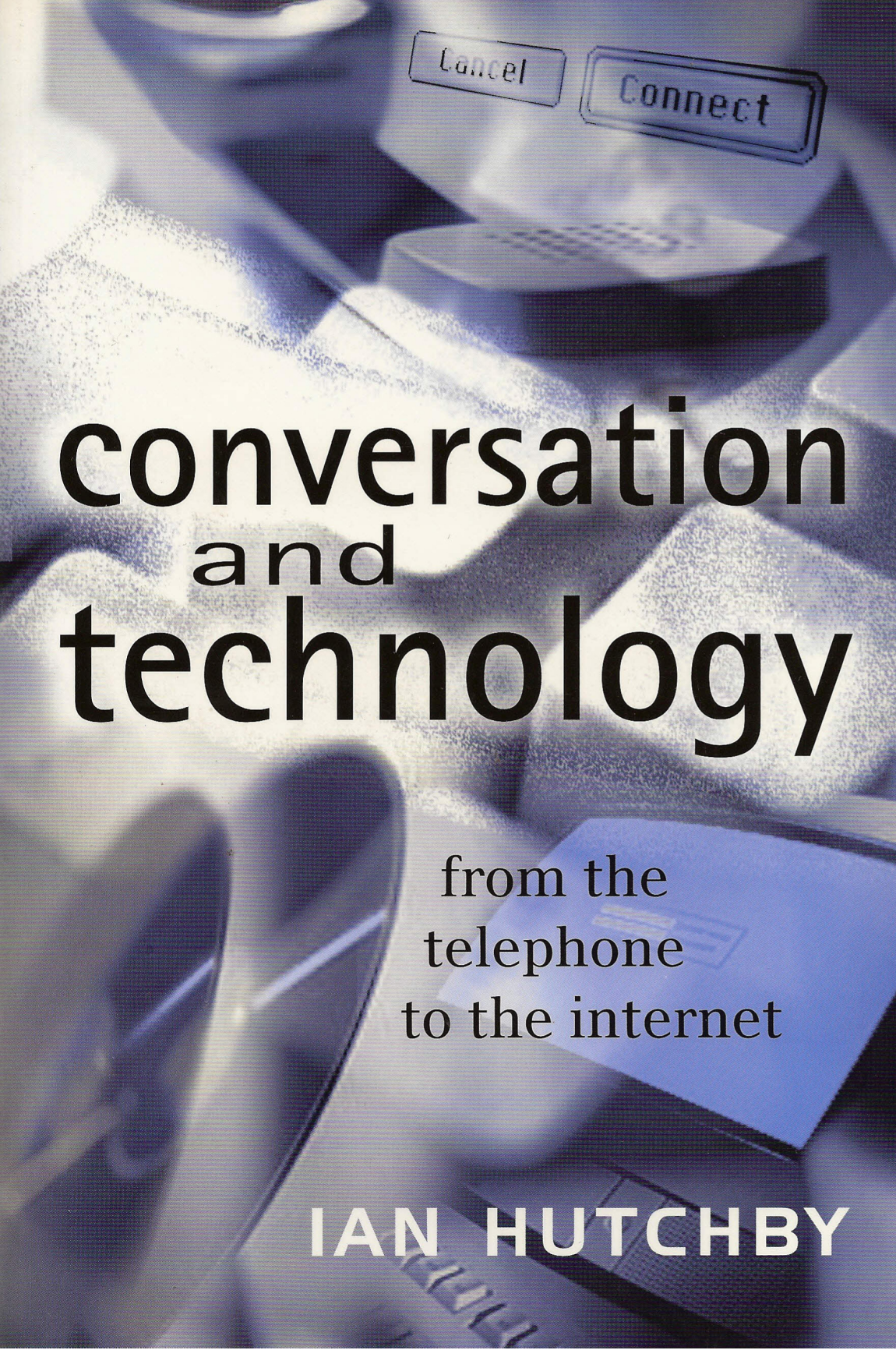




conversation and technology

from the
telephone
to the internet

IAN HUTCHBY

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From the Telephone to
the Internet

Ian Hutchby

Polity

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Introduction: Technologies for Communication

For some, the title of this book may pose a question: what does conversation have to do with technology? It is easy to think of technology in relation to the mechanical, the automatic, the inanimate, the electronic, the inorganic, the constructed, the non-thinking, the impersonal, the asocial. This seems quite different from conversation, one of our most common forms of social interaction, which seems by contrast spontaneous, involved, active, lived, mindful, sociable and deeply interpersonal. Indeed, it might be proposed that the very thing which distinguishes humankind from other species is our capacity not just to use language (after all, many other species are now known to use relatively complex forms of symbolic communication) but to use language in the form of ordinary conversation; to talk about ourselves and our interests, activities, desires and so on purely for the sake of talking to each other. Chat, in other words, may well be one of the most significant defining characteristics of the category ‘human’. In what sense, then, can technology and conversation be brought together?

