English Language Learning and Technology

Carol A. Chapelle

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Language Learning and Language Teaching

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English Language Learning and Technology: Lectures on applied linguistics
in the age of information and communication technology
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Lectures on applied linguistics in the age of information and communication technology

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For my parents

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Preface

People tend to think of technology as fast paced, quickly changing, and difficult to keep up with. In some ways this perception accurately characterizes the technology-related aspects of applied linguistics. Over the past 30 years drastic changes have occurred in the technologies that intersect with second language teaching, second language assessment, language analysis, and many aspects of language use. But while the technology is changing significantly in ways that affect professional practices, many of the important questions concerning technology-related issues remain exactly the same. How does technology intersect with language teaching practices in ways that benefit learning? How can research on second language acquisition help to inform the design of technology-based language learning? How can the learning accomplished through technology be evaluated? How do technology-based practices influence and advance applied linguistics? This book explores these timeless issues in applied linguistics.

Not altogether independent of changing technology, the role of English in international communication has expanded in ways that intersect with applied linguistics as well. In many settings, the Internet and other electronic sources make large quantities of English available to learners, and accordingly amplify the importance of English internationally. Because of the linguistic and sociocultural difference between English and other languages, in this volume I have explicitly focused on English. Nevertheless, many of the general issues discussed in this volume – the role of second language acquisition research, evaluation issues, and the interface of technology and applied linguistics – pertain to the profession more broadly than to the domain of English language. In fact it remains an open question to what extent English is unique among the languages studied within the profession.

English has been the primary interest of audiences for some of the lectures that provide the basis of these chapters, but typically the interest was the technology-applied linguistics connection more generally. The first chapter comes from a combination of lectures introducing the ways in which technology is changing many aspects of the profession, more specifically because of the

changes in opportunities for language use offered to language learners and options for language teaching, assessment, and research. It seems critical to point out these changes explicitly because in many places of the English-speaking world, technology is becoming "invisible." With technology in the background, the dramatic changes it offers for students, teachers, and the profession will remain underexplored. I argue that it is worthwhile for applied linguists to engage more consciously and proactively with the complex language-technology reality in which the profession is working.

The second chapter takes a step toward exploring this reality by addressing one of the most frequently asked questions about technology and language learning: how can computer-assisted language learning be informed by professional knowledge about second language acquisition? An hour of browsing through English language teaching Web sites reveals a wide variety of activities for learners, from ESL chatrooms, and discussion boards, to resources for listening, sites for finding communication pals, and pages and pages of quizzes. Enthusiasts act as advocates for the value of their favorite activities, but it would be difficult to argue that the findings from second language acquisition research have been applied extensively to the development of these activities. Rather, advocates for particular activities attempt to portray them in general, positive terms such as authentic, motivating, and interactive.

At one level, such global characterizations may be useful, but as a profession, one would hope we could develop a more analytic, research-based, and critical stance on technology-based learning activities. Researchers attempting to develop more complex learning programs seem to have similarly tentative links between the design of materials and second language acquisition. The second chapter synthesizes several lectures that have attempted to articulate concrete links between findings from second language acquisition research and CALL. Even while the area of CALL in general remains a hot bed of controversy about everything from what should be studied to appropriate methods for research, I suggest that that some principles can fruitfully be applied to L2 software development and computer-based learning tasks, and I illustrate how this might be accomplished.

In looking at each of the examples in Chapter 2 as well as the many activities one finds on the Web and in multimedia collections, many ESL teachers question the extent to which learners' participation and practice with such activities actually helps them to learn English. In other words, are such tasks believed to hold any potential for language learning? In Chapter 3, I discuss the complexity of this question by arguing the need to consider the audiences whom research investigating effectiveness of technology might serve. Even be-

yond the individual CALL enthusiast, I have met educators, publishers, and representatives who are interested in research documenting the effectiveness of CALL for language development. In Chapter 3, I point out that motivating many of the calls for research on effectiveness is the feeling that the use of technology for language learning must be justified. In other words, the normal or natural way to learn language would be without the use of computers, and only if a solid case can be made would computers be considered.

This assumption that a case must be made for technology sits uncomfortably with my everyday reality in which using technology has become the unmarked, the normal and natural, way of doing so many things. To those of us in higher education in an English-speaking country where our administrators delight in encouraging teaching through technology, it is not at all clear to whom the case for technology would be made. In these settings, the idea has been sold, and now it seems the real issues in applied linguistics point in a different direction. Rather than comparing classroom with CALL, it seems the challenge is to provide evidence for the most effective ways to design software for CALL, to use the software effectively in tasks, and to help learners to take advantage of the electronic resources available to them. I provide examples of research that has addressed each of these goals, and discuss how this research relies on theory from second language acquisition.

Even a brief look at the examples of research and what it can reveal suggests the need to better articulate the issues involved in the study of the processes learners use in working on technology-mediated language learning tasks. Processes such as learners' choices of Web pages, selection of help, and on-line conversations are readily evident in the data that researchers can gather as learners work on CALL tasks. A number of studies have examined such data, but overarching principles remain to be developed for understanding these data from the perspective of research objectives and methods in applied linguistics. In Chapter 4, such principles are outlined by distinguishing three research objectives: description, interpretation, and evaluation. Other research in applied linguistics such as classroom discourse analysis and language assessment offers methodological perspectives for guidance in research on process data. In Chapter 4, I discuss how these perspectives help to inform such research.

Examination of technology use through these perspectives turns out to amplify and expand the researchers' understanding of issues in applied linguistics. In the final two chapters, I examine two areas central to research in applied linguistics that focuses on second language learning: the study of language learning tasks and second language assessment. To move beyond important but superficial issues of making instruction and testing more efficient, I

argue that it is necessary to first recognize that efficiency has been the primary target of much of the work on technology for second language learning and assessment. In contrast, other related areas, such as psychology and linguistics, have engaged in research intended to use technology to help expand and strengthen theoretical understanding. The final two chapters sketch the directions in which theoretical knowledge of L2 learning tasks and assessment can move if the efficiency goals are set aside to use technology as a tool for applied linguistics research.

As the title of this volume suggests, these papers were synthesized from a number of lectures given at conferences and universities over the past several years. The first chapter includes material from lectures given at the conference of the International Association for Teachers of English as a Foreign Language (IATEFL) in Brighton, England in April 2001; the European Conference for Computer-Assisted Language Learning (EUROCALL) at the University of Abertay in Dundee, Scotland, August and September 2000; and at a lecture presented at L'Université Pierre Mendès France in Grenoble, March 2002.

The second chapter is based on lectures given at the Congreso Internactional de Profesores de Ingles, August 1999; le Symposium sur L'Enseignement-apprentissage de la L2 dans des Environnements Multimédias at the University of Ottawa, November 1998; the MidTESOL conference, Iowa City, October 1999; the Eighth Conference of the English Teachers' Association of the Republic of China in Taipei, November 1999; the CALL for the 21st Century ESADE/IATEFL Joint Conference in Barcelona, June and July 2000; and Le Troisieme Colloque des Usages des Nouvelles Technologies dans l'Enseignement des Langues Etrangères à l'Université de Technologie de Compiègne, March 2000.

The third chapter is based on lectures presented at the University of Illinois at Urbana-Champaign, March 2001; the University of Ottawa, October 2001; the Conference on CALL professionals and the future of CALL research at the University of Antwerp, August 2002; and Michigan State University in April 2003. The fourth chapter is based on lectures presented at a Colloquium at the Centre for Research on Language Teaching and Learning at the University of Ottawa, May1999; and the Summer School in Language and Communication at the University of Southern Denmark in Odense, Denmark, June 2001.

The fourth and fifth chapters are based on lectures presented at the American Association of Applied Linguistics (AAAL) in St. Louis, Missouri, February 2001; the LET Conference in Nagoya, Japan, August 2001; the Southern California Association for Language Assessment Research (SCALAR) Conference at the University of California at Los Angeles, May 2000.

I am grateful to those who invited to me to participate in each of these conferences and events, from which I benefited immeasurably. In particular I thank Jeanne Angel, Lyle Bachman, Susan Barduhn, Sergio Calderón, Michael Carrier, Ninette Cartes, Thierry Chanier, Jean Compain, Jozef Colpaert, Phillippe DeCloque, Lise Desmarais, Lise Duquette, Susan Gass, Susan Gonzo, Bill Grabe, Johanna Katchen, Abdi Kazeroni, Hélène Knoerr, Hsien-Chin Liou, Numa Markee, Gary Motteram, Micheal Laurier, Françoise Raby, Nora Rocca, Yasuyo Sawaki, Setsuko Hirao, Adrian Underhill, Jane Vinter, and Johannes Wagner.

I would also like to thank the students in my CALL classes at Iowa State University and my colleagues in the Grapes seminar in applied linguistics and rhetoric at Iowa State University for their comments on some of these papers and for their ongoing contributions to this work; I thank Jonathan Compton, Joan Jamieson, Jagdish Kaur, Sherry Preiss, Rafael Salaberry and an anonymous reviewer for their very useful comments and editing on the first draft. I thank Viviana Cortes for the lexical bundle analysis in Chapter 2. I thank Kees Vaes for his many years of interest and encouragement as well as for his careful editing. It is an honor for me to have this volume appear in the series of Birgit Harley and Jan Hulstijn, to whom I am grateful for their feedback and for including my book.

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Ames, Iowa
April 27, 2003

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The changing world of English language teaching

> As technologies embed themselves in everyday discourse and activity, a curious thing happens. The more we look, the more they slip into the background. Despite our attention, we lose sight of the way they shape our daily lives.
>
> (Bruce & Hogan 1998: 270)

This observation about the embedding of technology into daily life may not seem profound. Phenomena that occur gradually, such as corn growing in the summer, or a city expanding over the course of ten years are considered unremarkable and unproblematic to most people. Things change. However, as technology becomes the normal and expected means of communication and education, Bruce and Hogan (1998) point out, important changes occur in expectations about the abilities students have to acquire to be successful language users. The abilities required by English language users should be directly relevant to English language teachers. Moreover, the bond between technology and language use in the modern world should prompt all language professionals to reflect on the ways in which technology is changing the profession of English language teaching in particular, and applied linguistics as a whole. But how does one reflect on something that is invisible?

