeeded is for others to judge, but I believe the potential benefits of such mixed approaches to CSCW are substantial enough to justify this attempt.

A comprehensive account of the process of writing must include an understanding of the larger context in which writing is done (Odell, 1985, and Duin, 1991). I argue that such a comprehensive understanding of the process of collaborative writing is necessary for software designers to create appropriate coauthoring support systems. Studies focusing on the role of context in the process (in other words the interaction between the environment in which the activity takes place, and what work people actually do), can contribute by highlighting *how* context is part of that process. Put differently, what it might mean, in practice, and as relevant to the design of technologies, for people to be engaged in situated activity. Some ways in which the environment can interact with the task at hand are demonstrated in the thesis, and how this interaction thus appears to be intrinsic to the process of carrying out the task.

1.2.2. Why focus on computer support for distributed collaborative writing

The study of collaborative writing over distance has the potential to raise interesting issues for those interested in collaboration as such (whether as practitioners or 'observers'), for system developers, and, although not considered further here, for writing researchers. In particular:

Work carried out through the collaboration of two or more persons is of interest for a number reasons, not least because it is a phenomenon which observably exists outside the laboratory; it is one way work gets done at work places and in private lives. Furthermore, its importance is only beginning to be charted, and as yet, little is understood about what happens when collaboration takes place. Questions such as what the components of collaboration may be, or how they interrelate, are unanswered. In particular, the function or importance of informal

contact within collaborations which also have more formal elements (for example, one where formal regulations exist for timing and form of communication), remains unknown.

For computer science, *collaborative* work is of interest not only because of the relative novelty within the area of supporting group work, but also because addressing the work situation of people *as collaborators,* as opposed to single individuals working on their own, poses substantial challenges to some fundamental aspects of how computer systems are constructed (Rodden, Mariani, Blair, 1992).

Distributed work, or collaboration over distance, is to me particularly interesting, because here the dependence on technology is most readily evident, and the potential usefulness—and perhaps, the potential impact (in the sense of potential to make a difference)—of computer systems is greatest.

Writing is of interest because, first, it is an element in the everyday work of many people, and, as such, is of interest to theorists and practitioners alike. Second, there are authors (people) who regularly and observably engage in writing as part of their ordinary work; hence it can be studied in a naturalistic setting. Third, as studied here, writing is not itself seen as the primary focus of the work done. Rather, it is one aspect of a routine of work which serves some other purpose. It is, however, an essential part of getting that other work done. For example, for an academic to be successful at the work of research, her work must be recognised by a community of researchers; this requires some form of communication of the work to peers; and for this, writing various documents is a prime route. It is interesting to focus attention on such a task; one which is not necessarily perceived as the main focus of work, but which nevertheless demands considerable resources (typically, time and effort). Finally, studying articulation work (Strauss, 1985) as undertaken by people when engaged in some activity is arguably of particular relevance to computer support for distributed working. The outcome of the work—the published document—is itself part of another discourse (Thralls, 1992), and hence, is articulation. Writing is therefore interesting as an area in which articulation takes place at multiple levels. Collaborative writing in particular may render the process of articulation visible to an observer (*cf.* discussion in chapter 2).

1.3. Summary of contributions made

The contributions I claim this thesis makes fall broadly into those which may be of interest from a methodological point of view, and those which are due to the specific analytic results obtained.

Methodological contribution: the thesis uses an open-ended enquiry into the work of writing together to identify aspects of distributed collaborative writing as interesting and *relevant* to CSCW system building. This consists of a combination of approaches, gradually homing in on aspects seen, at first, as 'merely' interesting for understanding collaborative writing. Later, this understanding allows a critical stance to be taken on assumptions underlying much existing system building in this domain.

Analytic contribution: from the studies undertaken, pointers can be provided to specific ways of organising (and conceptualising, perceiving, experiencing) the work of collaborative writing which have implications for how designers of CSCW systems approach their task. In particular, many of these are pointers to the practical reality of the essential situatedness of the activity to the participants in the studies—for example, the writing task being but one of several ongoing activities or commitments that together constitute "working"—and how this fundamentally affects the constitution of the writing task.

The next two sections present the contributions outlined above in more detail.

1.3.1. Methodological contribution

Collaborative writing is a complex phenomenon. As this thesis will show, there are great variations in how it is achieved. Therefore it is probably unrealistic to advocate one particular method of investigation as being right; one should choose the methods that are appropriate for answering the kind of questions one is interested in. Hartley, 1991, in a review of psychological research on writing, reports on work which classifies writing research into different categories, and points out that "In many cases, of course, more than one method will be appropriate" (page 50 in the draft paper).

The research described in this thesis takes a perspective on collaborative writing which emphasises the medium-term process. It is an attempt at capturing, and conveying, some sense of the character of the process of writing a joint paper, from when coauthors decide to write together and ideas about the content begin to emerge, through weeks and months of working on it alongside other projects, to the work on the paper being in some sense completed. The focus of these studies is thus neither on the detail of exactly how, and how much, coauthors communicate (though some such detail was obtained, and is presented), nor on the more long-term issues of, for example, what role this may have in the formation of careers (though again, some such detail was obtained, and is presented where relevant).

The work presented in this thesis combines data from three levels of detail. The thesis seeks to identify qualitative commonalities, and also differences, between the kinds of results obtainable across different methods of investigation. Regardless of the extent to which I have succeeded,

the attempt itself may constitute a contribution to the development of methods in this area. This applies, for example, to the presentation of material from the field studies in chapter 7. Furthermore, through its successive attempts at addressing practices of collaboration in writing, the thesis provides examples of what kinds of data can be gathered through different methods.

This thesis tries to bring understanding from social science style investigations into computer science. It is not the first such attempt, but much work is still needed in the area, and it is interesting and important to the research area that these questions continue to be addressed.

The studies attempt to capture some of the perspectives of the coauthors themselves. This research is not, however, grounded in a principled commitment to people's own experiences, and as such, it is not, for example, phenomenology (see chapter 2, section 2.5.6). Instead, my motivation for paying attention to the writers' experiences of the process, is the belief that this is highly relevant to how people come to use computer systems in certain ways, and hence, to system design. The iterative development of a set of salient questions through a series of studies and a gradual refocusing what such questions might beneficially address, may serve as an example of the benefit of keeping close to the data at a more general level in addition to the within-study iteration advocated for example in Strauss, 1987. In this case this is done through refocusing the questions when studies showed them to be inappropriate.

Finally, this thesis is explicit about the process by which some methods were tried, found inadequate, and led onto different approaches in subsequent studies.

1.3.2. Analytical and results contributions

In terms of concrete results, contributions of this thesis include:

An improved understanding of the process of collaborative writing. In particular, an improved understanding of collaborative writing in its context and of some of the dynamics of collaborative writing in practice, *i.e.* in some sense, how does it come to happen the way it does. Contributing to an understanding of the process of collaborative writing brings benefits to people who want to write collaboratively (getting to know about others' solutions to problems), people who are collaborating (knowing how others do it has the potential to improve one's understanding of the range of possibilities), and people who study collaborative writing (whether for its own sake, or in order to design appropriate technologies).

The thesis investigations are motivated by the question of how computer systems best can support people writing together over distance. This consideration has shaped the qualitative enquiry, and the findings do, I believe, contribute to this question. In particular, a perspective is provided on collaboration over distance which can help sensitise designers to the range and

kinds of issues faced by prospective users of their systems. The field studies, interviews, and survey provide a number of pointers to practices coauthors engage in. On the basis of those studies, the penultimate chapter provides examples of design implications which can be drawn from studies such as these.

Sets of research questions are proposed throughout the thesis which frame the studies. In terms of the aims of this thesis, the last set is considered the most helpful; however, for different studies, others may find elements of the original questions useful in pointing to potential areas for research to focus on. Furthermore, as stated above, two related concepts, based on the findings, are proposed. Being abstractions, these broaden the focus and are intended not only to help pull together the findings of the thesis, but also raise the question of the applicability of the issues raised in these studies to other collaborative work. Areas for further research are also identified.

1.4. Organisation of thesis

The thesis is organised as follows:

In chapter 2, background for the work is provided in terms of a discussion of the notions of 'support', 'collaboration', 'authoring', and 'distance', and of some relevant literature. An initial set of research questions which was the starting point for the work of the thesis is also presented. In chapter 3, the rationale for the methods employed is given in terms of the tension between, on the one hand, the needs of system developers for precise requirements and the resulting desire to see users' activities as predictable, and, on the other, the focus of qualitative, ethnographic field studies on questioning assumptions and highlighting the contingent nature of activity.

Preliminary studies are presented in chapter 4, as well as a five-point framework—an initial attempt at structuring the empirical investigations of this work. Chapter 5 reports on a survey based on this framework and discusses the results obtained. The survey is based on a small sample, but identifies some interesting issues. These include: changing group membership, unsureness of who are the group members, a leadership role being emergent or non-existing at times, a sense of "sharing" being, to some respondents, an important element of collaborative writing. The great spread of responses obtained to most questions begins to raise the question of what it is that apparently makes each case so different, and of the appropriateness of the framework.

Chapters 6 and 7 present three case studies which were intended to provide the detail which seemed necessary to get more specific information for system design implications. In chapter 6,

the case studies are introduced and the five-point framework from chapter 4 is applied to the case studies in an initial analysis of the gathered data. The framework, however, proves inadequate in terms of helping to understand what work coauthors do in managing their activities and coordinating their work. The crucial question remains unaddressed of how people who write together deal with the great variation which the studies indicate. In other words, if there are no set patterns, how do they know, or decide, at any point what would be appropriate actions. This constitutes an important shift of focus from attempting to pin down a model of collaborative writing: instead of trying to reduce the variation, the question becomes: *given* the variation, how does coauthoring work? This is expressed in terms of a refocusing of the previous framework into three research questions: how a document comes to exist and develop; how individual coauthors decide what and when to write; and how the coauthors manage access to the evolving document. Chapter 7 examines the case studies in terms of these three questions. It is shown that the evolution of the documents took different paths for the three groups; that managing document access was highly contingent on circumstances and that there was no sign that the coauthors missed technical enforcement of access restrictions; and that individual coauthors were highly autonomous in their making of decisions what to write, and that this was facilitated by offering each other information which each could take into account as and when judged appropriate.

In chapter 8, *informed opportunism* and *documenting changes* are proposed as concepts capturing some of the main lessons to be drawn from the empirical investigations. The first captures the offering and use of information that seems characteristic for this kind of collaboration. The second focuses on the detail of how coauthors document to each other changes in the evolving document. Then some example system design implications are considered. The final chapter summarises the main points of the thesis and suggests some areas for future work.

The work reported in the following chapters is mine[1]. However, without the opportunities I have had to work with other researchers, ranging from one-off discussions to joint publication, this work could not have happened. Some of this is evident in terms of joint articles. A clarification of what is and what is not my work in relation to those publications, may therefore be warranted:

One of the preliminary studies in chapter 4 (section 4.2.) was published in Mhashi, Rada, Beck, Michailidis, and Zeb, 1992. The paper includes a comparison between two studies, one of which was conducted by Mahmoud Mhashi. The comparison was joint work between Mahmoud Mhashi and myself. Only the second study, however, is presented in this thesis and that was

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[1] The work reported on was developed and carried out by myself, but not without contributions from various others. Their input has been essential for my ability to do this work, but has been, in comparison, small. In this sense the work is 'mine'.

entirely my own work. Chapter 5 was published almost in its entirety as Beck, 1993. An analysis of the case studies of chapters 6 and 7, conducted by me, has been published in Beck and Bellotti, 1993, and a second analysis, of other aspects of case study (i), also conducted by me, is to appear in Beck (forthcoming). Chapters 6, 7, and 8 draw on these two publications. Note that for our joint paper, Victoria Bellotti and I together formulated the three central research questions, as well as the notion of 'informed opportunism', as articulations of my concerns. In this thesis, the three research questions appear in section 6.5 and in 7.1 as the revised focal questions of my study, and 'informed opportunism' is one of the concepts proposed in chapter 8. Furthermore, Victoria did much of the work in developing the specific design implications in that paper on the basis of my findings. Some of those ideas appear in the design implications in this thesis. Pointers to previous publications are provided within the chapters, as relevant. Copies of publications directly drawn on in the thesis are included in appendix B.

Conventions of presentation

I use single quotes for words which are mine, but I wish to highlight *as terms*. Italics emphasise a word, and is also used for Latin expressions. Double quotes surround words and sentences taken from elsewhere, whether quotes from the literature or in another sense 'borrowed' (such as those from the empirical data). In quotes from transcripts of conversations, brackets indicate that I have been unsure of a word.

In this thesis, citations of publications are given with the complete list of authors, except where the same publication gets a mention several times close together. This is to make more evident the collaboration behind those publications. Furthermore, in the case of a citation of one book, that of Ede and Lunsford (or Lunsford and Ede), 1990, their names appear either way round. This is highly unconventional practice, but in line with the authors of that book: they went to great length not to specify who is the first author.

CHAPTER 2. BACKGROUND

2.1. Introduction

The work described in this thesis belongs to the interdisciplinary field of Computers and Writing, and to the larger field of Computer Support for Cooperative Work (or Computer Support for Collaborative Work, or CSCW). This chapter provides some background to the work described in subsequent chapters.

CSCW has as its general aim to develop computer systems which provide support for work done by several people together. From a computer science point of view, the ultimate problem area of CSCW is computer systems development. However, Grudin, in introducing a special issue on CSCW, writes:

> "We interact with other people continually and usually without much effort. Yet (...) providing computer support for collaboration is difficult and requires a much better understanding of the way groups and organizations function. (...) [O]ur effortless interactions with others make it easy to overlook the complexity of workplaces and the poorly understood nature of collaboration in general. To design systems that support collaboration and to predict the impact of technologies on groups and organizations will require an expansion of our understanding. For this reason, a fundamental element of CSCW is research into individual and group behavior and into the nature of workplaces and organizations." (Grudin, 1991, p.32)

The development of appropriate computer systems for collaborative work therefore requires an understanding of joint work. As regards collaborative writing in particular, Newman and Newman, 1993, write:

> "In view of the central role that written text plays in many forms of professional collaboration, support for joint or multiple authorship is a significant issue for (...) CSCW. Design of systems for collaborative writing will need to take into account an array of social factors and social practices that are commonly taken for granted and invisible in normal *[sic]* face-to-face collaboration." (Newman and Newman, 1993, p.29)

2.1.1. Concerns of fields contributing to CSCW

Many areas of research contribute to CSCW, each of which carries its own approach and priorities. The different disciplines represent different interests, or at least different points of view on the problem, and bring with them correspondingly different methodological concerns.

One of the problems computer scientists are facing in CSCW is developing technology before it is clear to what use it should be put. Whereas this may not be a problem exclusive to CSCW, the nature of the problems CSCW aims to address, has forced computer scientists to look towards the social sciences for answers. However, there is an inherent conflict in that those parts of the social sciences that are arguably most suited to explore the kinds of questions CSCW poses, the ethnomethodological/phenomenological end of sociology, are least willing to commit themselves to the kinds of predictive certainties (*i.e.* models) desired by systems developers as a base for their design decisions.

Some of the contributions from the social sciences are: use of sociological methods to gain insight into real-world situations relevant to system design; use of experimental methods to investigate detailed hypotheses about the cognitive functioning of individuals in groups; studies of individuals' subjective experiences[2]; and concern with the role of user participation in designing acceptable systems.

Inherent in CSCW is the combination of approaches arising from taking results from one kind of study and using them as input into system design. There are, however, serious and as yet unresolved problems with this approach, given the widely different frames of interpretation of the different disciplines. A note of caution on the indiscriminate mix of results from different fields has been sounded by Rogers (1992), who argues that the benefits of better understanding of collaboration must be offset against the potential pitfall of the use of methods of investigation by non-specialists who may not fully appreciate the underlying approach and limitations of the method, and may therefore use it outside its intended remit.

2.1.2. Terminology in the thesis

This thesis addresses 'close' coauthoring—as opposed to, for example, editing. This is defined as the writing of documents by two or more persons, where the names appearing in the author list are those of people who considered themselves involved in the writing of that document. Distributed coauthoring groups are those working together across geographic distance.

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[2] Contributions from phenomenology to computer support for collaborative writing is briefly discussed in section 2.5.6.

Strauss, 1985, in discussing concepts for studying divisions of labour, introduces the terms *actor*, *arc of work*, and *project* (or *trajectory*). These concepts introduce some useful distinctions. People, institutions, *etc.* who act, are actors. Projects are overall aims or goals, and arcs of work are the way these are carried out. In Strauss' words, "An arc for any given trajectory—or project—consists of the totality of tasks arrayed both sequentially and simultaneously along the course of the trajectory or project." (Strauss, 1985, p.4). In terms of this thesis, actors who act together collaborate, and collaborating actors whose *project* it is to write a document together are engaged in collaborative writing. Each project of writing together has its own *arc of work*, which is the way individual *tasks* are carried out. The task-project distinction is particularly useful for the later discussions. In this thesis, institutions are not considered, so 'actor' is treated as synonymous with a person who engages in some activity of interest.

Collaborating writers, or collaborating authors, are actors engaged in the project of writing a document together with at least one other person. (Issues arising from defining writing as collaborative are further discussed in section 2.4.)

The terms 'writing' and 'authoring' are not, strictly speaking, synonymous. There are cases where one is acceptable and the other not ('authoring' implies becoming an author, *i.e.* (working towards) having the product published with one's name as (one of) the author(s); whereas 'writing' possibly implies less interest in the status of the product than in its production). However, this distinction is not central to this thesis, and the terms writing and authoring are used interchangeably. The terms collaborative writing and collaborative authoring will at times be abbreviated to co-writing and coauthoring respectively. Thus, coauthoring and co-writing are considered to be synonymous, as are collaborative writing, writing in a group, group authorship, team writing.

As for the terms collaboration and cooperation, the former is preferred in this thesis, as the latter may imply a common purpose among the people working together which the former does not: in the dictionary, collaborate is defined as "Work jointly (with), esp. on a literary or scientific project" (SOED, 1993). Cooperate, on the other hand, as applied to "people", is defined as "work together for the same purpose or in the same task." (and "Of an individual: act jointly with another; participate in a joint or mutual enterprise") (SOED, 1993). However, Star, 1993, contends that "Cooperation need not rely on consensus, even for tasks like scientific problem solving" (p.106). To the extent that 'cooperation' may suggest an *a priori* assumption that participants' reasons for working together concur (see section 2.4.1 below), this is not an ideal term. In this thesis, therefore, 'cooperation' is interpreted as the less restrictive 'collaboration'.

2.1.3. Overview of chapter

The argument put forward in this chapter is that research in the field of computer support for collaborative writing has so far failed to fully address certain issues in the organisation of collaborative writing which are important for the design of computer support for this activity—namely, the *nature* of the work we are concerned with; fundamentally, what it might be like to be engaged in that work, with all the contingencies and messiness encountered in the real world of work. Within writing research, interest for such areas is beginning to gather, with a notable call for context and cognition to be seen as related and integrated in 'observation-based theory' building from Linda Flower, an influential writing researcher (Flower, 1989). Little of this broadening of interest, however, has penetrated the collaborative writing section of the CSCW community—surprising, perhaps, considering the substantial interest in the 'messiness' of work settings in CSCW more generally.

In this chapter I first introduce the general area of concern to this thesis, namely, the question of how the social sciences can inform CSCW, and what we mean by 'support'. Then I discuss some alternative notions for terms which are fundamental to the thesis, such as 'collaboration', 'authoring', and 'distance'. Next, literatures on collaborative writing, CSCW, and related fields are surveyed. Finally, a first attempt at framing the key questions to be addressed in the empirical work is made. These are the starting point for the empirical work, and are subsequently further developed in the thesis. In particular, they point to the methodological approach discussed in chapter 3.

2.2. CSCW: system development meets sociology

One way of conceptualising CSCW is as a meeting ground between computer system development and certain approaches to the study of human activity. This section examines the relationship between requirements elicitation (or Requirements Analysis, or Requirements Engineering, or System Analysis) and qualitative sociological enquiry; in particular what role the latter can play in the former.

2.2.1. Methods of investigation in CSCW system design

What I would consider a hallmark of CSCW, the use of social sciences in systems development, can take place in at least the following conceptual elements in the development of a computer system. (Note that these are analytic 'parts' only; it is not suggested that they would be empirically identifiable as separate stages.)

a) Requirements engineering (or requirements elicitation), in which the requirements for the system are established for the technical systems development. From a computer systems development point of view, requirements engineering is to decide what the future system is to do; what functionality it is to provide to its users. Conceptually this information is contained in what is known as the Requirements Specification. Important methodological contributions come from (i) ethnomethodology, qualitative sociology, social psychology, *etc.* (case studies); (ii) statistical data analysis (surveys); and (iii) cognitive/experimental methods. The aim is to provide a basic understanding of some aspect of how people work and/or how a computer system might be helpful.

b) System design and development. At this point the actual computer system gets planned and implemented; conceptually the Requirements Specification gets turned into a design and the design into an implementation[3]. Here, participative approaches aim to involve (representatives of) the future users in the design of the system itself as it takes place.

c) Testing. After a system has been built, systematic testing of systems usage with appropriate user groups is another area in which studies of people take place. In CSCW, this has been used not so much to test whether the implemented system technically does what it was intended to, as is the computer science sense, but rather as a vehicle of research on how people use such technologies.

d) Conceptualisation of problem space. While a system is being used, and when demands for a new system are first being formulated, the requirements analysis will also be delineated. The question of what is seen as rightfully the domain of an investigation on which a system is to be designed, is one to which ethnographic approaches should be able to make considerable contributions.

Note that one frequently mentioned problem area in the development of CSCW systems, namely lack of communication between social and computer scientists, may in this framework be expressed as the problem of carrying results between these areas (as opposed to the execution of the work within each). This thesis addresses the problem in terms of (a) and (d) above. The aim is for the implications for requirements engineering to be taken far enough towards system design that a system designer can make use of some directly, others more as a sensitising exercise.

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[3] Note that in the specialist field of Requirements Engineering or Requirements Analysis it is widely recognised that this is an ideal only and that in practice, for a number of reasons relating to the ambiguity of such specifications, the design rarely follows the specification closely. Within Requirements Analysis this is usually considered a problem.

Bringing in approaches that are new to computer systems development, as is done in CSCW, where many are aiming to make use of findings from the social sciences to inform computer system design, is problematic. An immediate problem in this is that the disciplines have different languages and deal with different concepts. This may be relatively easy to tackle; some practitioners could plausibly learn sufficiently of each others' thinking and language to understand both. A more profound problem, however, may be that the aims of the disciplines and their philosophical underpinnings differ sharply, for example on issues of description *vs.* prediction/prescription. These are further discussed in chapter 3.

2.2.2. The problem of requirements engineering for CSCW systems

Designing a computer system involves making decisions about features and functionalities; which to include as well as how to implement them. This is often done on the basis of some notion of the 'requirements' of the system, *i.e.* what it is expected to do. The design is, at least in theory, supposed to convert the 'what' into 'how'. In practice it may not happen like this, for several reasons. First, the design process involves a substantial problem of interpretation of anticipated use situations. In System Analysis, the branch of computer science traditionally concerned with this part of design, this problem shows up in problems encountered due to the complexity of 'capturing' the 'requirements' of future users of the system. Robinson and Bannon, 1991, go further in posing *ontological drift*, or the shift of the meaning of any work objects as they are passed on between communities, as a major problem in the computer system design process. Second, the separation into these two conceptual phases is in many cases an idealisation rather than an accurate reflection of the practice of developing a computer system (*i.e.* the practice is more back-and-forth, with the two going on at the same time or in iterations). Decisions about 'how' will often affect subsequent 'whats'. Thus certain functions may not be offered at all because they are considered too difficult or costly to implement, and, importantly, early decisions on the computer system architecture affect what kinds of higher-level functions are offered.

The issue of requirements elicitation in CSCW is a complex one, and is currently the subject of considerable research effort. Examples are the work carried out for several years at the Oxford Programming Research Group (Goguen, 1992), and the Lancaster-based SYCOMT and COMIC (Strand 2) projects.

System requirements specifications are typically written in a natural language (as opposed to a programming language), such as English. One trend in requirements engineering, called "dry culture" by Goguen, 1992, is the move towards specifications being expressed in formalised language which can both be formally verified for 'correctness' and, ideally, executable as they are. This, it is argued, will reduce what is seen as the problem of 'error', which otherwise is

introduced either in the content of the specification or in humans' translation of it into a machine readable form, such as a programming language. (Automatic execution, *i.e.* without human intervention, would seem attractive also because of its potential to speed up this part of the process of system design.) There are a number of problems with this approach. An interesting one is that the malleability of a specification has arguably been advantageous to people who get involved in the design process late, as interface consultants and in particular users have tended to be.

The distinction between requirements elicitation and design is fluid in CSCW systems design, as it is in other areas of Software Engineering. In CSCW, a division of labour could be said to exist roughly between sociologists, whose task it is, roughly, to 'understand' collaboration, and computer scientists, who are expected to provide the technology to meet the requirements. This process, however, is problematic, as reflected in current debates in CSCW (for example, Hughes, Randall and Shapiro, 1993). First, there is the problem of where to delineate between actual human action and abstract system design: to what extent do those who carry out fieldwork have to understand system design in order to understand what kind of information (or knowledge, or understanding) designers need, and in what form? Equally, to what extent do computer scientists need to understand sociological enquiry? Second, as pointed out above, there is the question of whether field workers and analysts are willing to, or able to, supply the kind of information sought by designers. On the face of it, the notion that the system design task should be informed by studies of how people work has much to commend it, as the resulting systems are to 'support', and hence, influence in some sense, people's work. This is the view taken in this thesis, as in much other CSCW research. At the same time, however, there is an inherent conflict between a system designer's job of, on the one hand, anticipating (while designing) and prescribing (through the computer system) aspects of the activities of future users, and on the other hand, field work, which orients to descriptive accounts of action, and which by its very nature refuses, for reasons well established in their fields, to provide prescriptive models. Third, whereas in my opinion there is no doubt about the importance and value of the kind of questioning seen in CSCW more than in purely 'technical' parts of computer science, the uncomfortable question of whether the project of CSCW is feasible, or at least whether current work really is bringing us closer to good design solutions that work in practice, remains open. Suchman writes, in her introduction to the Proceedings of the CSCW88 conference, that:

> "this slogan ["computer-supported cooperative work"] has opened as many questions as it has answered concerning the process of computer system design and the nature of the work that we mean to support" (Suchman, 1988, p.v).

2.3. Thesis central issue: how can we support practises of distributed collaborative writing?

The motivation for this thesis is to contribute to the design of appropriate computer systems to support collaborative writing over distance through an improved understanding of that process. Networked computers have a particular potential to be of benefit to such distributed groups, who rely on mediation by technological artefacts, such as postal mail, telephones, *etc*. A powerful technology such as networked computers could be of great help. Networked computers provide for high speed transfer of large volumes of, in particular, textual information over arbitrary distances, which on the face of it ought to be well suited to support distributed work in general, and distributed writing in particular—if put to appropriate use. The great malleability of computer systems in terms of design possibilities means that they probably *can* be made to provide 'appropriate' support—once designers know what would constitute appropriate support. That is a complex question with many contingencies, to which no single study or approach can provide a full answer.

2.3.1. In what sense can technology provide 'support'?

In a paper discussing notions of cooperation, Holand and Danielsen write: "We believe that the words we use and the descriptions we make, create the objects, and thereby also the conditions for our further studies. In a way the descriptions constrain the questions which might be raised and the answers which might be given." (Holand and Danielsen, 1991, p.17). However, Holand and Danielsen do not question what is meant when we talk about technology 'supporting' a task; a question I regard as essential and which should receive more attention. What is meant by 'support' is highly open to interpretation and opinion.

To start with the dictionary definition, Oxford Advanced Learner's Dictionary of Current English (third edition, 1985 revision) defines support thus: to "bear the weight of; hold up or keep in place", or "strengthen; help (sb or sth) to continue". The Shorter Oxford English Dictionary adds, among others: "The action of contributing to the success of or maintaining the value of something" (SOED, 1993). If CSCW research aims to contribute to the success of (or maintain the value of) collaborative work, what is success, and what is valuable in collaborative work? Once established, *how* are CSCW systems to contribute to these? Is CSCW to develop computer systems which 'bear the weight of' collaboration? Or which in some sense 'hold it up', or 'keep collaboration in place'? Such issues, though (it would appear) fundamental to the project of CSCW, have not been much debated, let alone resolved, within the field. In this thesis the view is taken that well-designed computer systems may be able to 'support' collaboration in the sense of 'strengthening' aspects of the process. Furthermore, some kinds of activity, including some that are a necessary part of geographically distributed work, would not be

possible without mediating technologies. In those cases we are talking about 'enabling' something that might otherwise have been impossible. (For distributed coauthoring groups, then, there may be a particular potential for appropriately designed computer-based tools to be supportive, *i.e.* in some sense to strengthen collaboration over distance. What 'strengthening' might mean in practise, is addressed empirically in this thesis.)

In general, in what sense(s) might it be possible to 'strengthen' an activity or task? In what sense can technology provide 'support' for any kind of collaborative work? We have to ask what would constitute a strengthening of working together. In particular, what one considers supportive, or strengthening, depends on what one sees as the ideal. What is seen as 'good' collaborative work is therefore worth examining. For example, if the focus is on the process, as in this thesis, and one considers that working together requires communication, making communication possible, or easier, or clearer, or quicker, might 'strengthen' joint work. Other ways that one could consider working together to be strengthened, might be through contributing to the process taking less time, if time is a scarce resource, or the *outcome* being in some sense better or more successful. Or, if the process was in some sense made more enjoyable to the participants, would that count as strengthening it?

Notions of what constitutes 'good' collaborative work profoundly affect CSCW research, including system development issues. For example, if face-to-face interaction is seen as the ideal[4], it follows that an aim of supporting distributed work would be to make the existence of distance as transparent as possible, and hence the mediation of computers and other media. However, it is not clear that this is the most useful approach to supporting distributed work.

In CSCW, the problem of defining what constitutes support is closely linked with the ongoing debate about what CSCW is, or should be, as a research field. Some early writings, such as in Greif's (1988) introduction to a volume of readings on CSCW, reveal an optimism about the technologies to be built which now seems rather naïve in its assumption that the technology would transform the way people work:

> "Over the last half-dozen years, Computer-Supported Cooperative Work has emerged as an identifiable research field focused on the role of the computer in group work. The question being asked relate to all aspects of how large and small groups can collaborate using computer technology: How should people plan to work together to take advantage of this powerful medium? What kinds of software should be developed? How will group work be defined and redefined to tap the potential of people and technology?" (Greif, 1988, p.5)

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[4] Martin Lea once pointed out that whereas holding face-to-face interaction as an ideal seemed to be a trend in CSCW, its assumed superiority over other modalities had not been properly investigated (Lea, personal communication, ca. 1990).

It would seem that the notion of support here, in which technology (somehow) can open up a whole new 'potential', the technology has come to embody the answer(s) to how to work together. People, then, are left with adapting to the technology. Such optimism about the benefits of technology, I believe, is closely linked with a desire to use technologies to structure collaborative work; a tendency which also has been in evidence in CSCW. This becomes justified on the basis of studies which examine collaboration in terms of assumed structures, and which therefore—whatever else they may achieve—do not question the existence of identifiable and generalisable structures or procedures for design to model. An example is categories presented to a questionnaire respondent, or conducting experiments on different 'phases' of a process. (Examples in relation to research on writing, are discussed later in this chapter.)

In contrast, two papers which present a different view of support are Rodden, Mariani and Blair, and Schmidt and Bannon, both in the 1992 issue of the Journal of CSCW. Rodden, Mariani and Blair discuss technical implications of supporting collaborative work from the point of view of computer science. They say that "CSCW is essentially about supporting the rich patterns of interpersonal cooperative applications", and further, that "While the needs of CSCW are still being discovered, it is already apparent that the support provided for cooperative applications should be enabling rather than constraining" (Rodden, Mariani and Blair, 1992, both quotes p.43). Schmidt and Bannon explicitly set out to advance their agenda for what CSCW should be concerned with. In their view, "CSCW should be conceived of as *an endeavor to understand the nature and requirements of cooperative work with the objective of designing computer-based technologies for cooperative work arrangements*" (Schmidt and Bannon, 1992, p.11, emphasis orig.). They propose support for articulation work as a central issue for CSCW to address, in terms of "supporting self-organization of cooperative ensembles as opposed to disrupting cooperative work by computerizing formal procedures." (p.24). An alternative approach is "to allow the members of a cooperating ensemble to interact freely (...) through the provision of facilities enabling them to cooperate via the joint construction of a *common information space*" (p.27, emphasis orig.).

Given the lack of agreement on definitions not only of 'support', but also of the field of CSCW itself, one must also ask whose perspective(s) get(s) to determine what is considered 'strengthening' in CSCW; whose idea of 'support' becomes current? In computer support for collaborative writing, there is some evidence that modelling and structure are in vogue, as discussed in sections 2.5 and 2.6, more than may be the case for example in meeting support. This may well suit some system designers, in that the tradition of computer science arguably favours implementations based on clear models of expected user behaviour to the complexity and uncertainty of a constantly changing, unpredictable dynamic process. On the other hand, people engaged in the collaborative work, while they certainly have a thorough understanding of

(aspects of) the work they do, may not have a realistic notion of what they do (for example what they spend most time on), or of the strengths and weaknesses of a hypothetical computer system. An alternative to these extremes is for others to try to get sufficiently involved in the work of particular collaborators to identify some of their concerns, and to attempt to translate these into issues for designers to consider. Much work in CSCW, including that reported in this thesis, is an attempt at the latter, with the problems that entails of bridging conflicting demands (*cf.* discussions in Hughes, Randall, and Shapiro, 1993, and at several points in this thesis).

2.3.2. Thesis approach

In this thesis a particular angle is taken on collaborative writing, namely to investigate the detailed practices of some coauthors in coordinating their work, in particular when separated by geographic distance. This thesis examines whether conceptualisations evident in the literature and in collaborative writing systems of what the 'task' of collaborative writing is, are adequate as foundations to design support for such practices. An overly narrow focus on 'task' could exclude from consideration important facets of collaboration, which might lead to designs which are inappropriate for their intended purposes.

Evidence of relevant practices relation to this could directly influence design of software for coauthoring. Findings consistent with existing conceptions would provide evidence to (but not proof of) their being reasonable in relation to the work of coauthoring. Findings which are inconsistent, would provide a prompt for designers to re-examine their conceptions. Providing evidence of what are the concerns of some coauthors is valuable in itself: whether or not generally true, *raising* these issues can alert designers to questions they might beneficially address to their own areas of concern, such as the appropriateness of assumptions about the nature of the work they are to provide 'support' for.

In the next section, three concepts which, along with 'support', are fundamental to the thesis topic, are discussed. These are: collaboration, authoring, and distance.

2.4. The basic concepts of collaboration, authoring, and distance

Tatar, Foster, and Bobrow (1991), in reviewing a major system development project, argue that it failed because the designers had too poor an understanding of the users' situation. In CSCW, fundamental notions about collaboration will influence design, whether these are implicit preconceptions or explicit design assumptions. Conceptions of collaboration therefore have important consequences for how CSCW systems are designed. One starting point for improved design is to discuss these explicitly.

In this section, different ways of conceptualising collaboration, authoring, and the implications of distance are discussed. The section is organised around the three questions of 'what is collaboration?', 'what is authoring?', and 'what is distance?'. For each, a range of potential answers are examined. These are some of the alternative perspectives I have come across in the literature, in discussions with people, and in the teachings of system design. Some of these are mutually exclusive, others overlap. These are not exhaustive lists, but suggestions of approaches that could be, or have been taken. The purpose is to examine alternative conceptualisations, and begin to discuss how these may impact on design.

2.4.1. What is collaboration?

We must query what exactly we mean by 'collaboration', or 'cooperation' (the two terms are often used interchangeably in the CSCW literature). Holand and Danielsen's (1991) paper is one of few which address this issue directly. They discuss alternative notions of 'cooperation' and how these have, historically, produced different foci, and hence different studies and different findings. They propose three "potential descriptions" of cooperation: focus on strategy, focus on coordination, and focus on creativity. These are arguably more general than those discussed below.

If we want to understand more about how people collaborate (which we require in order to design appropriate technology such as computer systems), we might usefully first consider *why* people collaborate. As shown in section 2.1.1, the dictionary definition of collaboration is working together, whereas cooperation is working together towards the same goal. This distinction is interesting, because it highlights the issue of whether or not 'working together' requires a shared goal. In a previous publication, colleagues and I concluded an extensive survey of literature on conflict and its implications for CSCW that conflict is an integral part of group behaviour, and, further, that overly simplistic assumptions about conflict are made in existing CSCW systems (Easterbrook, Beck, Goodlet, Plowman, Sharples, and Wood, 1993). It would seem important, therefore, to use a term which allows for differences of opinion, including on the overall goal. If people are (in some sense) working together, we can call it collaboration; if people are (in some sense) working together towards the same goal, we can call it cooperation.

This, however, still leaves unanswered the question of how closely people should be working 'together' before it is counted as collaboration: when is something collaboration, and when is it not? Alternative—and at times, conflicting—notions of what collaboration is are not ruled out by the dictionary definitions discussed above. Some of these notions are:

Collaboration as purpose

More common, perhaps, is to define, or at least talk about collaboration as a function of an (assumed) joint goal among the collaborators. For example, when asking academics why they have written something together with another, I have often heard replies to the effect that they both, or all, need publications, or that they need to publish something on this work they have done together. This is an explanation of collaboration as the (somewhat 'magical') result of some common purpose. It is an explanation of (some of) the motivation for the collaboration to come about, but it does not address the issue of what the collaboration itself is, or what it might be like to be engaged in collaboration. It is therefore inadequate for the purposes of this study, as it is for making design decisions.

Collaboration as agreement processing

One way of conceptualising collaboration, would be to see collaboration as processing of agreement. This might go something like: 'a proposal/suggestion/problem is brought to the attention of group members; they discuss the issue, and when they reach agreement on a solution (and probably a timetable/deadline, or perhaps postponement), execution of the plan follows (or should follow) as agreed.' Such a view seems to correspond with many people's idealised picture of what collaboration could, or should, be like. For example, Lea identifies a "system-rationalist perspective" as prevalent in the literature on computer-mediated communication, which "sees the medium primarily as an efficient channel for information transfer in specific organizational tasks" (Lea, 1991, p.153). A rationalist view of collaboration is enticing in that it translates neatly into a host of ideas of how a computer system may make the process more 'efficient' by providing functions which would steer the participants towards this ideal (for example, by prompting participants to adhere to formal agreements). Lea and others argue, however, that such a view fails to account for the empirical observations, whether in laboratories (for example, Lea and Spears, 1991), or in 'real life' (for example, Agre, 1988).

What are the practical consequences of seeing collaboration simply as 'processing of agreement', *i.e.* as the process of identifying the next issues, reaching a decision (perhaps through negotiation) on what to do about it, and do it, repeatedly, until finished? A system which aims to support collaboration by structuring work according to this model, would, for example, probably ask for the names of the project members in order to register them as having permission to make changes to the document. Non-members might be allowed to read the document, but would perhaps not be allowed to make changes. The plan—that these are the members of the group, and that only they should be allowed to access the document—is executed and, according to this model, that is that. Any changes to an agreement would have to be explicitly registered as such.

Some immediate problems with this approach are: what if some of the group members' names are not known at the outset? What if the number of members changes during the project? What if someone who was not initially part of the group, and perhaps is not supposed to be one, needs to make changes after all (a reviewer may want to correct spelling mistakes, or another person may help out by typing in amendments made on a paper copy)? As will be discussed in this thesis, issues such as these confront coauthors.