It does not take a great deal of reflection to see that there is, in today’s world, a multiplicity of ways in which conversational practices interface with technological devices. For instance, artefacts such as the telephone and the internet – one so established as to be all but invisible to sociologists, the other so novel as to all but fill the cultural horizon for many – function primarily as technologies through which communication of certain sorts is enabled. In different ways, both of them function as channels by means of which individuals or groups can be situated in co-presence, yet an abstract form of co-presence, in which space and often also time separate the participants.

Computer technologies such as expert systems and those for supporting cooperative work-based tasks also operate as media for communication of a certain sort. Such systems, typically deployed in

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workplace environments, are designed ostensibly to assist or complement human workers in carrying out specific tasks. But they do not operate independently of human work and communication, and the humans who work with them need to find ways of incorporating into their interactions with each other the demands and constraints that emerge from the design of the system. At the same time, there are ways in which the technological artefacts themselves can be seen as ‘participants’ in the interaction, at least in the sense that their outputs (such as words or pictures on a screen) can become oriented to as ‘contributions’ which are the subject of mutual, active and collaborative sense-making on the part of humans.

We also increasingly communicate *with* certain forms of technology. Although they have not yet reached particularly high levels of conversational sophistication, speech-generating computers and artificial intelligence systems are increasingly encountered in information-seeking and other basic service encounters. Designers of more advanced systems are attempting to build computers which could hold ‘conversations’ with humans, and this prompts the question of what those conversations will look like, whether they will manifest any significant differences with human–human conversation; and also, significantly, what are the implicit assumptions about the nature of human interaction which underlie the design of such systems?

Together, I will label these forms of technology ‘technologies for communication’. The telephone, the videophone, internet conferencing, computerized expert systems, artificial intelligence systems based on natural language, are all technologies through which, around which and with which humans attempt to communicate. Such communication incorporates an enormous range of activities, from holding a conversation with a friend to trying to extract information from a database by ‘conversing’ with a computer. But because, in each case, the interaction involved is interpersonal or (very broadly) conversational, these are not simply communications technologies but, in an important sense, technologies *for* communication.

The existence of technologies for communication poses a question: what is the nature of the communication that takes place when humans interact through, around, or with them? Put more broadly, what is the relationship between forms of technology and structures of social interaction? In this book, my aim is to explore what this particular category of technologies can tell us about that relationship. In the following chapters I explore the multiplicity of ways that technologies for communication can become implicated in our ordinary conversational practices while, at the same time, those very practices

may not only adapt to but also shape the cultural meanings and communicative purposes that such artefacts have. My central argument is that we can learn more about the nature of human communication by observing how it is affected by technology, and, correspondingly, we can learn more about the social nature of communications technologies by thinking about how they both rely upon and transform basic human communicative patterns.

There are a number of prongs to this argument. Two significant questions that are raised immediately concern the nature of technology and the nature of human communication. It is not my aim to answer these questions by means of definitive, metaphysical statements on what I take to be the 'essential' nature of these things. Rather, I will take an analytical stance on technologies and their relationship with human communication. In other words, I want to argue for a particular way of conceptualizing technology, and a particular method of studying communication, which together help us to understand the ways that technologies can impact on the interactive social world of humans, and how humans can find ways of managing those impacts.