If technology has, as Bruce and Hogan suggest, slipped into the background, it may be necessary to attempt to bring it back into the foreground to explore its implications for language teachers and researchers. Explicit treatment of technology as an object of inquiry invites examination of the technology-related practices associated with language use, but it also affords the opportunity to position oneself with respect to technology within society in general and specifically within language teaching. At least three perspectives are useful to consider and perhaps ultimately to synthesize to begin to see the role of technology in English language teaching and applied linguistics.

Visions of the invisible

At the turn of the century, events and publications attempted to reveal how, where, and why technology had crept into the professional lives of all English language teachers and to predict what the continued spread of technology might mean for the future. For example, in Europe, the CALL (i.e., computer-assisted language learning) section of the International Association of Teachers of English as a Foreign Language (IATEFL) held a special conference, *CALL in the 21st Century*, in July of 2000 in Barcelona (Brett 2001). The same year, a special issue of *TESOL Quarterly* also looked to the future of ELT with a focus on technology. Both attempted to reveal how technology is likely to affect English language teaching in the coming years. They suggest broad changes that extend beyond methods of classroom instruction to changes in communication in and outside the classroom, changing needs for professional development, and changes in the English language itself. These broad themes, which have been taken up by recent publications in applied linguistics as well (e.g., Burns & Coffin 2001; Crystal 2001), shed some light on what can otherwise be the invisible force of technology.

The perspectives from applied linguists are intriguing – clearly worth exploring through a look at how futurists see technology developing in the coming years. Just as language teachers differ in their approaches, futurists' opinions about the development and spread of technology vary depending on the factors they consider important. Therefore, a balanced view of the future should be developed through multiple perspectives including those offered by technically-minded people who base their vision on analysis of existing technologies and trends, by socially-minded analysts who consider the pragmatic human and social dimensions of technology use, and by the critically-minded who question the ethical implications of technology. As illustrated in Figure 1.1, together these three perspectives suggest the need for a critical, technologically-informed pragmatism to help professionals in applied linguistics navigate the complex environment.

The technologist's vision

Futurists taking a technological perspective examine existing technologies and past patterns of change to make predictions about things to come. Such futurists gained a reputation for their over-interpretation of the goals and results of projects developed within the framework of artificial intelligence (AI) throughout the middle of the 1900s. In one introductory text, for example, the authors

Technologist's vision
of technical possibilities

Social pragmatist's view
of situated reality

**Critical,
technologically-informed
pragmatism**

Critical analyst's
perspective of technology
as not neutral
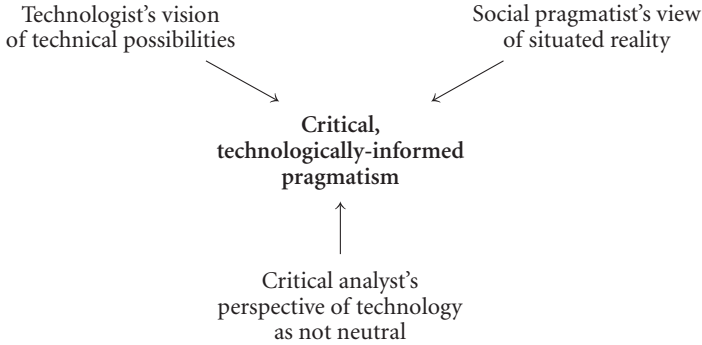
Figure 1.1 Contributing perspectives to a critical, technologically-informed pragmatism

state that "the ultimate goal of AI research (which we are very far from achieving) is to build a person, or, more humbly, an animal" (Charniak & McDermott 1985: 7). A somewhat more modest statement of goals is "to make computers more useful and to understand the principles which make intelligence possible" (Winston 1977: 1). Related to language, for example, the best known accomplishment was a computer program that could carry on a coherent written "conversation" with a human as long as the human referred to objects within a particular domain (Winograd 1972). The meaning of this work for philosophy, psychology, and engineering have been debated by major figures in these areas (e.g., Searle 1981). Thought-provoking discussion aside, the main issue for the technologist is what an accomplishment such as the human-computer conversation about blocks on a table means for the capabilities of subsequent generations of machines.

At the beginning of the 21st Century, some argue that the lack of success of AI offers strong evidence that early claims about what computers can do were drastically overstated. But while some see the glass of machine intelligence as half empty, today's futurists are quick to point out that it is at least half full, as well. Consistent with Bruce and Hogan's point about invisible technology, they argue that many of the technologies that were researched within AI projects in the latter part of the 20th century are now technologies in use behind the scenes of daily life. Such technologies, again focusing on language, include the software within word processing programs that identify words written in English, underline in red unrecognized words, and correct misspellings automatically as the user types. Still another is the speech recognition technology that people communicate with on the telephone when they call an airline to inquire

about the status of a lost piece of luggage, for example. Another is the software that recognizes an e-mail address or Web address in typed input to an e-mail message. What today's futurists do is to look at the technologies involved in developing the spelling corrector or the airline's speech recognition systems, and the speed with which these developed. They use this analysis of the past to project forward to other language recognition technologies.

One such futurist, Kurzweil (1999), predicted significant changes in areas of direct concern for English language teaching and research. In particular, he has made detailed predications about the changes he expects to take place in communication and education because of advances in technology. His analysis is based on his model of the speed of intellectual progress that he calls the "Law of increasing chaos." The idea is that with the increase of scientific understanding of how relevant systems and processes (e.g., the flow of electricity, or the phonemic recognition of an acoustic signal) operate, a decrease occurs in what he calls "chaos." A decrease in chaos, alternatively an increase in order, is what facilitates intellectual and scientific progress, and therefore technological progress (Kurzweil 1999: 29). Based on his analysis of decreasing chaos, Kurzweil predicts that within the next 20 years, a large portion of communication will take place between humans and computers. In other words, the computer that answers the phone at the airlines will be joined by phone-answering computers of other businesses as well as those that may greet customers at the gas station, dry cleaners, and grocery store. If this prediction actually plays out as he predicted, English language learners would need communicative competence not only for the events, interlocutors, and media typically covered in language course books (e.g., calling the human travel agent on the phone, asking the salesperson for two bananas) but also for the interactions that may take place through oral and written communication with a computer (e.g., requesting a hotel room on a Web page or paying a bill with a credit card through a phone call to a computer).

Kurzweil also predicted that much of the instructional time learners spend will consist of interaction with a computer. In higher education, attempts to lay the groundwork for this vision can be seen as faculty are encouraged to get courses on-line. In English language teaching, on-line courses have been or are being developed by the major publishers and providers of English language teaching. Kurzweil's vision extends beyond the current reality of such courses, which rely on existing technologies of selected-response questions (such as multiple-choice), multimedia presentation, and computer-mediated communication in chatrooms and discussions, for example. The vision is that the coming generations of such courses will include an interface and learning tasks that

model interactions with a private human tutor. The suggestion is reminiscent of Charniak and McDermott's (1985) provoking statement that the goal of AI was to create a person. And like the claims of his predecessors, Kurzweil's predictions have been criticized by many, including the social pragmatist, who observes what is practically feasible in the real world.

The social pragmatist's vision

Brown and Duguid (2000) revise the technologist's picture of the future with anecdotes of how the technological possibilities line up against their real experience in working with information and communication technology in business. They argue that predictions about the speed of technology integration are grossly over-estimated because they are based on examination of technology alone: The technologist's view "isolates information and informational aspects of life and discounts all else. This makes it blind to other forces at work in society" (p. 31). They illustrate their basic point with an anecdote about trying to get client software installed on a home computer from a commercial Internet provider after having to discontinue receiving e-mail from the office computer at home, despite the fact that this method had been used for several years. The unfortunate protagonist in the story had been able to receive the e-mail coming to his office due to a leak in the company's firewall, but he did not realize that he was getting the desired mail flow due to an error. The epic adventure of identifying the problem, and then finding a solution will draw empathy from any one who uses a computer: It consists of many days of computer crashes and repeated explanations to different people without achieving resolution. It includes multiple modes of communication over a long, frustrating sequence that, if not recorded, would be impossible to reconstruct. The scenario (and its credibility) supports their contention that technologists' projections are unrealistic:

> The more cavalier futurists sometimes appear to work with a magical brand of computer not available to the rest of us. It's hard to believe that if they had to work with the inexplicable crashes, data corruption, incompatibilities, buggy downloads, terrifying error messages, and power outages that are standard fare for most, they could remain quite so confident. ... (p. 69)

Brown and Duguid's observations about technology in society are relevant for English language teaching. Their observations and the credible supporting anecdotes about the difficult and frustrating reality of working with technology is set in the United States, where one might expect that technological knowl-

edge and capabilities may be most readily available. It is difficult to imagine that potential on-line learners around the world face fewer obstacles as they attempt to learn English on-line from their homes. The technology presents a new set of issues for an English teacher. How does the teacher respond to a student in Chile who did not contribute to the required on-line discussion because his Internet service provider (ISP) changed the requirements for the modem the student needed, and even though the student bought the new modem, it did not work, and the ISP referred the student to the modem company in the United States? Such a scenario would include an e-mail to the teacher from the student's friend explaining that the student had called the modem company repeatedly, but only got an answering machine that presented him with so many options that it was unclear how to proceed with the phone call.

The pragmatic reality of day-to-day technology use offers a contrasting balance to the vision of the technologist. The social pragmatist points out that the latter has captured the imagination of those in the media who forecast sweeping social consequences of the technologist's predictions, such as the end of such institutions as companies, universities, and governments at the municipal, state, and national levels. Brown and Duguid expose the pro-technology discourse that glorifies the "information" as both the impetus for ending social institutions and the solution to all problems. They argue not against change in general, but suggest "that envisioned change will not happen or will not be fruitful until people look beyond the simplicities of information and individuals to the complexities of learning, knowledge, judgment, communities, organizations, and institutions" (p. 213). Their critique is intended as a moderating voice in what they see as the under-informed and misguided discourse on technology. In this sense, their message resonates with that of the critical analyst.