Collaboration as learning; thought and writing as inherently social acts

In developmental psychology, the western preoccupation with individual exploration has been contrasted with the Soviet, or Russian, psychology of Lev Vygotsky, with its emphasis on societal construction of learning (John-Steiner and Souberman, 1978). In the Vygotskyan view, children learn through what is known as 'scaffolding': adults—typically parents and teachers—making limited parts of the world available at a time for the child. Language is instrumental in children's learning about the world, and the genesis of thought is collaborative culture, such as language. Even apparently individual activity, such as thinking, is internalised cultural activities.

Vygotsky's ideas are extended towards reading and writing by Bruffee (for example, Bruffee, 1983). Bruffee argues that thought being instrumental extends to adults, and therefore to society as a whole. This is how knowledge is transferred, and collaboration, in this sense, is fundamental to society. Bruffee's position is that "viewed as a form of instrumental speech (...) Like any other learning or problem-solving activity, writing becomes essentially and inextricably social or collaborative acts" (Bruffee, 1983, p.166).

As for writing and reading often being done alone, Bruffee contends that:

> "if we accept the notion that writing and reading are inherently social or collaborative acts, what do we do with the fact that we normally write and read alone? (...) What we do with that fact is to reexamine the value and purpose of the written word in light of a collaborative theory of knowledge and learning. The value and purpose of the written word from this point of view, in contrast with the more obviously social or collaborative acts of speaking and listening, is that it allows us to displace the acts of speech and listening. Writing and reading are displaced social or collaborative acts. They are practical means allowing us to overcome the limitations of time and distance that would otherwise inhibit the communication essential to accomplishing many of the most complex and sophisticated tasks we attempt." (Bruffee, 1983, p.167)

Bruffee's position that all writing is collaborative activity, raises interesting questions about the status of the boundary between acts which in the western tradition are conventionally attributed to the activity of an individual, and those attributed to acts of collaboration. In the Vygotskyan view that an individual's thought is internalised culture, observably collaborative acts, such as

those treated in this thesis, rather than being special cases, could be considered primary for understanding a task (such as writing).

For the sake of convenience and clarity of terminology, and since these issues are not the central ones to be addressed in this thesis, the words collaborative and cooperative are here used in the conventional sense of 'observably' joint work.

Collaboration as awareness and overview

In contrast with the extreme stance discussed above, in ordinary language we typically do not consider something a collaboration—in other words, working together, in some sense—without, a) the participants being aware of the existence of the collaboration as such, and b) some notion of the relationship (or expected relationship) between their own work and that of their collaborator(s). Brown (1988) defines a group in similar terms. One way of seeing collaboration might therefore be as an awareness of others' work in relation to one's own work. This would be a necessary, but not sufficient, condition of collaboration, as one could imagine awareness of others' work without collaboration. For example, when a friend, working in a different field from me, tells me about her work frequently enough that I am fairly aware of what she does, but I do not provide feedback that influences her work, I would not call this collaboration about work. (Note that it is not true that my friend and I provide no input at all to each other in doing this: the information passing often has the effect of providing each other with support. This could be called collaboration about emotional support, but it is not collaboration about work, and is outside the scope of this thesis.)

Computer support for awareness in work groups is discussed in Dourish and Bellotti, 1992. They propose that computer systems can provide 'low-key' information about people's activities, which facilitate their collaborators orienting to their busyness or otherwise. An important concept is that the information is gathered (and, to a large extent, presented) in the background, without the persons either using or 'providing' the information having to make an explicit effort to do so, once they have given their general consent to that person making those sorts of connections to them.

Thus, the notion of awareness is a useful concept in that it may provide a point of contact between system designers and sociological enquiry. On its own, the concept of awareness may not be sufficiently clear for making practical design decisions. More fundamentally, awareness raises the question of the nature of the relationship between awareness and collaboration: does this line of thought require, for example, a view that the higher the awareness (whatever is meant by that), the 'closer' the collaboration? If so, is it possible to influence the 'closeness' by providing collaborators with more information which facilitates or even encourages more

awareness? I would argue that this is still an open question requiring further research. However, concern with this issue is very much in evidence in CSCW system building, in the guise of a concern to make evidence of others' activities in the system available to other system users[5]. This is a position which directly contradicts a long established assumption in system design—namely the desirability of hiding from any user the fact that other users are also using the system (Rodden, Mariani and Blair, 1992). In those terms, it poses major technical and cultural challenges to designers of operating systems and development platforms.

Collaboration as a nonpredictable process

Strauss (1985), in a paper on the division of labour in which he turns the focus on work, and on the work of dividing, or sharing, work, introduces the notion of the course of a project being nonpredictable. This was based on extensive empirical data, gathered over several years, in particular from observations of hospital work. After introducing the concept of an arc of work, he writes: "At least some of the arc is planned for, designed, forseen; but almost inevitably there are unexpected contingencies which alter the tasks, the clusters of tasks, and much of the overall task organization. Hence the arc cannot be known in all its details—except in very standard, contingency-minimal projects—until and if the actors look back and review the entire course which they have traversed." (Strauss, 1985, p.4).

One aspect of the contingent nature of action is developed by Suchman in her book "Plans and situated action: the problem of human-machine communication" (Suchman, 1987); a powerful critique of cognitive and modelling approaches to HCI. In particular, she focuses on the question of whether plans in any sense determine action's course, arguing that all action is inherently situated. Therefore, the meaning of action necessarily derives, at least in part, from the context (or 'situation') in which it is embedded. Hence, plans do not prescribe, or in any strong sense determine, action; instead, plans are (one of many) resources for action. Agre, for example 1988, similarly makes a case against simplistic notions of plan execution in Artificial Intelligence, and for the dynamic nature of everyday activity (arising from its situatedness), arguing, in his case, for a different approach to robot design. In her 1993 paper, Suchman

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[5] Cooper, Hine, Low, and Woolgar, 1993, describe work of theirs aiming at deconstructing notions of 'users' and 'providers' of computer systems; their central point being that users are not merely passive recipients of what the providers hand down (and that the 'providers' studied, themselves are 'users' with respect to other system suppliers). In this thesis, the term 'user' denotes any person while in the situation of , in some sense, using the system being referred to as part of their work activities. There is rich evidence for the active role of a 'user' in shaping her use of the system; for example, Mackay, 1990, who coins the term "co-adaptive" to describe the mutual process of adaptation she saw between users of a new system and the technology (through its developers). This thesis itself presents some such evidence (see later chapters). The term 'user' as denoting an activity, not a person as such or status in a hierarchy, is useful for the purposes of this thesis. It should be clear, however, that this in no way implies a static, passive role for the person acting as a 'user', neither with respect to the technology or those who design, supply, and maintain (alter) it.

analyses the impact of one such line of thought she argues against in CSCW, the Language/Action Perspective. Suchman criticises the Coordinator system (Winograd and Flores, 1986), built on this approach, for not taking account of the inherent situatedness of all action. She further considers some of the vested interests that lead to an admiration for controlling interactions.

The question of how plans are used is important not only for those concerned with theories of human action, but also for the practical design of computer systems. If it were the case that plans are typically executed as made, a huge potential would open up for providing computer support for carrying out plans (for example, by providing reminders of plans to be executed) organising joint work, including in CSCW. An interesting issue therefore becomes whether, or to what extent, plans can be said to be pivotal in organising the process of working—either alone or together: interestingly, the empirical examples in Suchman's influential 1987 book are from joint work, but her argument addresses cognitive science in HCI, and are concerned with a single human and a machine interface[6]. Suchman's design implications also address themselves to human-machine communication and to interface design: "Because of the asymmetry of user and machine, interface design is less a project of simulating human communication than of engineering alternatives to interaction's situated properties." (Suchman, 1987, p.185). As discussed above, in other publications Suchman directly addresses implications from the situated nature of activity for CSCW. It is not clear, however, that the question of what function plans and planning may play in joint work has been treated as such in the literature. (This is further discussed in chapter 9.)

Collaboration as articulation work

In addressing CSCW's ongoing debate about focus on the development of new technologies versus understanding how people collaborate, Schmidt and Bannon, 1992, propose a conception of "CSCW (...) as a research area devoted to exploring and meeting the support requirements of cooperative work arrangements" (p.11), central to which is the question of "how to support the `articulation work' that people must engage in in order to make the cooperative mechanisms developed to support different aspects of work in complex environments fit together and fit to local circumstances" (p.22). The notion of articulation work was originally introduced by Strauss, who defines it in the following way. "Articulation work amounts to the following. First, the meshing of the often numerous tasks, clusters of tasks, and segments of the total arc. Second, the meshing of efforts of various unit-workers (individuals, departments,

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[6] I am grateful to Yvonne Rogers for pointing out the difference between my use of Suchman's work and its original standpoint.

etc.). Third, the meshing of actors with their various types of work and implicated tasks." (Strauss, 1985, p.8)

Cooper, Hine, Low, and Woolgar, 1993, present as one of several aspects of the style of ethnography they advocate, what they describe in terms of an ongoing dialogue between the ethnographer and the participants. They see one role of the ethnographer as, in my words, articulation of (aspects of) the work setting, in particular in terms of questioning 'given' concepts. To the extent that the dialogue they describe is a collaboration, this is arguably another example of collaboration as articulation.

The notion of articulation work being inherent to collaboration is useful in an analysis of distributed collaborative writing, because it allows some more specific analysis of what kind of information collaborators make available to each other, and, possibly, why.

Conceptualising collaboration: a summary

Conceptualising collaboration is, as we have seen above, an issue of considerable debate, with highly contradictory approaches. My concern in this thesis is with empirical evidence of collaboration as a nonpredictable process, and how this relates to collaborators' engagement in articulation work and to their maintenance of awareness and overview.

2.4.2. What is authoring?

Not only is the question of what authors do when they author, an issue addressed in this thesis, poorly understood by those who study writing, but the very practical question of how much of that work someone needs to do, or what part of that work, to earn the credit of authorship, is itself the subject of negotiation and networking among scientific authors (Trimbur and Braun, 1992).

Authoring as collaboration

Lunsford and Ede, 1990, include an interesting survey of the historical roots of conceptions of authorship (see section 2.5.2 for a more full discussion of their work). They point out that joint production of manuscripts goes back to at least the middle ages, and conclude that the solitary author is a relatively modern notion.

In fact, a strong argument can be made that there is no principled distinction between writing on your own and collaboratively, cf. discussion in section 2.4.1. Thralls, 1992, argues that, since writing is an example of "discourse-production" (p.65), writing is collaborative. This is based on Bakhtin's theory of discourse, namely that all communication is an active process involving

collaboration partnerships, and that collaboration partners are linked through a chain of responsive reactions (Thralls, 1992, p.65). Even a single person's written communication cannot be taken separately from a larger discourse chain (pp.67-68). A similar argument is made by Reither and Vipond (1989), who additionally focus on close colleagues' contributions in reviewing drafts, pointing out how writers "establish and maintain immediate communities which function within the larger, "disciplinary" communities where their knowledge claims might find a fit", and that "the members of such a community-within-a-community (...) support and sustain one another" (both quotes p.859).

More fundamentally, consider again Bruffee's argument, discussed above, that writing and reading are inherently collaborative (section 2.4.1). In this light, the fuzziness of the boundary between writing on your own and collaboratively—a concern in Couture and Rymer, 1991, and Ede and Lunsford, 1990, among others—becomes irrelevant, or, to be precise, the concern for a principled distinction diminishes. One might still, however, choose, for pragmatic reasons, to delineate one's area of interest. This thesis is concerned not with collaboration as distinct from non-collaboration, but with what people actually do in those cases where writing enters the realm of social, or collaborative, acts that are in some sense 'observable'. For this aim, more pragmatic definitions of the kind of collaboration studied in this thesis are offered below. These are intended to delineate the area of study rather than propose a principled distinction.

Authoring as articulation work

Authoring, as studied here, is a particular kind of work. It involves writing, *i.e.* verbal, textual articulation of thoughts, ideas, opinions and/or emotions. An argument can be made that writing as an activity is particularly subject to articulation work because not only must the cooperation mechanisms which support any collaboration task be developed and articulated, as discussed in section 2.4.1 above, but the task of writing is itself subject to development and creative change. People writing a document together is a non-routine task, in that it takes place over a relatively long time (weeks, months, or years, for academic coauthors), and is rarely repeated.

For collaborative writing, there are several levels at which articulation takes place: one is the expression of facts, opinions, *etc.* which are to go into the document. This is articulation as the object of the writing process. The other kind is the articulation work performed by the collaborators which serves to coordinate the collaboration, in other words articulation as (part of) the content of the writing process. This is articulation in the sense used by Strauss, as discussed below.

The former notion of articulation work, in which focus is on the conversion of ideas, thoughts, facts, *etc.* created in social interaction, in people's heads, or in external records (for example,

other papers or reports), is addressed in Plowman's (1993) study of a group of people writing an assignment over a couple of hours: she traces in some detail how parts of the (spoken) discussions of the participants get turned into notes, then a first draft, then the final document version.

A final, and quite different, notion of authoring as articulation work is in literary criticism's view of authoring as an expression, in some sense, of the writer's self. Literary criticism has a long tradition of analysing writing, though primarily, perhaps, its product, *i.e.* the completed texts. Interesting to note, then, is work done on analysing authors' alterations of their original manuscripts, such as that done by Hildick (1965). He studies alterations made by nine well-known fiction writers, and comments on and records, in great detail, the precise sequence of insertions, deletions and additions made to the original manuscripts. On studying authors' alterations, he writes:

> "To read an author's manuscript can be an enthralling experience, especially if it is written in longhand. We see the places where his *[sic]* pen has scudded along, the dots of the i's and the crosses of the t's trailing behind like smoke from an express train, and we see the places where, in the argot of the profession, he 'bleeds', and words are crossed out heavily, almost it seems with a savage deliberation at times, or intensely thoughtfully, letter by letter, or where scribbled arabesques begin to creep along the borders of the page. Soon we begin to feel that we are actually with him, looking over his shoulder, and this feeling is strengthened when, in a margin, or on a blank sheet, or even, occasionally, in the body of the composition, the writer utters an aside. 'BEDDING' shouts a message in large ornate letters, reminding us as well as Charlotte Brontë that other households than Mr Rochester's have claims on her attention. (...) [S]uddenly to come across (...) private comments (...) is to be made to feel almost too intrusively close." (pp.25-26)

Hildick contends that the kinds of alterations made fall roughly into three categories:

> "Physically, an author makes only three kinds of alterations: he *[sic]* substitutes, he deletes and he inserts. But when the intention behind each change is taken into account we find a much wider range of groups and sub-divisions." (p.13)
>
> "(...) Less elementary than the positive tidying-up changes are (...) [t]he power-group (...), where the power to be increased is the power of penetration as well as of projection and persuasion, and perhaps it is the most important of all. In it are found all those strivings after the right word erected by Flaubert into a form of religious devotion and signalled in the manuscripts of some writers by small pillars of deletion and substitution, deletion and substitution—steeples, domes and leaning towers that rise above the lines or totter and sprawl into the margins as first one word, then another, then another, then the original, then yet another, is tried or tried again." (p.15)
>
> "None of these groups is rigidly exclusive, of course, and it is really only a matter of degree to move from what I have called the power group to the group embracing the major structural alterations (...). Furthermore, they are so sweeping that they generally make necessary scores of minor alterations of all kinds in every part of a work" (p.20)

Authoring as cognitive activity

The cognitive properties of writing activity have received the attention of a large proportion of the research on writing outside literary criticism, inspired by the influential work of Hayes and Flower (for example Hayes and Flower, 1980a; see section 2.5.5). Their work was exclusively focused on the cognitive aspects of writing, and became highly influential for a generation of studies of writing, and for the development of research prototypes for writing support systems.

Though still cognitive in its orientation, a slightly different development, which constitutes a limited opening up to other factors, is an "increasing[ ] aware[ness] of the importance of rhetorical context" (Odell, 1985); alternatively an emphasis on the importance of "external representations" (Sharples and Pemberton, 1988). Flower herself argues later that research on the process of writing must include an understanding of the context in which the writing takes place (Flower, 1989). This constitutes an interesting call for a broadening of researchers' perspectives on what is considered relevant to writing compared to, for example, the work that she and Hayes conducted in the early 1980's.

Authoring as academic work

The studies introduced below focus on collaborative writing in research in the academic and academic related community. This is characterised by some general constraints leading many to want to write and publish—for example, for building up personal or group reputation among peers, or for advancement of career, or for dissemination of information to research community. Furthermore, a desire to join a particular research project, may have significant impact on the decision to write.

One notable feature of such academic writing is that strong indications exist of expectations to some aspects of what the final product, the document, should be like. Areas which apparently are of concern to the academic community include how the *contents* of the document should be arrived at (the methods used to arrive at the results described), and how the contents are *presented* (Reither and Vipond, 1989). Law and Williams, 1982, in one of very few ethnographies of academic collaborative writing, analysed the construction of a coauthored document as an act of persuasion by the coauthors of their peers. Perhaps paradoxically, it is harder to find evidence of conventions being shared on the detail of the *process* of writing the papers, books, or reports, especially for collaborative writing. This, it would appear, must be re-created by each group as they face their particular task. The studies in the subsequent chapters indicate that this is so, and point to possible reasons.

Reither and Vipond (1989), in putting forward the argument for collaborative writing to be taught in composition classes, examine a case of academic collaborative writing and argue strongly

that writing is inherently collaborative, and conclude: "All of us who make meaning through writing—scholars, teachers, students—do so in community with others who share our interests in the knowing and the knowledge making processes that constitute our fields of inquiry. Writing *is* collaboration. It cannot be otherwise." (p. 866; emphasis orig.)

Authoring as an observable phenomenon

In the work reported on in this thesis, authoring, and coauthoring in particular, has been made an object of study. It is thus treated as a phenomenon which can, in some sense, be observed. This necessarily implies some distortion from authoring as experienced by the actors themselves.

As far as 'observably collaborative' writing goes—in other words, what is usually meant in CSCW when referring to 'collaborative' writing—one still has a range of, at one extreme, people sitting down together, writing everything out together, resulting in no-one knowing exactly who wrote what. At the other extreme, someone could be producing all the text on their own, but getting comments from colleagues, friends, an editor, or someone the ground work was done with. Coauthoring can be defined in many ways (Lunsford and Ede, 1990, Forman, 1992a, b), giving different perspectives on what the practices of coauthoring are (Couture and Rymer, 1991).

Conceptualising authoring: a summary

Alternative views on authoring and on writing produce very different focuses. These are not all incompatible, but result in quite different approaches to writing, and, by extension, to what it is that could be, or should be, addressed in a support system. My concern in this thesis is with joint authoring as part of academics' work, in particular with the articulation work involved when this takes place over distance.

2.4.3. What is distance?

In CSCW, much research effort is directed at situations in which collaborators are separated by geographic distance; large or small. Some early CSCW papers showed a negative effect of distance on likelihood of scientific research collaboration (Kraut, Egido, and Galegher, 1988; a survey of scientific research collaboration within one organisation), but also that whereas an audio link was deemed clearly helpful in a laboratory study of distributed collaboration, no significant effect was obtained when a video link was added (Gale, 1989); a result which went against the expectations of not only the researchers conducting the studies but many others too. Distance, or distributed, working therefore seems to be both problematic for participants

and an unusually potent area for technological solutions—an ideal combination, one might think, for a research area such as CSCW. However, if even quite reasonable guesses as to how these might be related cannot be relied on until tested empirically, progress will be slow. Empirically based insights, furthermore, have been few and far between. Few longitudinal studies of work over distance have been conducted, either in CSCW or in contributing areas. In particular, few such observational studies have been conducted (some reasons why this may be so are discussed in chapter 3, where methodological implications of studying distributed groups are discussed).

In this section I consider briefly some implications of people working together while separated by physical distance.

Distance as distributed authoring

Within CSCW, Computer Support of Collaborative Writing may be the most promising area in which to make advances on distributed work. Not only has one of the contributing fields, literary criticism, some tradition for interest in work across distance (in terms of studies of letter-writing by, and exchanges between, authors; *cf.* Sharples, 1993b), but also—since distributed writing as an activity has a history, and since some of the mediating technologies available for communication are likely to be familiar to participants (such as letter writing, telephone)—existing norms may be more readily used, and not have to be stretched or developed quite as radically as, for example, for video mediated meetings. Continuously, there are people engaged in actual distributed work of this kind for their own purposes. Finally, the minimum demands for technical innovation are arguably more humble than those in, for example, video mediated communication, where little exists in the way of ground to build on. This not only makes it potentially easier for system developers to supply "something useful" for participants in trials, *etc.*, but, significantly, makes it possible for distributed coauthors to, in a sense, *themselves* get started on developing more appropriate technologies by subverting, or adapting, whatever is available to them. This makes collaborative writing a highly appropriate focus for studying distributed work.

Distance as geographic separation

Two persons being distributed, in the sense intended here, means that they are separated by physical distance. In this thesis the interest is in people who write together being at a great enough distance from each other that we would say they are working remotely, or in a distributed fashion. This roughly translates to a distance great enough to have an observable effect on their ability to meet in the same place at the same time, such that the persons

routinely have to make use of technologies that mediate over geographical distance—such as telephones, motorised transport, or electronic transmission—in order to accomplish their work.

Actors have strategies for making work, or the result of their work visible to each other (Strauss, 1985). In the case of distributed work, this translates into the question of what the 'observable effect' of the geographic distance might be on such patterns: *How do **separated** actors render their work visible to each other?* This issue is addressed in chapters 7 and 8.

Distance as disembodiment

An argument can be made that all activity stems from our physical being in the world, and our understanding of even complex abstract concepts is arguably grounded in our experience of being in the world, in other words our embodiment (Lemmen, personal communication, 1994). As pointed out below, norms for communication which have developed over centuries and millennia were based on the communicators being co-present (*i.e.* same place, at the same time), with the exception of a limited amount of non-interactive communication, such as writing.

What it means, then, for two persons to communicate, and more generally, relate to each other, when they are not co-present is an important question. Heath and Luff, 1991, introduce the term "disembodied conduct" to denote video mediated communication with its associated bodiless talking head. They point out how bodily cues, such as gestures, become distorted because of this medium, and how this in various ways reduces communicative effectiveness. Interestingly, they also point out that the reduced awareness of each other's activities could in fact be an advantage compared with the bodily presence of actually sharing offices, in making it easier to ignore those of the others' activities they do not want to pay attention to, and which would otherwise constitute a distraction. By implication, actual physical bodily presence commands more attention and more easily affords interaction. Distance, therefore, appears to make a difference discernible not only in the general pattern of research collaboration, as indicated above, but also in the specific detail of interaction mediated by technology. In each case there is a link to the discussion of awareness in collaboration and to support (sections 2.3.1 and 2.4.1): what kind of awareness of each other's activities can be necessary, or useful, in distance collaboration?

Distance as a technological challenge

Writing, or inscription of symbols on some surface, was an early technology that started breaking down the need to be in the same place at the same time in order to communicate. Writing could either require co-location, but not at the same time (as with cave walls), or require neither, if the inscription was done on a transportable medium (such as a piece of parchment

which could be carried to a different place and read there). Norms for how to deal with this form of technologically mediated, disembodied, communication have developed. The last century or two has seen the development of a large number of new technologies, many of which make possible forms of disembodied communication not known before (for example, the telephone, radio). Using these new communicative technologies put people in new communicative situations, where existing norms may prove inadequate. For example, in letter writing the convention has evolved of recording explicitly in the letter the date of writing; a norm which has no equivalent in real-time conversation, where different dates between the communicators has never been an issue. Thus, new norms develop, or existing norms are extended for new media. This, however, takes time, and relatively new media may pose communicators with challenges of etiquette, as seen in the debate over 'flaming' wars of strong words in electronic mail. In the field of Conversation Analysis, people's communicative coordination has been studied in great detail, including conversations mediated by the telephone.

The implication of Heath and Luff's study, discussed above, is that communicative interaction is affected by the properties of any mediating technology (Heath and Luff, 1991). The options for designers of mediating technologies—*i.e.* technologies intended to bridge physical distance, such as telephones, video connections, and various kinds of computer systems—thus are either to design technologies which aim to change existing communicative practices as little as possible, or to design technologies which will change such practices radically. In the latter case, the challenge becomes on what grounds to make design decisions and against what criteria to test the system[7]. Either way, the best starting point for designers must be a thorough understanding of the nature of the activity and in particular a feel for the range of existing communicative practices of actors.

Conceptualising distance: a summary

Separation of people by geographic distance has significant consequences not only for issues of coordination among people who work together, but also for how collaboration can be studied, an issue returned to in chapter 3 (section 3.3.6). Collaborative writing is a promising area for studying distributed work, as it already takes place, and with relatively simple technology. In this thesis, the concern is with authors collaborating over distance over some time.

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[7] To some extent, this is a problem of technological innovation as such. In this case, techniques such as participative design and rapid prototyping, may have some merit. Arguably, however, if there is a need for the innovation, someone somewhere is doing the same thing now in another, perhaps more cumbersome way. In CSCWriting, this is very evident. Examining practices of use of current technologies, in particular their "subversion", or co-adaptation by co-writers, as discussed above, could provide another lead.

2.5. Research on collaborative writing

The activity studied in this thesis is that of joint writing, or authoring, academic papers. This involves putting words to paper (or screen), but also a host of other activities, including deciding on contents and style; negotiating goals for the intended paper; deciding on where to submit it to; obtaining and checking conformity to submission guidelines; coordinating effort to avoid duplication between coauthors; and more. Few of these activities have been studied, let alone are understood. Colleagues and I have previously suggested a number of research issues relevant to computer support for collaborative writing (Sharples, Goodlet, Beck, Wood, Easterbrook, and Plowman, 1993). Despite weaknesses, the paper demonstrates the complexity of the issues involved in studying collaborative writing, and the wide range of approaches to this which are possible.

In this section I review research relevant to the study of collaborative writing, focusing on the contribution to be made by various disciplines.

2.5.1. The proliferation of multi-authored papers

For scientific papers, the proportion of multi- to single-authored papers is increasing sharply, and also the number of authors on each multi-authored paper (Trimbur and Brown, 1992). Trimbur and Brown, 1992, explain this in terms of a historical shift from science as a craft to a science built on an industrial model—or, in the words of de Solla Price, a shift from "little science" to "big science"; the latter requiring extensive collaboration (Price, 1965). "The expense of scientific equipment, the technical complexities of research, the patterns of grant funding (...), the extended apprenticeship systems of training (...), and the growing specialization within scientific fields have increasingly necessitated both a division of labor within laboratories and the entrepreneurial activity of laboratory heads (...)" (Trimbur and Brown, 1992, p. 23). Following de Solla Price, they suggest that the trend towards increasing collaboration may be the clearest difference between premodern and modern science. Other influences, such as, in the UK, changes in the structure of research funding (for example, Plowman, 1994), also affect collaboration among academics. With increasing collaboration, more academic papers are being written together.

However, research attention has centred almost exclusively on single person writing (Ede and Lunsford, 1990). There is little in the way of an established literature on collaborative writing. In one of the few monographs on collaborative writing, "Singular Texts/Plural Authors", Ede and Lunsford (1990) discuss reasons why this may be so. Research interest in collaborative writing has recently been increasing, both among humanists and literary critics on the one hand, where it forms part of a questioning of prevailing conceptions of authorship as being a single person

activity (Ede and Lunsford, 1990), and in Human-Computer Interaction and CSCW on the other, where the purpose is to develop computer systems to support collaborative writing, either for distributed or co-located groups.

Literature on collaborative writing from the fields of literary criticism, composition research (where the concern is how to teach writing), and the sociology of science are surveyed below, as well as fields which contribute to CSCW generally. It is interesting to examine what contribution they are making, or could be making, to CSCW writing (CSCWriting) research.

2.5.2. Literary criticism and composition teaching

Apart from recent interest within CSCW, collaborative writing has been studied primarily by composition teaching researchers, including some from literary criticism. Studies of collaborative writing other than those in composition research or in literary criticism appear to be more scattered, and perhaps more the result of individuals' interest than the concern of a research field. In the humanities, however, research on coauthoring is on the increase (Lunsford and Ede, 1990; Forman, 1992b). A full survey of research on writing can be found, among other places, in Lunsford and Ede, 1990.

A significant part of research on collaborative writing, then, comes from the North American tradition of Composition Research, where research on writing, including collaborative writing, is motivated by a desire to improve teaching through the introduction of collaborative writing (a few examples are Odell, 1985; Reither and Vipond, 1989; Ede and Lunsford, 1990; the papers in Forman, 1992a; and Couture and Rymer, 1991). The interest from composition teachers is thus in the pedagogical implications, their primary concern being what writing skills their students should be taught, and how. There is a concern with charting the writing strategies used by students (such as novices' failures), with structuring courses and lessons to engage students in collaborative reading and writing, and with arguments for the pedagogical benefits of collaboration. Furthermore, interest in teaching collaborative writing from business and management schools stems from a concern to teach practical skills that relate closely to the work students can be expected to undertake later, when they are employed. Thus, some work on collaborative writing among composition researchers has a slant towards business writing. Some of the studies with the latter concern are case studies of writing in the 'real' world (for example, Lunsford and Ede's studies and Couture and Rymer's, cited above), as are a few of the others (notably Reither and Vipond, who report on Reither's own experience of academic collaborative writing).

In literary criticism there is arguably more of a history of interest in collaborative writing, at least as a side issue. It has, from time to time, been noted how a work of writing—typically fiction—emerged as the product of some extensive collaboration between the (often single) author and

other persons (Lunsford and Ede, 1990). Sharples, 1993b, cites examples of extensive scientific and political correspondence, which were acknowledged as important in the development of, for example, Darwin's work, but not presented as collaborative work.

The task of improving the teaching of writing is largely seen in terms of introducing, or campaigning for, the use of pedagogical techniques centred on getting students to work (write, but also read) in groups as opposed to individually. Note that this project is not necessarily straightforward (*cf.* the debate in Forman, 1992a, on the relationship between pedagogy and research; in particular Trimbur and Braun's note of caution about the relationship between collaborative writing research and pedagogy).

Ede and Lunsford (or Lunsford and Ede) take the position that despite its modern prevalence as the image of writing, single person writing is a relatively recent invention, and an artificial one. (It is interesting to note that Ede and Lunsford go to some length to avoid specifying in their book which of the two is the first author.) The aim of their research was to demonstrate the pervasiveness of joint writing activities as part of the work of the persons they surveyed, in particular to examine differences in patterns of coauthoring between people in different professions. To this end, they conducted a large survey of about 700 respondents who were members of seven "professions" in the US; a second, more in-depth survey followed up about 80 of the original respondents. They also conducted interviews with six of those individuals. In the large survey, respondents reported that by their own estimate, 44% of their time was spent "in some kind of writing activity" (p.47), and 87% reported that they sometimes wrote as members of a team or a group (Ede and Lunsford, 1990).

Couture and Rymer, 1991, contains a brief report of the results of their study of about 400 professionals in the US. This survey found that 24% of respondents reported contributing to a team-authored document sometimes, often, or very often; 76% sometimes or more often talked over their writing with others before drafting. The substantial difference between their figures for the prevalence of co-writing and that from Ede and Lunsford's study appears to be, in part, explained by a difference in definition of collaborative writing (Ede and Lunsford were happy to include feedback from others, for example, discussions, on the paper as collaborative writing, whereas Couture and Rymer's survey defined it more narrowly). In addition, Couture and Rymer make a distinction between "'routine' and 'special' writing tasks", reporting that the amount of collaboration is less for routine writing.

2.5.3. The sociology of writing

Contributions to understanding collaboration among academics come from research on science itself: sociology of science and philosophy of science. The sociology of science studies how science develops in communities, including through writing.

As discussed in section 2.4, various kinds of sociological enquiry are the main contributors to the requirements engineering in CSCW. In collaborative writing, there is less of a dominance of sociology. Instead, much of the research comes from a tradition of experimental studies of the cognition of (originally, single person) writing, and from educational research and literary criticism.

As mentioned above, Flower, one of the main researchers in the cognition of writing, has later called for research on writing to include the environment in which the writing takes place (Flower, 1989). Others have gone further, and there is now a growing body of research on writing from a sociological point of view. Ethnographies of collaborative writing include Law and Williams, 1982, a study of academic persuasion (discussed elsewhere); Riley, 1983, a study of the joint production of teaching material among academics; Odell, 1985, a study of the (social) process of enquiry behind the writing of documents in an office; and Doheny-Farina, 1986, one of very few longitudinal studies of writing, in which the year-long writing of a vital company document was shown to influence the company structure and *vice versa*. Within CSCW, ethnographic studies of joint writing have been conducted by Newman and Newman (for example, 1993), and Star (for example, 1993).

Law and Williams, 1982, and Star, 1993, are also examples of interest in collaborative writing originating in the sociology of science, where the production of scientific papers is studied as one way in which scientists distribute credit, build careers, and spread their views.

2.5.4. Collaborative writing studies in social psychology

In social psychology, experimental studies of group processes test detailed claims about group behaviour in terms of their statistical validity. While not explicitly addressing writing, some of these studies are highly relevant to the working conditions many groups, including coauthoring groups, find themselves in. In particular, the debate on the effects of communication being mediated by computers (as opposed to face-to-face), is worth noting:

Early, influential work on the effects of the (potential) anonymity of e-mail was conducted by Kiesler, Siegel and McGuire. They found that opinions are more polarised in groups whose communication is mediated by computers, and suggested that this is due to a weakening of social norms (Kiesler, Siegel and McGuire, 1984). This explanation is questioned by Lea and Spears, who explore the complexity of the issue, and suggest that the role of social contextual factors and 'normative processes' have been underestimated. Their experiments indicated, in contrast, that "compared with face-to-face interaction, the social and normative context may be of even greater importance in computer-mediated communication" (Lea and Spears, 1991, p.299).

As for social psychological research on coauthoring in particular, Hartley and Branthwaite, 1989, report on a questionnaire study of 88 productive academic psychologist writers. Whereas most of their study is not about writing in collaboration, they report that the writers who were the most productive "sometimes collaborated with long-standing colleagues when they wrote" (p.440). (No data is reported on how frequent such collaborations were.) They also found that for respondents with high productivity with books (defined, in this case, as writers who had written 2-5 books over the preceding three year period), one of the three most predictive factors was that when they collaborated with others in writing, "they were more likely to work on separate parts of text and then to put the parts together" (Hartley and Branthwaite, 1989, p.436, and Table 7). Hartley and Branthwaite do not elaborate further on aspects of collaborative writing.

2.5.5. Cognitive and modelling approaches

Cognitive science contributes to CSCW through investigation of detailed hypotheses about the cognitive functioning of individuals in groups. In writing research, much effort has gone into charting the activity of writing from a cognitive perspective. Particularly notable has been the influence of Flower and Hayes' cognitive model of writing (for example, Hayes and Flower, 1980a, b). This identifies three 'major processes' in writing: planning, translating, and reviewing (1980a). The function of Planning is "to take information from the task environment and from long-term memory and to use it to set goals and to establish a writing plan to guide the production of a text that will meet those goals" (1980a, p.12), through the 'sub-processes' of generating, organising, and goal setting. Translation "acts under the guidance of the writing plan to produce language corresponding to information in the writer's memory", whereas Reviewing is to "improve the quality of text" through the sub-processes of reading and editing (these quotes, 1980a, p.12). The model based on these categories is presented as sufficient to describe the act of (single person) writing, with only "Minor variations in its simple control structure" (1980a, p.10) being required to cater for individual differences. The model therefore presents the writer as a decontextualised actor. This is possible despite it being 'tested' against a writing protocol, because the method applied demands the systematic exclusion of context for the sake of an underlying 'truth' (in the shape of a model): "The psychologist's task in analyzing a protocol is to take the incomplete record that the protocol provides together with his *[sic]* knowledge of the nature of the task and of human capabilities and to infer from these a model of the underlying psychological processes by which the subject performs the task" (1980a, p.9).

An interesting aspect of Hayes and Flower's model to this thesis, especially considering its influence on subsequent research on writing and on (single person) writing support systems, is its lack of treatment of any factors other than those deemed strictly task related. Although the 'task environment' is said to "include[ ] everything outside the writer's skin that influences the

performance of the task" (1980a, p.12), the manner in which this may take place is not discussed. Furthermore, in their subsequent paper this is severely restricted in the statement that "The relevant parts of the task environment [to the model] are assumed to be: (1) The rhetorical situation—that is, the specifications of topic and audience to which a writer must respond; and (2) The text which the writer has produced so far" (Hayes and Flower, 1980b, p.391). There is thus little scope in Hayes and Flower's model for considering potentially cognitive relevant factors such as effects of media (Sharples and Pemberton, 1988), let alone collaborative writing.

A different approach within cognitive science which does examine group work and which in those terms might have the potential to contribute to the study of collaborative writing, is distributed cognition (for example, Hutchins, 1990). Distributed cognition studies "the representation of knowledge both inside the heads of individuals and in the world; the propagation of knowledge between different individuals and artifacts; and the transformations which external structures undergo when operated on by individuals and artifacts"; the goal being obtaining "an understanding of how intelligence is manifested at the systems level" (both quotes Flor and Hutchins, 1991, p.272; references omitted). Field studies are used, as well as (semi)-experimental setups, and interaction between participants is one of the foci of the investigations. As such, distributed cognition has the potential to be considerably more appropriate for the study of collaborative writing than the more traditional cognitive approach exemplified by the Hayes and Flower studies reported above. In one of the distributed cognition studies which comes closer to collaborative writing than many others, Flor and Hutchins, 1991, apply a distributed cognition analysis to an experiment with a software development team. Their analysis, however, retains a narrow focus on task, as do other such studies. Distributed cognition thus has the potential to contribute to analysis of cognitive aspects of collaborative writing, but not necessarily contextual aspects.

2.5.6. Experiences of writing together

Phenomenology[8] is interesting to writing researchers for its focusing of attention on subjective experience. Such a focus also seems to have potential in informing the design of computer systems. In particular, Marton's call for phenomenographic inquiry (Marton, 1981)—related to phenomenology, but focusing on *descriptions* of experiences—would seem to have much to offer a study of the situated use of computers.

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[8] Phenomenology is the philosophical position that the significance of phenomena can only be comprehended subjectively, as we only have access to the world through experience. Central to phenomenology is some notion of 'essence', or 'pure experience' (Marton, 1981; Sharrock and Anderson, 1986). The term phenomenology also refers to the corresponding methodology for investigations of phenomena of experience.

It is interesting to note that few of the references in this area are from CSCW. Phenomenological writing research, however, has two proponents in Chandler and Rimmershaw. Chandler's thesis includes a survey where perceptions of academic writing, including practises in light of the environment of the writers, are addressed (Chandler, 1992). He presents a survey of mainly single person writing among 107 academics at a university in the UK, addressing experiences of writing, but not with respect to collaborative writing. On patterns of coauthoring among respondents from different subject backgrounds, a statistically significant difference between the prevalence of coauthoring in arts and sciences was found. Rimmershaw, 1992, presents interviews with collaborative authors and their experiences of writing together.

2.6. Computer systems to support collaborative writing

2.6.1. Models in CSCWriting research

The use of models in CSCW system design generally is discussed in Robinson and Bannon, 1991. The traditional view of modelling as "merely description of an accepted reality, or an abstraction of it" is seen as a problem by Robinson and Bannon, who instead argue for a view of models as "interpretations, as constructions, which for some purposes, under certain conditions, used by certain people, in certain situations may be found useful, not true or false" (both quotes Robinson and Bannon, 1991, p.221). One example of such a 'traditional' view of modelling, is Hayes and Flower's influential model of the cognition of writing, discussed in section 2.5.5 above. This model, which represents writing strictly devoid of context, has influenced the design of single person writing systems. It is therefore interesting to examine whether this decontextualised notion of writing also has influenced the design of collaborative writing systems.