As I outline in detail in the first few chapters of the book, this involves taking issue with certain aspects of the recent radical sociology of technology, centred as it is around an uneasy social constructivist consensus. The main thrust of this consensus has cast into doubt the very validity of asking questions about the nature of technologies and communication, and the impacts of technologies on social life. Technologies, in the constructivist way of thinking, can only amount to what humans make of them in and through their uses of them; or at least, that is deemed to be the most appropriate way for sociologists to approach them. As I will argue in chapter 2, this is to overlook the very materiality of technological artefacts and to downplay the extent to which humans' uses of artefacts are not just shaped but constrained by aspects of that materiality. Materiality here need not be thought of only in physical terms. We may, for instance, be able to conceive of the telephone as having a materiality affecting the distribution of interactional space through the promotion of what I will call conversational 'intimacy at a distance' (see chapter 5). Likewise, we can conceive of the interfaces of expert systems or internet conferencing software as having a materiality affecting navigation through a technically bounded interactional space as people attempt to orient themselves in the sequential order of a particular interaction.

This inevitably implies a conception of what communication is, how it is produced and how best to analyse it. As I outline fur-

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ther in chapters 3 and 4, my perspective derives from conversation analysis (Sacks 1992; Psathas 1979; see also Atkinson and Heritage 1984; Hutchby and Wooffitt 1998), an approach which is distinctive on both conceptual and methodological grounds. Conversation analysis (CA) is characterized by the view that there are discoverable rules, procedures and conventions which underlie the orderly production of talk in interactional circumstances. These conventions comprise a form of social organization which makes for the very possibility of mutually intelligible communication. Methodologically, CA takes the view that this underlying social organization cannot be discovered using conventional sociological research techniques such as interviews, surveys, or even participant observation and the conscientious taking of field notes. Rather, it is viewed as available to observation in the details of naturally occurring interactions, which are recorded using audio and video equipment and then carefully transcribed.

Taken together, these angles on the relationship between technological artefacts and the social organization of communication enable us to think anew about fundamental questions such as the nature of human sociality and the phenomenon of intersubjectivity. The question of how humans manage to act in concert, how we are able to understand one another, and the extent to which it is possible for us to 'know' the intentions, mental states or consciousness of another person is one that has concerned philosophers since the beginnings of systematic human inquiry and, latterly, social theorists as well. One effect of the advent of 'conversational' machines – machines that exhibit features of humanness – is to raise again, from a different angle, the issue of whether there are any specific characteristics of being human (Woolgar 1985). Along with that, the spectacle of a human being engaging in conversation with a computer may prompt us to think differently about the nature of human intersubjectivity, understanding and co-communication.

Clearly, an issue that has been around as long as the problem of intersubjectivity does not lend itself to easy or straightforward solution. In fact, it might be more accurate to say that the very longevity of the problem reflects the fact that, as it is conventionally stated ('How is it possible for me to know whether you are really the same as me, as opposed to being, for example, a machine, a robot, an automaton or an alien?'), it has no answer. It is certainly not my aim in this book to suggest any definitive answer. Instead, drawing on a range of writing on the topic, I will outline what seem to be the two principal alternative models or frameworks through which human intersubjectivity and social interaction have been accounted for.

I call these the ‘computational’ and the ‘interactional’ models. The former focuses mainly on internal processes, centred in the brain, as the explanatory basis for human action; while the latter, of which CA is a constituent, rejects this view and focuses instead on how intersubjectivity is ongoingly constructed and negotiated in the public space between interactants. Thus, while the computational model addresses itself to furnishing ostensibly causal explanations for human interactive behaviour, the interactional model aims rather to provide a robust framework for analysing intersubjectivity as an interpersonal accomplishment. The writings of Wittgenstein (1958), Schutz (1962) and, more recently, Garfinkel (1967) and Sacks (1992) all suggest that this model provides the most appropriate framework for thinking about human intersubjectivity and interaction. I will propose that the interactional model also provides the best basis for analysing the ways in which non-human technological artefacts can become important elements in the patterns of ordinary human conduct.

As these brief preliminary remarks suggest, I range across a wide terrain of theoretical thought and empirical research in the following chapters. It is worth considering at this point why such a large body of work looms in front of us once we start to think about conversation and technology. One way of accounting for it is to suggest that the era we live in is seeing great, and rapid, changes in the very nature of social interaction.

Technologized interaction?

I began with a question: why might there be a link between technology and social activities such as conversation? In fact, sociologists have always argued against the notion that the ‘technological’ equates with the ‘asocial’ (see chapter 2). But, more recently, the idea has grown up that the properties of new technologies themselves – particularly information and communications technologies – mean that we in the developed capitalist world are currently entering a phase of what might be called ‘technologized interaction’.