The critical analyst's perspective

Unlike the technologist or social pragmatist, the critical analyst does not accept the idea that the development and use of technology constitutes the natural evolution of society, but instead questions the underlying assumptions that technology is inevitable, positive, and culturally neutral. Like the social pragmatists, critical analysts seek alternatives to the mainstream images that glorify access to information. One critical analyst's reinterpretation of the media-generated positive images of the Internet illustrates the alternative-seeking mission of the critical analyst:

> ...the Internet could be looked at as one giant garbage dump: people and or-
> ganizations dump information in bits and pieces; they also retrieve whatever
> is of use and interest to them. What is found by scavengers depends on where
> they dig, what is dumped, and what is considered useful or relevant enough to
> be retrieved.   (Franklin 1999: 144)

Part of the critical mission is to expose the origins and bases of ideas that appear on the surface to be the normal or natural way of perceiving technology. Focusing on education, Bowers (2000) suggests that the glorification of data is part of the implicit ideology conveyed at the universities:

> Within the educational institutions that promote high-status forms of knowl-
> edge and certify the scientists, journalists, and other experts who promote
> consumer-oriented technological culture, the pervasive influence of comput-
> ers has contributed to the acceptance of data as the basis of thought. (p. 11)

His extensive analysis appears in a book entitled *Let them Eat Data: How computers affect education, cultural diversity, and the prospects of ecological sustainability,* which weaves together concerns about the glorification of information with issues of the hegemony of technology from a cross-cultural perspective. Of particular interest is his analysis of the values and underlying perspectives portrayed through the use of technology in education. He suggests that technology helps to portray knowledge as explicit and decontextualized through focus on data, information, and models. Such knowledge is conveyed through texts of unknown authorship, frequently delivered as a result of what Franklin describes as a search through the "garbage dump" of the Internet.

In contrast to the mainstream image of computer-mediated communication as the panacea of e-learning wherein learners expand their sociocultural horizons as they learn through collaboration, Bowers offers a different interpretation:

> Just as data should be viewed as a degraded form of knowledge, computer-
> mediated communication should be viewed as a degraded form of symbolic
> interaction – one that reinforces the rootless individual who is comfortable
> with the expressions of self-creation that the computer industry finds prof-
> itable to encourage.   (Bowers 2000: 47)

Bowers obviously sees computer-using educators who uncritically accept the inevitability of e-learning as complicit with the interest of leaders in industry whose interest is served by developing consumer citizens of cyberspace. He suggests that this motive is far from culturally neutral as "...the characteristics of 'cyberspace citizens' represent the most extreme individualism at the

heart of Western liberalism – creative, experimental, emancipated from traditions and supposedly altruistic enough to use power only for the betterment of humanity" (p. 118).

The critical perspectives represented by Franklin and Bowers recognize themselves as a minority voice against the "technological euphoria and the authoritative tone" (Bowers 2000:4) of the technologists who take "for granted the Western myths that represent change as linear, progressive, and evolutionary and view themselves as spokespersons for an emergent universal culture" (Bowers 2000:8). The authoritative words of the technologist comprise a plentiful and lush harvest for critical discourse analysis. Not only do the technologists paint their picture with many new words such as the ones that Brown and Duguid highlight (e.g., demassification) that add to the futuristic tone of the discourse, but they also construct their message with such positive and progressive language so as to cast those who question the message in a negative and retrogressive light. "The result is an ongoing and often bitter contest between two extremes: those who view technology as the ultimate panacea for all educational ills, and those who cling to traditional values which they argue are being destroyed by the infiltration of digital media into instructional spaces" (Rose 2000:2).

Through her critical discourse analysis of the language that she associates with the "pro" and "con" stances toward educational technology, Rose depicts the challenge educators face if they wish to learn and teach through and about technology without at the same time becoming caught up in the uncritical support of the technological way of life that concerns Franklin and Bowers. She points out that

> …the formation of these two distinct schools of thought has the unfortunate effect of encouraging all of us to do likewise: to become eager proponents or angry deriders of educational computing. When it comes to consideration of the role of technology in our schools, there appears to be no reasoned middle ground…. The problem with such extreme stances is that they tend to preclude a serious consideration of what it really means to learn with a computer or to think about learning in terms of digital technology.   (Rose 2000:xi)

The paradox offered by critical perspectives on technology is no stranger to English language teachers, who have been duly warned about their complicity with imperialistic motives as they engage in the political act of English language teaching (Phillipson 1992).

The fundamental issue, according to critical applied linguists, is that teachers need to recognize that English language teaching is inherently value-laden.

Pennycook (1999) summarizes the position that motivates much of the work in critical pedagogy in TESOL:

> Given the global and local contexts and discourses with which English is bound up, all of us involved in TESOL might do well to consider our work not merely according to the reductive meanings often attached to labels such as *teaching* and *English* but rather as located at the very heart of some of the most crucial educational, cultural, and political issues of our time.
>
> (1999: 346; italics in original)

In the 21st century, English language teachers apparently need to add another thick layer to the object of their critical reflection – technology.

Visioning the future of ELT

A vision of the future of English language teaching and applied linguistics needs to be informed by the contributions of all three of the perspectives. All agree that technology is a force worthy of consideration, whether one wishes to focus on the technological potential, to examine pragmatic technology use, or to criticize both. But how can the three perspectives inform a new vision of the profession? The three positions need to be balanced to suggest implications for the profession, as shown in Table 1.1. The picture that the technologist paints seems to have enough credibility and significance for teachers and researchers in ELT that it would seem responsible to seek knowledge about technological possibilities that could change the profession for the better or worse. At the same time, teachers and researchers should remain skeptical of the precise predictions made within the technologist's "tunnel vision" (Brown & Duguid 2000: 1), and should carefully analyze real options in view of the experience of others and their own context and experience. Perhaps even more so than any other professionals, ELT practitioners need to be critically aware of the connections among technology, culture, and ideology, and specifically about the ways in which technology amplifies and constrains aspects of language learning and research. In short, a balanced perspective for English language teaching today might be a critical, technologically-informed pragmatism. Elements of such a perspective are evident in analyses that examine the complex of factors that make computer-mediated communication different from face-to-face communication for language teaching (e.g., Salaberry 2000) in contrast to the one-sided advocacy for computer-mediated communication for language teaching.

Table 1.1 Summary of three perspectives on technology and implications for ELT

Vision of the...	Focuses on...	Perspective	Implication for ELT
Technologist	Technological potentials	Rapid advances in technology suggest pervasive access to and use of technology in a very different high-tech life style.	Teachers and researchers should be educated about possibilities that could improve or change their work.
Social pragmatist	Human practices in technology use	Imperfect technologies and normal human working practices act as constraints affecting technology use.	Teachers and researchers should carefully analyze their real options in view of the experience of others and their own context and experience.
Critical analyst	Value implications of technology	Technology is not neutral and inevitable.	Teachers and researchers should be critically aware of the connection between technology and culturally-bound ideologies.

These perspectives on technology hint at the broader context where work in applied linguistics is situated, but to see how critical, technologically-informed pragmatism plays out, it needs to be linked to the specifics of English language teaching. In particular, we need to examine the ways in which technology touches English language learners, their teachers, and teacher education.

English language learners

Most English teachers would agree that their students need to practice using English outside the classroom if they are to increase their communicative competence, but "practice" can consist of many different types of English language use. As an ESL teacher at large research universities in the United States for most of my career, I have always been fascinated to observe how and where the international students (i.e., my students) at the university chose to spend their time out of class. Their out-of-class experience was interesting because I wanted to note the extent to which it constituted the type of English language practice I thought would be beneficial. In particular, I used to notice the large number of international students who populated the public computer labora-

tories on campus at all hours of the day and night. At large universities, these labs are open seven days a week, fifty-two weeks a year, and so one can observe at 1:00 am on January 1, for example, a room that may be more sparsely filled than usual, but that nevertheless contains a remarkable number of international students sitting at the computers, quietly typing on the keyboard. Today, of course, the language they are reading on the screen might be Chinese or Spanish, because although the majority of language on the Internet remains English, other languages appear today in large quantities as well. However, ten years ago when I made the same observation, students sitting in the computer lab at 1:00 am were almost certainly using English, and when I saw them 20 years ago, the language was definitely English.

This observation was not part of a research study. I was studying other things, and often showing up at the computer lab to pick up my statistical results that I had submitted from home or another lab. But this observation was important to me and I have remembered it and informally made it repeatedly across time and at universities in different parts of the United States. It is relevant to changes prompted by technology for English language teaching for three reasons. First, it frequently appeared to me that the students in the computer labs chose to be there because peers were there. They may not have been interested in practicing their English except insofar as it let them engage in activities that brought them out of their rooms and into a place where their peers were. Second, the fact that computers were involved, and that interacting with the computer often required them to use English at least part of the time, meant that the English they used was in a way shaped by the technology. For example, if the editor on an older system asked "Do you want to save the newer version (Y/N)?" the ESL learner needed to understand the question, and to do so, might turn to the person at the next computer to ask a question which would refer to the printed question, and would receive a response, likely to be focused on the same topic. My third observation was that the linguistic demands for using English in the computer lab were something I should consider as a teacher who was trying to teach students the English they needed in academic life. These three observations were my personal discovery and experience of three familiar and important constructs in English language teaching: motivation, registers of language use, and communicative language ability.

Motivation for English use with peers

Twenty years ago the computer lab was a place for peers at a university to meet and work on the computers, but the modern day version of communica-

tion and collaboration among peers at their computers has expanded beyond the computer lab. Rather than requiring learners to meet in a single physical location, the Internet is host to new spaces in which learners communicate through chat rooms, e-mail, and discussion groups. Some of these meeting places are constructed specifically for ESL learners, but most, like the physical computer lab, are places where people come to meet with their peers while they are working or playing.