In the area of CSCW concerned with collaborative writing (CSCWriting, for short), an early indication that a distinction between discussion and annotation may not be useful for all coauthors (*cf.* Mhashi, Rada, Beck, Michailidis, and Zeb, 1992), prompted my interest in whether other such distinctions make sense to collaborating authors as users of computer systems, or whether inappropriate assumptions are finding their way into collaborative writing systems in the guise of reified 'models'. The modelling approach much in evidence in (single person) writing research could prove an enticing provider of apparently clear models, in particular for CSCWriting research based on a modelling tradition. The concern here is not with the appropriateness of such distinctions in the analysis of writing or collaborative writing as such, but, rather, with the possibility of under-critical assumptions about the relevance and direct applicability of distinctions derived for different analytic purposes to the actual situation(s)

of writing together. Important lessons can no doubt be learned from such basic research on the writing process; however, the different purposes of such work must be born in mind. For example, Flower and Hayes' influential cognitive model of writing (for example, Flower and Hayes, 1980), when directly used as the basis of a computer system, may encourage a rationalistic task-oriented approach which may prove unnecessarily restrictive to users if the context for their particular work is forgotten. This is, they were looking for analytically distinct categories of cognitive functioning in the writing task itself, and not, for example, how the work of writing is affected by, say, interruptions, the handling of which may be another potentially fertile area for innovative system design.

Three issues of particular interest in the modelling of collaborative writing in CSCWriting systems are, the notion of collaborative writing progressing through discernible stages or phases; coauthors occupying distinct roles; and the existence of distinct categories of strategies for writing together. The stance taken on all of these issues have direct consequences for the design of support systems, and are examined as part of the empirical studies in this thesis. Their treatment in the CSCWriting literature are discussed next.

Distinct phases

Hayes and Flower's model of the cognition of (single person) writing, discussed above, suggests distinct activities (planning, editing, revision, *etc.*) and that a writer can be observed to move between them; these have been the focus for much research on single person writing. However, does this approach scale up to the study of coauthoring? Does coauthoring proceed through 'stages' or 'phases' which it is meaningful to try to support? The hypertext[9] coauthoring system CoAUTHOR (Hahn, Jarke, Eherer, and Kreplin, 1991) is one of several systems which has a strong separation of idea generation from text writing. Here, despite "no rigid phase model [being] intended" (p. 81), strong assumptions of there being phases, and what they are, including the order in which work should be done, are evident:

> "The first phase of *idea processing* determines the issues (major topics) which have to be covered by the document. (...) This first phase is entirely dedicated to the *conceptual* level of the authoring process (what actually should be communicated in the text). During the second phase of *document design* a *formal* document structure has to be set up and associated with the conceptual items from the idea processing phase. In this round the physical organization of ideas in terms of their localization in a hypermedia document graph is fixed (...) Finally, during *document generation* ideas get implemented by appropriate hypermedia chunks." (Hahn, Jarke, Eherer, and Kreplin, 1991, pp. 80-81, orig. italics).

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[9] The discussion of CoAUTHOR assumes a sufficient overlap between the coauthoring research drawn on for hypertext coauthoring systems and for linear text coauthoring systems, that their conceptual basis with respect to perspectives on the coauthoring process can be taken to be the same, or very similar.

They later explain that this is not intended to be particular to collaborative writing: "So far, we have been concentrating on [aspects which] could have equally well been developed for a single-author application." (Hahn, Jarke, Eherer, and Kreplin, 1991, p.90). (One could speculate here whether the superficial similarity of the phases in CoAUTHOR to Hayes and Flowers' model of writing, at a different level of generality—Hayes and Flowers' basic cognitive processes have become document level coauthoring activities—could be taken to indicate the pervasiveness of that strictly task-oriented model in research on writing.)

Another interesting introduction of the notion of phases into collaborative writing is that of Kraut, Galegher, Fish, and Chalfonte, 1992. In presenting the experimental studies which are the focus of that paper, they summarise results of a previous interview study (Kraut, Galegher, and Egido, 1988) in which the "predictable phase structure" of scientific writing categories underlying the current experiments were derived. However, the applicable categories are given as "planning, drafting, and revision" (both quotes Kraut, Galegher, Fish, and Chalfonte, 1992, p.379), whereas the original paper apparently only has two categories for the corresponding notions, namely "planning" and "writing"[10]. (It should be noted that the focus of Kraut *et al.*'s 1992 paper is on media choice, in particular face-to-face interaction *vs.* mediated interaction, and not on phases of collaborative writing. However, their slip could inadvertently serve to reify to others the reasonableness of the notion of three such "phases", especially as they make extensive use of the three-phase notion in the paper. The work presented is partly structured round the notion of three such phases which follow each other in time.) A close reading of these two papers gives a consistent impression of variety in practices and intertwining of the timing of the activities classified in the 1992 paper as phases, while predictions of the analysts which depend on the phase structure model, several times fail to come to full fruition (see section 3.3.1). The 1992 paper includes a conclusion about "the difficulty of segmenting a project into stages characterized by more or less equivocality", and that "cleanly separating a planning stage from a writing stage is very difficult" (both quotes p.402). Such a conclusion would appear to be more consistent than the phase model with empirical work on collaborative writing, including that of their 1988 paper.

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[10] The 1988 paper describes the results of an interview study of 55 academics about their research collaboration with others (not just writing, but the whole process). One of three foci of interests is the work, relationships, obstacles, *etc.*, involved in the public presentation of their results. Each focus is divided into a "Relationship Level" and a "Task Level". In relation to public presentation, the sub-issues of "Division of Credit" (Relationship Level), "Planning", "Writing", and "Technology for Multiauthor Documents" (all three at the Task Level) are discussed. The word revision is hardly mentioned in the paper, instead, the section on "Writing" appears to include all aspects of putting words down. In contrast with a "phase structure" of the process, the 1988 paper pays much attention to variation, context, and contingencies, a position more congruent with the argument of this thesis.

Distinct roles

A second element of models of collaborative writing worth examining is that of member, or coauthor, roles. Roles have been extensively researched in sociology, where role theory became a substantial subdiscipline (*cf.* Biddle and Thomas, 1966). Group roles have also been a theme in CSCW research, where a notable example is the COSMOS project, which set out to address support for roles but found the task too complex to model in ways suitable for computer implementation (Lea, personal communication (ca.1990); also see Robinson and Bannon, 1991, for a critique of COSMOS and other role-based research). But do coauthors allocate responsibilities *pre hoc* and stick with those decisions so that choosing and enforcing 'roles' is useful?

The allocation of roles (and, the assumption is, following those roles) has been proposed in the CSCW writing literature as a technique writing groups use to coordinate their work; notably by Leland, Fish and Kraut (1988), who propose a role hierarchy ("Role Hierarchy: Reader<Commenter<Co-Author", p.209), according to which access permissions to the document can be allocated. Other calls for role support in collaborative writing come from Baecker, Nastos, Posner, and Mawby, 1993, and Neuwirth, Kaufer, Chandhok, and Morris, 1990. From the suggestions that roles be supported in collaborative writing systems, and discussions of how this can be done, one would get the impression that this is pivotal for how coauthoring groups coordinate work. However, there is little evidence that general roles as such exist as something coauthors orient to, which would seem necessary for computer support for roles to be a useful addition to the process. Neuwirth, Kaufer, Chandhok and Morris, 1990, take a more differentiated view than most in saying that "Despite potential problems, role specification is likely to be a useful strategy for managing some coordination problems; however, roles such as "co-author" and "commenter" substantially underspecify the activities involved in coordinating complex tasks such as collaborative writing" (p.185). Role definition is still, however, seen as properly the domain of computer support.

How notions of roles in the literature have been arrived at is worth a closer examination. To take one example, the coauthor roles arrived at in Posner, 1991, from interviews with coauthors, were derived from *post hoc* analysis of what activities the coauthors had spent most of their time on. This may be interesting in itself, but the roles were not necessarily what the coauthors themselves would have chosen at the time (indeed, the final role had changed from initial expectations in one of the cases), whereas explicit role support presumably would require coauthors to commit to roles early. (Premature definitions of roles is suggested as a potential problem by Neuwirth, Kaufer, Chandhok and Morris, 1990.) Despite the more nuanced approach of the investigations in Posner's 1991 work, however, a later paper, dealing more briefly with the issues, calls for the support of roles (Posner and Baecker, 1993).

In contrast, Thomas and Biddle, 1966, in a substantial volume devoted to role theory, review the wide range of definitions of role, and show the magnitude of the concept:

> "The concept of role is the central idea in the language of most role analysts but, ironically, there is probably more disagreement concerning this concept than there is for any other in role theory. (...)
>
> [I]t is possible to confine the definition of role to those behaviors associated with a position and that of position to those persons who exhibit a role. Such a set of definitions suggests the interrelationships between aggregates of persons whom we choose to differentiate and their characteristic behavior. But the definitions are too restrictive. As we have just seen, positions may be differentiated upon behavioral or nonbehavioral criteria, and significant portions of role analysis treat positions based upon physical characteristics, or accidents of birth. Similarly, the role concept has also been applied to behaviors not associated with positions. In addition, the definitions suggested by Linton commit us to considering only those roles that are collectively recognized. If we confine the concepts in these ways, the compass of role theory becomes too limited.
>
> The preference of the authors [of this book] is to define role in broader terms and thereby encompass the numerous and subtle ways in which persons may be associated with behaviors." (Thomas and Biddle, p.29)

The question of computer support for roles is therefore highly complex, and will be further discussed in relation to the empirical studies of the thesis.

Distinct strategies

Finally in this discussion of models of collaborative writing, in what sense do writing groups devise 'strategies'? Composition teachers have traditionally been interested in writing strategies to teach their students, and a search for strategies is in evidence not only in some of the research on single person writing (for example, Flower, 1989; Chandler, 1992), but also in some collaborative writing research. Despite proposals of collaborative writing strategies (for example, in Sharples, 1993a, who proposes 'parallel', 'sequential', and 'reciprocal' strategies), little empirical work has been conducted on how coauthors organise their work. Little is understood, for example, about how such strategies emerge, to what extent they may overlap, or the practical consequences of being involved in one style of work as opposed to another. In this thesis, the organisation of work among coauthors is examined in detailed empirical studies, resulting in a suggestion for an alternative approach to conceptualising writing strategies among coauthors (see chapter 8).

2.6.2. Implemented CSCWriting systems

Over the past few years there has been a rapid growth in the number of prototype collaborative writing tools. Early ones include Quilt (Leland, Fish, and Kraut, 1988), a system which, among other features, supported notions of social roles and allowed access permissions to be attached

to those, and Grove (Ellis, Gibbs, and Rein, 1988). Hypermedia coauthoring tools include CoAUTHOR (Hahn, Jarke, Eherer, and Kreplin, 1991) and SEPIA (Streitz, Haake, Hannemann, Lemke, Shuler, Schütt, and Thüring, 1992). Some are designed to support writing together both at the same time and at different times, for example SASSE (Baecker, Nastos, Posner, and Mawby, 1993). Few are designed for distributed coauthoring, an exception being MESSIE (Sasse, Chuang, and Handley, 1993). Further systems are surveyed for example in Posner and Baecker, 1993, who survey a number of such tools and to what extent they support certain ways of working.

There is no evidence, however, of widespread use of special collaborative writing tools, except among those close to the development teams. Instead, face-to-face meetings, conventional workstation and printing technology, telephone, facsimile (fax), and post appear to be the means by which information is exchanged and activities managed. This is consistent with a general concern, for example with Grudin, 1988, and Kling, 1991, that the use of CSCW tools has not proliferated at a rate corresponding to the increasingly sophisticated range of systems available. This, which is seen as a problem by many in the CSCW community, was initially attributed to factors relating to the difficulty of designing and evaluating such systems, and a disparity between those who use and those who benefit from them (Grudin, 1988). More recently, the problem has been attributed to a poor understanding of the way in which groups collaborate (Kraemer and Pinsonneault, 1990; Grudin, 1991).

Developing prototypes can certainly help identify and solve technical problems, and can be used in studies of how various features of the technology are received by users. This was an aim, for example, of ShrEdit (McGuffin and Olson, 1992). Little of the above development effort, however, has addressed certain fundamental questions such as how coauthors actually organise their work, or whether this technology will fit in with a work environment in which writing is only one of many tasks. There is some work within CSCWriting research which addresses a wider range of issues. For example, the PREP system (Neuwirth, Kaufer, Chandhok, and Morris, 1990) is built on findings in the literature, and its developers were early to call for support for social aspects of collaborative writing relationships, while acknowledging our poor understanding of these (Neuwirth, Kaufer, Chandhok, and Morris, 1990). In PREP, this has been started to be addressed through the provision of possibilities for communicating about comments, roles and plans.

2.7. Some research issues

The major concern above is that unhelpful assumptions about coauthoring may become reified and find their way into system design, repeating the problem identified by Tatar, Foster and Bobrow, 1991: in examining reasons for failures of the COGNOTER system, Tatar *et al.* found

that incorrect assumptions about human communication had become enshrined in the design. They concluded that "In a field that is as new and as complex as computer-supported cooperative work, [...] highly directed studies need to be augmented by other approaches such as undirected observation" (Tatar, Foster, and Bobrow, 1991, p. 207).

This thesis is an attempt at just such an augmenting of directed studies. To frame the research, a set of questions considered particularly important was devised. The following are some fundamental questions, the answers to which, if they were possible to find, would help in designing systems for CSCW writing tools.

1. "What kinds of factors (tools, situations, *etc.*) affect the performance of writing groups?" The aim is to establish factors which are relevant and factors which are not. This is the paramount question which forms the basis of my investigations, and which encompasses all the other issues. More specifically, "What are factors which facilitate and constrain successful collaborative authoring?" Understanding the tools and situations which may have positive and negative effects on the success of collaborative writing is highly relevant to understanding what kind of support from a computer system would be most appropriate.

2. "What are appropriate methods for describing/analysing collaborative writing?" No single methodology emerges from the literature as particularly appropriate for studying computer support for collaborative writing. An important part of this thesis is therefore to identify a suitable method for the kinds of questions asked here.

3. "How can the success of a collaborative authoring task be assessed?" This is a sub-issue of what the appropriate methods might be, but also relates to the first point inasmuch as the notion of success cannot be expected to be independent of an assessment of performance.

4. "How do writers perceive the task of collaborative authoring?"

These were the starting points for the studies described in subsequent chapters. However, none of them are simple, and as the research progressed, the list of questions was significantly changed (first, into a framework of five focus areas (chapter 4); then, in chapter 6, into three basic research questions derived from the studies). These remain, however, underlying concerns motivating the work of the thesis.

2.8. Summary of chapter 2

This chapter has given the background to the work described in subsequent chapters, by discussing some central concepts, surveying literature from relevant areas, and presenting the key issues addressed in the thesis.

There is a growing literature on collaborative writing, but computer support for the process is still in its early stages and many questions remain unanswered. Some basic questions about how people work together when writing, in particular when writing over distance, remain unanswered. Few longitudinal studies of collaborative writing exist. The potentially important area of context and dynamics of writing groups is beginning to be researched in the collaborative writing literature, but little of this interest has yet been carried across to CSCWriting.

The next chapter, chapter 3, discusses methodological approaches of relevance to the empirical studies in this thesis.

CHAPTER 3. METHOD

3.1. Introduction

As stated in chapter 2, the aim of the thesis is to contribute to the design of good collaborative writing systems by encouraging an approach to their design and development which takes into consideration existing work in the social sciences, as well as understanding from studies of use of existing technologies. In this chapter, the methodological approach taken in the thesis is discussed, in terms of how to elicit the kinds of data sought on the work of coauthors (see chapter 2).

Two major approaches to qualitative studies in sociology which have contributed significantly to the main empirical work of this thesis are introduced, with particular attention to their strengths and weaknesses for my purposes. Methodological constraints and challenges for the work reported on in this thesis are discussed, and the evolutionary approach to empirical method is introduced, showing how shortcomings in the preliminary studies (chapter 4) and survey (chapter 5) lead to the kind of qualitative study which is the empirical focus of the thesis (chapters 6 and 7). The detailed argument and the specific methods are found in the respective chapters.

3.2. Looking at the whole project

A common problem in social research is the trade-off between studying small items of data from a large number of people on the one hand, and more detail from a smaller number of cases on the other. This thesis to some extent follows the precedence of Lunsford and Ede (1990) in attempting to combine both, though it is primarily an exploratory study of how a few people go about collaborating with their colleagues over writing. A relatively high level of abstraction has been chosen, in the focus on an overview over a whole "project" (Strauss, 1985) of writing, which can take weeks or months, as opposed to smaller tasks within the project.

Experiential data in its purest form, *i.e.* the recounting of one's own experience, is not a central part of this study. As a researcher I am, of course, influenced by my own experiences, and

these have served to identify areas of interest. There has, however, been a deliberate attempt to capture study-participants' experiences of collaborative writing. This is not only generally or theoretically interesting, but has a particular contribution to make and direct relevance to computer systems design. This is because when the system is being used in the future, in many situations the experience of the user in each situation will determine the action they take and their perception of, and satisfaction with, the system.

This thesis mainly makes use of naturalistic observational data, and elicits some experiential (second order; see below) data. No experimental studies have been carried out for this thesis.

3.3. How can distributed collaboration in writing groups be studied?

In chapter 2, alternative conceptualisations of collaboration, authoring, and distance were discussed (sections 2.4.1-3). This section addresses the question of how these can be studied. Underpinning the discussion is a search for an approach to exploring the situated nature of activity which will identify aspects of relevance to CSCW system design.

Studying groups of people is different from studying a single person in several respects.

First, because of the increased number of people involved, with a larger number of combinations of individual preferences, personalities, *etc.*, there is arguable a different order of complexity in the situation under scrutiny.

Second, observing people working together has the advantage that some aspects of their work are articulated as a natural part of their work. This has been an important point for researchers into collaborative writing who are concerned with the cognitive processes involved, such as Wood, 1992, and Plowman, 1991. One can guess that the communication between the participants in some respects must become more explicit when the participants are in different places. Because they have to use a mediating technology, their efforts to communicate may become more visible to the researcher.

Third, there is much less in the way of established methods of observation or analysis of gathered data. Experimental methods exist, in which, typically, different groups are being compared with each other with respect to responses to a particular difference in their environment (namely, the experimental condition being varied by the experimenter). However, few methods based on either observational or experiential data exist for studying groups, with the exception of Grounded Theory and ethnomethodology, both discussed below, and distributed cognition (reviewed in chapter 2).

Experimental methods are highly appropriate to evaluate the validity of clear and limited hypotheses stated in testable terms, but not for exploratory research, such as that reported on in this thesis. Other methods are therefore more appropriate. Exploratory methods include those using what Marton has termed first- and second order perspectives (Marton, 1981). The first order perspective is the description of various aspects of the world, which is what much research is about. From a second order perspective, the focus is on the description of *experience* of aspects of the world. Marton sees these as complementary, but argues for an increase in the amount of research from the second order perspective. The best understanding of people's experiences can probably be gained through qualitative methods, such as participant-observation or interviews. This has the significant advantage of addressing in depth the situation in which the task takes place. However, such an approach has limitations. The results cannot readily be quantified, thus making it more difficult to use as a basis for generalisations. It can also be a time consuming way of gathering data. Qualitative methods typically gain data from a small number of people, which brings the problem that they may not be representative, or exhibit the range of styles and approaches to collaborative writing used by all collaborative writers. This may be a particular problem when the ultimate aim of a study is to serve as the basis for predictions on the behaviour of others in similar situations, as is the case with research for computer system design where the ultimate purpose is to make reasonable predictions about the behaviours, needs, *etc.*, of future users. There are also limitations inherent in the use of questionnaires (see Hartley and Branthwaite, 1989, for a discussion of these). The most appropriate method for gaining an overall view may not be one or the other, but a combination of the two, both for studying writing (Hartley and Branthwaite, 1989) and in the design of computer systems (Wright and Monk, 1991).

3.3.1. Quantitative and experimental methods

Quantitative methods, roughly speaking, are those based on the counting of instances of some event or condition, as is commonly done in the statistical analysis of surveys. They have the advantage of summarising large amounts of data; typically small items of data, defined in advance as precisely as possible, from a large number of instances. Quantitative data can be easy to compare and check, and results are often considered more reliable than those arrived at by qualitative methods. The ideal is one of measuring, objectively and without interpretation, instances of pre-existing and well-defined categories. This depends on the assumptions that definitions and categories are precise and unambiguous, and that data is available and accurate. Interpretations and rationalisations are, however, often an inherent part of quantitative methods as well, and may be made without being evident in the final presentation of results.

Quantitative methods require prior categorisation of instances so that they can be counted. In the relatively new field of collaborative writing, few studies have yet been conducted, and the

question of what kinds of categories might be appropriate for quantitative investigations is totally open. As indicated above (see chapter 2), the tradition of studying writers is primarily one following the experimental paradigm of controlled studies and/or measuring pre-categorised attributes. Such approaches have arguably also been the dominant ones in research in CSCW on the process of collaborative writing. One such study is that of Kraut, Galegher, Fish, and Chalfonte, 1992, who set out to examine media choice in scientific collaborative writing (see section 2.6.1). In particular, they examine two hypotheses arrived at by applying 'Contingency Theory' to collaborative writing, namely whether "as the equivocality of the writing task increases, communication modalities that support rich communication are more likely to be used", and whether "if these modalities are used, equivocal tasks can be carried out with greater ease and better results" (p.375). The three experimental studies they present address aspects of media use and collaborative writing. As discussed above, these studies were based on a categorisation of scientific writing into three distinct "phases", for which the empirical basis appears to be weak (see section 2.6.1). Furthermore, based on the assumption of a causal relationship between planning and writing, Kraut, Galegher, Fish, and Chalfonte made assumptions about other aspects of the process of coauthoring which they endeavoured to test experimentally: "planning a manuscript or its revision is highly equivocal (i.e., ambiguous as to a correct solution), whereas other tasks, such as drafting or revision itself, are less so because they involve enacting solutions in accord with previously (even if temporarily) established plans and goals." (p.378). Not surprisingly, perhaps, the conclusiveness of their results are limited.

Underpinning Kraut, Galegher, Fish, and Chalfonte's assumption of the lesser equivocality of the writing task than of planning, is a notion of the status of plans in relation to action, as well as a notion of a 'correct' solution existing (in general or in the minds of the coauthors) which is disputed elsewhere in this thesis. These matters aside, the work is an example of the weakness of experimental approaches for exploratory research: experimental approaches necessarily require advance assumptions to be made about the nature of the activity, and they are sensitive to the fit of those distinctions to the phenomena. At the same time, this is not made explicit, nor is the approach flexible enough to adapt once problems arise.

How appropriate, then, are such methods for getting data that can help system designers think about how to support the *organisation* of the work? In the work reported on in this thesis, that tradition was initially attempted by conducting a survey. There were problems with this survey resulting from it being intended as a pilot (for example, the small number of respondents meant that only very limited use could be made of the power of statistical methods). The reason for abandoning the original plan of following it up with a larger survey, is, however, worth noting; namely that it was clear that such a survey could not provide the *kinds* of answers sought. Despite asking a range of questions on various aspects of writing together, answers could only

provide a static view over a whole process, as seen by the respondent at the time. No indications of how those views emerged could be obtained.

3.3.2. Qualitative and ethnographic methods

Qualitative methods, in contrast to quantitative or experimental methods, typically examine fewer cases in more detail, going deeper into a topic, or covering it more broadly. Several hold as an ideal that no preconceptions (or as few as possible) should be held by the researcher about the object of the enquiry. To what extent this is possible in practice, is an important question—it is hard to imagine that a researcher, in choosing a particular line of enquiry, would have had no expectations to the *kinds* of issues that are likely to emerge, and these cannot easily be left behind when embarking on the empirical work. Furthermore, it may be necessary or useful to have some focus (or foci) for an enquiry—even one which is allowed to change—to maintain some bounds on the investigation. Many writers on qualitative research are aware of these problems, to the extent that systematic techniques for the researcher to distance him- or herself, and to derive an appropriate focus for the investigation have been incorporated into Grounded Theory (see below).

To the extent that qualitative, or ethnographic, methods do not require prior commitment to set beliefs about the world, they are highly appropriate for exploratory studies, such as the one in this thesis. For system design purposes, their strength lies not only in the amount of detail about situations of use that such methods can produce, but in their ability to come up with issues not anticipated in advance (Bentley, Hughes, Randall, Rodden, Sawyer, Shapiro, and Sommerville, 1992).[11]

The distinction between the terms 'qualitative' and 'ethnographic' is not always clear. They overlap in that all ethnographic research is probably qualitative, but not *vice versa*. Preferences for one over the other appear to stem from historical background; the empirical approaches advocated are not necessarily distinct (though they may be). Thus, the term 'qualitative' contrasts more vividly with 'quantitative', *i.e.* disciplines based on experimentation and measurement, whereas 'ethnography' evokes an anthropological tradition of studying ethnic groups—a tradition of conducting field work in the location of the groups themselves. For the purposes of this thesis the two terms are treated as roughly synonymous.

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[11] This could potentially be a mixed blessing to system developers. How does one determine what is salient? And how much richness, *i.e.* complexity, can designers take in? Also, at what point does one decide to stop looking for new issues and start on the design? Interestingly, some ethnographers in CSCW have started considering how they can take the results of their work further across towards what system designers need for their work (*cf.* COMIC workshop, University of Lancaster, 25-27 May 1994). The issue of how much 'context' to include in such studies is further discussed in chapter 9.

Two methods based on ethnographic, or qualitative, enquiry, are ethnomethodology and Grounded Theory. Ethnomethodology's strong commitment to the data and to the dialogical relationship between the ethnographer and the evolving enquiry, and Grounded Theory's commitment to any theory being firmly grounded in data, are factors which have had a substantial influence on the enquiry of this thesis. These approaches are presented in the next two sections. Reasons why neither was wholly appropriate for the purposes of this thesis are discussed in section 3.3.5.

3.3.3. Ethnomethodology

Ethnomethodology is a particular kind of ethnography, with specific philosophical commitments which sets it out as a radical contrast to other, theory-oriented social science. Shapiro, 1994, contains the following succinct ("absurdly simplified", in his words) account of the project of ethnomethodology:

> "[M]ost mainstream social science sees itself as proceeding theoretically — that is, by proposing concepts and logical relations between them which abstract successfully from the state of things in the real world and help to explain them. Ethnomethodologists (in the wake of phenomenologists) claim that attempts to do this fail for a variety of reasons. One is that the theoretical approach has to assume that the social order is an external 'given' which people 'enact' (...). Yet attempts to explore this (...) reveal that people in fact construct their social order in radically creative ways in the very process of acting together. Because of this, attempts by 'conventional' social science to explore the empirical implications of theoretical accounts fall down(...). They therefore do not exhibit the constancy and stability that is required for them to be investigated (e.g., measured) in ways consistent with the theoretical approach." (Shapiro, 1994, p.418).

Ethnomethodology instead sees as its project to make evident how "that readily recognized, commonplace orderliness [which anyone who inhabits the daily round might identify] is produced and recognized". Further, rather than being concerned with what connections data might show, as theory building does, "it wants to ask by what procedures the data was put together in the first place". (Both quotes from Sharrock and Anderson's (1986) introductory text on ethnomethodology, p.113.) Ethnomethodology emphasises the intersubjective nature of any descriptions and making visible the work of the researcher herself in constructing the description (Sharrock and Anderson, 1986; Cooper, Hine, Low, and Woolgar, 1993).

In practice, its practitioners in CSCW embark on detailed and long-term field studies to understand the work they are studying. The emphasis on rendering visible the work of maintaining orderliness has produced notable insights such as Heath and Luff's study (for example, 1992) of controllers at the London Underground, in which they demonstrate how the controllers tailor their work activity to the needs of their colleagues, by making parts which are relevant to others visible to them, and by monitoring others' activities. Hughes, Randall, and

Shapiro, 1992, report on a project in which an (ethnomethodological) ethnography was conducted of air traffic control. The understanding gained of how that work is socially constructed, was used to inform the design of a prototype system to computer-implement an aspect of the work done on and with pieces of paper (the use of 'flight strips'). This (apparently close) collaboration between ethnographers and system designers did sensitise the designers to issues otherwise not thought of, but did not provide specific design issues (Bentley, Hughes, Randall, Rodden, Sawyer, Shapiro, and Sommerville, 1992).

Such an approach has the potential to be of great help in addressing the question of this thesis, of what work coauthors have to do in order to achieve working together when in different places. For example, ethnomethodology's strong stance on sensemaking as being fundamentally indexical (Sharrock and Anderson, 1986, Suchman, 1987, Shapiro, 1994)—expressed in Shapiro, 1994, as the contention that "Indexicality is the triumph rather than the shame of everyday language [and interactions]" (p.418), and in Suchman, 1987, and Agre, 1988, as the situated nature of action and the non-determining relationship of plans to action—leads to the question of what role indexicality plays in the co-ordination of work projects. Is it the case that a corresponding significance can be attached to the indexicality/situatedness of the ongoing co-ordination of larger projects?

Such questions, inspired by ethnomethodology, are drawn on in the empirical work of this thesis.

3.3.4. Grounded Theory

Grounded Theory (Strauss, 1987; Strauss and Corbin, 1990) is an approach to qualitative sociological enquiry, which, in contrast with ethnomethodology, is committed to building theory. It does see itself as proceeding theoretically, and aims to propose concepts and relations between them which abstract from the world (*cf.* Shapiro, 1994, cited above). However, central to Grounded Theory is, as the name suggests, that theory building has to be grounded in data. The theories arrived at are not abstract hypotheses validated by testing, but rather are built bottom up from concepts present in the rich data from field studies: from the data, which typically consists of observations of how people carry out work, interviews, *etc.*, concepts central to the work being done are elicited which are gradually condensed into a theory in a bottom-up way (*i.e.* from the concrete specifics of the data towards more abstract concepts). The importance of a close 'fit' with the observed phenomena is emphasised and the method comprises a number of techniques for ensuring this is achieved, or for detecting when this is not the case. Throughout the analysis, Grounded Theory emphasises interaction between analysis and further data gathering. Various techniques are suggested for ensuring the robustness of the resulting theory, such as particular questions to be asked of the data. Initially, this would be

"what is the work being done?". As the concepts are developed, techniques such as looking for variation and expressing this in terms of dimensions, are used to ensure the broadness of the concepts and thus the robustness of the resulting theory.

These techniques lead to a process of analysis for which the tools are specified in advance, resulting in an analysis which is arguably much more structured in Grounded Theory than for, say, ethnomethodological ethnography. However, throughout his introductory book, Strauss (1987) stresses the importance of creativity in how these analytic tools are used. In this light, the ethnographic methods advocated for data gathering are in practice not necessarily disjoint with those of ethnomethodology. The fundamental approaches, however, in particular the position of the researcher in relation to the phenomena investigated and, as pointed out above, the stances on theory building, remain fundamentally incompatible in the two methodologies, a fact reflected in the different methods of analysis advocated.

An advantage of Grounded Theory in CSCW research is precisely the construction of central concepts which have been thoroughly explored in relation to data. Such concepts, once established, can arguably more readily provide input into the design process than ethnomethodology's lengthy and detailed reports. However, ethnomethodology's strong stance on the status of descriptions as constructed accounts of a subjective reality, alerts us to the problem of any such concepts being used as the basis for system design. Robinson and Bannon, 1991, discuss how the meaning of data shifts as its interpretation becomes reified, or frozen as description rather than interpretation, through further and further removal from its original context (p.228). Pidgeon, Turner, and Blockley, 1991, arguably go further than Strauss in explicitly recognising how, as all descriptions are subjective constructs, any Grounded Theory is also no more than that. However, the method remains in essence oriented towards producing decontextualised abstractions as can be seen in Pigeon *et al.*'s advocation of such abstractions being applied to the construction of expert system knowledge bases. A wholly unproblematic contribution of Grounded Theory to the study of work is its suggestion of specific techniques which alert the ethnographer to a broader range of perspectives on the situation. This can help the researcher deepen her understanding of the phenomena, even if the subsequent structured analysis is not desired. Thus, many of the methodological concepts and questions of Grounded Theory are likely to be highly useful resources in any ethnography.

3.3.5. Limitations of ethnomethodology and Grounded Theory for thesis purposes

For the qualitative analysis sought for the empirical work of this thesis, there is little doubt that some kind of ethnographic approach was needed. Grounded Theory and ethnomethodology each have considerable strengths. They both value rendering visible the process of arriving at

interpretations, though they differ substantially on what that means in practice (*cf.* Pidgeon, Turner, and Blockley's (1991) double-checking their systems of concepts with the interviewees, *vs.* Cooper, Hine, Low, and Woolgar's (1993) active involvement in the work of the participants and the converse involvement of the participants in shaping the enquiry). Ethnomethodology's strong commitment to the data and to the dialogical relationship between the ethnographer and the evolving enquiry, and Grounded Theory's commitment to any theory being firmly grounded in data, are all factors which have influenced the enquiry of this thesis.

Both approaches, however, have shortcomings, and neither is perfectly suited for the thesis enquiry as it is. Grounded Theory as a method has been applied mainly to work which is much more routine in character than academic collaborative writing. To a large extent the method relies on this, in the way it calls for the researcher to keep going back to observe the same situation after some conceptual work has been done (Strauss, 1987). An example is in developing dimensions for concepts, where Grounded Theory asks the researcher to be looking for variation including ways in which the concept being investigated varies or could have varied (including how it might vary under different conditions). This is based on the examining of recurring situations, which requires that "this is the same situation again" can be identified. In the books introducing Grounded Theory (Strauss, 1987, Strauss and Corbin, 1990), the examples given, from Strauss' and others' work, are routine work in which this seems to make sense (for example, in an Intensive Care unit at a hospital, *each time* a new patient is admitted, certain types of action by the staff can be observed, though at times the routine is broken). In my own analysis of case study data (see chapters 6 and 7), I made considerable use of Grounded Theory's techniques for asking questions of the data early on, but encountered problems at the point where Grounded Theory advocates distilling recurring concepts into more abstract forms. My interaction with the data threw up more diversity than recurrence, and appeared to demand more attention to be paid to the unpredictable influence of contextual factors (and how the participants themselves dealt with them) rather than analytical abstractions across a number of situations. (I chose to follow what my data appeared to demand, and abandoned applying Grounded Theory as I had understood it[12].)

Ethnomethodology's central philosophical point, the impossibility of building theory, makes little contribution to the practical problems of building computer systems, which, as discussed in chapter 2, is fundamentally a process of (attempted) anticipation of people's future actions and motives, and as such requires prediction. Shapiro, 1994, points to a number of problems with

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[12] It is conceivable that my problems stemmed in part from my lack of exposure to the practice of applying the methods of Grounded Theory to data. Strauss (1987, and personal communication) advocates groups of researchers supporting each other in the analysis of data, and Pidgeon, Turner, and Blockley, 1991, explicitly recommend training in Grounded Theory before attempting to apply it. My experience is at least an indication that reading completed analyses and the introductory books, clear as they may appear, may not be sufficient training.

the use of ethnomethodology to inform system design, and calls for hybrid methods to be developed which are not pure ethnomethodology, but in which ethnographers themselves get involved in the design process. One possible approach—an extension of the dialogical relationship between the ethnographer and the ethnographed advanced by Cooper, Hine, Low, and Woolgar, 1993, and discussed in Hughes, Randall, and Shapiro, 1992—is a closer involvement of the ethnographer in the development of the computer system.

Thus, both Grounded Theory and ethnomethodology have important contributions to make, although neither as such is perfectly suited for the investigation in this thesis. This thesis draws on elements of both (arguably creating my own form of 'hybrid' method).

However, how valid is it to combine methods? Turning to collaborative writing in particular, as research on collaborative writing is still fairly sparse, the area of computer support for collaborative writing has seen relatively little in the way of establishing methods. We do not know that any particular approach is going to yield the most useful results. Research contributions from a range of fields should therefore be welcomed. Insights gained by such varied work can in the longer term contribute to a richer understanding of the field under scrutiny. They can also be immediately combined in individual studies or families of studies.

Research within the individual disciplines is not just valuable, but in a real sense fundamental, because expectations can be made of domain experts' familiarity with the methods and the underlying thinking. However, a cross-disciplinary understanding is essential to advances within CSCW, because CSCW is itself a cross-disciplinary field. Whereas it may be beneficial to achieve some of this through *post hoc* combination of research results from within the individual disciplines, it is at least possible that a different kind of insight—and invaluable insight—may be obtained through research projects which themselves are interdisciplinary (Shapiro, 1994).

Cross-disciplinary research has often been conducted through the means of research groups or development teams consisting of specialists from different domains (for example, at the University of Lancaster, UK, where sociologists and computer scientists work together—*cf.* Bentley, Hughes, Randall, Rodden, Sawyer, Shapiro, and Sommerville, 1992). In the work described in this thesis a different approach was adopted, in which a single person has been responsible on her own for obtaining input from a variety of disciplines.

The work of this thesis is not part of a particular development effort, but rather, seeks to contribute to a more general understanding of collaborative writing and distributed work. In looking at the various ways in which ethnographic studies can contribute to system design, Hughes, King, Rodden, and Andersen, 1994, propose four uses of the method: ‘concurrent’, ‘quick and dirty’, and ‘evaluative’ ethnography, and 're-examination of previous studies'. The first three are uses in conjunction with the development or evaluation of a particular computer

system. The fourth implies the possibility of building up a corpus of case studies to be drawn on—with caveats—for a variety of development purposes; a perspective on the use of ethnography in system design which accords with the purposes of this thesis[13]. About such a use of ethnographic studies, Hughes *et al.* say: “The use of a range of studies also holds the promise of uncovering some properties that generally hold true and a common service should support. For this reason, we suggest that this use of ethnographic materials is especially useful where obtaining sight of general infrastructural CSCW principles is the prime goal.” They further say: “This is not a substitute for the more directed uses of ethnography when there are specific design issues to address but, depending on the design objectives, can perform a useful role in making designers aware of what to avoid and what the more specific issues might be.” (Both quotes Hughes, King, Rodden, and Andersen, 1994, p.436.)

3.3.6. The methodological challenge of studying distributed coauthoring groups

The question of what it means for a group to be distributed, discussed in section 2.4.3, has a parallel in the problem of how to study distributed groups: given that a researcher cannot be in different geographic locations at the same time, what are the methodological implications of studying distributed groups? At first sight, this appears to be a simple variation on the kinds of studies more commonly conducted. Looking closer, however, the implications for the methodologies discussed above are significant. If one were to use a team of ethnographers, perhaps one at each site, what would be the relative status of the different accounts arrived at by the researchers? To what extent could they readily be used as the bases for any comparison—explicit or implicit, through juxtaposition of accounts—between, for example, the cultures at the different sites? Neither ethnomethodology nor Grounded Theory addresses this problem, a problem with both practical and theoretical implications. To Grounded Theory, this might not be an insurmountable problem, as it aims to build theory which is abstracted from the situations described in such a way that any (or any of many) analyst would have arrived at the same. There is also some precedence for teams of researchers working together, though on the same site. Ethnomethodological ethnographers have not fully addressed the problem of being in several places at once, although it is a central methodological problem in the application of ethnographic methods to the study of distributed work groups[14]. Cooper, Hine, Low, and Woolgar (1993), in discussing their own experience of studying a group which communicated electronically, propose a version of ethnography in which the presence of the

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[13] I am grateful to Steve Viller for pointing this out to me.

[14] I am grateful to Yvonne Rogers for first pointing out this to me, and for providing a pointer to the work of Cooper et al.

researcher is less important than the researcher's questioning of this "virtual community". They further say that:

> "...whilst these issues are vividly highlighted in technological settings, they are not confined to them: for example, it could legitimately be argued that laboratory studies have consistently privileged face-to-face interaction in their quest to find out what is going on behind the cleaned-up facade of the scientific method as enshrined in research papers.
>
> In the sense that we give to the word, ethnography must therefore include questioning even those very tenets which would appear to be central to its rationale: in this case, that ethnography entails being present within a given community in order to observe what goes on: for 'presence', 'community' and 'observation' are all problematised." (pp.16-17; footnote omitted).