For instance, the advent and rapid expansion of the internet, on which people can engage in computer-mediated ‘chat’ from their bedrooms, studies or offices with any number of anonymous logged-on others, has led some to suggest that the nature of human subjectivity is undergoing a process of fundamental change. Poster (1995), one of the leading proponents of this view, argues that electronic communi-

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cations technologies allow the physical body to be separated from 'presence' to such an extent that our common-sense notion of the self is being fragmented, since identities can no longer meaningfully be pinned to their concrete individual 'owners'. Turkle (1995) in some respects goes further. She has always been fascinated with the way in which some computer programmers search for an almost symbiotic relationship with their machines (see Turkle (1986)). In a similar vein, her more recent ethnography of regular participants in real-time internet games such as MUDs (multi-user domains) prompts her to claim that 'as human beings become increasingly intertwined with the technology and with each other via the technology, old distinctions between what is specifically human and specifically technological become more complex. Are we living life *on* the screen or life *in* the screen?' (Turkle 1995: 21, emphasis in original).

But the internet is only the most high-profile phenomenon involved in the idea that we are at a moment of technologized interaction. The telephone is a much more well-established technology for enabling spatially – indeed globally – distributed conversation. Since its development, and its rapid and widespread uptake in the early years of the twentieth century, the telephone has become a technology for communication that is so familiar as to be all but invisible as an object for sociological attention (a notable exception is the work of Hopper (1992) which I discuss further in chapters 5 and 6). Yet one thing we might be encouraged to ask is: what does the existence of the telephone mean for the nature of interpersonal interaction? Some time ago, Pool (1981) edited a collection of studies which traced some of the ways in which the adoption of the telephone could lead to shifts in cultural patterns of living and socializing. But, for the most part, these studies paid little attention to the details of what people could be seen (or rather heard) to *do* on the telephone. By far the most radical aspect of the telephone as a technology for communication is that its invention enabled people, for the first time ever, to talk to each other as if they were co-present when in fact they were not. While most of us now take this experience in our stride, traces of its strangeness still show in the unease or confusion that very young children sometimes manifest when they first begin to encounter telephone conversation.

So what of the details? What are the structures of telephone interaction like and how, if at all, do they differ from the more primary patterns of co-present interaction? (I call these patterns 'primary' because they obviously precede in temporal terms, and outweigh in terms of global distribution, the phenomenon of telephone conversation.) Patterns of talk-in-interaction change as people

adapt to developments in the circumstances and the possibilities for talk. What kinds of adaptations can people be said to have made – and still be making – to the contingencies of talking on the telephone?

The idea of technologized interaction gains further impetus from the way in which technologies, both large and small, with which we are required to interact in various ways are now pervasive in almost all aspects of our daily lives. Consider, for example, the automated telling machines which most people in developed capitalist societies now use as their principal mode for gaining access to cash. Or the increasing prevalence of automated answering systems which are encountered whenever we make a telephone enquiry to a bank or airport. Indeed, emerging cultural practices such as home banking or teleshopping rely in large part on computer systems that are able to recognize basic elements of ordinary speech and generate appropriate (if pre-programmed) responses. Of interest not merely in technical or engineering terms, these 'interactive' technologies are worthy of investigation because they invite us to ask some fundamental questions about human sociality in a society where much of our interaction is mediated by technological forms.

To what extent, then, are we 'technologized' conversationalists? How far are our conversational practices configured by technologies for communication and interaction; or from the opposite angle, how far may we as competent conversationalists be configurers of the communicative properties of these technologies? In an era which has seen more than a century of extraordinarily rapid technological innovation and development, a commonplace assumption, particularly in populist treatments of the question, is that information and communications technologies are so deeply embedded in cultural existence that the shape of our lives is determined by them (Toffler 1981). This is also reflected, albeit in a less explicitly deterministic fashion, in contemporary theories of the 'information society' (Webster 1995). Critics of the various forms of technological determinism have asserted, by contrast, that information and communications technologies have no effects outside the interpretive constructions made of them by humans (Grint and Woolgar 1997).