A study conducted in the late 1990s offers some insights into the motivation of ESL learners as it relates to Internet communication by providing an in-depth look at how one learner was afforded opportunities for successful use of English through technology. Lam (2000) described the ESL learner, Almon, in the US who began using the Internet as a means for developing his interest in a Japanese singer:

> After attending an introductory class on E-mail and browsing for information on the web in a high school from which he would soon graduate, he continued to look up websites for tutorials on how to make personal home pages and conduct on-line chat. By Fall 1997, when he began his studies at a local Junior College, he had almost completed a personal homepage on a Japanese pop singer, had compiled a long list of on-line chat mates in several countries around the world, and was starting to write regularly to a few E-mail pals.
>
> (Lam 2000: 467)

In reading this study, I am reminded of the late night computer lab, where the students appeared to have been motivated to come to escape the solitude of their dormitory rooms and apartments by engaging in some intellectual activity and interacting with other like-minded students.

Lam's study is particularly compelling because she was able to gather evidence about the changes that the learner detected about his English and his identity as an American. As summarized in Table 1.2, before he got involved in the Internet community, he was overwhelmed, feeling that English was the worst problem he faced, that he did not belong in the United States, and that his English would never improve. She noticed that after he had spent two years working with these communities on-line, his observations were much different. What had started as an interest in the Internet as a venue for expression of his creativity and interest, developed as motivation and desire to communicate with his newly-found friends, and apparently resulted in a process of positive personal and linguistic development. He had not sought to practice English; nor did he seem to be set on increasing his technological skills for the sake of

Table 1.2 Summary of an ESL learner's comments *before* and *after* entering Internet discourse communities

Before Internet	After Internet
"English is my biggest *problem*"	"I've improved, it's because of ICQ or e-mail or other reasons…"
"It's like this place [the US] isn't my world…"	"…now I feel there's nothing much to be afraid of… it was my [Internet friends] who helped me to change and encouraged me."
"…my English won't be that good even in 10 years."	"I'm not as afraid now."

(summarized from Lam 2000: 467–468)

having these credentials. The technology and English, hand in hand, were the tools needed to accomplish what he wanted to do.

Technology-shaped registers of English use

The students I saw in the computer labs often sat quietly reading from the screen and typing on their keyboards, perhaps single commands to perform such functions as copying a file from one location to another, instructing the editor to show lines of the program code, run the program, or print the output of the program, for example. Today, they click on buttons to search, read the lists resulting from the searches, and click on words on the screen. Sometimes a student looks away from his or her own terminal to ask another student a question, and the response usually consists of a few words given orally interspersed with pointing at the terminal and typing at the keyboard. One might call these varieties of English that are used to interact with the computer and with others in the immediate location "labspeak." A study about fifteen years ago looked carefully at the oral labspeak that ESL learners used while working in pairs at the computer. Piper (1986) documented many instances of what I would call labspeak, concluding that the conversational "spin-off" from pairs working in front of a computer screen could be characterized as a reduced and incoherent register, the implication being that such tasks were probably not valuable for English language teaching.

But do the linguistic features observed in this study really indicate that engaging in labspeak does not constitute valuable language practice? It is interesting to note another study that looked at ESL learners' labspeak as they collaborated in several different tasks in front of the computer, and that interpreted the data from a more functional perspective. Rather than expressing

concern over the form of the language, Mohan (1992) recognized that the lab-speak was used for "problem-solving discussion," noting that the "computer can offer communication tasks with high cognitive demands and high contextual support" (p. 124). The implication of this analysis better resonates with my personal experience using labspeak in my second language, French. Moreover, it better explains my observation that labspeak is among the most satisfying uses of French that I have experienced because with a limited vocabulary, moderate pronunciation, and the support of the finite set of objects and events in the immediate context, I can almost fully succeed as a speaker of French labspeak. I can direct confused people to find the printer in the other room, inform the third, fourth, and fifth person who sits down at the machine next to me that it doesn't work, ask how to type the "@," find out what the password is, and if someone is using the machine I want to work on, I can ask them how long they will be on it. My knowledge of the technology and my presence in the lab give me access to a speech community which uses a register in which I can solve precisely the communication problems that arise.

Computer labs where learners are physically present to participate in lab-speak represent only a small-proportion of the speech communities that ESL learners have access to through the use of technology. The Internet connects learners to a wide range of discussions and information such as the group that Almon, the student in Lam's study, got involved with. Crystal (2001) discusses e-mail, chatgroups, virtual worlds, and the World Wide Web, to explore the nature of "Netspeak." Through his exploration of the linguistic features traditionally used to identify a linguistic variety, Crystal helps to describe the varieties of Netspeak in use in each of these Internet situations, i.e., the graphical, lexical, syntactic, and discourse features. From the perspective of discourse, for example, he points out that e-mail often consists of text interspersed with what was written in a previous message and a reply to that such as the following:

> >Since this page is so weak, could we please have the faculty homepage
> >link as an option on this page?
> I'm not sure what you mean here (not the "weak" part...I get that), ...

In chatroom language, the graphical representations frequently consist of abbreviated forms such as "u" for "you," and in virtual worlds, participants regularly make up new lexical forms. Analyzing the language of electronic communication, Murray suggests that participants in a specialized Netspeak register might usefully be thought of as a speech community, which she defines as "a group of people who share linguistic and non-linguistic interaction but whose norms may be evolving or may be the site of struggle" (2000: 399).

It is difficult to estimate the extent to which English learners around the world have access to and take advantage of such English-using speech communities on the Internet. Was Almon a typical ESL learner or an odd case? Data gathered and displayed by those working in international marketing suggest that speakers of languages other than English increasingly have access to the Internet. For example, Global Reach (http://www.glreach.com/globstats/) estimates that in 2002 over half (i.e., 59.8%) of the world's population with access to the Internet were native speakers of languages other than English. These figures need to be interpreted in view of the fact that such estimates are difficult to make and that Global Reach is in the business of promoting multilingual Websites for business. Nevertheless, the point is that access to the Internet extends far and deep beyond the English-speaking world. Other publications (such as *Cyberatlas*) on the Internet that publish statistics about who is using the Internet, attest to the steady growth of speakers of languages other than English. Complementing these quantitative data, a collection of qualitative studies conducted in the late 1990s and reporting on Internet use by speakers of other languages supports the view that significant types of Internet use extend beyond the English speaking world. Other research has indicated that computer (not necessarily Internet) use was very widespread among English language learners internationally in the late 1990s, although regional variation existed, and undoubtedly still does (Taylor, Jamieson, & Eignor 2000).

Of course, having physical access to a computer and the Internet only opens the door to opportunities for participating in English language speech communities that may be beneficial for language development. Research on learners living and working in English-speaking communities has revealed that learners also need to feel that they have the right to step into the room. In other words, individual perceptions of identity play a role in deciding to what extent the learner will participate in an English-speaking speech community (Peirce 1995). Internet speech communities clearly put a new twist on the constraints learners feel about contributing in face-to-face communication. Learners can avail themselves of a large amount of input, participate in interactions without revealing their true identity, and author Web pages that unknown people may look at if and when they are interested. They can lurk in a discussion perhaps to benefit from the input without being pressed to produce any language. If and when learners choose to participate, the interactive written language in computer-mediated communication on the Internet means that learners do not have to reveal an accent in their oral language, and they have more time to reflect on and even correct their language, if they choose to do so. Perhaps like the satisfaction I feel with my French labspeak, at least some learners seem

to attain satisfaction by taking on opportunities afforded by Internet speech communities in English. But certainly participation in Internet speech communities in English requires something from the participant in addition to access, interest, authority, and time. What are the language abilities required to participate successfully in Internet communication?

Communicative language ability for the 21st century

The question of what abilities are required for using English on the Internet is the modern realization of my concern many years ago about the language abilities my students needed to participate in labspeak. Language teachers plan their instruction with the goal of increasing learners' communicative language ability, but precisely what the construct means depends on the situations in which the learners will use English in the future. The clearest example of this principle is in English for specific purposes classes which focus on the abilities needed to work as a doctor, a secretary, a sales representative or an engineer, for example, through practice with the type of registers (e.g., the conversations, written texts, and lectures) that are prevalent in these professions. Even in courses targeting "general" communication skills, however, particular conversations, written texts, and lectures are chosen as sufficiently representative to warrant inclusion. In a general English course, for example, a teacher would be unlikely to choose a conversation between an ostrich rancher and a veterinarian in which the veterinarian is giving instructions on how to increase the production of eggs by shouting across a barn in which animals are making noise. The situation is too uncommon, and therefore the language that one might learn from practicing with it (e.g., now pretend that your ostrich has been tired lately and has no appetite, and shout over to the vet about that. . .) may not apply to the situations where the learners need to use English.

In contrast, conversations taking place through Netspeak or Labspeak varieties of English are likely to be common for English language learners' future use of English, and therefore, the question for teachers is what abilities are required to participate in the conversations, to read and write the texts, and to comprehend and produce oral language through technology? In other words, is there a specific and different "communicative language ability with technology?" In many language programs, the curriculum distinguishes between oral and written language teaching explicitly (e.g., with different courses) on the assumption that the two modes should imply different abilities to be learned. But what about computer-mediated communication? Does this represent a third mode, and a third set of abilities that students should be learning?

Crystal's analysis of the registers that he broadly calls "Netspeak" leads him to the conclusion that "[t]he electronic medium…presents us with a channel which facilitates and constrains our ability to communicate in ways that are fundamentally different from those found in other semiotic situations" (Crystal 2001:5). Given an essentially different way of communicating, he further argues that language users have to "acquire the rules (of how to communicate via e-mail, of how to talk in chatgroups, of how to construct an effective Web page, of how to socialize in fantasy roles)." He suggests that while rules must be acquired, it is difficult to pin down exactly what those rules consist of because "there are no rules, in the sense of universally agreed modes of behavior established by generations of usage" (Crystal 2001:14–15). In other words, whereas English teachers can teach the generic conventions and typical register choices of the business letter, the face-to-face service encounter, and the weather report, for example, Crystal suggests that identifying the typical generic choices for the e-mail message or chatroom conversation would be much more difficult. Salaberry (2000) works toward an analysis that might ultimately help to systematize and understand the moves made in electronic communication through analysis of the sociolinguistic parameters operating in these contexts of communication. For the time being, therefore, teachers' best option might be to show examples and help students to become more aware of the effects of the linguistic choices they might make in these registers.