In the case of my studies, as a result of the groups studied being distributed, I did not have as much access to most of the group members as I would have wished for. A significant implication of this was, for example, that the aim of studying the individual group member's experiences separately became complicated, since in each case I had to rely on one group member as my main informer.

For coauthoring groups, an additional challenge to the researcher is the negotiated status of authorship, with the resulting ambiguity of group membership, discussed in chapter 2. When the two major survey studies in the area use different definitions of coauthoring, and their results differ sharply on the figures obtained for the prevalence of coauthoring (see section 2.5.2), it becomes clear that deciding where to draw the line (and, in the case of surveys, how this is conveyed to respondents) becomes a question with considerable methodological implications. Several researchers on collaborative writing note how different people than the official authors may be involved in the production of a document (for example, Kraut, Galegher and Egido, 1988; Reither and Vipond, 1989; Ede and Lunsford, 1990; Trimbur and Brown, 1992). For conducting case studies of collaborative writing, then, the researcher may have to deal with the problem of how broadly to cast her interest: with so many potential collaborators, who does one follow?[15]

3.4. Methods of investigation in the thesis

In summary, the research agenda of the thesis can be characterised in terms of the following constraints:

First, 'fuzzy', ill defined, often subjective concepts would be included in the analysis, such as the wider context in which writing takes place (*cf.* Odell, 1985), the dynamics of the ongoing activity

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[15] Parallel problems also exist in research projects in other areas (Viller, personal communication, 1994, and Plowman, 1994).

(*cf.* Agre, 1988), and the work involved in the division of labour (*cf.* Strauss, 1985). Further, I did not wish to forsake a subjective viewpoint for (some idealised notion of) objectivity. Goguen contends that "it may be necessary to abandon, or at least dilute, the notion of "objectivity" in order to properly handle situated information" (Goguen, 1992, 1st page).

Second, collaborative writing should be studied situated in its natural context. A bottom up understanding of the process(es) of collaborative writing, *i.e.* grounded in data on people's experiences (*cf.* Strauss, 1987, and Shapiro, 1994), helps ensure that subsequent theory building is ultimately grounded in empirical data. Furthermore, if the writing groups' context is as similar as possible to the ones in which future systems are expected to be used (*i.e.* the workplaces; in this case academic workplaces), this would make it more likely that theory would be relevant to future use situations, and hence, this thesis argues, to system design. In contrast, experimental studies cannot address the contingent nature of work as it takes place; experiments are *designed* to exclude contingencies. This is the very purpose of prototypical experimental manipulation of conditions. Dealing with contingencies, however, is very much part of people's ordinary everyday activity. How some people—coauthors—do this for one kind of work they do, is the focus of this thesis. Hence, explorations that enable us to understand these processes better according to the purposes of this thesis, start with making observations of work as it takes place in its 'natural' setting (*i.e.* not in a laboratory or under experimental conditions). The analysis should produce insights which would contribute to improving our understanding of the area.

Third, the exploratory nature of this study meant that I initially wished to explore different viewpoints as provided by different approaches, or methods, to analysing the issues under scrutiny. The wish to retain a broad picture meant being open to a number of methods. Furthermore, an effect of the commitment to naturalistic setting was the gathering of large amounts of data, which could be analysed at different levels.

Finally, an aim was that the results which were most immediately relevant to system design should be provided in a form which would help their interpretation by system design practitioners.

The constraints above allow for a range of methodological perspectives. In the initial studies, different approaches were attempted until I arrived at a qualitative approach which seemed appropriate for the nature of the problem investigated in the thesis. It was this dialogical interaction with the evolving study (akin to Cooper, Hine, Low, and Woolgar's (1993) notion of "ethnography as dialogue") which lead to the use of the somewhat disparate approaches for the different parts of the thesis investigation. These are introduced in section 3.4.2 below, and covered in detail in the respective chapters.

3.4.1. Which coauthors to study

Due to the great problems in defining the boundaries of collaborative writing, discussed in chapter 2, this thesis the view was taken that only writing projects that were undoubtedly collaborative would be considered in the empirical studies. This was turned into the condition that the participants' names all had to appear (or be intended to appear) on the final document as authors, and that all participants broadly agreed with each other on who were taking part[16].

Co-writing ranges from where people volunteer to write together, through to situations in which people are compelled (typically because of their jobs) to write together. In community writing groups people come together to support each others' writing in whatever ways they can, whereas in other kinds of groups there may be established rules for assignment of jobs (for example, between a commenter and an author).

This thesis studies collaborative writing among academics, focusing on how they organise their work. Academics are relatively free to choose who they collaborate with. In academic coauthoring, there is no generally applicable rule for which writing job(s) go with which position in an organisation. A research assistant may be seen as being in charge of the direction of a paper, while a coauthor more senior in position, may take a junior role in writing. It is generally up to each collection of would-be coauthors to arrive at a division of tasks. (An interesting point arises when the same group of people have written several papers together, an issue pursued in one of the case studies in chapters 6 and 7.) It is therefore interesting to study academic coauthors.

For the case studies, the logistics of obtaining access to groups to follow (observe) was a significant constraint. Thus, what had originally been envisaged as only an initial use of academic coauthors—my peers—as objects of observation, turned into the focus of the entire investigation when plans to study other, non-academic groups, fell through. This carries the problem of 'navel gazing', *i.e.* that the study is concerned with a work environment similar to my own, so I may be less aware of my own preconceptions and how they have affected the enquiry. On the other hand, my competence as a member of that community could also be seen as a resource. Such a dualism in carrying out fieldwork is not unique: Cooper, Hine, Low, and Woolgar, 1993, in a discussion of the need for the ethnographer to maintain some distance towards the phenomena under investigation, say: "In some ways the aspiration towards analytic scepticism is in tension with the ethnographer's attempts to become an accepted member of the setting, although the schizophrenic nature of his/her position can also be put to good use" (p.7).

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[16] Although, interestingly, in the observational studies, temporary departures from this were observed; a point which will be returned to in later chapters.

(On my part, a few iterations with the data were frequently necessary to realise I was taking for granted a phenomenon which should more usefully be questioned.)

As well as what method is used, it is also important how a method is employed with respect to the integrity of the people affected by the research, such as participants in the studies. In the work reported on in this thesis, the advance permission of participants was obtained for all recording, mechanical or otherwise. Care has been taken that possible clues to participants' identities are given only inasmuch as it is necessary for the points made, and not more than was agreed with the participants. Participants have been shown, and had the opportunity to comment on, at least one earlier write-up of the case studies for publication. (Ideally they would have been able to vet all such write-ups, including this thesis, but this proved impractical.)

3.4.2. Overview of thesis investigations

As discussed above, the methods used in this thesis have advantages and limitations. An emphasis on qualitative methods seems highly appropriate for exploratory investigations, such as that presented in this thesis. More equivocal, perhaps, is the benefit of combining methods, where one could argue that a spread of effort dilutes the generalisability of the results. However, an overview of the area is a prerequisite for deciding on where to focus the detailed studies which subsequently might feed into theory or system design.

With respect to generalisability, the present work is of limited value as it stands on its own. In particular, the case studies are concerned with three groups only, with the bulk of the data coming from one of them. In these terms the contribution lies in being part of a wider body of case study research on collaborative writing on the one hand, and on distributed collaboration on the other. As part of such a larger body of studies, the specific results obtained in these studies can gain generalisability.[17] Also, however, salient questions for system design are already raised by the present work. For a practical example of how such questions can contribute to CSCW, the survey results, while statistically unreliable due to the selection and number of respondents (see chapter 5), clearly indicate the *possibility* that a concept such as that of a (single) "group leader" is not relevant to how a proportion of group members orient to their group's organisation and functioning. In terms of system design, this renders problematic whether support for group work should be oriented towards differentiated "leader" and other member roles.

In this thesis, the investigation progressed through initial investigations leading to a five-point framework; the application of this framework in a survey and to an initial examination of three

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[17] An argument can be made that case studies provide for generalisations in their own right, *cf.* Adelman, Jenkins, and Kemmis, 1976.

case studies; a reevaluation of the appropriateness of the framework as the basis of an investigation of the issues of interest in this thesis; the formulation, in its place, of some basic research questions, and their application in a reexamination of the case studies; eventually leading to considerations for system design. More specifically:

In order to gain an initial sense of some of the issues involved, two smaller preliminary studies were conducted on a participant-observation basis. These were a group annotation exercise, in which members of a research group jointly commented on a book draft, and a series of semi-structured interviews with academics about their coauthoring experience. Both studies had significant elements of naturally occurring writing work, but they were not 'naturalistic' studies (see chapter 4 for more detail). From these preliminary studies, an initial framework of topics to focus subsequent studies on was developed. This framework formed the basis for an exploratory survey on "Non-task focused" aspects of collaborative writing (see chapter 5). The survey addressed academics who have written at least one document together with at least one other person, and asked questions on various aspects of the experience of writing collaboratively.

From the survey, a number of interesting issues were identified. These formed the basis of a another set of questions on which the main empirical investigation was based: the case studies.

For the fieldwork (chapters 6 and 7), an approach was adopted which was, essentially, a hybrid between ethnomethodological ethnography and grounded theory. Initially, it was attempted to apply the framework presented in chapter 4 to the case studies (chapter 6). However, as the cases were developing it was becoming increasingly difficult to follow the requirement of returning to similar situations, and to gain and keep the required overview over the data, in particular as there was the danger of missing out on any shift of focus of the participants during their writing project. Instead, I relaxed the requirement to stay focused on the early concepts, and adopted a more open approach to the data (chapter 7). In this way, the details of the questions asked were developed as the studies progressed, not only with respect to the actual questions I posed to participants, but also what the issues of interest to me more generally were. In that sense, the method eventually adopted was more akin to ethnomethodological ethnography, though it should be stressed that as I do not have the commitment to the central issues underlying ethnomethodology, this is not to be taken as any more than a statement that I have been influenced by what I have seen of the ethnomethodological approach, and a claim that this was useful for my purposes. The practical and theoretical problems discussed above when groups studied are distributed, required *ad hoc* solutions which do not necessarily belong to any particular methodological approach. Finally, from Grounded Theory was borrowed the notion of distilling concepts from the data, as a start towards building theory (chapter 8). Thus, a mixture of approaches is used.

3.5. Summary of chapter 3

This chapter has shown how some methods are appropriate for an investigation of the issues raised in chapter 1, and thrown more light on the issues which have not been sufficiently addressed in the literature, as shown in chapter 2. The primary investigations of the thesis are a survey and three case studies.

The methodology of the work reported on in this thesis has been one of starting from a general exploration of the area, moving towards developing specific questions. Subsequent studies have become more detailed in their exploration of what activities are involved in the work of writing together. An initial framework for the enquiry was based on the results of two preliminary studies. As a result of responses to a survey, that initial framework was found to be conceptually limited, and was subsequently developed through more detailed studies of collaborating authors writing together.

The next chapter, chapter 4, presents the preliminary studies and that initial framework.

CHAPTER 4. A SEARCH FOR STRUCTURE: PRELIMINARY INVESTIGATIONS

4.1. Introduction

This chapter presents two preliminary studies which, together with the survey in chapter 5, served to focus the direction of the main empirical work of the thesis, the field studies. The first of the preliminary studies was an exercise in the use of a particular technology for supporting a group's work of annotating a manuscript; the second was a series of semi-structured interviews with coauthors about their experiences of writing documents together with someone. On the basis of the issues arising from these preliminary studies, an initial framework of areas of concern was developed (section 4.4). This framework later formed the basis of the questions in the survey.

The preliminary studies are a first attempt at conceptualising the issues of interest, the resulting framework is very much part of the story of how this thesis came to gain the focus it has. (The framework was, as later became evident, itself to some extent an example of the kind of problem identified in chapter 2, in which a conceptualisation of collaboration is not sufficiently grounded in an appreciation of what people actually do when they work together.) Cooper, Hine, Low, and Woolgar, 1993, discuss how certain problems they encountered in carrying out one of their studies contributed to the progress of their research when taken as material for the investigation. Here, the researcher's problem rendered visible issues which the practitioners themselves had to deal with; in this case maintaining an overview over what people are doing when they are all separated in different offices and much of the communication took place by e-mail. Similarly, the evolution of the research project of this thesis, is itself a reflection of what coauthors themselves have to deal with in the situation.

For example, the problems of defining membership of a group discussed in chapter 2, may be a theoretical issue to the extent that whether or not a particular collection of people gets labelled a 'group' by an analyst may have no consequence for the people concerned. However, when examining what makes this concept hard to define, the implications for practices of collaborative writing, and for computer support, are substantial: in the first of the preliminary studies, I had a

considerable "problem" of deciding who, at any one point, was and who was not taking part (see below, in particular section 4.2.3). I gradually realised how sharply my concern to thus define the group contrasted with the other participants' apparent lack of concern about this (it was not mentioned). The lack of evidence in this study of what I had considered basic to working in any group—knowing exactly who one is working with—raised questions of what group membership is, how solid coauthoring group boundaries are, how they are set and maintained *etc.* These are issues which would have immediate and obvious consequences for computer system design. Furthermore, this raised the question of what other preconceptions I might have about working in a group. More generally, my significant problems with understanding the process(es) in terms of identifiable structures which can be abstracted away from the specific circumstances of each case, forces the question of whether the coauthors themselves make sense of the process in these terms, and if not, how they do. The reason for wanting to understand something about the process from their perspective, is to enable us to design computer systems which are seen as relevant to their work situation. There is no evidence that formulating general hypotheses about the ways in which collaborating authors are influenced by contextual (or non-task) factors in carrying out their work captures or reflects coauthors' perspective(s). The process is too complex to be adequately addressed in such a simplified way, and this is not necessarily how coauthors themselves make sense of it.

As a result of the studies described below and reflection over the problems encountered (and after discounting a different approach, described in chapter 5, of answering the problem), the issue of primary interest to me changed from one which can be characterised in terms of trying to answer the question "where is the structure in this?", to one which focuses on "If it is that hard for me as an observer to make sense of the complexity of the large number of contingencies there appears to be, *how do they themselves deal with it*?" This was an important refocusing of the thesis project, and one which took place gradually, as will become evident from chapters 4 to 7.

Thus, the resulting framework is interesting as it formed the basis for the subsequent survey, and as some of the issues identified at this early stage remained foci of interest in the case studies, though in a different form.

The study described in section 4.2 has previously been briefly discussed in Mhashi, Rada, Beck, Michailidis, and Zeb, 1992. The framework of section 4.4 is part of a technical report (Beck, 1991; appendix B.I).

4.2. Joint annotation of a book

This was a semi-structured group exercise I conducted in 1989/90[18], consisting of a group of around seven volunteers (fellow Ph.D. students, and myself) reading and commenting on a book draft. My aim was to gain an initial understanding of certain issues in collaborative writing (see below), while the author of the book, our supervisor, wanted comments on the draft. For my purposes it was important that the group would have a real task, *i.e.* one that had a purpose beyond that of my exercise. In that way commitment and effort could more readily be expected to reflect the dynamics of real groups, which I considered important inasmuch as little is understood about the dynamics of group work, save that it is a complex situation with many factors interacting with each other. The task in hand was genuine inasmuch as the author of the book wanted feedback on the book draft prior to its submission to publishers. I considered the task interesting and relevant to the thesis inasmuch as it appeared to represent a 'subset' of the complexity of a full collaborative writing project. As later became evident, however, many participants' motives for taking part were such that this study arguably became more of a set exercise than the real task envisaged (see below).

4.2.1. Design and participants

For my purposes, this was to be a study of 'informal' (later called 'non-task focused') aspects of the group's work. I was particularly interested in the choices made about face-to-face *vs.* computer-based communication, and how suited those would turn out to be for the annotation task. All participants were highly computer literate. Communication channels available were any or all of: face-to-face communication of various degrees of formality (for example, planned meetings between all or some participants; accidental or impromptu meetings; exchange of comments); unstructured electronic, asynchronous communication (e-mail); structured electronic, asynchronous communication (the HERD system; see below). No restrictions were set on how to conduct the task or what channels to use, and I attempted not to take part in or otherwise influence such decisions.

The book draft requiring comments was available to participants both online and as a printout. Feedback to the author could be provided any way which was convenient, including verbally, by notes in the margin of the printouts, or through online comments. For coordinating the work, and for monitoring progress, the group could make use of face-to-face meetings (we were all based in the same or close offices, though we were rarely all there at the same time), telephone, writing each other notes (paper or e-mail), or using a computer system called HERD

[18] At the time I was a student at the Dept. of Computer Science, University of Liverpool.

(Hypertext Environment for Reasoned Discourse), which was being developed by one of the participants in the study (M. Mhashi).

The HERD computer system was a re-implementation of a subset of a system called gIBIS. HERD provided for the creation of "nodes" (areas for writing text in) which a user could link to other nodes (a node could contain any amount of text). This created a hierarchy of nodes, which could be viewed through a simple graphical interface. The design of the system expected each link to be given a label which was to denote the relative status of the two nodes linked. Labels available were "issue", "position", and "argument"[19]. "Issues" were supposed to denote topics for discussion; "positions" were positions on the issue, typically in favour or against; "arguments" were supposed to be reasons for taking a particular position. Thus, the system aimed to capture a discussion and structure the presentation of the different viewpoints arising during its course. Participants were all competent users of the underlying operating system and of e-mail. However, their prior experience with and understanding of the HERD system ranged from none at all to extensive (the developer was one of the participants).

I asked for copies of all communication over e-mail and other media (for example, notes), and agreement was given by the participants, but little came from it. Only one note was submitted to me, reportedly because there was no more such communication because of lack of activity. At meetings I would take field notes. After the project, I conducted post-interviews with most of the participants. These were semi-structured, informal talks loosely based on a written set of questions centred on the interviewee's experience of taking part in the group on the one hand (including personal motivation for joining), and use of the computer system on the other.

4.2.2. The group's work

The group of annotators met regularly (once every week or two) over a period of 2-3 months. Initially, it was thought that each person would read and comment on parts of the book as and when it suited them. Participants faithfully turned up at the meetings; however, little progress was made in terms of gathering comments on the book. When the possibility of using the HERD system for the annotation task was raised, the group decided almost unanimously to use it. Meeting activity had been low; e-mail activity even lower, and the HERD system was seen by some participants as a solution to the problem of everyone having to be in the same place at the same time for meetings. After a couple of weeks of technical problems, HERD became ready to use. Its use was slow to take off, however, and I created a rudimental tree structure on HERD; one node for each chapter in the book, to facilitate participants contributing by making it unambiguous where comments on parts of the book should be posted. (It is worth noting that

[19] Note that the original IBIS system, as well as the later version with a graphical interface, gIBIS, both allowed many more "link types", or labels, to be used than did HERD.

although I had wanted to play a more 'backstage' role, I ended up facilitating much of the activity. At a later meeting where I said I did not want to do this, it was agreed to share the administrative responsibility.)

Contrary to expectations, meetings still took place as frequently as before HERD was used. A considerable amount of time was spent on the administration and facilitation of the group's work, in part because participants felt unsure about its purpose. A reorganisation then emerged from the group. Participants decided to work in a more synchronised way (such as read the same chapter at the same time) so that all would be discussing the same work, and that even if an individual had not had time to complete their work, some feedback would be obtained. At this point, considerable dissatisfaction with HERD had been expressed, in particular the long time taken to connect a new node, and the handling of concurrent requests to link nodes (HERD had no protection against the problem of 'lost updates'). Thus, the output from the group was still very low, with me posting by far the largest number of nodes. Gradually participants stopped taking part, and the project eventually ground to a complete halt in the face of me going away for a while.

4.2.3. Analysis and findings

In the end, a total of 56 nodes had been created on the HERD tree; 45 of which were concerned with the book (11 nodes had purely the function of organising the HERD tree). In addition, the post-interviews revealed that four participants had comments they had not entered into the HERD system. Reasons for this were given as the long time it took to create a node, and reluctance to express thoughts in writing.

It is interesting to note that it was not easy even for me, the participant-observer, to tell at any one point who was and who was not taking part. In the case of this exercise it was due to low level of activity and dwindling interest among the participants; however, as this is a question of prioritising one kind of work over another, one can imagine scenarios in which this could plausibly be the case in a real situation (for example, if annotators became engrossed in other work, perhaps because a deadline looms). Annotators, in the sense of people who are enlisted to provide feedback to the authors (but are themselves not the authors), may, as Reither and Vipond, 1989, argue, have an important role in the writing of academic publications, but almost inevitably their core interests will lie elsewhere, as they did for the participants in this study. Furthermore, if there are several annotators, it may be unclear to what extent a particular person's effort is required. For annotators, therefore, it is perhaps not surprising that it can be unclear who is involved at any one time. For coauthors themselves, however, we might expect the question of who is participating to be clear-cut. This point was raised in the subsequent survey, with interesting results (see chapter 5).

In the post-interviews, participants agreed that the exercise had not been a success. As for the reasons, very different ones were mentioned, ranging from personal animosity to the technical system problems. The main reasons for having wanted to take part in the exercise were either to help me, or to please the supervisor (the author of the book).

Our use of the particular computer system for annotation was later compared with another exercise in which the same system had been used for group discussion[20]; apparently with more success. In Mhashi, Rada, Beck, Zeb, and Michailidis, 1992, we discussed some characteristic differences between annotation and discussion which we thought might have contributed to this. One main point was the apparent problem, in annotation, of cumbersome reference because the comments could not refer to parts of a document without having to explain (verbalise, in a number of words) which parts are being referred to. This is apparently consistent with the thinking of the designers of a currently existing collaborative writing support system which explicitly supports annotation (Neuwirth, Kaufer, Chandhok, and Morris, 1990; see chapter 9).

4.2.4. Discussion

The most interesting specific result to come out of this study is perhaps the inescapable conclusion that introducing a technology in itself does not necessarily help a group which is struggling, at least when, as here, motivation (and time) were major problems. In particular, it is interesting to note the expectation that the computer technology, because it appeared to allow the same function of coordinating the work as the meetings were set up to do, would reduce or eliminate the need for those (face-to-face) meetings. Whereas one cannot discount the possibility that without the technology the number of meetings may have increased at that point, it is nevertheless interesting to note that contrary to the expectations of some group members, with the HERD system meetings were still held as frequently as before.

Methodologically, the study reveals some of the limitations of set-up studies to understand non-task focused aspects of collaborative work. The motivation of the participants was purely to help others (the author, in commenting on his manuscript, and me, in helping with my study). Doing the task required considerable amount of time and commitment over a long period, while it did not relate to what most participants saw as their work.

The conclusion for the thesis project was the need to study collaborative writing where participants' motivation to take part stems from their own interest in the work or its result. Consequently, the next study gathered data on groups who had gone ahead and written together for reasons unconnected with my studying them. This was a series of interviews with coauthors.

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[20] That comparison was joint work between M. Mhashi and myself.

4.3. Stories of writing in collaboration: semi-structured interviews

For the second preliminary study, I interviewed eleven academics about their experiences of writing together with others. The interviews were semi-structured, in that they were conducted around a list of questions, all of which were covered in each interview. The questions arose from the first preliminary study and my considering what informal, or non-task focused, aspects of the process of writing together might be which could influence the process. Most interviews lasted between one and a half and two hours. Interviewees were asked to draw on their general experience of collaborative writing for some of the questions, but discuss one particular project for others. Six of the interviewees had been taking part in writing a paper for which I was one of the coauthors. It was therefore partly a participant-observation exercise.

The purpose was to elicit some subjective experiences of collaborative writing. It was thought extremely important that the participants should feel able to talk about potentially sensitive issues such as conflicts between the coauthors, and also should feel welcome to raise issues outside the questions asked. Therefore, confidential, semi-structured, interviews were chosen[21].

4.3.1. Design and participants

For this study, I conducted interviews with eleven persons who had taken or who were taking part in writing a document together with at least one other person. All interviewees were academic researchers in the university department in which I work.

A set of open-ended questions was developed. Approximately fourteen questions were concerned with the interviewees' familiarity with and opinions about collaborative writing in general, and twenty-eight with their experiences of one particular instance of collaborative writing. The final list of questions can be found in appendix A.I (the list was slightly changed after the first interviews).

4.3.2. Data collection and analysis

Each interview lasted 1½ - 2 hours. Field notes were taken, and, in most cases, an audio record made. The analysis presented below is based on the field notes. Table 4–1 summarises some of the interview responses.

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[21] Responses may have been affected by my ambiguous status as a participant-observer.

Four interviewees were the only members from their writing group (interviewee number 3, 10, and 11 in the table); from one group (group A), two members were interviewed (1 and 2), and from group C, six members were interviewed (see table below). In group C, I was myself a participant. The interviews in group C allowed particular attention to be paid to indications of different perspectives on the same instance of collaborative working. The last two interviews, 10 and 11, went into considerably more detail about the respective projects than the others did, and in conducting them I followed up the evolving stories more than the prepared questionnaire. These were in effect small case studies, which allowed more of a history to be built up (for example, interview 10 consisted of two interviews on consecutive days, before and after the interviewee had engaged in a group writing exercise).

4.3.3. Findings and discussion

Some background from each of the interviews are summarised in table 4–1. The first column gives the number of the interview (and, hence, interviewee), the second shows which persons were members of the same group. The third column shows what response interviewees gave to the question of how many members were in their group. The fourth shows whether or not the group discussed in the interview was distributed over a number of sites, and if so, over how many sites. The fifth column shows, first, the number of other joint writing project the interviewee had been engaged in, then, if one or more, for each of them, it gives the size of that project in terms of number of participants, whether or not that project was distributed, and if so, how many sites the project was distributed over. The sixth column shows whether I was myself a member of the group. Finally, the seventh column shows points worth noting about that particular case.

Of the many issues raised in the eleven interviews, however, the discussion here will focus on a few topics of particular interest. These are the interviewees' perceptions of the function of plans, differences in perspective between coauthors in the same group, and differences in perspective over time for individual coauthors.

Alternative perspectives in the same group were in evidence in interviews number 4–9, who all belonged to the group labelled C in table 4–1. Note how, in column three of the table, different responses were given on the apparently straightforward question of how many members the group has. Whilst the reason for this disparity can be explained (in this case, that one person who had been a member of the research group when the paper was started, had left before the writing was finished), the point of interest is that such a situation can arise, and may be part of the ordinary workings of such groups.

Table 4-1. A summary of some of the interview responses.

(Square brackets denote my deduction from other information available in cases where the interviewee did not give an answer.)

Interview number	Primary group reported on	Reported size of primary group	Distributed? (yes/no) : no. of sites	No. of other joint writing proj's (size, distr?:number of sites)	Participant observation?	Comments
1	A	4	yes : 2	3 (? , yes : 3) (?, yes : 4) (?, no)	[no]	distance adds difficulty
2	A	4	? [2]	1 (2, no)	[no]	
3	B	2	yes : 2	1 (?, ?)	[no]	started as joke
4	C	7	[no]	1 (2, no?)	[yes]	other writing proj. is fiction
5	C	7	[no]	ca. 20	[yes]	
6	C	7 1/2	[no]	6 +	[yes]	
7	C	from 8 to 7	[no]	[0?]	[yes]	
8	C	[7]	[no]	1	[yes]	
9	C	[7 + 1/2]	[no]	12	[yes]	
10	D	5	[no]	?	[no]	interv. before and after
11	E	2	yes : 2	1 (at least)	[no]	group split (produced two documents)

On a different question, the members of group C also had differences of opinion worth noting. The question was "Do you feel anyone took the general lead?". Responses ranged from one interviewee's unequivocal 'No', through 'semi-led by [X]', to 'Yes, [X] did, quite clearly'[22]. [X] himself said 'Yes, I did'. These responses could be analysed in terms of clues the interviewees give to where such a difference of opinion comes from (for example, a follow-up question of how it became clear to them who took the lead, revealed differences of opinion of what constituted leadership). Again, however, the important point to note is simply the existence of such significant differences within this group, and that the group nevertheless did produce a paper as it had set out to do.

On the subject of following plans, there was apparently more agreement between the members of group C. Most mentioned plans being made and, to some extent, followed, but not fully. One said 'we seemed to be happy about deviating from the plan' (interviewee 9). Interviewee 3, however (group B), reported that they never made plans. Interviewee 2, of group A, a group which consisted of two persons in the UK and two in another country, responded that they had decided 'early' who would write each section, and had agreed in one month on a deadline two months later. Their work, however, progressed through him and his collaborator in the UK

[22] In this chapter, single quotes denote the gist of a statement (for example quotes from field notes); double quotes are literal quotes of statements made.

writing sections and sending them to the other two for feedback. This was confirmed by his collaborator, who was interviewee 1 in the study (see below for more detail on her perspective).

Changes over time in the perception of the writing project, were seen in interviews number 1, 6, 10, and 11. In the case of interviewee 1, this was due to problems arising with an important argument of their paper. She writes:

> *"Each site was supposed to produce one part of the paper, the relationship between the two parts should have been established by my site. This was agreed at a meeting when everybody was present. However, soon after that meeting it turned out that the expected relationship did not exist. [...] Some decision will have to be made concerning all partners: going back to the old definition (revising everything again) or keeping the revised version loosing (evtl.) one result."*

In interview 6, the interviewee provided the following potted summary of his changing approach to the task: at the start he said he felt like a spectator, detached. Around Christmas, he was concerned there was not sufficient productive output, which motivated him to 'get involved'. He reported that up to three weeks before the deadline, he felt there was 'no way' the document would be finished. A week before the deadline, he described being 'amazed it was going to work'. At the deadline, he thought it 'good'. At the time of the interview, however, he had 'more reservations about it again'.

Interviewee 10 was taking part in a single group writing session, in which the participants prepared for an exam by jointly answering a question in a previous year's exam. I conducted two interviews with this person; one before and one after the exercise. The difference in his concerns was striking, despite the two interviews being conducted on consecutive days. Prior to taking part in the writing exercise, he was primarily concerned with the group dynamics and the issues he expected to surface about his own role. He explicitly said he was more interested in those issues than the outcome of the writing itself. In the post-interview, while making some comments on this, his concern was now primarily with the task itself: about the short time they had to complete it.

The collaboration reported on by interviewee 11, broke down. Two persons were to have written a commissioned report together, but, after more than ten months of work, ended up submitting two separate reports. It started out well: 'We talked quite well about what was going to be in the report.' However, interviewee 11's account reveals a number of examples of her expectations of the writing process being violated. She was a professional writer, and was used to working to deadlines that were absolute. She expected a similar approach from her coauthor, an academic, but did not feel she got it: 'I was new to the academic life [...]. Where I came from, people do things straight away." On the other hand, her coauthor criticised her writing for not being academic enough, but, in her perception, was not willing to work with her to change it.

Mounting frustration ensued, and in the end their collaboration was terminated and they presented their work to the funding organisation as separate reports. Interviewee 11 says 'it was *not* a personality clash. Everything that went wrong was because of the writing itself.'

These examples further highlight how coauthors' perceptions of the task they are engaged in can differ. Views on what process they are engaged in cannot be taken as given even for an individual coauthor, but rather, are closely intertwined with the situation in which she at any point finds herself.

4.3.4. Discussion

This study was small, the interview style varied between interviews, and some of the interviews were participant-observation while others not. The results are not readily comparable and no claim is made to their general representativeness. However, the study is interesting inasmuch as it points to aspects of writing together which have received little attention in the literature, and which are potentially highly relevant to system design and to theories of collaborative writing. One example is the possibility that some co-writing groups may not have clearly defined membership, as seen in group C in the study, without this necessarily preventing the group's work (in this case of group C, the group completed the work successfully inasmuch as a joint paper was produced which was subsequently published). If this were to prove to be common, it would challenge implicit assumptions that 'the group' can be referred to as an entity whose boundaries are clearly defined to the participants.

The study, then, raised a number of questions of theoretical and practical interest to the study of collaborating authors. In particular, this study was a pointer to the existence of great variations in how coauthors see the process of coauthoring.

4.4. Looking for structure in the non-task focused aspects of collaborative writing: an initial framework

Although the specific results may be of limited interest, the two studies described above were beginning to identify areas of concern within the informal, or 'non-task focused', aspects of collaborative writing[23]. This concern was with the function of all those things that go on which

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[23] Benne and Sheats, 1948, split functional roles of groups into "three broad groupings" (p.42), of which two have been highly influential in the analysis of group behaviour. "Group task roles" are "related to the task which the group is deciding to undertake or has undertaken", whereas "Group building and maintenance roles (...) are oriented toward the functioning of the group as a group" (p.42). I see the former as a rationalistic account of 'task focused' aspects of group work. My interest at this point was in the influence of aspects *other* than those, on the process, and on carrying out 'task' activities—this was where I felt there was a gap in the literature. However, my interest was not restricted to group building

are not specifically to do with putting words to paper or screen, in a process which seemed unlikely to be as easy to model rationally as the existing literature in CSCW might lead one to believe.

The studies had been conducted in the belief that there would be some easily identifiable structure to non-task activity in the process, aspects of which future computer systems perhaps might support. This turned out not to be borne out in the studies, inasmuch as the studies, small as they were, seemed to *question* an assumption of existence of commonalities, rather than point to areas where they might be found. In particular, the first study indicated that the notion of a group may be a problem in itself, inasmuch as who the members are may not be clear-cut, and both studies showed the range of conceptions possible of what the work of the group was even amongst members of the same group. The second of these preliminary studies was, furthermore, a first indication that a great spread of practices of collaborative writing may exist among practitioners, and thus, that it may be hard to find common structures for a computer system to support.

The following framework was developed as a reformulation of my interest in light of these considerations, and of current issues in the literature. It was an attempt at devising a structure within which the relationship of 'non-task' to 'task' aspects of the process were to be examined (see appendix B.I), though this approach was later abandoned.

I grouped non-task focused aspects of collaborative writing of interest to me into five categories: *orientation:* the orientation of members to the group and to the task; *spontaneity vs. planning:* to what extent interactions between group members and the general progress of the work are planned beforehand; *control and roles:* patterns of control and member roles; *resources:* distribution and use; and the *group as an organism:* looking at the group as one whole, functioning unit (as opposed to interrelationships between its members).

Orientation

Orientation addresses the question of the participants' perception of the activities they are engaged in. Here, Marton's second order perspective (Marton, 1981; see chapter 2) of descriptions of experiences are addressed. In the preliminary studies, the relevance of this was indicated through the different notions of the task being evident among participants. Particularly interesting are cases where differences exist between the approaches of members of the same group: does this hamper collaboration? Do coauthors have to share an overall goal to be able to work together? In concrete terms, an open-ended question can be used to address this, along

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and maintenance (or 'socio-emotional') factors, and I introduced the new term 'non-task' aspects to emphasise the broader perspective.

the lines of "what is your understanding of collaborative writing?", and "what is the purpose of your current collaborative writing task?". For the interpretation of the replies, it is of paramount importance not to have prior expectations to what they might be.

Spontaneity vs. planning

This category focuses on the nature of the planning, if any, that coauthors do, and what is its relation to the actions they take. It stems from the literature and from the coauthor interviews discussed above: Suchman, 1987, raised concerns about an assumed causal relationship between plans and actions in cognitive science research, arguing that plans do not determine action, as discussed in chapter 2. The results of the interview study are consistent with Suchman's concerns being relevant to the study of collaborative writers. This is particularly interesting in view of cognitively based research being one of two major traditions in the study of collaborative writing (see chapter 2, section 2.5).

The question of the interactive nature of decision making is applied to coordination of the work, and also planning of the 'coordination points', or interactions and exchanges, between the coauthors. Issues addressed are: to what extent are plans followed after being made? To what extent are interactions between group members planned beforehand, and to what extent to they arise spontaneously?

Control and roles

This concerns the distribution of social roles and control over how work is allocated, decisions made, *etc.*, within the group. If it were the case that members of a writing group always, or often, occupy highly differentiated roles, this would be highly relevant to how one might design computer support for the group. For example, if a certain job, such as deciding who gets access to a document, was always done by one person within a group, one could justifiably consider designing for one person only, or one person at a time, to allocate technical access rights. (This may still not be an optimal solution, but it would be justifiable.)

Dynamics of interest are patterns of leadership and participation, in particular in relation to the orientation of the individual coauthor. The relevance of this was demonstrated in the first of the preliminary studies, where the group was wanting me to take a clear lead, and in the second study, where a range of approaches to leadership and participation were encountered.

Resource distribution and use

This concerns issues such as the minimum and the optimum set of resources for writing groups. The optimum set of 'supporting' resources might be smaller than the maximum set. This issue was highlighted in the first case study, where the use of the new technology had been assumed more helpful than it proved. Also of interest is how resources are shared between participants, in particular how access to shared resources (such as a document) is negotiated between people who are in different places.

The group as one organism

Here, the use of the organism metaphor is intended to provide a perspective on looking at the group as one unit; how it comes to exist, how different parts work together, in what ways it may maintain itself as one unit and react to internal and external pressures, and cease to exist. Issues of the meaning of boundaries of the groups came to light particularly in the interview study, in the ambiguity about who were members in group C, and in other interviewees' stories about differences of opinion between coauthors about the significance of showing work to non-members.

4.5. Summary of chapter 4

Two preliminary studies were conducted; a group annotation exercise and a series of semi-structured interviews with coauthors. The studies raised a number of questions of theoretical and practical interest to the study of collaborating authors, including the implications of:

plans not necessarily being followed; of

the possibility of variation in how members of the same group see their group and their own part in it; and of

coauthors' perceptions of the process changing over time. In particular, these studies begin to raise the possibility of the existence of great variations in how coauthors see the process of coauthoring.

On the grounds of the issues raised, a framework of issues to be further investigated was developed. Chapter 5 presents a survey with questions based on this framework.

CHAPTER 5. ASKING HOW THEY DO IT: A SURVEY

5.1. Introduction

This chapter describes a survey which addresses what I call 'non-task focused' aspects of the process, the question of how factors other than creating text are part of, and affect, the (co-) writing process. The survey described in this chapter was originally intended as a pilot study for a larger survey. A prime purpose of the survey was to explore how such data can be gathered. The aim was to gather some initial data, in quantifiable terms, on the experiences of coauthors in this respect. At the time, I had wanted to explore how common certain experiences of the process were among coauthors, in other words I wanted to extrapolate statistical generalisations. This line of inquiry was subsequently abandoned, for reasons discussed at the end of the chapter. Partly, the results below are therefore presented more as an example of the difficulty of capturing certain aspects of coauthoring (and perhaps any) group processes, than as part of the quantitative demonstration of prevalence originally envisaged. Mainly, however, the results are presented because they raise a number of issues of interest to the thesis. As discussed in section 5.5, the findings of, and the problems experienced with the survey, caused a change in the empirical focus of the thesis.

One approach to obtaining the desired understanding of salient contextual issues in collaborative writing would be to look at how coauthoring is experienced. As argued in chapter 2, the perceptions people have of the activity they are engaged in, is highly relevant to system use, and hence should be of interest to system design. In the study reported on in this chapter, experiences of non-fiction coauthors are collected through their responses to a survey questionnaire. The range of investigations in this thesis is to some extent reflected within the survey, in that it examines, in some detail, the respondents' experience of collaborative writing, and in that there are open-ended questions as well as more restricted questions.

The main objective of conducting the survey was to gain an initial insight into aspects of dynamics within, and the context for, on-fiction writing as it takes place in writing groups in the UK. Further, I envisaged that the work would provide pointers to interesting areas of investigation for co-writing in general, and to some preliminary implications for computer support

of collaborative writing. By doing that, I sought to combine the need for predictability arising directly from systems design issues with a concern for the importance of the contexts in which writing in collaboration takes place. The survey was thus intended to elicit, in quantifiable terms, descriptions of individual collaborators' subjective experiences of writing with others. To this end the survey includes some contextual, including qualitative, questions.

