THE UNIVERSITY OF HULL

Conversation Analysis in Interactive Computer System Design

being a Thesis submitted for the Degree of Doctor of Philosophy

in the University of Hull

by

Peter James Thomas BA Hons. (Leeds)

January 1990

Contents

Publication Note

A number of papers report aspects of the research described in this study:

Thomas P. J. (1990) Conversation Analysis and HCI Design. ESRC *Social Perspectives on Software Workshop*, Oxford, 13-14 January 1990.

Thomas P. J. and Norman M. A. (1990) Interacting with hypertext: functional simplicity without conversational competence. *HyperText II*, The University of York, 28-30 June, 1989. To appear in C. Green and R. McAleese (eds) *HyperText: Theory into Practice II*. (Oxford: Intellect).

Norman M. A. and Thomas P. J. (1990a) The Very Idea: informing HCI design from Conversation Analysis. *Computers and Conversation Symposium*, University of Surrey, Social and Computer Sciences Research Group, 25-26 September 1989. To appear in P. Luff *et al.* (eds) *Computers and Conversation Analysis*. (London: Academic Press).

Norman M. A. and Thomas P. J. (1990b) Informing HCI Design through Conversation Analysis. *International Journal of Man-Machine Studies*.

Preface

> In this age, in which social critics complain about the replacement of men by machines, this small corner of the social world has not been uninvaded. It is possible, nowadays, to hear the phone you are calling picked up and hear a human voice answer, but nevertheless not be talking to a human. However small its measure of consolation, we may note that even machines such as the automatic answering device are constructed on social, and not only mechanical principles. The machine's magnetic voice will not only answer the caller's ring but will also inform him when its ears will be available to receive his message, and warns him both to wait for the beep and confine his interests to fifteen seconds.
>
> Emmanuel Schegloff, *Sequencing in Conversational Openings*. (Schegloff 1968: 1090).

From the perspective of the 1960's, Emmanuel Schegloff could hardly have anticipated both the scale and nature of the invasion of what we had previously considered the most private corners of our world by machines. Our momentary and simple encounters with the telephone answering machine now stand in marked contrast to our everyday encounters with *computational* machines.

Schegloff's remarks serve to indicate, in very general terms, the scope of this study, which concerns the *interaction* between humans and computer systems. Those remarks also indicate its more closely circumscribed concerns. These lie in an examination of the bases on which interactive computer systems may be designed to facilitate human-computer interaction. The telephone answering machine, even though clearly constructed on "mechanical principles", is designed in such a way as to be integrated with our normal patterns of social inter-

action. It serves as a reminder that there is a fundamental character to our interaction which is to be provided for in the design of even the simplest interactive artefacts. This study investigates the possibility that interactive computer systems may be constructed on such social principles. Both as a finding, and as an imperative for further study, it is suggested that the definition of 'interaction' adopted by many researchers is incomplete, since it has not sought to include these social principles in the design of interactive artefacts. It is suggested that this deficiency may be addressed through the use of *conversation analysis*, a social-scientific approach to the investigation of human social interaction, in design.

The rationale of such an enterprise is not merely to illustrate the utility of a particular sociological method - or a particular formulation of sociological concerns - in the design of information technology; nor is it to advance those ideas by application in another, foreign, domain; nor only to promote sociological awareness in those concerned with information technology, although these might be laudable motives in themselves. It is rather to provide principled solutions to ubiquitous design problems.

Acknowledgements

Principally, my thanks go to my supervisor, Professor Mike Norman, for engineering the resources which have made it possible for me to undertake this work, and for his supervision and support. As with all projects, this work owes a great deal to others, and I would like therefore to thank my unwitting, and occasionally unwilling, collaborators: Tim Gibson and Andrew Stewart for listening to these ideas repeated ad nauseam; Peter French, for his level-headed advice; and to Jane, for her considerable patience and understanding. My greatest thanks are reserved for my parents, who, having invested their time and energy in my education, may hopefully find some of that effort reflected here.

Chapter 1

Introduction

Thou cunning'st pattern of excelling nature.

Shakespeare, *Othello*, V, ii. (Arden 1988: 178).

1. Introduction

The history of productive human effort is a history of design. Amongst the variety of ways to formulate the properties, outcomes, methods, and subjects of design, one is common: to design is to *invent a pattern*. One obvious interpretation of design under the auspices of this definition is in terms of the arts: the arrangement, form, and interplay of visual, musical or linguistic patterns. A second interpretation of design as the invention of a pattern is in terms of *technological artefacts*. Here, instead of a criterion of appropriateness formed in aesthetic terms, a criterion of effectiveness is framed in terms of the interplay of form and function. The ingeniousness, form, or symmetry of a technological artefact appears when the designed object is used for its purpose. The designer's concerns relate to the eventual *use* of the artefact, and a successful design may be judged in terms of the "degree of fit" (Holgate 1986) between the design and the practical requirements of the artefact.

Designing, or inventing a pattern, for technological artefacts is a complex technical problem, in the true sense of *arte factum* - requiring skill to make. Whilst the design of commonplace tools is regulated by

statutory requirements on safety, pragmatic requirements on utility, and the requirements of some aesthetic, there has been a new design revolution. This concerns the design of interactive computer systems. In the 'first generation' of computing systems (Gaines and Shaw 1986a, 1986b) the fact that there were few users meant that issues concerned with *design for use* were given little serious attention. The arrival of the personal computer through the mass production of computer hardware, and the development general purpose applications, has meant that the effective circle of users has widened to include, it seems, almost every member of the population (Kruesi 1984). At the dawn of the 'sixth generation', substantial technological, financial, and human resources are being channeled into the development of computing systems.

Designing for use has increasingly come to mean designing the *interface* (Shneiderman 1986).[1] It has been estimated that anything up to to 50% of the code in commercial systems, and a great proportion of design effort in the system development cycle is centred upon the user interface (Bobrow *et al.* 1986, Smith 1986, Smith and Mosier 1984b). This is not surprising, since the interface is a major determinant of the acceptability, and thus commercial success, of a system (Baeker and Buxton 1987, Farooq and Dominick 1988, Rowe and Shoens 1983). Ease of use, the provision of habitable working environments for users, and increased productivity are claimed to be the fruits of designing the

---

[1]Definitions of 'interface' have been posed in terms of the interface as a *mental construct*, for example as "the part of the system that represents the user's model of it" (Edmonds 1982: 231), or the "system image" (Norman 1986). It is also possible to interpret 'interface' as referring to hardware devices, such as displays (Smith 1984), and input devices (Card *et al.* 1978). Card and Moran (1986) give a fourfold interpretation of interface (*physical, cognitive, conceptual* and *task*).

interface. Moreover, falling costs of system development, and rising labour costs, have created an economic design imperative. Labour resources, rather than computational resources, must be used more efficiently, and this is typically achieved by redesigning the interface to promote more effective working practices (Gaines and Shaw 1986b). Additionally, the expansion of computing technology into areas where it was previously considered unthinkable that tasks be done in any other than traditional ways, has resulted in more inexpert users now than ever before (Hill 1987). Whilst users may be highly-specialised in their various professional areas of expertise, making computer systems accessible to them as non-professional computer-users is possible only by designing for their needs.

2. Human Computer Interaction (HCI) research

This realisation has led to substantial state-funded research initiatives (Alvey 1982, Moto-Oka 1982) to investigate and promote design for use, on a par with programmes of technological research and development. The importance of research into *Human-Computer Interaction* (HCI), is indicated by a burgeoning specialist literature, with several international conferences and a range of specialist journals.

In general terms, HCI research is concerned with three areas: the nature, characteristics and abilities of the *user*, the nature of the user's *task*, and the features of the *system*; their conjunction forms the totality of the *interaction* between human and machine; and their interro-

gation defines the scope of HCI research.[2] In investigating the nature of human-computer interaction as the intersection of user, task and system, HCI has generated diverse findings.[3]

Activity ranges from the derivation of task analysis techniques (and associated methodologies for design) such as CLG (Moran 1981), and GUEPS (Thimbleby 1984), Formal Grammars (Reisner 1981), and TAG (Payne 1984, Payne and Green 1986); through interface evaluation techniques (Howard and Murray 1987); psychological models and predictive design techniques such as the Keystroke Level Model (Card *et al.* 1980), GOMS (Card *et al.* 1983), and UDM (Kieras and Polson 1985). Other, less familiar, approaches to investigating the interface and its properties have been pursued, such as metaphor analysis (Carroll and Thomas 1982, Norman and Chin 1989). One prominent approach to evaluating the interface has been to construct simulations of the the system, through 'facading' or the 'Oz' technique (Gould *et al.* 1983), and through software tools for 'rapid prototyping' (Hartson *et al.* 1984, Wasserman and Shewmake 1985). Detailed specifications of dialogue and the sequence of user actions have been modelled as transition networks, in MUMPS (Farooq and Dominick 1988), Taxis (Mylopoulos *et al.* 1980), and using various BNF formalisms (Robinson 1982, Shneiderman 1982). Other areas of research, such as the development of 'self-adaptive' interfaces which aim to model the changing skill of the user are embraced by HCI (Edmonds 1981, 1982, Innocent 1982, Totterdell *et al.* 1987).

---

[2]Shackel (1985), and Gaines (1984), provide comprehensive reviews of the development of HCI.

[3]A recent volume by Baeker and Buxton (1987) provides a compendium of past, current, and possible future trends in HCI research and design.

The recognition that the activity of design must be supported in a practical way - to transform design practice from intuitive and haphazard activity, to methodical, principled and structured endeavour - has led to two important directions in HCI research. The first is research and development of design *tools*, which are interactive systems themselves, and which serve to standardise and automate the design process. These are known as User Interface Management Systems (Buxton *et al.* 1983, Edmonds and Guest 1984, Henderson 1986, Olsen 1983, Olsen *et al.* 1984).

The second direction is the specification of *rules*, *principles*, and *guidelines* for designers (Gaines 1981, Gould *et al.* 1987, Gould and Lewis 1985, Norman 1983, Thimbleby 1984, Shneiderman 1986).[4] Rules, principles, and guidelines have a relatively long history, making their first appearance in works such as those by Martin (1967) and Hansen (1971). In the 1990's the literature proposing guidelines is testament to their perceived utility: the *Mitre Corporation Guidelines* (Smith and Mosier 1984a) contains some 600 design guidelines, and the recent *HUSAT* publication runs to six volumes (Shackel *et al.* 1988), for example. Many other publications also seek to provide advice on how to engineer the interface from various perspectives (Fitter 1979, Foley and Wallace 1974, Jacob 1983, Malone 1982, *inter alia*).

---

[4]The exact definition of, and the relationship between, rules, principles and guidelines is not straightforward (Baeker and Buxton 1987, Smith 1986, Smith and Mosier 1984b). However, it is possible to see these forms of guidance as varying in specificity: rules attempt to provide direct, algorithmic and unambiguous application; guidelines, being less specific, require interpretation in particular contexts; whereas principles serve to locate the designer within some particular design philosophy.

A concern with the nature of mental or conceptual *models* in human-computer interaction, that of user embodied in the system and that of the system assumed by the user (Briggs 1988, DuBoulay *et al.* 1981, Norman 1987, Young 1981), has emphasised the fact that HCI is a *multidisciplinary* activity (Diaper 1989). Since HCI deals with human abilities in the context of information technology, it has been recognised that there must be an active collaboration between 'engineering' and 'human' disciplines. This perspective has been apparent in calls for a discipline of *user-centred design* (Norman and Draper 1986). Under such an initiative, HCI should embrace a variety of disciplines including linguistics, information processing psychology, cognitive science and ergonomics (Reisner 1987).

3. The scope of HCI research

HCI has been prolific in the generation of software tools, design methods, design information and, generally, knowledge about the interactive system and its users. However it is possible to make an important critical observation concerning the claim of HCI research to be multidisciplinary. This is that the scope of HCI research is in fact quite narrowly restricted, and that this has had a particular, and detrimental, effect on the view of 'interaction' adopted in HCI, on the methods used in its research programmes and, correspondingly, has influenced the design of systems. The claim for HCI as a multidisciplinary enterprise is that the integration of disparate disciplines will lead to superior design solutions through a holistic approach (Baeker and Buxton 1986). However, closer examination might suggest that what is claimed to be multidisciplinary study is, in fact, merely the pooling of work within a common investigative paradigm. This is because the

methods adopted, and the findings generated, by HCI are "inherently and inextricably" (Carroll and Campbell 1989: 250), pervaded by psychological or cognitive theory.

Under the auspices of such theories, the user is typically seen as an "information-processing system" (Card *et al.* 1983) engaged, almost wholly, in special-purpose 'cognitive' activity in interacting with computer systems. In methodological terms, the experimental investigative approach of psychology, which "emulate[s] not just the form but the very content of the methodology of physics" (Coulter 1985: 21), has been adopted by HCI research. Of course, for an enterprise such as HCI concerned with the practical production of artefacts this is not surprising of course, since it is *precisely* the quantitative results produced by experimentation which are seen as being most amenable to immediate implementation.

Yet it is clear that HCI constituted in this way has little to say about a particular dimension of the relationship and interaction between humans and computer systems. This concerns the way in which computers have entered into our cultural imagination, and relates to the often very *personal* relationship between users and systems. Those entangled in the subterranean world of adventure games are a more obvious manifestation (Carroll 1982, Malone 1982), the hacker subculture another (Turkle 1984, Weisenbaum 1976), and it has been widely observed that users anthropomorphise systems which present only the semblance of a personality and interactional skills (Stevens 1983,

Weisenbaum 1976, Turkle 1984);[5] and of course, there is the popular, yet "seductive but restricting" (Stevens 1983), description of computers as 'user-friendly'.

In this sense computers have become *social,* rather than only *technological,* objects: possible since social status is *ascribed to* an object by an observer, rather than an *inherent property of* that object (Gilbert *et al.* 1990). This has been persuasively argued by Lucy Suchman (Suchman 1987), who suggests that the *reactive, linguistic,* and *complex* nature of computer systems encourages users to ascribe intention and purpose to their actions. Naturally, this view does not find universal agreement. Many commentators simply dismiss the attributed social status of technological objects as "the pathetic fallacy of anthopomorphism" (Bench-Capon and McEnery 1989), and view human-computer interaction as a process of interacting *through* rather than *with* computer systems (Barlow *et al.* 1989).

Despite the growing importance of this view of the relationship between user and interactive computer system, it has not found significant expression in HCI. Necessarily, the failure of HCI to systematically take into account this aspect of user-system interaction has lent its research a particular character. On one hand, HCI research has typically been oriented to the *technological* aspects of user system interaction:

---

[5]The most widely-cited example being perhaps Weisenbaum's ELIZA, well-known for engaging in natural language communication using only simple rules for comprehending, and generating answers to, users' questions. In its DOCTOR incarnation, the program masqueraded as a Rogerian psychotherapist. It was surprising (not least to its designer), that users imputed knowledge, understanding and inferential abilities to the system. More surprising, and somewhat worrying, was the proposal by some (Colby *et al.* 1982), that automated psychotherapy would replace human psychotherapeutic treatment (Weisenbaum 1977).

the preoccupation with *dialogue styles* (Sime and Coombs 1983) being one example. The competing merits of graphical (Foley and Wallace 1974), iconic (Gittins 1986), direct manipulation (Shneiderman 1983, Hutchins *et al.* 1986), Natural Language (Blanning 1984), and speech interfaces (Hauptmann and Rudnicky 1988) have been repeatedly, and exhaustively, debated for a number of years within the discipline.

The technological focus of HCI research is complemented by a conspicuous failure to seriously consider the relationship between *human* interaction and human-computer interaction. This is apparent in the largely metaphorical treatment of the *conversational* nature of human-computer interaction. The idea of user-system interaction as conversation was notably propounded in a work by Gaines and Shaw (1984) which presented "conversational principles" for system design, and can be traced back to the cybernetics of Weiner (Weiner 1948), and to Orr's *Computers and Conversation* (Orr 1968).[6] Gaines and Shaw, in *The Art of Computer Conversation*,[7] state that they are concerned to "promot[e] simple and effective conversational styles for personal computing" (Gaines and Shaw 1983: 10), and consider that designing user-system interaction is

> mostly cosmetic in nature and follows from commonsense [...] Once we start thinking of computer dialog as analogous to people dialog, then the basic

---

[6]It has also featured in work by Bolt (1985), Martin (1967), Nofsinger (1976, 1977), Pask (1980), and has been recently revived in the MIT Media Laboratory's *Conversational Desktop* (Brand 1988).

[7]Gaines and Shaw provide a number of "proverbs" for the design of human-computer interaction. For example proverb 5 a proverb of "past experience", states that in human-computer dialogues the "normal vocabulary" of both expert and user should be employed, and this should be achieved by "listen[ing] carefully to their conversation" (Gaines and Shaw 1983:40).

> rules become obvious and easily remembered. (Gaines and Shaw 1983: 10).

Similarly, Raymond Nickerson (1976, 1981) observes that "few if any systems permit the kind of give-and-take that characterises interperson conversations" (Nickerson 1976: 102), and

> if the computer [...] were given the ability to accommodate anything like the informality of the language which characterises interperson conversations [...] it would be a good thing (Nickerson 1976: 107).

It is clear that these studies, based on predominantly *ad hominem* arguments, and little more than anecdotal evidence, present only a metaphorical view of human-computer interaction as conversation, providing little in the way of detailed *systematic* or *principled* investigation of the possible relationship between conversation and human-computer interaction.

The technologically-oriented nature of research and the unsystematic nature of studies of human-computer 'conversation' thus indicate a dimension of user-system interaction which has yet to be explored, and suggest alternative interests which may be pursued in relation to the investigation and design of user-system interaction. This is concerned with the possible continuities between the "culturally furnished" (Coulter 1979: 21) abilities and expectancies upon which human interaction is based, and those which are employed in human-computer interaction. It is clear that a systematic exploration of this relationship requires both *detailed knowledge* about the abilities, and expectancies upon which human interaction is based, and a way of *systematically incorporating this knowledge into design*. To accom-

plish this requires an expansion of the multidisciplinary base of HCI to encompass the findings of disciplines which deal specifically with the nature of human social interaction.

The disciplines relevant in this context are those from within the social sciences, and the expansion of the multidisciplinary base may be accomplished through the incorporation of the theoretical framework, methods, and findings of *conversation analysis* (and to a lesser extent *ethnomethodology*), which specifically deal with the nature of everyday human action and interaction. Ethnomethodology is concerned, at the most general level, with the reasoning abilities required to make sense of the world, and conversation analysis with those required for making sense of conversation. Both offer a perspective which stresses that interaction is not haphazard or random, but displays *detailed structure* and is the result of the operation of *systematic skills*. In contrast to the account provided by disciplines such as psychology, these skills are not seen as abstract 'cognitive' skills, but are socially-constituted abilities. From the perspective of conversation analysis, the structured nature of interaction, and the systematic skills which underlie it, are a reflection of the fact that interaction between humans is characterised by the maintenance of *mutual intelligibility*. Mutual intelligibility describes the way in which behaviour, actions, and natural language utterances are specifically designed to display their intent, meaning or significance to other speakers. This implies that not only producers, but observers, possess abilities to comprehend actions that are "recipient designed" (Sacks 1972). Thus, a view of humans as information processing systems is replaced by a view of members of society as

> active social actors, located in time and space, reflexively and recursively acting upon the world in which they live and which they fashion at the same time. (Lave 1988: 8).

It is clear that the significance of such an enterprise is consonant with the recognised need for HCI to assess and apply the established findings and methods of other disciplines to encourage user-centred design. As Gaines (1978), considering the future of HCI research, notes

> Until I know what it is for *you* to understand me, how can I hope to program a machine to do likewise. As in all dialectical questions the resolution is a synthesis - a combination of philosophical, psychological and linguistic scholarship, under the pressure of commercial requirements for improved man-computer communication. (Gaines 1978: 232).

4. Informing HCI design through Conversation Analysis

The use of conversation analysis in HCI is advantageous in three particular ways. Firstly, the information generated by employing conversation analysis provides fundamental knowledge about interaction, which can be used to design *more natural interactive systems*. Secondly, this information concerns the detailed structure of interaction and is *communicable to designers* in ways which avoid the ambiguity of current design guidelines. Thirdly, the *methods* characteristic of conversation analysis provide a *principled* approach to the investigation of user-system interaction which will provide *applicable* findings for design. The following sections of this chapter address the first and second of these issues. The issue of the use of conversation analytic methods in HCI research is explored in detail in Chapter three, which

is concerned with the relationship between existing methods used in HCI, and those of conversation analysis.

4.1 More natural interactive systems

Conversation analysis prospectively provides knowledge about the *normative features of human interaction*, and can thus provide the basis for the design of *more natural interactive systems*. Systems which are designed in accordance with pre-existing interactional abilities and expectations will be more natural to use simply because those abilities and expectations are automatic, unnoticed, commonplace, and represent a 'bedrock' of interactional competence. These abilities, as the discussion of ethnomethodology and conversation analysis in Chapter two will indicate, represent the possibility of rational action by members of society and coherent communication between them; they are abilities acquired through socialisation and rehearsed in everyday situations; they are 'autonomic' and 'automatic' social systems. On this view, users do not approach interactive systems as a *tabla rasa* - an image often evoked when the term 'user' is employed (Robinson 1990).[8] Users' reactions to Weisenbaum's ELIZA for example, argue simply, but persuasively, for the presence and operation of the skills used in everyday action and interaction in human-computer interaction.

---

[8]Similarly, it has been suggested that users react strongly to the gender-marked aspects of interactional styles, assuming systems to be male (Fulton 1985), and that systems may present particular personality traits which affect users' perception and operation of the system (Cook and Salvendy 1989).

The ingrained nature of these interactional abilities and expectations has two particular consequences. Firstly, since they are the result of evolutionary change directed to the selection of interactionally-efficient procedures, systems designed around them will provide for *ease of use*. Secondly, these abilities and expectations must be possessed by *all* members of society, since they represent the possibility of communication between *any* one member of society and *any* other. Thus, since users (as members of society) are all *experts at interaction*, systems designed on the basis of features of human interaction will effectively support both novice *and* expert users.

It is thus clear that design may be interpreted directly as the invention of a pattern, where in this case the pattern is that of the normative pattern of human social interaction: the measure of closeness between the interactional patterns embodied in an interface and those in human interaction prospectively provides a single criterion for the assessment of the 'naturalness' of an interface (Stevens 1983).

4.2 More applicable and accessible design guidelines

The second advantage which the use of conversation analysis provides is the formulation of more applicable and accessible design guidelines. It is clear that this is an important advantage, since whilst "impact on design practice is the touchstone of a successful approach to HCI" (Carroll and Campbell 1989: 248), dissemination of the findings of HCI research remains a significant problem.

Whilst there has been little conclusive research into the nature of designers' work, it has been suggested, by Belloti (1988) (*inter alios*), that

designers see HCI research findings as irrelevant, that designers typically have little confidence in HCI as a discipline, are inadequately informed about HCI research, and that HCI techniques are viewed as complex and unnecessarily time-consuming. This has resulted in the "marginalisation" of HCI concerns in software design; it remains a discipline which is characterised by a "rhetoric of objective engineering practice based on mathematical science" (Robinson 1990: 5), manifesting the "preference of the technologist for logical and repeatable processes" (Holgate 1986: 195). Consequently,

> the need to deliver reliable designs quickly and to maintain a standard profit margin will encourage the use of standard solutions for what will be perceived as standard problems (Holgate 1986: 198).[9]

Other studies have suggested that the problem is more consequential. Work by (*inter alios)* Dagwell and Weber (1983), Rosson *et al.* (1987), Hammond *et al.* (1983), indicates that designers may not design in a structured or systematic manner, and may employ complex logical formalisms irrelevant to user requirements. This emphasis on coherent formalism may dominate designers' thinking to the exclusion of considerations regarding its possible utility: as Holgate (1986) notes

> Many design methodologists [are] more concerned with fascinating diagrams and mathematical symbols than within the complexities of reality. (Holgate 1986: 212).

---

[9]Holgate's remarks in this chapter are taken from a text on architectural design. There are intimate connections between architectural design and interactive system design since they both concern the relationship between form and function, and between social context and technological possibility (see, for example, Bannon 1986a, Edmonds 1987, Kolm 1987; and the extended discussion in Hooper 1986).

Gould and Lewis (1985), speculate that designers rely on guidelines more than generally attested principles (Gould *et al.* 1985). Yet those same guidelines are criticised because of their context-bound, and thus limited character, and their lack of empirical testing, and are "based on informed opinion rather than data or established principles" (Gould and Lewis 1985: 303). Maguire (1982), finds many guidelines to be contradictory, due to their strongly contextual nature, and Mosier and Smith (1986) have noted the problems of prioritising guideline application.

In contrast, design guidelines formulated from conversation analysis firstly represent the possibility of guidance which is *widely applicable and portable,* and thus more *reliable* from the designer's point of view. This is the case since the guidance offered may be related to an *established and secure theoretical background* provided by the ethnomethodological perspective on interaction.

Secondly, the guidance offered will be at a level of detail which will both identify the *particular situations* in which it may be applied, yet will not proscribe the *specific content* of the interaction. Since conversation analysis, as will be shown in Chapter two, stresses the importance of *structure* in interaction, guidelines from conversation analysis will thus apply specifically to the detailed structural features of interaction, without specifying in restrictive detail the content of the interaction. Thus designers may apply the guidelines in both a "knowledge-based" and "rule-based" fashion (Hill 1987).

Thirdly, the way in which such guidelines address the structure of interaction clearly has consequences for their wider applicability. Such

guidance addresses *fundamental features of interaction,* and thus cuts across the pervasive categories of novice and expert: the expectations and skills which are involved in user-system interaction are similar to those used in human interaction, and as such, are possessed by all members of society in relatively invariant forms.

Fourthly, the wider applicability of such guidelines is also ensured since they are *technology-independent,* both in terms of their applicability across the various interactional features at the designer's disposal, and in terms of their applicability across *emergent technologies.* Systems are undergoing continual evolution, and the appearance of various new interactional devices (Buxton 1986), the use of various communication media such as sound and speech input-output (Gaver 1986; Fallside and Woods 1985), and the possibilities of multimodal interaction and multimedia interfaces (Taylor 1988; Baeker and Buxton 1987), serve, to some extent, to nullify currently available knowledge and techniques, forcing HCI research into an evaluative role. As Gaines and Shaw (1986b) suggest:

> Fourth generation computing systems are already making demands on human factors specialists that stretch their capabilities to their current limits. The fifth, sixth and beyond generations will make substantially greater demands and require conceptual advances of which we are at present only dimly aware. (Gaines and Shaw 1986b: 3).

The technology-independent nature of guidelines is crucial since this means that they are relevant to the changing body of practice and circumstance which constitutes real-world design. As Smith (1986) notes,

> for a designer whose professional life is spent in solving immediate problems, the imperative argument is that today's design decisions must be made today. As human factors practitioners our influence with designers may be diminished if we come to them without hard data; but our influence will disappear altogether if we come to them too late. (Smith 1986: 55).

If it is possible to articulate a small number of guidelines which address the fundamental and unchanging features of user-system interaction which are independent of particular technologies, users and tasks, then such guidelines will form secure user-system interaction design standards. The promise is that designers will be able to apply a set of guidelines to emergent technology to achieve consistent results.

Finally, such guidelines are the product of *empirical investigation*, rather than the product of informed opinion, guesswork or intuition. The specific nature of their empirical foundation - the methods and findings of conversation analysis - represents a principled approach, in contrast to those based on experimental processes or on *ad hoc* investigative procedures. It is clear that experimental approaches in particular may be inadequate. As Smith (1986: 56) notes, "we may question whether a comprehensive set of design guidelines can ever be derived from experimental data", since

> Even the testing of just a few interacting variables, at a few levels of implementations, requires an experimental design of challenging complexity [...]. As a practical matter, then, our research studies will always be too narrow in scope to take full account of all the complexities of user interface design and the potential interactions of different design features. (Smith 1986: 56).

4.3 The current role of social science in HCI

It is not surprising that ethnomethodology and conversation analysis have so far merited little attention in the context of HCI research. As will be argued in Chapter three, methodologies such as that of conversation analysis, which generate no quantitative results, will inevitably be regarded with scepticism, if not hostility, by those who espouse controlled experimental investigation.

This is not to say that social-scientific perspectives and findings have failed to find expression in information technology research and development programmes. They have however, generally only been employed to reflect upon the changes that computing technology has wrought upon pre-existing social patterns in some group, organisation or institution, or in society as a whole (Olson and Lucas 1982, Ord 1989 Attewell and Rule 1984, Pomfrett *et al.* 1984). Any integration between the concerns of sociology and those of technology design has been seen as problematic. As Woolgar (1985) argues in connection with Artificial Intelligence, sociology is typically seen as

> dealing with matters left over from other disciplines [...] in this view 'social' has to do with the *effects* of artificial intelligence, but not with its *genesis*. (Woolgar 1985: 558, original emphasis).

Although this recognition, by Woolgar and others, in 'social constructivist' studies of technology (Bijker *et al.* 1987, Pinch and Bijker 1987, Sharrock and Anderson 1990, Suchman 1988b, Woolgar 1988), has provided a climate for sociological studies *of* technology (for example the investigation of the working practices of design teams by Walker, 1989), the use of sociology *for* the design of technology has not previ-

ously been pursued with any vigour. Ethnomethodology in particular has received only passing attention in the context of HCI (by Chang 1987, or Stenton 1987, for example).[10] Norman's (1987) view is representative of the poor general level of awareness:

> sociology, especially ethnomethodology, has a lot to say about real-world patterns and how people's behaviours deviate dramatically from their descriptions of their behaviours (Norman 1987: 329).

Conversation analysis has received somewhat more attention in connection with both Computer-Mediated Communication and, less surprisingly, Natural Language Processing. Bowers (1987), for example, discusses conversation analytic findings in the context of the COSMOS computer conferencing system, and the ESPRIT II SUNDIAL project is exploring the possibility of engineering Natural Language dialogues using conversation analytic findings (Frohlich and Luff 1990, Gilbert *et al*. 1990, Gilbert 1990).

It is clear that disciplines such as conversation analysis and ethnomethodology have much to contribute to current approaches to

---

[10]Robinson (1990) has recently noted the relevance of ethnomethodology for software design:

> [it] offers a way of restoring context and situation to the descriptions and accounts of human-computer interaction; a way that reappraises the relevance of 'non-technical' issues of software engineering so that they do not stand divorced from the 'technical issues' (Robinson 1990: 7).

However the "unacceptable if not incomprehensible" character of conversation analysis and ethnomethodology (Goldthorpe 1973), may militate against their wider recognition. Suchman's (1987) work is a case in point: although it has received "sympathetic reviews and not inconsiderable publicity within the computing industry press" (Robinson 1990: 7) (by, for example, Durham 1987), the extent to which Suchman's work has been recognised by software designers as relevant to their work remains unclear.

HCI research and design, and thus to our understanding of the interaction between human and machine. Whilst the methods and findings of conversation analysis are, of course, not to be seen as a panacea for the inherent problems involved in HCI research and design, they can serve to ameliorate many of them. In particular, as Chapter three will discuss in detail, it possible to see conversation analysis and ethnomethodology as providing a valuable addition to the researcher's methodological and theoretical armoury. In addition, the use of the methods and findings of conversation analysis provide a view of the relevance of a body of findings, and a theoretical orientation, from a sociological discipline which has so far been considered as inapplicable to the concerns of HCI.

4.4 Is human-computer interaction 'conversation'?

This chapter has argued that the findings of conversation analysis can be employed in the design of interactive systems through the formulation of design guidelines. However, it should be emphasised that human-computer interaction is not being equated narrowly with human conversation. This is an interpretation which is often foisted upon work which suggests some connection between human communicative abilities and human-computer interaction (see, for example, Stevens 1983). The more overt characteristics of conversation - phatic elements, such as the exchange of greetings - may be present in 'user-friendly' interfaces, but it quite clear that human-computer interaction, as a phenomenon, is not isomorphic with human conversation. There are also clear conceptual and theoretical dangers in the attempt to formalise conversation analytic findings into com-

putationally tractable mechanisms in the service of building speech and natural language interfaces (in the work of, for example, Gilbert *et al.* 1990), and more generally in the attempt to translate *sociological* descriptions of social norms into *logical* schemes (Button 1990; Norman and Thomas 1990a, Oldman and Drucker 1985, Pateman 1985, Stamper 1985).

There are, nevertheless, obvious similarities between human-computer interaction and conversation. Human-computer interaction, like conversation, is essentially *non-deterministic,* in that interactions with systems may be more or less structured, but allow for a large range of user-actions at any given stage, and thus human-computer interaction is essentially *unplanned* and *improvised;* human-computer interaction, like conversation, is *sequentially organised,* in that the significance of system actions is embedded in the context of past and future actions; finally human-computer interaction, like conversation, is *organised from within,* in the sense that is the outcome of the interaction between human *and* machine.

5. Relationship to existing work

There is little other published work which explicitly emphasises the links between conversation analysis and interactive system design, and no other studies propose an explicit relationship between the findings of conversation analysis and the formulation of HCI design guidelines. However, one particular theme of this study, the presentation of a competing perspective to the 'cognitivist' view of human-computer interaction, is a feature of a number of other studies. This

concern is especially apparent in a dissatisfaction, expressed in a number of studies, with the emphasis on 'planning', 'representation', and 'rules' in Artificial Intelligence (AI) research. The restricted conception of the way in which the individual construes and interacts with the world, characteristic of AI research, is becoming less tenable to those who see that considerations of computational tractability, rather than fidelity to empirical features of the 'everyday world', currently dominate the design of intelligent artefacts: Artificial Intelligence and Cognitive Science, in Jean Lave's words, deal with the "indoors", rather than the "outdoors", of "cognition in practice" (Lave 1988). Although the studies discussed here do not constitute a 'movement' of any kind, they have a distinct ideological and intellectual momentum. Since there are relatively few studies, they are discussed here, rather than in the more usual review chapter.

5.1 Suchman: the nature of human-machine interaction

The most closely related work to this study is that of Lucy Suchman (1982, 1987). In *Plans and Situated Actions,* (1987) Suchman declares her aim to "examine the conception of purposeful action and [...] interaction, informing the design of interactive machines" (Suchman 1987: 2). One particular aspect of this conception which she examines is that current in Artificial Intelligence, which proposes that action can be accounted for in terms of plans, and that intelligent interactive systems can be designed by representing users' actions in terms of a developing plan. However, Suchman denies the specificatory role of plans in human action, and proposes that

> neither typifications of intent, nor general rules for its interpretation are sufficient to account for [...] mutual intelligibility (Suchman 1987: 42).

Using the term "situated action" for the non-susceptibility of action to analysis in terms of plans, Suchman draws upon the ethnomethodological perspective, which views plans not as a causal devices through which behaviour is generated, but as an interpretive devices through which behaviour is understood. To illustrate this notion, Suchman employs a videotaped record of, and 'two-person protocols' generated by, the interaction between users and a plan-based interactive help system. Her investigation focuses on the resources employed both by users and systems in interaction, and provides a description and analysis of users' 'troubles' in interacting with the system. These are, proposes Suchman, the result of "constraints imposed by asymmetries in respective situational resources of human and machine" (Suchman 1987: 118), and that limitations on the machine's "access to the evidential resources on which human communication of intent routinely relies" (Suchman 1987: 169), means that the situated actions of users may be in conflict with the system's internal representations of them in the form of plans. In human communication, such problems are resolved by efficient and comprehensive mechanisms based on humans' access to the *full* particulars of context. Suchman thus concludes that any breakdown of communication between interactants possessing differing abilities is inevitably "fatal". In doing so, Suchman provides a powerful critique of cognitivism, which indicates the intractable problems which arise from any attempt to deal with the complexity of practical, situated action through increasingly complex, and unrealistic, technical mechanisms.

Suchman's work clearly represents a considerable achievement in applying the methods, perspectives and findings of interpretive sociological approaches to the investigation of human interaction to the problems of human-computer communication. However, the work reported in this study is an attempt to move beyond her aim to "construct [...] a descriptive foundation for the analysis of human-computer communication" (Suchman 1987: 180). The intention here is to use the perspectives, methods and findings of conversation analysis to provide *practical* results for the design of user-system interaction, rather than to illustrate the deficiencies of a particular conception of interaction and action embodied in a particular type of system. The results of this study are to be seen as of a more general and more widely applicable nature since, firstly, the studies reported in Chapter four seek to examine in detail the interaction between user and *system* rather than, as in the case of Suchman's study, with the interaction between user and *user*. It is clear in this respect that the methodological device used by Suchman - the 'two-person protocol' - may introduce unwanted distortions into an attempt to explore the process of interaction between human and computer. Secondly, rather than concentrating on a particular, and somewhat esoteric, system (the plan-based intelligent help system) the studies reported in Chapter four are concerned with systems which users are likely to encounter in their everyday interaction with machines, and thus are concerned with more general features of the process of human-computer interaction.

5.2 Agre: the indexical nature of interaction

This critique of cognitivism is a characteristic of the work of a number of researchers at MIT's AI Laboratory on what has become informally known as *activity theory* (Agre 1988a, 1988b).[11] This approach also argues for the practical use of socially-grounded accounts for the design of intelligent systems, and work within this perspective emphasises that the *context* of an activity, or in Agre's terms "the dynamic structure of everyday life", is crucial for an understanding of practical action[12].

Agre's work describes a system which takes into account the 'dynamic' structure of the world. This is an intelligent system, *Pengi*, which operates using *deictic representation* and *contingent action*. These features are proposed as a more practical, and theoretically sound, approach to representation than that proposed by workers in Artificial Intelligence, which is based on *individuating* entities rather than specifying *functional relationships* irrespective of unique identity. Since Artificial Intelligence consigns "the phenomena of contingency and improvisation to peripheral roles" notes Agre, this has led to "grossly impractical technical proposals" (Agre 1988b: 1), which "allow the planner to live in a simple, abstract world" (Agre and Chapman 1988: 3). Rather than concentrate on building, monitoring, discarding and processing plans, any system which aims to act in complex real-world environments, Agre *et al.* argue, must take into account that environment, its immersion in it, and the resources which the envi-

---

[11]See also Agre and Chapman (1986, 1987a, 1987b, 1987c, 1988).

[12]The theoretical background of much of the work comes from the philosophy of Heidegger. Preston (1988) outlines the phenomenology of Heidegger in relation to Artificial Intelligence.

ronment provides for acting. In this way, a system should be "in constant interaction with its environment, rather than building and pondering models of it" (Agre and Chapman 1988: 7).[13]

5.3 Norman: the psychology of everyday things

Design which recognises the immersion of artefacts in a dynamic, changing real world, populated by intelligent, purposeful agents, is a theme taken up by Donald Norman (1988). The articulation between designed objects and the features of the real world is the basis for a "psychology of everyday things". Norman's argument is that by deriving a psychology of this kind, a "world filled with frustration, with objects that cannot be understood, with devices that lead to error" (Norman 1988: 2), may be avoided. The nature of this enterprise is that it should examine the properties of everyday objects, the nature of action, and the features of human thought, and thus attempt to provide explanations of why objects are found problematic in use. In support of this assertion, Norman notes that knowledge resides "in the world" rather than "in the head", which makes cognition a practical activity, and means that precise behaviour can come from imprecise knowledge, since the environment provides a set of physical, semantic, cultural, and logical constraints on action. Problems which arise in the interface between the nature of objects, the nature of action, and the nature of knowledge, are seen by Norman as *errors*. One locus for successful design is thus to deal with errors by either

---

[13]Similarly, Winograd and Flores (1987) note "the most successful designs are not those which try to fully model the domain in which they operate but those that are 'in alignment' with the fundamental structure of that domain and that allow for modification" (Winograd and Flores 1987: 53).

preventing them, or by providing heuristics for detecting and remedying them. Norman thus illustrates the notion that design should be *user-centred* (Norman and Draper 1986), and "make use of the natural properties of people and of the world: it should exploit natural relationships and natural constraints" (Norman 1988: 188).