In my view, neither of these extremes is solely adequate for thinking about the relationships between forms of communications technology and human interaction. Instead we need to develop a framework that argues both that technologies for communication do indeed bring into existence – in the sense of enable and promote – new forms of participatory possibilities in human interaction, new

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categories of what might be called 'localized social identities', and that these new forms of interaction are at the same time the product of humans' active appropriation and configuration of the technology in pursuit of their own purposes. How we might develop such a model is explored in chapter 2.

In the process, as already mentioned, we must address other questions. For example, what are the assumptions about the nature of human communication that are embedded in the design of technologies for communication? What are the effects that these assumptions have on the situated, practical actions through which communication is accomplished? How do the configuring properties of technologies such as telephones, expert systems and speech-based computers interrelate with the normative structures of social interaction? It is only through a consideration of these questions that we can come to an understanding of the relationship between conversation and technology and its contemporary sociological significance.

The relevance of conversation

As these remarks suggest, there is a particular relevance in thinking about the nature of ordinary conversation for our understanding of how technologies for communication function in everyday life. This connection is not entirely novel. Some years ago, it was observed that 'new technology has brought with it the idea that we no longer simply use machines, we interact with them' (Suchman 1987: 1). Focusing on computerized 'help' systems, Suchman argued that the operation of such machines is an activity less akin to a mechanical process and more like a linguistic or discursive one. That is, in using a modern computer, the actions we engage in involve not so much the operation of switches or levers with some determinate physical outcome as engagement in a form of dialogue with the machine. Most people who use a computer nowadays will be familiar with graphical user interfaces (GUIs) such as those used in Macintosh or Windows operating systems. These make extensive use of what are called 'dialogue boxes'. At certain points, such as when we create or save a file, when we move a file from one location to another, or when we ask the computer to do something that it cannot do or does not understand, the system presents us with a set of choices and asks us which we would prefer.

Note that I have started to talk here of a human ‘asking’ the machine to ‘do something’ which the machine may ‘not understand’, and of the machine ‘presenting’ the human with choices about actions and ‘asking’ for a preferred option. Part of Suchman’s point was that the very design features of information technology artefacts make it extraordinarily easy to slip into this type of anthropomorphic language. GUIs are of course designed with precisely this kind of conversational metaphor in mind. Related to the metaphor of conversational turn-taking (asking and answering; offering options and choosing preferences – see chapter 4), GUIs also frequently aim to simulate on the screen features of the non-computer world outside the screen. Users of modern personal computers take it for granted that their computer screen is a ‘desktop’ on which there reside ‘folders’ which in turn contain ‘documents’. The folders themselves are represented by little pictures (known as icons) that look like the cardboard folders the user may have in the metal filing cabinet across the office. In order to ‘throw away’ a document (that is, erase a file from the computer’s disk) we can use a pointer to ‘pick it up’ and ‘drop it’ into a little icon of a wastebasket. When the wastebasket has things in it, its lid may be lifted off and scrunched up papers can be seen inside. When ‘emptied’, the lid is replaced.

To most people reading this book, no doubt all this will seem quite commonplace. Yet the idea that we interact with machines rather than just using them brings with it a question: precisely *how* do humans interact with such devices? What is the nature of human–machine interaction? And what are the most appropriate methods for engaging in the analysis of that interaction?

As Suchman herself saw, the fact that technological devices may be designed with an interactional metaphor in mind means that techniques for analysing human–human interaction may fruitfully be applied to human–machine interaction. Extending this slightly, I suggest that the same techniques may be used to analyse human–machine–human interaction: that is, interaction that is somehow mediated by technologies for communication.

Suchman (1987) used aspects of CA to analyse interaction with one form of technology, a supposedly ‘user-friendly’ xeroxing machine. But I will range much further and wider in the domain of technologies for communication, using the techniques of CA to develop what is hopefully a general account of the ways in which such artefacts may become involved in everyday interpersonal interaction. In this account, conversation becomes not simply a metaphor but an analytical baseline from which I will gauge the

nature of the relationship between forms of technology and structures of interaction.

Outline of the book

I begin in chapters 2 and 3 by exploring the two poles around which the book's arguments are set out: the social study of technology as a specific phenomenon, and the sociology of interpersonal communication and social interaction. These chapters are designed to take issue both with prevailing dichotomies in the social study of technology and with notions in communication studies deriving from cognitive science and information theory. In chapter 2 I discuss the main theories put forward in the recent sociology of technology. Most of these embrace one form or another of social constructivism. However it should be noted that Grint and Woolgar (1997) have recently taken issue with what they see as an underlying essentialism in even the most constructivist accounts, which suggests that technological artefacts possess properties which are beyond the reach of sociological analysis. I argue that while Grint and Woolgar's relativist standpoint is a powerful one, it actually deflects attention away from some of the most sociologically important features of technologies for communication.