A second objective of the survey described in this chapter was to serve as an example of a combination of strengths of quantitative and qualitative methods of research, in terms of their respective benefits for systems design. Wright and Monk, 1991, advocate a combination of such methods for the evaluation of user reactions to early systems designs. Hartley and Branthwaite, 1989, regard questionnaire approaches as "complementary" (p.448) to other approaches in the study of writing. This survey attempts one solution to the trade-off between the approaches, namely partial combination. This is done by obtaining, mainly in quantified terms, perceptions on contextual issues, supplemented by qualitative responses. This has revealed the necessity to take account of the dynamic structure of writing groups when, for example, designing computer systems to support them.

The chapter is organised as follows: first, the survey is presented, with method (section 5.2) and results (section 5.3), followed, in section 5.4, by a discussion of the results and of the issues raised. Section 5.5 is a discussion of the implications of this work for the initial framework from chapter 4, and for the direction of the thesis enquiry.

Substantial parts of this chapter have been published as Beck, 1993 (see appendix B.II).

5.2. Method and survey design

The survey consisted of 27 questions about experiences of non-task focused aspects of coauthoring (the full survey questionnaire is in appendix A.II). It was distributed to participants at a conference (the Computers and Writing IV conference), and to members of two university departments. Surveys were offered to interested persons to pick up, if they had experience with coauthoring. This was explained as having in at least one instance taken part in a writing project in which their own name and that of at least one other was to appear on the final paper, report or book. In a sense, then, the respondents were self selective, in that they volunteered to fill in the questionnaire, and we do not know what proportion of potential respondents actually did so. All who did respond, had, in their own view, coauthored a document. In the survey, they were asked to think of one instance in which they had taken part in collaborative/group authoring and answer the questions with respect to their personal experiences that particular time. It was suggested to respondents they choose their last such project.

The questions were mostly framed around the issues raised in the framework presented in chapter 4 (section 4.4). Others were based on interview questions from the second preliminary study (see section 4.3). The attention of the framework to coauthors' orientation was addressed in questions about motivation, perceptions of success, and perceptions of collaborative writing. The issue of planning was more problematic to address in a survey, since, according to Suchman's (1987) argument, plans can be constructed by individuals as retrospective accounts of action. By extension, if individual collaborators reported having followed a plan, this might be a retrospective view. To examine the issue of whether plans made in advance tended to be followed or not, would therefore seem to require recording of events at least when plans are made and after it has become clear whether the planned activity took place or not[24]. Thus, planning was in the survey addressed in terms of suites of questions about discussions between members of the group before, during, and after writing[25]. When it came to roles, a somewhat similar problem was encountered: it was impossible to enumerate potential roles without presupposing their existence. I chose to ask about one potential role only; the one that seemed most well-established in the literature and in ordinary talk, and which I therefore thought most likely to find signs of: leadership. Further, one suite of questions asked about the sharing of responsibility in the writing group. With respect to resource use, I found no adequate way of addressing the issue in a survey, so no question about that was included. Several questions were asked about aspects of the relationships between coauthors and about working in a group, including about changes in group membership. Other questions were added which I considered to be potentially relevant in terms of providing some further context, such as what kind of document was being written.

Some of the statements were intended to approach a subject from several angles, to provide a possibility for different aspects of a phenomenon to be captured, and to enable some checking for consistency in the analysis.

Furthermore, in the survey itself, the questions were not presented to respondents in terms of the framework. This was because doing so might guide responses in the direction of confirming the framework, whereas an aim was to examine the grounds for the categories of the framework. The framework from chapter 4 was therefore in practice followed fairly loosely.

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[24] This was done in later studies; see chapters 6 and 7.

[25] I put some effort into finding alternative ways of addressing planning within the questionnaire, and my considerable difficulties in formulating appropriate questions may be worth noting: how does one in any sense quantify, enumerate, or categorise a range of plans for respondents to tick as having taken place in the course of writing a document? In fact, as discussed in chapter 6 or 7, this became no less of a problem in my later studies in which I followed groups' writing directly, despite there no longer being a requirement for the co-authors themselves to fit their experiences into categories of mine.

The analysis presented in the subsequent sections is based on the major themes of the questionnaire, and not the framework as such. Instead, the framework issues are addressed as relevant in the discussion.

Topics of the questions were: the document being written (for example, audience; publication); the group which was writing it (for example, group purpose; membership); organisation of the work (for example, leadership; discussions in the group); experiences of working in the group (for example, satisfaction with own and colleagues' inputs); and orientation (for example, motivation for joining group; conceptions of success; perceptions of collaborative writing).

Question formats were:

a) multiple choice: 14 questions, 3-5 choices in each;

b) statements to be ranked on seven-point scales ('Likert Scales'): 11 questions, 3-17 statements in each; and

c) other formats encouraging expression of further comments. These were one open-ended question and several smaller supplementary questions.

Note that there were certain problems with consistency in the design of the questionnaire, in particular with some of the questions posed as Likert scales. First, the grouping of statements (see survey in appendix A.II) meant that respondents could misunderstand the instructions and not rate the statements independently. Second, for some statements, the labels provided on the scales were inappropriate (see covering note to appendix A.II). For both problems, respondents may have misunderstood the intention of the design, and responses must be treated with caution.

In the instructions which accompanied the questionnaires, the confidentiality of the data was assured. There was also a form asking for volunteers for a further study, which required the respondents' names, however, these were to be (and were) detached from the questions upon collection.

5.3. Findings

The results are presented as completely as is practical, so that readers have access to much of the original data and can, if appropriate, draw their own conclusions about its meaning. An attempt has been made to present the results in such a way that the specific statistics can be skimmed by those for whom they add little or no information. This should contribute to making the results meaningful to readers from a range of backgrounds.

The number of respondents was twenty three[26]. This relatively small sample size reduced the generalisability of the findings. Twenty two (96%) described an academic writing project. Prior experience with collaborative authoring varied from zero to, in one case, "hundreds" of other projects. As far as is known, each respondent was reporting on a different writing group (this was certainly the case for 87% of the respondents).

Note that the number of respondents answering any particular question varied. Non-responses have been ignored, although for some questions—those with scales ranging from "least important" to "most important"—one could arguably interpret them as a "low interest" response. In the tables below, the number of responses is given for each statement.

5.3.1. Document

Questions related to the document being written are considered together in this section. These provided some background for the subsequent questions.

Document purpose and current state

Respondents were asked multiple choice questions on the purpose of the document. The documents were mainly academic (19 of 22, *i.e.* 86%). In eighteen cases (82%) the purpose was external publication. The majority were to become a paper or article submitted to a conference or a journal (15 of 23, or 65%), two (9%) were to become a book, another two a grant proposal, one (4%) a report and one a paper or article for part of a book. Two respondents chose "other".

Fourteen of 21 (67%) reported that their project was finished. Of the other five, *i.e.* those that were still on-going at the time the survey was filled in, four indicated that they were still taking part in them, and one that he did not know whether or not he was taking part.

Audience

In reply to the question "who do you understand to be the audience of your document", respondents were asked to rate each of eight potential audiences on a seven-point scale (1 = "Least important"; 7 = "Most important"). These responses are summarised in table 5–1. The analysis of this question shows much variation among the respondents, as evidenced by wide inter-quartile ranges (i.q.r.'s) of the responses. Exceptions were that the respondents overwhelmingly agreed that the most important audience was "the research

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[26] Six respondents (26%) were women and seventeen (74%) men.

community/academic peers", and that the least important audience was the general public. There was also a some agreement on reviewers of the document being important.

Note that not too much should be made of the specific results, as the number of respondents (N in the table) was low for the whole survey.

Table 5-1. Perceived document audience.

(1=least important; 7=most important)

Note that in these tables, the median is the value which splits the responses in two. The range refers to the highest and lowest responses. The i.q.r. is the inter-quartile range, *i.e.* the number of units between the lowest and highest quarters of the responses (a measure of the spread of the middle half of the responses). N is the number of respondents who replied to the question.

Statement	median	range	i.q.r.	N
The research community/academic peers	6.5	1-7	1.0	22
Reviewers of the document	5	1-7	2.0	22
Attendees at talk or conference	5	1-7	6.0	22
Our writing group collectively	3	1-7	4.0	22
Buyers of book or conference proceedings	3	1-7	5.0	21
Bosses/managers/funding bodies	2.5	1-7	3.0	22
One or more individuals in our group	1	1-7	3.25	21
The general public	1	1-7	1.0	21

Perceived influences on the document

Five potential sources of influence on the final document were given, see table 5–2, for the respondents to rate on a seven-point scale of importance. Wide inter-quartile ranges indicate that opinions differed among respondents. (Two respondents reported other reasons also being important in their projects; these were the need to follow the length and contents of a previous book, and "the geographical distribution of the group".)

Table 5-2. Perceived sources of influence on the document.

(1=not important; 7=very important)

Statement	median	range	i.q.r.	N
The whole group (group consensus)	5	1-7	3.25	23
One particular individual	5	1-7	3.75	23
The deadline (if any)	5	1-7	4.25	21
Persons external to the group	2	1-7	3	20
A sub-group	1	1-7	4	19

Discussions on document content and structure

Respondents were asked to report the frequency with which they discussed the content and structure of the document. They reported such discussions as taking place most frequently during writing as opposed to before or particularly after writing, and reported feeling that their discussions had been adequate. The results are summarised in table 5–3. (Note the very low response rates for two of the statements. This was due to an error on some of the questionnaires whereby a dividing line between those two statements was missing. The responses which did not distinguish between these have been omitted.)

Table 5-3. Reported discussions on content and structure of the document.

(1=very infrequently; 7=very frequently)

Statement	median	range	i.q.r.	N
With the benefit of hindsight, I now think our discussions on content and structure were adequate	5.5	1-7	3.5	20
We discussed content and structure during writing	5	3-7	3	22
At the time, I felt that our discussions on content and structure were adequate	5	2-7	3.25	21
We discussed content and structure before starting writing	4.5	2-7	3	10
There were group-wide discussions about content or structure of the document	4	1-7	5	22
We discussed content and structure after finishing writing	2.5	1-7	4	22
There were discussions in sub-groups about the content or structure of the document	2	1-7	4	8

5.3.2. Organisation of work

This section presents questions relating to how the work was organised, at what point group members had discussions on this, how responsibilities were shared, *etc.* These questions were intended to shed some light on the issue of roles in the groups and on the division of labour.

Discussions on organisation

Respondents were asked to indicate on a seven-point scale the frequencies of discussions on "how to organise the work" between the coauthors in their group at various stages in the writing process. The responses are summarised in table 5–4.

The discussions were felt to be reasonably adequate, but opinion differed on this, particularly with hindsight. Whether the organisation of work was discussed before starting writing received the highest score, but opinion differed particularly much on this issue. There was more agreement on the organisation having been discussed during writing. Discussions on the organisation of the work between the coauthors *after* finishing writing received the lowest score.

Nevertheless, 50% of the respondents did report some such discussions (eleven rated this above 1). Note that this result may be confounded by an interest in writing among about half the respondents (attendees at a writing conference). They may be particularly conscious of issues around writing, and therefore discuss writing more.

Table 5-4. Organisation of work between the coauthors.

(1=very infrequently; 7=very frequently)

Statement	median	range	i.q.r.	N
We discussed organisation of work before starting writing.	5	1-7	4.25	21
We discussed organisation of work while writing the document.	4.5	1-7	2	22
At the time, I felt that our discussions on how to organise the work were adequate.	4	1-7	2.5	20
With the benefit of hindsight, I now think our discussions on how to organise the work were adequate.	4	1-7	3.25	21
There were group-wide discussions about how to organise the work.	4	1-7	4.25	21
There were discussions in sub-groups about how to organise the work.	3.5	1-7	4.5	16
We discussed organisation of work after finishing writing.	1.5	1-6	3	22

Comparisons between discussions

The reported frequencies of two kinds of discussions—discussions on content or structure of the document and discussions on the organisation of work between the individuals—were compared to test whether respondents who reported frequent (or infrequent) discussions on content and structure in their group, tended to also report frequent (or infrequent) discussions on organisation of work. A positive correlation, statistically significant at $p<0.01$[27], was found between reported frequencies of the two kinds of discussions. In other words, those who reported having had much discussion on content and structure tended also to report much discussion on organisation of work, whereas those who reported infrequently discussing one tended to report infrequently discussing the other. (Spearman Rank test for correlation; rho-value for correlation = 0.806; N=21.)[28] The distribution of the combinations of replies are plotted in scattergram 5–1; see appendix A.III. (Note in the scattergrams, that an enlarged point

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[27] P is the probability, out of 1.00, of the result being obtained by random chance.

[28] This is a test for correlation between two variables which uses rank order rather than the absolute values of the variables. The strength of co-occurrence of similar ranking lists are computed (in this case using a computer statistics program) and expressed in terms of a number, rho. The value of rho is then used to look up in a table, for a given N, the probability (p) for a correlation having been obtained by accident. A lower p therefore indicates a higher probability of the two variables changing values together. (It is important to note, though, that this test does not indicate whether a causal connection exists, and does not exclude, for example, the possibility that a third variable with which these two co-occur, causes the detected correlation.)

indicates more than one respondent with that combination of responses, and that a high correlation in the data produces a clear diagonal in the scattergram.)

A further two such tests were made to examine correlations between reports on the frequency of discussion on the organisation of work prior to writing with the perceived adequacy of those discussions, and between the perceived adequacy and the perceived frequency of such discussions while the writing was on-going. Significant positive correlations ($p<0.01$) were found in each case, indicating that those who reported that they thought their group had high frequency of such discussions also reported that they felt those discussions had been adequate, while those who reported that their group infrequently had such discussions reported that they felt that those discussions were not adequate. (Spearman Rank test for correlation, rho for correlation between adequacy and pre-writing discussion = 0.664; rho for correlation between adequacy and during-writing discussions = 0.824; N=20 and 21 respectively). See scattergrams 5–2 and 5–3 in appendix A.III for the distributions of combinations of replies.

Group-wide discussions on the content and structure of the document showed particularly sharp differences between the respondents. There were tendencies towards a two-way split between respondents who reported having had such discussions very frequently, and those who reported having had such discussions very infrequently (median 4; range 1-7; i.q.r. 5.0; see table 5–3). Figure 5–1 shows the frequency distribution of the responses obtained.

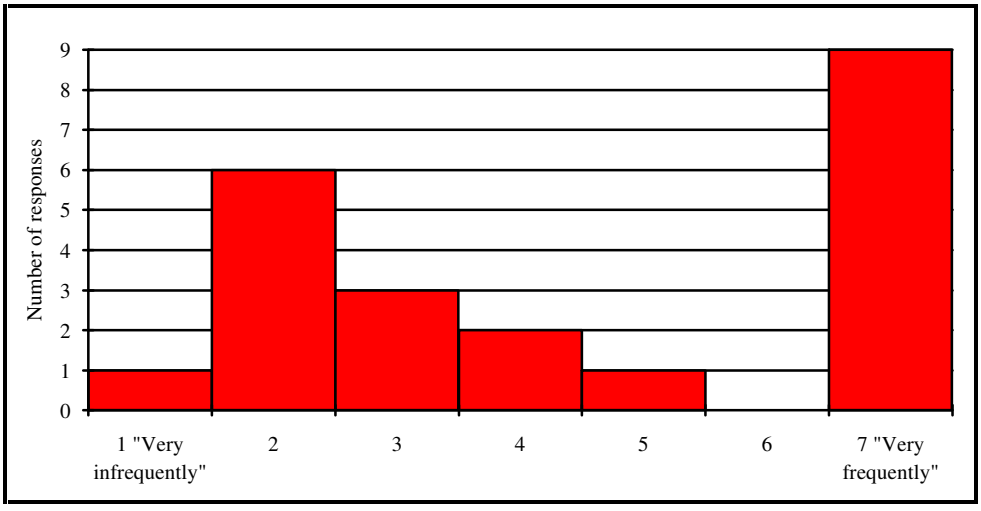

Figure 5–1. Frequencies of group-wide discussions on content and structure.

Statement: "There were group-wide discussions about the content or structure of the document"

Leadership

Respondents were asked to choose one of seven replies to the question "who was it, if any, who in your opinion took the general lead?". Twenty three responses were obtained. Seven

(30%) indicated that a self-appointed leader or facilitator took the lead; six (26%) chose "no-one took the general lead"; five respondents (22%) indicated that an agreed leader or project manager did; one (4%) that an agreed editor or editors did, and another one that an agreed group facilitator or coordinator did. Three (13%) replied "other" (these replies were "myself, the researcher"; "initially I took the lead [...] later my co-author"; and "one person wrote most of the text and the rest revised & added parts").

Sharing the responsibilities

In the respondents' consideration of four statements on the general distribution of work among the collaborators, a picture emerged of the sharing of responsibilities between the coauthors being somewhat complicated (see table 5–5 for details). Responses showed a spread of opinions on whether "a person or subgroup had primary responsibility for the production", on whether all were collectively responsible, and on the extent of overlap between responsibilities. Respondents agreed more that they infrequently felt responsible for their own part only. In other words, responses indicated a mixture of perceptions of how responsibility was shared among coauthors. Areas of responsibility were not necessarily clearly delineated (they felt responsibility for other parts than just "their own", few reported that there was little overlap between areas of responsibility, and they were divided on whether the coauthors were collectively responsible or not).

Table 5-5. Perceived sharing of responsibilities.

(1=very infrequently; 7=very frequently)

Statement	median	range	i.q.r.	N
That a person or a subgroup had primary responsibility for the production	5	1-7	3	23
That we were all collectively responsible for the whole document	4	1-7	3	23
That I was responsible for my own part only	2	1-7	1.75	23
There was little or no overlap between areas of responsibility	2	1-6	3	23

5.3.3. The phenomenon of group

In this section I present questions which loosely explored aspects of the phenomenon of group: its construction and maintenance through membership and relationships between members. Perceptions of progress and purpose are also considered.

Group sizes

Sizes of writing groups were small in this survey: when asked about the average size of their writing group, thirteen of 23 (57%) indicated two in the group (one plus themselves), with the percentage rapidly declining as group size grew.

Changing group membership

There were also indications of transient group membership. In a multiple choice question (Yes/No/Don't know), respondents were asked to indicate whether there were any changes in the number of persons in their co-writing group while they were writing the document. Five replied Yes (however, see below).

Respondents who replied Yes to the first question were asked to indicate the nature of the changes by chronologically listing the numbers of members in their group. Respondents were asked to indicate coincidental arrival and departure of members by repeating a count. Six reports were obtained. Some of the reported changes in membership were considerable. The changes were in two cases decreases (from 9 to 1 and from 10 to 3), and in four cases increases in membership (three were from 1 and 2 to 3, and one from 4 to 10).

Cross checking revealed that two respondents who had reported no changes in their group membership, had nevertheless given reports of changing numbers, and that one respondent who had replied that the group membership had changed, had not provided such a report. There were therefore altogether eight respondents of 23 (35%) who in some way indicated that the number of coauthors in their group had changed during the writing of the document.

In another Yes/No/Don't know-question, respondents were asked "Except for right at the beginning, were you at any point ever unsure about who were going to be the co-authors?". Twenty two replies were obtained; five of these (23%) were affirmative. Here, one might expect that those respondents who had been unsure about who their coauthors were, had been so when changes in the membership were actually taking place. If this were the case, the five who reported uncertainty would be a subset of the eight who reported actual changes. However, relating individuals' responses to these questions revealed that two respondents reported having felt unsure about who the coauthors were although they reported no actual changes in their groups. In this sample, then, being unsure about who the coauthors were, appears to have arisen for other reasons as well as actual changes in group membership. Explanations may be that in these groups questioning of group membership occurred without it ever coming to actual changes, or that for some groups, membership had never been clear. Either way, it is interesting to note that the question of who was and was not a coauthor was not always clear cut. This could have implications for issues such as security and locking (who will have access

to documents), decision making (who takes part in making decisions), and communication (who should know be included in exchanges between coauthors) in designed support systems.

There were thus ten respondents altogether in this sample (43%) who *either* had been unsure of who the coauthors were going to be, *or* had actual changes in their groups (or both).

In another question, respondents were asked to what extent they agreed or disagreed with the statement "once or more during the production of the document I changed my mind about being a member", by indicating a number from 1 ("Disagree most") to 7 ("Agree most"). On this question there was a clear polarisation between those who totally disagreed, and those who agreed to some extent with the statement: twelve of the 21 who replied (57%) indicated that they had never changed their minds about being members (these all chose 1, or disagree most with the statement). Nine (43%) indicated that they agreed to some degree that they had changed their minds (these chose numbers between 3 and 7). Figure 5–2 shows the frequency distribution of the replies to this question.

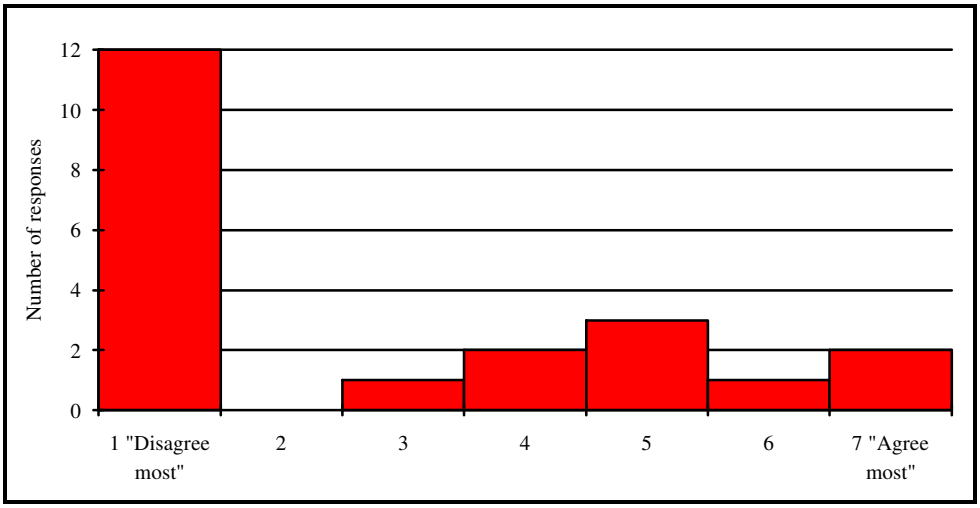

Figure 5–2. Reported changes of mind about remaining members of the group.
Statement: "Changed my mind about remaining in group once or more during writing"

Discussions on relationships between coauthors

In different questions, respondents were asked to indicate how frequently their group had discussions on the relationships between the coauthors before, during, and after writing their document, and to what extent discussions were had in the group as a whole *vs.* in subgroups. The results are presented in table 5–6.

Table 5-6. Discussions on the relationships between coauthors in the group.

(1=very infrequently; 7=very frequently)

Statement	median	range	i.q.r.	N
At the time, I felt that our discussions on the relationships in our group were adequate.	4	1-7	4.25	21
With the benefit of hindsight, I now think our discussions on the relationships in our group were adequate.	4	1-7	5.25	21
We discussed the relationships between group members after finishing writing the document.	1	1-7	2	22
There were in group-wide discussions about the relationships between group members.	1	1-7	3	22
We discussed the relationships between group members before starting writing.	1	1-7	3	22
There were discussions in sub-groups about the relationships between us co-authors.	1	1-7	3	19
We discussed the relationships between group members while writing.	1	1-7	4	22

Particularly striking is the extremely high inter-quartile range for responses when asked about the adequacy of those discussions with hindsight. Respondents thus appear to be split on whether they considered their discussions on this to have been adequate. Taken together with the very low frequencies overall reported for these kinds of discussions, this could indicate that the coauthors surveyed did not discuss the interrelationships with their coauthors much, and that almost half considered that they had fewer discussions on their interrelationships than they thought beneficial. The histogram in figure 5–3 shows the polarised frequency distribution for the statement "With the benefit of hindsight, I now think our discussions on the relationships in our group were adequate", indicating that the respondents were split on this question.

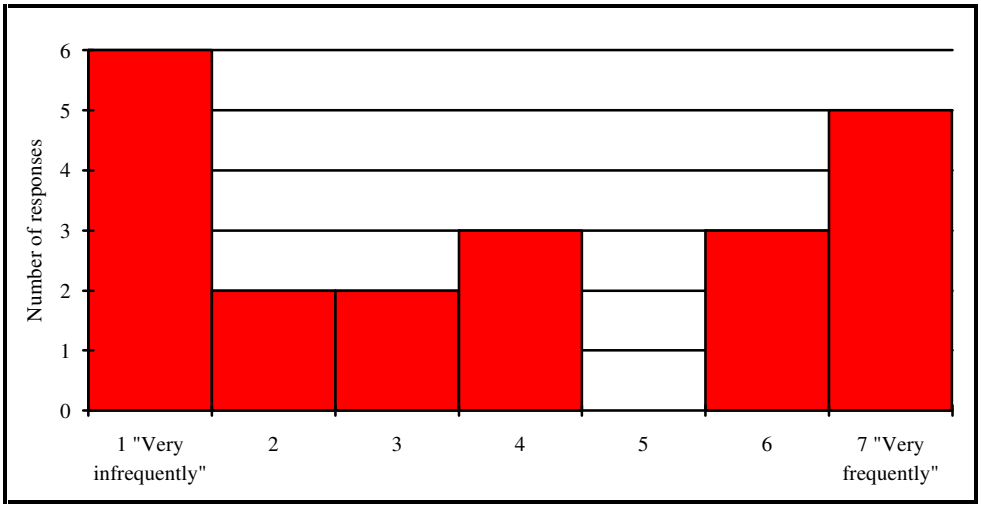

Figure 5–3. Perceived adequacy of discussions on coauthor interrelations.

Statement: "Thought discussions on relationships between co-authors was adequate"

General progress of the collaboration

Respondents were asked to indicate how frequently they thought they had held certain opinions about themselves and the progress (or otherwise) of the writing project while they were writing. Some of the statements were about the perceived amount of work put in by the group and its members. One might have expected that academic writers in this survey would be feeling some pressure towards being prolific and successful writers (because of the importance of the number and prestige of publications in their career structure), and that this might be reflected in conceptions of collaboration in writing; perhaps through apportioning blame on colleagues. Taking all respondents, there was no general trend towards claiming that their colleagues were doing too little: the statement "others were contributing too little" received a median slightly lower than "I (personally) was doing too much". Opinion differed on these two statements, but overall coauthors tended to report infrequently thinking this; see table 5–7.

Table 5-7. Perceptions of the progress of the work.

(1=very infrequently; 7=very frequently)

Statement	median	range	i.q.r.	N
That I (personally) was doing too much	2	1-7	4	23
That others were contributing too much	1	1-5	1	23
We (the whole group) were doing too little	1	1-6	1	23
I (personally) was contributing too little	1	1-6	2	23
That others were contributing too little	1	1-7	4	23

However, the fairly wide inter-quartile ranges for these two questions indicated that the respondents had varied opinions. A test was made to examine a possible correlation between respondents thinking that they themselves had been doing "too much" and that others were contributing too little. A positive correlation, significant at $p<0.01$, was found (Spearman Rank test for correlation; rho=0.722; N=23). For the scattergram for combinations of responses to these two statements, see scattergram 5–4 in appendix A.III. (Note that due to the possibility of bias from the high density of points at one end of the diagonal of the scattergram, a cross check of the significance of the result was made by excluding all respondents who chose 1 for both questions and repeating the correlation test. The correlation retains its significance only at the less favourable probability of $p<0.05$ (rho in this case=0.727, N=10).) Thus, in this sample of collaborating authors, feeling that they themselves were doing too much was closely related to feeling that others were contributing too little.

Purpose of the writing group

In response to the question "in your **own** opinion, what was or were the purpose(s) of the creation of the writing group?" respondents were asked to rate seven statements from 1 ("Least

important") to 7 ("Most important"). Table 5–8 shows the statements, along with the responses obtained. The most popular reason was getting the document written; second was to work together. What the respondents agreed most on, was that creating new co-operation on matters other than that dealt with in their paper was *not* important. It is perhaps also worth noting that maintaining existing co-operation or relationships relevant to the subject of the document was rated no more important than maintaining existing relationships which did *not* relate to the paper.

Table 5-8. Perceived reason for establishment of writing group.

(1=least important; 7=most important)

Statement	median	range	i.q.r.	N
To get this paper written	7	1-7	2	23
To work together	5	1-7	3.25	21
To enhance or maintain among the co-writers **existing** co-operation or relationships **not** relating to the subject of the paper	4	1-7	4	19
To enhance or maintain among the co-writers **existing** co-operation or relationships relating to the subject of the paper	4	1-7	4.25	21
To create among the co-writers **new** co-operation relating to the subject of the paper	3	1-7	3.75	19
To obtain funding for another project	2	1-7	4.75	19
To create among the co-writers **new** co-operation **not** relating to the subject of the paper	1	1-4	1.5	20

Respondents were asked whether none, some, or all of the purposes listed in table 5–8 were explicitly agreed in the group, and whether other purposes than those had been agreed. In twelve cases (52%), respondents indicated that none of the purposes they saw for creating the writing group were explicitly agreed by the whole group. This may be an indication that the purpose of the group was (or appeared to be) so obvious that it was felt no discussion was needed, but it is also possible that the purpose was not clear to the participants.

5.3.4. Orientation

This section presents questions relating to the respondents' orientation to the collaborative writing task; how they perceived working in a group, what their motivation was, and what, to them, constituted success. At the end they were asked an open-ended question on what, to them, is collaborative writing, a question which goes back to the discussion in chapters 2 and 3.

Working in a group

Respondents were asked to indicate their level of agreement with statements about working as part of their writing group. The responses are listed in the two parts of table 5–9.

Table 5–9a shows statements for which respondents were asked to indicate their general satisfaction with the collaboration through the frequency with which they thought they had felt a number of factors during the writing. They reported thinking most frequently that the collaboration was worthwhile, that they were in some ways very pleased with the collaborations, and that they felt the group worked well together. They were not as sure that the cooperation of the writing group had been enhanced as a result of the collaborative writing, but only very few had frequently thought it had deteriorated.

Table 5-9a. General satisfaction with the collaboration.

(1=very infrequently; 7=very frequently)

Statement	median	range	i.q.r.	N
That the group worked well together	6	2-7	2	23
The collaboration was worthwhile	6	1-7	2	22
In some ways very pleased with the collaboration	6	1-7	3	22
I think the cooperation of the writing group was enhanced as a result of the collaborative writing	5	1-7	2	22
In some ways very displeased with the collaboration	2	1-7	3	23
That the group worked poorly together	2	1-7	3.75	23
I think the cooperation of the writing group deteriorated as a result of the collaborative writing	1	1-7	2	22

Table 5–9b shows statements asking for a comparison between writing the same document on their own and writing it as part of a writing group. The respondents differed noticeably on all the four statements, in particular whether they thought they could have done it (at all) on their own. Most did not agree much that they would have done it better had they done it on their own. The respondents also differed on whether the collaboration had taken less time than if they had done it on their own. It was more clear that they had *not* frequently felt that they had to sacrifice too much for the collaborative writing of the document.

Table 5-9b. Perception of collaboration *vs.* writing alone.

(1=disagree most; 7=agree most)

Statement	median	range	i.q.r.	N
It took less time to write with others than it would have taken on my own	4	1-7	3.75	23
I could not have done it on my own	4	1-7	4.75	23
I would have done it better on my own	2	1-7	3.75	23
I had to sacrifice too much for the collaborative writing of that document	1	1-6	3.75	23

Four of the statements in table 5–9a were concerned with the frequency of respondents' general feeling of their groups working well or poorly together, and feeling pleased/displeased about the collaboration. These statements were pairwise exact inverses of each other, and

could be tested to indicate the general reliability of the data obtained in the survey. High scores were obtained for the positively phrased statements (feeling the group worked well together; feeling pleased with the collaboration), and the corresponding low scores for their inverses (see table 5–9a). Tests found significant positive correlations ($p<0.01$) between individuals' responses to the two statements on frequently feeling that the group worked well together, and frequently feeling pleased with the collaboration (Spearman Rank test, rho=0.744, N=22); and also between feeling that the group worked poorly together and feeling displeased with the collaboration (Spearman Rank test, rho=0.698, N=23). These results indicate that for the coauthors in this survey, feeling pleased about the collaboration was closely connected with feeling that the group worked well together. Furthermore, negative correlations were, as expected, found between the negatively and the positively phrased statements, giving another indication that the data was reliable with respect to these questions.

Motivation

The respondents were asked to indicate to what extent they agreed with nine candidate reasons for joining a writing group. The most popular was "I thought I would enjoy it", and also "I thought it would be good for my future job or career prospects". The least popular were the statements on not knowing the reason for joining, to establish new private relationships, and joining as a consequence of pressure from outside the group, where, further, low inter-quartile ranges were obtain (*i.e.* the respondents tended to agree with each other that they disagreed with the statements as put). Greatest variance was found on establishing new work relationships or obtaining funding for another project. A few reported feeling some pressure from inside the group to join, though the overall score was low. See table 5–10 for the details.

Table 5-10. Personal motivation for joining writing group.

(1=disagree most; 7=agree most)

Statement	median	range	i.q.r.	N
I thought I would enjoy it	6	1-7	4	20
I thought it would be good for my future job or career prospects	4.5	1-7	3	22
To keep in touch with people I already knew	3	1-7	4	20
To establish new private relationships	1	1-6	0	19
I never knew why I joined	1	1-7	0	18
I felt some pressure from person(s)/body outside the group. (e.g., manager, leader, funding body)	1	1-7	1.5	20
I felt some pressure from person(s) in the group to join. (e.g. chairperson, colleague)	1	1-7	3.5	20
To establish new work relationships	1	1-7	5	21
To obtain funding for a specific other project	1	1-7	5.25	21

In addition, five respondents (22%) ticked the box for Other reasons for joining their writing group. Reasons given were that an existing group was continuing working/writing together (two respondents); because of an interest in seeing ideas published (two respondents); and joining to help ensure a deadline could be met.

In a separate question, respondents were asked to what extent they had wanted to be taking part in the group writing project prior to joining it. Given that these all had in fact ended up joining those writing groups, one might expect that this statement would receive a very high score. However, whereas eleven respondents (48%) did choose either 6 or 7 (7 being "agree most"), the other half of the 21 respondents were evenly spread between 1 ("disagree most") and 5. (Median for all responses 6; range 1-7; i.q.r. 4.0.)

Perceptions of success

As discussed in chapter 2 (section 2.3.1), the complex question of what constitutes "good" collaborative writing has to be addressed if we are trying to work out what we want to support. In this survey, the issue was addressed in terms of perceptions of the success of the writing group.

Respondents were first asked how confident they had felt during their collaboration that the group would succeed. Respondents appeared to have considerable confidence in the collaborative writing projects they were taking part in: they were united in quite frequently thinking the group would "definitely succeed" (median 5; range 2-7; i.q.r. 2), whereas they reported that they were much less frequently "unsure whether it would succeed or not" (median 2; range 1-7; i.q.r. 2). Finally, respondents reported infrequently thinking that the group would "definitely **not** succeed" (median 1; range 1-7; i.q.r. 2.75).

Table 5-11. Perceptions of success.

(1=very unimportant; 7=very important)

Statement	median	range	i.q.r.	N
Whether the resulting document is acceptable to its reviewers	6.5	2-7	1	22
Whether the resulting document is acceptable to you	6	5-7	1.75	23
Whether the group members get on well personally	6	2-7	1.75	23
Whether everyone in the group considers the finished document a good one	6	2-7	2	23
Whether there was good communication between the group members	5	2-7	3	21
Whether group members will carry on working with each other	4	1-7	3	21
Whether new work or personal relationships have been formed	3	1-6	2	21
Whether there was a close adherence to an initial plan	3	1-7	2	22

Respondents were then asked to consider in more detail the nature of their conception of success by indicating the importance of eight potential components of success in collaborative writing on a seven-point scale. See table 5–11 for a summary of these and the responses obtained. *All* respondents reported that an important determinant of success was the acceptability of the resulting document to themselves (all twenty three respondents replied to this question, and each gave this statement a rating between 5 and 7). Similarly high scores and a great deal of agreement were obtained on the importance of acceptance by reviewers, on the group members getting on well, and on everyone in the group liking the document. In contrast, close adherence to an initial plan, and forming new relationships, were rated unimportant.

Perceptions of collaborative writing (open-ended question)

In chapters 2 and 3, the question of what is collaborative writing was shown to have many aspects. In this survey, the issue of definition was addressed in terms of the respondents' own perceptions of collaborative writing. Respondents were asked the open-ended question "What is to you, *personally,* and in your own words, the purpose of taking part in collaborative writing/co-authoring/writing in a group?". All twenty three respondents replied to this question; most of them indicating more than one reason.

This provided a number of interesting responses, summarised in table 5–12. The grouping of the responses in the table are the result of my tentative analysis of the responses into seemingly related issues of concern. The "categories" suggested are intended as no more than a second-level summary. In short, then, my analysis identified these as areas of concern to the respondents: concern with improved quality of the resulting document (more combined knowledge, more criticism); concern with faster process (increase in speed/decrease in work for a document); collaboration in writing as a consequence of collaboration on the reported work; concern with relationships with collaborators; and concern with sharing (statements which cannot reliably be attributed to one of the other categories). Strikingly different perspectives, in evidence from three respondents, were that work and writing were fundamentally social activities (2 respondents), and that the respondent had no choice in whether to write collaboratively or not, as managers decided for her (1 response). According to the proposed categorisation, improved quality of the resulting document was the most frequently stated purpose in taking part in collaborative writing. Thirteen respondents (57%) were considered to have in some way indicated this purpose. The next most frequently stated purposes for joint writing was as a result of joint work (6 respondents) and that the process of producing a document was faster (4 respondents). Note that, to make the responses easier to present, I have collapsed responses or elements of responses which I deem to have virtually identical phrasing into single items (these are the unquoted items).

Table 5-12. Perceptions of collaborative writing; summary of responses.

(Numbers in []'s indicate which respondent(s) provided each response.)

Responses	Issue of concern?
"create something better than individuals could achieve alone" [2]; "produce a better paper" [5]; "I know better quality work results from collaboration" [12]; "the whole is greater than the sum of the parts" [13]	Quality of product
combining expertise/complementing each other [1, 5, 13, 14, 20, 21]; larger set of views/ideas [8, 10, 12]; idea creation/review [10, 22, 23]; coauthors' challenges/critical attention before submission [4, 12]	(13 respondents)
"natural part of such a culture [of working in small teams within a sub-task]" to cooperate on reports, papers, etc. [6]; for work which has been undertaken collaboratively [17, 19, 22]; providing/representing a picture of the whole group doing the work by all being coauthors [16, 18]	Result of other collaboration (6 respondents)
"efficient process" [1]; speed of producing a paper [7, 13]; "doing more work in less time" [20]	Fast process (4 respondents)
sharing the load [2, 4, 10]; "sharing the problems, worries, decisions, work [from initial conception to layout]" [15]; "the pleasure of 'marriage of minds'" [10]	Sharing (4 respondents)
"to get the work done" [9]	Getting the work done
"motivation" [21]; "less easy to be non-productive" [13]	(3 respondents)
"get to know people" [21]; "establish a working (and possibly also private) relationship [...] since a successful[] collaboration [...] requires trust and a common world view" [23]	Relationships (2 respondents)
"I think I see work as inseparable from interaction with others. While I sometimes enjoy going off for a while to write alone, the work itself and writing seem to me to be fundamentally social activities, so I almost have to turn the question around & ask what would be the purpose i[f] not collaborating" (from a respondent who reported taking place in hundreds of writing projects of various kinds)." [3] "I think individual writing is almost impossible" [12]	Necessarily joint activity (2 respondents)
"My experience of collaborative writing is restricted to the "real world" employment situation, in which I basically do as I'm told: if I'm told to work with others, I work with others. The purpose of collaboration is usually to ensure that deadlines are met. Occasionally it happens in order to allow a trainee to work with a more experienced writer." (from the only respondent who indicated writing journalistic, technical or popular non-research prose, as opposed to academic research or other purposes). [11]	No choice (1 respondent)

Finally, it is worth noting that in their (voluntary) general comments on the questionnaire itself, three respondents made reference to how collaborative writing will change over different instances of co-writing even for the same person, due to factors such as different partners, writing goals, experience, group composition, or leadership (respondents no. 12, 15, 17). One respondent wrote that he edits much, but does not himself generate the ideas in the text, and in that respect asked, poignantly, "What is collaborative writing?".