5.4 Turkle: the computer as evocative object

The articulation between computer and world is taken up in Sherry Turkle's *The Second Self* (1984) from a somewhat different perspective. Turkle adopts an ethnographic approach to examine the computer as "a new mind that is not a yet a mind" (Turkle 1984: 12), and investigates the computer not as a tool, but as it

> enters into social life and psychological development, the computer as it effects the way that we think, especially the way that we think about ourselves [...] in terms of its 'second nature' as an evocative object (Turkle 1984: 13).

Turkle examines phenomena such as "thinking of yourself as a machine" and shows that many inhabitants of 'computer cultures' (such as workers in Artificial Intelligence), both think of machines as similar to themselves, and as themselves as machines. As did Suchman, Turkle points to the reactivity, complexity, and opacity of interactive systems as stimulating the attribution of mind-like qualities to computers, and notes that in interacting with computers "you inevitably find yourself interacting with a computer as you would with a mind, even if a limited one" (Turkle 1984: 16).

Turkle shows that by adopting an ethnographic rather than experimental approach, the use of computers in everyday settings may be illuminated in terms which are relevant to those who participate in those settings. Such an approach is valuable since it pays "particularly close attention to the experience of individuals" (Turkle 1984: 317), and the way in which "thoughts and feelings" may be analysed in "the expression of ideas through action" (Turkle 1984: 318).

6. Review and overview of the study

This chapter has discussed the rationale for, and the aims of, this study. The design of interactive computer systems is an enterprise quite distinct from the design of other artefacts: design, or inventing a pattern, for interactive computer systems is a matter of *design for use.* HCI research has recognised the need for a user-centred approach to design, and has correspondingly drawn upon a variety of disciplines. However, the dominance of psychological theory and method has led to the exclusion of a body of applicable findings and methods from disciplines which deal with human interaction, and to a failure to systematically investigate the the links between human interaction and human-computer interaction. Prospectively, conversation analysis provides the resources for design of more natural interactive systems, and represents the possibility of design guidance which avoids the problems inherent in current design guidelines. The methods and findings of conversation analysis, this chapter has proposed, will provide a *principled* approach both to the investigation of human-computer interaction, and to the design of interactive systems.

Within the general aim of investigating the applicability of conversation analysis to HCI, the remainder of this study addresses both the theoretical issues, and illustrates the practical outcomes, in relation to an empirical study of user-system interaction. Chapter two examines in greater detail the perspective of ethnomethodology and the findings of conversation analysis. The expository materials, such as exist in these fields, are recognised as being difficult, especially so for those who may be approaching these topics for the first time, and from other than sociological backgrounds. Accordingly the discussion concentrates upon only their more central assumptions and findings.

This chapter has observed that conversation analysis and ethnomethodology have not yet found expression in HCI research largely because of the divergence between their *methods* and those of psychology. The exact nature of those methods, and their advantages for HCI research, are explored in Chapter three. This discussion concerns both the practical methodology adopted in this study, the relationship between experimental and non-experimental investigative methods, and the practical applicability of the methods of conversation analysis in the investigation of human-computer interaction.

An empirical study of human-computer interaction is undertaken in Chapter four. The examination of videotaped sequences of human-computer interaction through conversation analytic methods is combined with the findings of conversation analysis, to formulate design guidelines and recommendations.

Finally, chapter five attempts to assess the significance of this approach to HCI research and design. The promising route which conversation

analysis provides for investigation of user-system interaction, and the possibility that it can inform the design of future interactive systems, is explored.

Chapter 2

Theory

As Sir William Bragg said, we use the classical theory on Mondays, Wednesdays and Fridays, and the quantum theory on Tuesdays, Thursdays and Saturdays.

William Cecil Dampier, *A History of Science.* (Dampier 1948: 495).

1. Introduction

This chapter discusses the theoretical perspectives and findings of conversation analysis. Such a discussion is appropriate, not only in the context of the theoretical orientations of this study, but because a lack of accessible exposition of this, and other 'interpretive' sociological approaches, has in part contributed to the failure of social-scientific findings to attract attention in the context of HCI research.

Although the concerns of this study lie particularly with conversation analysis and its applicability to HCI, many of the theoretical assumptions of conversation analysis are coextensive with those of ethnomethodology,[1] and accordingly a discussion of ethnomethodology is

---

[1]To those not familiar with the distinctive expository style of conversation analysis and ethnomethodology, both the problems, and the way in which they are presented, may be at first be rather difficult to grasp. This is clearly in part due to the "dense and elephantine" (Attewell 1974) nature of much ethnomethodological writing, which has been observed to have "the creative ambiguity of a prophet exhorting his followers and confounding a heathen" (Wallace 1968). Comprehensive, and more or less comprehensible, accounts of ethnomethodology are to be found in Benson and Hughes (1983), Leiter (1980), Livingston (1987), Moerman (1988), Sharrock and Anderson

first provided. The exposition of both ethnomethodology and conversation analysis is substantially condensed, does not aim to provide a platform for them, contribute to theory or findings in either discipline, or challenge the notion that they are "intrinsically stable" modes of description (Sacks, quoted in Jefferson 1981).

2. Ethnomethodology

The programme of research known as ethnomethodology, first outlined by Harold Garfinkel in *Studies in Ethnomethodology* (1967)[2], represented a radical departure from what was commonly recognised as acceptable or 'conventional' sociological study. This difference lay not in the areas of social life which were to be the focus of enquiry but in the ways in which investigation of those areas should proceed. The aim of ethnomethodological studies was to examine 'routine', 'everyday' and 'mundane' social activities, and

> by paying to the most commonplace activities of daily life the attention accorded to extraordinary events, seek to learn about them as phenomena in their own right (Garfinkel 1967: 1).

(1986), and Zimmerman (1978). The problem is is also in part due to the fact that conversation analysis makes "something of a principle of presenting itself through its work" (Sharrock and Anderson 1987: 291). There are however several extended commentaries on conversation analysis, such as the introductory chapters in Atkinson and Drew (1979), and Button and Lee (1987); and Sharrock and Anderson (1986, 1987), and West and Zimmerman (1982), provide overviews of conversation analysis. Wooton (1988) provides a clear exposition and discussion of conversation analytic methods.

[2]And taken up in several collections of studies, notably those by Douglas (1971), Garfinkel (1986), Psalthas (1979, 1983), Sudnow (1972), Turner (1974).

This was by no means a novel proposal. The same "commonplace activities of daily life" which are the focus of ethnomethodological writing had also featured in other sociological work, such as that by Erving Goffman (1955, 1963), for example. Rather, the novel nature of the ethnomethodological perspective is illustrated by its approach to the central sociological question of 'social order'.

All sociology assumes that the social world is experienced by members of society as orderly: this is merely to note that life 'makes sense', and commonplace occurrences are seen as, simply, commonplace "social facts" (Durkheim 1952, 1982). The explanation provided by conventional sociological approaches of social order is generally in terms of the operation of some compelling force, principle or constraining rule, such as 'power' or 'status' (Sharrock and Anderson 1987).

There is however, an alternative view, which involves the notion that social order is a *practical accomplishment*. In establishing the ethnomethodological programme, Garfinkel (1967), drawing on phenomenological work by Husserl (1965), and Schutz (1967, 1970), realised that arguments regarding the 'subjective' or 'objective' status of the social world were undecidable in principle. This led to the conclusion that such questions should be bracketed, in favour of the examination of *how* members of society experience the social world as ordered. Social order, in ethnomethodological terms, is thus better viewed as a *sense of social order* (Leiter 1980). This means that social behaviour, utterances and actions do not have inherent meanings, but gain their meanings through the process of producing a rational or acceptable descriptions of them, or in ethnomethodological terms,

accounting for them. Therefore, the interest of students of society should not be in substantive meanings or interpretations, but in *how they are produced and recognised*. A view of social order as the result of the operation of external rules is thus replaced by a view of society constructed 'from within', and the basis for this accomplishment, as ethnomethodology demonstrates, is the member of society's cultur-ally-acquired *methods* for understanding or 'sense-making'. Hence, ethno*method*ology (Garfinkel 1974), is the investigation of those methods; and the bracketing of the substantive features of social life, in favour of emphasis on how those features are interpreted, forms the core of the ethnomethodological perspective.

2.1 Ethnomethodology and methodology

The ethnomethodological emphasis on the accomplished nature of sense-making has important methodological consequences, recommending an alternative to the methods used in conventional sociological studies. For example, in administering and interpreting the results of questionnaires as a standard sociological research instrument, the sociologist uses tacit shared knowledge about the world to fit respondents' answers to the questionnaire. Later, the same shared knowledge is employed to reconstruct the intended meanings of answers in the coding of the questionnaire. This reliance is, however, obscured in the *findings* of an investigation, which are considered to be 'objective' and 'scientific'. In this way, the ethnomethodologist claims that conventional sociologists use their everyday commonplace knowledge as an *unacknowledged* resource for investigation. A great

deal of ethnomethodological writing thus dwells upon the essential similarity between 'professional' and 'lay' sociology.[3] One natural consequence of this about-turn is that professional sociology *itself* becomes the subject of ethnomethodological scrutiny, since any sociological analysis may be inspected for the role of commonsense reasoning by investigators (Garfinkel 1967).[4] It is, of course, necessarily the case that commonsense knowledge is also employed by the ethnomethodologist. This does not pose a problem however, but rather allows the ethnomethodologist to further examine the cultural resources of members of society, by claiming that ethnomethodology produces an 'insider's view' of sense-making processes not available to other approaches. This lends ethnomethodology its distinctive methodologically self-conscious character.

In contrast to analyses founded on experimental or statistical data, an ethnomethodological analysis consists of two distinct components, which have been succinctly and authoritatively described by Turner (1971). These are that, firstly

> *The sociologist inevitably trades on his members' knowledge* in recognising the activities that participants to interaction are engaged in [...] This is not to claim that members are infallible or that there is perfect agreement in recognising any and every instances; it is only to claim that no resolution of

---

[3]Much has been made in original ethnomethodological writing and in later commentaries that ethnomethodology is not meant as a criticism of conventional sociology. Garfinkel's original assertion (Garfinkel 1967: viii) that "Ethnomethodological studies are not directed to formulating or arguing correctives", has been echoed in later commentaries and expository texts (Benson and Hughes 1983, Leiter 1980). However, a great deal of ethnomethodological writing is in fact concerned with criticism of conventional sociology and its research methods (for example Cicourel, 1973).

[4]The work of McHugh *et al.* (1974) represents the extreme pole of ethnomethodological work in this respect (Law 1974).

> problematic cases can be effected by resorting to procedures that are supposedly uncontaminated by members' knowledge (Turner 1971: 177, original emphasis).

and secondly that,

> The sociologist having made his first-level decision on the basis of members' knowledge, must then *pose as problematic* how utterances come off as recognizable unit activities. This requires the sociologist to *explicate the resources* he shares with the participants in making sense of utterances in a stretch of talk. At every step of the way, inevitably, the sociologist will continue to employ his socialised competence while continuing to make explicit *what* these resources are and *how* he employs them (Turner 1971: 177, original emphasis).

The way in which an ethnomethodological analysis simultaneously draws upon "the resources [...] shared with the participants" and explicates them "at every step of the way" clearly distinguishes an ethnomethodological investigation from that of the conventional sociologist. Ethnomethodological investigation is in this way said to involve the use of commonsense knowledge as both as a *topic* and a *resource*. This is the basis for the claim that ethnomethodology represents an 'insider's view', and is, as Heap (1980) notes, a "phenomenological empiricism".

It is possible to provide a simple example of the ethnomethodological approach. In *Studies in Ethnomethodology,* Garfinkel proposes that conventional sociology portrays the member of society as a "judgemental dope of a cultural or psychological kind" (Garfinkel

1967: 67). Garfinkel designed an 'experiment'[5] to display the way in which the judgemental dope is portrayed, by investigating a social encounter where behaviour is supposedly conditioned by 'standardised' expectations. This was done by breaching the 'institutionalised one price rule' which states that merchandise is retailed for the price for which it is offered. Garfinkel's students were asked to dispute the clearly marked price of goods, and try to obtain a lower price. The result of the experiment was, in Garfinkel's words, that

> salespersons can be dismissed as either having been dopes in different ways than current theories of standardised expectancies provide, or not dopes enough (Garfinkel 1967: 69).

Instead of fear and shame which should have been generated on the part of customers, and anger and anxiety on the part of salespersons, only mild anticipatory anxiety was reported on the part of the customers, and very little disturbance on the part of sales staff. The conclusion drawn by Garfinkel is that 'standardisation' may only really consist of an *attributed* standardisation

> which is supported by the fact that persons avoid the very situations in which they might learn about them (Garfinkel 1967: 70).

In this sense, ethnomethodology begins from the premise that what people know and use - their *methods* for understanding - should be the focus of inquiry. In ethnomethodological terms, to examine these

---

[5]Garfinkel cautions that the experiments are "not properly speaking experimental. They are demonstrations" (Garfinkel 1967: 38).

methods is to examine *commonsense knowledge* and *background expectancies, interpretive procedures* and *practical reasoning.*

2.2 Commonsense knowledge

In stressing the 'commonsense' nature of sense-making, ethnomethodology shifts the focus towards the *practical*. Thus reasoning becomes practical reasoning, action becomes practical action, and understanding becomes practical understanding.[6] This serves to emphasise that it is everyday and practical matters, rather than detached, analytic, or abstract considerations, which are important to members of society.[7]

Commonsense knowledge, as defined in ethnomethodological writings, may be seen to consist of three elements. The first is the *stock of knowledge* (Leiter 1980), comprising culturally transmitted knowledge about persons, places, and likely events and actions. The second is the *natural attitude* (Husserl 1965), which describes the acceptance that reality is independent of individual perception. The third component, which is the explicit focus of the ethnomethodological investigation of sense-making methods, is *commonsense reasoning*. Commonsense reasoning is seen to be composed of two main types of sense-making method, the *documentary method of interpretation*, and *interpretive procedures*.

---

[6]The emphasis on practical understanding and the situated nature of action is not, of course, unique to ethnomethodological work. *Action theory* (Argyris and Schön 1974, Schön 1987) for example, emphasises awareness of practical action in the development of pedagogical strategies.

[7]Woolgar (1988), shows that scientists' practical activities are directed towards avoiding "methodological horrors" in the course of laboratory work.

2.2.1 The documentary method of interpretation

The documentary method of interpretation is the process by which isolated appearances are interpreted as standing for, or providing a 'document' for, an underlying pattern. Garfinkel performed an experiment to examine the operation of the documentary method. This was accomplished by observing and interviewing subjects being fed a series of random yes and no answers to a connected series of questions by an experimenter posing as counsellor (Garfinkel 1967, 1983). Following a question and answer session, subjects were asked to comment on the unseen counsellor's 'advice'. Garfinkel found not only that the individual occurrences (random yes or no answers) were taken as standing for some pattern, but that the pattern itself (the cogency of the advice) was inferred by seeing the individual instances as evidence of a developing pattern.[8] The importance of the documentary method lies in its involvement in all sense-making activities and the way in which it "both creates and presupposes a factual world" (Leiter 1980: 171).

2.2.2 Interpretive procedures

The second type of sense-making device is a collection of *interpretive procedures*.[9] The commonly recognised procedures are

---

[8]This is strongly paralleled by the reactions of users of Weisenbaum's ELIZA/DOCTOR which effectively behaved in the same way as the unseen counsellor. The claim would be, as Weisenbaum supports, that the program relied for its effectiveness on use of the documentary method of interpretation by its users. Suchman (1988b) provides an extended discussion of this phenomenon and its implications.

[9]There have been various formulations of the procedures, which vary both in definition and number. Cicourel (1973) lists six, but there are other proposals (for example Leiter 1980).

(1) the *reciprocity of perspectives*, which specifies that members of society assume an interchangeability of standpoints. Therefore differences of "biography and perception" (Leiter 1980: 174) are ignored unless discrepancies arise, when those differences are used to account for discrepancies;

(2) *normal forms*, which is the assumption that actions will be recognisable *prima facie* as intelligible. Thus any action, behaviour or utterance will be given a rational interpretation, rather than labeled as irrational or random;

(3) *the et cetera principle*, which states that members of society attach a virtual 'et cetera' clause to their utterances, assuming that hearers will be able to fill in any non-obvious details. Thus to sustain the assumption of normal forms the presence of an et cetera instruction will be assumed;

(4) *descriptive vocabularies as indexical expressions*, which specifies that to recover the specific sense of utterances, literal meanings will be supplemented by knowledge of context, history, biography or situation;

and (5) the *retrospective-prospective sense of occurrence*, which specifies that judgement about an interpretation of an action or utterance will be reserved until clarification is provided by some future action or utterance.

2.3 Features of behaviour and interaction

Ethnomethodology asserts that the documentary method of interpretation and interpretive procedures are not merely optional but *necessary* processes of sense-making. This is the case because social action is characterised by two properties, *indexicality* and *reflexivity, which* make sense-making a continuing 'problem' for members of society, and one from which there is no 'time out' (Garfinkel and Sacks 1970: 356).

Indexicality refers to the *context-bound* nature of behaviour, in the sense that meaning is dependant on contextual features, and behaviours act as 'indices' to the larger contexts in which they are produced. Originally the concept of indexicality, in the work of for example Bar-Hilliel (1954), referred only to a subset of linguistic signs such as pronouns, which have an infinite range of context-dependant meanings. The notion of indexicality was extended in the work of Garfinkel to include *all* social activity. Indexicality is thus an inescapable feature of all social situations, because behaviour is made meaningful *only* when

> embedded in an ethnographic context that is without specified boundaries and made up of ethnographic particulars which are also indexical (Leiter 1980:106).

Meaning, in the view of ethnomethodology, is therefore not a matter of negotiating a fit between sign and rule, but emerges from the relationship between contexts and "occasional expressions" (Husserl 1965). However, this should not be taken to mean that indexicality is experienced as a *conscious* problem for members of society, or to suggest that

behaviour is meaningless, but "points[s] to the accomplished nature of meaning". (Leiter 1980: 110). Similarly, it should not be taken to mean that the *exact* interpretation of behaviour is impossible, but to mean that 'for-all-practical-purposes-interpretations' are the inevitable outcome of practical reasoning. As Benson and Hughes (1983: 101) observe, considerations of *truth-value* in everyday situations may be unimportant. Indexicality is therefore, in Garfinkel's terms, a "normal, natural trouble" (Garfinkel 1967: 191).

The second property of social behaviour which necessitates the operation of sense-making methods is that of *reflexivity*. Since behaviours are indexical, the contexts which they index *include the indexical behaviours themselves*. Behaviour and context is mutually elaborating: the sense of some behaviour can only be established for all practical purposes by referring to context, which in turn contains that behaviour and thus affects its interpretation. As Leiter notes, "behaviour and talk are simultaneously in and about the settings they describe" (Leiter 1980: 130). Reflexivity appears in ethnomethodological work as a feature of the *accounts* used by members of society to analyse, comment upon, describe or summarise their and others' activities. Accounts are said to be reflexive, in that they do not only comment upon situations, but become *a part of* the situations which they describe. As with indexicality, the reflexivity of accounts is not consciously attended to by members of society, since this would distract them from the practical business of sense-making.

2.4 Summary

This discussion of the ethnomethodological perspective has presented some of its important assumptions. The core of the ethnomethodological perspective was shown to be that the investigation of social behaviour, action, and interaction should centre upon the sense-making methods of members of society. The major sense-making methods - the documentary method of interpretation and a collection of interpretive procedures - were shown to be necessary features of sense-making as a result of the pervasive indexicality and reflexivity of social behaviour. In general terms ethnomethodology is a *theory of meaning*. However, it is a very different one from theories which depict understanding as a cognitive consensus, and where meaning is viewed as the overlapping of sets of knowledge. Rather ethnomethodology sees meaning as a *procedural* matter, and is thus a theory of meaning "by context" (Leiter 1980: 154).

This view of sense-making as a *procedural* matter, meaning as an accomplishment based on tacit abilities, and a view of the social actor as engaged in a continual construction of reality through the operation of sense-making methods, forms the essential link to *conversation analysis*.

3. Conversation analysis

Whilst ethnomethodology examines the sense-making procedures used in interpreting behaviour, conversation analysis investigates the detailed organisation of interaction.[10] The fine-grained details of the patterning of utterances are then used as an indication of the specific procedures employed in the understanding and production of interaction.

This shift towards an examination of the "organisational features of conversational interaction" (Jefferson and Schenkein 1977: 91), becomes more apparent when the methodological characteristics of conversation analysis are considered. Conversation analytic studies typically take the form of the demonstration of the occurrence of regular structures in conversation across large volumes of data produced by speakers at different times, places, and on different topics. The traditional forms of data collection native to sociological research (the questionnaire, interview and participant observation), are replaced in conversation analysis by audio recordings of everyday conversations,[11] which are then meticulously transcribed in a modified orthography.[12] Transcription has in fact assumed a central role in conversation analysis' methodological repertoire: it is seen not as a preliminary or

---

[10]Button (1981) has identified two parallel strands of conversation analytic enquiry: 'structural', which is concerned with the ways in which the ordering of conversation is used as a resource for understanding; and 'ethnographic', concerned with the generally available cultural resources which underlie conversation (for example Sacks' (1972) discussion of "membership categorisation devices"). The version of conversation analysis of interest in this study is 'structural' conversation analysis.

[11]And video-recordings in the work of C. Goodwin (1979, 1981), M. H. Goodwin (1980), Beattie (1983).

[12]The system generally used is that proposed by Gail Jefferson. It is described in Schenkein (1978), and a variant appears in Appendix two of this study.

prefatory part of investigation, but as an essential part of the investigative process which is generative of research (Jefferson 1988). The level of detail in both analysis and transcription is often a source of considerable bewilderment to the uninitiated, but is motivated by the assumption that it is not possible to specify in advance what level of detail may be important.

In conversation analytic studies, fragments of transcripts accompany the details of their 'excavation' - the detailed investigation of the structure of the fragment. This juxtaposition is seen as necessary, since whilst it impossible to ever produce an 'objective' analysis (for reasons which the the ethnomethodological perspective makes clear), it is nonetheless possible to indicate clearly the relationship between the analysis proposed and the data on which it is predicated. In this way, the use of commonsense knowledge and the processes of commonsense reasoning which ethnomethodology stresses are part of *any* sociological enquiry, whether 'lay' or 'professional', may be laid "open for inspection and scrutiny" (Atkinson and Drew 1979: 26). It is thus possible to see the emphasis on naturally-occurring data, detailed transcription, and the juxtaposition of analysis and data, as an attempt to inject ethnomethodological analyses with greater levels of rigour and objectivity (Atkinson and Drew 1979).

To this end, rather than just amass collections of similar conversational sequences which are presented alongside analyses, it is stressed that analyses must be answerable to data in a specific way. Analysis should not 'go beyond' the data itself in search of evidence. This amounts to the recommendation that the analyst must justify analytic claims about how some utterance was interpreted by looking at how

other participants in the conversation interpreted that utterance. The 'orientation' of participants to an analyst's interpretation, rather than speculation about the motives, beliefs, desires or other psychological attributes of speakers, is thus said to provide strong support for a particular analysis.

However, conversation analysis seeks to avoid the use of *common-sense* categories, and rather concentrate on generating *technical* ones. Thus, Schegloff (1984) cautions that it is a mistake to focus upon categories of activities such as 'questions', or 'promises'. Instead the real focus of interest should lie in the *particular* data: thus utterances which might appear, on a lexico-syntactic analysis, to be 'bets' or 'promises' for example, may in fact be seen to performing *technical activities* such as 'closing' or 'opening' a conversation (Schegloff 1984, Schegloff and Sacks 1973; Schegloff 1968, 1979), 'repairing' an utterance (Jefferson 1987, Schegloff *et al.* 1977) or 'generating topic' (Button and Casey 1984, Erickson 1981, Maynard 1980). This shift of focus to the *activities* that talk performs is crucial, since it allows for the fact that the phenomena with which conversation analysis deals may not only be verbal but non-verbal, and emphasises that the focus is on *the structure of actions in interaction*. Sharrock and Anderson (1987) observe

> There is [...] no need for CA to insist that verbal actions can only relate to other verbal actions for they may relate, as well, to non-verbal ones. [...] It is entirely possible for [a] first action to be a verbal action and for [the] 'next' to be a non-verbal one. (Sharrock and Anderson 1987: 302).

3.1 The analysis of conversation: an example

An example of conversation analytic approach is provided by Schegloff's (1984) analysis of an 'ambiguous' question. Schegloff's datum consists of an excerpt from a radio talk-show where B, a student, is describing to A, a talk show host, the differences he (B) has been having with a tutor over the morality of American foreign policy (Schegloff 1984: 28).[13]

(1)

B: our main difference: I feel that a government, i- the main thing, is- th- the purpose a' the government, is, what is best for the country
A: Mmhmm
B: He says, governments, an' you know he keeps- he talks about governments, they sh- the thing that they sh'd do is what's right or wrong
→A: for whom
B: well he says ⌐ he-
→A: ⌊-By what standard
B: that's what- that's exactly what I mean.

The investigation centres upon A's utterance "for whom" and the way that it may be seen as ambiguous. Schegloff firstly proposes that the question "for whom" produced by A is a *real,* as opposed to an *analytic,* ambiguity. Schegloff suggests that A clearly intended "for whom" to be an *agreement* with B's view, but that B misinterpreted it as a *question requesting clarification.* It is further proposed that A can see that B misunderstood "for whom", through the positioning of the word "well" at the opening of B's subsequent utterance, which suggests that it was intended to be an answer, rather than the more expectable agreement.

---

[13]The transcription conventions used are those described in Appendix 2.

Schegloff thus concludes that A employs a generic procedure which involves looking for the utterance which occasioned the misinterpretation, (in this case "for whom") and producing a second version of it to invite a second interpretation, i.e. this time not as a question but as an agreement (Schegloff 1984: 40). That this procedure was successful, i.e. that B now recognises "for whom" was an agreement rather than a question, is shown by B's utterance "that's exactly what I mean". Schegloff thus demonstrates that the ambiguity is one recognised by the participants themselves, since both 'analyses' are considered.

This example illustrates that conversation analytic studies make no attempt to conceal the analyst's status as member of society and the reliance on commonsense knowledge that this entails. Instead it is used as an acknowledged source of analytical evidence, and provides a counter to those methods that are founded upon experimental or invented data, and where "operational definitions are applied to produce description by fiat" (Button and Lee 1987: 28).

3.2 Sequence in conversation analysis

The brief discussion of Schegloff's analysis provides a view of the lynchpin around which conversation analytic studies turn. This is that interaction is seen as a *sequential* phenomenon. The central role of sequence in interaction is important in two particular, and closely related, respects. The first concerns the importance of sequence to *speakers*, the second its importance to *analysts*.

Conversation analytic studies show that talk is meaningful for *speakers* themselves only when it is embedded in sequences of conversation. This means that in the first instance utterances are contextually understood by reference to their *placement,* and thus

> it is sequences and turns within sequences, rather than isolated sentences and utterances, that have become the primary units of analysis (Atkinson and Heritage 1984: 6).

In engaging in conversation, conversation analysis argues, it is these structural and sequential features to which speakers attend, rather than decontextualised sentences and their syntactic or semantic markings. Schegloff (1984) comments that whilst it may appear at first glance that features of syntax, semantics or prosody allow for the interpretation of utterances as of particular types, in reality

> no analysis, grammatical, pragmatic, semantic, etc., of these utterances taken singly and out of sequence, will yield their import in use, will show what co-participants might make of them and do about them. (Schegloff 1984: 31).

In this way a 'first' conversational action (such as a greeting, say) can provide the basis for the production and recognition of an appropriate 'second' part to that 'first' (another greeting). The emphasis in conversation analytic work is thus on the detailed structure of *sequences* of interaction[14].

---

[14]Clark and Shafer (1987) similarly emphasise the sequential nature of 'contributions' to interaction.

It can also be seen that the sequential nature of interaction has an important methodological consequence for the analysis of conversation. This is that the behaviour of conversationalists themselves provides the analyst with the materials for analysis. Since all talk is directed towards its sequentially *prior* talk, it can be heard as providing an analysis of that prior talk. And, given that such analysis is publicly available for the participants in conversation, it is also, by virtue of the analyst's own conversational competence as a member of society, *available for analytic examination*. The sequential nature of conversation thus provides a "context of publicly displayed and continuously updated intersubjective understandings" (Atkinson and Heritage 1984: 11).

3.3 Other approaches to the interaction analysis

Even though the methods and assumptions of conversation analysis appear novel, its interest in speech and conversation as legitimate objects of enquiry is not in itself a novel one. Work within ordinary-language philosophy such as speech act theory (Austin 1962, Searle 1970), has shown that language can be analysed as social action. However, speech act theory takes as its material isolated sentences, and analyses of their social functions are conducted on syntactic and semantic properties which are treated as independent of discursive considerations. Given the decontextualising nature of speech act theory, it is clear that it stands at odds with the conversation analytic perspective, which asserts that the literal meaning of some conversational action cannot be established by reference to a 'null context'

(Levinson 1983).[15] The notion that interaction is cooperative work also stands in contrast to (social)-psychological approaches (Bull and Roger 1988, Hopper 1988), which view talk as the outward expression of individual psychological states. Similarly, it is distinct from linguistic approaches as transformational-generative grammar (Chomsky 1957), which depicts conversation as the intersection of individual speakers' linguistic 'competence' in a domain of degraded 'performance' (Schegloff 1968).

3.4 Review

The preceding discussion has discussed central themes of conversation analysis. Conversation analysis focuses on the structural details of conversation as an activity performed on the basis of shared procedures. The following sections discuss some findings from published studies.[16] Firstly a discussion of *turn-taking* is provided, followed by a discussion of *adjacency pairs*. These findings are considered central to conversation analysis, and are drawn upon in the investigation of human-computer interaction presented in Chapter four.

3.5 Conversation analytic findings

Conversation analytic findings reveal conversation as composed of three general forms of sequential organisation. The first is 'local' organisation, or sequencing of individual utterances, the second is the overall structural organisation of a conversation, and the third is the

---

[15]Levinson (1978a, 1978b) provides a critique of speech act theory from the perspective of conversation analysis.

[16]A concise overview of conversation analytic studies, along with a comprehensive bibliography, appear in Heritage (1985, 1988).

organisation of topic. Whilst these three forms of sequential organisation are interrelated, the discussion here is restricted to the first of these forms as specifically relevant to the concerns of HCI.

3.5.1 Turn-taking

It is not surprising that one of the initial interests of conversation analysts, and one of the most widely known, was in the nature of *turn-taking*. Conversation analysis views turn-taking as a sequence of options which arise whenever speaker change occurs, and turns are conceived of as spaces in which speakers have the right to speak, and at the end of which speaker change may occur. Turns are seen to project these change-over points, so that speaker change can be achieved smoothly.

Sacks *et al.* (1974) present what they term a "simplest systematics" for the organisation of turn-taking. They firstly observe that turns at talk are a valuable resource, as as such, require a procedure for allotting them to particular speakers.[17] The existence of such a mechanism, they note, is indicated since little talk occurs in *overlap* - simultaneously - in the normal course of a conversation, yet the conversational 'floor' is passed between speakers with great regularity. In an attempt to define a model of the the turn-taking system, Sacks *et al.* point to these, and some other "grossly apparent facts" about conversation. These are that one speaker talks at a time; the order of speakers is not not predetermined; conversations are of variable length; topic is not pre-

---

[17]Other approaches to turn-taking, such as that which proposes a system based on cues (Duncan 1972, Duncan and Fiske 1977), or a model based on on stochastic processes (Jaffe and Feldstein 1970), are discussed in Wilson *et al.* (1984).

specified; the numbers of speakers can vary; talk is subject to gaps and pauses; turns can have various components (one phone, one word, one clause, one sentence); and that there are remedies for the resolution of simultaneous talk.

The model which they propose to account for these observations has two features. Firstly, it consists of a *turn-constructional component*, which describes the resources from which a speaker may construct a turn at talk (sentences, clauses, phrases, words, phones). A *transition relevance place* (TRP) occurs at the possible completion of the turn, and at which point the second feature of the model, the *turn-allocation component* comes into play. This component is envisioned as a set of ordered rules which provide for the allocation of a turn to a speaker with minimal overlapping talk from successive speakers. These rules are of two types: those which provide for *the selection of next speaker by the current speaker*, and those which provide for the *self-selection of the next speaker*. The rules for turn-allocation can be summarised as follows:

> *Rule 1* - applies at the initial TRP of any turn:
>
> > If the current turn selects a next speaker, then only the selected speaker has the right to speak.
> >
> > If the current turn does not select a next speaker, then another speaker may self-select. The first speaker to self-select acquires the right to speak.
> >
> > Alternatively, the current speaker can continue to talk.
>
> *Rule 2* - if, at the initial TRP neither 1(a) (current speaker selects next), or 1(b) (self-selection) has occurred, and 1(c) has applied (current speaker continues), then rules 1(a) - (c) reapply at the next TRP, and recursively at each next TRP until speaker change occurs.

The fact that the rules for turn-taking are ordered is important, since it accounts for the 'one speaker speaks at a time' norm in conversation. Thus rule 1(a) needs to be employed *before* the initial TRP of any turn (i.e. inside the turn), otherwise rule 1(b) will apply. Similarly, rule 1(b) needs to be employed *at* the initial TRP, and *before* rule 1(c) has been invoked. If 1(c) *is* invoked, then the rule set 1(a)-(c) will cyclically reapply. In this way, the rules are mutually constraining, and their ordered nature precludes the possibility that they will apply simultaneously - thus violating the 'one speaker at a time' norm in conversation. In this way the minimisation of overlap between speaking turns is accomplished by eliminating it from individual turns, specifying that speaker change must occur at the TRP of a turn. The possibilities for gap and overlap are thus centred around the TRP of any turn, and this means that where gap and overlap does occur, it will be as a result of simultaneous talk from 'competing first-starters' for the next turn - under rule 1(b). The rules thus allow the discrimination between inadvertent overlap and interruptions, and predict that silence will be differentially assigned as a *gap* (before the application of rules 1(b) or 1(c)), as a *lapse* on the non-application of rules 1(a)-(c), or as an *attributable silence* (one which 'belongs' to a particular speaker) after the application of rule 1(a).[18]

The model is, in Sacks *et al.*'s terms a *local management system* in that it deals with only single transitions between successive turns. In each case the turn it allocates is the next turn, and thus operates on a

---

[18]Segments of talk on which Sacks *et al.*'s analysis is based may be found in the original paper, *passim*.

turn-by-turn basis. This aspect of the turn-taking model is termed "party-administration":

> The party-administered, local management of turn-order is effected through the rule-set, whose ordered property provides a cycle of options in which any part's contribution to turn-order determination is contingent on, and oriented to, the contributions of other parties. (Sacks *et al.* 1974: 726).

The locally-managed, party-administered character of the model of turn-taking points to a general feature of conversation, that of *recipient design*, which refers to fact that talk is designed to display a sensitivity to other speakers. Similarly, it points to the intrinsic motivation for *listening* in conversation (West and Zimmerman 1982), a motivation not accounted for by concerns of politeness, or being seen to be attentive, but by the fact that only by a continued awareness of the state of the conversation can any speaker become next speaker, or recognise the fact that they have been selected to talk.

3.5.2 Adjacency Pairs

A second finding concerning local conversational organisation is that some turns *project* the range of actions which may occur in the following turn from a subsequent speaker. 'Next speakers' are therefore under a constraint to produce an appropriate next utterance. This can be seen in the structure of activities such as offers, greetings, or questions (invented data):

(2)

Offer/acceptance
A: like one?
B: thanks

Greeting/greeting
A: hi
B: hello

Question/answer
A: what time is it?
B: five ten

These two part structures are termed *adjacency pairs* (Schegloff and Sacks 1973), which consist of adjacent utterances produced by different speakers. In conversation analytic terms the second part (or "second pair part") is *conditionally relevant on* the first part (or "first pair part"). This means that the activity accomplished in the first pair part (which may be recognisable through syntactic or lexical properties) projects the range of activities which may occur in the second pair part. The constraint of conditional relevance is formulated by Schegloff and Sacks as an 'adjacency pair rule':

> given the recognisable production of a first pair part, on its first possible completion its speaker should stop and a next speaker should start and produce a second pair part from the pair type of which the first is recognisably a member. (Schegloff and Sacks 1973: 196).

Conditional relevance is a real expectation for speakers, since when a second pair part does not follow a first, speakers treat it as a 'noticeable event' and may infer either that the listener did not hear, or is unwilling to respond.

Aside from this simple expectation that *some* second pair part must occur after a first pair part, it is also clear that there are constraints on the types of seconds which may occur after a first, and a requirement that an *appropriate* second should occur. For example neither a greet-

ing/greeting nor an accusation/denial sequence can be said to have been successfully performed in the examples below (invented data)

(3)

Greeting
A: Hi
B: get lost

Accusation
A: it was your fault, wasn't it?
B: five o'clock.

This simply reflects our commonsense knowledge that answers may follow questions, acceptances may follow offers, agreements may follow assessments, and denials may follow accusations. Conditional relevance then, in setting up these expectations implies that a second pair part will be examined for its 'fit' with the activity that the first pair part projects. This also applies to silences. A silence following a first pair part invites the speaker to reason about the silence and how it may be interpreted. As Schegloff notes,

> the culture provides that variety of 'strong inferences' can be drawn from the fact of the official absence of an answer, and any member who does not answer does so at the peril of those inferences being made (Schegloff 1979: 367).

However, conditional relevance does not impose strict constraints on the range of seconds that may follow a first. As Levinson (1983) notes, adjacency is in fact not criterial to the adjacency pair, so that the second part of a pair may occur at some later stage in the conversation, separated from its first by intervening adjacency pairs or other utterances. In this sense, the phenomenon of 'questions following questions' is not an unusual one (Merrit 1977). For example in (4) below, B's response to A's request is separated by intervening talk (invented data)

(4)

A: Can I have a box of matches please?
B: large or small?
A: small
B: sure

Adjacency pairs are also employed in such activities as opening and closing conversations. Whilst it might not seem that such activities are an 'accomplishment' of any sort, conversation analysis argues that, like other aspects of conversation, openings and closings occur in structured ways. In particular, since a conversation requires a speaker to to produce a first utterance to bring the turn-taking rules into play, and once activated would not stop by inertia, closing must therefore be an accomplishment. Schegloff and Sacks (1973) discuss closing as a 'problem', but caution

> we do not intend puzzle, in the sense that participants need to ponder the matter of how to close a conversation. We mean that closings are to be seen as achievements, as solutions to certain problems of conversational organisation. [...] The problem we are concerned with [...] does not require that such practical problems occur. (Schegloff and Sacks 1973: 290-291).

The 'closing problem' thus requires that conditional relevance be suspended, so that conversationalists may arrive at a point where

> one speaker's completion will not occasion another speaker's talk, and that will not be heard as some speaker's silence (Schegloff and Sacks 1973: 294-5).

If conditional relevance were still applicable, a silence, (which must inevitably be the final outcome of the close of a conversation), would be, in their terms, 'attributable' to the next speaker. It is this sense that

they state "simply to stop talking is not a solution to the closing problem" (Schegloff and Sacks 1973: 295). The adjacency-pair structure, in this case a 'terminal exchange', consisting of the exchange of ritualised utterances, such as 'bye', or 'see you', resolves the closing problem. The utterance 'bye' as the first part of an adjacency pair, sets up a constraint that the reply to that first should a be second part of an appropriate type. If that second does occur, and is of the appropriate type, both parties can be seen to have understood the nature of the sequence in which they are engaged, and the conversation is brought to a successful close.

4. Review

This chapter has discussed the perspectives of ethnomethodology and conversation analysis. Common to both ethnomethodology and conversation analysis is the finding that in engaging in interaction is an improvised activity dependant on a vast amount of interpretive work. This is necessary since members of society need to arrive at practical interpretations and coordinate their own actions with the actions of others. The final sections of the chapter discussed some prominent findings of conversation analysis, concerning the detailed organisation of conversation.