Whereas Crystal offers a close look at the language of electronic communication, Rasool (1999) focuses on the context in which communication is used. The implication appears to be the same: that applied linguists need to reconsider the meaning of communicative competence implied by modes of communication in the modern world, which includes such complexities as rapidly evolving technologies, multimodal texts, the large volumes of texts and information, and our physical capability to interact with texts and information. In view of these observations about effects of technology, Rassool argues that the construct of communicative competence needs to include the idea that information technology comes into play in the meaning making process: "Ultimately, communicative competence refers to the interactive process in which meanings are produced dynamically between information technology and the world in which we live…" (Rassool 1999:238). Suggesting the implications of this view for English language teaching, Warschauer (2000) argues for capturing the idea that new language and literacy skills are needed for effective communication by replacing the target constructs of reading and writing in English language teaching with the broader abilities he calls reading/research and writing/authorship (Warschauer 2000:521). In essence, he suggests that a strategic

dimension be explicitly included in these constructs. These observations about the need to reconsider communicative competence in light of technology seem to head in the right direction, but they may go too far, as much communication today continues to take place *without* the use of information technology!

In fact current theory of communicative competence is framed in a way that allows for, or actually requires, a conceptualization that includes contexts in which information technology is used as a topic, an interlocutor, or a vehicle of communication. A theory that expresses communicative competence as a context dependent construct was articulated over ten years ago: *communicative language ability* – the ability to deploy the appropriate language knowledge and strategic competence for a particular context (Bachman 1990). This suggests that the context, which refers to all situational factors that have been described by linguists as, such as the topics being discussed, the participants in the language use, and the mode of communication (Halliday & Hasan 1989) is critical in the analysis of the specific abilities required to do something in a particular context. If the topic of discussion is how to get the computer to print out the entire page that appears on the computer screen, this topic calls for knowledge of particular vocabulary and functions, for example. If the interlocutor is the computer, knowledge of the language of the disk management, for example, is needed to communicate. I once lost a file that I needed on my disk because I responded incorrectly to a question in Danish which in retrospect I think must have asked if it was ok to write over the file that I was trying to open. If the computer is the mode of communication, the situation described by Crystal is apt – the rules for engagement are different depending on the particularities of the communication.

In short, the general perspective for conceptualizing communicative language ability through technology has been formulated through work in applied linguistics over the past fifty years. While the framework exists, the particulars require careful study and analysis. What does technology mean for the additional kinds of strategies that must be a part of strategic competence? For example, what strategies are involved in a chat room where written messages are exchanged among unfamiliar people? What does it mean for aspects of language knowledge or aspects of pragmatics for coping and dealing with a variety of technology-mediated situations? Answering these questions requires careful analysis of the contexts of communication, the registers, and the strategic competencies they draw on as Rassool, Crystal, Salaberry, and Warschauer are doing.

An understanding of these contexts, registers, strategies and abilities is essential in view of the fact that learners will have to be able to control them if

they are to attain communicative competence today. Such abilities are becoming normal and expected as technology disappears: "We cannot simply choose our tools (i.e., to write longhand, use a typewriter, a word processor, or e-mail) in order to be literate participants. Instead, the technology chooses us; it marks us as full, marginal, or nonparticipating..." (Bruce & Hogan 1998:271). The words "marginal" and "nonparticipating" from the technology literature ignite the passion of anyone concerned with teaching language learners who struggle to gain the communicative competence required to participate in English speech communities.

English language teachers

The perspectives of the technologist, social scientist, and critical analyst offer teachers food for thought about their roles in the changing world of technology. Some members of the profession have adopted the stance of the technologist, projecting and promoting great possibilities for the future while highlighting the successes of today's on-line learning opportunities for English language learners. I've noticed that level-headed teachers tend to be put off by the euphoric discourse of their colleagues who take up technology with what seems like religious conviction. On the other side, most of the voices from critical pedagogy in ELT have been so preoccupied with the hegemony of English that they have not yet gotten their analytic teeth into what may be an equally hegemonic force. Nevertheless, some critical analysts both within ELT and in other areas have been careful to note that the choices teachers make about technology use in the classroom constitute a political act that portrays their complicity with Western-style corporations and consumerism. Cummins' (2000) moderating perspective helps to articulate the middle ground for English language teaching:

> Rather than dismissing IT as another corporate plot, as many critical educators have tended to do, or lamenting its perverse impact on educational priorities, we should acknowledge the fundamental changes that IT is bringing to our societies and seek ways to use its power for transformative purposes.
>
> (Cummins 2000:539)

Four examples below show the fundamental changes technology is bringing to ELT even if these changes may not be seen as "transformative" from the view of the critical analyst. From the perspective of the social pragmatist they document the actual conceptual and practical changes affecting English language

teaching because they affect the English language, methods for its study, tasks for language learning, assessment, and research.

The English language

All languages evolve over time as they are used by a variety of speakers with different needs (Aitchison 2001). As a counter measure to such natural change, standards-setting forces such as dictionaries, writing, publishing, and broadcasting have succeeded in maintaining some standards and resistance to change. One observer of linguistic trends in English, Graddol, notes that the days of the standardization through these means may be gone: "…with increasing use of electronic communication much of the social and cultural effect of the stability of print has already been lost, along with central 'gatekeeping' agents such as editors and publishers who maintain consistent, standardized forms of language" (2001:27). Graddol's vision of the loss of standards seems at least somewhat overstated. Even though many more authors are succeeding in getting their own unedited ideolect in print on the Web, keepers of the standards seem unlikely to be shaken by what many consider "bad language" (Andersson & Trudgill 1990).

Rather than the loss of standardized forms of English, these forms now co-exist with a wide variety of native and non-native varieties. The Internet is a site for language contact, as language users from around the world contribute pages and comments in many different languages and language mixes. A search for Web pages on a topic such as the famous singer Céline Dion returns thousands of pages on which words of English appear in a mix with other languages, images, and sound. This multilingual, multimodal combination of expression further expands the varieties of communication in which English plays a role (Kress & van Leeuwen 2001), and these pervasive, new hybrid varieties deserve additional study.

The study of language

The study of every level of the linguistic system has changed because of technology. At the discourse level, the language of electronic communication creates the impetus for robust theory to help make sense of new registers with their own conventions. The study of phonology includes methods for speech recognition and synthesis that have pushed former limits of knowledge. The study of grammar has been affected dramatically by computer-assisted meth-

ods through corpus linguistics, which has changed how grammar is studied as well as who can conduct research on English grammar.

Corpus linguists study language in electronically stored texts through the use of computer programs that search and count grammatical features. Whereas the former authoritative descriptive grammar of English (Quirk, Greenbaum, Leech, & Svartvik 1972) was based on a methodology described as the authors' research and interpretations of linguists, the recent Longman grammar (Biber, Johansson, Leech, Conrad, & Finegan 1999) is based on empirical analysis of electronic corpora. The move from intuition-based approaches to data-based approaches puts the native and nonnative speaker of English on a more even playing field when it comes to research and teaching of English grammar.

Based on her view of grammar from the corpus linguist's perspective, Conrad (2000) makes three predictions about the effects of corpus linguistics on language teaching: First, she suggests that monolithic descriptions of English will give way to *register-specific* descriptions. Conrad illustrates the importance of register-specific description with the example of linking adverbials (e.g. but, however, therefore, etc.) showing how they are used across three registers: conversation, news reportage, academic language. Conrad points out that linking adverbials are used less than half as frequently in news reports as they are in conversation or academic prose and that particular adverbials are chosen with different frequencies depending on the register. She concludes that adverbials should be introduced and practiced in view of the registers in which they are actually used. This observation about grammar is complemented with one from the study of lexical phrases such as "as shown in Figure 1" which are frequent in professional biology writing, but much less so in other genres (Cortez 2002).

A second prediction Conrad (2000) made is that the teaching of grammar will become more integrated with the teaching of *vocabulary*. She presents examples of the way in which verb complements are tied to particular verbs:

a.   Everyone says to eat vegetables.
b.   Everyone says that you should eat vegetables.

Both sentences are grammatically correct, since the verb *say* can have a *to-*complement or a *that-*complement. I remember teaching grammar from intuition-based grammars years ago that would require the learners to memorize lists of verbs with their complements, and so the learners would memorize the fact that *say* can take both complements. The work in corpus linguistics, however, provides more useful information than all the grammatically correct possibilities. It also tells which complements are actually chosen with

the greater frequency by proficient English users. For the example above, *that*-complements are more frequently used with *say.* So, what do we want to teach, considering that most time, students will come across and need to use *that*-complements? The link between grammar and vocabulary has been taken up in both second language acquisition theory (e.g., N. Ellis 2001; Skehan 1998) and teaching methodology (e.g., Lewis 2000), but corpus linguistics provides the essential methodology for identifying lexical combinations that are actually used and with what frequency.

A third influence Conrad predicted is that focus on grammar teaching will change from structural accuracy to *appropriate conditions* of use. Her examples are the two grammatically correct sentences used in different situations:

a.   "It should be recognized, however, that not everyone wishes to display power."
b.   "That not everyone wishes to display power should be recognized."

Again, here, the fact that the two syntactic structures are possible in English is far less useful to the learner than the fact that the structure in example (a) is more frequently used, and that (b) is a variant used to signal that the that-clause deserves particular attention in the topic position. For the learner knowing that both are grammatical is much less useful than knowing which one is the unmarked structure and under what pragmatic conditions the marked structure is used.

These insights coming from computer-assisted corpus linguistics studies concerning links of grammar to register, lexis, and pragmatic choices have been important for changing the profession's view of grammar and how it should be taught. Changes in perspectives on grammar and in who can offer authoritative perspectives on grammar are altering how grammar is taught, and the use of corpora of oral language is likely to provide more insights and teaching resources in the future.