5.4. Discussion of results

5.4.1. Group discussions

Any writing group must at some level agree on the content and structure of the text they are producing, if the result is to be a single document. One might expect that in academic writing groups, such discussions would be prevalent, whether in sub-groups or in the whole groups. It was therefore perhaps surprising to come across tendencies of a binary split among respondents to this survey with respect to group-wide discussions on content and structure. It is possible that those who reported relatively infrequent group-wide discussions reported relatively frequent sub-group discussions, but due to an error on some of the questionnaires on the sub-group issue, this cannot be properly investigated. Another possible explanation is that since the measures are to some extent relative to the respondents' own expectations, it may be that such discussions were frequent, but that some respondents felt that in their latest collaborative writing group, such discussions were somewhat less frequent than expected and therefore gave a low score. Perhaps more plausibly, it is possible that the responses describe a situation in which the collaborating writers have such clear notions of what the content and structure of the document is going to be that there is little need for such discussions. Finally, it is possible that discussions on the content and structure of emerging documents are so common that they are not being noticed and hence not reported in the survey.

Discussions were perceived of as taking place no more frequently before writing than during writing. For discussions of content and structure of the document, discussions during writing were reported slightly more frequently than prior to writing. Rather, this is consistent with a view that joint decisions (assuming these require discussion) are taken along the way, as the work is done.

The correlations found between responses to statements about group-wide discussions on the organisation of work, and discussions on the content and structure of the document, means that the more frequent one kind of group-wide discussion was seen to be, the more frequent the other kind was seen to be. One explanation for this may be that the two kinds of discussion normally take place together, perhaps because they are causally linked, *i.e.*, that one causes the other. If this were the case, then systems designers may need to know, for example, how temporally close these tend to occur, and therefore how integrated with each other any support functions for the two kinds of discussions need to be. Another explanation is that some other factor causes the two to co-occur; in this case perhaps opportunity for having discussions at all. The implications of this view is that given the opportunity, coauthors will discuss such issues. Considering the correlation between the frequency of discussions on organisation and how

adequate they are considered to be, it might become an aim to the design to provide plenty of opportunities for such discussions.

The correlation found between perceived frequency of discussions on work organisation and reported high satisfaction with the adequacy of those discussions, also indicates that in this survey, respondents who reported infrequent discussions were less inclined to describe the discussions they did have as adequate. If this is a general tendency among collaborating authors, and if reports of adequacy means that expectations are felt to have been met, then this result could indicate a general expectation among coauthors that discussions on organisation of writing will, or should, take place frequently. If coauthors feel that it is not adequate to have little discussion on the organisation of writing, an environment for collaborating authors must at least provide spaces in which such discussions can easily take place; the question is also raised of whether discussions on the organisation of the work could and should be actively encouraged.

5.4.2. Organisation of work

It seems like there could be an element of collective responsibility running in parallel with individual or sub-group responsibility for almost all of the instances of group writing reported on by the respondents to this survey, and that this responsibility is exercised in such a way that individuals' areas overlap during the joint writing project (respondents thought infrequently that there was little or no overlap between areas of responsibility, or that they were responsible for their own part only). This could be either concurrent overlaps, or overlaps arising from changing responsibilities at different stages. Either way, this would seem to be a pointer to the allocation of responsibility itself being dynamically—perhaps continuously—renegotiated during the writing process.

5.4.3. General satisfaction

Questions phrased positively in terms of belief in the group, enjoyment of participation, the group working well together, *etc.*, scored consistently higher than those phrased negatively (for example, group would definitely not succeed). Thus respondents appeared to be quite pleased with the collaboration they were taking part in. This result is however, somewhat paradoxical considering that almost half had at some point during the collaboration changed their minds about remaining in the group. One explanation for this apparent contradiction might have been that many respondents were reluctant to expose their (private) criticisms of their coauthors in this survey, or that respondents were "agreeing" with the statements as put. However, low scores were, as expected, obtained for statements which were opposites, making it unlikely that the responses were the mere results of poor question design. An alternative explanation could be that the respondents in retrospect were fairly happy with the efforts of the writing groups they

were members of, but at the time had reasons to consider leaving, whether related to now-forgotten problems in the group, or other reasons not captured here. Thus the result obtained in the survey could be a product of coauthors believing, or presenting, a better image of their collaboration than experienced at the time. Finally, the apparent contradiction may be an indication of the process of writing together having involved periods of crisis in the groups which were later resolved and/or did not affect the overall impression of the joint writing effort as satisfactory. If this is the case, then co-writers could conceivably benefit from support of some kind to get through the difficult periods. (The issue of what kind of support would be helpful in this respect was beyond the scope of this study. This may, however, be addressed in other studies, for example case studies, where turning points and their causes during the co-writing process might be identified.)

5.4.4. What is success?

If the quality of collaborative writing technologies is to be evaluated, some answers to the question of what constitutes "good" collaborative writing must be found. In this survey, participants' conceptions of success were addressed in the question "How important are or were these factors to you in determining the success of the writing project?". High scores were obtained for statements addressing the acceptability of the finished document to participants and reviewers, *i.e.* the respondents considered it an important determinant of the success of the writing project that individuals involved in its production and its review found it acceptable. A notably low score was given to forming new work or private relationships, and to "close adherence to an initial plan". The latter may indicate that coauthors do not see following plans as important for successful collaborative writing, or that initial plans may be significantly revised (or are seen as being open to revision) during the writing process. This corresponds with Hartley and Branthwaite's (1989) recommendation that someone who wishes to improve their writing productivity in academia should make a rough plan initially, but one which "you needn't necessarily stick to" (p.449). This preliminary study therefore suggests that any computer tools which aim to support planning should also be designed to support their easy alteration. It follows that any automatic enforcement of plans (for example, automatic reminders of work which is due) must be easy to override by the users.

5.4.5. Limitations of the results

The results reported above are tentative, based on a sample of twenty three mainly academic coauthors, and should not be generalised too far. However, these findings already raise a number of issues, including some specific design issues, which are worth considering further.

It should be stressed that the results from this survey are preliminary. First, the instances of collaborative authoring reported on by the respondents were almost exclusively academic writing. Therefore they do not necessarily generalise to collaborative writing in general. Second, there were problems with the design of the survey and its instructions. For example, some respondents reported that a few of the questions were ambiguous, resulting in some questions being omitted from the analysis. Furthermore, there were possibilities for misunderstandings about whether respondents were expected to treat the statements within a section independently. Third, the respondents were self-selecting on engagement in "collaborative authoring". There is no one definition of collaborative authoring which is agreed to be the correct one. For example, Lunsford and Ede (1990), in the study cited in chapter 2, section 2.5.2, used a broad definition of writing which included "writing activities". Couture and Rymer (1991), on the other hand, made a distinction between writing in a group on the one hand and interacting with others during the writing process on the other, and obtained a different figure for the prevalence of collaborative writing in "the professions", as reported above. For the purposes of the survey reported in this chapter, this problem of definition was resolved by in effect allowing the (potential) respondents apply their own definition of collaborative authoring (the survey was clearly labelled "co-authoring survey" and it is assumed that only those who, by their own definition, considered themselves to have written collaboratively with others replied). However, given the lack of an unambiguous definition of collaborative writing, and given that the purpose of this survey was not to establish the frequency of collaborative writing, but to examine some characteristics of collaborative writing when it is seen to be taking place, this is not considered too grave a limitation.

5.5. Implications

5.5.1. Implications for system design

A view is emerging from the data so far (*i.e.* the preliminary studies and the survey) of the experience of collaborative writing as a process which is dynamically negotiated. It is necessary for designers of computer support systems for collaborative writing to take into account the need for space in which coauthors can negotiate and renegotiate not only the contents of the emerging document, but also their organisation of the work that needs to be done, and the relationships between them. For example when the data shows that the reported groups split fairly evenly between having an agreed leader, a self-appointed leader, and no-one taking the lead, this raises the issue of how a computer system might be designed for, or designed around, the necessary flexibility to handle these different organisations of writing groups. If one was envisaging a system which provided support for a person to take on a leader/facilitator role, it might be quite reasonable to include a computer system through which any person (or none)

could claim leader status; this might remain in force until challenged. This would initially cover the case of three scenarios in which a leader had been agreed between the group members, a self-appointed person took the lead, and no-one took the lead, respectively: in the first case one could stipulate that any discussion about who should be the leader would have taken place prior to invoking this function, such that the agreed leader subsequently could claim the prescribed "leader" role. (However, see below.)

The findings in the survey of fluctuating group membership, and hence, fluctuating commitment to the group, implies that an environment in which coauthors are expected to work might have to allow for changing involvement in the task among the group members. Allowing people to join and leave a group with ease could be important. Possibilities for (somehow) supporting the substitution of coauthors for others might also be explored. For example, it might be useful to explore whether alerting coauthors to the possible benefit of making ideas, incomplete drafts, *etc.*, accessible to others who are to take over might be useful; going further, one might even consider encouraging coauthors to store such items in a way which makes them easier to access later (note that this does not necessarily imply computer-based storage).

There are, however, still substantial, unanswered questions. Consider again the cases where respondents reported that their group had a self-appointed leader. The types of situations covered by this might range from there being very clearly a leader—this may even have been agreed between the rest of the group apart from the respondent—through a "natural" leader gradually emerging during the writing project; to, at the other extreme, a situation in which all (or both) group members are taking a share of organisational responsibility, but where, something (for example, a comment), makes the coauthor(s) perceive of one of the collaborators as a self-appointed leader. How is a designer to get ideas for scenarios to anticipate? This survey does not provide the answer to such questions, nor is it clear that any survey could, even if on a larger scale.

5.5.2. Turning the question round: Implications for the proposed framework

Even with a survey as detailed as this one, it turned out to be difficult to form impressions of the concerns of the coauthors. There were great variances in what kinds of concerns respondents had, as evidenced in the consistently wide spread of responses. Not too much should be made of the statistics, as with relatively few respondents, the survey cannot be assumed to be typical of collaborating authors. The consistently high variation among the twenty-three respondents, is, however, nevertheless worth noting, in particular as it is consistent with the interviews of the second preliminary study. The survey also provided further evidence that some groups change substantially over their lifetime, and also that individuals may differ in different groups—even in

two instances of working where the group stayed exactly the same. In terms of analysis, this translated into a significant problem of how to structure the results in terms of categories, either as typical problems encountered, or as approaches to the work.

Gradually, however, I realised that the apparent resistance of the data to provide those kinds of answers was in itself interesting. Furthermore, even though statistically valid groupings might well be found if a larger survey (with more respondents) were to be conducted, such categories, whilst useful in predicting whether many coauthors were likely to be affected by a stated concern, could not provide insight into what this meant in practice; what the implications might be for the process at a level of detail required to see qualitative system design implications. An implication of this was that the areas identified in the framework, while interesting in themselves, fail to capture the perspective of the unpredictability of the process of writing together. While struggling with these issues, a question which gradually rose to the foreground was not so much how I, as a researcher, should deal with the variation, but how the coauthors themselves do: if there really are such differences; if the variation really is what coauthors experience; if each case is a one-off, how do *they* cope with it? This basic issue, which turns out to be largely ignored in the literature, became the basis of the subsequent enquiries.

To address such a question, an understanding of what happens when people write together is needed in much more detail than what could be provided in a survey, even a detailed one. The survey approach was therefore abandoned in favour of case studies of close observation of a few writing groups in a naturalistic setting. The above concerns thus formed the basis for three case studies, which are presented in chapters 6 and 7.

5.6. Summary of chapter 5

This chapter has reported on a survey of the experience of collaborative writing of twenty three largely academic coauthors. It was found that discussions took place during writing more than before (or after) writing, and that adherence to an initial plan was not seen as an important determinant of success. Different leadership types existed in the writing groups reported on in this survey, including self-appointed leader and no leader at all. Fluctuating membership and commitment to the writing group were shown to be common. The emerging picture of the collaborative writing reported on by these respondents is one of a dynamic process with continuous negotiation and renegotiation of questions relating to both the contents of the document, and to a range of other issues, such as leadership role, and sharing of responsibilities between the coauthors.

There are problems with this survey, not least the small number of respondents, which make the statistical validity of the results poor. However, a number of very interesting questions have

been raised. Most notably, the survey raises the issue of the dynamic structure of writing groups, and of great variation among practices of collaborative writing.

In order to examine whether this variation is borne out in the detail of how coauthors work, the investigation turns, in chapter 6, to case studies.

CHAPTER 6. TURNING TO CASE STUDIES: AN INITIAL ANALYSIS

6.1. Introduction

This chapter introduces the case studies. An initial analysis is presented in which the five-point framework from chapters 4 and 5 is applied to the data. A more detailed analysis of the same case studies follows in chapter 7.

Dillon, 1993, writes: "There is currently a shortage of firm evidence in the literature on how real-world collaborative authoring proceeds and how it feels to be involved in this process with existing technology." (p. 71). This chapter and chapter 7, provide some such evidence.

Parts of this chapter have been published in Beck and Bellotti, 1993 (appendix B.III), or are to appear in Beck, forthcoming (appendix B.IV).

6.2. Method and design

The purpose of the case studies was to examine, in detail, how collaborating authors who are not all in the same location organise and coordinate their work. In particular, what are the concerns they have and how do they address such concerns. In other words, to examine how context and dynamics affected the progress of the distributed writing process.

Ethnographic field studies of three groups were conducted between the autumn of 1991 and the summer of 1993. These were 'observational' inasmuch as I did not take part in the main task, though I did once or twice contribute to their work by pointing to a potentially relevant reference. The aim was to obtain a broad picture of the ingredients in the writing process (*cf.* my previous interest in 'non-task' aspects). Each study required the full cooperation and commitment of the authors, who were asked to contribute not insignificant amounts of time and inconvenience. As it was important that the intrusion on the participating authors should be minimised, the detail of the design evolved differently in each case (see below).

Each member of all three groups gave me permission to see and to copy drafts, comments on drafts, personal notes, and communication between the coauthors. My intention had been to conduct semi-structured interviews with the participants separately at several points during their writing: soon after the start of their writing project, during the writing, and after they had sent the finished manuscript to reviewers. Briefer and more informal interviews were to follow up on specific developments. For reasons discussed below, in two of the three case studies this did not happen quite as originally envisaged.

All interviews were either audio recorded or extensive notes were taken (or both), though only a limited amount of the audio records were transcribed. In each case study, interviews were conducted with the coauthors as soon as possible after their decision to write a paper, and after the completion of the writing. There were a number of follow-up interviews in between, many over the telephone. During the interviews, field notes were taken; most were also audio recorded. Interviews were conducted with each coauthor independently.

Some observation of coauthors working together face-to-face was possible[29]. In addition, communication between the coauthors was recorded. Telephone conversations between the coauthors in group (i) were audio recorded, and I was also present at several of those conversations. In all groups, any e-mail messages exchanged were collected. Furthermore, copies of notes on, and intermediate versions of, the document were obtained. For one of the groups, virtually all communication between the coauthors about the paper was recorded.

6.3. The case studies

In this section, some background information is provided on each of the groups studied.

Three observational case studies were conducted of in vivo distributed collaborative writing, *i.e.* as it was taking place in everyday work. The case studies were conducted with authors in academia and in academic-style industrial research. The coauthors were employed in research in academia and industry. The completed documents were to be papers presenting research findings for publication in academic journals or conferences. The length of the joint writing ranged from three weeks (plus a post-review, final camera-ready copy preparation effort) to over a year.

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[29] The relatively minor proportion of time spent observing face-to-face work in these studies may lead some to question my use of the term ethnography to describe these studies (Plowman, personal communication). However, the nature of the work was such that the participants themselves rarely (and, for the coauthors in group (i), never) met face-to-face. Methodological ramifications of cases such as these for ethnography have been raised in Cooper, Hine, Low, and Woolgar, 1993, and in Plowman, 1994; *cf.* discussion in chapter 3, section 3.3.6.

6.3.1. Group (i)[30]

Context, document and members

Two coauthors, here called Mark and Fiona, were writing an academic publication together, separated by great distance and an 8 hour time difference. They had done research together, partly while in the same place, but mainly at a distance. The paper was to describe the results of their joint work and was to be submitted, ready formatted, to a conference. During the three weeks while most of the writing was done, there was considerable time pressure to meet the deadline for dispatch. The submission deadline was met, and the paper was accepted to the conference. A second period of work ensued months later, as further modifications were made to the paper before the final, 'camera-ready' version was produced for publication.

Communication and use of technology

Mark and Fiona had met face-to-face very early on, before the writing really started, but not while writing. The bulk of the writing took place over three weeks. While writing, their main channels of communication were electronic mail (e-mail) and telephone calls. The e-mail exchanges were daily; telephone calls were 1-2 per week during the busiest 3 weeks. Both authors used a sophisticated single-user text editing computer system which showed the text in near-typeset quality (*i.e.* fonts, page formatting, *etc.* would appear on the screen as printed). They transferred the whole document between them using electronic file exchange on networked workstations. This would normally be near instantaneous, and was done by the coauthors most days they were both at work. The exchange would be made one, two, or even (once) three times in a 24-hr period. Both authors had access to printers at their own site, and could print out the document. One or both would often print out a copy of the document and write comments on it, but they only exchanged the altered electronic versions. Fax, which they also had access to, was only used once (to send publishers' formatting instructions). They had visited each others' sites, and had close knowledge of each others' work environment. In the period of work leading up to initial submission, the rate of writing work was by far the most intensive in this group compared to the other two case studies.

This case study focused on the three weeks which formed the main period of writing. I was in a different location from both coauthors, but was able to travel to Mark's site, who became my main informant. I was present to listen in on, take field notes from, and make audio records of phone calls between the two coauthors. Phone calls where I was not present, were recorded for

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[30] Group (i) was referred to as group B in Beck and Bellotti, 1993, and 'Mark' and 'Fiona' as B1 and B2 respectively.

me by one of the coauthors. All e-mail messages sent between the coauthors were copied to my e-mail account, which meant that I was often able to follow their daily progress literally from a distance. Electronic copies of the document were saved for me in a file each time Mark retrieved or sent another version[31] of the document to Fiona's site. This built up to a chronological record of the paper at different points in its development, which I was later able to print out on paper and also manipulate electronically. I have been able to compare versions of the draft both quantitatively (lengths of drafts) and qualitatively (what parts of the text and layout had been changed or moved and how). The electronically stored material (e-mail messages and drafts of papers) had dates attached which identified the point of exchange.

I thus had access to an almost complete record of all communication between these two coauthors: 89 e-mail messages of varying length, exchanged over an 18-day period, plus another 14 sent over a 48-day period a couple of months later, while the version to be published was produced; and 24 different drafts, 21 of which related to the first, main period of writing.

In addition, I regularly conducted interviews with Mark (largely face-to-face), and with Fiona (over the telephone), though less frequently. At the interviews, field notes were taken and usually an audio record made. Case study (i) is therefore a particularly rich source of information, not only compared to the other two studies presented in this chapter, but compared to others' published accounts of similar studies. This could itself be a reason to draw heavily on this group in the analysis that follows in this chapter and in chapter 7. Furthermore, however, the intensity of their work—in the sense of the relatively much shorter time in which they produced their paper—meant that it required all my attention while I was gathering the data (as opposed to the other two case studies, in which weeks and months went between each time I contacted them). Therefore, I was considerably more closely involved in the process this group went through. This will, of course, be reflected in my analysis of the three case studies, although an attempt has been made to draw examples from all of them.

6.3.2. Group (ii)[32]

Document, members and deadlines

There were three coauthors, here referred to as John, Carlo, and Alan. Carlo and Alan were in the same building, whereas John was at a different institution 2-3 hours' drive away. The three formed the core of a research group which had already published one journal article and was

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[31] A note on terminology: the words "draft" and "version" both appear in e-mail messages between these two co-authors in reference to electronic copies of the document.

[32] Group (ii) was referred to as group A in Beck and Bellotti, 1993, and 'John', 'Carlo', and 'Alan' as A1, A2, and A3, respectively.

talking about writing more. The document followed in this case study was another journal paper reporting on further research findings. There was no deadline. John and Carlo were working on two other papers as well as a book concurrently with this paper, and separating work on the different papers from each other, which I required for my analysis, was often difficult. This writing project took more than one year.

Communication and use of technology

Alan had been anticipated fully involved, but in fact rarely took part in meetings, even at his own institution. Instead, John and Carlo produced most of the paper without him. John and Carlo were in regular contact, travelling to meet face-to-face 1-2 times per month, and telephoning 1-2 times per week. They made use of stand-alone text editors, diskettes, and occasionally fax transmission (3-4 times over four months). Other technologies available included electronic mail (e-mail), which was viewed as potentially useful but was never used during my period of study, because one of the coauthors (John) at first did not have technical access to an e-mail account, but also was not familiar with the technology and was for a while hesitant to invest the time needed to learn how to use it (despite Carlo's offers of help). These coauthors provided the clearest evidence of valuing meeting face-to-face, in that John and Carlo regularly travelled to meet each other.

In this case study I had considerable problems keeping track of the developments. The coauthors were working on several projects at once. My decision to focus on the production of one paper in each group (other work of the group, including writing other papers, being treated as context for the work on that paper) required, to some extent, a separation of the work on one paper from the rest of the work of the authors. For groups (i) and (iii), where such a perspective did not seem to jar too much with the perspective of the coauthors, this worked well. In this, however, their work involved several projects intertwined, and my attempts to attend to work on only one of the papers contrasted sharply with the coauthors' perspective on it as only one of several tasks in a joint project (see below).

I interviewed all three coauthors; John most often, Carlo fewer times, and Alan only once. I was present at two working sessions; one at John's institution and the other at Carlo and Alan's. Note that on both occasions only John and Carlo took part, although there had been some talk about Alan being present (initiated by John asking Carlo about him), and in the case of the second meeting, Alan was present in the building at the time. Alan's involvement in the writing of the paper did in fact turn out to be hard for me to see evidence of (I mainly saw *expectations* of him being involved, and efforts from John to involve him). It was apparently considerably less than John had been expecting in my first interview with him at the start of the case study.

Particularly striking in this case study, then, was the writing of a particular paper being just one of several tasks in a joint project, and the (apparently) loose definition of who was and was not in the writing group—something which was never an issue in the other two case studies. In both of the other two case studies other writing projects were talked about in general terms as something they intended to do, but it never happened while I followed them. This group, however, very evidently were working on several things at once, to the extent that we uncovered misunderstandings about precisely which paper I was enquiring about the progress of, as the papers were concerned with (it seemed to me) overlapping aspects of the same work.

This, together with a problem with dating the several drafts I received from them (because I received copies of the drafts in retrospect, without dates on them), lead to a problem for me in deciding the exact sequence of the drafts. This raises the question of how *they*, the coauthors themselves, were able to make sense of what the different drafts were (as they did not, for example, update the date on the title page of the document for at least two months, despite apparently exchanging four versions in that period. Furthermore, they invented a naming scheme for quick reference to the different papers. Later, however, a drift in meaning appeared to have taken place (somehow), so that a paper previously referred to as [Name]-2, later became known as [Name]-1. The implications of posing this as an issue are returned to in section 6.5, and taken further in chapter 7.[33]

Interestingly, the difference between the three groups on the uniqueness of the paper I was following the production of, was quite noticeable despite the fact that in all three groups the coauthors were explicitly talking about their current work in terms of one of several joint publications, at least at the outset. Only in group (ii) was this actually being done at the time of my study, however.

6.3.3. Group (iii)[34]

Document, members and deadlines

Two coauthors, Fred and David, worked in the same department while developing the first draft, but were then separated by significant geographic distance (5 hours time difference). There was no deadline.

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[33] No detailed comparison, therefore, was conducted between the document versions for this group; only a cursory look at the kinds of changes made and the approximate intensity of exchange of drafts.

[34] Group (iii) was referred to as group C in Beck and Bellotti, 1993, and 'Fred' and 'David' as C1 and C2 respectively.

Communication and use of technology

Prior to separating, printouts of the whole document were transferred between them twice. When moving away (for the foreseeable future), David took a copy of the file on a diskette. After this separation, e-mail was the only means of communication until a visit by David to Fred (for purposes other than this paper). The cost of telephoning was considered prohibitive. The writing was ongoing for a long time: at the time of my first interview (with both of them, in September 1992), it was a year since David had given Fred the first few pages, which later were turned into a draft by Fred. I then followed their progress for approximately another year, before ceasing to follow their work as a case study. By that time they reported being close to the end but had not yet submitted the paper to a journal. The finishing of this group's work is therefore not considered in this case study.

In this case study it was particularly evident that expectations to what will happen—to the progress of the work, *etc.*—may not come to fruition, but be amended in the face of contingencies, and without necessarily telling the other. In this group, few concrete plans were made about the general progress of the writing (in terms of when one of the coauthors was to hand over a new version), and those that were, were rarely followed. The level of activity turned out to be much lower than the participants had expected. This was due to various unexpected delays.

6.4. An initial analysis: applying the framework to the case studies

Initially, the framework presented in chapter 4 was applied to the case studies, looking at how issues of *orientation*, *planning*, *roles*, *resource use*, and *group* in the groups. This section presents issues that came to light from that initial analysis. Later, however, the framework came to be reformulated in terms of three basic questions (see section 6.5), which are further addressed in chapter 7.

6.4.1. Orientation

The issue of the orientation of the individual coauthors to the activity of writing together was posed to the coauthors in initial interviews, through the question of what they saw as collaboration being, and why they themselves were engaged in it. Most had a mix of reasons, though noticeable differences were also in evidence (for example,, in group (iii), David explicitly said he primarily wanted publications, while Fred's primary concern was to have published to peers what he saw as important research findings). However, during the co-writing as followed by me, these issues did not appear important; I saw no evidence that such differences were of

concern to the coauthors or that they in any noticeable way affected the collaboration. (One could speculate as to why that was, such as their concerns weren't that different, or that they were aware of differences but accepted them; or perhaps that these differences may have mattered in getting together and deciding to write, but not anymore after having agreed to write together.) In group (ii), John, in an early interview, showed understanding that Carlo, being a more junior researcher than himself and being eager to build his career, was particularly keen to get publications.

Differences in orientation to writing, in particular of the status of the manuscript as a reflection of the capabilities of the coauthors, did surface in groups (i) and (iii), when they started discussing at what point to show the unfinished draft to colleagues for feedback (this relates to notions of group; see section 6.4.5 below). In group (iii), primarily wanting a publication, David was not too troubled about the state of the document when shown to colleagues, in contrast with Fred, who showed concern that the document, even as a draft, should reflect well on them.

There was some indications of the use of previous experience, and within that, of awareness that perhaps the other coauthor had more experience (for example, Mark expressed, in interviews, knowing that Fiona had more experience (and this was a positive reason, one of many, for it being easy to work with her).

6.4.2. Planning

The use of plans among the coauthors was an area of particular interest to me, because of the focus on this in the CSCW literature. An aim was therefore to explore the making and use of plans in distributed collaborative writing, inspired by Suchman's (1987) critique of cognitive science notions of planning, discussed elsewhere (for example, in chapter 2, section 2.4.1, and in chapter 9, section 9.2.2, where the relationship between Suchman's focus on individual action is contrasted with my interest in planning as the negotiation of agreements between collaborators).

This was perhaps the most successful of the five categories of the framework in terms of providing an interesting focus, not least because of the revealing fact of considerable problems encountered in deciding, from an analytic point of view, what in fact was a plan. Some plans, of various kinds, were indisputably discussed, agreed, and carried out between the coauthors, such as, in group (i), when to show drafts of the paper to others for feedback, or, in group (ii), when to meet up. However, first, determining at the time whether or not an agreement had been made, as such, when two coauthors had discussed an issue, was, to me as an 'observer', not a trivial matter. Second, agreements made on action to be taken, regularly turned out not to be carried out. The way in which I came to realise this, is interesting to note: I would make a note of anything that seemed to me to be an agreement between the coauthors for one or both to do

something in particular, but when in a later interview I enquired about whether this had happened, it would often not have. In such cases my informant would, more often than not, seem somewhat surprised or at least reminded of something which she or he apparently had not given much thought to lately [which to me at the time of making had sounded like a firm plan to do something, maybe by a particular time]. This happened so regularly in all three groups that I came to expect no agreement made, however definite it seemed, to actually have been carried out until (and if) I was told it had. In this respect I gradually became hesitant to regard any agreement made as a 'plan' to do something.

Also striking was the incidence of tasks having been done by a coauthor (and being reported to the other coauthor) which had (apparently) not been discussed between them previously. Furthermore, the other's work plans could be anticipated outside any agreements made, such as in the following e-mail message from Fiona to Mark:

> *"Mark,*
>
> *In case you're working on Sunday, can't get the paper (which I can't [transmit] Saturday), and want to see some changes....*
>
> *Here is the plain text of some paragraphs:"*
>
> [This was followed by 10 paragraphs of text, with brief indication of where in the document the paragraphs belonged]

This is an example of an apparently considerable autonomy of an individual coauthor in deciding what to do and whether to follow agreements made.

An interesting example of a number of the issues discussed in relation to plans, in this section and in chapters 7 and 8, is the following e-mail message from Fiona to Mark. Fiona shows expectations to have heard from Mark despite no such agreement having been made (*"Should I be concerned that I haven't heard from you"*), and self-awareness that this is what she is doing (*"No, no, we hadn't said that I "should""*). She provides information on what she is doing that day, indicates by what time she expects to have had a version from him (*"when I'm out at 5pm"*), and in what interval she expects to work on the paper (from she receives it, to: *"give you some comments/modifications before I go home tonight"*), all in the first paragraph. In the second paragraph, the way she offers various kinds of information on what she will be doing the next day and demonstrates knowledge of Mark's programme (*"you'll be in [a meeting]"*), shows awareness of the consequences for the coordination of their joint work. She is aware of the likely implications of Mark's programme for his work on their joint project, and for their need to coordinate (*"we won't need much overlap until Wednesday"*), but also the possibility that there might nevertheless be things he wants to communicate (*"Feel free to call me"*). She sanctions him contacting her at home and facilitates this by providing her phone number:

"HI Mark,

Should I be concerned that I haven't heard from you this afternoon (no, no, we hadn't said that I "should" :-) I'm off to [meetings]. I will expect to grab the paper when I'm out at 5pm and give you some comments/modifications before I go home tonight.

My current plan is to work at home tomorrow. The problem in doing that is file and even e-mail transmission. However, you'll be in [a meeting] so I expect we won't need much, if any, overlap until Wednesday. Feel free to call me at home, [phone number], if you wish. I plan to work on an upcoming talk and/or [a book] on the Mac ....

Fiona"

We thus see her awareness of the effects of various contingencies on the process and on their coordination needs, and how she uses subtle cues to display this to Mark. If this is to be called 'planning', much planning at this level was in evidence in this group (and examples of this kind of coordination of the next or next few interactions can be found for the other two groups). However, little evidence was found of planning at the level of the whole writing project[35].

6.4.3. Roles

I did not see evidence of specific roles being allocated. However, in groups (i) and (ii), there was evidence of a split of tasks along lines of expertise. (This seemed related to a broader issue of how each coauthor knows (and/or decides) what to write; see section 6.5.) But gradually this specialisation broke down; each coauthor, instead, opportunistically doing what they could, often taking into account how busy the other coauthor was. Thus, I saw evidence of some tendencies for some coauthors to do certain kinds of work (expectations were expressed that a particular coauthor write sections on a certain aspect of the work, for example, in group (ii), where Alan was expected by John and Carlo to write sections he was considered an expert in). However, there was apparently a complex mix of reasons for this, such as technical ability/specialisation and personal preference. In the example above, Carlo later expressed disappointment that Alan had not done what was expected of him, mainly because he was not expected to do much else. His part as a coauthor had been explained to me early on by John in terms of intellectual property right (a key idea from which the work originated had been Alan's), but later resentment was evident, particularly in Carlo, that Alan's name appeared as a coauthor despite his input in terms of actual writing work being minimal. In one sense, then, Alan's 'role' as a coauthor stemmed from another 'role', namely that of having started the research group

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[35] This could be explained by the relatively less data I have from the very start of each of the writing projects. However, in that case one might expect references to such a general plan to be made at least a few times during projects as complex as these and taking place over such long times. This was not observed.

and the current line of work, but not from his actual input into the document, something Carlo showed more signs of unease with than John did.

Coauthor roles, therefore, seemed a considerably more complicated question in the practice of writing together than some of the literature would indicate. How this relates to questions of support is further discussed in chapter 9 (section 9.2.1).

6.4.4. Resource use

A notable feature as far as use of the available resources were concerned, was that the most important/scarce resource appeared to be *time.* This was an issue that cropped up regularly in the deliberations of all three groups: In group (i), the gradually approaching deadline was of course an issue, but also—and much more evident as an important concern in the actual practice of their work—their daily, or near-daily discussions of when to transfer the document between them. In group (ii), time was an issue as a background urgency to get their work done; there was much work to be done, many papers to write, and only a minimum of time was spent on chitchat or off-task talk in the sessions I observed.

The prominence of time as a prime concern of the authors contrasts sharply with my original expectations that coauthors would be more concerned with negotiation of access to technical resources. As far as those were concerned, it was interesting to note that as I did expect, not all technology available to the coauthors (including technology which from the outside would seem 'supportive', and which they were aware of) was used. In group (ii), e-mail was not adopted until very late despite Carlo's regular mentioning of it and arguing for its benefits; in group (i), fax was not used except once.

An interesting point to note is the commitment of great resources in terms of time and/or money to contact between the coauthors in groups (i) and (ii): expensive, long-distance telephone conversations were apparently considered essential in group (i); as was, in group (ii), travelling to see each other, despite the fairly long distance to be covered. This raises the question of what the benefit was, in particular in group (ii), where the resource in question was personal time rather than company money.

6.4.5. Group

In these case-studies, there was evidence of tacit expectations existing of levels of contribution from coauthors (all groups), and of dissatisfaction (group (i)) or slowdown in progress (groups (ii) and (iii)) when expectations were not met. In group (i), the expectation that both coauthors work enough was an issue that kept being referred to in e-mail messages, for example, "you

would've noticed that I've actually done some work" (Fiona; in reference to an e-mail message that went missing).

As indicated above, in group (ii) Alan's work on the paper was almost negligible compared to the other two, which caused dissatisfaction. His lack of involvement even in a meeting at his site, while he was in the building (I interviewed him that day; he himself appeared to have as little involvement in the work of the other two on this paper as the impression I had from talking with the other two), was striking. To me, it was always unclear whether or not he really could be said to be a member of that group. This is interesting inasmuch as the coauthors nevertheless went ahead and wrote this paper and others. (The two, John and Carlo, were writing another paper together with a third person while this case study was going on, a situation which was apparently much more satisfactory to Carlo. However, John, Carlo, and Alan were also 'officially' all involved in the writing of a book, which also took place in parallel with this case study. From my perspective it looked like much the same situation again: John and Carlo were arranging meetings, exchanging drafts, talking about what they would have to do in the future, apparently without the involvement of Alan more than in the occasional effort by John to involve him on limited tasks.) The issue of where the group boundaries are, is therefore not a simple one. For this study, the interesting point to note is that this group was able to do its work despite this uncertainty. It is therefore not the case that the group has to be clearly defined to work.

Another issue relating to the group as a phenomenon, is what happens when work objects cross its boundaries. In academic writing groups this happens in the ordinary practice of showing drafts of the manuscript to colleagues for feedback before crossing the further boundary of submitting it to an editor for formal peer review for publication. In groups (i) and (iii), differences of opinion about when to do this were in evidence, apparently because of differences in how they saw writing (see section 6.4.1 above).

6.5. The framework reconsidered

The initial analysis in the sections above has provided interesting questions. However, while working with the proposed categories in conducting the analysis, their limited empirical basis became a problem. This section considers a different framework more appropriate to framing the field studies, emerging in parallel with the last part of the field studies.

The framework soon came to diverge from what appeared to be more central to the concerns of the coauthors themselves. Limiting attention to the five areas proposed in the framework provided the impetus for including certain questions to start with, but it became clear that substantial aspects of the process that seemed more part of coauthors' concerns, and which

were highly relevant to my general interests, would have to be omitted if the framework was to be followed closely. These included coauthors' concerns with exchanging documents; what function meeting up or telephoning each other had on top of other communication media, and the question of the function of duplication of messages in summaries; group (i)'s orientation towards a deadline and groups (ii) and (iii)'s concern with where to submit their paper. In particular, the question of the function of (apparently) 'redundant' communication, *i.e.* the duplication of message content in separate summaries, and the exchange of chitchat about apparently unrelated issues, could not be adequately addressed through the framework. If there are no clear stages of the process, is there something else to be said about changes the documents go through? What kinds of issues do coauthors who are far away from each other have to deal with in working on the same work object? And if plans can be broken without sanction, they cannot be considered the organising pivot for the collaboration. How, then, do individual coauthors decide what work they should be doing at any one point? (In other words, how is work coordinated?)

In short, the framework did not provide a 'fit' with the data. This was inadequate in relation to the issues of interest, and the five-point framework had to be rejected or reformulated in favour of a more open-ended approach. This time, the attempt at separating 'task' from 'non-task' issues was to be abandoned, as it had proved a somewhat contrived focus in the initial analysis. Instead, evidence of practices which would appear to be important to the coauthors in carrying out their work was sought. The analysis was to focus on three basic questions about the workings of the groups[36]:

> What transformations does a document go through? (*I.e.* how does it come to exist and evolve into its final version?)
> How do coauthors manage access to the (shared) document?
> How do coauthors decide when to make changes to a manuscript and what to write?

In chapter 7, these questions are applied to the field studies introduced in this chapter.

6.6. Summary of chapter 6

This chapter has introduced three case studies conducted with academic coauthors distributed over distance, as well as an initial analysis in terms of the framework from chapter 4. A number of interesting practices have been documented, such as the possibility that plans agreed between the coauthors can, under some circumstances, be contradicted without sanction.

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[36] These questions were first presented in Beck and Bellotti, 1993 (appendix B.III). They were formulated in a series of discussions between Victoria Bellotti, Paul Dourish, and myself, as a distillation of what had been a confusing melée of concerns in my analysis. I gratefully acknowledge their contribution.

However, some fundamental questions remain unaddressed because of shortcomings of the framework, notably some prime concerns of the coauthors themselves. In this light, the framework has been reconsidered, and a new set of focus questions, more fundamental than the previous, has been derived.

The next chapter, chapter 7, presents further data from these case studies and discusses them in terms of the revised set of questions. In it are drawn out some themes emerging from the case studies themselves. Implications are discussed in chapter 8 in terms of proposals for conceptualising distributed work in general, and distributed collaborative writing in particular. Design implications are discussed in chapter 9.

CHAPTER 7. LOOKING AT THE DETAIL: A FURTHER ANALYSIS OF THE CASE STUDIES

7.1. Introduction

The initial analysis of the data from the case studies introduced in chapter 6 in terms of a previously derived set of categories, proved, as discussed in section 6.5, inadequate in terms of capturing the concerns of the coauthors themselves. To capture some of this perspective—important to system design at an abstract and a concrete level (*cf.* discussion in chapter 2, section 2.5.6)—a different approach was needed. This chapter discusses the data from these three case studies in terms of the three basic questions posed in section 6.5. Not much is understood about some fundamental questions about the process of collaborative writing. These were:

> How a document comes to exist and evolve into its final version.
>
> How coauthors manage access to the document.
>
> How coauthors decide what and when to write.