This chapter has only provided a brief account of the *methods* of conversation analysis, in terms the practical activity of transcription, and the attempt to provide an 'insider's view' through an acknowledgement of the subjective involvement of the analyst. Whilst conversation analysis itself has produced an adequate account of its meth-

ods for the analysis of conversation, there remain issues concerned with the way in which it may be applied to *human-computer interaction*. The following chapter addresses these issues, and attempts to produce a coherent account of the ways in which the methodology of conversation analysis, especially in its strongly empirical and non-experimental character, may be applied in the context HCI to generate *principled* but *practical* findings for design.

Chapter 3

Method

> Observation is always selective. It needs a chosen object, a definite task, an interest, a point of view, a problem. And its description presupposes a descriptive language, with property words; it presupposes interests, points of view and problems.
>
> Karl Popper, *Conjectures and Refutations* (Popper 1963: 46).

1. Introduction

Popper's view of the theory-dependence of observation serves to emphasise that rather than being of merely prefatory interest, issues of method must be raised as a matter of priority to the point of visibility in any research enterprise.

Of course, a concern with method is a quotidian feature of many studies from a variety of theoretical perspectives. However, in these studies, concern with method is typically synonymous with a simple description of praxis. Although this chapter is partly concerned with method interpreted in this narrow sense, larger methodological issues are implicated in a study concerned with multidisciplinary research and the relationship between the divergent, and to some extent inimical, methods typical of HCI research, and those characteristic of conversation analysis.

As Chapter one observed, conversation analysis has not so far been employed in the investigation of human-computer interaction. The account of ethnomethodology and conversation analysis in Chapter two provided one reason for this failure, which rests in their joint concern with the nature of unquantifiable, socially constituted aspects of interaction. Chapter one also indicated a second reason for this failure, concerned with the nature of conversation analytic *methods*. Conversation analysis recommends that interaction must be studied in everyday circumstances rather than in contrived research settings and, since the study of interaction is the study of meaning, interpretation, and mutual intelligibility, must be investigated in the light of an explicit acknowledgement of the 'socialised competence' of the analyst.

It is clear that there is a considerable divergence between the experimental approach common in psychology and adopted in HCI research - structured research settings, hypothesis testing, the use of statistical measures of significance - and the methods of conversation analysis. There is also, necessarily, a tension between the ways in which the findings of both enterprises are viewed: a tension fuelled by, on the one hand, those experimentalists who see interpretive approaches as unsystematic and 'unscientific', and on the other, those analysts of human interaction, who see the experimental investigation of human abilities as the mis-application of a methodology only truly appropriate for the investigation of the physical world. This chapter argues that experimentation, and experimental approaches to the study of user-system interaction, are subject to a number of shortcomings, and it is these which lead to a lack of applicability of previous findings from psychology, and the results of experimental

studies, to HCI research and design. The methods of conversation analysis, it will be argued, provide a corrective to experimental methods, and represent a *principled* approach to the analysis of human-computer interaction.

2. Experimentation and HCI research

Carroll and Campbell (1989) have observed that much HCI research is in the "laboratory-bound tradition of task analysis", characterised by

> analyses [of] small-scaled, repetitive performances conducted in highly-constrained conditions on system-like laboratory apparatus (Carroll and Campbell 1989: 249).

"Small-scaled repetitive performances" in "highly-constrained conditions" clearly describes the methodology of the natural sciences, where the emphasis is on strictly controlled research settings, the isolation of relevant of variables, and the search for standard statistical measures of significance. In its most extreme form this method is accompanied by a 'positivist' outlook, which depicts the human actor as "cognizing subject" (Coulter 1989), and sees the mind as "a self-perpetuating closed input/output system" (Lave 1988: 191).

A number of critical observations have of course been made about experimental approaches to the investigation of human abilities.[1] For example, the desire for a *formal* description of behaviour requires

---

[1]Westland (1978) provides a comprehensive critical account of the problems of experimentation in psychology.

procedures which generate highly *abstract* versions of real-world events, which may bear little or no resemblance to events which might occur in everyday, uncontrolled situations (Briggs 1988). Similarly, as Douglas (1971) notes

> the meanings of the research situation, and of the social researcher himself, have a great deal of effect on what human actors do in any nonsecret research setting (Douglas 1971: 29).

Controlled experimentation discounts subjects' reflections about their own behaviour and its circumstances, and commonly ignores their obvious desire to provide what is perceived as the 'correct' behaviour. Experimenters, on the other hand, are constrained from explaining their intentions to participants by the demands of experimental procedure (Lave 1988). Of more consequence, experimentation is seen as the source of unassailably 'objective' and 'scientific' knowledge. However, as ethnomethodology has argued, primarily in relation to sociology, the practical involvement of investigators means that 'objective' results are necessarily informed by investigators' commonsense reasoning. As Garfinkel *et al.* (1981) observe, even a seemingly 'objective' and 'scientific' process such as astronomical observation, involves the use of commonsense reasoning on the part of investigators. Thus, despite attempts to achieve greater objectivity through the generation of more strict experimental controls, scientific findings, like Kuhn's scientific paradigms, remain firmly social constructs (Latour and Woolgar 1979).

The force of these critical observations is of course to illustrate the lack of *ecological validity* in existing investigation, and to raise the issue,

seen as an unproblematic in many approaches, of the relationship between events in controlled experimental settings and events in the real world. Of course, alternative strategies have been devised to avoid problems raised by the relationship between laboratory and real-world events, which at least indicate that there is a need to move beyond experimental approaches. One prominent response has been to employ the introspective abilities of subjects to provide investigators with 'objective' access to 'subjective' processes. 'Knowledge elicitation' techniques (Hoffman 1989, Nisbett and Wilson 1977, Stevenson *et al.* 1988), and think-aloud protocols (Bailey and Kay 1987, Ericsson and Simon 1980; Mack *et al.* 1983, Shaw 1979) for example, which require subjects to verbalise during task performance. Variants such as two-person protocols (used in the work of Suchman 1982, 1987), and the "constructive interaction" of O'Malley *et al.* (1984), employ the interaction between subjects as evidence for cognitive or cognitive-interactional processes. Researchers have also attempted to use their own interpretations and observations as data, through techniques such as participant observation where investigators, as members of the community being investigated, observe, participate in, and analyse events (for example the 'action research' discussed by Candy 1988). Other, more introspective techniques, are exemplified by the 'vignettes' of experience employed by Agre (1988a, 1988b).[2]

These approaches, however, are themselves open to criticism, prominently in terms of the presumed unproblematic link between lan-

---

[2]As Turkle notes, "major sectors of the artificial intelligence community have given new life to the self-analytic method, and in doing so have developed a somewhat paradoxical identity as the cybernetic descendants of Freud" (Turkle 1984: 258).

guage, action and cognition, and the assumption that "verbal discourse processes constitute the exclusive condition for efficacious action" (Lave 1988: 182). If the ethnomethodological arguments regarding the tacit and automatic nature of interactional processes are accepted, verbalisation or introspection may not be reliable guides (Bainbridge 1979, Dreyfus and Dreyfus 1986, Good 1982). Wooton, (1988), states the case simply

> In interacting we employ highly sophisticated forms of practical inference which even as interactants ourselves we are barely aware of. And as participants we would be as incapable of specifying in any serious analytic way the procedure through which those inferences are made (Wooton 1988: 254).

It is in this sense that studies which exhibit a restricted view of what constitutes 'objective' and 'scientific' investigation, and attempt to remedy the the more obvious problems of experimentation through the substitution of *ad hoc* strategies for strict experimental procedures, are guilty of methodological naivete. As Lave notes, they attempt to do so "without rethinking their theoretical underpinnings" (Lave 1988: 101). To take an example from HCI research, Eason (1984), in an investigation of the concept of 'usability' in HCI, stresses that experimentation is the prime source of objective and reliable knowledge, and views the development of more productive methods as a process of "bring[ing] as much as possible of field conditions into the laboratory" (Eason 1984: 141). This is so since

> field studies are notoriously difficult to control and if we are to subject the concept [of usability] to rigorous examination we need to investigate it in controlled experimental conditions (Eason 1984: 134).

Eason, recognising the lack of established experimental designs for the investigation of usability, declares an aim to investigate "users employing real systems to undertake real tasks" (Eason 1984: 134). However, Eason takes a "short cut" to "real data" by presenting a *questionnaire* to users, which was then assessed by systems staff. Similarly, approaches to the evaluation of user-system interaction such as niche description (Totterdell *et al.* 1988), and the approaches to evaluation described by Scriven (1967), and Howard and Murray (1987), rest on similarly *ad hoc* practices.[3] The lack of ecological validity in the *processes* of experimental investigation means that the *products* of these investigations may be less than adequate. This has resulted in the failure of psychological approaches to provide applicable knowledge and findings, or to generate applicable novel results, for HCI design. This is both attributable to the restricted nature of psychological theories, which are "partial theories focused on a specific component of mental life" (Barnard 1987: 113), and to the "small class of simplified and well-delineated laboratory paradigms" (Barnard 1987: 112) to which they relate.

This lack of success has been recently illustrated in a volume, edited by John Carroll, which addresses the links between cognitive psychology and HCI (Carroll 1987). The contributions by a number of authors, for example those by Barnard, Landauer, and Whiteside and Wixon, discuss the problematic relationship between cognitive psychology and HCI research. Landauer's contribution in particular highlights the issues involved, providing an explicit definition of the ways in which

---

[3]Yang (1989) provides a recent review of evaluation techniques, in particular the use of surveys in design.

cognitive psychology might, but has so far failed, to engage in "a more fruitful interconnection [with] the science, art, and engineering of computer systems" (Landauer 1987: 3). Landauer's definition is useful in the context of this chapter, since it provides a definition of the possible relationships between HCI and psychology, and prospectively, between *any* discipline and HCI design.

Landauer firstly observes that cognitive psychology can interact with HCI through the application of *existing knowledge and principles* to HCI issues. Card and Moran's (1980) Keystroke Model, and Card *et al.*'s (1978) application of Fitts' Law, are cited as examples of approaches which have provided practical results. However, Landauer notes that there is a general "applicative poverty" surrounding psychological findings, attributable to the way in which experimental methods encourage the development of theories which lead "away from rather than toward attempts to describe in full the performance in any task situation" (Landauer 1987: 11). As a consequence, experimental approaches encourage hypothetical particularism, promoting an interest in variables which do not have "large and robust effects" (Landauer 1987: 13).

The second locus of interaction between cognitive psychology and HCI is the application of *existing perspectives and theoretical machinery* to arrive at "new models, analyses and engineering tools" (Landauer 1987: 3). But, notes Landauer, psychology may be seen as having only limited success in this respect, since many of the contributions from psychology (Landauer cites Card *et al.*'s model of the "human information processor"), are "engineering models" which

> seem aimed primarily at providing feedback evaluation for the design process, rather than fundamental knowledge useful as its foundation (Landauer 1987: 13).

The third area in which cognitive psychology and HCI might interact is through the application of *established empirical methods* to the investigation of user-system interaction. Again, notes Landauer, the possibilities of direct applicability are limited, because psychology is generally concerned with

> hypothesis testing by factorial laboratory experiments in which the goal is to find some critical variable that will have an effect that confirms or disconfirms a theory (Landauer 1987: 15);

and to employ such methods in HCI design may require, at the very least, "new ways of thinking and considerable ingenuity on the part of the scientist" (Landauer 1987: 15).

3. Conversation analytic methods

If psychology has produced few applicable findings, theories, and methods it is clearly because its approach, as adopted by HCI research, is not motivated by any coherent underlying assumptions about the *nature* of the phenomena under consideration. Since legitimate objects of interest in the investigation of user-system interaction are the unquantifiable processes which are used in its interpretation, and their links with human interaction, effective methods of study are not to be arrived at by making them increasingly 'objective' and 'scientific'. As Coulter (1979) notes, the essential issue to be confronted concerns the

nature of "concealed commonsense commitments". It is not, Coulter notes, "a logical option to cancel the commitment entailed in the various forms of description of action" (Coulter 1979: 11).

The approach of conversation analysis is appropriate in this sense since it is motivated by a coherent set of assumptions, drawn from ethnomethodology, and represents a *principled*, rather than *ad hoc*, approach to the investigation of user-system interaction, and provides findings more *applicable* to the concerns of HCI design. As described briefly in Chapter two, the methodology of conversation analysis consists of the transcription and analysis of large amount of recorded data, the search for regularities, and the demonstration that the structures described are not merely analytic constructs but represent 'oriented-to' features of interaction. The empirical approach taken by conversation analysis is thus based upon the dual aims of "retain[ing] the integrity of the phenomena" and (Douglas 1971: 16), and providing an 'insider's view' of interaction. Central to conversation analysis is the recommendation that investigation of interaction requires an *inductive* approach to the analysis of *objective records of behaviour*, which acknowledges the *analyst's subjective involvement*.

3.1 The situated nature of action and interaction

Conversation analysis asserts that the 'real world' is not merely a background against which events are enacted, but a *part of* those events. Behaviour, action, and interaction should thus be seen, in Suchman's terms, as 'situated' in particular physical and temporal contexts, which provide resources for understanding, knowing and acting. The emphasis on the situated and improvisatory nature of ac-

tion clearly places conversation analysis at odds with many of the aprioristic assumptions of disciplines, such as cognitive psychology, that behaviour is primarily 'goal-oriented' and that goals are "organised in a strict hierarchy, and [do not] undergo radical, moment-by-moment transformation" (Whiteside and Wixon 1987: 359).

Conversation analysis, in contrast, assumes that the connection between world and behaviour is complex, and argues that an investigation cannot proceed on the basis of aprioristic judgements regarding what, in the conjunction of world and behaviour, is important. Investigations should thus avoid "premature closures", in addition to recognising "the grave dangers of bias involved in inadvertently structuring the meanings of research situations" (Douglas 1971: 31). This amounts to a recommendation that human behaviour should be investigated in 'naturally-occurring' settings and that the events studied should be real, rather than mock ups, trials, or exemplars. As Douglas notes

> the only valid and reliable (or hard, scientific) evidence concerning socially meaningful phenomena we can possibly have is that based ultimately on systematic observations and analyses of everyday life (Douglas 1971: 12).

The recordings which are the basis for the investigation in Chapter four of this study represent user-system interactions which took place in as natural a way as possible, where users were encouraged to go about whatever tasks they had planned, were not discouraged from pausing and resuming work, or prevented from requesting help from those around them.

3.2 An objective record of behaviour

However, if investigation is to proceed without being shaped by *a priori* considerations, investigators cannot predict with any accuracy the *exact* form their data will take. Since the locus of investigative control has been removed from the hands of investigators, this means that the basis for "systematic observations and analyses of everyday life" must be an *objective record* which captures transient, uncontrolled events. As Suchman (1987) notes, "situated action"

> cannot be captured empirically through either examples constructed by the researcher, paper and pencil observations, or interview reports. Analysis of contrived examples, observations or interviews all rest upon accounts of circumstances that are either imagined or recollected (Suchman 1987: 109).

Since the situated action captured is open-ended and continuous, investigation proceeds by collecting instances of events, which are then "set side by side for comparison, and where single instances are explored as exemplary of multiple phenomena" (Suchman 1988a: 134-5).

3.3 The use of video-technology

Any examination of the structure, nature, and relationship between "single instances" and "multiple phenomena" requires that the objective record must be available for repeated examination, and must capture as much *detail* the specifics of the events under consideration. Early conversation analytic studies used as data surreptitiously recorded telephone conversations, in combination with an extensive and detailed transcription notation, to achieve the aim of an objective record which was available for repeated and detailed scrutiny. In the case of practical activities which are not necessarily language-based,

such as human-computer interaction, the most appropriate form of objective record is video-recording. Videotape provides an objective record which is eminently suited to re-examination, editing, and collaborative examination by groups of investigators.

However, the use of videotape can be problematic. This is partly attributable to the lack of available tools for video analysis, although it has been suggested that parametric transcription is appropriate for video materials (Goodwin 1981, Roger and Bull 1989, Tatar 1988, Thomas 1985). Additionally, it is not clear, in an academic culture which relies heavily on paper-based dissemination of results, how videotaped data can reach a wider audience (Suchman 1988a), although those in the field of Computer Supported Cooperative Work (Foster 1986, Stefik *et al.* 1987), are attempting to create technologies to address this problem.

The problematic nature of video-recordings as data sources is also in part concerned with the time-consuming nature of any analysis, however simple, of those materials. A minute of videotape may take as much as an hour to productively examine, and the amount of data collected is a function of decisions concerning the way in which recording is to performed, what equipment is used, and which settings are recorded. The use of more comprehensive recording equipment, with provision for keystroke recording for example, may effectively cloud investigation by making possible ever more detailed levels of analysis. The use of such equipment in HCI may parallel the use of oscilloscopes and pausometers in analyses of talk (for example Beattie 1983) which has been criticised as providing data which is irrelevant to participants in interaction (French 1985). It is also clear that data col-

lection may become an end in its own right, and the "filmable and photogenic character of phenomena" (Sharrock and Anderson 1986: 111) may come to dictate analysts' interests.[4] In this study, it seemed appropriate that attempting to reconcile sources of data from multiple cameras or system monitors would create a barrier to any effective analysis. The approach taken here to attempt to examine the events which are most salient to the user, which effectively are those which happen through and around the *display*. Thus the examination in Chapter four does not describe in detail the use of the keyboard, mouse or other devices. There have been not unreasonable suggestions, however, that features such as the audible *whirr* of disk drives may be relevant in users' reasoning about interaction (Cooper 1989).

3.4 Induction and conversation analysis

The desire to avoid the imposition of *a priori* judgements is apparent in an inductive approach to data exploration. Investigation for conversation analysts should have a presuppositionless character where, as Sacks states,

> one sits down with a piece of data, makes a bunch of observations and sees where they'll go (Sacks 1967-72 quoted in Jefferson 1981: 7).

Analysts stress that this approach emphasises the ethnomethodological foundations of conversation analysis and its aim to

---

[4]The use of video-recording is, of course, not particularly novel in the context of HCI research: video-recordings are used at any stage from initial prototyping of systems through to final implementation and evaluation. Similarly, analysis of user activity may employ video-recording (Anderson and Olson 1985, Lund 1985), and observational data acquired through video-technology is employed to guide design changes (Hoecker and Pew 1980).

provide a *descriptive* account of interaction, rather than one which is directed to the prediction of behaviour, or the generation of causal explanations.[5] However, it is notable that whilst the initial stages of a conversation analytic inquiry are inductive, the approach is not an example of pure induction, which has of course been the object of criticism from philosophers of science of various persuasions. Rather, the approach of conversation analysis is to operate with a set of loose assumptions which provide open-ended possibilities for analysis. These central assumptions are those described by Heritage (1988), and are firstly, that interaction is not random but structured, secondly, that no aspect of interaction can be ruled out *a priori* as meaningless or chaotic, and thirdly that interaction is both context-shaping and context-renewing. Analysis thus proceeds by the unconstrained search for evidence of the structured, detailed, and contextual nature of interaction.

In investigating interaction with reference to these assumptions, an important resource for the provision of an 'insider's view' of the abilities and expectations employed in conversation is provided by the public nature of talk as a display understanding. It is through the examination of the relationship between current and previous talk, in particular the way in which current talk provides an 'analysis' of previous talk, that a demonstration of participant orientation may be

---

[5]Various studies have attempted to apply the methods of conversation analysis to describe the features of 'institutional' settings in relation to conversation as the "basic form of speech-exchange system" (Sacks *et al.* 1974: 730). Areas studied include, for example, courtroom interaction (Atkinson and Drew 1979), political debate and oratory (Atkinson 1983, 1984), and doctor-patient interaction (Frankel 1984). Other studies, which "do not baulk at suggesting social applications" (French 1985), discuss the practical use of conversation analysis (French 1984, Beattie 1983).

made. The reluctance of conversation analysts to use statistical analysis stems from the desire to provide an insider's view, since the expectations involved in conversation are not statistical probabilities, as has been assumed in many social-psychological investigations of interaction (Collett 1989).

For investigators of human computer interaction however, there is no such resource, beyond the behaviour of user and system, and the analysts' competence to see what the interaction amounts to. The constraints imposed by the non-availability of publicly accessible performances of private events mean that the investigator of human-computer interaction has less available evidence in which to ground reasonable accounts. It is this lack of warrant that prevents the easy translation of the methodology of conversation analysis to the analysis of human-computer interaction. However, it is possible, as the investigation in Chapter four shows, to examine both the responses of the user recorded on videotape, and the actions of the system with reference to its *known design rationale,* to arrive at a coherent interpretation of the interaction between user and system.

Additionally, the fact that talk is not a *necessary* resource for analysing interaction is supported by observing that Sacks *et al.*'s (1974) claim that the examination of current talk as an analysis of prior talk is a "proof procedure" may be challenged. Coulter (1983), for example, points out that there may be unresolved asymmetrical interpretations in interaction, which are unseen by analysts since they assume that speakers' own interpretations have an "incorrigible status" (Coulter 1983: 370) even when "the parties' actual understandings may remain unreconciled" (Coulter 1983: 370). Coulter thus notes

> in the present state of the art, our cultural knowledge, our rational intuitions, are still basic resources in this matter, and warrant an argument which cannot be given an algorithmic form, let alone constitute a 'proof procedure' (Coulter 1983: 371).

The task of providing insider's views of interaction - or in Agre's (1988a:19) terms the separation of "issues-for-us" and "issues-for-them" when examining video data - illustrates the need for a continued awareness of the fact that "recovering the interactional significance that people attach to moves in conversation is complicated" (Wooton 1988: 253).

3.5 The 'scientific' status of conversation analysis

The most consequential issue regarding the use of conversation analytic methods in HCI research concerns the fact that, when viewed against experimental investigations, they appear to be 'subjective', 'unscientific' and 'vague'. Indeed criticisms of conversation analysis are often framed as part of a wider criticism of the social sciences, centred upon a supposed absence of cumulative scientific progress and a failure of its theories to provide strong predictive capacities. Although this view cannot be challenged in any detail here, it is clear that such criticisms are framed against a somewhat restricted view of science. A view of scientific endeavour in terms of socially-motivated paradigms as seen by Lakatos (1974) and Kuhn (1970), indicates that 'articulating the paradigm' takes a different form for conversation analysis and other 'interpretive' studies of interaction. Even though ethnomethodology and conversation analysis have let go of the idea of any one 'objective' analysis, and the generation of *strongly* predic-

tive theories, such disciplines locate prediction in the interpretive abilities of members of society, which "reach a certain level of predictive precision and stop" (Rosenberg 1988: 89). Thus, attempts to 'improve' the predictive capacity of such theories, by imposing a requirement that they should produce exceptionless laws of behaviour, "are secured, if at all, by approaches that forego the *meaning* of action" (Rosenberg 1988: 89).

In fact it is possible to observe rather than failing to be concerned with replicability, it is a *central* concern of conversation analysis. Wooton (1988) notes that there are two senses in which a conversation analytic study can be seen as 'replicable' or 'reproducible'. The first concerns the *investigative process,* and relates to the ability of other investigators to "to understand and replicate the procedures of analysis that have been employed" (Wooton 1989: 239). The second concerns the *nature of the phenomena under examination,* and relates to the mutual intelligibility which is apparent in interaction, and to the way in which "members of society are continually organising their conduct so as to have it identifiable by others" (Wooton 1989: 239). It is clear that conversation analysis is concerned with reproducibility in the *second* sense, since the "shared design principles of conduct" (Wooton 1989: 238) which are the focus of conversation analysis are abilities possessed by *all* members of society. This is indicated by the fact that mutual intelligibility is maintained across a variety of 'unique' interactions, in a number of settings, with any number of different participants, at any time of day, and to some extent across a variety of cultures and languages (Jordan and Fuller 1975).

Additionally, it is clear that the findings of conversation analysis may be used in a predictive fashion. Sequences such as the adjacency pair, for example, form a "logic for conversational sequences" (Coulter 1983: 365), and this suggests that the adjacency pair is "not an empirical generalisation but a normative principle" (Coulter 1983: 366). Once such findings become established, Coulter argues, although this may be through a large amount of inductive empirical observation and analysis, those findings then become "analytic givens" which are "incorrigible with respect to further instances" (Coulter 1983: 366).

4. Review

This chapter has argued that the lack of applicability of such disciplines as psychology is largely due to the nature of experimental methods. In contrast, the methods of conversation analysis - which emphasises the inductive examination of naturally occurring data - provide a principled approach to the investigation of human computer interaction. The discussion attempted to show that conversation analytic methods, which have been seen by some as unscientific and unsystematic, are motivated by a coherent set of assumptions regarding the nature of interaction.

Thus, the lack of applicability of psychological methods and findings may be contrasted with the applicability of the methods and findings of conversation analysis to HCI research and design. There are three aspects of this applicability which the investigation of the corpus of user-system interactions in the following chapter will demonstrate.

Firstly, the use of the *theoretical background* of conversation analysis provides a framework in which user-system interaction may be investigated. The major contribution here is a perspective on human-computer interaction which emphasises its accomplished nature, and its basis in the tacit interactional abilities and expectations used in human interaction.

Secondly, the established *findings* of conversation analysis provide a source of secure information on which to base user-centred design. Chapter four illustrates the way in which those established findings provide a basis for the provision of design guidance for specific interactional sequences concerned with correction.

Thirdly, the *methods* of conversation analysis, discussed in this chapter, provide a productive and methodologically sound approach to the investigation of interaction. Chapter four illustrates the applicability of these methods in an investigation of specific sequences of user-system interaction, concerned with correction, and in an investigation of a phenomenon where there are few applicable findings from conversation analysis, the talk between users and on-hand advisers.

Chapter 4

Analysis

It is a good morning exercise for a scientist to discard a pet hypothesis every day before breakfast. It keeps him young.

Konrad Lorenz, *On Aggression*. (Lorenz 1963: 8).

1. Introduction

This chapter presents an investigation of human-computer interaction employing the methods and findings of conversation analysis. The data on which this investigation is based is a corpus of video-recorded human-computer interactions.

1.1 Data and Settings

The video-recordings were conducted in line with the methodological characteristics of conversation analysis which recommend that behaviour be studied in everyday, natural and uncontrived situations. They were collected by placing recording equipment in subjects' usual working environments, during their normal working hours, with the aim of capturing their routine activities with the systems.

The recordings show users engaged in varied research - which they had pursued for some time before, and continued to pursue following, the recordings - in the Department of Computer Science at the

University of Hull. This research concerned, for example, the development of Hypertext educational packages, and more generally the development of Hypertext systems using Apple HyperCard, and design issues centered upon the implementation of interactive system design tools using systems such as SmallTalk-80 and interface prototyping software such as Rapid/USE and DoubleView. SUN workstations were used for the development of design tools and Apple Macintosh systems used for hypertext research and development. The environment in which this research was carried was that characteristic of a university department - both groups and individuals working in small shared offices or in larger laboratories in which a number of activities were taking place.

Although the settings were completely unconstrained, the recordings predominantly show sophisticated interactive graphical or direct manipulation systems. This bias in the recordings was partly dictated by practical exigencies, since users were employing these systems on a regular basis and users' interaction with them formed a ready source of data. More pointedly, these systems may be taken to represent the most sophisticated widely accessible 'interactional artefacts' and these interfaces - which have a distinct style (Newman 1988) based on a coherent ethos - represent 'computing' for a great many users.

The naturalistic nature of the recordings was ensured since the users were not instructed as to how they should behave, what tasks they should perform, and were not instructed to refrain from any activity in which they might usually engage. Thus users worked in collaboration, talked to other users in their office or laboratory, were not instructed to leave or resume work at any particular time, and

were not prohibited from requesting help when in difficulties. This in particular proved to be a particularly valuable part of the recordings, and provides the material for the third part of the investigation in this chapter. This concerns the way in which the methods of conversation analysis can be employed to investigate the *talk* between users and advisers to inform the process of providing interactive computer-based help. The conversations which form the data for this part of the chapter were captured on the running soundtrack of the video-recordings, and were transcribed using the conventions usually employed in conversation analytic studies. In the transcriptions of these conversations, which appear in this chapter and in Appendix 3, the author of this study took the role of adviser. This was not prearranged, but a result of the fact that the author and the users shared a close working environment.

The corpus itself contains in total some 45 hours of interaction recorded on videotape with an audio soundtrack and running tape numbering. On each of the 15 videotapes which forms the corpus, there is more than one recording session, which represents a working period (for example one afternoon, morning, or a particular task). A notation is used to reference sequences of interaction which allows the location of that particular sequence on the videotapes. Thus in the examples which follow and in those which are referenced in footnotes in this chapter, stretches of videotape are numbered in the format *(tape)(section)hour:minute:second*. A sequence numbered (1)(1) 11:22:33 therefore denotes a stretch of interaction on videotape 1, section 1, with a starting point at tape counter 11:22:33. Appendix 1 lists in detail the software and hardware which appear in the recordings,

discusses the users who participated, and describes the recording equipment used.

The investigation in this chapter is divided into three parts. The first suggests that expectancies from human interaction are evident in human-computer interaction, and is concerned with situations where the system is unresponsive to user actions. Findings from conversation analysis are drawn upon to provide the basis for an investigation of sequences of interaction taken from the data, and to suggest design recommendations.

The second illustrates the way in which specific findings from conversation analysis may be used to formulate design guidance for the activity of *correction* in human-computer interaction. Representative sequences of interaction are used to illustrate the ways in which correction in a current design are found problematic for the user, and it is argued that a more effective basis for the design of correction lies in the findings of conversation analysis regarding organisation of *repair* in human interaction.

The third part of the investigation concerns the contrast between the way that *help* is provided in the current systems, and the characteristics of help provided by human advisers. This final part is somewhat different in nature, since it represents an investigation not into user-*system* interaction, but into the interaction between user and *human* adviser. That their interaction should be a focus of investigation is not a novel proposal, but it is demonstrated that, although little relevant conversation analytic findings exist, the *methods* of conversation analysis taken alone provide a systematic approach to the

investigation of user-adviser interaction, which leads to recommendations for the design of system-based help.

1.2 The analysis of user-system interaction

Since a central assertion of this research is that conversation analysis can be employed to provide a novel approach to the analysis and design of human-computer interaction, not only the methodological recommendations outlined above, but its particular approach to analysis of interaction was used to investigate the corpus of data.

As Chapter three noted, the purely inductive approach claimed by its practitioners to be characteristic of conversation analytic studies, is not tenable for a practical enterprise such as HCI research and design, where the focus must be on more *practical* issues. The investigation therefore required a focus which could then guide further investigation of the corpus. The first and second of the areas discussed in this chapter arise from a focus on some particularly salient 'problematic sequences' of interaction.

These sequences were 'salient' because they were marked out, both for analyst and user, as 'troublesome', 'difficult', 'interruptive of the current task' and as marking 'time out' from the user's current concerns. However, the 'problematic' character of the examples in this chapter is not to be interpreted in terms of some general 'difficulty with using the system', something which was also apparent in the data. This is not surprising since the data shows several novice users, and their interaction was marked by a number of problems attributable, simply, to a lack of knowledge about the system. In

arriving at a collection of 'problematic sequences', these problems were therefore discounted. The kinds of problems which were discounted in this way concerned, for example, the novices' lack of knowledge about the physical characteristics of the system (the layout of the keyboard, the use of the mouse or the numeric keypad), or more conceptual problems (the distinction between application and operating system, the confusion between system objects such as files and applications).

In this light is clear that in terms of a theme common in HCI research, these sequences might be described under the general rubric of 'error'. Typical of such an approach is Norman (1983) for example, who proposes a taxonomy of error types, where the major distinction between types is framed in terms of the those errors which arise from 'competence' problems, and those which are the result of 'performance' problems.[1] However, from a perspective which emphasises the improvisatory and situated nature of the interaction between user and system, it is misleading to concentrate on 'error', since this assumes that there is some 'correct' and 'abstract' version of the user's actions against which to compare an 'erroneous' performance. It is the case that in a variety of occasions where users find interaction problematic, there is no such bona fide, 'official' version against which their actions might be compared. The notion of problematic sequences seeks to capture the idea that whatever problems arise are unplanned, contingent, and are outcomes of the particular sequences of interaction with particular, unique, character-

---

[1] A similar distinction between "model" and "input" failures is made by Ringle and Bruce (1987).

istics. Although these sequences of interaction are problematic for the user, it is clear that they are not examples of *catastrophic* events, and it is not unreasonable to suggest that for the designer, there is little virtue in paying attention to these particular problems since they are not massively detrimental to the interaction between user and system. However, there are reasons to assume that it is *precisely* these sort of problems which should be the focus of HCI design. One is that underlying these problematic interactions are commonalities with events which may be, in fact, catastrophic. Thus, a focus on these phenomena will serve to illuminate the causes of more consequential events, and the wider concerns in interactive system design. A second is that there is a clear imperative for good software design to deal with the events which constitute our *qualitative* experience of interaction. Designing for the "needs, preferences and aesthetic pleasures" of users (Edmonds 1987: 333) directs our attention not only to the infrequent calamity, but to the multitude of less crucial events, which *in toto* amount to the users interactional "troubles" (Suchman 1987).

In practical terms, the investigation involved the collection of a number of problematic sequences from the recordings, by viewing, in a more or less undirected fashion, several hours of video-recording and attempting to isolate instances which appeared to constitute 'the same' phenomenon. The decisions which led to the judgments of the 'similarity' of these sequences must, in this sense, be attributed to the 'socialised competence' of the analyst to see the similarity of events, rather than to any specific 'coding scheme'. This process may be simply illustrated in relation to the first part of the investigation.

A number of problems concerning the activity of *selection* - that is where users of WIMP systems attempted as part of a task to select objects using the mouse - were noted on an initial viewing of the videotapes. These recurrent sequences of events were observed, on an initial examination, to involve the use of similar system features - menus and dialogue boxes when selection occurred, and to have similar outcomes - the user selects a menu or invokes a dialogue box without selecting an item. These sequences were then collected by noting their start and end points on the videotapes.

Once a collection of these sequences was made, they were then examined in terms of their component parts, particularly the sequence of users' actions, the role of the particular interface features, and the outcomes of the interaction. Once an account of their constituent parts had been arrived at, in the the case of first example a particular feature of the design of the systems used and, more importantly others of its type, this provided an impetus to examine, in a more directed way, further interactions contained on the videotapes. The analytic process, therefore, is both inductive (the amassing of collections of similar sequences), and deductive (the search for, and analysis of, other instances with similar properties).

In the case of the first two examples in this chapter, there were a number of findings from conversation analysis, concerned with the ways in which social actors construe the actions of others and with specific expectations about the specific activity of correction is performed, which could be related to the sequences. By examining the formats of the interaction between user and system, and noting their disparity between the expected formats for interaction as provided by

findings from conversation analysis, it was possible to formulate recommendations for the redesign of the system to accommodate those findings.

The analyses in this chapter are illustrated with reference to paradigmatic examples of collections of sequences. The sequence concerning menu selection, for example, is a representative instance of a situation where the user selects an item from a menu, and then immediately reselects the same menu without performing the selection of an item; the example of the dialogue box, similarly, is a representative example of the situation where the user opens a dialogue box without, finally, accomplishing any selection through it.[2] Although it is not possible to convey in this study the full nature of the interaction between user and system without an elaborate transcription system, it is nevertheless possible to provide a descriptive account of sequences of interaction. This is done both by providing snapshots of the the interface features involved, and by providing schematic versions of the sequence of user and system actions.

The problematic sequences examined in this chapter centre upon the ways in which the system fails to correspond to expectations about the likely structure of interaction, and the ways in which this poses problems for users. 'Problematic sequence' then, is concomitant of a particular view of the process of human computer interaction, which

---

[2]The other examples in the collections are not discussed here. Footnotes, where appropriate, detail the videotape reference numbers of those sequences, showing their exact location in the video-recordings.

assumes that interaction is shaped partly by the interactional preconceptions and skills of users as human social interactants.

However, both this perspective and this process of investigation is not being advanced as the *sole* manifesto for the investigation of human-computer interaction. Whilst it provides a methodological corrective to a number of other approaches, as Chapter three suggested, it is clear that it must be viewed as complementary to, rather than as a replacement for, established approaches to examining the structure and nature of human-computer interaction. Furthermore, the approach taken here does not guarantee either that competing analyses may not be found, or that further analysis is not possible.

It is clear however, that this approach is radically different to those currently employed. This is both the case because of its methodological approach, and because it is based on a particular model of the process of the human-machine interaction, which views that interaction as fundamentally based on the exercise of the user's 'sense-making skills' (the nature of which were outlined in Chapter one, and discussed in detail in the review of the findings of ethnomethodology and conversation analysis in Chapter three), to interpret and make constructive use of, the properties of the system and its design.

It is strongly suggested that this model of the interactive process provides a starting point both for further investigative work into the detailed features of human-computer interaction, and importantly, the derivation of a framework which starts to map the established findings of conversation analysis, onto human-computer interaction to provide possibilities for the design of interactive systems. Such a

framework provides an account of the similarities, and divergencies, between human interaction and human-computer interaction, and allow for the design of systems based on the findings of conversation analysis. The examples in this chapter seek to articulate a part of this framework, concerned with the similarities between the sequential nature of human interaction, (here the nature of response and the particular activity of 'repair'), and the features of human-computer interaction.

This chapter aims to provide evidence for the utility of the approach and its practical consequences. However, it remains to be assessed whether a working design team could themselves engage in this type of investigation directly, or whether this analysis may be need to be conducted by researchers and formulated, after suitable evaluation, as design standards to be incorporated into the designed artefact. Whilst the outcomes of this investigation are formulated here as, simply, 'recommendations for design', it is clear that such recommendations, if they are to be widespread practical utility, require systematic evaluation and testing before they may be seen having the status of design guidelines or principles. The recommendations in this chapter are therefore put forward as examples of the results of using the methods and findings of conversation analysis.

2. Response in human-computer interaction

This first part of the investigation will address three issues. Firstly, through the investigation of sequences of interaction where the system is unresponsive to user actions, it will be suggested that expectancies from human interaction are operative in human-computer

interaction. These expectancies are both those which concern the relationship between successive actions in human interaction, and those which concern the attribution of purposeful unresponsiveness to the system. Secondly, it will be suggested that a similar procedure to that evident in human conversational interaction, that of *reformulation*, is employed in human-computer interaction when systems are unresponsive. Thirdly, it is suggested that the nature of these problematic sequences turn on a particular feature of the design of sophisticated interactive systems - the separation of selection and action - and that constructive use may be made of users' repeated actions to provide smooth and unproblematic interaction.

The first sequence of interest centres around users' selection of items from a menu based 'palette' of tools in the hypertext authoring system HyperCard. The data from which these examples are drawn concerns the use of HyperCard by a novice user, who is engaged in constructing a hypertext application which aimed to introduce new users to the Macintosh interface, HyperCard, and the functionality of WIMP systems.

The example here concerns the fact that HyperCard, as a hypertext authoring environment, has several standard modes of operation, which have a corresponding choice of menu-selectable tools. These browse the contents of a display (normal cursor operations), allow the user to enter text, or to examine and modify screen areas such as fields (text entry areas) or buttons (active screen regions). These standard modes are entered by selecting a tool, represented by an icon, from the palette. The menu itself has a standard sequence of operations: the user selects a tool from the palette to enter a particular mode (drawing,

text entry, object selection). This menu, and its selections, are used extensively by users of HyperCard, since the process of authoring hypertext material consists of the incremental construction of displays using buttons, fields and paint objects, and the browsing of the results.

The sequence of interaction under consideration concerns exactly that sequence of events - the use of the menu to select a tool and enter a mode, but is marked by its difference from the expected sequence of events. The example discussed here is, as noted in Section 1 of this chapter, paradigmatic of a number of other sequences which regularly occurred in the data, in the interaction of both novice and experienced users.[3] The menu itself is shown in Figure 1. This paradigmatic sequence consists of the following steps:[4]

1. The user selects a symbol from the palette of tools using the mouse in the expected way
2 The user reselects the menu without performing any tool selection

3. The user continues with the current task

The menu itself is shown in Figure 1.

---

[3]This a collection of sequences located at 1(1)02:30:42, 1(1)35:30, 1(2)03:34, 1(3)08:30, 1(1)14:26, 12(2)00:53.