Tasks for language learning

Technology-mediated L2 learning tasks are discussed more extensively in Chapters 2 and 3, but they are introduced here as comprised of two types of tasks that teachers can construct for their students. One type of task is developed from software for computer-mediated communication (such as e-mail or chats), whereas the other is based on interactions between the learner and the computer (such as hypermedia listening or concordancing).
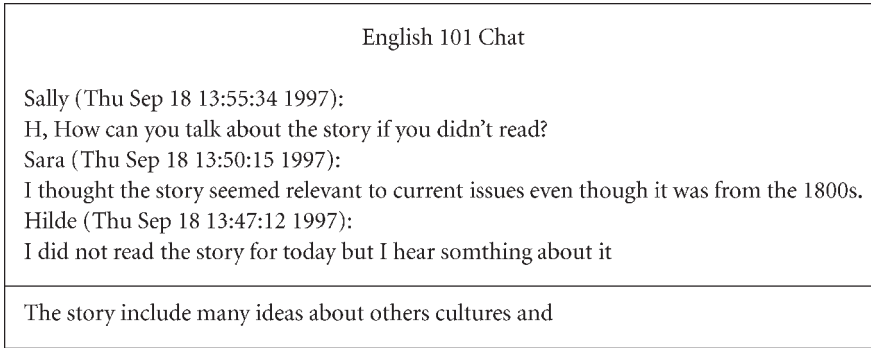

English 101 Chat

Sally (Thu Sep 18 13:55:34 1997):
H, How can you talk about the story if you didn't read?
Sara (Thu Sep 18 13:50:15 1997):
I thought the story seemed relevant to current issues even though it was from the 1800s.
Hilde (Thu Sep 18 13:47:12 1997):
I did not read the story for today but I hear somthing about it

---

The story include many ideas about others cultures and

Figure 1.2 An example of a screen for a chat room or a computer-assisted classroom discussion

Computer-mediated communication

The software for computer-mediated communication, or "CMC" as it is called, can allow for either synchronous or asynchronous communication. Synchronous means that the communication is taking place in real time, so learners might, for example, sit in the computer lab during the course period to read and respond to each other's messages discussing a story that they have read, as illustrated in Figure 1.2, which shows one learner's text partially typed in the bottom frame and the dialogue that has been constructed so far on the top. The same type of chat can take place over the Internet and can be conducted through voice messaging as well as text, or a combination of the two. Asynchronous communication allows learners to read/speak and write/hear electronic messages, which are stored on a server to be produced and accessed anytime, so the process of communication can be spread out across hours, days, weeks, or months. A number of books describe tasks developed through CMC (Egbert & Hanson-Smith 1999; Swaffar, Romano, Markley, & Arens 1998), and several researchers have investigated their use (e.g., Chun 1994; Kern 1995; Warschauer 1995/1996).

CMC activities can involve a variety of participant configurations including one individual sending messages to another, one individual sending to many others, groups sending to other groups, etc. The technology adds new and interesting dimensions to the tasks developed through the Internet and can therefore change critical dimensions of the task situation. For example, rather than being confined to the topics for which the teacher brings enough information or for which students can rely on their own knowledge and opinions, learners can discuss information and opinions of others, as well as news
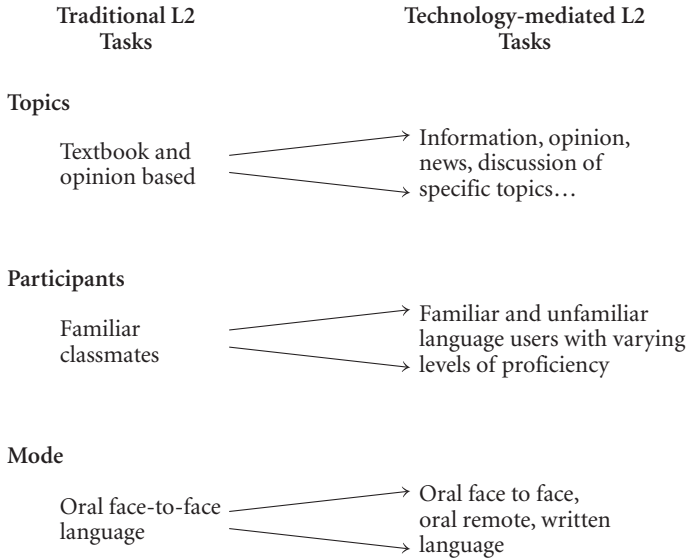
	Traditional L2 Tasks	Technology-mediated L2 Tasks

Topics

Textbook and → Information, opinion,
opinion based → news, discussion of
→ specific topics…

Participants

Familiar → Familiar and unfamiliar
classmates → language users with varying
→ levels of proficiency

Mode

Oral face-to-face → Oral face to face,
language → oral remote, written
→ language

Figure 1.3 Expanding options for L2 tasks with technology

and specific topics through bulletin boards. Participants in these activities are not limited to familiar classmates, but also involve unfamiliar ones in other countries. The feasibility of tasks not confined by distance provides the opportunity to develop tasks requiring learners to communicate with proficient speakers of English, knowledgeable informants, and interesting interlocutors, none of whom might be available in the classroom. The tasks can consist of both written and oral language, but most interesting from the perspective of language teaching are the valuable opportunities afforded by written interactive exchanges. This mode, which allows the learner time to reflect on the language (both during and after production) while engaging in interaction appears to have the best of both modes for the learner. Figure 1.3 illustrates the expanded options afforded the teacher through the use of technology relative to classrooms that rely on the use of paper textbooks alone.

The expanded options shown in Figure 1.3 do not suggest that the capabilities afforded by the technology-based tasks are impossible to configure in classroom tasks. Instead the point is that the normal procedures and constraints existing in the classroom of paper-based books and materials offer fewer options relative to the normal means of developing tasks through technology. Developing technology-based tasks is within reach of more and more English language teachers who can, for example, set up a listserv with the help of the computer

support staff or through the use of instructional software tools for the Web. After the instructor has created a list or discussion group, any one in the class can register or subscribe to the list, compose a message and mail it to the group. A listserv will distribute the message to all members of the class and a news group will post the message at the location where all can see it. These types of Internet software extend computer-assisted discussion beyond the time, location – and even the participants – of one classroom.

Teachers can also develop tasks requiring students to communicate by posting, or "publishing" their written and oral work on the World Wide Web where others can access it. For Web publishing activities, it is not essential that each student have his or her own computer account; however, the class must have access to a server, where students can place their materials. In the United States most universities and schools have servers on which a class could use some space to store their materials. Once server space has been found, the process of producing and publishing Web documents is straightforward enough that many school children have created their own Web pages. Students simply work in an editor (e.g., a wordprocessor) to compose their work, and then add some markup tags (exemplified below) to the text that will make it display appropriately when it is looked at through a browser such as Netscape.

Learner-computer interaction
Other technology-mediated tasks provide controlled opportunities for linguistic input for the learner and interaction with the computer. Interaction occurs as the learner clicks to move forward, or to request additional information such as word definitions or cultural notes about the input. Software tools exist for constructing such hypertext and hypermedia applications by providing the author with a means of establishing links among various "objects" within a software environment. Objects may be text, images, audio segments, or video clips. The links allow the user to move from one to another by clicking on buttons or highlighted text – a process familiar to all Web users. Figure 1.4 shows an example from the World Wide Web of one part of an ESL story on the screen with words highlighted indicating links to definitions.

Figure 1.5 provides a look at what is behind the hyperlinks, showing how the author marked up that text using HTML (Hypertext Markup Language), the software for constructing hypertext and hypermedia links on the on the World Wide Web. There are two types of linking-related tags illustrated. One is the type that encloses each idiom. For example, the idiom "foot the bill" is enclosed by the tag <A HREF="defwt10.html">...</A>, which means that "foot the bill" should appear in the text as a hot spot (highlighted and under-

Daniel Brunson, on the other hand, knew that foreign languages were not at all <u>up his alley</u>. Dan was very unhappy at the thought of leaving his house on the west side, but he knew that they <u>had him over a barrel</u>. He had to accept the transfer to the designated city or <u>get the axe</u>. He accepted the assignment and <u>crossed his fingers</u> that the move would work out.

The company, of course, intended to <u>foot the bill</u> for the trip. They also took care of most of the details of the move. This left Dan with one major arrangement to make: He had to figure out how to get his huge dog, <u>Bernie</u>, to their new location. Dan's friends thought that transporting a 70-pound <u>Airedale</u> to a foreign country was a <u>half-baked</u> idea, but Dan was determined that, <u>by hook or by crook</u>, his best friend would accompany him. When he called the airport to make arrangements, he found out that the dog had to be transported in a box that would ride in the luggage compartment of the plane. Dan was not <u>tickled with</u> the idea of his best friend riding in the luggage compartment, but he decided that if this was the only way, he would have to do it. When the day of the trip came, Dan arrived at the airport – dog in box – and boarded the plane.

(see Chapelle 1997 for a functional electronic version)

Figure 1.4 A page from "The World Traveler" as it appears to readers on the World Wide Web

```
<HTML>
.
.
<A NAME="PA2"> </A>
<P>The company, of course, intended to <A HREF="defwt10.html">foot the bill</A>
for the trip. They also took care of most of the details of the move. This left Dan with
one major arrangement to make: He had to figure out how to get his huge dog, <A
HREF="bernie.html"> Bernie</A>, to their new location. Dan's friends thought that
transporting a 70-pound <A HREF="bernie.html"> Airedale</A> to a foreign coun-
try was a <A HREF="defwt11.html">half-baked</A> idea, but Dan was determined
that, <A HREF="defwt12.html">by hook or by crook</A>, his best friend would ac-
company him. When he called the airport to make arrangements, he found out that the
dog had to be transported in a box that would ride in the luggage compartment of the
plane. Dan was not <A HREF="defwt13.html">tickled with</A> the idea of his best
friend riding in the luggage compartment, but he decided that if this was the only way,
he would have to do it. When the day of the trip came, Dan arrived at the airport – dog
in box – and boarded the plane.
.
.
</HTML>
```

Figure 1.5 HTML-coded text with links to definitions and graphics

lined, in most cases), and that when the reader clicks on it, the browser should display the contents of the file called defwt10.html. The specified file needs to include sufficient address information for the browser to find it. In this case, the author had placed the "defwt10.html" file in the same directory on the university's server as the file that called it, so there was no need for additional locating information, but links can be made to files in other locations as well with the same syntax but with the complete Web address of the desired location. The other link-related tag in this example is <A NAME="PA2>...</A>, which names a specific location in this file to which a link from another file can be made. After readers have looked at the definition for "foot the bill," and clicked to return to the original text, the author does not want them to return to the beginning of the text, but instead to return to the same paragraph they were reading when they clicked. The linking tag in the definition file, then looks like this:

<A HREF="idiomswt.html#PA2">Click here to return</A>

The link refers not only to the file name, idiomswt.html, but also to the position in the file where the link is to be made, PA2.