Chapter 3 proceeds to consider how social interaction, and especially conversation, is best conceptualized. Noting the extent to which technological metaphors have informed models of human communication, I outline in more detail the basic distinction between computational and interactional models of communication. I discuss how these models have informed research in various traditions over the past few decades: principally, parts of linguistics, cognitive science and communication studies. I argue that the most radically interactional model of communication is to be found in the field of CA (Hutchby and Wooffitt 1998). This is then introduced in detail in chapter 4.

The remaining chapters present empirical accounts of various technologies for communication and their relationship with the structures of interaction. Chapters 5 and 6 focus on the telephone as a 'technology of sociability'. I discuss the extent to which the invention and widespread adoption of the telephone in modern culture has transformed the nature of social interaction. Drawing on literature which addresses both the social impacts of the telephone, and the nature of telephone conversation as social interaction, I develop two

arguments. First, that the telephone has brought into existence not only new forms of interaction but also new forms of identity which participants need to negotiate competently. Second, that arguments which stress either telephone technology's configuration of its users, or users' configuration of telephone technology, are equally limited. We are both configured by, and configurers of, the telephone as a communication technology. This is a position that informs my discussions of other technologies in subsequent chapters.

In chapter 7 I turn to look at computer technologies and how people interact around them in various workplace settings. I look at how novel forms of workplace technology such as collaborative video links can be seen to encourage the development of apparently new forms of interpersonal interaction. However, as in the following two chapters, my overall argument is that humans who attempt to communicate via these technologies are still reliant upon everyday interactional competencies, which in turn leads to many of the problems that are experienced in computer-supported collaborative working. In the second part of the chapter I look at the contributions made by ethnomethodological and conversation-analytic perspectives on human interaction around 'intelligent' machines. Here Suchman's (1987) work receives a more extended treatment. I also examine recent studies of service encounters which illustrate both positive and negative impacts of so-called 'expert' systems on the delivery of public services.

Chapter 8 address a range of issues around the question of artificial intelligence (AI) and human-computer interaction (HCI). An initial concern here is with the various designs and design strategies which underlie attempts to construct computers that can engage in 'conversations' with humans. These are now moving out of the purely experimental domain and into the arena of public services such as banking or airport enquiries services. As well as providing some empirical analyses of issues raised when humans attempt to engage in interaction with computers that give the appearance of conversational competence, I discuss some of the conceptual and philosophical issues around the very possibility of human-computer conversation. I consider the arguments within ethnomethodology and CA which oppose those in the AI and HCI community who believe that social studies of interaction can represent the basis for truly conversational computers, and discuss how this debate itself raises issues about the nature of social interaction and communication.

Chapter 9 focuses on new forms of interaction currently being brought into existence via the internet. Mirroring the argument of chapter 5, in which we saw how the telephone enables and promotes

new forms of identity and of participation in social interaction, I suggest that computer-mediated communication (CMC) is effecting similar transformations. In the first part I discuss CMC in relation to questions of identity, social interaction and the formation of social relationships; then, in the second half, I look at multi-user 'conversations' in real-time Internet Relay Chat (IRC), and adapt the basic perspective of conversation analysis to investigate the nature of participation in this novel arena for social interaction.

The Communicative Affordances of Technological Artefacts

My aim in this book is to investigate whether there may be specific forms of social interaction that have grown up around what I am calling technologies for communication. The argument centres upon a complex interplay between the *normative structures* of conversational interaction and the *communicative affordances* offered by different forms of technology. In chapters 3 and 4 I say more about the idea of normative structures of conversation. In this chapter, the focus will be on how the notion of communicative affordances relates to other perspectives in the sociology of technology.