[4]The sequence of events is only represented schematically here. As Chapter three noted, there are few effective transcription methods for capturing the details of such interaction. These simple attempts to capture the situations in the recordings are thus ideally to be examined alongside the original video-recordings themselves. The recordings are provided as an appendix to the study.

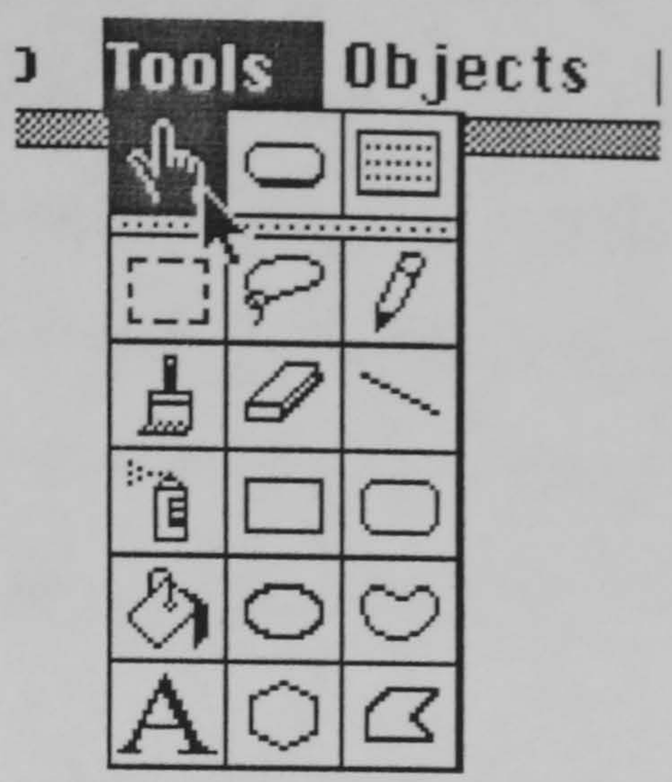


Figure 1: The HyperCard Tool Window

The interest here is in step 2 of the sequence where the user, having performed a tool selection from the menu, immediately rereselects the menu, without performing any tool selection. When the menu is reselected following an initial selection, the previous choice of tool is explicitly indicated by the highlighting of the the appropriate symbol, as in Figure 2. Here the 'field tool', which appears in the top right of the menu, is highlighted when the user reselects.

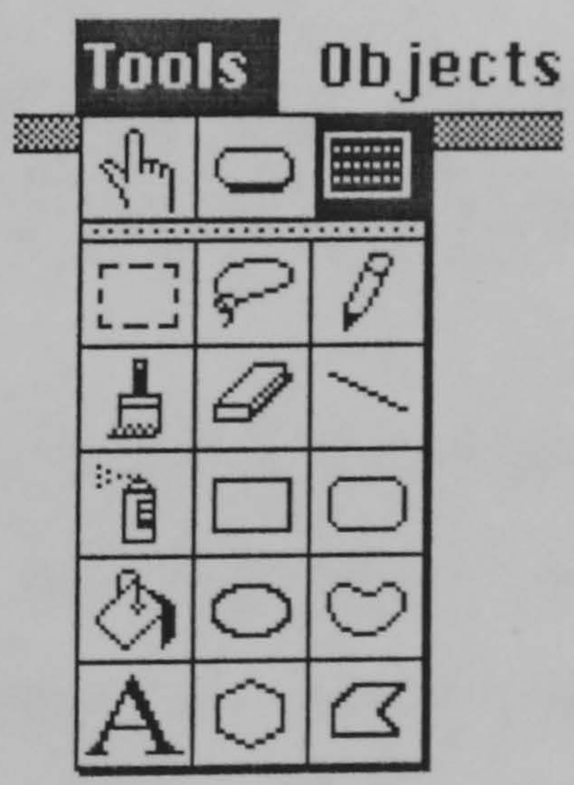


Figure 2: confirming the tool selection.

The importance of the menu reselection without accompanying tool selection is important, since it appears immediately following the

original selection of the menu. It is possible to assert that it can only be a reflection of the user's uncertainty about the current state of the interaction, since it can serve no other purpose in the current task, or contribute to the user's understanding of the interaction in any other way. This simple interaction then, it is clear, rests on the fact that *the user is not provided with an appropriate response by the system.*

The discovery of these simple sequences, and the assumption that the user found the operation of this simple feature problematic since the user was not provided with an appropriate response, led to a search for other such problematic sequences, involving situations where repeated user selections indicated that the user had an expectation, which was not fulfilled, that the system should provide a response. This further examination revealed a number of sequences concerned, again, with the use of another 'standard' and 'simple' interface feature, in this case a file selection dialogue box. The following discussion centres upon another paradigmatic sequence.[5] The example is drawn from the activities of the same novice user, engaged in a similar task, although this type of problematic sequence occurred with the more expert users who participated in the recordings.

Figure 3 shows the generic Apple file selection dialogue box, which provides a mechanism for importing files from the external file system into an application. The selection may be performed via a double-mouseclick on the required item, or by explicitly selecting the

---

[5]Although many of these sequences occurred in the data, only 3 were of comparable length and complexity. They are located at 14(1)05:07-05:49; 12(1)13:27; 12(1)32:58-35:14.

Open button. Alternatively, the user can direct the search to an external disk through the *Drive* button, or the whole message box can be removed, and the interaction aborted, by selecting the *Cancel* button.

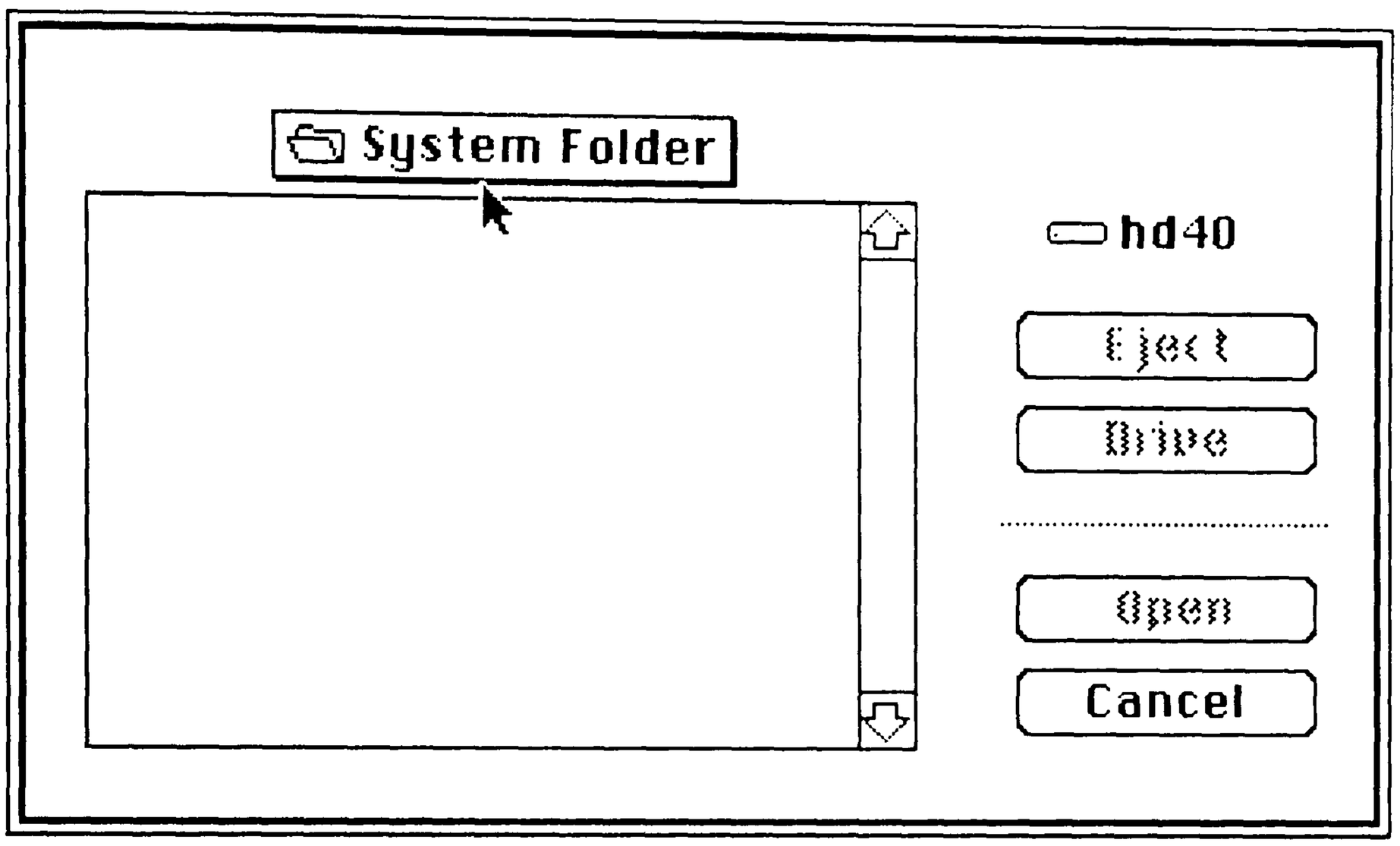


Figure 3: Standard File Selection Box

This sequence of interest consists of the following steps

1. The user selects a menu item to open a dialogue box.
2. The user uses the menu to view the contexts of a folder to locate an item. The item is not present.

3. The user repeatedly selects sub-menus from within the box to locate the item, without performing an associated action.
3. The user deselects the dialogue box, closing it.

Here the user invokes the file selection dialogue box from within HyperCard to open a HyperCard stack which she mistakenly assumes to be in a particular level of the file system designated by a folder name (*System Folder)*. On arriving at this level in the file structure, the user finds no selectable items, in fact nothing at all, since the dialogue box

displays *only* appropriate file types. The user is clearly confused at this point, selecting first the empty display areas in the centre of the dialogue box; selecting the dimmed *Open* button; selecting the drop-down menu *System Folder*; and finally selecting *Cancel* to abort the interaction. The user then repeats this whole interaction: attempting repeatedly to select, with even more vigorous and emphatic mouse clicks, the same objects. Eventually, the user aborts the interaction. It is clear again here that the user, on arriving at the level of the file structure where she assumes the file to be located receives no response from the system. As with the previous example of the menu selection, this is manifested as problematic through a repeated selection, without any accompanying action.

2.1 Providing a response

It is, of course, quite clear where one aspect of the problem lies: in invoking the dialogue box the user has entered an unusually constraining mode, in which not only are certain commands disabled, but also prohibited is the ability to view files not of the current application type.

There are, of course, a variety of solutions to this problem, of varying merit, one of which is suggested in the Apple guidelines as as generic mechanism for marking the contextual non-availability of objects (Apple 1986, *passim*) by displaying them in grey. However it is clear that this proposal is merely a pragmatic approach to the problem of context-sensitive or modal operation and whilst it may be more or less successful on some occasions, it clearly fails to address fundamental

features of the nature of providing an appropriate response for the user.

One important observation about this type of design solution is that it does not take into account the *sequential* nature of interaction, and the ways in which sequence plays a crucial part in the user's understanding of the system's actions. Viewed as a sequential matter, the sequence involving the menu selection, and the sequence involving the dialogue box, have in common that the user is seeking a *relevant next action* from the system. This is, of course, not in itself a novel observation. Suchman (1987) has observed that *conditional relevance* applies in human-computer interaction, since

> designer and user share an expectation that the relevance of each utterance is conditional upon the last; that given an action by one party that calls for a response, for example, the other's next action will be a response. The expectation does not ensure that any next action in fact will be a response to the last, but it does mean that, wherever possible, the user will look for an interpretation of the next action that makes it so. (Suchman 1987: 144).

It was observed in the discussion of the findings of conversation analysis in Chapter two, that certain actions in interaction are organised around a two part structure, where the two discernible parts are produced by successive speakers, and where conditional relevance holds between these parts. Thus, when a first pair part has been produced, a relevant second becomes expectable. The adjacency pair structure discussed in Chapter two is thus seen as coherent by virtue of the constraint imposed on next speakers to provide a second. As Schegloff (1968), in discussing conversational openings observes, *summons-answer sequences* are composed of an adjacency pair.

Summons and answers are powerful features in interaction, which provide strong constraints on the obligations of speakers to pursue the sequence, and hearers to respond:

> Just as the summoner, by virtue of his summons, obligates himself for further interaction, so the answerer, by virtue of his answer, commits himself to staying with the encounter. (Schegloff 1968: 1081).

It would seem them, that the problematic nature of the interactions concerning the menu selection and the file selection dialogue box, are concerned with the expectation by the user that the system should provide a relevant response as a next action, itself in response to the user's selection.

The operation of these constraints in human-computer interaction is apparent in situations where the non-responsiveness of the system is transformed from a passing trouble to a catastrophe. This happens where it is unclear if the system, in response to a user's actions, is busy but slow, waiting for some action on the user's part, or is irretrievably crashed. Such sequences are qualitatively different from the interactions involving the use of the menu or the dialogue box above, where the user may choose to deal with the missing response by *terminating* the particular sequence of interaction. The sequential implicativeness of actions and the inference-generative nature of non-responsiveness are heightened in situations where is this not possible. This is due to the tendency, discussed in Chapter one, for users to

ascribe socially grounded motives to systems, and may be seen in terms of the system effectively *snubbing* the user. [6]

There is, of course, clear precedent for the user to draw inferences when a response is absent. In conversation, missing responses are in fact not merely perceived as gaps, but are seen as *owned* by a particular speaker. User actions, especially in situations where selection is taking place, may thus be seen to be "non-terminal" (Schegloff 1968: 1084). The sorts of inferences that are typically drawn in such situations take the form of assuming that the speaker is engaging in "insolent or quasi-insolent activities" (Schegloff 1968: 1086). It is the tacit knowledge of this fact - that inferences will be generated by the absence of response - which implies that "a member of the society may not 'naively choose' to not answer a summons" (Schegloff 1968: 1086). In this sense the user might be said to assume, similarly, that the system is not making a 'naive choice' in failing to provide a response.

A distinction made in conversation analysis is useful in considering this and similar sequences where the user cannot determine why the system will not respond. This is the distinction between *physical presence* and *interactional presence*. Physical presence refers, in human interaction, to the obvious fact that the listener is co-present and visible (and alive). In terms of the human-computer interaction, a judgement of physical presence does not rest on mere co-presence, but,

---

[6]Although the use of the term 'snub' in this context is somewhat flippant, it clearly reflects the subjective impressions of many users to the system's non-responsiveness, something supported by one user's comments collected in an informal debriefing session, when the system was described as "lacking in interaction" since it "never initiates anything".

necessarily, on other signs. Thus, users assume that the system is physically present when the machine is plugged in, the display is active, the power light is illuminated, the fan is humming, the disk drive is whirring etc. In contrast, *interactional presence* cannot be judged by such simple appearances. In human interaction, interactional presence is of constant concern, simply because it is possible to be physically present without being interactionally present. Interactional presence is

> not satisfied by the mere copresence of two persons, one of whom is talking. It requires that there be both a "speaker" and a "hearer" [...] To behave as a "speaker" or as a "hearer" when the other is not observably available is to subject oneself to a review of one's competence or "normality". Speakers without hearers can be seen to be "talking to themselves" (Schegloff 1968: 1093).

In telephone conversations for example, where signs of physical presence are not directly accessible, there would seem to be an even more pressing concern to establish, and continually re-establish, interactional presence. In this way the opening sequences of telephone calls are concerned with establishing the telephone call as a "two-party" activity. As Schegloff notes:

> a person who wants to engage in an activity that requires the collaborative work of two parties must first establish, via some interactional procedure, that another party is available to collaborate. (Schegloff 1968: 1089).

'Snubbing' is possible precisely because the obvious signs of physical presence may be subverted by a denial of interactional presence. In this

sense non-responsiveness may be viewed not as a matter of chance but as a *purposeful* non-response.

The notion of interactional presence may be further examined. The discussion above suggested that the system's physical and interactional availability are, in fact, co-extensive in human-computer interaction, and users find unresponsiveness problematic because the system has no way to indicate, in response to a user action, its status as 'in play' or 'out of play' interactionally. However, in human interaction, speakers and hearers do not require the mere establishment of interactional presence, but seek to organise two-part activities in more *specific* ways. In human interaction it may not be enough to be merely interactionally present, but to seek and provide signs of interactional *readiness* at a specific time. Heath (1982), in a discussion of the ways in which doctors and patients structure verbal and non-verbal behaviour to co-ordinate the start of a medical consultation, outlines the contrast between *recipiency* and *availability*:

> The display of availability is an action that creates, for its recipient, a range of undifferentiated opportunities in which to initiate action. It is a pre-initiating activity, allowing an actor to proclaim that he is ready when the other is. It creates an environment of opportunity for its recipient which can be exploited for his own purpose, when and where he so wishes. The display of recipiency on the other hand, creates within the environment of 'free-floating opportunity' a specific moment and location for its recipient to 'respond' with an action. It declares an interest in receiving response, a response in immediate juxtaposition with the display. It elicits an action by creating a location for its occurrence. (Heath 1982: 154).

2.2 Unresponsiveness and pursuing a response

A further sequence of interaction concerning the non-responsiveness of the system which was observed in the recordings may be examined. It must be made clear at the outset that this sequence is unusual since it is not as result of the design of the system, but of the user's *own* attempts to design the system's behaviour. However, it provides a view of the operation of a specific procedure concerned with response from conversation used in human-computer interaction.

In this sequence the same user is engaged the in same task of authoring a HyperCard stack, intended for use by first-time users of HyperCard, to acquire the rudiments of the Macintosh system and WIMP interfaces.

Some detail regarding the nature of HyperCard is necessary to adequately describe this sequence. HyperCard stacks are collections of individual displays (cards), which may contain textual or pictorial material, and which can be linked multidirectionally to other cards. The enduser may browse through the cards in a stack within the framework of links created by the author.[7] In this sequence of interaction the user wishes to create a card which is not intended to be accessible to the enduser, but is to form a 'frontispiece' to the stack as a whole. The user intends that the card should provide the enduser with a welcome message, which is presented for a few seconds before the next card is displayed. To this end the user has placed a HyperTalk

---

[7]This an extremely abridged account. Readers can find further details of HyperCard in Goodman (1987), and of HyperTalk in Shafer (1988).

'lockmessages' instruction in the script of the first card, which inhibits the receipt of any keyboard or mouse events. Having done so, the user then finds that when she wishes to return to edit this script she cannot, since the instruction represents an *absolute* prohibition on examining the script in any way, or, in fact preventing the execution of the script.

The interaction consists of the following sequence of events

1. The user instructs the system to present the first card.
2. the user selects menu to edit the script of the card. This is unsuccessful.
3. The user instructs the system to present the first card.

4. The user executes keystroke equivalent to the menu commands. This is unsuccessful.
5. The user instructs the system to present the first card.

6. The user employs the message box to issue a textual command to edit the script of the card. This is unsuccessful.

The user thus engages in a repeated series of actions to attempt to remedy this problem, none of which are effective. Firstly, the user attempts to select the appropriate *menu* which contains the instruction to edit the script of the current card: the menu is not accessible since input from the keyboard is inhibited, and this is repeated several times. Secondly, the user attempts to execute the *key-equivalents* to the menu-based commands. This too fails, since keyboard input is similarly prohibited. Thirdly, the user invokes an interpreter window to execute a HyperText *textual command* to edit the script of the card. Finally, the user attempts to *interrupt* execution of the script 'just before' the execution commences, or 'just after' it has ended by issuing commands though the interpreter window. The whole sequence lasts several minutes and is terminated by the user seeking the help of an adviser.

The user's actions are divided into four distinct episodes, using first the mouse, followed by an attempt to execute menu-based commands, followed by keyboard equivalents and finally then formulation of textual version of the commands. One account of these episodes is that they are used in the sequence *mouse - menu - key-equivalent - textual-command* because of a perceived difference in their ability to obtain a response from the system,[8] and the user does not revert to using the mouse, menus, and key-equivalents *after* attempting to gain a response through the execution of a textual command.

Amongst the general findings of conversation analysis on the nature of response - for example the discussion of conditional relevance which were drawn upon above - there are specific findings which concern situations in conversation where speakers receive a response which is inadequate in some way. In these situations, as Pomerantz (1984) notes, speakers may either

> abandon the attempt to get a response, may infer the recipients response but let it remain articulated, or may pursue an articulated response (Pomerantz 1984: 152).

Pomerantz notes that when a recipient fails to give a coherent response there are three assumptions that may be made, one of which is of particular interest in this context. This is that a there is a "reference

---

[8]Although there are no other comparable sequences of *extended* length in the data similar sequences, involving the user's attempt to deal with unresponsiveness appear at 1(2)03:34 and 1(1)14:26.

unclear or a term unknown" (Pomerantz 1984: 152),[9] and this is addressed by the speaker

> reviewing his or her assertion, scanning for any troublesome word selections, for example unclear pronouns or unknown vocabulary. If one is found, the speaker would offer a more understandable reference to replace the troublesome one (Pomerantz 1984: 153).

These findings, which specify a particular set of assumptions regarding the possibilities for non-responsiveness and a particular mechanism for the resolution of that situation, thus provide one account of the users actions in this sequence of human-computer interaction. The user's shift from *non-specific* action in the pursuit of a response by simple mouseclick, to *specific* actions through the use of textual commands, suggest an orientation to the fact that one way to obtain a response is attempt to gain *more control* over the *specificity* of the action by *reformulating* it.

2.3 Implications for design

The sequences investigated above serve, at the most general level, to indicate that users are engaged in a continual process of inference regarding the relationship between their actions and the actions of the system. In particular three features of human interaction have been observed to play a part in these sequences. The first are expectations

---

[9]The others are the that the assumption that there is some *lack of assumed shared knowledge,* where speakers as a remedy will formulate the knowledge which is presumed to be missing; and the assumption that responses may be inappropriate because of some basic *attitudinal or propositional disagreement* where speakers as a remedy may modify the strength or direction of their original assertion (Pomerantz 1984: 153).

regarding the cohesion which obtains between successive actions in interaction. The second concern the ways in which expectations regarding interactional presence create the impression of purposeful non-responsiveness on the part of the system. The third is a particular process, and a particular structural organisation, concerned with pursuing a response.

However, it is clear that deriving systematic and detailed design recommendations for 'providing an appropriate response' is problematic, since this requires abilities to interpret the user's actions. As Suchman (1987) notes, *any* definite interpretation of users' actions is impossible due to the strongly indexical nature of behaviour.

Nevertheless, both the sequences of interaction examined here and the findings of conversation analysis drawn upon in this section do allow the formulation of some less ambitious recommendations which may allow the design of *general* mechanisms both for recognising situations where users find interaction problematic, and providing remedies which can lead to the resolution of those problems. These recommendations, although simple, are clearly superior to the gloss offered by many design guidelines, such as "keep the user informed" (Apple 1987: 7), or that "there should be some apparent reaction from the computer" (Smith and Mosier 1984a: 182). These recommendations must be seen at the level of fundamental requirements for design, rather than detailed blueprints for any particular design, and are based upon the lessening of the divergence between the behaviour of the designed object and the expectations and skills of its users.

The first such recommendation concerns the possibility that constructive use may be made of interactions where users receive no response. The sequences of interaction examined here have in common that their problematic nature was indicated by repeated sequences of *selections,* without any accompanying *action*. In the case of the menu selection sequence, the user repeatedly reselected the menu in the absence of response from the system without attempting a selection. In the case of the dialogue box, both the interaction as a whole, and the reselection of the drop down menu was repeated several times without any file selection. This suggests that *the separation of selection and action,* which has come about in the course of developing easy-to-use interactional artefacts, is at the root of these problematic interactions. This possibility, that the user may engage in sequences of interaction which consist of a never-ending sequence of selections without any action, clearly stands in contrast to the expectations from human interaction where actions elicit an appropriate response. It is thus possible to use instances of repeated selections without accompanying action as a trigger for the use of procedures which provide specific forms of assistance for the user. A simple version of this mechanism may be observed in the interface to the *SmallTalk80* system, where a delay in executing a menu-based command after its selection results in the display of a synopsis of the function of the menu item.

The second recommendation concerns the role of assumptions concerning interactional availability, recipiency, presence and absence, and suggests possibilities for design to circumvent problems of users inferring the purposeful unresponsiveness of the system. This may involve producing *active* indications of appropriate points for user ac-

tions, thus indicating that the system is interactionally ready at specific points in the interaction. Of course, the problems of indicating the current state of the system have not gone unnoticed: there are a variety of pragmatic mechanisms in use, such as those which employ a cursor transformed into an hourglass symbol, or those which use 'percent-done indicators' (Myers 1985).

It is possible in this case to provide a more detailed interpretation, although this is not the only way in which the findings might be applied. Applying these findings might lead to a model of the action-response sequence where the system presents a number of differentiated states of responsiveness, which clearly indicates to the user the difference between in a a state of non-availability, a state of general availability and specific readiness states where the users actions are to be performed. It is clear that the design of such features such as dialogue boxes, based on this readiness model shown in figure 4, can be interpreted by designers to accommodate more particular design scenarios.

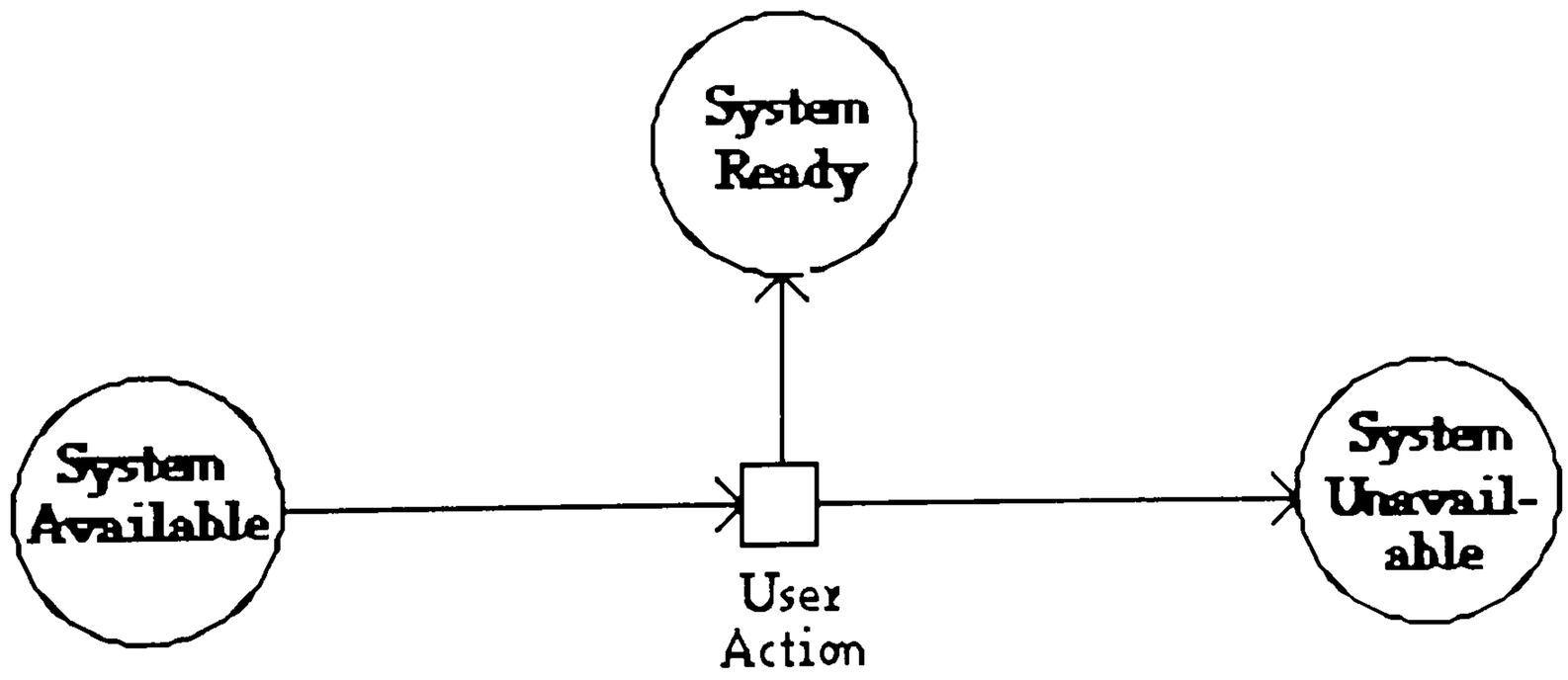


Figure 4: Interactional states - availability, readiness and unavailability.

The third recommendation concerns the observation that users employ the familiar mechanisms for the *pursuit* of response by users through the reformulation of utterances, and suggests a need to take into account the ways in which systems provide opportunities for users to pursue responses. If interaction between humans and machines is to be effected so that trouble is minimised but still provides the opportunity for the optimal remedy of trouble, the ways in which responses are pursued, in terms of clarifying parts of commands, reviewing assumed common knowledge, or modifying position or attitude will need to be taken into account. One of the ways in which designers may minimise the local trouble, and maximise the possibility of a successful outcome is by *prompting* the user through specific mechanisms for clarifications, reformulations or accounts of the original command or query in problematic situations.

3. Error correction and repair in human-computer interaction

The second part of the investigation again centres upon a collection of problematic sequences. Whilst the previous section of this chapter has served to indicate that general expectations about the nature of interaction from conversation are operative in human computer interaction, the sequences examined in this section indicate that more specific expectations about the structure of interaction play a part in users' interaction with the system. An examination of these sequences, and specific findings from conversation analysis, are used to provide more specific suggestions about how designers might go about shaping the features of interaction.

These sequences are concerned with the problems of users with error messages presented by the system. It will be suggested that these problems are rooted in the difference between the organisation of correction provided by the current design of the system the normative format of what is termed in conversation analytic studies, *repair* in human interaction. Two paradigmatic sequences are examined which show users dealing with two different types of dialogue box used in HyperCard. The HyperCard system was again being used to construct educational materials. The collections of sequences were isolated by the same process of inductive search and deductive examination of the video-recordings employed in the first section of this chapter.

The first type of dialogue box appears when users of HyperCard provide invalid textual commands into an interpreter window. A typical example is shown in Figure 5, where the dialogue box indicates that the user has provided an invalid argument to the command *show*.

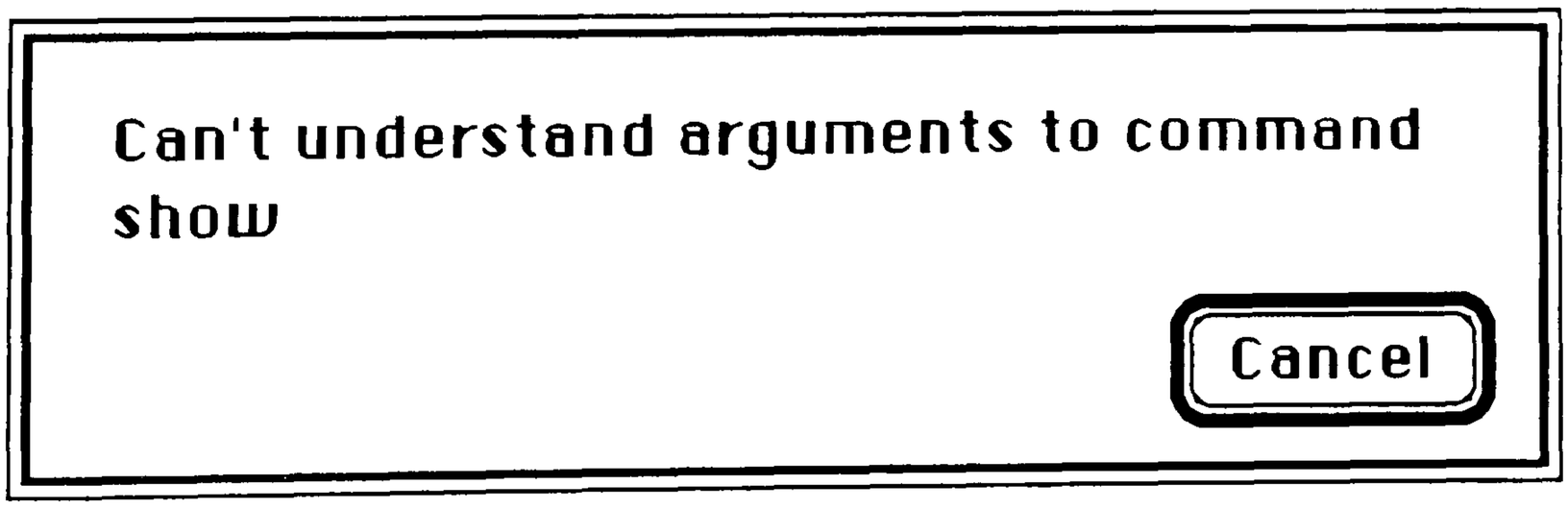


Figure 5: HyperCard dialogue box

The second type appears when users define an illegal construct within a HyperCard script. An additional option is contained in this dialogue

box, which is shown in Figure 6. In this example the user has misused the *do* command in a HyperCard script.

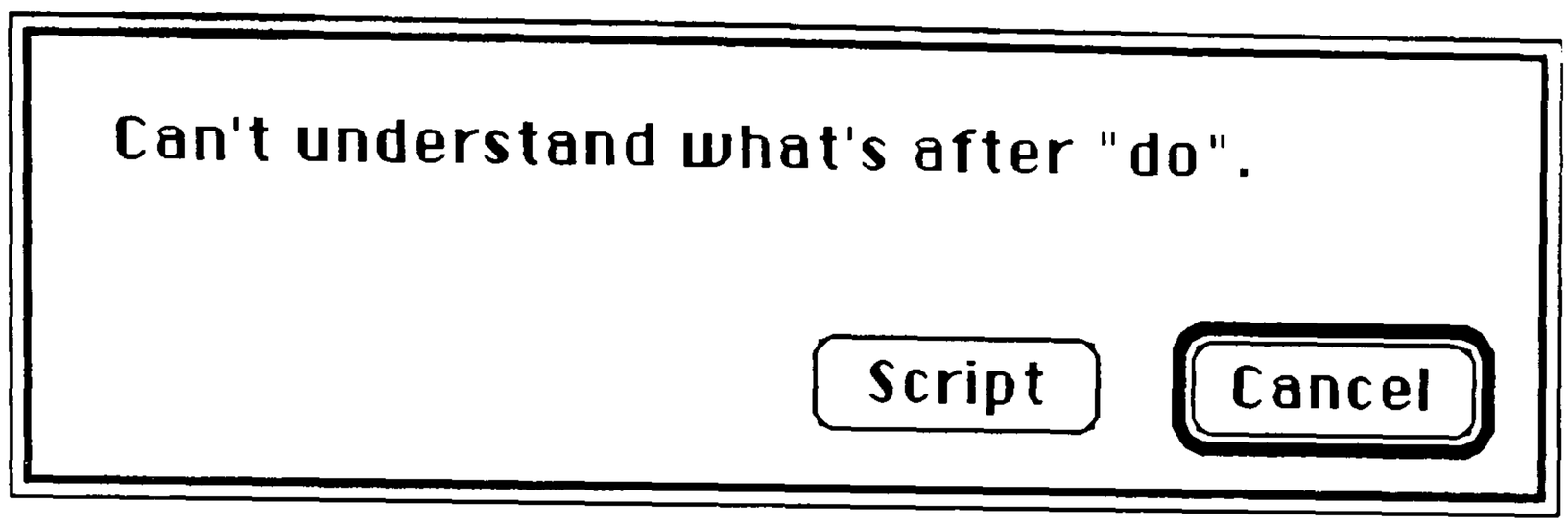


Figure 6: HyperCard dialogue box

The operation of these dialogue boxes is based on an explicitly stated design rationale contained in *The Apple Human Interface Guidelines* (1987). The guidelines which relate to the design of these dialogue boxes define them as "modal" dialogue boxes, which are to be used when "it's important for the user to complete an operation before doing anything else" (Apple 1987: 59).[10] This type of mechanism would appear to be an efficient method for providing the user with an indication that their entry in the interpreter window, or script-construct, stands in need of rectification.

In a number of sequences of interaction however, these seemingly pragmatic methods of providing correction were found problematic.[11] In the case of the dialogue box in Figure 5 users attempted to correct their mistyping or erroneous command by attempting to *immediately*

---

[10]The first example discussed above may be possibly better defined as an *alert*, since, under the Apple definition, dialogue boxes allow the user to provide additional information, whereas alerts notify the user of an unusual situation (Apple 1987: 55).

[11]These are a collection of 9 sequences located at: 1(1)21:24; 1(1)07:35:08; 1(2)04:37; 1(1)02:30:42; 1(1)14:26; 1(1)35:30; 1(2)03:34; 1(3) 08: 30; 10(2)13:21:30.

select the text in the interpreter window, and re-type the command. They however found that this was not possible until the dialogue box has been removed, by selecting the *Cancel* option - the response to any attempt to perform other activities being an aural or visual warning.

The sequence thus consists of the following events

1. User enters/performs non-permissible command/action.
2. System provides dialogue box.
3. User attempts a correction.
4. System provides aural warning.
5. User selects cancel from dialogue box.
6. User performs correction.

The dialogue box in Figure 6 was found problematic for somewhat different reasons.[12] The message displayed in the dialogue box is designed to identify the construct which the system cannot parse as a legal HyperTalk expression. The dialogue box thus not only provides the user with the possibility of canceling the interaction, but provides the opportunity to examine the cause of the problem by opening a *script editor window*. Once the editor window is open, the design provides for the visual orientation of the user to the problematic construct, by placing the cursor at the end of the command line where the construct is located. Figure 7 shows the cursor placed at the end of the second line of a script in the editor window.

---

[12]12 similar sequences appeared at 11(1)02:48; 11(1)17:45; 11(1)20:08; 10(2)13:13; 10(3)00:58; 10(3)14:36; 19(3)16:49; 9(3)17:19; 10(3)24:53; 10(3)25:23; 9(3)25:39; 10(4)18:13.

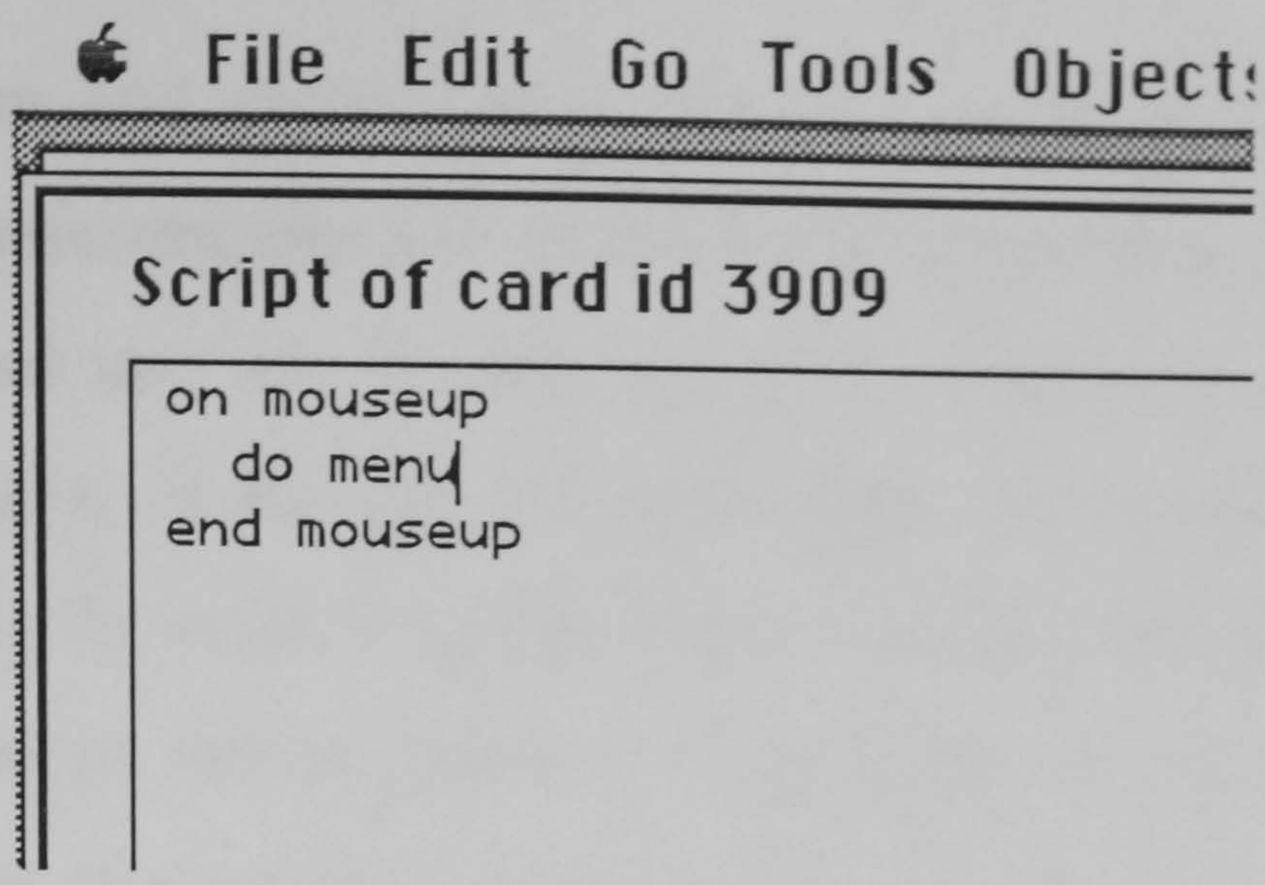


Figure 7: the HyperCard script editor.