This type of interactivity can be developed by teachers who wish to offer hypertextual support for electronic texts their students read. The hyperlink, of course, is not confined to text; the file named in the linking tag can refer to an image, audio, or video file rather than a text file as shown in the example. Software exists for putting in the links and what is linked to without writing the tags one at a time. Moreover, Mills (2000) describes sophisticated options that allow the teacher to mark text and video in a way that allows learners to choose what is highlighted as they proceed through a task. In the example above, some of the idioms are verb-like (e.g., foot the bill) and the others are used as predicate adjectives (e.g., half-baked). So, the author could add <V> and <PA> to <I>. With these user-defined tags in the text, the learner could be given the option to see the idioms acting as predicate adjectives in red, for example, and thereby have the tools for studying the grammatical properties of the idioms rather than being confined to the hypertext definitions. These are just a couple of examples of the ways in which software can produce displays focusing on particular linguistic features. There are comparable audio and video programs, some of them already implemented in CD ROM packages. Chapter 2 will discuss how decisions about the construction of hyperlinks can be conceptualized in a way that allows developers to consider theory and results from research on second language acquisition.

New forms of assessments

Technology-based learning tasks have been seen as an exciting opportunity whereas the idea of developing novel assessment tasks through technology is seen by some as a double-edged sword. On the one hand, technology offers a rich variety of options for presenting text and media to examinees, adapting to individual levels during test taking, and soliciting responses. For example, teachers and test takers have always questioned the validity of a test of listening comprehension that requires examinees to listen to lectures and conversations without any visual cues. A listening test delivered by computer can use video or images in the input to examinees, and therefore increase the authenticity of the input relative to situations in which visual information is part of the input. On the other hand, some test developers and users question the extent to which test taking through technology might be more difficult, or simply different than paper-and-pencil tests. In other words, technology in English language testing is far from invisible.

As technology takes root in the daily experiences of language learners, however, the argument that using technology for an English test represents a departure from the normal becomes more difficult to make. Therefore, for many teachers the implication is that learners need to be prepared for taking computer-based language tests. The obvious way of accomplishing this preparation is through the routine use of the computer in and out of the classroom. Take for example one of the test items on the reading comprehension part of the TOEFL. In the past, examinees were required to respond to multiple choice questions about the meanings expressed in the reading. The computer-based TOEFL also contains such items, but it also includes other response formats, one of which requires examinees to highlight portions of the text that respond to a question. From a measurement perspective, this offers some advantages as an item, but an examinee who has never used the cursor to highlight textual information on the screen may not readily understand what is to be done. A learning activity that would help as part of the English reading class would be to routinely give learners reading assignments that require them to read texts on the Web, find specific pieces of information to highlight and copy, and then paste them into a word document. Beyond large-scale assessment and preparation for it, however, the technologies that help to develop instruction are also changing the way that assessment can be used by learners to improve their learning. On-line learning materials (e.g., *Longman English Interactive*) often contain extensive assessments that allow the learners to monitor their progress. A number of papers have described the potential benefits of the use of technol-

ogy for language assessment practices (e.g., Burstein, Frase, Ginther, & Grant 1996); Chapter 6 will suggest how technology is prompting examination of important theoretical issues in assessment as well.

Research on learning

Technology provides a means for capturing a record of the learners' interactions in technology-mediated tasks. Chapter 4 explores how these data have expanded considerably the research base for investigating second language learning through tasks. However, one important aspect of these records is their availability to teachers and students. Learner-computer interaction gets reported and allows us to look at the extent to which learners use resource materials available in a CD ROM or the extent to which learners use the review materials provided. Research examining these aspects of software use has repeatedly found a great deal of individual variation in learners' use of such resource materials. Ideally, teachers who have access to such data may be able to use it to help them guide learners to make the most out of language software.

Teachers and researchers are also making use of corpora of learner language that are gathered and analyzed for the type and frequency of particular grammatical forms (Granger 1998). Like corpus approaches to target forms of English grammar, corpus research on learner language is providing a clearer picture of learners' grammars from a quantitative perspective. Knowledge of the frequency of occurrence of particular forms has clear implications both for better understanding interlanguage development and effectively designing learning materials. For example, Cowan, Choi, and Kim (2003) investigated the extent to which errors predicted on the basis of the learners, L1 actually appeared in a corpus of the ESL writing of advanced learners. Based on the finding that some of the predicted errors (e.g., problems were existed) occurred frequently in the corpus, the researchers designed CALL materials intended to address these specific errors.

Learner-learner interactions through written communication can be recorded for teachers to examine and use in subsequent teaching (e.g., Pellettieri 2000). For example, a chat conversation that is conducted in writing is available for examination of the ideas and language that have been contributed by the participants. The teacher can use such a transcript as a springboard for discussion, for monitoring the extent of participation, and evaluating the quality of the topic for promoting useful discussion. These are some options available with the new technologies that are of interest to English teachers who are interested in and prepared to work with data concerning learners' language. To

make use of these resources, teachers need to know how to get access to the data as well as how to interpret them in a way that will inform subsequent teaching and learning. Therefore, the key to accessing the novel possibilities outlined above is teacher education.

Teacher education and applied linguistics

The changes outlined above paint a picture of a very different world for L2 users and their teachers, but what do they imply for English language teacher education in the 21st Century? Examining the day-to-day reality of the English language teaching profession from the critical technologically-informed pragmatic perspective seems to suggest that the treatment of technology education should be given careful consideration by all teacher educators in advanced degree programs in English language teaching and applied linguistics. What do advanced degree students in applied linguistics need to learn in order to participate and contribute in the 21st Century?

One way of beginning to think about the question is to clarify an approach to technology that would be unacceptable in applied linguistics. Describing an article Bowers considers typical of those in the literature on educational computing, he points out that it "introduces teachers to computer vocabulary, but it fails to mention the distinctive characteristics of computers that directly relate to the teacher's responsibility in the primary socialization that students undergo when using a computer" (Bowers 2000: 125–126). The alarming picture Bowers paints of the approach to technology in departments of education in the United States is at least food for thought as applied linguists attempt to move forward with appropriate curriculum development for advanced degree programs. This warning along with a picture of the current and future context of English language teaching and research suggest the need for advanced education to include at least four components.

Applied linguistics

Students need to develop an understanding of fundamental issues and concepts in applied linguistics. The discussion of the technological world of ELT and applied linguistics throughout this chapter drew on concepts for applied linguistics that have been developed over the many years of research and practice. Concepts such as registers, context-specific strategic competence, communication tasks, and learner language as data did not originate with the wide-spread

use of the Internet in the 1990s. These and the other constructs that can offer perspectives for research and teaching through technology have a history of theory and research that adds depth to current technology-related studies. Technology-based language teaching and research is not a departure from applied linguistics. It is a continuation – the 21st century version of what applied linguists do. The knowledge, practices, and communities responsible for developing the profession of English language teaching and applied linguistics have not become irrelevant because of technology. In the final two chapters, I argue that the concepts and practices in applied linguistics can be usefully extended, thereby strengthening the field, but this can only happen if technology-using applied linguists are firmly grounded in the field, and are therefore able to do applied linguistics with technology.

Technology

The way that students will learn to do applied linguistics with technology is by learning applied linguistics through technology. Although much can be learned about technology and technology use from other disciplines, applied linguistics technology cannot be taught separately from applied linguistics – i.e., as something to be added on after the academic content and procedural knowledge of applied linguistics have been covered. Teachers need to learn to use computer technology for constructing and implementing materials for teaching and assessing English, and they need to engage in innovative teaching and assessments through the use of technology.

　　If students of applied linguistics are to develop these competencies, technology education cannot be relegated to a general course in education. Based on observations of her students' (future ESL teachers) use of interactive bulletin boards in her TESOL methods course, Kamhi-Stein (2000) suggested that "if ESL teachers are to use technology effectively for teaching in the future, they must use it for learning while they are students. Limiting technology experiences to one course or to one area of teacher preparation is insufficient for developing teachers who can use technology creatively and flexibly" (Kamhi-Stein 2000:424). Creative and flexible use of technology seems to be what is needed in a profession in which the practices and issues are becoming increasingly complex. Technology is barely mentioned in a recent paper on L2 teaching in the postmodern world (Kumaravadivelu 2001), but the issues raised are central to the need for applied linguists to have facility for technology use for the contextually appropriate technology use.

However, everyone needs technology skills – secretaries, car mechanics, insurance adjustors, political analysts. The question for language teachers is what are the specific technology skills and knowledge that are needed to implement pedagogical practices in the postmodern, high-tech era? Graddol's (2001) observation about questions concerning global English in the next century are equally apropos to the question about technology: "it demands a more complicated answer than those who ask probably desire" (p. 26).

Research methods

Over the history of the discipline, research methods in applied linguistics have evolved as they have drawn on statistical thinking and scientific methods, incorporated ethnographic approaches, developed discourse analytic and qualitative methods, and added critical ethnographic and applied linguistic perspectives as well. The full range of these methodologies needs to be brought to bear on the use of technology in applied linguistics, and therefore students need to know how to conduct empirical research and engage in critical analysis to evaluate computer applications for English language teaching and assessment.

Critical analysis

Throughout the evolution of research methods in applied linguistics, technology has been used (e.g., for analyzing statistical and linguistic data, or recording field observations), but it has been all but invisible. Taking a cue from limitations with the way that technology is taught in some general education courses, applied linguists can begin to reflect on the substantive issues that technology raises for the discipline:

> . . .the emphasis on technique, process and application that characterizes most professional literature on computer-mediated learning traces back to the educational background of professors of education, and further back to their professors. With few exceptions, their education never cultivated an appreciation of differences in cultural ways of knowing, and understanding of metaphorical language and cultural intelligence, or even the cultural. . .. As a result, university 'experts' on educational computing, with few exceptions, are unable to see, much less explain, cultural nuances and teachers' responsibilities for safeguarding them. . ..   (Bowers 2000: 125)

It seems clear that students in applied linguistics need to be educated in a manner that would foster their understanding of multiple perspectives on the

spread of technology and its roles throughout world, particularly as they relate to English language teaching.