Analysing the ways in which technologies for communication can become involved in ordinary interactional processes entails developing a specific view of the relationship between technology and social processes. The issue for this chapter therefore is to disentangle my position from other theories in the recent sociology of technology. I start by outlining some of the key social constructivist responses which have been made to what is seen as the technological determinist consensus in earlier sociology of technology. Then, in order to situate my own argument in relation to these perspectives, I turn to some major critiques which claim to be presenting a more rigorous social constructivism. One approach focuses on the idea that technologies should be seen as 'texts' which have no necessary characteristics at all but are meaningful only in and through the 'readings' that social actors give them (Grint and Woolgar 1997). From a slightly different angle, others have suggested that the focus of attention should be shifted away from the question of what is social about technologies towards that of how technologies are situated within concrete social contexts of action, and how social actors knowingly constitute those artefacts, and their actions in relation to them, as 'technological' (Button 1993). My own approach draws on the

concept of ‘affordances’ (Gibson 1979) in order to propose an alternative which takes account of the constraining, as well as enabling, materiality of artefacts.

The social dynamics of technology

Recent years have seen a resurgence of interest in technology as an object of sociological investigation. Technology has always figured in the list of sociology’s key topics, along with themes such as power, bureaucracy, work, class, and more recently, deviance, gender and ethnicity. But technology has now taken on a new lease of sociological life in the form of ‘social studies of science and technology’. This is an offshoot of the more well-established sociology of scientific knowledge (Woolgar 1991). The main aim of social studies of science and technology is to argue that technological artefacts, in both their form and their meaning, are socially shaped, as opposed to being the clearly defined products of particular inventors or innovators. As two of the key figures in the development of the field have put it:

Technologies do not have a momentum of their own at the outset that allows them . . . to pass through a neutral social medium. Rather, they are subject to contingency as they pass from figurative hand to hand, and so are shaped and reshaped. Sometimes they disappear altogether: no-one felt moved, or was obliged, to pass them on. At other times they take novel forms, or are subverted by users to be employed in ways quite different from those for which they were originally intended. (Bijker and Law 1992: 8)

As this quote suggests, most of the work in this field is not about technology in the abstract, but about the complex relationships between technologies and the social and interactional circumstances in which they exist and through which they attain their meaning. This is in stark contrast to earlier sociological concerns with technology which focused on the development of factories, the introduction of machines and the increasing automation of work. The explicit aim was to develop a critical, and political, account of the effects of these processes in terms of class division and the nature of the labour process (for example, Braverman 1974). Underpinning much of the theory was a particular conception of the social impacts of new technologies, often described as ‘technological determinism’: the view that

forms of technology actively cause new forms of social relations to come about.

Whether in a strong or a diluted form, this view courses through much of the populist discourse about the social 'impacts' of new information and communication technologies. Toffler (1981), one of the most well-known 'sociologists of the future', has argued that the invention of computers heralded a 'Third Wave' in Western culture, following the First Wave of agriculturalism and the Second Wave of industrialism, in which just as profound a set of social and cultural changes will be caused as came in the wake of the preceding Waves. This view also influences many of the more serious sociological accounts that have been produced in recent years. Poster (1995), for instance, takes a similar, if theoretically more sophisticated, line to Toffler when he argues that the current 'era of electronic exchange' is the third in a series of communication eras that have characterized human societies (the others are the era of 'oralism', prior to the development of writing systems, and the era of 'written exchange' which allowed rationalism and science, with their objective representations of the world, to flourish). What is being brought about by the era of electronic mediation, for Poster, is a fragmentation of the self and a resulting crisis of identity in which there is an increasing separation between the things that we can be or have done to us in the world, and our physical presence in any given social space.

It is, of course, very easy to think in these terms. Indeed, in the previous chapter I talked of an era of 'technologized interaction' which is possibly being brought about by the advent of technologies for communication. I tried not to assume that such an era was actually upon us; in fact one of the aims of this book is to question whether or not that might be the case, and if so, what are the different roles played by technology and conversation in the process. Yet technological determinism is easily identifiable as the *bête noire* of recent developments in science and technology studies. This is a field which is riven by often fierce theoretical and epistemological debates; however, if the different schools are united by one thing it is their opposition to the view that technologies have determinate, causal effects on social change.

Responses to technological determinism have taken a number of forms. One of the key ideas is that common-sense dichotomies between the 'technical' and the 'social' need to be challenged. Sociologists need to recognize and to analyse the ways in which social processes and technological artefacts are interrelated and intertwined. Thus, contrary to technological determinism, in which the inherent characteristics of a technology are thought to have deter-