For each question I focus on information exchange and ask what coauthors inform each other of, and how.

In each case study, interviews were conducted with the coauthors as soon as possible after their decision to write a paper, and after the completion of the writing. There were frequent follow-up interviews in between, mainly over the telephone. During the interviews, field notes were taken. Most were also audio recorded. They were conducted with coauthors on their own, some over the telephone. In addition, some observation of coauthors working together was possible. E-mail messages, as well as notes on and intermediate versions of the document, were collected. In group (i), virtually all communication between the coauthors about the paper was recorded.

Parts of this chapter have been published in Beck and Bellotti, 1993, or are to appear in Beck (forthcoming).

7.2. Document creation and evolution

7.2.1. Creation

In both groups (i) and (ii), an explicit decision to start writing a paper existed before writing started. Group (i) met to discuss the topic and content of their document before they began writing it. In group (iii), on the other hand, there was a gradual process by which an initial note was developed into a long enough document that the authors decided to turn it into a full-length publication. For all three case studies the shared document coming into existence was a gradual realisation; it was not an event which even in retrospect could be clearly determined.

7.2.2. Evolution

For group (i), I was able to collect a complete set of versions of the document exchanged between the coauthors. Figure 7–1 shows the development of the paper in terms of the sizes of each of the 24 drafts they exchanged. Sizes of the documents are given in both formatted and unformatted versions, to illustrate an analytic point: note the slightly different impression one might get of the development of the document from the two sets of data. On the one hand, sizes of the formatted versions would be an obvious statistic to work from, since this is what coauthors work with, and since any computer support system would be easily able to track such information, should it prove useful. On the other hand, that version changed so much in size with the figures which the coauthors inserted and deleted from their document, that a different scale would have been needed to display these, and they certainly would have obscured the changes there are (see caption for figure 7–1). Even so, the changes appear less prominent in the formatted versions than in the text-only versions.

The bulk of the writing took place over 22 days. The gaps between versions 2 and 3, and 18 and 22, were due to absence of Mark or Fiona. In each case, the other one went on writing. So, although the last exchange before the deadline was day 17 when Mark went away on a trip, Fiona continued writing up to day 19. On day 11 the network connection was not working and thus no exchanges were possible.

A high level of activity
drafts on day 16. The c
version 21 to the con
returned and saw a co
as a final revision befo

months after initial submission.

Figure 7–1 shows that in group (i), the document reached its full size early: already version 7 was of a similar size to the last versions. Examination of the actual version changes revealed that much of the total effort went into rearranging and rephrasing existing text, as opposed to generating new text.

Concern about formatting emerged early in Mark's and Fiona's communications. They inserted headers, some with mock section contents, which helped organise existing text and apparently acted as place-holders and reminders of actions to be completed in the future. Headers were also important aides when communicating summaries of changes, where they were extensively used as coordination points or shorthand references to the section contents: "[The new version] has the [required] format (hopefully), the figure moved to the last page (since it looks like it will require manual placement), a rewrite of the [section name] stuff, and various other small modifications." (e-mail message accompanying version 6). Some formatting changes also show up in the graph: between versions 5 and 6, the document was re-formatted from single-column to double-column, resulting in an increase in the formatted size but not the text size.

In producing group (i)'s document, no significant restructuring was done from version 13 onwards. Interestingly, most other changes—additions, deletions, and rewordings—occurred throughout. The volume of changes trailed off after version 18.

For group (ii), the process of writing was closely intertwined with other work including writing of other publications. Their way of working together was diverse, changing throughout the process. At face-to-face meetings, they would often sit down by the word processor and compose or review parts of the document together. Twice, an electronic file was exchanged by storing it on a floppy disk and handing this over at face-to-face meetings. Between meetings, they would normally work on separate sections, which one of them (usually Carlo, who was more experienced with the word processor) would incorporate into the current version. During the three months of writing, the document evolved largely through parts being passed between John and Carlo (rarely the whole document), typically every week or two.

The rate of communication in group (iii) was the lowest of the three case studies. Over one year the document was expanded from an initial 3-4 page version written by David without a view to producing a full-length paper, to an expansion by Fred into 20-odd pages; in retrospect referred to as the first draft. David had done related writing for other purposes and incorporated this into a second draft, which was discussed when they met six months later. After one meeting discussing the paper, David made amendments and left the paper with Fred to review, which David did after some months. When I stopped following the group, the paper was back with David, for what was hoped would be a final revision.

7.3. Managing document access

In chapter 6, the general situation in which the groups were working was introduced (section 6.3), and group membership, which in one sense means access to the document, was discussed (section 6.4.5). In this section, some of the detail of how the coauthors managed access to the document is discussed.

7.3.1. Timing and organisation of document access

The available technology and the respective work rhythms (such as determined by time zone differences or other work commitments) seemed to be important factors in choosing access strategies, as well as time available, or urgency of the writing. In groups (i) and (iii), explicit agreements on how to access the document were followed most of the time, whereas in group (ii), no such general agreement on document access was observed.

Opportunistic decisions on document control were most evident in group (ii). For example, one version of a document was exchanged between coauthors by handing over a diskette when the coauthors were meeting for other reasons (a seminar).

In group (i), an alternative document control strategy of parallel work and later merging emerged to allow both coauthors to work despite a technical communications problem. Furthermore, Fiona once changed the document despite Mark "having" control. From previous 'non-task' talk, Fiona knew Mark was tied up with other work, and that there was no system enforcement of the control. This opportunistic breach of agreement caused no problem to Mark when told; he knew Fiona had had the knowledge to make a good decision.

In group (iii), the document was initially passed between the two coauthors in its entirety, such that each had complete control. This strategy was later changed to a plan for David to be in charge of combining sections, as indicated above, and still later readjusted in response to slower progress than anticipated.

7.4. Deciding what and when to write

Coauthors may agree on writing strategies, but these are not necessarily adhered to. None of the groups had an evident leader; instead individuals made agreements as required, and made autonomous decisions and took opportunistic action in response to unforeseen developments. Agreements on who does what, when, were made and broken in all three groups, without necessarily causing problems.

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Figure 7–2 shows an example of group (i)'s e-mail exchanges during days 6 and 7, a time when the document size was rapidly expanding, and the rate of messages exchanged high.

Sending and reception times are indicated in the local time of each coauthor. It should be clear that transmission time was usually almost instantaneous. Two messages from Fiona on day 7 were held up, and crossed with other messages, which went undetected for a while, but in this case caused no problem. Once, however, a missing message did cause problems and subsequently some double-checking was done on the telephone of whether e-mail had got through. This suggests that the unreliability of e-mail may occasionally cause problems even for experienced e-mail users.

It is interesting to note, in figure 7–2, that each coauthor would send several messages apparently without waiting for a response. This was a typical pattern of exchanges in group (i). Specific coordination information not requiring a reply was often contained in short messages: for example, that a new version of the document was ready for handing over. This information was important, as it marked transfer of responsibility for the document—of who "had" it. Note also that the e-mail messages are relatively short—two-thirds of the messages have less than 20 lines of text. This was not untypical for the e-mail exchanges in group (i)[37].

In group (ii), towards the end of writing, John and Carlo had agreed that John should look over the near-final version and provide Carlo with final changes. But after waiting for a while without any notification of changes, and being aware that John was particularly busy in that period, Carlo opportunistically made the last changes himself, in order to get the paper submitted sooner. It is interesting to note that both Carlo, and Fiona, in the somewhat similar situation above, were able to do this because access restrictions were not technically enforced; only socially. John, like Mark, was only notified after the event, but no disquiet about this overt breach of agreed control strategy was evident.

Changes were not always communicated and this sometimes lead to problems. Communication failures could result in coauthors becoming disgruntled with one another, and could mean that precious effort went to waste. On one occasion an important e-mail message from Fiona failed to get to Mark. It set out a proposed structure and some contents for the paper and was sent off just before a week's absence by Fiona. Despite regular communication in the intervening period, it took a few weeks to discover the loss, by which time the message and the effort that had gone into it was of little use. On discovery of the loss of the message, Fiona was clearly disappointed: "(Jeez), Mark, and I worked so hard to get this out before I left" (from telephone conversation).

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[37] This contrasts with a claim in Sharples, 1993a, that elaborate communication is required for intense collaboration.

Group (iii) had a different problem, in that an expectation of no feedback in case of progress meant that at one point, Fred, having heard nothing, was half waiting for a second draft to turn up at any time when, in fact, there had been no progress.

7.4.2. Making changes visible

In group (i), coauthors made their own changes visible to their coauthor in a number of ways: telling them explicitly in summaries; putting in devices to attract attention in the text itself (comments in italics and square brackets), and by the removal of such devices.

Letting the document carry comments

Both in groups (i) and (iii), coauthors would often make comments in the text of the document itself which for example questioned something, and were not just writing in text that should go in that place. In group (i), there might even be replies to such statements or queries through the document versions, creating a dialogue embedded within the emerging document, but with its own discourse. The ability to attach a comment to the point in the text it referred to allowed efficient use of deictic references in the comments, which was extensively used. The following excerpt is a particularly striking example, in which the single word "why" conveys meaning because it is understood in the context of the immediately preceding sentence:

> *"*... is a common activity. *[F: Why? I don't think this is intuitively obvious. There are implications in the next paragraph but maybe something would be useful here?] "* (group (i), document version 14, in mid-paragraph; orig. brackets and italics).

Comments could also serve as status indicators; a sign that further work was needed. Comments would remain until a solution was implemented. For example, the following comment from Mark, which serves as a place-holder suggesting what kind of argument he wants to make in a rewritten paragraph without having to formulate it (yet), remained untouched in the next version: "Based on *[M: something or other]*, we have ..." (in versions 12 and 13; orig. brackets and italics). Then it was replaced by "Based on our experiences with [...], we have ..." (version 14, my brackets).

One dialogue, which seems to have served a number of functions, including an indication of work to be dealt with, is the following, again from group (i):

In version 6, a comment appears which starts "*[I'm not sure how much we want to say here."* (orig. italics). In version 7, the paragraph has been rewritten and the comment replaced by "*[M: I'm still not *entirely* happy with this, but it's closer.]"* (orig. italics). (Note that there now is an initial which identifies the commenter.) In version 8, Fiona replies without deleting Mark's

comment: "*[M: I'm still not *entirely* happy with this, but it's closer. F: Me neither. "How?" to your last sentence.]"* (orig. italics). This comment remains unchanged for two more versions of the paper, then more comment is added in version 11, and in version 12 (a version sent by Mark to Fiona), the comment no longer appears, the paragraph has been slightly amended (by Mark) by the removal of the sentence questioned by Fiona.

In this example, it is worth noting that Fiona has chosen to keep Mark's original comment unchanged. This makes the immediate context for her own comment that of Mark's (as opposed to the document itself). This comment has more character of an open discussion than the example above, in which, for example, Fiona provides no explicit pointer into the document for her one-word ("why") question, as she does here. Another point to note is the awareness displayed by Fiona of who wrote the original text ("your sentence"), despite Mark arguably opening up the issue for general discussion. This seems to indicate that responsibility for some text can rest with the original author even when, as in the case of these two coauthors, their agreement was that when one person "had" the document, she or he could change any part of it (without having to obtain the permission of the other).

Another way of making changes visible was employed when Fiona had made changes to sections of the document while Mark "had control" over the document (see above). Mark, having made other changes to the same sections, left the old version of the sections in question at the end of the document for Fiona to see, as a historical trace of where the new version had come from. (This shows up in figure 7–1 as version 12 being significantly longer than 11. Note that this was deleted for version 13 by Fiona.)

Finally, both coauthors in group (i) would, in e-mail messages, regularly summarise the changes they had made to the document.

We thus see how these coauthors achieved compact communication of changes by employing both a textual and historical context to carry part of the meaning.

7.4.3. Balancing work on the document with other activities

The coauthors were continuously having to balance work on the joint document with other activities. In group (i), where the effort to produce the paper was most concentrated, there was an expectation of very high prioritising of work on the paper. In group (ii), the writing took place over a longer period and more other work was done in parallel. In group (iii), the proportion of time spent on activities unrelated to the collaborative writing was very high for both coauthors.

Coauthors made efforts to find out about and inform others about competing activities, and continuously made adjustments to expectations of the other's work. The exchange of detailed

information about each others' programme was particularly evident in group (i). But also in group (ii), coauthors John and Carlo knew a lot about each other's program (*i.e.* they had told/asked each other). For example, John knew that Carlo would be having a small operation one week and did not expect him to make any changes to the paper. In group (iii), Fred carried on with other work while remaining ready to prioritise the joint work, should David send him a new version of the document, showing great flexibility in adjusting to David's pace of work. However, lacking the information that David was busy with other work, caused Fred to be unsure whether to set time aside from other work for this paper. Note that Fred initiated communication with David at a point when other work was causing less pressure on him.

7.5. Discussion of case studies

Much existing literature on computer support for collaborative writing has suggested, as discussed in chapter 2 (in particular section 2.6.1), that positivist assumptions about the process of collaborative writing are reasonable when designing computer support for this process. In contrast, my research has documented practices of distributed coauthoring where salient features are great flexibility and context sensitivity with which coauthors interpret information and situations, and come to decisions about appropriate courses of action. Instead of, for example, carrying out tidy agreements, coauthors appear autonomous in relation to agreements, even to the extent of directly and unilaterally contradicting them when deemed appropriated. Such flexibility seems an integral part of necessary, but often subtle, adjustments to continuously changing circumstances. Coordination of work between the coauthors is achieved at least in part by the construction and reconstruction of common understanding, dynamically maintained, rather than a reliance on following agreed plans.

In the following, the findings are discussed in more detail. Their relation to the literature is returned to in chapter 9.

In terms of the three questions of document evolution, managing document access, and deciding when and what to write, the main findings are:

> The documents evolved differently in the three groups. In all groups, versions were exchanged between the coauthors several times during writing, but by different means. The intensities of document exchange differed substantially in the three groups. For group (i)'s document, sizes of versions exchanged were compared, and it was notable how a substantial part of the effort of the coauthors (in terms of proportion of time spent on it) was devoted not to adding to the document, but to rewriting, reorganising, *etc.* Many kinds of changes were made more or less throughout the writing project; particularly worth noting were the discussions of the purpose and main point of the

paper going on until quite late, and the early start with formatting changes. In all groups, the eventual path of the document's evolution appeared to be as much a product of responses to contingencies in the environment (for example, technical problems causing the coauthors in group (i) to decide to work in parallel for a while), as of following any laid out general plan.

Managing document access was highly contingent on circumstances. In group (iii) travel arrangements, again for other reasons than the writing, contributed to determining who had access. In group (ii), floppy disks were exchanged by post and when the coauthors met (whether to work on the document or for other reasons), and faxes were sent. In this group, a variety of ways to change the document were used: both of the main coauthors would type changes into the document; one of them would type in the other's suggestions; or, at least once, they would be in the same room, sitting by the same computer, working at the document together (one of them typing at the time; both discussing what changes to make). The third coauthor, who played a peripheral part in the process, did not, as far as I know, ever access the document itself. In group (i), electronic file exchange facilitated the easy exchange of documents. Social agreements only determined who had access. These were broken at times, evidently causing no problem. There were frequent exchanges. Comments were used in a highly dynamic way; including dialogues developing over several exchanges of the document. There was no sign that the coauthors missed technical enforcement of access restrictions.

Individual coauthors were highly autonomous in their making of decisions on what to write, including in relation to explicit agreements made. This was facilitated by offering to each other information which could be taken into account as and when judged appropriate. Information could be offered and questions asked also without the context of an immediate dialogue, such as, in group (i), by e-mail messages sent at times when the other was not likely to be at the office to receive them, and in groups (i) and (ii), when changes were summarised or open-ended questions asked along with communication for different reasons. Crucially, what was later to become relevant was not necessarily possible to tell in advance.

In addition, the following points are worth noting:

There was great *flexibility in the use of the available technologies*. The exploiting of the "as printed" formatting capabilities of their word processors in group (i), and the number of different media through which comments were exchanged and documents transmitted in group (ii), are two examples. In group (iii), there was a considerable difference between the two coauthors in how they, individually, used their word processors, with one (Fred) preferring to write out text

longhand at home and later type in the finished or near finished text, whereas the other preferred typing right away. In each case, ways of working together evolved which suited the various constraints.

Importance of 'non-task' and 'redundant' communication. Most of the information I observed communicated between the coauthors related in some fairly direct way to the construction of the document. However, other communication, at the time apparently unrelated, could later come to be used in a coauthor's assessment of what action to take; whether it would be appropriate to break an agreement, *etc.* Such 'non-task' communication was therefore not only social contact, but an integral part of the subsequent autonomous making of decisions which would be likely to be acceptable to the other. This indicates the subtlety of coordination between these coauthors, and supports the view that one can not separate out some communication as extraneous or redundant, as one might otherwise want to do if one wanted to encourage a more 'efficient' process. This is consistent with the conclusion of Plowman, 1993, with respect to talk among coauthors, that "'group' talk is inextricably bound up with procedural, executive and substantive talk" (p.159).

When the document was transferred, messages would often accompany the document (such as a fax cover sheet, in group (ii), or e-mail messages in group (i)). These were highly interesting for my analysis, because they usually contained little information that was not also conveyed elsewhere, yet their frequent appearances seemed to indicate that these messages were important to the coauthors. They appeared to serve several functions:

> First, they made the statement that a new version was available. In the case of fax transmission of the document, an explicit statement of this would not be strictly necessary, since the fax appearing would itself signify this. However, with group (i)'s document exchange scheme, the active informing of the other of the existence of a new version, saved the other unnecessary checking. Furthermore, the precise location, including the file name, would also be provided, though the same or similar name was used most of the time.
>
> Second, the messages exchanged in group (i)[38] would frequently summarise the changes the sender had made since the last version.
>
> Third, comments were made on the status of the document and of the progress of the writing project. In group (i), these comments appeared to be characterised by taking the opportunity, once communicating, of offering perspectives on the progress, especially emotional support.

These various kinds of information appeared to be important in *providing context for the other's interpretation* of the changes made.

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[38] In the other two groups I only gained access to one or two such accompanying notes.

'Piggybacking' communication. The transmission of the document could, as shown above, be used to comment on what was being made available. However, the opportunity was also taken, in many cases, to communicate other matters. In group (i), this was particularly evident and was frequently seen in the e-mail messages accompanying (*i.e.* announcing the availability of) new versions. These could be light-hearted comments on the writing work, or questions or comments about other issues which that coauthor was concerned with such as in Fiona's e-mail message quoted in chapter 6 (section 6.4.3). In group (ii), an example is the covering sheet to a fax, saying what the recipient is expected to do with the enclosed document (in this case, show it to a third person for comment), and, at the same time, arrange their next meeting.

The constant evolution of the coauthoring process in response to changing circumstances may be one of the causes of the significant variation between groups which in the early investigations of this thesis (see chapters 4 and 5) appeared problematic. Thus, the case studies have not only confirmed that the variation between groups can be great, but also that differences can exist between coauthors within a group, and for a group over time. Significantly, while these differences do, of course, cause problems at times, much variation which would be very hard for a model or most computer systems to handle, apparently caused little or no problems to the coauthors. From this, *variation* seems an *integral part of the process*.

7.6. Summary of chapter 7

The analysis of the case studies in this chapter was undertaken in order to examine what work coauthors do in managing their activities and coordinating their work, since the initial analysis, in chapter 6, had left unaddressed the crucial question of how people who coauthor deal with such great variation as the studies had appeared to indicate. Instead of trying to reduce the variation, the question of this chapter has been: *given* the variation, how does coauthoring work? This issue has been examined in terms of three questions. The case studies have pointed to some interesting issues, showing collaborative writing over distance, for these three groups, to be a process characterised by constant evolution and adapting to changing circumstances. Dynamic construction and maintenance of common ground appeared to play a pivotal part in these coauthors' working together.

Chapter 8 explores, on the basis of the case studies, the two concepts of *informed opportunism* and *documenting changes*.

CHAPTER 8. INFORMED OPPORTUNISM, AND DOCUMENTING CHANGES

8.1. Introduction

In this chapter, two concepts are proposed which in some sense reflect the concerns and findings of the preceding, empirical chapters. In doing so, I follow the example of Anselm Strauss (1985), who, based on many years of qualitative fieldwork-based research, proposes several concepts as being useful to research the area (including that of articulation, discussed in chapter 2 and elsewhere in this thesis). In reference to the concepts he proposes, he writes: "Properly utilized, the concepts [discussed in this paper] are instruments to guide research, not merely descriptive tags: to use them so would be useless." (Strauss, 1985, p.1).

This chapter presents two related concepts developed from the empirical studies of the preceding chapters. They are only two of several possibilities, but they do capture some of the essence of the studies conducted. The purpose of proposing them follows that of Strauss in presenting what I feel are interesting and important themes emerging from the studies, and, I hope, in a way which may provide a starting point for discussion, and which other researchers may (or may not) find useful in any further exploration of the issues. The concepts I propose, however, are not based on the same wealth of experience and reflection, and should be seen in that light.

The detail of studies is important to convey to preserve a sense of the richness and variety in what happens when people act in a messy world. This thesis conforms to that view, culminating in chapter 7's detail on how some people, in certain circumstances, came to work in certain ways. However, there may be a case for offering a concept or two to draw together the points made. This chapter does that. Two related concepts are proposed; that of 'informed opportunism' as a strategy, and, with a slightly different emphasis, that of the relationship between changing documents and their documenting of changes to each other. (These were first proposed in Beck and Bellotti 1993, and in Beck, forthcoming, respectively; see appendices B.III and B.IV.)

A note of caution about the status of these concepts might be in order. I believe they are useful in terms of the aim of this thesis of contributing to bridging the gap between computer design requirements and qualitative, sociological field studies. However, the problems of generalisation, which ethnomethodology argues so strongly against (see chapter 3), have not gone away. Stories of the activities of the coauthors in all their richness, already reduced in the preceding chapters compared with what I have seen (itself a reduction, and seen from a particular angle), are important in themselves. But in addition, given the desire to contribute to system design, providing concepts that capture *some* of the richness, may be useful. Grounded Theory, as discussed in chapter 3, does work towards, and through, the construction of categories and concepts to denote these. The concepts presented here have not, however, been derived through Grounded Theory's systematic relating of concepts and derivation of core categories. At the same time, the concepts as proposed may be too general to be directly useful for system designers. As discussed in chapter 3, increasingly the need for a compromise between these two positions is recognised in CSCW as essential for making progress on the practical tasks with which the research field is concerned. In this thesis, the implications from the studies, including these concepts, are proposed as part of such a compromise. The two concepts proposed in this chapter remain reasonably grounded in the empirical data, whereas the design implications in the next chapter are more tentative.

8.2. Informed opportunism as strategy

The presentation of the case studies in chapters 6 and 7 showed the process of collaborative writing for these three groups to evolve over time, continuously adapting to changing circumstances. Coauthors offered each other and made use of a range of information, from responses to direct questions, to comments which may or may not be of interest or relevance to the other. Their subsequent opportunistic use of such information to make appropriate *ad hoc* decisions in new circumstances appears to be essential to achieve flexibility and coordination. Salient features of the process, then, seemed to be great flexibility and context sensitivity with which coauthors interpreted information and situations and came to decisions about appropriate courses of action—even unilaterally contradicting agreements made, when deemed appropriate.[39] This is what I characterise as *informed opportunism*[40].

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[39]Interestingly, Odell conducted a study of writing in an office environment which suggested that even apparently individual writers relied on awareness of shared attitudes among their co-workers to determine the appropriateness of their choices while writing (Odell, 1985).

[40] As noted in chapter 1, the concept of informed opportunism was developed by Victoria Bellotti and myself. The writing process has also previously been characterised as 'opportunistic', but in a slightly different sense: Streitz, et al, 1992, see writing as a design process, and as such, the writing process has "*subproblems* [which] are solved by specific activities which are *opportunistic*, *i.e.*, they strongly interact

'Opportunism' is intended here in the sense of "being guided by what seems possible, or by circumstances, in determining policy; preferring what can be done to what should be done". We refer to this as a 'strategy' only in the sense of "skill in managing any affair", not, for example, the systematic making and execution of plans. (Both definitions from Oxford Advanced Learner's Dictionary of Current English, 1974 edition, 12th impression.) The definitions are important in setting out the difference between the concept proposed here, and that of, for example, the 'writing strategies' (in the sense of planned action) commonly sought by writing researchers, in particular those concerned with the teaching of writing (see chapter 2, section 2.5). The term has been chosen, partly, to speak to those who are accustomed to conceptualising writing in terms of writing strategies. 'Informed opportunism' focuses attention on the contingent and autonomous process(es) by which coauthors come to make decisions about what work they should be doing at any particular time, rather than on planning.

8.3. Changing documents/documenting changes

The work of coauthors, in one sense, is to make changes to a document. While the concept of informed opportunism addresses the different work involved in managing this work, and touches on the reporting of changes, the actual making and reporting of changes seems a fundamental part of what the coauthors do. To focus on this, and on the extent to which documenting changes can be said to be integral to the emergence of a document, I propose the dual concept of *changing documents/documenting changes*. This is intended to bring to the fore the particular work done in the articulation of changes made to the manuscript, and could be seen as part of the practice which enables informed opportunism to take place.

The focus is on the relationship between making changes and documenting them to each other. Newman and Newman, 1993, argue the importance of 'edited accounts' in the construction of a shared sense of reality:

> "Both conversational accounting practices and meeting practices maintain a shared sense of reality, and they do so by the formulation of edited accounts of the discussion. (...)
>
> Both in conversations and in meetings, the editing process plays a central part in the achievement of a shared reality; and the acceptance of the editing process is closely connected with the "local management" of members' time." (p.31).

The writing of messages accompanying document exchanges, discussed in chapter 7, section 7.5, could also be seen to be about the construction of joint ground. The messages summarising changes made, are precisely edited accounts of action, although In Newman and

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and build on each others' results" (Streitz, Haake, Hannemann, Lemke, Schuler, Schütt, Thüring, 1992, p.12).

Newman's use of the term, 'edited accounts' are jointly edited accounts of jointly held discussions. In these case studies, instead, the accounts are of activity in which the other coauthor has not directly taken part. Nevertheless, reiterating, summarising, and pointing to important points in the changes in parallel with passing on the detailed work (embedded in the new version of the document), is a way of constructing a 'shared reality': not only are the factual changes, as embodied in the changed document, passed on, but also information which provides context for its interpretation. This process could also be seen as an iterative *re*construction, repeated time and again, of a shared understanding of the joint work. As the other's attention is drawn to issues now seeming important, the coauthors are continuously updating each other on their perspectives. For these distributed coauthors, maintaining a 'shared reality', if partial, required continuous work. Bjerknes and Kautz, 1991, examine a closely related concept in cooperative work, that of achieving and maintaining an "overview". They argue that "To support cooperation [using] computer applications, we must design computer tools that support gaining and maintaining overview of people's particular work settings" (Bjerknes and Kautz, 1991, p.154).

These issues are of particular relevance to design of technology for distributed groups because of the reliance of such groups on technologies to mediate any kind of documentation (in the widest sense) between each other. In the case of the field studies presented in chapter 7, the media used ranged from telephone and face-to-face conversations, through messages in fax and e-mail, to comments within the document itself. As an example of documenting changes, below is a comment Mark, in group (i), inserted into the document before passing it on to his coauthor. In terms of their joint work, Mark's comment serves the function of providing a context for his coauthor's interpretation of the *status* of a new section he has written (*cf.* the discussion in chapter 7, section 7.5). He strongly indicates the preliminary and fluid nature of what he has written: he calls it "an experiment", says it "may get broken up", and demonstrates awareness that she has had no part in it ("*I'm* making claims (...) *we've* not discussed") and that he is open to critical comment ("you might disagree").

> *"[[M]: This section is an experiment. Bits of it may get broken up, reworded and put somewhere else. I'm making some strong claims here that we've not really discussed, and you might disagree violently!]"*
>
> (comment introducing new section in manuscript draft)

8.4. Consequences

The concepts proposed encourage, if not facilitate, the reconceptualisation of notions of collaborative writing, and potentially other collaborative work. They suggest that coauthors are autonomous individuals whose actions, while in a profound sense the details and timings of

actions are unpredictable, are reasonable in the context of the multiple tasks they concern themselves with. The concepts bring to the fore the possibility that in practice, informed opportunism may be as much an organising pivot as, for example planning (discussed in chapter 9). This gives quite a different perspective on collaborative writing research than that evident in much of the literature, as discussed in chapter 2.

For system design, these conceptualisation draw attention to aspects not addressed so far, but do not provide specific implications. Consider, for example, the observation that some coauthors produce summaries of changes they have made. One might suggest that the compilation of such summaries could be automated, on the grounds that this would 'support' coauthors by relieving them of work. However, the act of constructing these summaries may itself be an important facet of these messages: consider, for example, the significance of the receiving coauthor(s) knowing that the other has, on some grounds, selected issues to mention. Seeing the activity as providing evidence of work done, through the active documenting of changes, instead, leaves any computer support with only more 'low-level' tasks to do, but, in providing more flexibility, allows users to continue drawing on such social understanding of the significance of particular action in particular circumstances.[41]

8.5. Summary of chapter 8

Drawing on the empirical work of the preceding chapters, two concepts have been proposed as drawing together the issues of concern in the thesis, and as tools to explore in further research, in particular the practical design of collaborative writing systems.

In the next chapter, practical and theoretical implications of the empirical studies of the thesis are discussed, including limitations of the work.

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[41] Note the parallel with the findings of Bentley, Hughes, Randall, Rodden, Sawyer, Shapiro, and Sommerville, 1992, of the importance to flight controllers of the work of arranging flight strips. In the system prototype subsequently built, the arrangement of the strips was not automated, but left for the controllers to do.

CHAPTER 9. DISCUSSION: SUPPORTING AN UNPREDICTABLE PROCESS?

9.1. Introduction

In this chapter, some implications of the empirical investigations for the design of systems to support humans engaged in collaborative writing are discussed. As discussed in chapter 2, what is meant by support varies, and different notions of support can produce widely different approaches.

The existence of this chapter is not to be taken as support for an assumption, *a priori,* of the usefulness of new technology. Completely new technology may serve useful purposes. However, there is no reason to assume that is the only way to go. Relatively (conceptually) small changes to existing technical solutions may make a good improvement, at least to start with. For example, when asked what, if any, technologies coauthors would like which they don't have, the one issue which many interviewees have identified is that of the reliability of the technology being used. Whereas it is commonly held in systems analysis that asking users to imagine a system they might want is not a question most people can relate to easily, it is nevertheless interesting to get reactions to experiences with technologies that they do have experience with.

9.2. Supporting a varying, unpredictable process

9.2.1. Indexicality *vs.* structure

One tenet of the ethnomethodological approach is the indexicality which underlies human language and action (Suchman, 1987; Sharrock and Anderson, 1986), *i.e.*, that their meaning is derived in part from the context of the utterance or the action. In terms of human language, ordinary descriptions are sufficiently sparse to be efficient and portable across situations only because actors interpret them in light of whatever is the current context. This has been put to use in robot design by Agre (for example, 1988), who, like Suchman (1987), questions the notion that plans are laid and then executed. Agre's argument is that, within Artificial

Intelligence, a simplistic notion of plan execution becoming reified as a model of human action, led the discipline to design robots which in fundamental ways fail in their aim of modelling the basics of human action. Instead, close observation of everyday activity (his own and that in published literature) reveals a pattern of dynamic interaction between actor and environment, which may be based on a loose idea of what the goal is (for example, to get to his local subway station), but not necessarily how to get there. The detail of how to get there—precisely which route to take across the car park, *etc.*—becomes worked out as part of doing it, and the resulting path is (slightly) different each day, contingent on, for example, which car park slots are empty, and whether a tree which gives shade has leaves on or not. For a rule-based computer simulation to reproduce his paths, all possible situations would have to be enumerated. This would produce a combinatorial explosion which is a computationally intractable problem (*i.e.* not possible to compute). Instead, robots—simulated or otherwise—can be designed to reflect the indexical nature of humans' interactions with their environment. Agre's robot simulation makes extensive use of one such device, deictic reference, *i.e.* extremely situation dependent notions such as 'this' and 'that', enabling a computationally tractable solution precisely because of the efficiency of the indexicality which underlies human language and action.

Shapiro, 1994 says that "Indexicality is the triumph rather than the shame of ordinary language." (p.418), and that what is meant by the indexical character of common-sense talk and interaction, is that "they are radically contextual and cannot be fully 'specified' independently of their use". If the talk and interaction coauthors are engaged in, and maybe at a macro level, the whole process of collaborative writing, is also radically contextual, then how does one support the process? *That* (*i.e.* how to support radically contextual processes) is a highly complex issue.

In this thesis, the initial question of what structure there may be to the process of writing together over distance, has been turned around. The question then became, given the lack of structured strategies or procedures in academic collaborative writing, as observed in the studies in this thesis, how can the coauthors' work of dealing with that situation best be supported? This development is closely related to a number of the issues above. The following sections discuss these issues as they relate to the foci of this thesis.

9.2.2. Roles and plans as resources for action

Roles

As discussed in chapter 2, allocation of roles (and, the assumption is, following them once allocated) have been proposed in the CSCW writing literature as a technique writing groups use

to coordinate their work. However, the question of role is complex, and few studies have focused on the content of any such roles in coauthoring groups. In the literature on role theory, two types of roles are regularly referred to as being necessary to a group's functioning: task-related and socio-emotional roles (Brown, 1988). Benne and Sheats' original proposal included a third type, "individual" roles (Benne and Sheats, 1948). The literature on role theory shows roles enacted to be potentially influenced by a large number of factors, not all of which can be understood, let alone modelled. Statements about the variability and situation-dependent nature of roles abound in discussions of what people actually do (examples include Benne and Sheats, p.47, and Brown, 1988, p.55; and for collaborative writing, Posner, 1991, p.43). In early work in role theory, Parsons and Shils, 1966, discussed, in detail, the complex issue of the content of roles. Nevertheless, in calls for system support for roles, this perspective has often been lost, leaving instead a simplified notion of roles. CSCWriting's focus on roles has been rather one sided in its focus on task, and specifically what Brown calls "formally prescribed" roles (Brown, 1988, p.52). The focus has been, almost exclusively, on the roles of 'writer', 'editor', and 'commenter' (for example, Neuwirth *et al.* 1992, Posner, 1991).

The content of these roles are rarely discussed in detail in relation to system design, though arguably this is what any computer 'support' would have to address. Consequently, a simplistic notion of role which may not reflect the original studies is left in general calls for 'support for roles'. It would thus appear that a simplified notion of roles is in danger of being reified in parts of the CSCW literature (note the parallels with the development of notions of phases in collaborative writing research, discussed in section 2.6.1, and with Agre's concern, discussed above, for the development of the notion of planning in Artificial Intelligence).

One specific role that is in evidence in much literature on groups is that of the leader (for example, Brown, 1988). The 'leader' role could be explained, for example, in terms of the participants all orienting to one person's greater institutional powers, meaning she 'leads' in the sense of her opinions being invested with more institutional importance. In other cases a 'leader' might emerge as the person who does more work, and in that sense comes to be ahead of others (*cf.* group C in the preliminary studies, chapter 4). These two interpretations, and others, provide for quite different implications for how one would model 'leadership' in a computer system. In the second case, it might be technically feasible to incorporate into the system design some kind of computation of relative amounts of contribution, on the basis of which the system could come to an autonomous deduction of who the 'leader' is. Whether such a solution would be desirable is a different question (*cf.*, for example, Plowman's identification of two kinds of leadership in the writing group she studied (Plowman, 1993)), but conceivably it would be possible. In contrast with these emergent 'roles', Viller's use of the term denotes a person with particular skills, and perhaps training, : the group facilitator (Viller, 1991). In this usage, a 'role' seems more readily amenable to definition, to allocation to a person (or persons) at the start of

the project, and, hence, to be explicitly 'supported'. The question of what precisely we mean by 'roles' is therefore determinant in what a call for supporting roles implies.

The studies in this thesis addressed the question of roles in coauthoring groups through the examination of leadership and division of responsibility in the survey (chapter 5), and the examination of roles in the case studies (chapter 6, section 6.4.3). As reported in those chapters, little evidence of conformance to identifiable roles was found. Even when initially clearly delineated areas of expertise exist, these may become diffuse or break down later (*cf.* case study (i) and (ii), and interviewee 10 in the preliminary studies). Thus, while the evidence is that specialisms exist also between coauthors in a 'core' group, the notion of 'roles' is complex and highly dynamic. There seems to be little or no grounds for assuming, *a priori*, the relevance of this concept to coauthors[42]. The strive to provide 'role support' appears to be overly simplistic as a general requirement to CSCWriting system.

Plans

As discussed in chapter 2 (section 2.4.1), an issue which has occupied 'anti-cognitivists' such as Lucy Suchman, 1987, and Phil Agre, 1988, is the contrast between a perception of plans as determining action, and what they argue is the situated nature of human activity. In contrast with that view, Suchman proposes that plans are resources for action. Schmidt has pointed to a shortcoming in Suchman's argument (1987) that plans are resources for action, namely that she leaves open the question of in what *way* they are resources for action[43]. He further criticises what he sees as an implication of her statement that the usefulness of plans lies in them being underspecified, namely that the less specific a plan is, the more useful it is (Schmidt, personal communication). This section considers ways in which plans may have served as resources for action for the coauthors observed, and, further, the extent to which planning may have served a useful purpose among the coauthors at all.

The sense of planning investigated in this thesis is negotiation of agreements between collaborators of what action to take. This contrasts somewhat with Suchman's focus on individual planning, in which, for example, her use of two collaborators in the empirical studies is

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[42] I speculate, instead, (and I am probably not the first one to do so) that roles can be more accurately seen as an emergent property of the collaboration itself, which at times can be identified, at times not, even in retrospect. Roles are not, I argue, something collaborators themselves can be *assumed* to relate to *as such* in their experience of working together. Roles, instead, might be better conceived of as also a resource for action, though in a weaker sense (*i.e.* more analytic; further removed from collaborators' conceptualisation of their work) than plans, as there is less evidence that roles is a concept collaborators themselves orient to. An exception to this might be formally prescribed roles, which have not been addressed in the discussion of roles in this thesis. More research is needed on this.

[43] Schmidt, K., personal communication (presentation at COMIC project workshop, University of Lancaster, UK, 25-27 May 1994).

motivated by "a naturally generated protocol" being made available to the researcher (Suchman, 1987, p.115).[44] Furthermore, her analysis focuses of issues of communication between individuals and computers. For the examination of plans as agreements between collaborators, one might have expected their status to be stronger; that the need for coordination of work, and/or an element of commitment to another person would render the relationship between plans and action fixed even if it is not so for individual.

In contrast, the empirical investigations of this thesis show not only that plans may be broken, but render problematic any notion of planning for the collaborative work observed. A plan can probably be taken to constitute some form of agreement between the co-workers at the time of being made (whether the agreement is arrived at by mutual consent or by one person 'laying down the law' and the other accepting it). As discussed in chapter 6, however, the studies showed agreements to be made and broken with such regularity, and with such different time frames and levels of generality, that it became hard to determine, analytically, what was a 'plan'—except, under certain circumstances, in retrospect.