The sequence of events in the case was

1. User executes script with non-permissible construct.
2. System provides error box with indication of problem.
3. User selects script to view the offending script.
4. System provides script editor window.

Despite the prospective usefulness of this feature, users appeared to find it problematic, since on selecting *Script* and opening the editor, users could not seem to locate the source of the problem readily. The video-recording shows that users examine the screen for several seconds without engaging in any activity. It might be the case that the marker indicating the offending item has poor visual salience, especially in a complex script. However the same marker is used in other HyperCard features, such as text entry areas, where the marker indicates the insertion point. Here the user cannot comprehend the problem with the code she has written, except that she knows that it is to be located in a particular line of the script.

Issues of error and correction are of course important in software design, in that there is a general requirement that designers handle errors in 'graceful' ways. The design strategy here is to identify the

erroneous item and signal the error. The handling of an error thus amounts to these two distinct operations (identification, signal), which are compressed into one system 'turn'. The handling of error in this case is accomplished through the mechanism of a modal dialogue box, used to explicitly enter a *system mode* which "block[s] most other normal operations of the system" (Apple 1987: 12). In this way, these interactions are marked out by the designer, and by and for the user, as an activity which stands apart from the flow of normal interaction, designed to accomplish the particular activity of correction.

3.1 Correction: findings from conversation analysis

There are a set of specific findings from conversation analysis which may be consulted which bear upon the problematic nature of these interactions, since activities which interrupt the current 'business' of the interaction to perform a correction have a clear parallel in conversational interaction. This is a reflection not of the fact that talk is characterised by its *trouble-free* nature, but that there are well-developed mechanisms for the *resolution* of trouble. As Schegloff *et al.* (1977) note, there is a "self-righting mechanism for the organisation of language use in social interaction" (Schegloff *et al.* 1977: 381). It is these findings which will be drawn upon here to suggest that there is a disparity between the ways in which correction is handled by the system in these examples, and the ways in which the user might expect such sequences to be organised.

The organisation of correction has been extensively documented, directly and indirectly, in a variety of studies (Schegloff *et al.* 1977, Jefferson 1974, Jordan and Fuller 1975, Schegloff 1987a, Schegloff 1972) un-

der the general notion of *repair*.[13] Conversation analytic studies distinguish between 'correction' and 'repair', because 'repair' is not dependant on some 'error' being committed, nor is it limited to a simple correction of an erroneous item. Schegloff *et al.* (1977) give examples of the symmetrical situations where there is a repair without an error, and errors which provoke no repair. Using their original data, these situations can be seen respectively in (1) and (2). In (1) the repair consists of the replacement of "bell" by "door bell". In (2) however, the incorrect use of the word "fragrances" (the context makes it clear that it should be singular) is unrepaired.[14]

(1)

(Schegloff *et al.* 1977: 363)

	Ken:	Sure enough ten minutes later the
→		bell r- the door bell rang.....

(2)

(Schegloff *et al.* 1977: 363)

	Avon Lady:	and for ninety-nine cents uh especially in, Rapture, and the Au Coeur which is the newest
→		fragrances, uh that is very good value

A second distinction may be made between *initiation* and *outcomes* of repair. A repair may be initiated, but no repair may be performed. In

---

[13]The relatively well-documented nature of repair has meant that it was one of the first areas to be considered as a locus for the integration of conversation analytic findings into natural language processing (McTear 1985). The same theme has been taken up more recently by Raudaskoski (1989).

[14]In the transcribed sequences the phenomenon of interest is indicated by an arrow at the start of the relevant line.

(3), Roger attempts two initiations intended to elicit a response, which are eventually abandoned when a response is not forthcoming from Dan or Ken.

(3)

(Schegloff *et al*. 1977: 365)

→Roger:	It's kinduva - kinduv weird
Dan:	heh
(2.0)	
→Roger:	Whadda you think
(2.0)	
Ken:	Hm?
→Roger:	Ferget it.

In addition to distinguishing between initiation and outcome, there is also a clear distinction between *self*- and *other*-initiation of repair: the preceding example (3) being an example of other-initiated repair, the examples in (1) and (2) examples of self-initiated repair. There is also a corresponding distinction between self- and other-*repairs*, where example (1) represents a self-repair. It is thus possible to construct a matrix of initiation-outcome-participant combinations which allows the possibilities for repair to be enumerated as self-initiated self-repair, self-initiated other-repair, other-initiated self-repair and other-initiated other-repair.[15]

In addition to the possibilities for initiation and repair, there are several possible *starting* points for repair sequences which govern their trajectories from initiation to repair. The possible starting points are within the current turn; at the next transition space; in the next turn;

---

[15]McTear (1985: 107-8) provides examples of these combinations.

and in the third turn. Self-initiated self-repairs are started and completed in the current turn, whereas other-initiations are done in the following turn, (and may in fact be or delayed, or 'withheld' beyond the next turn). This has been seen as listeners providing opportunities for the current speaker to self-correct, and thus that there is a *preference for self-repair*. This is illustrated in example (4), which concerns several children in a counting game. Here, the possible places where other-repairs might have been performed are instead taken up with repeated attempts to other-initiate a self-repair by Steven (in the turns of Susan and Nancy):

(4)

(Schegloff *et al*. 1977: 372)

	Steven:	One , two, three, ((pause)) four, five, six, ((pause)) eleven eight nine ten.
→	Susan:	Eleven? eight, nine, ten?
	Steven:	Eleven, eight, nine, ten.
→	Nancy:	Eleven?
	Steven:	Seven, eight, nine, ten.
	Susan:	That's better.

In terms of the *outcomes* of repair, *other-initiations* tend to yield *self-corrections*. More importantly, other-initiations and self-initiations are different in construction. Self-initiations which result in self-repairs are often of the form *not X, Y*, where the *X* component locates the repairable, and *Y* is the repair itself, as in (5):

(5)

(Schegloff *et al*. 1977: 377)

	Louise:	Isn't it next week we're outta school?
→	Roger:	Yeah next week. No not next week,
→		the week after

In contrast, other-initiations take a variety of forms, but the most common is to initiate repair by *locating* the trouble source for the listener. In (6), Al repeats the repairable item "waiter" thus prompting the repair "waitress" from Ken.

(6)

(Schegloff *et al*. 1977: 377)

	Ken:	E' likes that waider over there
→	Al:	Wait-er
	Ken:	Waitress, sorry.

The sequence can also be extended beyond the typical three-turn sequence, if the repair is not forthcoming. (7) shows an example where B attempts initiation twice.

(7)

(Schegloff *et al*. 1977: 377)

	A:	It's just about three o'clock, so she's probably free. I'll call her now.
→	B:	what time is it?
	A:	Three, isn't it.
→	B:	I thought it was earlier.
	A:	Oh, two, sorry.

There are a variety of other-initiator techniques used, which, according to Schegloff *et al*. (1977: 369), are ordered from weak to strong in terms of their ability to precisely locate the repairable item. The weakest is *Huh?* or *What?*, as in (8)

(8)

(Schegloff *et al*. 1977: 367)

	D:	Wul did'e ever get married 'r anything?
→	C:	Hu:h?
	D:	Did jee ever get married?

The intermediate form is a partial repeat of the problematic item, as in (9):

(9)

(Schegloff *et al.* 1977: 368)

A: Well Monday, lemme think. Monday, Wednesday, an Fridays I'm home by one ten
→B: One ten?
A: Two o'clock, my class end at one ten.

The stronger form is *You mean X?*, where *X* is the repair (or possible repair) of the item is shown in (10):

(10)

(Schegloff *et al.* 1977: 368)

A: Why did I turn out this way.
→B: You mean homosexual?
A: Yes

These initiators may be used within a single repair sequence, where unsuccessful other-initiations may be repeated with stronger initiators (Schegloff *et al.* 1977: 369, footnote 15).

Initiation may also result in *other-repair*. However, other-repairs are uncommon, in the line the preference for self-repair, and are typically 'mitigated' or downgraded.[16] In (11), for example, a question format is used.

---

[16]Although other-repairs are uncommon, Schegloff *et al.* (1977) observe that they are routine, (especially in unmitigated forms) in adult-child conversation. They speculate that this reflects the fact that other-repairs are implicated in a socialisation process, whereby children are encouraged to become self-aware, self-monitoring members of society.

(11)

(Schegloff *et al*. 1977: 378)

	Ben:	Lissena pigeons
	(0.7)	
	Ellen:	Coo-coo:::coo:::
→	Bill:	Quail I think
	Ben:	Oh yeh?
	(1.5)	
	Ben:	No that's not quail, that's a pigeon

An alternative is an 'uncertainty marker', which gives the proffered correction the status of a guess or 'try' as in (12):

(12)

(Schegloff *et al*. 1977: 378)

	Lori:	But y'know single beds'r awfully thin tuh sleep on
→	Sam:	what?
	Lori:	Single beds. They're
→	Sam:	Y'mean narrow?
	Lori:	They're awfully narrow yeah.

3.2 Implications for design

3.2.1 The problematic nature of the correction sequences

It is possible to make several preliminary observations about the particular sequences discussed here, in the light of these findings from conversation analysis. Firstly, repair sequences in human-computer interaction are *other-initiated* but almost always are *self-repaired*. There are of course examples of what might loosely be called self-initiated self-repairs, or more appropriately "self-editings" (McTear 1985: 109) where users initiate and attempt to correct errors, particularly in text entry.

Secondly, other-initiations are done in *next turn*, rather than in any other of the four positions, since systems lack the resources to distinguish, and initiate repairs in, the intra-turn, inter-turn, and TRP positions.[17]

Thirdly, in human-computer interaction there is no necessity that following an other-initiation, that repair sequences are pursued to completion - i.e. that the repairable is *actually repaired*. In contrast, when such other-initiated repairs are instigated in conversation, there are few occasions where correction is *not* taken to completion. It would appear that once a speaker is committed to initiating repair, it must at least be pursued to a point where there is an explicit indication the attempt is to be abandoned, as in example (3).

The fact that such sequences are not typically run to completion, and that the originator of the repairable is not guided to the self-repair, may be seen to the possible causes of the problems in the original sequences. In the sequence concerning the first dialogue box, the user is led into an interaction which *resembles* a canonical other-initiated repair, because the repair is started in next turn, and the repair-initiator locates the source of the problem. However, the next action provided by the system is not, as the user might expect, *the opportunity to self-correct*, but a requirement on the part of the system that the mode which it has entered (signalled by the modal dialogue box with its explicit *Cancel* option) should be cancelled explicitly. This requirement places a constraint on the user's action which

---

[17]When re-naming Macintosh desktop icons, if the name is more than 20 characters the system will explicitly intervene, producing an interruptive intra-turn repair.

contravenes the conditional relevance which is set up by the other-initiation. The fact that the user *does* attempt to perform the repair, by attempting to select the erroneous items in the message box and replace them, suggests the presence of particular expectations from conversation about the normative structure of repair sequences.

The second correction sequence exhibits some of the same features. The system initiates a repair sequence though the provision of a dialogue box with, in this case, two separate options. The location of the repairable is indicated in the construction of the dialogue box, which provides the user, via separate buttons, with the possibility of examining the cause of the problem and repairing it, or canceling the dialogue box. The system further assists the user by placing a marker at the location of the offending item. Examining the videotape, the user is 'left to work it out for herself': having been led into a correction sequence in which firstly the problem is located, and secondly the problem is indicated in a specific manner, the user is then left unsupported. Finding that the problems of users are a result of the fact that a system cannot support them is hardly a novel discovery. But here, the notion of 'no support' may be given a specific, detailed interpretation. As indicated above, other-initiated repairs are typically taken to completion, and the user's consternation results from the abandonment of the repair sequence. This interpretation is reinforced by the fact that the system is seen to locate the repairable to the extent of flagging it, and its exact location, and can give some account of the exact nature of the problem (*Can't understand arguments to...*), yet does not appear to act *cooperatively* to effect repair.

These disparities between the ways that repairs are accomplished in the examples above, and the ways in which they are organised in conversation, provide more detailed suggestions about how a design might seek to provide for repair in human-computer interaction which is in accord with the ways they are organised in conversation. These suggestions locate a discrete phenomenon from the user's point of view, and orients the designer to consider the *sequence* of events, since it is through the sequential structure of interaction that the user is able to interpret the system's actions.

In the case of repair there are two specific expectations concerned with sequence which the user holds. These are that following an other-initiated repair, the next relevant action will be the opportunity to self-repair, and that when an other-initiated repair is instigated, the user expects that it will be taken to completion.

> There are sequences of interaction which are occupied with *repairing* the user's errors. These sequences of interaction should be considered as discrete events for the user. Repairing the user's error can be divided up into two components: the *initiation* of the repair (how the system signals to the user that there is a problem) and the *repair* (where the error is corrected).
>
> Users expect that the system will guide them through the process of repairing their errors. The system should provide an *initiator* which *locates* the source of the trouble. Examples of appropriate initiators are
>
> - audible or visual alarms
> - the highlighting of the object
> - textual comments on the error for example *Can't interpret X (in situation Y).*

Following the initiator, the user will expect to be able to *repair* the error. If the user's repair proves *successful* then the repair-sequence is complete. If the repair is *unsuccessful*, either because there is a delay or if the error is repeated then an *alternative initiator* should be used, which is more specific regarding the nature of the error, where this is possible. For example

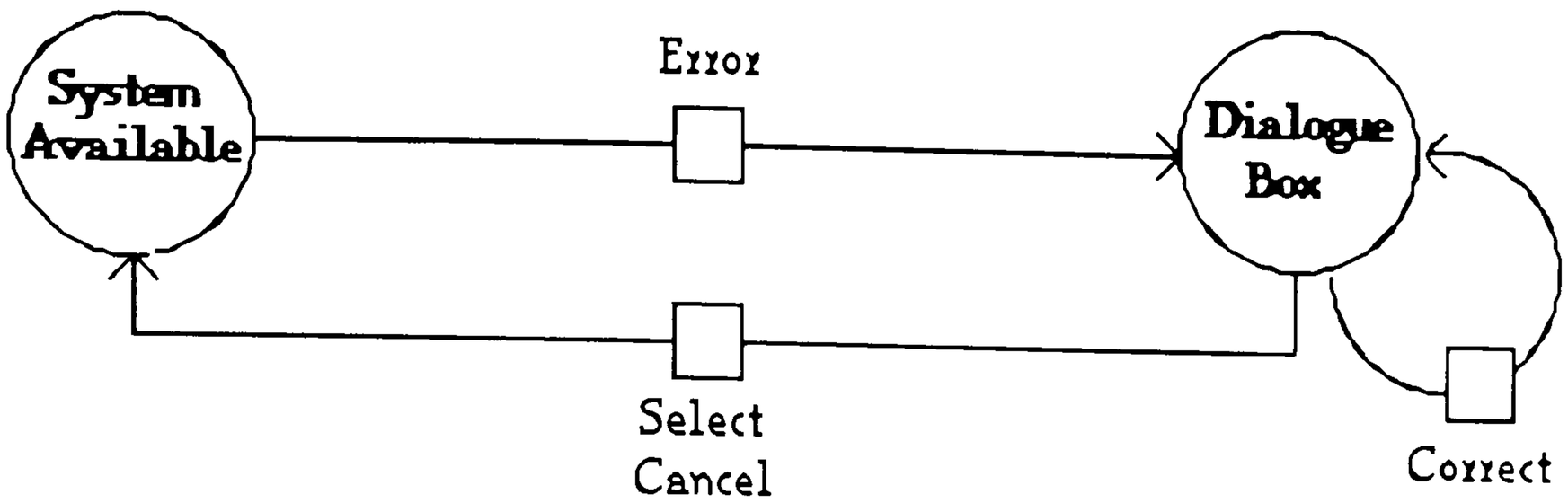
- in the case of command-argument errors suggest the form of the arguments as in *the arguments of command X should be of type Y* or *command X takes only one argument*

If the error still remains uncorrected then *provide a repair* for the user, if this is feasible, or inform the user that the system *cannot suggest the repair*. For example

- *command X cannot be used in y situation because Z*

- *object X cannot be Y unless Z*

In practical terms, if the system and the particular sequence of interaction which provided the first example were to be redesigned, the recommendation might be relatively straightforward (and somewhat unsurprising). It is that the *Cancel* option contained in the first dialogue box should not represent an absolute prohibition on the user's actions, since the user might expect that the following turn can be used to repair her previous action. However whilst it is straightforward, simple and unsurprising in this way, it illustrates simply the way in which the findings of conversation analysis can be employed to provide a resource for the design which allows the designer to address the specific and detailed sequence of events. Figure 8 shows schematic versions of both the original and redesigned repair sequences.



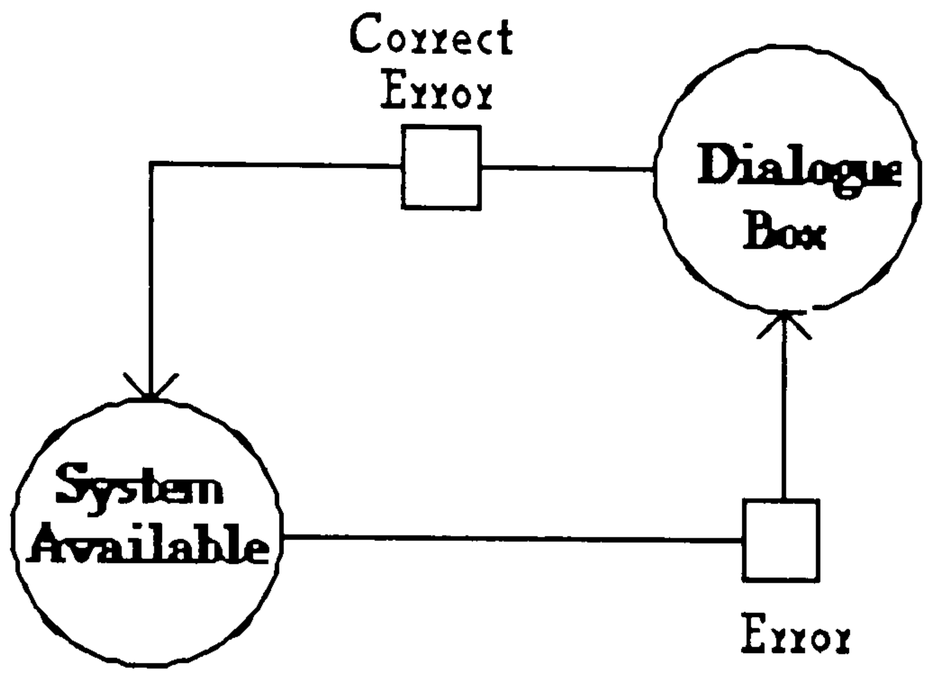


Figure 8: The repair sequence. The nodes represent system states or actions (such as waiting for input or providing a dialogue box), the boxes represent user actions, and the arcs show transitions between nodes. The upper diagram shows the original sequence where the user is prohibited from immediately self-correcting. The lower diagram shows the result of allowing the user to proceed with a repair of her error by removing the requirement that the dialogue box be explicitly cancelled.

In practical terms the recommendation concerning the second sequence is more complex, and is that rather than simply indicating the error and leaving the user to attempt to self-correct the error, the system should attempt to provide any further information about the error to assist the user in this process. Following the notion that the repair sequence should be modelled upon the normative format for repairs in conversation, this means that the design might incorporate a number of graded repair initiators, which are sequentially employed to guide the user through the repair process. Figure 9 again shows the sequence of actions in schematic form.

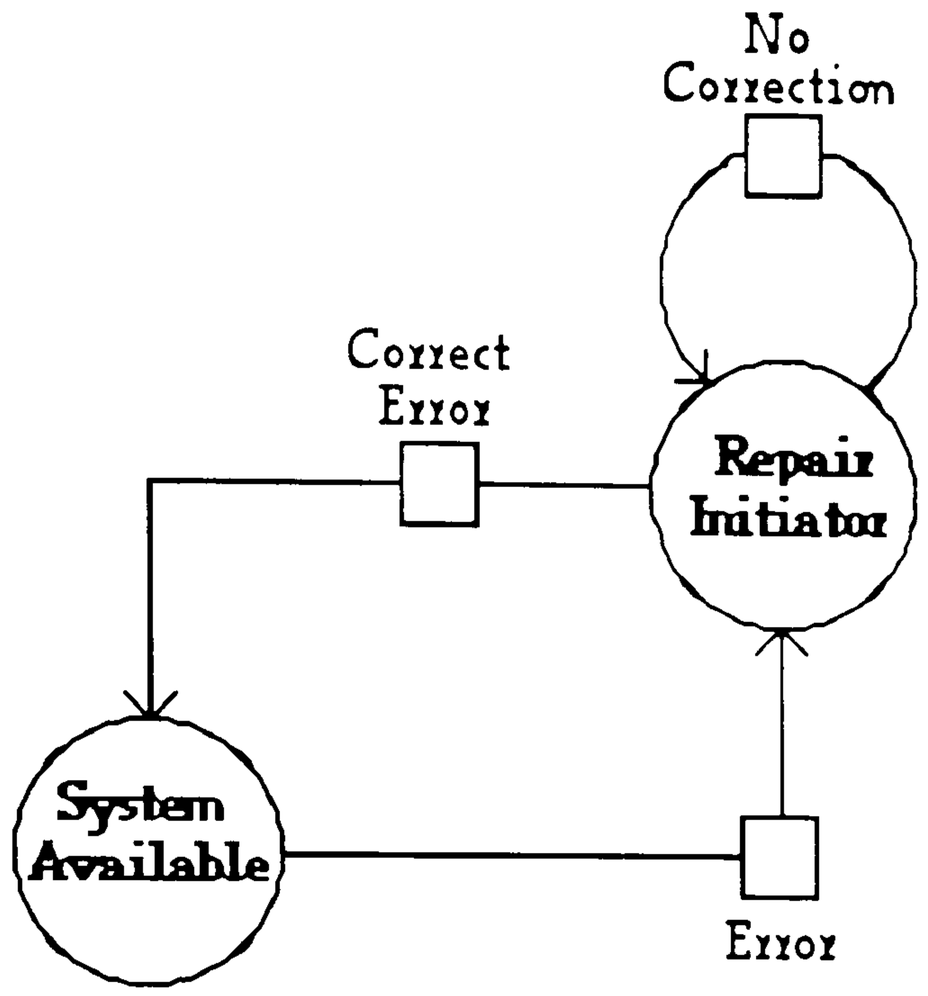


Figure 9: modified repair sequence. When the user is unable to correct the error, repair initiators are employed to prompt a self-correction by the user. The looped node *Repair Initiator* is a simplification since there may be several nodes with distinct repair initiators.

It is also possible to envisage the possibilities for repair in terms of the states of availability, readiness and unavailability discussed in section 2 of this chapter. The situation represented in figure 8 (where the prohibition is removed from the user's action) conforms to the possibility that the system can move from one state of availability to another without entering one of non-availability. The looped *System Available* node in figure 10 indicates that this is possible. Similarly, the modified repair sequence in figure 9 (where the user is prompted for repair by using repair initiators) conforms to the state of readiness proposed in section 2, and is indicated by the looped *System Ready* node in figure 10.

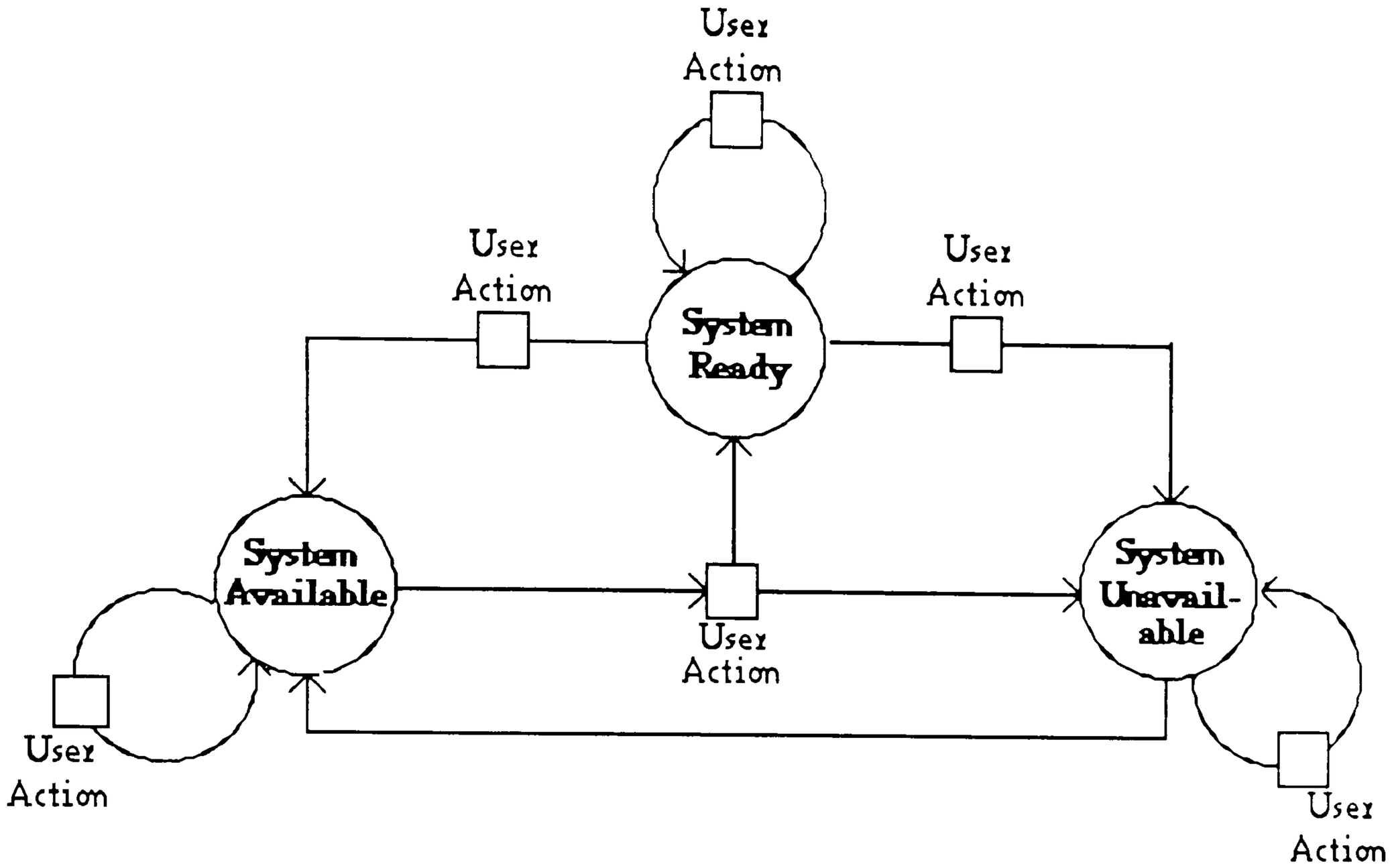


Figure 10: The interactional states and their relationship to the proposed correction sequences.

The recommendations outlined here serve to illustrate in a clear way the advantages of guidance formulated on the basis of conversation analytic findings. Such guidance is articulated against an established theoretical background (the assumptions of conversation analysis regarding the importance of *structure* in interaction); is widely applicable (for example to graphical, text or speech interfaces); concentrates on the *structure,* rather than the *content* of the interaction (the central recommendation concerns the the three-part structure of error-initiation-repair); concentrates on a particular *activity* in interaction (specifically the repair of errors); and has an *empirical foundation* (existing findings from conversation analysis regarding the organisation of repair, and its discovery as problematic through analysis).

4. Providing help

The final area of investigation concerns the provision of *help* for users. Previous sections of this chapter have examined two particular phenomena salient in the data by virtue of their problematic character. In contrast, the issue of help was salient by virtue of its unproblematic character. This was not, however, engendered by the user's interaction with the system, since the systems which appear in the video-recordings provided only passive lookup help, which merely presents an on-line version of the appropriate paper-based manual. The unproblematic character of the help in the recordings was rather occasioned by the fact that, not surprisingly, when there was another human present, the user typically turned to them for advice. This was of course captured on the video-recordings since they was, as described sat the opening of this chapter, conducted in as naturalistic way as possible. The recordings are therefore punctuated by often extended episodes of interaction between the user and an on-hand adviser.

The argument of this study has so far been that conversation analysis and its methods, findings, and perspective on interaction, provides a principled and systematic approach to problems in HCI design. It would seem that the analysis of the talk between advisers and users is a prime site for the application of conversation analysis, since it is talk which is the focus for, and the genesis of, its methods. However, this ready applicability must be contrasted with the points which arose from the discussion of conversation analysis in Chapter two, which suggested that talk is a complex phenomenon, and should be seen as a collaborative achievement. The multiplex methods by which conversationalists, in ethnomethodological terms 'remedy indexicality',

would thus seem, prospectively, to mitigate against any *direct* transliteration of the features human advice-giving, to advice-giving in interactive computer systems. Whilst recognising such obstacles, it is clear that an investigation employing the methods of conversation analysis can at least illuminate significant features of advice-giving in situations where user, adviser, and system are present. In contrast to the previous examples, where there were both general and specific conversation analytic findings which could be drawn upon, there are no such findings which may be used to formulate design recommendations in the case of the provision of help.[18] The final part of this chapter thus represents an attempt to use only the methods of conversation analysis to investigate some of the features of user-adviser talk.

4.1 Approaches to providing help

As Hellman (1989) has recently noted

> computer users may encounter insuperably complex use situations [and] that it is possible to assist users significantly by implementing computerized help systems (Hellman 1989: 417).

There are two notable approaches to providing help for users of interactive computer systems. The most widely used is a randomly accessible collection of information which approximates to the paper-based manual (Houghton 1984).[19] Users are left to consult this information when required. Almost every system now includes some

---

[18]Jefferson (1980), and Jefferson and Lee (1981) however, have examined the nature of "troubles talk".

[19]Cherry *et al.* (1989) provide a review of research into on-line help.

form of on-line documentation. However, this form of help often proves problematic for users, in the same way as the paper-based documentation which it has superseded. The contextual nature of both user-system interaction individual nature of the users' problems, means that manuals inevitably fall short of providing help which is really helpful. Much effort is required on the part of users consulting on-line documentation to fit descriptions of system features, and instructions as to their use, to particular problems. Inevitably the manual may become problematic in its own right for many users. The "situated" nature of user's problems is compounded by the fact that the help offered by such systems "draw[s] on a quite narrow, technically oriented, understanding of the use of computers" (Hellman 1989: 419).

A second kind of help is provided by the active or intelligent help system. The 'intelligence' of such a system rests in a parallel representation of the user's current activity and an 'ideal' version to which it is assumed to approximate. The user's current activity, and thus what is assumed to be the user's current understanding, is represented as an updatable user model, which is used to detect inconsistencies in the user's behaviour. The help provided by such systems is interventive and meant to approximate the behaviour of a human adviser who 'looks over the shoulder' of the user, providing corrective assistance at appropriate points (Rissland 1984).

However, the most preferred source of help is the local human on-hand adviser. The fact that human advisers have access immediately to the particular situations encountered, a stock of experience, and the shared resource of language, means that as intelligent help systems,

they are hard to emulate (Lang *et al.* 1981, O'Malley 1986). Given the superiority of human advice, there have naturally been suggestions that system-based advice should be modelled on human advice-giving. Much of this work is directed towards defining simple structures in advisory dialogues which can be implemented directly. Previous studies have addressed them at the level of conceptual moves, and have glossed them as 'task-oriented' (Guidon and Sladky 1986), or 'plan-based' (Cawsey 1989, 1990). In many studies, dialogues are analysed in terms of the distribution of noun-phrases, pronouns, or anaphors to support the decomposition of dialogues into sub-dialogues (Grosz 1987, Sidner 1987).

The reflexive notion of the system providing the key to its own use has proved a seductively simple idea. However seductive, and however simple, the ideal of the "self-explicating" system (Suchman 1987) has proved difficult to achieve. For an area so intimately tied to the use of computer systems, and so intimately linked to success in their operation by inexpert users, the provision of effective help has progressed little.

4.2 Two studies of advice-giving

It is fruitful at this point to examine the way in which the investigation of the provision of system-based help has been approached. Two studies will be briefly examined here, one which provides a descriptive account of human advice-giving, the second which explicitly proposes that features of human advice-giving may provide the basis for computational mechanisms. The first is that by Coombs and Alty (1980), and investigates the provision of help in university computer

installations, the second by Aaronson and Carroll (1987) which examines 'help desk' interactions.

Although Coombs and Alty (1980) do not explicitly aim to address the issue of the modelling of system-based advice on human advice-giving, a brief examination of their study is useful to illustrate some features of the view of help within HCI research, and the methods used in its investigation. Coombs and Alty gloss advice-giving as "conversation", and review approaches to the analysis of conversation, concluding that

> a researcher is faced with a fundamental decision when using conversational material as data. It is necessary to decide whether to concentrate first on the verbal text itself, and seek to isolate linguistic structure with reference to a general description of the purpose of the interaction, or whether to obtain a detailed account of these goals, concentrating on the meaning rather than the structure of the text. (Coombs and Alty 1980: 408).

They thus choose to generate a "functional" description through an analysis of tape-recordings of interaction between users and advisers, and through questions to participants about the "way they view[ed] the behaviour displayed" (Coombs and Alty 1980: 409). In general terms, Coombs and Alty note, advisory interactions are characterised by

> a flow or information between participating individuals, the information originating in the mind of one individual being passed across to the mind of the other individual. In the case of an advisory conversation, the critical information may be assumed to concern computing and so the conversation may be partially described in terms of the computing concepts passed between speakers and the order of their exchange. (Coombs and Alty 1980: 409).

They find that advisory conversations are "simply structured and remarkably uniform" (Coombs and Alty 1980: 427), and consist of three stages : the *definition of the query* by the advisee; *the formulation of the solution* by the adviser, accomplished by requesting more information from the advisee; and the *communication of the solution* from the adviser to the advisee (Coombs and Alty 1980: 427).

In the light of the discussion of conversation analysis in Chapter two, and its recommendation to view interaction as a *collaborative* matter, Coombs and Alty's investigation may be subjected to a variety of methodological criticisms. Not least of these concern their view of interaction as a "conduit" for meaning (Fox 1987) where messages are passed intact between speakers, rather than interaction as a negotiated event; the view that plans and goals are the *causes* of behaviour rather than social constructs which are used to view behaviour as meaningful; and an approach to data collection and analysis which, in the light of the discussion in Chapter three may be seen to be less than adequate for the study of human interaction.

A second study, by Aaronson and Carroll (1987) provides a "protocol study" of spoken interactions with a help desk. They find that a recurrent feature of the protocols is the occurrence of a *verification strategy* (which approximates to Coombs and Alty's "definition of the query"). This takes the form of "questions (often syntactically implicit) which contain presuppositional statements that are partial answers to the query" (Aaronson and Carroll 1987: 393). An example of such a strategy may be seen in (1) and (2)

(1)

(Aaronson and Carroll 1987: 395)

How do I make it a data label - Just get rid of the colon?

(2)

(Aaronson and Carroll 1987: 395)

If you make it NF macro, I bet the CALL CUE goes away.

The verification strategy represents the advisee as an *active partner* in the interaction, rather than a passive recipient of proffered advice. Verification, Aaronson and Carroll suggest, works since it is multi-functional: it is confirmatory, mnemonic and demonstrative of professional or social competence (Aaronson and Carroll 1987: 399). However, rather than proposing this as a merely descriptive account, they suggest that

> designs for intelligent help systems might exploit this finding by supporting the verification strategy and attempting to extract and use the presupposed statements in these questions to generate advice (Aaronson and Carroll 1987: 393).

Aaronson and Carroll's study may also be subjected a number of methodological criticisms. The protocols were generated by examining at the interactions between users and a help desk, a situation which for the majority of users would be an unfamiliar experience. It is also possible to conjecture that the problems which are taken to a help desk are of a qualitatively different nature to those which occur as part of

users' *routine* use of systems.[20] The kinds of problems referred to the help desk, and consequently the ways in which advice is offered, would be of a kind which could *not* be resolved through consulting paper-based manuals, on-line manuals, or asking other users. The most obvious aspect of this qualitative difference is the fact that the problems referred to the help desk are 'preformulated' (users go to the help desk with a 'puzzle' to solve) and this may contribute to their appearance of uniformity. It is thus possible to suggest that nature of the interaction upon which Aaronson and Carroll's study is based is fundamentally distinct from advice requested, and given, *in situ*. In particular, as the following sections will demonstrate, this type of formal and organised help desk setting excludes the possible role of other important features of the advice-giving situation, such as the interlinked roles of the user, adviser *and* system.

4.3 Features of human advice-giving

The instances of help talk which appeared in the video-recording recordings were transcribed, following a version of the transcription conventions normally adopted in conversation analysis, described in Appendix 2. Where they were available, the non-verbal actions of the speakers were transcribed, and textual descriptions of these actions are indicated in square parentheses in the transcriptions. This simple way of capturing non-vocal features of the situation is adopted here, since although there are a number of transcription systems for rendering the involvement of non-verbal actions in spoken interaction (for

---

[20]In fact the help-desk was contrived: it was sited in a "large research laboratory" (Aaronson and Carroll 1987: 394).

example Goodwin M. H. 1980, Goodwin C. 1981) these are somewhat elaborate, dealing as they do with the details of gesture and gaze pattering in interaction. Short segments of talk are presented in the following sections, and larger stretches of user-adviser talk contained in the videotapes are provided in Appendix 3. The labelling for each example is the same scheme adopted for the sequences of videotape in this chapter. They are provided both for contextual purposes, since readers might wish to ascertain the context from which specific examples are drawn, and to allow other readers to attempt competing or complementary analyses of their own. The interactions are between users involved in authoring educational hypertext materials and an adviser (in this case the author of this study), and between a user and the author of an interactive system implemented in *SmallTalk80*.

Whilst the investigation here is conducted broadly in line with the analytic methods of conversation analysis discussed in Chapter three and at the opening of this chapter, this investigation should in no way be considered to be complete or as representing the only way in which these materials might be investigated. In particular, many practitioners of conversation analysis might see this attempt to investigate these materials as less than exhaustive, and falling short of the (somewhat tortuous) levels of detailed investigation that is seen as requisite for conversation analytic studies. Whilst recognising that this is indeed the case, it is clear that those levels of detail are clearly inappropriate for an investigation which aims to derive simple practical recommendations for the design of advice-giving in interactive computer systems. For example, no attempt is made to examine the specifics of the internal organisation of the turns-at-talk

of the speakers. Rather the examination concentrates on some general trends in ways in which certain actions occur regularly in the data.

The investigation will address a range of features. Firstly, it will be shown that help and advice giving is not a particularly uniform activity, or at least not uniform in the ways that previous studies suggest, but a complex and variegated one. Secondly, it will be suggested that not only are the user and adviser participants in the advice-giving situation but the *system itself* is a crucial part of the context of advice-giving. Thirdly, some general features will be discussed concerning the strategies which advisers use to elicit information from the user, and the strategies which are used to formulate that advice.

4.4 Features of initial help requests

In contrast to somewhat idealised forms of users' attempts to seek help, advice, or solicit an explanation which are represented in other studies of advice-giving, there may be no *direct* request for an explanation or help as such. Users requests take a variety of forms, of which several are prominent in the data.

a) Some take the form of a statement of *inability* transformed into one of a *projected action*, where the request is formulated as a problem of recall (3):

(3)

6 (1) 15: 05

U: what I'm going to do is open that up ( ) if I can remember how

b) Alternatively, a request may be truncated to a projection of the action to be performed as in (4) and (5):

(4)

6 (1) 11:47

U: right I just wanna close that down

(5)

5 (1) 1:59:23

U: o:::h.hhh ( ) go away ( ) Michael what I want to actually do is collapse that

c) Users' requests may also be in the more usual form of an interrogative as in (6):

(6)

5 (1) 1 07:25

U: what do I need to do

d) The request may be in the form of a query about the *permissibility* of some action:

(7)

5 (1) 39:05

U: I ca- °(..)° can I ( ) identify a new object can't I=

f) The user's request may take the form of an *enquiry proposing a solution*. The adviser uses a repeat, or partial repeat, of the user's query in the response to the request, which then provides an occasion for the user to reformulate the request in another way.

(8)

2 (3) 25:43

→U: can you just ask it to delete °(text)°
( )
A: °(delete text)°
( )
→U: I was just thinking y'see on open- ( ) y'see ( ) I created a field for them in which they can type ( ) then ( ) then if I can get it so that they move on - ( ) so that on opencard again

g) The request may be in the form of a bald statement of inability, as in (9) and (10):

(9)

10 (2) 17:30.

→U: I can't get the animation to work at all now
( )
A: what's the problem
( )
U: don't know

(10)

10 (2) 06:05.

→U: I still can't figure out why this bloody s- (.) thing won't work
( )
A: right okay ( ) he::rm

4.5 Advisers' initial responses

Similarly, advisers' responses to users' requests may take a variety of forms. Importantly, advice is often characterised by *uncertainty* and *misunderstanding* on the part of the adviser. This is both a reflection, and a cause of, the fact that advisers often rely not only on talk, but on

action to arrive at an understanding of the problems of the user. Advisers' responses may be

a) In the form of a *request for a repeat of the action* rather than a restatement of the problem by the user as in (11) and (12):

(11)

8 (4) 41:45

U: Pete ( ) I'm stuck inside a repeat ( ) construct again ( ) is there any way I can get in it again other than b-y

→A: - show me what it's done
( )
U: I'm stuck inside the repeat=

→A: = well what's its doing what's it doing=

(12)

1 (3) 10:03

U: bloody locked it an I can't get at it to make the sodding menu bar ( ) how the hell do you get at it
( )
→A: what have you done ( ) what have you locked
( )
U: w- ( ) w- y' see( ) I can't get at the the th- bar to ( ) if I go back right ( ) I can't ( ) it sticks in go ( ) I can't it's locked the screen

b) The linkage between verbal and non-verbal action in help talk would appear to complex. This linkage is one way in which it can be said that the user, adviser *and system* are involved in advisory interactions. One aspect is shown in (13) and (14) where a deictic reference may stand as a turn:

(13)

5 (1) 1: 48:56

A: say no ( ) and it should pick up message recipients

[U selects 'no' and nothing happens]
( )
→[A points at word 'recipients']
A: ( ) got an es.

(14)

6 (1) 02:10

U: I haven't done <u>any</u> descriptions
( )
→A: no I meant <u>that</u> [points] description

[U selects 'accept' over window]
( )
U: that it=
A: =yeah

c) Advisers may choose to *mitigate* advice, by casting their advice in the form of a statement conveying uncertainty. There is in fact, as A's second turn shows in (15) below, no uncertainty:

(15)

6 (1) 02:10

→A: = I don't think you've accepted ( ) the description part yet
( )
U: I haven't done <u>any</u> descriptions
( )
A: no I meant <u>that</u> [points] description

4.6 Other features of advice-giving.

There are several other recurrent features of the data which seem to indicate more general processes in advice-giving. The first of these is the role of *rehearsal*. Rehearsal appears to be used both by the user to formulating the query in a way which is acceptable to the adviser, and for the adviser to formulate comprehensible responses for user. This is shown in (16), where the adviser refers to a previous problem encountered by a user to formulate the solution to the current problem:

(16)

10 (2) 06:05.

U: <u>that</u> [points at text] is ( ) the script of a button ( )
e::rm that that works ( ) well you've just watched it
really ( ) you know ( ) well anyway it works ( )
and this - won't

→A: -I had this problem before with Janet °she
got in the script ( ) can't remember now why
something to do with what she'd drawn ( ) either
where she'd put it or how she'd drawn it ( ) an I
can't remember what it was° ( ) the thing is to go
through the steps one by one ( ) right so ( ) choose
select tool [does] ( ) and then ( ) type ( ) domenu
select all [does]
( )
U: °then domenu select°=

A: =yep ( ) °(in the)° message box

A second feature is that both the request and advice are *contextually tied*, and involve the user and adviser using the presence of the machine as a resource for formulating queries and providing advice. This is simply to say that both users and advisers refer to the system by *pointing* at various objects as moves in the advice-giving process. This is shown in a variety of sequences:

(17)

10 (2) 06:05.

( )
→U: <u>that</u> [points at text] is ( ) the script of a button ( )
e::rm that that works ( ) well you've just watched it
really ( ) you know ( ) well anyway it works ( )
and this won't

(18)

10 (2) 06:05.

A: do ( ) just do drag from ( ) what first (place) [beep
from machine] you have to place the cursor [A
→points to the screen] select it all [does] yep

(19)

10 (2) 06:05.

→A: exit repeat [points]

U: that's the first one ( ) cos that one ends there ( )
but I'm actually getting stuck inside there 'cos it's
doing

(20)

8 (4) 41:45.

A:=°if the sound is done°=

→U:= <u>that</u> ( ) then it got stuck inside here [U points]
→I want it to wait until <u>this</u> [points] sound is done
and then it does this ( ) an then I want it to wait
until this sound is done before it does this ( ) then it
got stuck in there somewhere

(21)

1 (1) 10:48

A: y'see the usu - sal

U: - I think I think I did it as one before it's just with redoing it=

A:= the usual thing is to capitalise the separate
→word [A points] so you'll have capital

A third feature is one which will only be briefly addressed here since it is a feature of many kinds of talk and has been a theme in many studies of human interaction. This is that user and adviser do not define queries and responses *unilaterally*. The formulation of query and response is a matter of *collaborative* effort, since in many cases the user does not know exactly what is to be asked, nor the adviser exactly what advice to propose (O'Malley 1986). In the lengthly sequence of interaction below, the user and adviser collaborate to define a version of the query. In this case the problem that user and adviser are concerned with is the provision of a mechanism for experimenting with paint tools in a controlled fashion. Specifically, the user wants to allow endusers to select the drawing tool from a menu, draw onto a card, and then, when the next card is selected, have the drawing automatically erased.

(22)

2 (1) 1:29:24

U: why is it when you tell it to choose a tool and then tell it to wait ( ) it won't choose the tool ( ) all it does is go onto the wait °and the clock° it won't choose the tool ( ) I've got the card ( ) script you see ( ) on the put choose pencil tool wait sixty
second - s °(...)°

A: └ why do you want it to wait=

U:=because I want it to go back you see ( ) I don't want it to be all the time ( ) d'you know what I mean
( )
A: what do you want to do with choosing and then wait ┌ ing what do you want to do with the tool
U: └ well( ) I want them to be able to have a chance to draw with it
( )
A: yeah
( )
U: y'see ( ) and obviously this is the pencil tool ( )press that [A mouseclicks on button] and go to the next thing ( ) and then have a pencil that you can draw with ( ) right and I don't want them to stick on that ( ) I want them to be able to undo it as well=

A: =undo what
( )
U: what they've drawn ( ) right ( ) an then go on
( )

The user's first formulation of the query ("why is it when you tell it to choose a tool and then tell it to wait it won't choose the tool all it does is go onto the wait and the clock it won't choose the tool") is gradually redefined by the user and adviser through an intermediate form ("then have a pencil that you can draw with ... and I don't want them to stick on that I want them to be able to undo it as well"), into a final version, jointly articulated by the user and adviser:

(23)

2 (1) 1:29:24 - end of sequence

A: undo what they've drawn ( ) you want them to undo it explicitly=

U:= that's right yeah ( ) well ( ) it to be undone yes
( )

A: well you can I don't think you'll be able to do that what you'll have to do is ( ) e::rm ( ) if you do wait ( ) wait means it can't do any action at all
( )
U: a::ha:- :

A: -right it means you can't draw either
( )
U: °I see°

A fourth feature is that, in contrast to the kinds of interactions discussed in studies by Aaronson and Carroll, and the 'plan-based' interactions discussed by Cawsey (1989, 1990), user-adviser interaction is not composed of 'monolithic' turns. That is, interaction is characterised by a mass of overlappings, interruptions, incomplete turns and abandoned turns, as in the example below:

(24)

5 (1) 39:05

U: an if I now hit return ( ) we're now back again (it) it's °(..)° back in there=

A:= but not in the tasks=

U: an what I have to do now is get it through every
( ) (..- ..)

A: -yeah ( ) so find out what ( ) if you say that's going to say somethi - ng

U: - °it's in everywhere we know that°

(.....)

U: what I did wuz ( ) wu - z/

A: press /return=

U: = nope I deleted so there was nothing left in the b - ox

A: └ an then you pressed return=

U: = an then pressed return
( )
A: but it should've deleted message then
( )
U: but it thought it had message still ( ) I ( ) I er I guess ( ) well th ┌ e

A: └ that shouldn't be there
°(there's something wr ┌ ong)°

U: └ alright ( ) I'll ( ) if I take this thing called read message [U drags opened window]
( ) <u>wha</u> ┌ <u>t</u>

A: └ °(interesting isn't it)°

4.7 Review

The examples have shown a variety of forms of both user queries and adviser responses. Several recurrent features of the user's initial query have been described. The query may take the form of

- a statement of inability transformed into one of a projected action, where the request is formulated as a problem of recall;
- a projection of the action;
- in the form of simple interrogative;
- be concerned with permissibility of actions;
- serve to draw attention to some pre-existing problem;
- take the form of an enquiry proposing a solution;
- contain a bald statement of inability.

Similarly, the adviser's initial response may take various forms. These are that

- advisers will request a repeat of the action rather than a restatement of the problem by the user;
- deictic reference may stand as an unspoken activity turn;
- advisers may choose to mitigate advice, by casting their advice in the form of a statement conveying uncertainty.

Additionally a number of general features common to both the user's query and the adviser's response were noted. These were

- the role of rehearsal in the user and advisers interaction;
- the role of context in the formulation of a query or request for help and the provision of help by the adviser;
- the collaborative nature of advice-giving;
- the 'non-monolithic' nature of user and adviser turns.

4.8 Advisory strategies.

A number of additional observations may be made concerning several general strategies which appear to be used by advisers. Firstly there are those which are used to *elicit the user's query* after the user has indicated that there is some problem. Secondly there are those which are used to *suggest or demonstrate a solution* in order to bring the user to an understanding of the problem.

One strategy used in eliciting the user's query is one of *non-intervention*. This is achieved by allowing the user to attempt a number of reformulations, and involves the adviser passing up opportunities to intervene in the user's query and propose a solution. This is shown in (25):

(25)

1 (3) 33:03

→U: you know this idea of the the- mouse
accidentally getting into that field and flipping to
the next one ( ) was there something do you say you
could put into the field °to stop it doing that° ( ) or
do you reckon °(it's a)° problem ( ) could you put it
on a card
( )
A: what you have to do is ( ) map out the region
contained by the newspaper [A points] right

Here the adviser passes up the opportunity to intervene in the user's query, at expectable points such as pauses and clause boundaries. This, combined with the absence of confirmatory remarks from the adviser suggest that the adviser is, simply, 'waiting to see how the query turns out'. It would seem that this is successful, since the adviser proposes a direct and unambiguous solution in his first turn. The fact that such a strategy is in operation is indicated by the fact that in a great majority of cases the user-adviser talk is marked by a great deal of intervention and confirmatory utterances, as shown below:

(26)

1 (1) 10:48

U: I've tried the button up on prawn cocktail on prawn cocktail ( ) so it does that [U selects button]
( )
→A: that's fine=

U:= which is fine the trouble is ( ) °go back° [U selects menu item] you've then got a problem with the other button scripts

(27)

2 (3) 25:43

U: I was just thinking y'see on open- ( ) y'see ( ) I created a field for then in which they
can typ- e

→A: -right
( )
U: then ( ) then if I can get it so
that they move on - ( ) so that on opencard again

→A: - yeah

The strategy of non-intervention is paralleled by a second strategy which appears to be employed to providing the solution to the user's problem. This is to encourage the user to *perform the action which is the cause of the problem*. A variant which appears here is to encourage the user to examine the program code, rather than speculate about the problem in abstract terms. These are illustrated below.

(28)

10 (2) 17:30.

U: I can't get the animation to work at all now
( )
A: What's the problem
( )
U: don't know
( )
→A: show me the script
( )
[U opens script box]
( )
U: I've more or less ( ) I've copied it more or less ( ) apart from ( ) the obvious bits from the other animation I've done and it's just not working ( ) and I just can't figure out ┌why
→A: └well ( ) e:::rm ( ) °choose
→select tool ( ) domenu select all (.....)° show me
→again ( ) show me what it does

(29)

2 (1) 19:41

U: there's not a field available for it to go mousewithin ( ) see what I mean ( ) I've already realised the logic of that ( ) if y┌ ou put ( ) on °(.....)°
→A: └ show me what
→you tried to do=

U: = hang on a minute

However, advisers do offer advice in explicit terms which describe the steps required to arrive at the solution. In the instance below, the adviser formulates in the solution in an algorithmic fashion and addresses the more general problem implicated in the user's query. This regards a specific feature of the behaviour of the system, but the adviser's advice formulates the query at an abstract level which is applicable to a number of situations.

(30)

2 (1) 19:41

U: pete:::::::=

A: = yeah=

U: = if you've got an open card thing ( ) can it have ( ) a mousewithin between those °(points)° between the opencard and closecard

( )

A: what ( ) an on mousewithin °(..) handler° =

U: = yeah

( )

A: no (┌) y' can't

U: └ no::

A: think about it ( ) each (┌) think about the nature of the

U: └no::::: ( ) no::::::

A: things you're doing ( ) each ( ) <u>on</u> °(...)° statement (┌) represents how

U: └ mmm:::::

A: that ( ) s:: structure ( ) the <u>card</u> ( ) is gonna interpret some message ( ) right =

U: = yeah=

A: = so ( ) an on opencard means ( ) <u>for</u> this card=

U: =yeah =

A: how do you want to interpret the message opencard=

U: = yeah =

A: = right ( ) which means that ( ) for every message it want to receive it has to have a separate handler ( ) it won't let you do it inside ( ) there's no point in doing it inside

It is possible to ascertain a common feature of these two strategies. This is that such strategies may be directed towards encouraging users to become self-regulating and self-monitoring individuals. In the case of the previous example, this merely reflects the nature of traditional pedagogy which is designed to equip learners with general principles rather than specific knowledge. However, the way in which advisers encourage users to perform the action which raised the query, suggests that users are being encouraged to do this as a first step to understanding the solution. This provides a route for the adviser to compare the user's view of the system's actions and the actions themselves.

4.9 Implications for design

These observations serve to illustrate the difference between help as it is currently provided in interactive systems and that provided by on-hand advisers, provides a corrective to studies which suggest that advisory interactions are simply-structured events, and provides the basis for several simple design recommendations.

However, it must be recognised that a great part of the superiority of the advice provided by human advisers comes from the fact that the medium for the advice is the natural language shared by user and adviser. The kinds of features cited above may thus be inapplicable to interactions not conducted through natural language. Natural language serves to provide a medium for complex interpretive work

on the part of both user and adviser. This means that any system which is to emulate the sorts of advice provided by human advisers would need to provide complex interpretive abilities.

One simple recommendation arises from the observations regarding the ways that advice is formulated by advisers. This is that user may find advice presented in *mitigated forms* more acceptable than simple presentation of factual data. This will allow the presentation of help to appear less authoritarian than simple factual advice. A second recommendation arises from the fact that advisers will request a repeat of the user's action rather than a restatement of the problem. Clearly, a mechanism by which users were encouraged to *outline the action* that they wished to perform (for example dragging a non-deletable file to the wastebasket, say) could provide routes into the provision of contextually-sensitive help. A third recommendation may be made regarding the use of unspoken activity turns in both advice-seeking and advice provision. It is possible to envisage a simple mechanism whereby users could *point* to objects in the environment and receive advice regarding them. This means that the provision of help may be made more relevant to the user's concerns by providing mechanisms for the indication of sources of problems when in an explicit help mode. Thus, rather than scanning through the usual list of topics and subtopics, provision can be made for users to select particular objects in the environment and receive information about that object, so that 'help' is an attribute of every object in the system.[21]

---

[21]Some applications already use a version of this mechanism. Microsoft Word for example allows the user to obtain (limited) help by indicating objects when in 'help mode' via selecting objects with the cursor.

However, users' queries are typically, or not only, regarding the *properties* of individual objects, but about the intended *function*, particularities of operation, and scope of applicability of objects in the interface. This means that a 'point-and-request' mechanism may be augmented with a 'use-and-request' mechanism which allows users to perform sequences of actions and then request help on that sequence. Similarly the system's presentation of advice may use features in the environment to illustrate certain portions of advice. A fourth recommendation may be made concerning what was called the 'non-monolithic' nature of user-requests and advice. Clearly advice which was presented in sequence rather than displayed *en bloc* would correspond more to the processes shown here to be involved in human advice giving. In particular, advice might be segmented into particular functional displays which could then be further interrogated by the user.

The design recommendations above only address more tractable features of advice-giving as represented in this data. It is clear that some other features of advice-giving will prove resistant to simple solutions, and may call for complex inferential capabilities on the part of the system. In particular, the sort of co-ordination evident in the ways that users and advisers collaboratively work together to define a request and its solution are beyond a simple formulation, relying on situated contextual particulars, natural language abilities, and close visual monitoring by user and adviser for their effectiveness. The nature of the task in which the user is engaged would seem to be a particular problem for current advice systems which merely "focus on data accessibility and command parameters" (Hellman 1989: 420).

5. Review

This chapter has described an investigation of video-recorded user-system interaction using the methods and findings of conversation analysis. It has concentrated on three specific areas in order to demonstrate the way in which the use of those methods and findings provide a principled approach. Firstly, sequences of interaction where users received no response to actions where examined. It was demonstrated that expectations both regarding the sequential links between actions, and the way in which purposeful non-responsiveness may be ascribed to interactive systems, were apparent in human computer interaction. In addition, a particular process of reformulation used in human conversational interaction was shown to be used to obtain responses in human-computer interaction. These sequences from user-system interaction and findings from conversational analysis were used to recommend design changes. In particular it was suggested that repeated user actions could be taken as an indication of the problematic character of interaction, and that mechanisms might be provided for the reformulation of users' actions.

Secondly, sequences of interaction involving the correction of errors were examined. It was demonstrated that the problematic character of these sequences was attributable to their divergence from normative features of repair sequences in human conversational interaction. On the basis of detailed findings from conversation analysis regarding repair in interaction, a recommendation for the design of repair sequences was proposed.

Finally, the talk between users and advisers was examined. The investigation demonstrated that even though there were no specifically relevant findings from conversation analysis, the methods of conversation analysis could be employed to provide a novel perspective on the provision of help for users. Based on this investigation, a number of design recommendations were proposed.

6. Applicability of the recommendations

It is clear that the proposed recommendations regarding response, repair, and help have been based on a restricted range of applications and interfaces, and that it is not unreasonable to establish their wider relevance. This section investigates their wider applicability, demonstrating that the problems illustrated are not confined to the systems investigated, and that the proposed recommendations are applicable to other interfaces. This is based on a walkthrough of the Xerox Viewpoint document processing system, an example of a complex application, with an interface using a range of WIMP features. It must be recognised, however, that this is not an exhaustive, systematic, or rigorous evaluation.

The walkthrough concentrated on the most commonly-used menu-based document editing functions. Tables 1 and 2, in Appendix 4, describe in detail the menu items, the current system actions, any proposed design changes, and the applicable recommendation. The recommendations are represented here as recommendations 1 and 2. Recommendation 1 covers the proposed guidance for the provision of response, and the suggestions that active indications of system status be provided, that a relevant next action is necessary, and that a mecha-

nism for the reformulation be provided when repeated user actions are evident. Recommendation 2 refers to the provision of repair. The third area of guidance presented in this chapter, the recommendations for the design of help, are clearly applicable here, since Viewpoint provides only lookup help.

6.1 Viewpoint document editor

The document editor provides two auxiliary menus which are used to control various features of document creation, such as toggling the display of printing or non-printing characters, pagination, and the addition of tables to the document.

6.1.1 Auxiliary menu 1

Table 1 in Appendix 4 shows the menu items contained in auxiliary menu 1. It was found that the operation of 6 of these menu functions are sites for the application of the recommendations. As might be expected, a number of these menu items provide a relevant next response through performance of the action specified. The menu items *Show structure*, *Show Non Printing With/Without Spaces* (which display hidden formatting characters), and *Show Style Sheet*, are functions of this kind, which toggle document properties. The next four items, concerned with pagination, perform similar functions, but in this case do not provide the Xerox hourglass busy signal, and it is clear that an active indication of the system's non-availability should be provided under recommendation 1. The final two items, *Prompt For Fields* and *Enable Buttons*, which are only applicable when the document contains these particular objects, provide no response for

the user of any kind when the menu item is selected. It is clear in this case that recommendation 1, which specifies that user actions require appropriate next responses, is applicable.

6.1.2 Auxiliary menu 2

Table 2 in Appendix 4 shows the second auxiliary menu functions in the document editor. As in the case of the previous items on the first menu, the first 7 functions, concerned with tables, require specific items to be displayed and provide no response to the user's actions. Recommendation 1 is again applicable in this case. The following items, *Update Fields* and *Margins*, provide status messages or specialised dialogue boxes. The following item, *Set field/Table Fill-In Order* initiates a complex sequence of actions: the menu selection initiates a confirmatory message which allows the user to abort the sequence, and the system then displays a message which instructs the user to select various objects from the document and to select a further menu item (*End Field/Table Fill-In Order*) to complete the operation. There is no provision for the cancellation of the interaction, and repeated user actions merely causes the message to be redisplayed. (It is also, unfortunately, difficult for the user to end the sequence, since the message effectively masks the appropriate auxiliary menu icon). It is clear here that the user may wish to engage in other actions, or to request specific information regarding this sequence of interaction. Recommendation 1 is applicable in this case to provide the user with the relevant opportunities, or recommendation 2 may be applied if repairs can be provided to the user's actions.

6.2 Review

An alternative system was examined in terms of frequently used menu items. Of the 30 menu items, 10 were found to violate the recommendations proposed in this chapter.

Chapter 5

Conclusion

In my end is my beginning.

T. S. Eliot, *Four Quartets - East Coker, V* (Eliot 1963: 204).

1. Introduction

The preface to this study declared a concern with the provision of social principles for the design of interactive computer systems. The previous chapters of this study have described one way in which such principles can be formulated, through the use of the theoretical perspectives, methodology, and established findings of conversation analysis.

Chapter one argued that whilst significant advances have been made in increasing the usability of interactive systems, there is a prominent aspect of the interaction between human and computer not currently addressed by HCI research and design. This missing dimension, which concerns the role of abilities and expectations from human interaction, rests upon the failure of HCI to take into account social-scientific approaches to the study of human interaction. It was proposed that conversation analysis, a sociologically-based approach to the detailed analysis of human conversational interaction, would provide a principled and systematic approach to the design of 'natural' interactive systems, and allow the formulation of widely applicable and effective design guidelines.

Chapter two provided a view of the theoretical assumptions and significant findings of ethnomethodology and conversation analysis. It was shown that these disciplines are concerned centrally with the nature of mutual intelligibility in interaction. Whilst ethnomethodology is concerned with the practical reasoning used by members of society, conversation analysis, informed by ethnomethodological insights, provides an account of interaction which stressed its highly-organised nature.

Chapter three was concerned with the divergence between the methods prominent in HCI research and those of conversation analysis. It was argued that many approaches have proved less than effective in the production of applicable findings, since their methods are often inappropriate for the study of human behaviour. In contrast, the inductive non-experimental approach of conversation analysis was argued to provide an principled and systematic approach to the investigation of user-system interaction.

Chapter four demonstrated in a practical fashion the applicability of conversation analysis to issues in HCI design through an investigation of a corpus of naturally-occurring user-system interaction. The methods and findings of conversation analysis were employed in the examination of three particular phenomena. Firstly, sequences of interaction where users received no response to their actions were examined. It was argued that expectancies from human conversational interaction are employed in users' interaction with computer systems. Other issues, regarding the ways in which the non-responsiveness of systems appears purposeful, and the ways in which responses are pursued using mechanisms from human interaction, were discussed.

Secondly, users' problems in sequences of interaction concerned with correcting were demonstrated to be attributable to particular expectations from the organisation of repair in human interaction. Drawing upon findings from conversation analysis, a design guideline for repair in human-computer interaction was formulated. A third phenomenon, the talk between users and on-hand advisers was investigated, and it was suggested that system-based advice could be modelled on particular features of human advice-giving.

These four chapters have attempted to establish the practical applicability of the theoretical background, established findings and methods of conversation analysis in HCI design. This final chapter discusses the significance of this investigation in terms of the possible areas of applicability derived from Landauer's (1987) view of the relationship between cognitive psychology and HCI design, and suggests current and future research directions.

2. The significance of conversation analysis to HCI design

2.1 Existing knowledge and findings

The first way in which conversation analysis was asserted to be applicable was in terms of the application of existing knowledge and findings to HCI. Chapter four drew upon a number of findings from conversation analysis, both in terms of a general framework for the description of interaction, and more detailed findings regarding the organisation of interaction, and demonstrated that they may be used to formulate practical design guidance.

It is clear, however, that the findings drawn upon in this study represent only a fraction of those available from published sources. The ethnomethodological and conversation analytic literature contains a great many significant findings about issues of understanding, interaction, meaning, and action, which are applicable to the concerns of HCI design. The two most pressing and productive future directions for this research are thus to consider the applicability of other conversation analytic findings, in relation to detailed empirical studies of human-computer interaction.[1] This study has only isolated some of the more salient features from a restricted corpus of data to establish the validity of the approach, and no doubt more general opportunities for the design of interaction will emerge.

It is also clear that there are areas of information technology which will benefit from the application of conversation analysis. One prominent area is the construction of systems which provide facilities for group working, in particular Computer-Mediated Communication (CMC) systems. CMC is an overridingly social activity, where a significant number of users are non-experts, yet many existing systems provide only a passive medium, an interactional vacuum of undifferentiated message types, and simple asynchronous messaging functions (Chang 1987). Teleconferencing, computer-based conferencing, and computer messaging are communicative paths which are rapidly becoming more desirable for people who wish to communicate with each other from possibly diverse physical locations, and the need

---

[1]It is these directions which are being currently pursued by the author (with Prof. M. A. Norman) under DTI research initiative GR/F 38723/IED4/1/1162 *Informing HI Design from Interaction Analysis*.

to provide sensitivity to the context of an interaction is something which is considerably lacking, but would seem to be necessary, in systems which are designed to support collaborative activity between multiple users.[2] A necessary step forward in increasing the utility of these systems is to provide them with the capability to organise the interactions which take place within them by reference to the notion of an interactional context.[3]

2.2 Theoretical frameworks

The second aspect of the applicability of conversation analysis was argued to be the application of theoretical assumptions for the creation of novel forms of analysis. The exposition of ethnomethodology and conversation analysis in Chapter two, and the investigation in Chapter four, make clear that their theoretical frameworks provide a new and productive research direction. This study has only touched upon a small number of insights and articulated a portion of that framework: among those which have been touched upon are the situated nature of interaction; the role of members' socially distributed and articulated methods for interpretation of action; the indexicality of behaviour; the reflexivity of accounts; the view of interaction as improvisatory activity rather than planned action; and the view of rules as interpretive

---

[2]There is a plethora of work related to the design and evaluation of CMC systems. See for example, Bannon (1986b), Hiltz and Turoff (1981, 1985), Meeks (1985), Panbroke-Babatz (1984a, 1984b), Pullinger *et al.* (1984), Sarin and Greif (1985).

[3]There is recent research which moves beyond technical issues and is aimed towards the provision of interactional support for the user by the creation of user-definable tools, and the provision of features such as semistructured message templates, display-oriented editors and frame inheritance networks to represent message type taxonomies (Malone *et al.* 1987). The Alvey COSMOS project (Bowers 1987) is attempting to use conversation analytic perspectives in the design of a messaging system to be used for a variety of activities within an office environment.

devices rather than causal agents. It has been demonstrated that, in Landauer's terms, conversation analysis and its ethnomethodological assumptions *do* provide the "leverage on the specification of humanly usable systems" (Landauer 19876: 14) which has been sought, but which has not been forthcoming, from psychology. The recognition of the possible advantages of the use of conversation analysis - and more generally the findings, methods, and perspectives of 'interpretive' sociology - will hopefully provide an impetus not only for empirical work in this area, but work of a more speculative and theoretical nature.

2.3 Methodology

One prominent concern of this study was declared in Chapter three: the need to consider the appropriateness of methods for the study of user-system interaction, and to encourage a methodological awareness concerning the limitations and advantages of particular methods. Chapter three argued that the inductive non-experimental methods of conversation analysis provide a principled approach to the investigation of human-computer interaction. Those methods, which were used in the investigation of videotaped data of user-system interaction in Chapter four, represent what Landauer terms an "exploratory research paradigm" (Landauer 1987: 15), where the testing of hypotheses is replaced by the investigation of real-world activities. Chapter four demonstrated the usability of these methods in the investigation of user-system interaction and in the analysis of talk between users and advisers.

Yet it is clear that there are further methodological tools, congruent with the methods used in this investigation, which remain to be employed. One particularly promising approach is that of the 'breach' experiments discussed in the exposition of ethnomethodology in Chapter two. Breach experiments, by deliberately distorting the normal features of the environment, may be used to reveal the relevant "background expectancies" which are operative in human-computer interaction.

There is also a requirement for the development of more sophisticated data collection techniques for research into human-computer interaction. The investigation in Chapter four is based on only the most basic approach to data collection and analysis, and projects which aim to amass large corpora of data require high density storage media which are rapidly-accessible, with the ability to archive multimedia information from system monitors, data from reconstructed video frames, and animated sequences of interaction. It is also necessary to develop analysis tools which, to some, extent allow the automation of certain parts of the analysis such as the tagging of relevant sequences.

2.4 Applied studies and theory

Landauer's original discussion provided an additional suggestion regarding the relevance of cognitive psychology for HCI. This was that applied studies may lead to more generally-applicable findings about the nature of interaction. Applied studies thus might be used to guide investigation of, and provide substantive findings about, "the fundamentals of mental life" (Landauer 1987:3). As Norman, in the same volume notes in this respect, the investigation of practical problems

may provide "important insights and data to the developing theoretical basis" (Norman 1987: 325). The focus on user-system interaction as a real-life task may provide an important direction for fundamental research, since

> there is no sense in which we can study cognition meaningfully divorced from the task contexts in which it finds itself in the world (Landauer 1987: 19)

It is clear in this respect that the investigation of user-adviser talk in Chapter four represents an instance where the study of applied problems - in this the the almost intractable problem of providing system-based help to users - may provide findings for disciplines which study the nature of interaction in 'institutional' contexts. Although it is not claimed that the investigation in chapter four represents in any way a complete conversation analytic study of 'talk between computers users and human advisers in system-present situations', it is clear that a rigorous study of such situations will provide knowledge about the role that interactive artefacts play in communicative contexts, and the ways in which, if at all, does such communication display regular and systematic features.

In summary, the use of conversation analysis and its assumptions, methods, and findings in HCI research and design, is a fruitful and methodologically sound course to pursue.

Appendices

Appendix 1

Description of the Database

This appendix contains details of the data on which Chapter four is based, describing the users who participated, hardware and software used, and video-recording equipment.

1. Users

All users were of similar socio-economic status, educated to at least postgraduate level, from various regional backgrounds.

User A

Female, mid forties. Background in social sciences, health care and social skills training. No previous computing experience of any kind. A found many of the demands of learning interactive computing difficult and frustrating, although over several months she was to become proficient with the use of interactive systems and had started to write interactive HyperWare.

User B

Male, mid twenties. Computer science background and considerable experience of programming environments. B authored one of the in-

teractive systems shown in the recordings. Frequent user of complex software environments and word processing applications.

User C

Male, late forties. Considerable systems analysis and design, and extensive research experience. Frequent user of DTP systems.

User D

Female, mid thirties. Social science and information technology background. Limited computing experience with some programming and systems design experience. Occasional user of DTP interactive environments.

User E

Male, mid twenties. Mathematics/computer science background. Extensive experience of programming and systems design in a variety of languages and environments. Frequent user of DTP software with several years' experience in commercial software design.

User F

Male, mid-twenties. Computer science background. Extensive experience of many programming languages, environments and software systems. Experience of systems management and frequent user of DTP software.

2. Hardware and software used in the recordings

2.1 Hardware

Apple Macintosh SE. running Finder/System version 5.

Sun 2/50 workstation.

Apple Macintosh IIcx (colour) running Finder/System version 6.

2.2. Software[1]

HyperCard, version 1.1.

SoundEdit, version 1.

Microsoft Word, version 3.01.

AppleScan, version 1.0.2.

Smalltalk80, version 2.

TDL (*Task Definition Language* implemented in SmallTalk80, author Mike Thornton, University of Hull 1988).

DoubleView (University of York, Department of Computer Science).

3. Recording Equipment

Single VHS Panasonic NewViCon A1 Camera with timestamping to 60ths second. Panasonic VHS NV-180 portable recorder. Maxell EX180 3 hour videotapes.

---

[1]Microsoft® is a registered trademark of Microsoft Corporation. Apple® and Macintosh® are registered trademarks, and HyperCard™ and HyperTalk™ trademarks of Apple Computer Inc. Smalltalk80™ is a trademark of Xerox Corporation.

4. Database

The database consists of 15, 3 hour videocassettes, recorded during late 1988 and early 1989. The 15 videotapes form an appendix to this study. The users are shown using systems in completely iuncontrolled settings: the videorecording equipment was placed in whatever location they were at work and was intended to capture their current activity. The transcripts of the talk between users and adviser in Appendix 3 were collected from these recordings, and the talk which they represent was similarly uncontrived. The author appears as adviser in a number of the transcripts.

These transcripts, fragments of which appear in Chapter four, are numbered in the format *tape number (segment number) (hour): minute: second*. Due to the completely uncontrolled nature of the recording sessions - users were not required to complete any specified task in any time limits - some of the tapes contain less than 3 hours recording. The breakdown of the tapes is as follows

Tape 1: user A

Tape 2 : user A

Tape 3: user A

Tape 4: user A

Tape 5: users B, C

Tape 6: users B, C

Tape 7: users B, C

Tape 8: user D

Tape 9: user D

Tape 10: user D

Tape 11: user D

Tape 12: user D

Tape 13: user E

Tape 14: user E

Tape 15: user F

Appendix 2

Transcription Conventions

These are a slightly adapted form of the standard transcription conventions developed by Gail Jefferson, as described in Schenkein (1978: xi-xvi).

Items of interest are indicated by arrows in the left margin:

→A: show me what's it done
B: don't know

Speaker identities are indicated in the left margin, U representing user and A, adviser:

U: I can't get the animation to work at all now
A: What's the problem

Features of pronunciation are indicated impressionistically through modified orthography:

A:you've gotta create the buttons first
U: what I did wuz wuz

Occasionally they may be indicated through phonetic transcription:

A: you've des- you've [deskrIb?d] it haven't you=

Shortening of words is indicated by dashes:

U: it's the w- it's the way

Lengthening is indicated by colons:

U: o::h

Emphasis is indicated by underscoring:

A: yep <u>wait</u> <u>for</u>

(7) Severe emphasis is indicated by capitalization and underscoring:

U: -<u>CUT</u> <u>FIELD</u>

Pauses are indicated inside parentheses. A stop inside parentheses indicates a very short pause (less than 1/10th of a second):

A: yep ( ) wait (.) for (.) how

Unmeasured short pauses are indicated by empty parentheses:

U: e:::r ( ) is three seconds ( ) five seconds ( ) three seconds

Longer pauses are approximated in seconds:

U: y'c'n set the style of the card
(20.00)
A: I know what to do with it

Whispered or very quiet speech is contained in superscript degree marks:

U: °show (.) card (.) button ( ) chicken and chips°

Speech which could not be described accurately is enclosed in parentheses:

A: =yep ( ) (in the) message box

Speech which was untranscribable is represented by stops enclosed in parentheses, each stop representing a syllable:

A:°play (...) repeat if the sound is done then wait fifty
(.....) end if° ( ) oh yes

Continuous (non-overlapping speech) is prefixed and suffixed by an equals sign:

U: that's the first one ( ) cos that one ends there ( ) but I'm actu-
ally getting stuck inside there 'cos it's doing=
A:=°if the sound is done°=

Overlapp*ing* speech is indicated by the start of the overlap inserted with a bracket into the overlapp*ed* speech:

U: wait until this sound is done before it does this ( ) then it got
stuck in there somew[here
A: [does ( ) the sound ( ) does the sound know

In cases of ambiguity, the end of the of overlapp*ed* speech is indicated in the overlapp*ing* speech by a slash:

A: = yeah its not a bu- ( ) as long as you don't call two buttons
the same name like you can call a fie[ld ( )/
U: [we'll try it then/

Actions performed concurrently with the speech are indicated inside square parentheses:

U: now do it again [U selects from menu] ( )
[confirmation window appears] yes [U selects *yes*]
[*yes* is not selectable]
U: oh no ( ) I don't believe this

Features such as inbreaths are indicated by *.hhh* and *hhh* respectively:

U: o:::h.hhh ( ) go away ( ) Michael what I want to actually do is collapse that

Appendix 3

Transcripts of User-Adviser Talk

10 (2)17:30.

U: I can't get the animation to work at all now
( )
A: What's the problem
( )
U: don't know
( )
A: show me the script [opens script box]
( )
U: I've more or less ( ) I've copied it more or less ( )apart from ( ) the obvious bits from the other animation I've done and it's just not working ( )
and I just can't figure out -why

A: -well ( ) e:::rm ( ) °choose select tool ( ) domenu select all (.....)° show me again ( ) show me what it does
( )
U: what it's supposed to do is take the image and move it( ) its the only image on the card level
( )
A: it's on the card is it=

U:= yeah

10 (2) 06:05.

U: I still can't figure out why this bloody s- (.) thing won't work
( )
A: right okay ( ) he::rm
( )
U: that [points at text] is ( ) the script of a button ( ) e::rm that that works ( ) well you've just watched it really ( ) you know ( ) well anyway it works ( )
and this -won't

A: -I had this problem before with Janet °she got in the script ( ) can't remember now why something to do with what she'd drawn ( ) either where she'd put it or how she'd drawn it ( ) an I can't remember what it was ° ( ) the thing is to go through the steps one by one ( ) right so ( ) choose select tool [does] ( ) and then ( ) type ( ) domenu select all [does]
( )
U: °then domenu select°=

A: =yep ( ) °(in the)° message box

[goes on to execute script by hand]

A: do ( ) just do drag from ( ) what first (place) [beep from machine] you have to place the cursor [A points to the screen] select it all [does] yep
( )
A: ahhh ( ) well its because you haven't
( )
U: I -haven't got the cursor properly placed ( ) I haven't got the mouseloc/

A: - its something to do with/ ( ) yes ( ) it's something o do with you've got the positions wrong ( ) you need to get ( ) I don't know ( ) wha- ( ) is that ( ) are they two mouse locations
( ) what are they at the top=

U:= that's the mouseloc ( ) so [types instruction] °three seven five ( ) two nine five° slightly different
( )
A: Janet had this problem I remember her doing the same thing ( ) and she yeah it just dragged part of the image off ( ) and I can't remember how she
fixed it but it - was

U: - I'll try changing th - e er cursor positions

A: it was something to do with the cursor positions=

U: =°ye I'll try that°

[changes code]

U: ah ( ) I've moved the cursor and it's doing it
( )
A: so you moved the location of it
( )
U: yeah

8(4)41:45.