Leaving aside the issue of whether, and if so, how, coauthors themselves conceptualise their discussions as working with 'plans', it is hard to imagine that the coauthors would themselves always believe that when a plan is made it will definitely be carried out as agreed. It seems, therefore, that they were likely to be aware of the possibility that a plan might not be followed. An interesting observation, then, is that the coauthors would still make plans, or discuss what to do, resulting at times, in explicit agreements. The evidence therefore seems strong that plans could still be made even when they were allowed to be broken. This is not surprising considering the previous observation that plans were malleable and that agreements could be broken without sanction (chapter 6, and Beck and Bellotti 1993; see appendix B.III). However, an important question to consider is what they are *for*[45]: why make plans? It would seem that they may serve an organising purpose beyond the simple carrying out of explicit agreement. This would be consistent with Suchman's statement that plans are resources for (individual) action.

Extending Suchman's argument, if plans were resources for *joint* action, what work might the making of plans have done for the coauthors?

> One might hypothesise that plans served as *defaults* for subsequent action. In other words, once an agreement had been made, it would be followed unless, meanwhile, a

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[44] The examination of the differences between Suchman's discussion of planning as done by single persons and my interest in planning in collaborative work was suggested to me by Yvonne Rogers.

[45] I am indebted to Phil Agre for first pointing this out to me (personal communication, ca.1992).

different course of action had appeared which was judged to be 'better' (in some sense).

A second possibility, which relaxes to what extent a plan is seen as influencing subsequent action, would be to see a plan as a *starting point* for judging what action to take. In collaboration, plans may constitute a negotiated agreement of commonalities, at that point, in how the future is seen. They would therefore imply something on how the present situation is seen.

Thirdly, negotiating a plan could arguably be seen as a way of *distributing work over time* differently than if no joint planning took place. For example, the job of making various kinds of decisions that are part of the writing work, such as deciding on the relative urgency of different tasks, can be done together, maybe during a phone call, without having to do the task itself together. As argued above, discussions of issues may themselves be useful even if not resolved, for example in settling a collaborator's concerns about whether the other is aware of the problem. Extracting aspects of a task to be dealt with at some other time than when the bulk of the task is done (such as, a section written, or more data found), itself can serve a useful purpose. This could be an important aid for collaborators, as opposed to individuals, in distributing work between them.

Finally, one could consider the somewhat extreme position that a plan is only a 'product of the moment', and has *no influence beyond its negotiation*. In this view, it would be only the *action* of planning that would serve some purpose; not the product, the plan. In this case and that immediately above, it would not be meaningful to talk about the plans themselves being resources for subsequent action. However, one could consider a sister statement that *making* plans is a resource for action, in this case, for example, through benefits from the act of communicating.

The above are speculations about logical possibilities. My own opinion is that the field studies suggest that the importance of plans as tools for organising work may also lie in what their negotiation implies about common ground on how the future—and, by extension, the *present*—is seen; for example whether the amount of progress has been acceptable or should cause worry. According to this view, no definite difference is needed between negotiating agreements, discussing issues, making plans, *etc.*, as their importance lie as much in what they imply about the present, as constituting a commitment for the future. In this sense, plans may be seen as resources for action, but primarily action in the near future, even when plans relate to a more distant future. The commitment is one that stems from having negotiated an agreed joint view, not from having promised to take on a particular task. The commitment to the plan is equal to the extent to which it is seen as appropriate, or beneficial, to not disturb that common ground.

(In addition, as indicated above, adhering to a plan may have the attraction that some of the work has already been done, for example, in working out in what order some tasks could be done, so if the person is otherwise indifferent, there is an inherent incentive to stick with the plan.) Maintaining common ground was, as demonstrated in the extensive offering of information between the coauthors, an important part of the work done in the groups studied.

The above are speculations. However, they would appear to better explain some of the observations from the empirical investigations in this thesis, in particular from group (i), than previous approaches.

9.3. The issue of deriving implications

This chapter discusses implications for system design from the empirical and theoretical work reported elsewhere in this thesis. Before moving on to some practical implications of those investigations, however, it is worth considering some of the problems in deriving such implications.

9.3.1. How far 'context'?

A central argument of the thesis is the value to system design of studying work practices in context. However, whereas the case studies in chapters 6 and 7 are presented as examples of such a study, my reports of what took place (and even more so my observations on which those are based), had already been decontextualised by selection of some situations for presentation. Furthermore, the snippets from the case studies, and the statistics of chapter 5, *etc.*, are all, of course, presented in the context of a particular line of argument advanced in this thesis. At each point, the selection—whether prejudiced or rationally justified; conscious or not—removes context. Some such simplification is necessary for the researcher (me) to deal with the complexity, and for others to understand what I am saying. The question of how far to include context in such studies, and what, and how much, to present, cannot be determined in general. The argument of this thesis, however, is that it would be beneficial for the development of many CSCW systems to preserve more context from user studies than has traditionally been done in systems analysis/requirements engineering.

9.3.2. Questioning 'need'

Arguably one cannot in general talk about 'need' for computer support for anything, as it is a relative notion which varies with at least the resources and expectations of the prospective user, the state of technological development, and the intentions and desires of the developers. Discussing, in disconnected terms, what kind of system support is 'needed' for some application

area therefore is not only unhelpful in being ambiguous about what is meant by that, but also, and more insidiously, serves the purpose of obscuring the real question of *whether* a computer system is appropriate because it assumes a pre-existing 'need' independent of the process of studying or developing the relevant technologies. Rather than a question of 'need', the question of whether, and if so, what kind of computer system to make, becomes a question of identifying the audience of one's work.

While this chapter and discussions of 'support' in the thesis focus on support implemented on computer systems, this is not to be taken to imply that support must involve computers. A system is not necessarily a computer system, and support systems do not have to be implemented on computers. The focus of CSCW as a discipline concerned with 'computer support' is, in my opinion, to be taken not in the strict sense of interest in computer systems design only, but as an interest in systems for supporting collaborative work which include, or could conceivably include, computers. This leaves no less of a plethora of interesting questions for CSCW to be concerned with; rather the opposite, as questions of *whether* and *where* computer support might be useful become properly the domain of CSCW research. In particular, questions of the relation of computer support to other technologies warrants, in many parts of CSCW, further work, both in terms of qualitative comparisons between them (*i.e.*, could a different technology provide comparatively useful functions, or would a computer system be sufficiently *more* useful to justify its construction?), and in terms of the interface between them. Many computer systems in CSCW have been developed as if for an environment void of non-computing technology. Some computer conferencing and some collaborative writing systems have been built which are intended to be used together with telephones (*cf.* Gale's studies (1989), and ShrEdit (McGuffin and Olson, 1992)). However, the approach of much of CSCW system building appears to be that such solutions are temporary, for prototype and research only, whereas (the aim of) a 'serious' system is for all such functions to be incorporated into one, wholly computer-based, system[46].

In contrast, the studies above indicate that for distributed coauthors, having multiple media to communicate through can be essential, for example when one of them fails. Furthermore, even when there is no failure, certain communication protocols may be best left with people to 'implement' socially, completely outside technical enforcement.[47] Creative uses of well-established technologies, such as an unlimited telephone account, could be as useful in coordinating distributed work as a new computer system. One researcher into coauthoring who takes a broad view of technologies, Rachel Rimmershaw, concluded a talk somewhat tongue-in-cheek by saying that perhaps the four most useful technologies of coauthors would be "a bin

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[46] An extreme metaphor for this might be a monotheistic culture, in which only one 'God', the computer, is allowed to be worshipped.

[47] I develop this argument further in Beck, forthcoming; see appendix B.IV.

for ideas that bounced, an endless supply of coffee, a raisable screen for when you can't stand the sight of your coauthor, and an axminster rug for spreading out on the floor with all the papers"[48].

9.4. What might it mean to support distributed collaboration in writing?

In this section, more practical implications for system design are discussed, providing an example of how insights gained from a 'messy', open-ended investigation, such as that of this thesis, can prove useful for system design. In section 9.4.1, some of the main contributions are summarised in terms of the basic conceptualisation of the problem area. Section 9.4.2 presents detailed design implications for collaborative writing systems, and provides pointers to existing systems in which such issues have been addressed. A note of caution should be sounded, however: the more detailed suggestions are to be taken as tentative, and primarily as raising issues to be considered further.

9.4.1. Conceptualisation of problem area

Dynamics of work

The questionnaire in chapter 5 and the subsequent discussion demonstrated that much of the findings from the case studies reported in chapters 6 and 7 above are unlikely to have come out from a static study (such as a questionnaire). To understand how social systems function and the role played by computers and other technologies it is therefore important to study the dynamic organisation of work.

The studies presented in this thesis indicate that approaches to supporting work which rely substantially on structuring the work, or which try to rationalise the work, for example by excluding or discouraging 'non-task' communication or activity, may in practise inhibit essential dynamics of group work, and may therefore fail. Similarly, allowing apparent 'redundancies'—such as multiple channels of communication, and coauthors constructing edited accounts of their actions (instead of, for example, a computer compiling a summary)—may be important in allowing *joint and dynamic construction of the process*.

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[48] Presentation at Conference on Computers and Writing IV, Sussex, 22-23 March 1991.

Notions of task

What is attempted to be supported by a computer system depends on what is considered to be the task at hand, and what activities and information is considered relevant to carrying out that task. Given the failure of rationalism to account for people's behaviour (Star, 1992), a computer science rooted in a rationalistic tradition (Winograd and Flores, 1986) sees multiplicity and variation as a problem: *cf.*, for example, the technical usage of the term 'redundant' for duplicated, and the selling of computer systems in terms of making work more 'efficient'. Studies in other areas—for example, Orr's studies of "war stories" during coffee breaks (Orr and Crowfoot, 1992, and personal communication), the London Underground studies (for example, Heath and Luff, 1992), the Air Traffic Control studies (for example, Bentley, Hughes, Randall, Rodden, Sawyer, Shapiro, and Sommerville, 1992), and Lea's examination of rationalist assumptions in the literature on computer-mediated communication (Lea, 1991)—demonstrate the practical necessity of taking a different view if computer systems are to fit in with the richness and creativity with which people organise work.

The argument in this thesis for a rethinking of what is considered task relevant in collaborative writing, is therefore consistent with a general concern emerging in parts of CSCW and in other fields (sociology of science, 'radical' computer science) to undertake "a thorough review of concepts of actors and action, motivation, location and causality" (Star, 1992, p.395). A design implication of the newer perspective, is that when requirements engineering is undertaken for collaborative writing systems, notions of the work of collaboration, and of what is considered relevant, should not be too narrowly defined.

9.4.2. General implications

Flexibility

It seems clear from the studies conducted for this thesis that one requirement of systems which certainly is worth investigating is what in general could be called flexibility. The observations of great variety in writing practices, a finding consistent with those of Rimmershaw in her interview studies (Rimmershaw, 1992), poses a particular requirement for designing for flexibility. Agreed protocols may be adapted, or individual authors may make autonomous decisions as to whether it is appropriate to break agreements. This is not done in an irresponsible fashion; rather, it is in response to continuously changing circumstances, unforeseen events, technological breakdown, and so on. Awareness by the designer that groups may change over their lifetime, might mean, for example, allowing the way that document versions are managed, any access restrictions are enforced, and how annotations are done, to be dynamically changed by users. Designing for this kind of flexibility will, I believe, prove crucial to highly usable coauthoring

tools. Calls for flexibility have started to appear, and technical implications are starting to be explored in some areas of collaborative writing system designs (*cf.* justification for "flexible diff" in Neuwirth, Chandhok, Kaufer, Erion, Morris and Miller, 1992).

Providing flexibility, however, is not an easy task. Rodden, Mariani, and Blair, 1992, discuss the radical implications for the underlying system architecture of CSCW's requirement that information about fellow users can be made available. Dourish proposes a particular approach to computer systems architectures to achieve greater flexibility, that of computational reflection, in which the system embodies a model of its own 'behaviour', which the system itself can change, thereby changing its behaviour as well (Dourish, 1994).

The design recommendations presented below are an initial attempt at addressing what such flexibility might mean in terms of more concrete design issues.

Deciding what to do: offering and using a range of information

The management of distributed collaborative writing appears to be characterised by informed opportunism; a vast range of factors affect decisions on who does what, when. As part of the joint construction of 'sense' (*i.e.* helping the other in her or his sense-making) while the writing groups were working actively together, were, apparently, practices of accounting for one's actions and anticipated actions through offering various kinds of information of varying distance from the task at hand. There was some evidence of lack of this communication causing problems in group (iii) and the situation being somewhat helped when such communication was achieved again.

How can this be supported? It is unlikely that the enforcement of agreements (role or other) will be beneficial. Instead, changes of minds, breaks of agreements *etc.* should not be restricted if the coauthors want to do so, leaving it for them to sort out between them at any one point what they should do. This requires either a low level of 'interference' on part of the system, or, if a closer modelling approach is wanted, *great* flexibility.

Successful group work

'Success' *vs.* 'failure'. Has an answer been found to what constitutes success? There are (at least) two different ways of approaching the question of 'success': one is, what should be properly considered a successful outcome, and the other is, whatever a successful outcome is considered to be, what are some of the characteristics of groups that continue to work together as opposed to those who do not. The latter is perhaps partly illuminated by my case studies: could a sensitivity to the others' wants and needs (whatever the reason or motivation for that

may be), beyond the actual agreements made, be an important factor? If so, a design issue becomes not the detection or enforcement of agreements, but recognising the importance of the existence of communication media through which subtle cues can be given. What exactly these are, might depend on some basic design assumptions of, for example, the collaborators' familiarity with certain technologies (so if the design is intended for people who can reasonably be assumed to be comfortable users of e-mail or video links, it may be more reasonable to think subtleties could be expressed through those media). This may provide a hint to the apparent importance of face-to-face meetings among collaborative writers (*cf.* case study (ii) above, and, in the literature: Rogers and Horton, 1992; Kraut, Galegher, Fish and Chalfonte, 1992): namely, that the subtle cues, which are widely reported to be more easily exchanged in face-to-face situations (for example, Heath and Luff, 1991), help sensitivity, which is an important part of the collaborative writing process. Subtle cues which aid sensitivity cannot be exchanged in a highly structured environment. Therefore, my analysis indicates that some unstructured channels of communication will be necessary for groups to work successfully together.

Structured media and the use of document exchange as 'piggyback' to other information.

As shown in chapter 7, the transmission of the document could be used as an opportunity to comment on the status of what was being made available, but also communicate about other matters. This may provide a pointer to some of the reasons for the apparent success of 'low-tech', low-structure technologies such as e-mail, compared to more advanced (structured) technologies. If the case study findings can be taken as evidence that communication about one topic is easily seen as a convenient opportunity to communicate about another topic too, or that people, for whatever reasons, communicate about several things when they communicate (perhaps especially at times or from places where they do not get to communicate very often?), then a medium which does not structure communication, or one in which further, non-structured content can easily be added, might get preferred to one which restricts the communicator to a particular style of communication.

Negotiation

As discussed in chapter 5, a view emerged from the preliminary studies and the survey of the experience of collaborative writing as a process which is dynamically negotiated. This was not only supported, but strengthened by the analysis of the case studies. The studies indicate that it is essential for designers of computer support systems for collaborative writing to take into account the need for space in which coauthors can negotiate and renegotiate not only the

contents of the emerging document, but also the organising of the work, and the relationships between these.

Some of the more concrete design implications which could be drawn from the empirical investigations of this thesis are suggested in the next section.

9.4.3. Some tentative, specific implications

Here, design implications, many touched on in the discussions in the chapters above, are summarised and drawn into specific suggestions for what the implications might be for computer systems. This section could be considered a technological thought experiment inasmuch as little consideration is given to alternatives to computer implementation. Note, therefore, that these detailed suggestions are to be taken as tentative, and primarily as raising issues to be considered further. They are nevertheless presented, because it seems important to demonstrate the process by which an investigation starting from open-ended questions can lead to concrete system design implications.

Fluctuating group membership

In chapter 5, the implications of the survey findings of fluctuating group membership, and hence, fluctuating commitment to the group were discussed. The case studies provide considerably more detail of what this can mean, in one case, for the practical organisation of the work. In a coauthoring support system, document access and various permissions could easily be made to depend on group membership. However, if groups may have unclear definition of membership, it could become problematic if such permissions depend on membership. Further, the necessary specification to the system of who the members are, could be problematic to users, and even prove counterproductive in forcing the group to make explicit the status of various (potential) members. Design issues become, first, to consider carefully what the implication will be, in the case of any particular computer system, with a particular envisaged typical use situation, of implementing such boundaries; and second, whether the boundaries, if used, have to be binary 'either-or', or whether a scale of permissions would be more appropriate. In many cases computer implementation of group boundaries may prove unnecessary or restrictive; in others, perhaps, beneficial.

Further questions which will have to be considered are: what kind of support could groups benefit from with respect to this? How can it be incorporated in (anyone's) system such that any extra effort it requires from the users will clearly be seen to be worth it for them?

Integration with standard platforms

Shared documents may evolve from private documents, files from electronic communications and so on. Thus, support tools which allow existing text in other forms to be easily incorporated, may be useful. Many systems do this, including SEPIA (Streitz, Haake, Hannemann, Lemke, Shuler, Schütt, and Thüring, 1992).

Formatting

Coauthors may want to make formatting changes throughout. Easy-to-change formatting can be used in a flexible way not only to help visualise the final document, but can also support a range of signals among coauthors about interpretive context, for example, by making parts which are not intended to be in the final version stand out. Computer based tools could support flexibility by allowing exchange of the document in a formatted form throughout the writing process.

Grounding communication in the document

It appears that for some changes it is important to communicate the rationale behind them. Tools might support linkage of communication about the document to changes in the document. Such linkage could foster common grounding of communication between authors, improving the comprehensibility of discussion about the document and allowing efficient use of deictic references. Such facilities have been provided in coauthoring systems: PREP (Neuwirth, Kaufer, Chandhok, and Morris, 1990) provides facilities for anchoring annotations in particular "chunks", for example paragraphs, in a draft. For simultaneous coauthoring, SASSE (Baecker, Nastos, Posner, and Mawby, 1993) and SEPIA (Streitz, Haake, Hannemann, Lemke, Shuler, Schütt, and Thüring, 1992) both provide telepointers.

Communicating changes

The coauthors regularly drew others' attention to some of their changes by commenting on the location, and, frequently, their nature. Coauthors also communicated an intended incompleteness of what had been written through various cues (such as bracketed comments). This may be important in indicating a willingness to have changes made. Support tools could reduce overheads of highlighting selected changes by providing easy means of referring to change locations and optionally allowing notes about the changes to be attached. PREP's "flexible diff" (Neuwirth, Chandhok, Kaufer, Erion, Morris and Miller, 1992) is one technical solution to this, in highlighting changes of specified sizes (sentence, word, paragraph).

Author information

Decisions about when and what changes to make to a section were at times influenced by who had written it. A coauthoring tool *might* provide lightweight support for knowing who did what, which a user group may turn on and off. Several systems, including SASSE (Baecker, Nastos, Posner and Mawby, 1993), provide author information automatically. This is an issue which needs considerably more exploration, as the more immediate availability of such 'ownership' information could change the subtle dynamics of groups in which members see themselves as joint owners of the produced text.

History information

Editing may take place over a brief or extended period. Tools could incorporate lightweight support for making judgements about the completeness of, and confidence in, parts of the document. For example, an editing history may be presented as a quick replay of changes. This might cue coauthors about the context of particular changes, thereby potentially helping remember the reasons behind. An interesting approach to version management and history information is provided in the hypermedia version server CoVer (Haake and Haake, 1993), which is linked with the hypertext (and linear text) coauthoring system SEPIA.

Planning and status information

Authors must decide which part of the document they can most usefully work on and what to contribute in order to best fulfil goals and avoid duplications or omissions. No individual 'leader' can be assumed to take the lead in this. Furthermore, plans are not necessarily carried out even if explicitly agreed. Tools may be of more benefit to coauthors by supporting general exchange of information about future expectations; about goals achieved or attempted, *etc.*, than by requiring users to follow plans previously made. For a structuring and planning tool, such as GROVE (Ellis, Gibbs, and Rein, 1988), particular attention may need to be paid to making previous work easy to change. SEPIA's separate "planning space" may prove more useful to coauthors as a space for unstructured discussion on a variety of issues, including, in a loose sense, "a meta space for coordinating (...) activities", than as envisaged used to "externalize his *[sic]* writing plans, resp. goals", or for "controlling the progress of the design process" (all quotes Streitz, Haake, Hannemann, Lemke, Shuler, Schütt, and Thüring, 1992, p.15).

Information about ongoing activity and progress

Coauthors may be engaged in a range of other unrelated activities which make demands on their time and attention. To organise their own activities and set time aside for making contributions, they are dependent upon knowing about each others' activities. If desired, support tools could help foster group awareness of progress, for example by broadcasting automatic notifications as to when particular authors begin editing activity, and perhaps about what part of the document is being edited. Such automatic information must be possible to turn on and off easily. SASSE (Baecker, Nastos, Posner and Mawby, 1993) provides a document overview tool which addresses coordination of simultaneous working on a document by indicating who is working on the document at the time and where. This might be extended to preserve some such information over time (for example, where someone last worked on the document, and when). However, caution should be exercised, again, in the automatic provision of such definitive, unnegotiable, information on the precise activities of a collaborator. A more moderate approach to providing information about document changes might be to give an indication of what the latest changes have been, but not necessarily by whom (see section on history information above).

Control of access

At times, for maintaining consistency or ensuring that the best qualified person carries out certain tasks, it can be useful for one author to have exclusive access to part or all of the document. This may be successfully socially enforced, but support tools may feature facilities to alert coauthors to the status of document parts with respect to currently agreed access rights, on the understanding that these may be overridden. MESSIE (Sasse, Chuang, and Handley, 1993) permits one user at a time to have editing access to the document and sends an e-mail message with information about who is editing it to anyone else attempting to change it. This, however, removes from the group the possibility of working on parallel versions and merging them later, and may discourage short or intermittent working.

Roles vs. responsibilities: Inform, rather than constrain

Social control can be, it would seem, highly effectively used to manage the rights and responsibilities of each participant in a writing project. It allows areas of responsibility to be in continuous change without overheads, and avoids the problem that desired access restrictions may not coincide with predefined roles (Dourish and Bellotti, 1992). I therefore believe that rather than providing generic coauthor roles for tools to support, designers might usefully seek to support coauthors' exchange of information to help them make their own judgements about

appropriate contributions. Some such information may be appropriate to collect and make available automatically, other not; more research is needed on this.

9.5. Limitations of the thesis findings

9.5.1. How appropriate was the problem definition?

The definitions of coauthoring, distance, and support are problematic areas, as discussed in chapter 2. The question of what, for example, coauthoring is, was to some extent avoided in the empirical work, inasmuch as a 'safe', or uncontroversial, middle ground was chosen. This is an issue which may have to be addressed in system design. In particular, system features which in effect may contribute to defining group membership, such as access restrictions, must be considered carefully for unnecessary restrictiveness.

Distance is an interesting issue in this respect. Although the case studies were of groups which were unquestionably 'distributed', in that group members were based, and spent all or most of their time, at institutions and in towns which were geographically separate, anecdotal evidence suggests one cannot assume that people who are based at the same institution either are able to meet up easily, or coordinate their work without mediating technologies (for example due to extensive travelling, or the demands of other tasks). It is therefore quite possible that some of the issues examined in this thesis in terms of geographic separation may also affect some groups which are 'officially' co-located. This is an interesting area for further study. Coauthors and other collaborators working on long-term projects may find themselves facing, at least occasionally, similar concerns in needing to rely on either technological mediation or infrequent meetings when coordinating their work. Could it be, then, that the designation of some coauthoring or other groups as 'distributed', and hence, others as not, as done in this thesis, is only an extreme in a continuum?

To what extent have the research questions posed in chapter 2, section 2.7, as underlying and motivating the investigation of the thesis, been resolved? The first, of what kinds of factors affect the performance of writing groups, has been properly addressed by the investigation conducted. A number of factors have been identified, and although no definitive answer can be given, the studies indicate that the range of factors is so large that a model is unlikely to be able to incorporate all. The second question, what are appropriate methods for describing and analysing collaborative writing, has been addressed inasmuch as the thesis investigation has attempted to apply several methods to the first question, with varying degrees of success. It is clear that different approaches are appropriate for different kinds of concerns, and with respect to the issues investigated in this thesis, the latter approach—a qualitative, or ethnographic

approach to field studies—was successful since issues in collaborative writing which have apparently not been identified before, were identified.

The third motivating research question from section 2.7, how success can be assessed, was addressed in the survey, although its logical extension, what characterises the work of members of successful coauthoring groups, has only partly been addressed (the case studies were conducted with apparently successful groups; however, no comparison was made with unsuccessful groups). Finally, the fourth question, how coauthors perceive of collaborative writing, has been addressed to the extent that the grounded method used provided for coauthors' concerns to be examined.

In the place of these sets of questions, however, the investigation has emerged with a number of concepts, at different levels of abstraction. The five point framework used in chapters 4 to 6, was more concrete than the questions discussed immediately above, and resulted from concerns in the literature and from the preliminary studies, but they were not thoroughly grounded in data. A new set of three questions was used to investigate the case studies in chapter 7. These provided a more solid base to start the investigation from, resulting in a large number of interesting issues coming to light. Finally, grounded in the findings from the empirical investigations, two main concepts were proposed (chapter 8). As abstractions from the specifics of the studies, these were intended to be tools for conceptualising the many issues raised, when that may be appropriate (for example, as a contribution towards a general understanding of what collaboration is, or can be). Implications for system design of taking this perspective and of the specific empirical investigations have been discussed above.

Thus, although few of the original concerns have been directly addressed, they have given rise to a set of investigations and outcomes which arguably have been more useful than the original questions, both in terms of understanding the process studied, and system design.

9.5.2. How satisfactory were the approach taken and the methods employed?

As argued above, the approach, although hybrid, seems to have resulted in a useful collection of insights. Raising questions at different levels of abstraction is intended to address the different audiences who may be interested in the results of the investigations conducted. However, there are problems which should not be glossed over. Particular limitations of the empirical work are:

The results of the survey presented in chapter 5 are of limited statistical validity. The survey was not fully piloted. This may be defended on the grounds that it was so exploratory that the interviews served as pilots. Furthermore, the number of responses obtained was small, and

they were not obtained by random sampling but by self-selection. In terms of the statistical validity of the specific results obtained, therefore, the survey does not provide for generalisable results. A different issue in the survey is that, in a sense, it was an attempt to get 'hard' (quantitative) answers to 'soft' (qualitative) questions. It is not clear that the questionnaire succeeded in this, but making an attempt may nevertheless have been useful. Despite these problems, as an exploratory study exploring certain issues and raising unexpected issues, the survey served its purpose in this thesis in properly identifying, for example, changing membership of groups as an issue in more than the one group of the preliminary study.

For qualitative methods, such as those employed in the preliminary studies of chapter 4 and in the case studies, there is no general way of determining reliability and generalisability of the findings. In particular, the qualitative investigation of this thesis, strictly speaking, conforms to neither of the well-established approaches to qualitative study on which it draws. The reliability or generalisability of the findings, therefore, cannot be known until these are added to, and compared with, other comparable research. The temptation to try to generalise from this data should be resisted. In this light, a concern about the general applicability of concepts and implications based on the study of a few groups, and in this case, primarily one group, must be taken seriously.

This thesis is an attempt at combining different kinds of data in one exploratory investigation of distributed collaboration. As such, a particular solution has evolved to the question of how one might combine insights from such diverse studies, which was not known at the outset. It is also somewhat unclear what the status of the resulting analysis should be. If something useful comes out of this analysis, then the approach as it evolved can be said to be a (partial) success. Either way, other researchers may want to learn from the methodological insights gained.

9.5.3. Status and limitations of the findings as contributing to system design

The original intention to derive concrete system design implications, has only partly been fulfilled in the thesis. The reason, in one sense, is that the problem of the distance between ethnographic field studies and design implications has proved larger than envisaged, and has not been possible to address adequately within this project. Considering that several researchers have identified this as a problem for the whole field of CSCW (for example, Hughes, Randall, and Shapiro, 1993), this could be due to undue optimism on my part. It might be worth noting where such an optimism would have come from: in the first of the two preliminary studies reported on in chapter 4, a particular technology was being used. It seemed easy at the time to derive some clear implications to certain ways in which the technology failed

to support/address/fit in with the work practices of the participants. It is possible that these are the kinds of changes which are relatively easy to conceptualise and to implement. However, they may be of limited interest to others than the developers of that particular technology. In some cases, this may suffice, as for example in Orr and Crowfoot's (1992) ethnography of the introduction of radio technology to service engineers. In that case, the object of the study was the provision of adequate technology for that particular situation, not (apparently) deriving general implications. Feedback on the use of a particular technology may therefore be an area in which the contribution of ethnography is particularly appropriate (*cf.* also Hughes, King, Rodden, and Andersen, 1994, discussed in chapter 3, section 3.3.5).

Local design implications, *i.e.* those relating to technology for those groups (or, in some limited sense, similar ones), at that time, might well have been a useful approach to investigating collaborative writing, and could properly have addressed the question of what (in this case) we mean by support. In this thesis, however, more general questions of how people collaborate, in particular over distance, were sought to be explored. Ethnographic methods were used to explore how certain groups organise their work, with the intension of deriving more general design implications. To the extent that a number of issues have been raised in this thesis which had not been anticipated, and which apparently have not been explored before, it has been successful. Grudin identifies the breakdown of intuitive decision making as one of eight challenges for system developers, suggesting that "The problem often lies not in the detailed design but in the conception, in the nature of decision making in development environments." (Grudin, 1994, pp.100-101). Thus, the most important contribution of this thesis may be its contribution to a more general discussion in CSCW of the conceptualisation of collaboration and the nature of support.

The main design implications are provided in terms of raising issues for discussion. This is a weakness of the thesis in terms of its original goal of contributing more directly to system design. More fundamentally, however, some of the implications of the work—the need for flexibility, the inadequacy of modelling approaches—conflict with established approaches and practices within system design (though not with the latest developments in CSCW research). However, they also conflict with certain necessary fundamentals in the deliberate construction of a system of such complexity as we are talking about here (*i.e.* CSCW systems and other application software). These include the impossibility of avoiding all models, and the necessity to make guesses, assumptions and abstractions. In other words, much as it may be more faithful to only deal in descriptive accounts of action, prescription has to come in at some point in the design. This thesis has not fully addressed this problem.

9.6. Summary of chapter 9

In this chapter, some of the implications of the studies reported in the thesis for the design of computer systems to support collaborative work, in particular collaborative writing have been discussed. These include the rethinking of how 'task' is conceptualised, leading to a rejection of approaches imposing structure on the process, and a call for exploring how flexibility can be incorporated into system design.

The final chapter, chapter 10, provides a summary of the thesis, draws together the main points in a conclusion, and proposes directions for future research.

CHAPTER 10. CONCLUSIONS

10.1. Summary of thesis

This thesis has shown that interesting and relevant implications for systems design can be found by studying context and dynamics in writing groups. In particular:

In chapter 2, background for the work was provided in terms of a discussion of the notions of 'support', 'collaboration', 'authoring', and 'distance', and the relevant literature. An initial set of research questions which was the starting point for the work of the thesis were presented. In chapter 3, the rationale for the methods employed was given in terms of the tension between the needs of system developers for precise requirements and the desire to see activity as predictable, and the focus of qualitative, ethnographic field studies on questioning assumptions and highlighting the contingent nature of activity.

Two preliminary studies were presented in chapter 4, as well as a five-point framework—an initial attempt at structuring the empirical investigations of this work. Chapter 5 reported on a survey based on this framework and discussed the results obtained. Some of the interesting issues identified in the survey were: changing group membership and possible unsureness of who are the group members even in functioning coauthoring groups; a leadership role being emergent or non-existing in some groups; and a sense of "sharing" being, to some respondents, an important element of collaborative writing. The great spread of responses obtained to most questions started raising the question of what it is that apparently makes each case so different, and of the appropriateness of the framework; however, the small number of respondents allowed no generalisations to be made.

Chapters 6 and 7 presented three case studies which were intended to provide the kind of detail which, after the survey, seemed necessary to get more specific information for system design implications. First, in chapter 6, the case studies were introduced, and the five-point framework from chapter 4 applied to the case studies in an initial analysis of the data. The framework, however, proved inadequate in terms of helping to understand what work coauthors do in managing their activities and coordinating their work. The crucial question remained unaddressed of how people who coauthor deal with such great variation as the studies

appeared to indicate. This constituted an important shift of focus from attempting to pin down a model of collaborative writing: instead of trying to reduce the variation, the question became: *given* the variation, how does coauthoring work? This caused a refocusing of the previous framework in terms of three basic research questions: how a document comes to exist and develop; how individual coauthors decide what and when to write; and how the coauthors manage access to the evolving document. Chapter 7 examined the case studies in terms of these three questions. It was shown that the evolution of the documents took different paths for the three groups; that managing document access was highly contingent on circumstances and that there was no sign that the coauthors missed technical enforcement of access restrictions; and that individual coauthors were highly autonomous in their making of decisions what to write, including in relation to agreements, and that this was facilitated by an offering to each other of information which could be taken into account as and when judged appropriate (and, crucially, that what would become relevant was not necessarily possible to tell in advance).

In chapter 8, the two concepts of *informed opportunism* and *documenting changes* (to changing documents) were explored on the basis of the case studies, and were proposed as capturing some of the main lessons to be drawn from the empirical investigations. The first captures the offering and use of information that seems characteristic for this kind of collaboration. The second focuses on the detail of how coauthors document to each other changes in the evolving document. Then some tentative system design implications were considered.

10.2. Conclusions

The studies reported in this thesis demonstrated limitations in approaches to the support of collaborative writing in the CSCW writing literature. Instead of being explicitly structured, the process of writing together across distance in the studies has been shown to involve great flexibility on part of the coauthors. According to my research, central concerns of the coauthors were, in my words:

> *Informed opportunism:* The writing strategies observed are better characterised in terms of informed opportunism than planned action. Information on a range of issues, including personal, can be offered and made use of in autonomous assessment of appropriate action to take at any time.
>
> *Documenting changes made and anticipated:* Often, changes made were documented through the coauthors providing edited accounts of their actions or drawing attention to changes in the document. Furthermore, attention could in this way be drawn to changes anticipated made, without necessarily making it explicit who was expected to make them.

Integralness of disperse kinds of communication to the process: Communication between the coauthors which superficially might appear to be 'non-task' or 'redundant', was in the case studies shown to be an integral part of the process, and often provided contextual information which proved vital to the coordination of the work. A rationalistic strive for making their communication more 'efficient', could, for these coauthors, have hampered their subtle tuning in to each others' situation, thus potentially hindering their ability to coordinate their work. The usefulness of such approaches to 'support' has therefore been questioned in this thesis.

Tying these together, is:

Dynamic construction and maintenance of common understanding: Much of the communicative activity of the distributed coauthors can be characterised in terms of constructing and maintaining a common understanding between the coauthors in face of an environment which is in continuous evolution. This dynamic construction of joint ground is achieved through the documenting of changes and the exchange of various kinds of communication, not the strict adherence to agreements. This is what enables informed opportunism.

In terms of more theoretical issues of relevance to current debates in CSCW, the function of plans and roles in coauthoring groups have been addressed empirically. Suchman's notion of plans being individuals' resources for action (Suchman, 1987) has been extended and explored in the case of distributed collaborative work. This gave rise to insights on possible ways in which roles may be resources for action, as well as some of the empirical insights listed above. Notions of the process progressing through stages, and of role allocation being pivotal in the coordination of such work, have been critically examined, and shown to be more complex than current literature on computer support for collaborative writing would suggest.

10.3. Further work

Further theoretical/methodological work

Ways in which understanding from ethnographic field work can be brought to bear on computer system design has only started to be explored in CSCW, and will need further work. The problem of the requirements of designers to predict future use situations might be helped by emerging techniques, such as prototyping and evaluative ethnography (Hughes, King, Rodden and Andersen, 1994), but has not been resolved.

The range of plans and agreements made by group members in organising their work could usefully be further explored, as could the statuses such agreements can have, and their practical function in achieving the coordination of joint work. Some of the theoretical questions of the function of planning in joint work raised in chapter 9, section 9.2.1, might be addressed, for example, through either experimental or qualitative evaluation of the importance to collaborators of the permanence of agreements made. (One implementation which conceivably could be used is SEPIA (Streitz, Haake, Hannemann, Lemke, Shuler, Schütt, and Thüring, 1992), in which a separate 'planning space' is provided, and one could, presumably, allow manipulation of the permanence of records of agreements entered into the system.)

The relationship between the two notions of roles emerging from the discussion in chapter 9 could be further explored, in particular with respect to their function in distributed groups such as the collaborative writing groups focused on here. With respect to the design of support for roles, it may be important to better understand practices of working on joint writing in cases where external factors have allocated roles *pre hoc,* such as an editor representing a publisher. In these more limited cases, support for roles in group writing seems to have a greater potential to be of use than in the 'core' writing groups, studied in this thesis. A different aspect to explore further would be to examine specifically the emergence of roles in computer-mediated group working. Zigurs and Kozar, 1992, interestingly turn attention to roles in computer-mediated meetings, and further, briefly discuss the issue of allocating a 'role' to the computer system. Despite weaknesses in their approach—for example, they provided participants with pre-defined roles, problems with which would account for some of their unexpected findings (*cf.* p.32)—further enquiry into such issues for 'real-world' distributed groups could provide useful insights highly relevant to computer support for group work.

Implementation of design ideas

The work reported on in this thesis, as argued above, already contributes to an improved understanding of the work of coordinating distributed writing. However, the appropriateness of the issues raised and conclusions reached for system design will ultimately be explored only once employed in system design. In terms of the aims of the thesis of contributing to system design, therefore, a vital area for further work is the use of the thesis findings as the basis for making certain kinds of design decisions. This could be a substantial task. For example, how to achieve the flexibility called for in chapter 8 and 9 in practical system design has only been raised, not resolved, in this thesis. Considerable creativity may be needed on part of system designers to address this issue, with its many possible ramifications. A more gentle start than redesign from scratch could be to implement some of the more concrete of the recommendations in system prototypes (for example, by combining some of the features of existing collaborative writing systems). This might be appropriate since the investigations in this

thesis could not be used as a basis for designing standard word processing features as such; rather, it has proposed perspectives on what kinds of solutions might beneficially be sought with respect to certain aspects of collaborative work.

Further understanding of collaborative writing

The survey reported in this thesis identified considerable variation among reported experiences of coauthoring. The issue of where this comes from was not, however, addressed in the survey. For example, the origins of the respondents' writing tasks were not surveyed. Exploring such issues would add explanatory power to any subsequent survey undertaken.

The qualitative studies in this thesis, while, significantly, providing evidence of certain practices of theoretical and practical interest in CSCW writing research, become generalisable only as a contribution to a larger body of research (*cf.* discussion in chapter 3, section 3.3.5). Further research could beneficially be conducted on the nature of collaborative writing, in particular the role played by contextual factors in the dynamics of the coauthoring process. More case studies, particularly at the level of detail of case study (i), would help assess in particular the issues of collaboration mediated by technology. Further studies similar to those in the thesis, as well as new approaches to the issues raised, would be useful.

In this thesis, case studies were conducted of groups of 2-3 persons only. It is quite possible that different dynamics may operate in large groups, where the coordination of the activities may be significantly more complex, conceivably resulting in a greater need to make formal arrangements and to adhere to them. Thus, studying these issues for large writing groups could help delimit the scope of the findings of this study, and would be an interesting direction in which to take this work. In particular, the issue of sharing responsibility between coauthors; the practical significance of allocated roles, *etc.*, might have different facets for larger groups.

Relation to other groups

This thesis has focused on collaborative writing, and the question of how the findings relate to other forms of collaborative work has not been systematically examined. The possibility that similar results might be found if attention was turned to other groups with open-ended tasks would be interesting to explore. Particularly interesting would be further field studies of other distributed groups and how they currently coordinate their work.

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