U: Pete ( ) I'm stuck inside a repeat ( ) construct again ( ) is there any way I can get in it again other than b-y

A: show me what it's done
( )
U: I'm stuck inside the repeat=

A: = well what's its doing what's it doing=

U: it's just going round and round now ( ) it's not doing anything
( )
A: °how did you do that°
( )
U: it's quite easy I do it fairly regularly
( )
A: °get you out of it° [hits keys]
( )
U: what did you do what did you do then

( )
A: command ( ) full stop
( )
U: right=

A: = stops ( ) execution of anything that's going o-n

U: right-t

A: show me where the problem is
( ) its on the-ca-rd

U: card ( ) I'll be able to work it out ( ) don't tell me it's good exercise for me
( ) I'm nesting them you see its getting a bit ( ) y'know
( )
A: exit repeat [points]

U: that's the first one ( ) cos that one ends there ( ) but I'm actually getting stuck inside there 'cos it's doing=

A:=°if the sound is done°=

U: that ( ) then it got stuck inside here [points]
I want it to wait until this [points] sound is done and then it does this ( ) an then I want it to wait until this sound is done before it does this ( ) then it got
stuck in there somew here

A: does ( ) the sound ( ) does the sound know ( )
what oh yeah ( ) I don't know I've never used the sound before =

U: =it's a function that checks ( ) whether there's ( ) any noise ( ) any sound ( ) .hhh an if there is no sou nd

A: ° play (...) ° repeat if the sound is done then wait fifty (.....) end if
( ) oh yes ( ) it just ( ) as soon as the sound finishes ( ) you're waiting fifty ( ) doing that it goes back to the repeat loop if the sound is done ( ) it's still done cos it was done last time round wasn't it ( ) you don't want a repeat construct you just want an if construct
( )
U: no repeat in here=

A: = I don't think so ( ) well why would you want to repeat it
( )
U: well to keep checking if the sound is done

1 (1) 10:48

U: I've tried the button up on prawn cocktail on prawn cocktail ( ) so it does that [selects]
( )
A: that's fine=

U:= which is fine the trouble is ( ) ° go back° [selects menu item] you've then got a problem with the other button scripts
( )
A: why

( )
U: I mean- I'll show you ( ) hang on a minute ( ) because °(...)° what I did you see ( ) there's the button ( ) the other button ( ) here's the menu ( ) on the menu [opens button script] ( ) y' y' y' remember you put show card button ( ) that means y'v got to- get it to show all the card buttons haven't you
( )
A: well you just d- o

U: - if you've got a list ( ) how do you do that 'cos it di - dn't it wouldn't take it

A: put them all in
( )
U: it didn't it wouldn't accept that =

A: = well if will it won't if the buttons aren't there ( ) you've gotta create the buttons first=

U:= I have ( ) I had the buttons but it wouldn't=

A: = well just put them ( ) put both the menus in do show card button cocktail ( ) show card button whatever else=

U: = on a just ( ) an on you need the whole thing [points]
again ( ) - that's what I didn't do right that's what I wa- s

A: just do it it won't take more than one argument ( ) if you say show card button ( ) it's only referring to one ( ) you can't say show card button ay bee cee and dee
( )
U: °yeh° also I realised I've got prawn cocktail [points] so if you think it ( ) I've just called it cocktail ( ) to do you think that it's better than repeating the name
( )
A: doesn't make any odds ( ) call them ay bee cee if you like it doesn't know the difference () it's pretty stupid it doesn't know ( ) as long as you don't call things the same name ( )
that's alr - ight ( ) °then it gets (.....)°

U: well that's what I mean it is the same name ( )prawn cocktail=

A: = yeah its not a bu- ( ) as long as you don't call two buttons the same name like you can call a fie - ld ( )/ you can call a field and a button the same name cos

U: we'll try it then/

A: they're not the same kind of object
( )
U: yeah ( ) I'm with you
( )
A: you see the only thing it knows about is - (.....)

U: - an then you just do it on the return like that and then undern - eath [types] show (.) card (.) button ( ) oh what about cock- it better not be

A: yeah

U: capitals huh

( )
A: doesn't matter doesn't know any difference ( ) whether it's upper or lower case ( ) it just reads it

( )
U: [types] °show (.) card (.) button ( ) chicken and ch- ips°

A: a::h ( ) no ( ) it'll have to be one word ( ) oh did it say pr- ( ) did it show prawn cocktail as one ( ) two words
( )
U: o::h
( )
A: did it do show ( ) did it do it alright
( )
U: I don't know ( ) it probably didn't 'cos I altered it
( )
A: y'see the usu- sal

U: I think I think I did it as one before it's just with redoing it=

A:= the usual th- ing is to capitalise the separate word [points] so you'll have capital

U: yes I did it as one there

A: cee prawn cocktail yeah=

U: = yeah=

A:= so you can see personally what the difference is between the two words
( )
U: ah I see chicken and chips has to be o- ne

A: as like when you do mouse down [points] they only put the capital dee so you can see it's a se- perate word yeah

U: a::h ( ) I see ( ) I'll leave it as chicken anyway that

( )
A: yeah call it whatever you want

1 (2) 13:33.

A: I think that text is too close to that menu=

U: so do I ( ) but what am I going to do about it 'cos I can't get them both on=

A:= yes you can you can make that text ( ) format that field so that the text is justified

U: yeah

A: and make the field smaller ( ) so it'll ( ) be slightly ( ) °longer° ( ) yeah
( )
U: what ( ) you said that without moving your lips [opens field and looks at options]

A: °you can't do that why can't you do that°

1 (3) 04:07.

U: can you put a del┌ ay
A: └ yeah wait ( ) it's wait=
U:= is it wait ( ) right
( )
A: wait (.) for ( ) [U types] I don't know what the measurement is ( ) have to look in the help ( ) it's usually measured in ticks [U opens help information] go to commands ( ) hypertalk commands
( )
U: where is i┌ t
A: └ right hand side
( )
U: pardon=

A:=top of the right hand column ( ) should be right at the end ( ) yep ( ) wait (.) for (.) how many seconds you want
( )
U: e:::r ( ) is three second┌ s ( ) five seconds ( ) three seconds
A: └ alright

1 (3) 33:03

U: you know this idea of the the- mouse accidentally getting into that field and flipping to the next one ( ) was there something do you say you could put into the field °to stop it doing that° ( ) or do you reckon °·(it's a)° problem ( ) could you put it on a card
( )
A: what you have to do is ( ) map out the region contained by the newspaper [points]right
( )
U: ye::ah
( )
A: and then map out the region ( ) of the button with the spyglass on it ( ) and say ( ) if the location ( ) of the button ( ) is inside the location of the newspaper ( ) then you can go to he next card otherwise don't
( )
U: aha ( ) so I need the mouselock
( )
A: no you need regions ( ) you need the regions

2 (1) 05.00.

U: If I wanted these doors ( ) well I won't say open cos perhaps that's getting a bit too fancy () just to:: ( ) open ( ) ayeee:: for a space to clear - °(on this bag)°

A: °(...)°

U: when I do this right=

A: =°ha::::hm°

( )

U: an c' ( ) could I:: ( ) make this bit of field ( ) and then do ( ) and do a ( ) kind of select thing on it (-) °(and do a)° select all

A: °ahm:::::::°

U: -CUT ( ) FIELD °(...)°

A: -(just like) ( ) (no) ( ) just have a field ( ) and make that field hidden ( ) an when you want the doors to open ( ) just show it

( )

A: create a field that - size ( ) and - hide it ( ) yeah ( ) an in the script of the card

U: -yeah -yeah got it

A: put hide card field ( ) whatever ( ) doors=

U:= yeah ( ) yeah hang on a minute ( ) yeah=

A: an when you do whatever you're going to do with it ( ) to show card field doors

( )

U: right:: ( ) so::=

A: = °an opaque field°=

U: = °(....)°=

A: = with no lines

( )

U: there's the field ( ) oh ( ) ah ( ) oh ( ) hm mm what's happened ( ) what is that ( ) that's cos there already is a field there ( ) for the buttons ( ) may - ( ) maybe we could use that to do both ( ) yes ( )

A: °(....)°

2 (1) 19:41.

U: pete:::::::=

A: = yeah=

U: = if you've got an open card thing ( ) can it have ( ) a mousewithin between those °(points)° between the opencard and closecard

( )

A: what ( ) an on mousewithin °(..) handler° =

U: = yeah

( )

A: no (-) y' can't think about it ( ) each (-) think about the nature of the

U: - no:: no::::: ( ) no::::::

A: things you're doing ( ) each ( ) <u>on</u> °(...)° statement (-) represents how

U: mmm:::::

A: that ( ) s:: structure ( ) the <u>card</u> ( ) is gonna interpret some message ( ) right =

U: = yeah=

A: = so ( ) an on opencard means ( ) <u>for</u> this card=

U: =yeah =

A: how do you want to interpret the message opencard=

U: = yeah =

A: = right ( ) which means that ( ) for every message it want to receive it has to have a separate handler ( ) it wont let you do it inside ( ) there's no point in doing it inside

[section omitted - continue on same problem of doors and writing the script to crate the illusion of opening bank doors]

U: in which case it getting very difficult to do ( ) because if you want the field to be <u>hid</u> ( ) on the card ( ) you then can't get in it ( ) on the mousewithin ( ) cos the card's telling it to stay hidden

( )

A: <u>no</u>

<u>( )</u>

U: but it was doing just then ( ) that's why I've just asked it t - o

A: think about it ( ) you're giving instructions to the <u>field</u>

( )

U: yeah:::: (rising tone)

( )

A: y' c'n
U: so hang on a minute I'll
A: tell the card to hide the field ( ) ye ah
U: yeah just °(...)°
A: and tell the other thing you're doing to open ( ) to <u>show</u> the field ( ) y' c' n
U: yeah ( ) didn't work ( ) that's what I'm sayi ng
A: well it should've done
U: an I'll I'll go back I'll go back I've probably got myself very confused again ( ) now cos I've been doin about three things at once °(.....)° that's what ( ) but it won't work on the ( ) let's see °(.....)° yeah on the card y' see the ( ) <u>hide</u> it=

A: = m::::::=

U:= an it then had on mousewithin <u>show it</u> (-) an then it cant do it cos

A: °(...)°

U: there's not a field available for it to go mousewithin ( ) see what I mean ( ) I've already realised the logic of that ( ) if y ou put ( ) on °(.....)°

A: show me what you tried to do=

U: = hang on a minute =

A: =go back to the =

U: = no ( ) yeah ( ) what I'm trying to do ( ) look it'll stay here cos I'm not instructing it to not tell it to ( ) <u>on the card</u> ( ) on look the °(.....)° erm::::: ( ) what I did was put ( ) on open<u>card</u> ( ) put °(.....)° but it doing it anyway now ( ) and then I put on mouse<u>enter</u> ( ) show it right =

A:= right =

U: but of course the mouse can't enter anything that isn't there ( ) it isn't there

( )

A: no but what you wanna do is ( ) say ( ) well yes you can ( )even if you've hidden ( ) y' c'n sti- ll

U: - well it didn't ( ) that's what I'm saying ( ) see look it doesn't even show up as a field cos its hidden

( )

A: °that's true°

( )

U: see ( ) that's what I suddenly realised I can't tell you °(....)° I can get it off the card so what if - not °(...)° I thought - I thought I cancelled it

A: - alright °well°

U: off the card script in that case why is it still hiding it ( ) that's funny ( ) why isn't it showing now then it not on the ser- ( ) it not on the card script now to hide it (O wonder why it won't show it °(.....)° I'll do it [U types] sho:::w:::: ( ) uhh::::::: ( ) there it is there but why wont it show it °(....)° don't want a field to hide it ( ) don' you

( )

A: what is it you're trying to do

( )

U: jus to get it to look as though the doors have opened and the money and the money - goes in there

A: + what exactly ( ) what is it ( ) you're picking up that bag up =

U: = that's the money in the bag [U does]

( )

A: well why don't you sa- y

U: - its supposed to jump back but it isn't doing that now the one thing that I did have working and its screwed it up now but never mind I can go back and sort it out °(...)° sorry its got an instruction to go next °(.....)°

( )

A: well why don't you do it the other way round why don't you have a field ( ) that's got the doors on ( ) have a button right- which is the size of the

U: -hmm::::

A: doors =

U:= °to do that yeah°=

A: = and then show something °so it looks as though the doors opened° and now you can say ( ) do it the other way round instead of hiding it to start with show it to start with and hide it afterwards ( ) right

( )

U: yeah (falling tone)

( )

A: put a button here [A points] put a field ( ) right=

U: = it- it- it's there () as you moved ( ) the- the- this is what I can't understand you've got to do it ( ) is it showing it °(...)° its when you try to get rid of the bloody thing ( ) wait a minute ( ) it ( ) isn't showing it isn't it =

A: = °(.....)°

( )

U: now why has it done that

( )

A: °(.....)°

( )

U: no::::::::::::::::::

( )

A: alright well ( ) put the ( ) °(.....)°

U: °wonder why it isn't showing it °

(They create and position a button over the image of the bank doors)

A: you see =

U: = I get you I get yo u

A: yeah works the other way round ( ) °effectively° ( ) <u>also</u> ( ) what you could do is ( ) don't bother with a button ( ) just have a field and change the property of it ( ) change its opaque property =

U: = that's just I was just thinking that yeah=

A: = so set the property ( ) on mouseenter set the property ( ) set the ( ) whatever the syntax is ( ) set the property opaque of this button to true ( ) right ( ) or transparent to true so that removes the need to have a field in the first place °(.....)°

U: yeah hm:::::::::: I was thinking that when you were saying that about buttons you don't really need both ( ) you seldom need a button <u>and</u> a field ( ) you know what I mean

2 (1) 1:29:24

U: why is it when you tell it to choose a tool and then tell it to wait ( ) it won't choose the tool ( ) all it does is go onto the wait °and the clock° it won't choose the tool ( ) I've got the card ( ) script you see ( ) on the put choose pencil
tool wait sixty second - s °(...)°

A: - why do you want it to wait=

U:=because I want it to go back you see ( ) I don't want it to be all the time ( ) d'you know what I mean
( )
A: what do you want to do with choosing and
then wait - ing what do you want to do with the tool

U: - well
( )
U: I want them to be able to have a chance to draw with it
( )
A: yeah
( )
U: y'see ( ) and obviously this is th pencil tool ( )press that [mouseclick on button] and go to the next thing( ) and then have a pencil that you can draw with ( ) right and I don't want them to stick on that ( ) I want them to be able to undo it as well=

A: =undo what
( )
U: what they've drawn ( ) right ( ) an then go on
( )
A: undo what they've drawn ( ) you want them to undo it explicitly=

U: that's right yeah ( ) well ( ) it to be undone yes
( )
A: well you can I don't think you'll be able to do that what you'll have to do is ( ) e::rm ( ) if you do wait ( ) wait means it can't do any action at all
( )
U: a::ha:- :

A: - right it means you can't draw either
( )
U: °I se - e°

A: - so what you want to do is say ( ) something like ( ) erm ( ) °I don't know what you wanna do actual- ly°

U: - no I - I

A: - well I can think of various ways of doing it which are complicated but one way of doing it would be to do ( ) this ( ) hang on [A takes keyboard]

[sequence of various attempts to solve the problem by A]

U: would a field work do you think
( )
A: I think it would be the same

2 (3) 25:43

U: can you just ask it to delete (text)
( )
A: °(delete text)°
( )
U: I was just thinking y'see on open- ( ) y'see ( ) I created a field for then in which they can typ- e ( ) then ( ) then if I can get it so that they move on - ( ) so that on opencard again

A: - right

A: - yeah

U: that's been deleted so nothing's left so that they can start again ( ) d'you see what I'm saying ( ) right ( ) do you just put delete is is the instruction delete text in card field=

A:= yes well erm ( )there will be a property ( ) or something I would imagine=

U:= °look in the commands and that under help°
( )
A: do what
( )
U: do you think it would be best to see ( ) go to the help sta - ck

A - yeah have a look=

U:= and have a look right

2 (3) 35:39

U: do you think you can choose ( ) °you can't really choose can you° it won't have delete
( )
A: we - ll

U: - I can see how you do it ( ) I really can but I can't think what you do ( ) ° I couldn't read anything in the help instructions that y'know tells me how y'know ( ) °(....)° y'know delete what ( ) y'see what I mean I've put delete e::rm ( ) text ( ) and I don't think it wa- ( ) perhaps that wasn't what it wanted

(20.00) [A looks at help information]

U: °y'c'n set the style of the card°
(20.00)
A: (I know what to do with it)=

U:= yeah=

A: just do [A types]

(30.00)

A: there y'go=

U: a:::hhhh
( )
A: put nothing into it ( ) right
( )
U: o:::h brilliant ( ) and you use <u>set</u>
( )

A: no <u>put</u>=

U: = no sorry y' use put I was just thinking that that things I saw ( ) I noticed when you were going through it said things for setting to make it text appear
and thi ngs ( ) weren't there yeah

A: m::::::

3 (2) 51:00

U: what's the best thing to do then is it better to call th two things something different or not copy them or what
( )
A: don't bother about that we'll (..) them later ( ) just take whichever
( )
U: yeah this one's the old one you see ( ) on the hard disk this is open the hard disk if I put the quit
( )
A: what we need's a ( ) I'll think about it later on
( )
U: yeah ( ) oh hell I don't want you to be thinking about it anyway but what I'll do until then Pete ( ) the one that's on the hard disk [points]=

A:=yep=

U: = I'll leave on the hard disk
( )
A: doesn't matter yeah leave it on the hard disk ( ) yeah yeah leave a copy on the the hard disk=

U:= yeah and that's the old-fashioned one ( ) that won't have the cursors that change to nought or anything ( ) that's on the s- ( ) floppy

2 (3)33:00

U: a::h that's what happens Pete
( )
A: what
( )
U: if you release ( ) when you're c- carting this one about ( ) an you've just put one down right= [does]

A: = yeah =

U: and you go back for another one ( ) an if you kind of fiddle with it half way and go back it it it sometimes makes this one go back as well ( ) that's what I did y'know I- the that here with this blooming mouse ( ) me hand slipped a bit the other one [points] and it made the six go back ( ) so its something to do with clicking the mouse up and down n' y'know when you're in the middle of dragging rather than completing the dragging=

A:= it should work for all ⌐ (.....)

U: └ yeah that's what it's about something to do with that=

A: = shouldn't it should just when you et the mouse up ( ) eh go back again do ⌐ it

U: └ yeah it did

( )

A: its something to do with the script the number it's the way it resets the number that's all there's n ⌐ o way it can go back

U: └ yeah

( ) [attempts to move object]

U: if you do it r- ( ) if you do it slow it seems to be better

( )

A: it could be something the way that

( )

U: it's the w- ( ) it's the way that the way it releas- ( ) cos' I can remember that this mouse ( ) is ( ) this mouse and keyboard are a bit buggered

5 (1) 1 07:25

U: what do I need to do=

A: = middle ( ) select that one with the middle button and hold it down

[U does]

A: use the ( ) misc arcs ( ) there's a draw arcs rather than draws one so you can dra ⌐ w

U: └ draw arcs to=

A:= yeah ( ) so you can draw ( ) select [U does] ( ) move onto the other menu and select that one ( ) so that will allow you to draw a number of arcs from that one t ⌐ o

U: └ yeah and how do I do that

( )

A: just select the ones that you are going to draw the arcs to=

U: =by:::( ) the left hand button=

A: = yeah ( ) [does] and back on the original one when you've finished

( )

U: then back on the original one=

A: = yeah
( )
U: okay now ( ) if I want to sel- ect that

A: - select that ( ) you just do a single arcs to ( ) if you like
( )
U: [select move from menu] don't want that
( )
A: just ( ) click the left again ( ) it thinks you're moving it

[U gets wrong button and expands a window]

A: collapse ( ) on the right [U does] its the mi ddle button to draw ar cs

U: on middle - on=

A:= yeah
( )
U: why is that now in a different place
( )
A: well it automatically selects the last
( )
U: you mean it's adaptive
( )
A: °yeah°
( )
U: -hahahahahahahha

A: -hahhhahhahhhha
( )
U: you mean I've got to go back up to there ( ) this is really crazy ( ) right I wanna get that little lot lined up ( ) tidy up [gets menu] ( ) what do I do with that
( )
A: e::rm
( )
U: middle button ( ) format ( ) align

A: yeah y'c'n either align

A: align ( ) align aligns tasks with this one ( ) so you (...) you'd be aligning ( ) tidy up send message and read message for example ( ) if they are out of line=

U: = so if I want to tidy up all of those five together =[points]

A: = then you'd select one of the ones on that there=

U: = right so I'll just ( )one of those and I'll pick up that one ( ) f- ormat ( ) you say

A: - right ( ) select a line
( )
U: well that just says more subtree or align ( ) so I'm gonna select align - (.....) °(....)°

A: - yeah and then pick up those () that's it ( ) if it doesn't move it must be in the right place anyway

( )
U: hoho .huh ( ) wonderful ( ) yeah ( ) an then whadder we do
( )
A: e::r ( ) now ( ) there's a thing ( ) there's a thing to
space the subtasks out as w= ell

U: - well okay

A: but (..) °(..)° you'll have to move that one across o::r ( ) tell you what ( ) if you space
the subtasks o- ut

U: - I'll move this one across ( ) can I move this o - ne acr oss ( )

A: - yeah yeah

U: so what do I do t- o move it across

A: - select it with the middle but - ton

U: - select it with the middle
but - ton

A: - sorry it's still on align at the moment so it's back on the original one

( )
U: middle button ( ) format
( )
A: an it's right hand button to move

[U moves off a menu which remains]

U: I want out of this
( )
A: just click left to get rid of that ( ) right right right - hand button

U: - hold down the button ( ) that
says ( ) move=

A: =yeah ( ) now just move that one across ( ) o:: - :r

U: - ri::ght=

A: = yeah ( ) so now you c'n do ( ) y'c'n space the subtasks of send message
( )
U: °(...)° middle button=

A:= yeah ( ) space subtasks at ten °(...)° then space subtasks of tidy up °(...)°
( )
U: I need it to be more than ten
( )
A: alright well - ( ) yeah

U: - °(try it)°

(.....)

A: you can move that out of the way if you like ( ) put it up in the corner to give you
more room [U selects leftmost branch of tree]

( )
U: move which=

A: the whole thing °(.. - .)°

U: - how (-) select on that/

A: -well ( ) /yeah middle ( ) move subtree [U does] then just click

5 (1) 1 26:33

U: I want to actually highlight those things=

A: =yeah=

U:= so what do I do
( )
A: e::r ( ) you double click somewhere in the word it'll select that word for you [does] ( ) e::r select object with middle button menu ( ) yeah so you've got to make a selection first then select the object °(...)°

[line appears select in lower portion of window]

U: and what's it doing there
( )
A: well er
( )
U: what- what do I do=

A: it- it- nothing now ( ) well that's\ just a side effect to let you know what's happening ( ) it looks it looks through for any ( ) occurrences of mailbox ( ) in the text ( ) but without ( )
[U repeats action]

U: so that's it done ( ) an I just collapse that [does] ( ) where's it gone
( )
A: you need ( ) that's why you need to redisplay ( ) that's the problem

5 (1) 39:05

U: I ca- °(..)° can I ( ) identify a new object can't I=

A: =yeah=

U:= is that rig- ht

A: - it's just message

( )
U: an it's called ( ) [types] message

( )
A: right
( )
U: an if I now hit return ( ) we're now back again (it) it's °(..)° back in there=

A:= but not in the tasks=

U: an what I have to do now is get it through every ( ) (..- ..)

A: -yeah ( ) so find out what ( )
if you say that's going to say somethi - ng

U: - °it's in everywhere we know that°

(.....)

U: what I did wuz ( ) wu - z/

A: - press /return=

U: nope I deleted so there was nothing left in the b - ox

A: - an then you pressed return=

U: = an then pressed return
( )
A: but it should've deleted message then
( )
U: but it thought it had message still ( ) I ( ) I er I
guess ( ) well th - e

A: - that shouldn't be there °(there's something wr - ong)°

U: - alright ( ) I'll ( ) if I
take this thing called read message [drags opened window] ( ) wha - t

A: - °(interesting
isn't it)°

( )
U: but it believes it's unused

(.....)

U: an I'll collapse that ( ) right [collapses window] ( ) an we'll try [opens window] that one ( ) there we are an it's done it in that

5 (1) 40:57

A: no I'; tell you what ( ) try ( ) remove [points at window] °(...)° ( ) you're gonna have to [U collapses window] ( ) no because you've got to re- ( ) identify message now
( )
U: why=

A: because ( ) well [points at screen] open that up again

( )
U: well its obvious as to what the hell we're actually up to here isn't it=

A: °yeah something's going wrong°=

U: =°hm:::°
( )
A: yeah because yeah ( ) it- it still thinks message is in here [points] but it doesn't know it isn't over there [points]
( )
U: - so if I do [selects menu item]

A: - °(.....)° ( ) it won't work because message is already ( ) you'll have to get rid of that first [points] remove the highlighting (on that) first
( )
U: really=

A: °(m:::)°
( )
U: - °(.....)°

A: - yeah because it only picks up- it only picks up things that isn't already highlighted

5 (1) 1:02:07

U: no what do I wanna do now ( ) if anyt - hing

A: °(...)°

[U selects text]

A: yeah ( ) now what you have to do here is ( ) put down a list of the subtasks of this this task
( )
U: yeah ( ) okay
( )
A: so - () otherwise type them in

U: °(....)° [selects at end of text] there ( ) why have you ( ) why have you done it like that
( )
A: 'cos you don't ( ) you don't want that in the er
( )
U: so how do I get rid of it
( )
A: jus- ( ) double click [U clicks] either at the end or at the beginning [U double clicks and selects only one word] [A points] ( ) if you do down ( ) jus- put it in the middle and double click [U inadvertently opens a menu]

U: wh - at [moves off menu]

A: - no

[several attempts to click at end of text]

U: then what do I do
( )
A: just type in whatever you want to type in
( )
U: why have I done that
( )
A: to get rid of that rubbish

Appendix 4

Table 1: Auxiliary Menu 1, *Viewpoint* document editor.

Menu command	*Current system action*	*Proposed change*	*Applicable guideline*
Show Structure	relevant next action	none	none
Show Non-printing with Spaces	relevant next action	none	none
Show Non-printing without Spaces	relevant next action	none	none
Show Style Sheet	relevant next action	none	none
Paginate	no status indicator	provide active indication of status	1
Simple Paginate	no status indicator	provide active indication of status	1
Paginate displayed pages	no status indicator	provide active indication of status	1
Paginate Special Pages	no status indicator	provide active indication of status	1
Prompt for Fields	no response/toggle	provide relevant response	1
Enable Buttons	no response/toggle	provide relevant response	1

Table 2: Auxiliary Menu 2, *Viewpoint* document editor.

Menu command	*Current system action*	*Proposed change*	*Applicable guideline*
Select Table Column	no response	provide relevant next	1
Select Table Row	no response	provide relevant next	1
Subdivide table column	no response	provide relevant next	1
Sort table selection	no response	provide relevant next	1
Refresh Table Lines	no response	provide relevant next	1
Finalise Redlined Revisions	no response	provide relevant next	1
Fill Text Frames	no response	provide relevant next	1
Update Fields	message	none	none
Normalize Text	message	none	none
Set Margin Computation	message	none	none
Set Field/Table Fill-In Order	message, but if repeated action message is repeated	use repeated selection to allow mechanism for resolution of problem or repair of action	1/2
Edit Field/Table Fill-In Order	message	none	none
Set Text Frame Fill-In-Order	message but if repeated action message is repeated	use repeated selection to allow mechanism for resolution of problem or repair of action	1/2
Edit **Text** Frame Fill-In-Order	message	none	none
Go **Next** Page Format **Character**	relevant action	none	none
Go Next Break Character	relevant action	none	none
Go **Next** Footnote Reference	relevant action	none	none
Go **Next Index** Object	relevant action	none	none
Go Next Field	relevant action	none	none
Go Next Fill-In	no response	provide relevant next	1

Bibliography

Aaronson A. and Carroll J. M. (1987) The answer is in the question: a protocol study of intelligent help. *Behaviour and Information Technology* **6**, (4), 393-402.

Agre P. E. (1988a) Writing and Representation. MIT Artificial Intelligence Laboratory Working Paper 315.

Agre P. E. (1988b) The Dynamic Structure of Everyday Life. MIT Artificial Intelligence Laboratory Technical Report 1085.

Agre P. E. and Chapman D. (1986) Abstract Reasoning as Emergent from Concrete Activity. In Michael P. Georgeoff and Amy L. Lansky (eds) *Reasoning About Actions and Plans*. Proceedings of the 1986 Workshop at Timberline, Oregon (Los Altos, C.A.: Morgan Kaufmann) pp. 411-424.

Agre P. E. and Chapman D. (1987a) Pengi: An implementation of a theory of activity. *Proceedings of the American Association for Artificial Intelligence Conference (AAAI'87)*, 268-272.

Agre P. E. and Chapman D. (1987b) From reaction to Participation. MIT Artificial Intelligence Laboratory.

Agre P. E. and Chapman D. (1987c) Indexicality and the Binding Problem. MIT Artificial Intelligence Laboratory.

Agre P. E. and Chapman D. (1988) What are Plans for? MIT Artificial Intelligence Laboratory AI Memo 1050.

Alty J. L. and Coombs M. J. (1980) Face-to-face guidance of university computer users - I. A study of advisory services. *International Journal of Man Machine Studies*, **12**, 389-405.

Alvey (1982) *A Programme for Advanced Information Technology - the Report of the Alvey Committee.* (London: HSMO).

Anderson N. S. and Olson J. R. (eds) (1985) *Methods for Designing Software to Fit Human Needs and Capabilities: Proceedings of the Workshop on Software Human Factors*. Committee on Human Factors, Commission on Behavioural and Social Sciences and Education, National Research Council (Washington DC: National Academy).

Apple (1987) *Human Interface Guidelines: The Apple Desktop Interface.* (Reading, Mass.: Addison-Wesley).

Arden Shakespeare (1988) *Othello.* (London: Routledge).

Argyris C. and Schön D. A. (1974) *Theory in Practice: Increasing Professional Effectiveness.* (London: Jossey-Bass).

Atkinson J. M. (1983) Two devices for generating audience approval: a comparative study of public discourse and texts. In K. Ehlich *et al.* (eds) *Connectedness in sentence Text and Discourse.* (Tilburg, The Netherlands: Tilburg Papers in Linguistics) pp.199-236.

Atkinson J. M. (1984) The 1983 Election and the Demise of live oratory. In I. Crewe and M. Harrop (eds) *Political Communications: The General Election Campaign of 1983.* (Cambridge: Cambridge University Press).

Atkinson J. M. and Drew P. (1979) *Order in Court: The Organisation of Verbal Interaction in Judicial Settings.* (London: Macmillan).

Atkinson J. M. and Heritage J. C. (1984) *Structures of Social Interaction: Studies in Conversation Analysis.* (Cambridge: Cambridge University Press).

Attewell P. (1974) Ethnomethodology Since Garfinkel. *Theory and Society* **1,** 179-211.

Attewell P. and Rule J. (1984) Computing and organisations: what we know and what we don't know. *Communications of the Association for Computing Machinery (ACM)* **27,** (12), 1184-1192.

Austin J. L. (1962) *How to Do Things with Words.* (Oxford: Clarendon).

Baecker R. M. and Buxton W. A. S. (1987) (eds) *Readings in Human-Computer Interaction: A multidisciplinary approach.* (Los Altos, CA.: Morgan Kaufmann).

Bailey W. A. , and Kay. E. J. (1987) Structural Analysis of Verbal Data. In J. M. Carroll and P. P. Tanner (eds) *Human Factors in Computing Systems and Graphics Interface, CHI/GI Conference Proceedings, Toronto, Canada.* (Special Issue of the SIGCHI Bulletin). (New York: Association for Computing Machinery) pp. 297-303.

Bainbridge L. (1979) Verbal reports as evidence of the process operator's knowledge. *International Journal of Man-Machine Studies,* **11,** 411-436.

Bannon L. J. (1986a) Issues in Design: Some Notes. In D. A. Norman and S. W. Draper (eds) pp. 25-29.

Bannon L. J. (1986b) Computer-Mediated Communication. In D. A. Norman and S. W. Draper (eds) pp. 433-452.

Bar-Hilliel Y. (1954) Indexical expressions. *Mind* **63,** 359-76.

Barlow J., Rada R. and Diaper D. (1989) Interacting WITH computers. Interacting with Computers **1**, (1), 39-42.

Barnard P. (1987) Cognitive Resources and the Learning of Human-Computer Dialogues. In J. M. Carroll (ed.) pp. 112-158.

Bauman Z. (1973) On the philosophical status of ethnomethodology. *Sociological Review* **21,** 5-23.

Beattie G. (1983) *Talk: An Analysis of Speech and Non-Verbal Behaviour*. (Milton Keynes: Open University Press).

Belloti V. (1988) Implications of Current Design Practice for the Use of HCI Techniques. In D. M. Jones and R. Winder (eds) *People and Computers IV*. (Cambridge: CUP) pp. 13-34.

Bench-Capon T. J. M. and A. M. McEnery (1989) People interact through computers not with them. *Interacting with Computers* **1**, (1), 31-38.

Benson D. and Hughes J. A. (1983) *The Perspective of Ethnomethodology*. (London: Longman).

Benson D. (1974) A revolution in sociology. *Sociology* **8,** (1), 125-129.

Bijker W. E., Hughes T. P and Pinch T. J. (1987) (eds) *The Social Construction of Technological Systems*. (Cambridge, Mass.: MIT Press).

Blanning. R. W. (1984) Conversing with Management Systems in Natural Language. *Communications of the ACM* **27,** (3), 201-207.

Bobrow D., Mittal S. and Stefik M. J. (1986) Expert systems: perils and promise. *Communications of the ACM* **29,** (9), 880-894.

Bolt R. A. (1985) Conversing with Computers. *Technology Review* 88, (2), 35-43. Also in R. M. Baecker and W. A. S. Buxton (eds) pp. 694-702.

Bowers J. M. (1987) Discourse analysis, Speech Act Theory and Computer Mediated Communication: An Introductory Review. COSMOS Document No. 22 Department of Psychology, University of Manchester, COSMOS Project Coordinator's Office.

Brand S. (1988) *The Media Lab: Inventing the Future at M.I.T.* (Harmondsworth: Penguin).

Briggs P. (1988) What we know and what we need to know: the user model versus the user's model in human-computer interaction. *Behaviour and Information Technology* **7**, (4), 431-442.

Bull P. and Roger D. (1988) The Social Psychological Approach to Interpersonal Communication. In D. Roger and P. Bull (eds) pp. 9-21.

Button G. (1981) Comments on Conversation Analysis. *Analytic Sociology* **1,** (2), D09-S01.

Button G. (1990) Going up a Blind Alley? *Computers and Conversation Symposium,* University of Surrey Social and Computer Sciences Research Group, 25-26 September 1989. To appear in P. Luff *et al.* (eds) *Computers and Conversation Analysis.* (London: Academic Press).

Button G. and Casey N. (1984) Generating Topic: the use of topic initial electors. In J. M. Atkinson and J. C. Heritage (eds) pp. 167-190.

Button G. and Lee J. R. E. (eds) (1987) *Talk and Social Organisation* (Clevedon, Philadelphia: Multilingual Matters).

Buxton W. (1986) There's More to Interaction than Meets the Eye: Some Issues in Manual Input. In D. A. Norman and S. W Draper (eds) pp. 319-337.

Buxton W. Lamb M. R., Sherman D. and Smith K. C. (1983) Towards a Comprehensive User Interface Management System. *Computer Graphics* **17,** (3), 35-42.

Candy L. (1988) Computers and curriculum change: an action research perspective. *Journal of Computer Assisted Learning* **4**, 203-213.

Card S., English W., and Burr B. (1978) Evaluation of Mouse, Rate-Controlled Isometric Joystick, Step Keys and Text Keys for Text Selection on a CRT. *Ergonomics* **21,** (8), 601-613.

Card S. K. and Moran T. P. (1986) User technology: from pointing to pondering. *Proceedings of the ACM Conference on the History of Personal Workstations, Palo Alto, January 1986* (New York: ACM), 183-197.

Card S. K., Moran T. P. and Newell A. (1980) The Keystroke-Level Model for User Performance Times with Interactive Systems. *Communications of the ACM* **23,** (7), 396-410.

Card S. K., Moran T. P. and Newell A. (1983) *The Psychology of Human-Computer Interaction*. (Hillsdale NJ: Lawrence Earlbaum).

Carroll J. M. (1982) The adventure of getting to know a computer. *IEEE Computer* **15,** (11), 49-62.

Carroll J. M. (1987) (ed.) *Interfacing Thought*. (Cambridge, Mass.: MIT Press).

Carroll J. M. and Campbell R. L. (1989) Artefacts as psychological theories: the case of human-computer interaction. *Behaviour and Information Technology* **8,** (4), 247-256.

Carroll J. M. and Thomas J. C. (1982) Metaphor and the cognitive representation of computing systems. *IEEE Transactions on Systems, Man and Cybernetics* **12,** 107-116

Cawsey A. (1989) Explanatory Dialogues. *Interacting with Computers* **1,** 69-72.

Cawsey A. (1990) A Computational Model of Explanatory Discourse: Local Interactions in a Plan-Based Explanation. *Computers and Conversation Symposium,* University of Surrey Social and Computer Sciences Research Group, 25-26 September 1989. To appear in P. Luff *et al.* (eds) *Computers and Conversation Analysis*. (London: Academic Press).

Chang E. (1987) Participant Systems. *Future Computing Systems* **1,** (3), 254-270.

Cherry J. M., Fischer M. J., Fryer B. M. and Stockham M. J. (1989) Modes of presentation for on-line help: full screen, split screen and windowed formats. *Behaviour and Information Technology* **8,** (6), 405-416.

Chomsky N. (1957) *Aspects of The Theory of Syntax*. (The Hague: Mouton).

Cicourel A. V. (1973) *Cognitive Sociology - Language and Meaning in Social Interaction*. (Harmondsworth: Penguin).

Clark H. H. and Schaefer E. F. (1987) Collaborating on contributions to conversation. *Language and Cognitive Processes*, **2**, (1), 19-41.

Colby K., Weber S., and Kraemer H. (1982) Turing-like Indistinguishability Tests for the Validation of a Computer Simulation of Paranoid Processes. *Artificial Intelligence* **3**, 181-198.

Coleman J. (1968) Review symposium on Garfinkel's *Studies in Ethnomethodology*. *American Sociological Review* **33**, 122-130.

Collett P. (1989) Time and Action. In D. Roger and P. Bull (eds) pp. 218-238.

Cook J. and Salvendy G. (1989) Perception of computer dialogue personality: an exploratory study. *International Journal of Man-Machine Studies* **31**, 717-728.

Coombs M. J. and Alty J. L. (1980) Face-to-face guidance of university computer users - II. Characterising advisory interactions. *International Journal of Man Machine Studies* **12**, 389-405.

Coombs M. J. and Alty J. L. (1981) (eds) *Computing Skills and the User Interface*. (London: Academic Press).

Cooper G. (1989) Ethnomethodology: its potential contribution to HCI. In J. Crellin (ed). *Proceedings of the People and Computer Interaction Systems Students' Workshop*. Open University, May 1989. Mimeo.

Cosner L. A. (1975) Presidential Address: Two Methods In search of a Substance. *American Sociological Review*, **40**, 6, 691-700.

Coulter J. (1979) *The Social Construction of Mind*. (London: Macmillan).

Coulter J. (1983) Contingent and A Priori Structures in Sequential Analysis. *Human Studies* **6**, 361-376.

Coulter J. (1985) On comprehension and 'mental representation'. In G. N. Gilbert and C. Heath C. (eds) pp. 8-23.

Coulter J. (1989) *Mind in Action*. (Oxford: Blackwell).

Dagwell R. and Weber W. (1983) System designers' user models: A comparative study and methodological critique. *Communications of the ACM* **26,** 987-997.

Dampier W. C. (1948) *A History of Science and its Relations with Philosophy and Religion.* (Cambridge: CUP).

Diaper D. (1989) Editorial: The Discipline of HCI. *Interacting with Computers* **1,** (1), 3-5.

Douglas J. D. (ed.) (1971) *Understanding Everyday Life.* (London: Routledge and Kegan Paul).

Dreyfus H. L. and Dreyfus S. E. (1986) Why skills cannot be represented by rules. In N. E. Sharkey (ed.) *Advances in Cognitive Science.* (Chichester: Ellis Horwood), pp. 315-335.

Du Boulay B., O'Shea T. and Monk J. (1981) The black box inside the glass box: presenting computing concepts to novices. *International Journal of Man-Machine Studies* **14,** 237-249.

Duncan S. (1972) Some Signals and Rules for Taking Speaking Turns in Conversation. *Journal of Personality and Social Psychology* **23,** (2), 283-292.

Duncan S. and Fiske D. W. (1977) *Face-to-Face Interaction.* (Hillsdale NJ: Lawrence Earlbaum).

Durham T. (1987) Why Computers are Socially Disadvantaged. *Computing,* 4 June, 26-27.

Durkheim E. (1952) *Suicide: A Study in Sociology.* (London: Routledge).

Durkheim E. (1982) *The Rules of Sociological Method.* (London: Macmillan).

Eason K. (1984) Towards the experimental study of usability. *Behaviour and Information Technology* **3,** (2), 133-143.

Edmonds E. (1981) Adaptive Man-Computer Interfaces. In M. J. Coombs and J. L. Alty (eds) pp. 389-427.

Edmonds E. (1982) The man-computer interface: a note on concepts and design. *International Journal of Man-Machine Studies* **16,** 231-236.

Edmonds E. (1987) Good Software Design: What Does it Mean? In H. J. Bullinger and B. Shackel (eds) *Proceedings of the IFIP*

Conference on Human-Computer Interaction (Interact'87). (Amsterdam: Elsevier) pp. 333-335.

Edmonds E. and Guest S. P. (1984) The SYNICS2 user interface manager. In B. Shackel (ed.) *Proceedings of the First IFIP Conference on Human-Computer Interaction (Interact'84).* (Amsterdam: Elsevier), pp. 53-56.

Eliot T. (1963) *Collected Poems 1909-1962.* (London: Faber).

Ericsson K. A. and Simon H. A. (1980) Verbal Reports as Data. *Psychological Review* **87**, (3), 215-251.

Erickson F. (1981) Money Tree, Lasagna Bush, Salt and Pepper: Social Construction of Topical Cohesion in a Conversation Among Latin-Americans. In D. Tanner (ed.)*Georgetown Round Table on Languages and Linguistics 1981: Analysing Discourse: Text and Talk.* (Washington D.C.: Georgetown University Press), pp. 43-70.

Fallside F. and Woods W. A. (1985) (eds) *Computer Speech Processing.* (Englewood Cliffs: Prentice-Hall).

Farooq M. U. and Dominick W. D (1988) A survey of formal tools and models for developing user interfaces. *International Journal of Man-Machine Studies* **29**, 479-496.

Filmer P. (1972) On Harold Garfinkel's Ethnomethodology. In P. Filmer, M. Philipson, D. Silverman and D. Walsh (1972) *New Directions in Sociological Theory.* (London: Macmillan).

Fitter M. (1979) Towards more 'natural' interactive systems. *International Journal of Man-Machine Studies* **11**, 339-350.

Foley J. D. and Wallace V. L. (1974) The art of natural graphic man-machine conversation'. *Proceedings IEEE* **62,** (4), 462-471.

Foster G. (1986) Cognoter: theory and practice of a colab-orative tool. *Proceedings of the Conference on Computer-Supported Cooperative Work.* pp. 7-15.

Frankel R. (1984) From sentence to sequence: understanding the medical encounter through microinteractional analysis. *Discourse Processes* **7**, 135-170.

French P. (1984) Problem Statements and Directives: some aspects of control sequences in infant classrooms. Mimeo, Department

of Language Studies, College of Ripon and York St John, York.

French P. (1985) Review of G. Beattie (1983) *Talk: An Analysis of Speech and Non-Verbal Behaviour on Conversation. Sociological Review* **23,** 1985.

Frohlich D. M. and Luff P. (1990) Applying the technology of conversation to the technology for conversation.*Computers and Conversation Symposium,* University of Surrey Social and Computer Sciences Research Group, 25-26 September 1989. To appear in P. Luff *et al.* (eds) *Computers and Conversation Analysis.* (London: Academic Press).

Fulton M. A. (1985) A research model for studying the gender/power aspects of human-computer communication. *International Journal of Man-Machine Studies* **23,** 369-382.

Gaines B. R. (1978) Man-computer communication - what next? *International Journal of Man-machine studies* **10,** 225-232.

Gaines B. R. (1981) The technology of interaction - dialogue programming rules. *International Journal of Man-Machine Studies* **14,** 133-151.

Gaines B. R. (1984) From ergonomics to the fifth generation: 30 years of human-computer interaction studies. In B. Shackel (ed.) *Proceedings of the First IFIP Conference on Human-Computer Interaction (Interact'84).* (Amsterdam: Elsevier) pp. 3-7.

Gaines B. R. and Shaw M. L. G. (1984) *The Art of Computer Conversation: a New Medium for Communication.* (NJ.: Prentice-Hall).

Gaines B. R. and Shaw M. L. G. (1986a) From timesharing to the sixth generation: the development of human-computer interaction. Part I. *International Journal of Man-Machine Studies* **24,** 1-27.

Gaines B. R. and Shaw M. L. G. (1986b) Foundations of Dialog Engineering: the development of human-computer interaction. Part II. *International Journal of Man-Machine Studies* **24,** 101-123.

Garfinkel H. (1967) *Studies in Ethnomethodology.* (Englewood Cliffs NJ: Prentice Hall).

Garfinkel H. (1974) On the origins of the term Ethnomethodology. In R. Turner (ed.) pp. 15-18.

Garfinkel H. (1983) A conception of and experiments with trust as a condition of stable, concerted actions. In O. J. Harvey (ed.) *Motivation and Social Action*. (New York: Ronald Press) pp. 187 - 283.

Garfinkel H. (ed.) (1986) *Ethnomethodological Studies of Work*. (London: Routledge and Kegan Paul).

Garfinkel H., Lynch M. and Livingston E. (1981) The work of a Discovering Science Construed with Materials from the Optically Discovered Pulsar. *Philosophy of the Social Sciences* **11,** 131-158.

Garfinkel H. and Sacks H. (1970) On formal structures of practical actions. In J. McKinney and E. Tiryakian (eds) *Theoretical Sociology* (New York: Appleton-Century Crofts) pp. 338-366.

Gaver W. (1986) Auditory Icons: Using Sound in Computer Interfaces. *Human Computer Interaction* **2,** (2), 167-177.

Gellner E. (1975) Ethnomethodology: The Re-Enchantment Industry or The Californian Way of Subjectivity. *Philosophy of the Social Sciences* **5,** 431-450.

Gidlow B. (1972) Ethnomethodology - a new name for old practices. *British Journal of Sociology* **23,** 395-405.

Gilbert G. N. (1990) Sociology in machines: applying sociology to software design. *ESRC Social Perspectives on Sofware Workshop*, Oxford, 13-14 January 1990.

Gilbert G. N. and Heath C. (1985) (eds) *Social Action and Artificial Intelligence*. (London: Gower).

Gilbert G. N., Woofitt R. and Fraser N. (1990) Organising computer talk.*Computers and Conversation Symposium*, University of Surrey Social and Computer Sciences Research Group, 25-26 September 1989. To appear in P. Luff *et al*. (eds) *Computers and Conversation Analysis*. (London: Academic Press).

Gittins D. (1986) Icon-based human-computer interaction. *International Journal of Man-Machine Studies* 24, 519-545.

Goffman E. (1955) On Face Work. *Psychiatry* **18**, 213-231.

Goffman E. (1963) *Behaviour in Public Places.* (New York: Free Press).

Goffman E. (1971) *Relations in Public.* (New York: Basic Books)

Goldthorpe J. (1973) A Revolution in Sociology. *Sociology* **7,** 449-462.

Good M. D. (1982) A ease of use evaluation of an integrated document processing system. *Human Factors in Computing Systems, Proceedings of the CHI'82 Conference,* (New York: Association for Computing Machinery), 142-147.

Goodman D. (1987). *The Complete HyperCard™ Handbook.* (New York: Bantam Books).

Goodwin C. (1979) The interactive construction of a sentence in natural language. In G. Psalthas (ed.) pp. 97-121.

Goodwin C. (1981) *Conversational Organisation: Interaction Between speakers and Hearers.* (New York: Academic Press).

Goodwin M. H. (1980) Processes of mutual monitoring implicated in the production of description sequences. *Sociological Inquiry* **50,** (3-4), 303-317.

Gould J. D., Boies S. J., Levy S., Richards J. T. and Schoonard J. (1987) The 1984 Olympic Games Messaging System: A Test of Behavioural Principles of System Design. *Communications of the ACM* **30,** 785-796.

Gould J. D., Conti J. and Hovanyecz T. (1983) Composing Letters with a simulated listening typewriter. *Communications of the ACM* **26,** 295-308.

Gould J. D. and Lewis C. (1985) Designing for Usability - Key Principles and What Designers Think. *Communications of the ACM* **28,** 300-311.

Grosz B. (1987) The representation and use of focus in a system for understanding dialogues. In B. Grosz, K. Sparck-Jones and B. L. Webber (eds) *Readings in Natural Language Processing.* (Los Angeles: Morgan Kaufmann) pp. 353-363.

Guidon R. and Sladky P. (1986) The structure of user-adviser dialogues: is there a method in their madness? *Proceedings of the 24th ACL conference,* 224-230.

Hammond N., Jorgensen A., Maclean A. Barnard P. and Long J. (1983) Design Practice and Interface Usability: Evidence from interviews with designers. *Human Factors in Computing*

Systems, Proceedings of the CHI'83 Conference, Boston, December 1983, (New York: Association for Computing Machinery), 40-44.

Hansen W. J. (1971) User engineering principles for interactive systems. *AFIPS Conference Proceedings.* (New York: American Federation for Information Processing) pp. 523-532.

Hartson H. R., Johnson D. H. and Ehrich R. W. (1984) A human-computer dialogue management system. In B. Shackel (ed.) *Proceedings of the First IFIP Conference on Human-Computer Interaction (Interact'84).* (Amsterdam: Elsevier) pp. 57-61.

Hauptmann A. G. and Rudnicky A. I. (1988) Talking to computers: an empirical investigation. *International Journal of Man-Machine Studies* **28,** 583-604.

Heap J. L. (1980) Description in Ethnomethodology. *Human Studies* **3,** 87-106.

Heath C. (1982) The display of recipiency: an instance of a sequential relationship in speech and body movement. *Semiotica* **42,** 147-167.

Hellman R. (1989) User support: revealing structure instead of surface. *Behaviour and Information Technology* **8,** (6), 417-435.

Henderson D. A. (1986) The Trillium User Interface Design Environment. *Human Factors in Computing Systems, Proceedings of the CHI'86 Conference.* (New York: Association for Computing Machinery), 221-227.

Heritage J. C. (1985) Recent Developments in Conversation Analysis. *Sociolinguistics Newsletter* **15,** (1), 1-18.

Heritage J. C. (1988) Current developments in conversation analysis. In D. Roger and P. Bull (eds) pp. 9-21.

Hill D. R. (1987). Interacting with Future Computers. *Future Computing Systems* **2,** (1), 83-124.

Hiltz S. R and Turoff M. (1981) The Evolution of User Behaviour in a Computerised Conferencing System.*Communications of the ACM* **24,** (11), 739-751.

Hiltz S. R. and Turoff M. (1985) Structuring computer-mediated communication to avoid information overload. *Communications of the ACM* **28,** (7), 680-688.

Hoeker D. G. and Pew R. W. (1980) User input to the Design and Evaluation of Computer-Assisted Service Delivery. Report 4358, BBN Inc, Cambridge, Mass.

Hoffman R. R. (1989) A survey of methods for eliciting the knowledge of experts. *SIGART Newsletter* **108**, 19-27.

Holgate A. (1986) *The Art in Structural Design: An Introduction and Sourcebook.* (Oxford: OUP).

Holton G. (1981) Plenary Session: The Present State of Social Science, Comments on Professor Harold Garfinkel's Paper. *Philosophy of the Social Sciences* **11,** 159-161.

Hooper K. (1986) Architectural Design: An Analogy. In D. A. Norman and S. W. Draper (eds) pp. 9-25.

Hopper R. (1988) Conversation Analysis and Social Psychology as Descriptions of Interpersonal Communication. In D. Roger and P. Bull (eds) pp. 48- 66.

Houghton R. C. Jr. (1984) Online Help Systems: A Conspectus. *Communications of the ACM* **27,** (2), 126-133.

Howard S. and Murray D. M. (1987) A Taxonomy of Evaluation Techniques. In H. J. Bullinger and B. Shackel (eds) *Proceedings of the IFIP Conference on Human-Computer Interaction (Interact'87)* (Amsterdam: Elsevier) pp. 453-457.

Husserl E. (1965) *Phenomenology and the crisis of philosophy.* (New York: Harper).

Hutchins E. L., Hollan J. D. and Norman D. A. (1986) Direct Manipulation Interfaces. In D. A. Norman and S. W. Draper (eds) pp. 87-124.

Innocent P. R. (1982) Towards self-adaptive interface systems. *International Journal of Man-Machine Studies* **16,** 287-299.

Jacob R. J. K. (1983) Executable specifications in the design of a human-computer interface. *Human Factors in Computing Systems, Proceedings of the CHI'83 Conference.* (New York: Association for Computing Machinery), pp. 28-34.

Jaffe J. and Feldstein S. (1970) *Rhythms of Dialogue.* (New York: Academic Press).

Jefferson G. (1974) Error correction as an interactional resource. *Language and Society* **2,** 181-199.

Jefferson (1980) Final Report to the (British) SSRC on the Analysis of Conversations in which "Troubles" ands "anxieties" are Expressed. Report HR 4805/2.

Jefferson G. (1981) The Abominable 'Ne?': A working paper exploring the phenomenon of post-response pursuit of response. Occasional Paper No. 6, Department of Sociology, University of Manchester.

Jefferson G. (1984) On stepwise transition from talk about a trouble to inappropriately next-positioned matters. In J. M. Atkinson and J. C. Heritage (eds) pp. 191-221.

Jefferson G. (1987) On exposed and embedded correction in conversation. In G. Button and J. R. E. Lee (eds) pp. 86-99.

Jefferson G. (1988) Preliminary Notes on a Possible Metric which Provides for a 'Standard Maximum' Silence of Approximately One Second in Conversation. In D. Roger and P. Bull (eds) pp. 166-197.

Jefferson G. and Lee J. R. E. (1984) The Rejection of Advice: Managing the Problematic Convergence of a 'Troubles Telling' and a 'Service Encounter'. *Journal of Pragmatics* **5,** 399-522.

Jefferson G. and Schenkein J. (1977) Some Sequential Negotiations in Conversation. *Sociology* **11,** 87-103.

Jones J. and Millington M. (1988) Modelling UNIX Users with an Assumption-based Truth Maintenance System: Some Preliminary Findings. *Workshop on Reason Maintenance Systems and Their Applications,* Leeds University, April 1988.

Jordan B. and Fuller N. (1975) On the Non-Fatal Nature of Trouble: sense-making and trouble-management in *lingua franca* talk. *Semiotica* **13,** 1-31.

Kieras D. and Polson P. G. (1985) An Approach to the Formal Analysis of User Complexity. *International Journal of Man-Machine Studies* **22,** 365-394.

Kruesi E. (1984) The Human Engineering Task Area. *IEEE Computer* **16,** 86-93

Kuhn T. A. (1970) *The Structure of Scientific Revolutions*. Second Edition. (Cicago: University of Cicago Press).

Lakatos I. (1974) Falsification and the Methodology of Scientific Research Programmes. In I. Lakatos and A. Musgrave (eds) *Criticism and Growth of Knowledge*. (Cambridge: Cambridge University Press) pp. 91-196.

Landauer T. K. (1987) Relations between Cognitive Psychology and Computer System Design. In J. M. Carroll (ed.) pp. 1-25.

Lang K. N., Lang T. and Auld R. (1981) Support for users of operating systems and applications software. *International Journal of Man-Machine Studies* **14**, 269-282.

Latour B. and Woolgar S. (1979) *Laboratory Life: The Social Construction of Scientific Facts*. (Beverly Hills, Calif: Sage).

Lave J. (1988) *Cognition in Practice*. (Cambridge: Cambridge University Press).

Law J. (1974) Review of *On The Beginning of Social Inquiry* (P. McHugh *et al.*) *Sociological Review* **22**, pp. 433-434.

Lehnert W. G. and Ringle M. H. (eds) (1983) *Strategies for Natural Language Processing*. (Hillsdale NJ: Lawrence Earlbaum).

Leiter K. (1980) *A Primer on Ethnomethodology*. (London: Oxford University Press).

Levinson S. (1978a) Some Pre-Observations on the Modelling of Dialogue. Draft Mimeo, University of Cambridge.

Levinson S. (1978b) Activity Types and Language. Draft Mimeo, University of Cambridge. Also *Pragmatics Microfiche* **3**, (3-3), May 1978, D1-G5.

Levinson S. (1983) *Pragmatics*. (Cambridge: Cambridge University Press).

Livingston E. (1987) *Making Sense of Ethnomethodology*. (London: Routledge and Kegan Paul).

Lorenz K. (1963) *On Aggression*. London: Methuen.

Lund M. A. (1985) Evaluating the user-interface: a candid camera approach. *Human Factors in Computing Systems, Proceedings of the CHI'85 Conference*. (New York: Association for Computing Machinery), 107-113.

Mack R. L., Lewis C, and Carrol J. M. (1983) Learning to use word-processors: problems and prospects. *ACM Transactions on Office Information Systems* **1,** 254-271.

Maguire M. (1982) An evaluation of published recommendations on the design of man-computer dialogues. *International Journal of Man-Machine Studies* **16,** 237-261.

Malone T. W. (1982) Heuristics for designing enjoyable user interfaces: lessons from computer games. *Proceeding of the Human Factors in Computer Systems Conference,* Gaithersburg. (Gaithersburg: National Bureau of Standards).

Martin J. (1967) *The Design of Real-Time Computer Systems.* (Englewood-Cliffs: Prentice-Hall).

Maynard D. (1980) Placement of Topic changes in Conversation. *Semiotica* **30,** 263-290

McHugh P., Raffel S., Foss D. C. and Blum A. F. (1974) *On the Beginning of Social Enquiry.* (London: Routledge).

McTear M. (1985) Breakdown and repair in naturally occurring conversation and human-computer dialogue. In G. N. Gilbert and C. Heath (eds) pp. 104-123.

Meeks B. N. (1985) An overview of conferencing systems. *BYTE* **10,** (13), 169-184.

Merritt M. (1977) On questions following question in service encounters. *Language in Society* **5,** 315-357.

Moerman M. (1988) *Talking Culture.* (Philadelphia: University of Pennsylvania Press).

Moerman M. and Sacks H. (1971) On "Understanding" in the Analysis of Natural Conversation. In M. Moerman (1988) pp. 181-186.

Moran T. P. (1981) The Command Language Grammar: A representation of the User Interface of Interactive Computer Systems. *International Journal of Man-machine Studies* **15,** 3-50.

Mosier J. N. and Smith S. L. (1986) Application of guidelines for designing user interface software. *Behaviour and Information Technology* **5,** (1), 39-46.

Moto-Oka T. (1982) *Fifth Generation Computer Systems*. (Amsterdam: North-Holland).

Murray D. and Bevan N. (1984) The social psychology of computer conversations. In B. Shackel (ed.) *Proceedings of the First IFIP Conference on Human-Computer Interaction (Interact'84)*. (Amsterdam: Elsevier) pp. 268-273.

Myers B. (1985) The Importance of Percent-Done Progress Indicators for Computer-Human Interfaces. *Human Factors in Computing Systems, Proceedings of the CHI'85 Conference, San Fransisco, April,* (New York: Association for Computing Machinery), 11-17.

Mylopolous J., Bernstein P. and Wong H. (1980) A language facility for the design of interactive database-intensive applications. *Transactions on Database Systems* **5,** 185-207.

Newman W. M. (1988) The Representation of User Interface Style. In D. M. Jones and R. Winder (eds) *People and Computers IV*. (Cambridge: CUP) pp. 123-137.

Nickerson R. S. (1976) On Conversational Interaction with Computers. In R. M. Baecker and W. A. S. Buxton (eds) pp. 681-693.

Nickerson R. S. (1981) Some characteristics of conversations. In H. J. Bullinger and B. Shackel (eds) *Man-Computer Interaction: Human Factors Aspects of Computers and People*. (London: Sijhoff and Nordhoff) pp. 53-65.

Nisbett R. E. and Wilson T. D. (1977) Telling more than we can know: verbal reports of mental processes. *Psychological Review* **84,** (3), 231-259.

Norman D. A. (1983) Design Rules Based on Analyses of Human Error. *Communications of the ACM* **26,** (4), 254-258.

Norman D. A. (1986) Cognitive Engineering. In D. A. Norman and S. W. Draper (eds) pp. 31-61.

Norman D. A. (1987) Cognitive Engineering - Cognitive Science. In J. M. Carroll (ed.) pp. 325-226.

Norman D. A. (1988) *The Psychology of Everyday Things*. (New York: Basic Books).

Norman D. A. and Draper S. W. (1986) (eds)*User Centered System Design*. (Hillsdale N. J.: Lawrence Earlbaum).

Norman K. L. and Chin J. P. (1989) The menu metaphor: food for thought. *Behaviour and Information Technology* 8, (2), 125-134.

Oldman D. and Drucker C. (1985) Can humans and computers form a society? The irreducibility of ethnoemethods. In G. N. Gilbert and C. Heath (eds) pp. 155-159.

Olsen D. R. (1983) Automatic generation of interactive systems. *Computer Graphics*, **17**, 53-57.

Olsen D. R., Buxton W., Ehrich R., Kasik D. J., Rhyne J. R. and Sibert J. (1984) A context for user interface management. *IEEE Computer Graphics and Applications*, **4**, 33-42.

Olson M. H. and Lucas H. C. (1982) The impact of office automation on the organisation: Some implications for research and practice. *Communications of the ACM* **25**, (11), 838-847.

O'Malley C. E. (1986) Helping Users Help Themselves. In D. A. Norman and S. W. Draper (eds) pp. 377-398.

O'Malley C. E., Draper S. W. and Riley M. S. (1984) Constructive Interaction: a method for studying human-computer interaction. In B. Shackel (ed.) *Proceedings of the First IFIP Conference on Human-Computer Interaction (Interact'84).* (Amsterdam: Elsevier) pp. 269-273.

Ord J. G. (1989) Who's Joking? The information system at play. *Interacting with Computers* **1**, (1), 118-128.

Orr W. D. (1968) (ed.) *Conversational Computers*. (New York: Wiley).

Owen D. (1986) Answers First, Then Questions. In D. A. Norman and S. W. Draper (eds) pp. 361-375.

Panbroke-Babatz U. (1984a) The computer conferencing system KOMEX. In B. Shackel (ed.) *Proceedings of the First IFIP Conference on Human-Computer Interaction (Interact'84).* (Amsterdam: Elsevier) pp. 929-930.

Panboke-Babatz U. (1984b) Results from evaluation studies with the computer conferencing system KOMEX. In B. Shackel (ed.) *Proceedings of the First IFIP Conference on Human-Computer Interaction (Interact'84).* (Amsterdam: Elsevier) pp. 941-944.

Pask G. (1980) Developments in Conversation Theory - Part 1. *International Journal of Man-Machine Studies* **13**, 357-411.

Pateman T. (1985) Using and defending cognitive theory. In G. N. Gilbert and C. Heath (eds) pp. 24-39.

Payne S. J. (1984) Task-Action Grammars. In B Shackel (ed.) *Proceedings of the First IFIP Conference on Human-Computer Interaction (Interact'84).* (Amsterdam: Elsevier).

Payne S. J. and Green T. R. G. (1986) Task-Action Grammars: A Model of the Mental Representation of Task Languages. *Human-Computer Interaction* **2,** (2), 93-133.

Pinch T. J. and Bijker (1987) The Social Construction of Facts and Artefacts: Or How the Sociology of Science and the Sociology of Technology Might Benefit Each Other. In W. E. Bijker *et al.* (eds) pp. 17-51.

Pomerantz A. M. (1984) Pursuing a Response. In J. M. Atkinson and J. C. Heritage (eds) pp. 152-163.

Pomfrett S. M., Olphert C. W. and Eason K. D. (1984) Work organisation implications of word processing. In B. Shackel (ed.) *Proceedings of the First IFIP Conference on Human-Computer Interaction (Interact'84).* (Amsterdam: Elsevier) pp. 847-853.

Popper K. R. (1963) *Conjectures and Refutations: The Growth of Scientific Knowledge* (Fourth Edition). (London: Routledge and Kegan Paul).

Power R. J. D. and Dal Martello M. F. (1985) Methods of investigating conversation. *Semiotica* **53,** 239-257.

Preston B. (1988) Heidegger and Artificial Intelligence. Mimeo.

Psalthas G. (ed.) (1979) *Everyday Language: Studies in Ethnomethodology.* (New York: Irvington).

Psalthas G. (ed.) (1983) *Interactional Competence.* (Norwood N.J.: Ablex).

Raudaskoski P. (1990) Repair work in human-computer interaction. *Computers and Conversation Symposium,* University of Surrey Social and Computer Sciences Research Group, 25-26 September 1989. To appear in P. Luff *et al.* (eds) *Computers and Conversation Analysis.* (London: Academic Press).

Reilly R. G. (ed.) (1987) *Communication Failure in Dialogue and Discourse.* (Amsterdam: Elsevier).

Reisner P. (1981) Formal Grammar and the Design of an Interactive System. *IEEE Transactions on Software Engineering* **7**, 229-240.

Reisner P. (1987) Discussion: HCI, What Is It and What Research Is Needed. In J. M. Carroll (ed.) pp. 337-352.

Ringle M. H. and Bruce B. C. (1987) Conversation Failure. In W. G. Lehnert and M. H. Ringle (eds) pp. 203-221.

Rissland E. (1984) Ingredients of Intelligent User-Interfaces. *International Journal of Man-Machine Studies* **21**, 377-388.

Robinson H. (1990) Towards a sociology of human-computer interaction: a software engineer's perspective.*Computers and Conversation Symposium*, University of Surrey Social and Computer Sciences Research Group, 25-26 September 1989. To appear in P. Luff *et al.* (eds) *Computers and Conversation Analysis*. (London: Academic Press).

Robinson J. J. (1982) DIAGRAM: A grammar for dialogues. *Communications of the ACM* **25**, 26-47.

Roger D. and Bull P. (eds) (1988) *Conversation: An Interdisciplinary Perspective*. (Clevedon, Philadelphia: Multilingual Matters).

Rosenberg A. (1988) *Philosophy of Social Science*. (Oxford: Clarendon).

Rosson M. B., Maass S. and Kellog W. A. (1987) Designing for Designers: an analysis of design practice in the real world. In J. M. Carroll and P. P. Tanner (eds) *Human Factors in Computing Systems and Graphics Interface, CHI/GI Conference Proceedings, Toronto, Canada*. (Special Issue of the SIGCHI Bulletin). (New York: Association for Computing Machinery) pp. 137-143.

Rosson M. B., Maass S. and Kellog W. A. (1988) The designer as user: building requirements for design tools from design practice. *Communications of the ACM* **31**, 1289-1298.

Rowe L. A. and Shoens K. A. (1983) Programming language constructs for screen definition. *IEEE Transactions on Software Engineering*, **9**, 31-39.

Sacks H. (1964-1972) *Unpublished Lectures*. (University of California, Irvine).

Sacks H. (1972) An Initial Investigation of the Usability of Conversational Data for Doing Sociology. In D. Sudnow (ed.) pp. 31-74.

Sacks H. and Schegloff (1979) Two Preferences in the Organisation of Reference to Persons in Conversation and their Interaction. In G. Psalthas (ed) pp. 15-21.

Sacks H. Schegloff, E. and Jefferson, G. (1974) A Simplest Systematics for the Organisation of Turn-taking in Conversation. *Language* **50,** 696-735.

Sarin S. and Greif I (1985) Computer-based real-time conferencing systems. *IEEE Computer* **18,** (10), 33-45.

Schegloff E. (1968) Sequencing in Conversational Openings. *American Anthropologist* **70,** 1075-1095.

Schegloff E. (1972) Notes on Conversational Practice: formulating place. In D. Sudnow (ed.) pp. 75-119.

Schegloff E. (1979) Identification and Recognition in Telephone Conversation Openings. In G. Psalthas (ed.) pp. 23-78.

Schegloff E. (1984) On Some Questions and Ambiguities in Conversation. In J. M. Atkinson and J. C. Heritage (eds) pp. 28-52.

Schegloff E. and Sacks H. (1973) Opening Up Closings. *Semiotica* **7,** 289-327.

Schegloff E., Sacks H. and Jefferson G. (1977) The Preference for Self-correction in the Organisation of Repair in Conversation. *Language* **53,** 361-382

Schenkein J. N. (ed.) (1978) *Studies in the Organisation of Conversational Interaction.* (New York: Academic Press).

Schön D. A. (1987) *Educating the Reflective Practitioner.* (London: Jossey-Bass).

Schutz A. (1967) *Collected Papers II: Studies in Social Theory.* (The Hague: Nijhoff).

Schutz A. (1970) *On Phenomenology and Social Relations: Selected Writings* (ed. Helmut Wagner). (Chicago: University of Chicago Press).

Scriven M. (1967) The methodology of evaluation. In R. Tyler, R. Gagne and M. Scriven (eds) *Perspectives of Curriculum Evaluation*. (Chicago: Rand McNally).

Searle J. R. (1970) *Speech Acts: an essay in the philosophy of language*. (Cambridge: Cambridge University Press).

Shackel B. (1985) Ergonomics in information technology in Europe - a review. *Behaviour and Information Technology* **4**, (4), 263-287.

Shackel B., Eason K., Gardener A. and McKenzie J. (1988) *Human Factors Guidelines for the design of Computer-Based Systems*. (London: HMSO).

Shafer D. (1988) *HyperTalk™ Programming*. (Indianapolis: Hayden Books).

Sharrock W. and Anderson B. (1986) *The Ethnomethodologists*. (Chichester: Ellis Horwood).

Sharrock W. and Anderson B. (1987) Epilogue: The definition of alternatives: Some sources of confusion in interdisciplinary discussion. In G. Button and J. R. E. Lee (eds) pp. 290-321.

Sharrock W. and Anderson B. (1990) Virtual Space Time as an Interactional Achievement.*Computers and Conversation Symposium*, University of Surrey Social and Computer Sciences Research Group, 25-26 September 1989. To appear in P. Luff *et al.* (eds) *Computers and Conversation Analysis*. (London: Academic Press).

Shaw M. L. G. (1979) Conversational heuristics for eliciting shared understanding. *International Journal of Man-Machine Studies* **11**, 621-634.

Shneiderman. B (1982) Multiparty Grammars and Related Features for Defining Interactive Systems. *IEEE Transactions on Systems, Man and Cybernetics* **12**, (2), 148-154.

Shneiderman B. (1983) Direct Manipulation: A Step Beyond Programming Languages. *IEEE Computer*, August 1983, 57-62.

Shneiderman B. (1986) *Designing the Interface: Strategies for Effective Human-Computer Interaction*. (Reading Mass.: Addison-Wesley).

Sidner C. L. (1987) Focussing in the comprehension of definite anaphora. In B. Grosz *et al.* (eds) pp. 363-395.

Sime M. E. and Coombs M. J. (1983) *Designing for Human-Computer Communication*. (London: Academic Press).

Sinclair J. McH. and Coulthard R. M. (1975) *Towards an Analysis of Discourse*. (London: Oxford University Press).

Smith M. J. (1984) Human Factors Issues in VDT Work. In J. Bennet, D. Case, J. Sandelin and M. Smith (eds) *Visual Display Terminals: Usability Issues and Health Concerns*. (Englewood Cliffs, N J.: Prentice-Hall) pp. 193-228. Also in R. M. Baecker and W. A. S. Buxton (eds) pp. 109-116.

Smith H. T. and Green T. R. G. (1980) *Human Communication with Computers*. (London: Academic Press).

Smith S. L. (1986) Standards versus guidelines for designing user interface software. *Behaviour and Information Technology* **5,** (1), 47-61.

Smith S. L. and Mosier J. N. (1984a) Design Guidelines for user-system interface software. Mitre Corporation Research Report MTR-9420.

Smith S. L. and Mosier J. N. (1984b) The user interface to computer-based information systems: a survey of current software design practice. *Behaviour and Information Technology* **3,** 195-203.

Stamper R. (1985) Knowledge as action: a logic of social norms and individual affordances. In G. N. Gilbert and C. Heath (eds) pp. 172-191.

Stefik M., Foster G., Bobrow D. G., Kahn K., Lanning S. and Suchman L. (1987) Beyond the Chalkboard: Computer Support for Collaboration and Problem Solving in Meetings. *Communications of the ACM* **30,** (1), 32-47.

Stenton S. P. (1987) Dialogue management for co-operative knowledge-based systems. *Knowledge Engineering Review* **2,** (2), 99-121.

Stevens G. C. (1983) User-friendly computer systems? A critical examination of the concept. *Behaviour and Information Technology* **2,** (1), 3-16.

Stevenson R. J., Mankelow K. I. and Howard M. J. (1988) Knowledge Elicitation: Dissociating Conscious Reflections from

Automatic Processes. In D. M. Jones and R. Winder (eds) *People and Computers IV*. (Cambridge: CUP) pp. 565-579.

Suchman L. A. (1982) Toward a Sociology of Human-Machine Interaction - Pragmatics of Instruction-Following. Draft report, Xerox PARC, Palo Alto.

Suchman L. A. (1987) *Plans and Situated Actions: The problem of Human-Computer Communication*. (Cambridge: Cambridge University Press).

Suchman L. A. (1988a) Video: Data for Studying Human-Computer Interaction. *Human Factors in Computing Systems, Proceedings of the CHI'88 Conference* (Washington: ACM Press) pp. 133-177.

Suchman L. A. (1988b) Representing Practice in Cognitive Science. *Human Studies* **11,** 305-325.

Sudnow D. (ed.) (1972) *Studies in Social Interaction*. (New York: Free Press).

Swanson G. (1968) Review symposium on Garfinkel's *Studies in Ethnomethodology*. *American Sociological Review* **33,** 122-130

Tatar D. (1988) Video: Data for Studying Human-Computer Interaction. *Human Factors in Computing Systems, Proceedings of the CHI'88 Conference* (Washington: ACM Press) pp. 133-177.

Taylor M. M. (1988) Editorial to Special Issue on Multimodal Computer-Human Interaction. *International Journal of Man-Machine Studies* **28,** 99-100.

Thimbleby H. W. (1984) Generative User-Engineering Principles for User Interface Design. In B. Shackel (ed.) *Proceedings of the First IFIP Conference on Human-Computer Interaction (Interact'84)*. (Amsterdam: Elsevier) pp. 102-107.

Thomas P. J. (1985) Asking Questions, Avoiding Answers. Unpublished dissertation, College of Ripon and York St. John, York.

Totterdell P. A., Norman M. A. and Browne D. P. (1987) Levels of Adaptivity in Interface Design. In H. J. Bullinger and B. Shackel (eds) *Proceedings of the IFIP Conference on Human-Computer Interaction (Interact'87)*. (Amsterdam: Elsevier) pp. 715-722.

Totterdell P. A., Boyle E., Mayes T. and McEachen P. (1988) Designing for User Benefit - a methodological cautionary tale. Alvey *Adaptive Intelligent Dialogues Project* Internal Report.

Turkle S. (1984) *The Second Self - Computers and the Human Spirit.* (New York: Simon and Shuster).

Turner J. (1984) Computer mediated work: the interplay between technology and structured jobs. *Communications of the ACM* **27,** (12), 1210-1217.

Turner R. (1971) Words, Utterances, and Activities. In J. D. Douglas (ed.) pp. 169-187.

Turner R. (ed.) (1974) *Ethnomethodology.* (Harmondsworth: Penguin).

Turner R. (1976) Utterance Positioning as an Interactional Resource. *Semiotica* **17,** (3), 233-254.

Walker T. (1989) High Technology as Oral Culture. Mimeo, CRICT, Brunel University of Technology.

Wallace A. (1968) Review symposium on Garfinkel's *Studies in Ethnomethodology. American Sociological Review* 33, 122-130.

Wasserman A. I. and Shewmake D. T. (1985) The role of prototypes in the User Software Engineering (USE) Methodology. In H. R. Hartson *Advances in Human-Computer Interaction.* (Norwood, NJ.: Ablex), pp. 191-211.

Weider D. L. (1971) On meaning by rule. In J. D. Douglas (ed.) pp. 107-135.

Weisenbaum J. (1976) *Computer Power and Human Reason.* (San Fransisco: W. H. Freeman).

Weisenbaum J. (1977) Book Review: A response to Donald Michie. *International Journal of Man-Machine Studies* **9,** 503-505.

West C. and Zimmerman D. H. (1982) Conversation Analysis. In K. R. Scherer and P. Ekman (eds) *Handbook of Methods in Non-Verbal Behaviour Research.* (Cambridge: Cambridge University Press) pp. 506-541.

Westland G. (1978) *Current Crises of Psychology.* (London: Heinemann).

Wiener N. (1948) *Cybernetics.* (Cambridge, Mass.: MIT Press).

Whiteside J. and Wixon D. (1987) Discussion: Improving Human-Computer Interaction - A Quest for Cognitive Science. In J. M. Carroll (ed.) pp. 353-365.

Wilson P. (1984) Structures for group working in mailbox systems. In B. Shackel (ed.) *Proceedings of the First IFIP Conference on Human-Computer Interaction (Interact'84).* (Amsterdam: Elsevier) pp. 951-958.

Wilson T. P., Weinmann J. M. and Zimmerman D. H. (1984) Models of Turn Taking in Conversational Interaction. *Journal of Language and Social Psychology* **3**, (3), 159-182.

Winograd T. and Flores F. (1986) *Understanding Computers and Cognition.* (Norwood, NJ: Ablex).

Woolgar S. (1985) Why not a sociology of machines? The case of sociology and Artificial Intelligence. *Sociology* **19,** 4, 557-572.

Woolgar S. (1988) Time and documents in researcher interaction: Some ways of making out what is happening in experimental science. *Human Studies* **11**, 171-200.

Wooton A. (1988) Remarks on the methodology of conversation analysis. In D. Roger and P. Bull (eds) pp. 238-258.

Yang Y. (1989) Survey steered design: evaluating user recovery and command reuse support by questionnaire. *Behaviour and Information Technology* **8,** (6), 437-459.

Young R. M. (1981) The machine inside the machine: Users' models of pocket calculators. *International of Man-Machine Studies* **15,** 51-85.

Zimmerman D. H. (1978) Ethnomethodology. *American Sociologist* **13,** (1), 6-14.