Conclusion

This chapter has attempted to express multiple perspectives on the fundamental changes in technology-using society as they affect English language teaching and research. Technology is "both a contributor to and a result of the broader socioeconomic changes [which affect] the entire context and ecology of language teaching today" (Warschauer 2000: 520). In this context, the technology risks becoming invisible unless applied linguists attempt to expose it, and subject it to study. In the following chapters, I therefore address some of the issues that are exposed when technology is studied in applied linguistics. Chapter 2 outlines the implications of research on instructed second language acquisition for technology-mediated learning tasks. Chapter 3 discusses approaches to research on CALL, and Chapter 4 isolates the methodological issues in analysis of the unique data obtained through computer-mediated interactions. Chapters 5 and 6 demonstrate how the use of technology amplifies issues in applied linguistics in ways that expand theory.

Throughout these chapters, I am using a variety of terms to signify technology in applied linguistics, including technology-mediated tasks, computer-mediated communication, computer-assisted language learning, and other collocations. I have intentionally not adopted a uniform term throughout because as Rose's critical discourse analysis of the literature of educational computing points out:

> The subtle and apparently trivial differences in meaning between these terms are in fact points of contention; and the acronyms are signifiers of authority and efficiency which play a serious role in an on-going power struggle among various factions to privilege their meanings and interpretations above those of others.   (Rose 2000: 8)

The technology-using applied linguists have indeed invented new terms for every iteration of changes in technology and perspectives. However, in discussing the larger issues of technology and applied linguistics, it may be more productive to set aside this struggle in favor of attempting to expose the more central issues.

The potential of technology
for language learning

Thousands of web pages claim to teach ESL through explicit language instruction by providing a forum for contact among individuals who can participate in various discussion forums, chat rooms, and e-mail. Is there any reason to think that anyone is really learning English from these? Can a secretary in Korea, a manager in Italy, or a college student in Saudi Arabia really learn English by working on electronic learning materials on the Web? Do English language teachers and researchers have opinions and advice for such learners? The answers to these questions are not as simple as one may be led to believe by the current rhetoric on electronic learning. Moreover, as I pointed out in the previous chapter, the public discourse on technology offers better data for critical discourse analysis than wisdom about learning. This chapter interprets the professional knowledge in ELT and applied linguistics as it pertains to electronic English language learning. It begins by questioning the sources of relevant professional knowledge that can be brought to bear on principles for language learning through technology. The majority of the chapter suggests particular features in electronic learning materials and tasks that appear to be justified by theory and research and it illustrates how these features would be implemented in learning materials, thereby presenting some initial components of pedagogy for CALL.

Language learning and instruction

In keeping with the common wisdom suggesting that if you want to learn English, you should go live in a place where English is spoken, many sites for communication among English learners through computer-mediated communication on the Internet offer opportunities for conversation with other English speakers. The idea is that even though learners may not be able to visit Australia, for example, they can certainly have access to the chat room and bulletin

board discussion of Dave's ESL Café. Upon entering the chat room at Dave's ESL Café, one finds virtual conversations in progress with a series of "Hi, how are you doing?" type messages. One suspects that the conversations go beyond greetings at some point, as they do in the bulletin board section of Dave's ESL Café, where one might find a comment such as this under the category of "The Strange and Mysterious."

> Do you know the EATON center in downtown toronto? There are many ATMs, which we can find pretty close to the entrance. one day i tried to withdraw $300,however i got the only $140. The receipt said the withdraw ammount was $240.????

These Web sites in addition to the many other linguistic opportunities on the Web available to English learners such as Almon in the previous chapter constitute a kind of virtual immersion setting for those who choose to participate in it.

Internet immersion is new, but the more traditional forms of immersion for developing second language ability find support from many English language teachers. In many teachers' minds today, principles for explaining why immersion is expected to help develop language ability derive from Krashen's (1982) idea about the value of "comprehensible input," language comprehended without the learner knowing all of the linguistic forms in the message. Surely with all of the material in English on the Internet, any learner can find sufficient comprehensible input for a kind of virtual immersion. If comprehensible input alone were sufficient for L2 development, much of the computer-using time learners spend might indeed result in L2 development. Indeed, results from experience with the immersion principle suggest that learners who are given a lot of exposure to the target language might develop their ability to comprehend, particularly the spoken language, but this experience is limited in terms of the degree to which it can help the learner to develop grammatical competence and particularly the ability to produce grammatical language. How can instruction help? Can e-learning help?

Insights from the classroom and materials

Are there any insights that can be gained from classroom language teaching that might help to formulate some methodological principles for developing effective on-line learning tasks? This question has not been explored thoroughly, in part because CALL enthusiasts tend to see the differences rather than similarities between classroom teaching and CALL. CALL has developed a knowledge

base distinct from classroom teaching with separate interest sections in organizations such as TESOL, IATEFL, and JALT, as well as conferences and journals devoted exclusively to CALL. Perhaps the distinctness of work in CALL has developed for good reason. After all, many of the important aspects of classroom pedagogy fail to address the concerns of developers of CALL materials. For example, the classic *Fundamental Concepts in Language Teaching* (Stern 1983) includes a wide range of concepts from methodology on one level, to educational linguistics theory and research on another, and foundations such as the history of language teaching, linguistics, sociology, sociolinguistics and anthropology, psychology and psycholinguistics, and educational theory (p. 44). However, at the level of what would constitute the best design for an interactive task that takes advantage of a rich set of resources, for example, readers are left to make the connections. The concept of teaching method is criticized for its generality with respect even to classroom teaching, and the type of postmethodology parameters (Kumaravadivelu 2001) currently discussed as a way to guide teaching practice seem to be even more abstract.

Nevertheless, a body of professional knowledge does exist for classroom teaching. In contrast, scholarly knowledge about materials and materials development is more difficult to document. Teachers and publishers produce learning materials, but research on materials tends to be limited to corpus-based research and needs analysis, both of which help to identify appropriate language to include. An understanding of what constitutes quality materials from the perspective of acquisition processes is not well developed, as indicated by the gray font in the box in Figure 2.1. As Pica (1997) points out, the research interests of publishers tend to focus more on the "acquisition of markets and profits" than on acquisition of English. Although these interests do not point in the opposite direction from research on the quality of materials for language acquisition, in practice, research focusing on materials is rare. In view of the tenuous knowledge base for materials development and the tenuous links between CALL and classroom methods or materials, many CALL practitioners have felt that methodological principles for CALL must be developed from scratch. One would hope that all of the research on second language acquisition (SLA) over the past 20 years would have something to offer in the analysis and development of CALL. Whereas paper and audio tape materials seem to be produced and consumed without much concern for research, evidence of quality, or critical examination, CALL seems to prompt the question of whether or not the design of the materials is efficient – i.e., worth the time of both learner and developer.
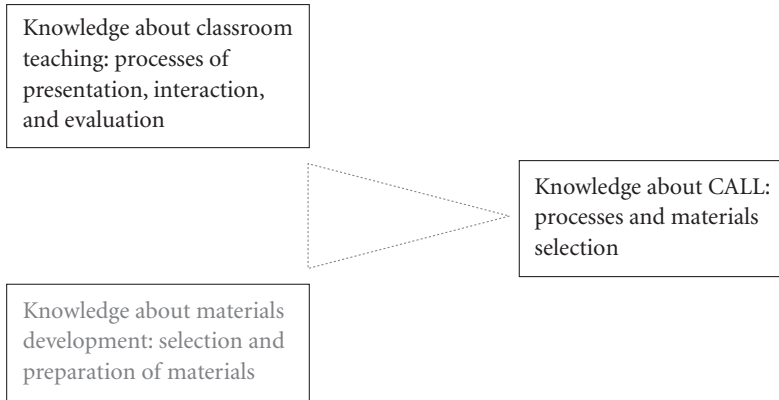
Figure 2.1 The distinct knowledge bases of classroom teaching (materials development) and CALL

Insights from theory and research

Pica's analysis of the connection between teaching and SLA research is useful for navigating the Bermuda triangle between classroom teaching, materials and CALL illustrated in Figure 2.1. She points out that a relationship exists

> ...with respect to their mutual interests in the cognitive and social processes of L2 learning. . . . From the cognitive perspective, among the most prominent [interests] are L2 comprehension, planning, and production; motivation; and attention to, and awareness of, L2 meaning and form. Social processes include various forms of communication and interaction, ranging from collaborative dialogue to instructional intervention, with mediation through negotiation of meaning. (Pica 1997: 56)

Although Pica was writing about SLA research and teaching in general, the point is equally apt for the more particular issues that arise in seeking some guidance for CALL. The common area, and the most useful for guidance concerning how CALL tasks might promote second language learning, are the cognitive and social processes through which learners acquire a second language, as illustrated in Figure 2.2.

Focusing on cognitive and social processes of classroom learning has directed the attention of researchers to the classroom episode or learning task as a unit of analysis. This unit is defined in a variety of ways by researchers of classroom learning, but in general it can be thought of as a unit that requires the analysis of specific interactions that the learner engages in while working
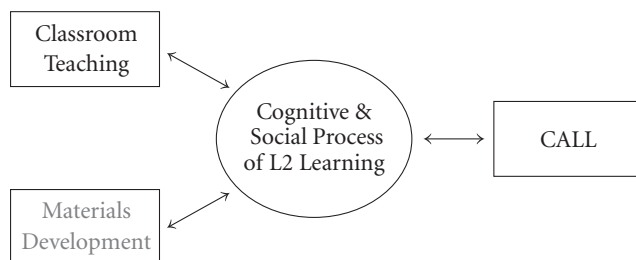
Classroom Teaching

Cognitive & Social Process of L2 Learning

CALL

Materials Development

Figure 2.2 The relationship between knowledge of classroom teaching and knowledge of CALL

with learning materials or communicating with the teacher and others. In other words, whereas the construct of method (or more general parameters) associated with classroom teaching may be of limited use for an understanding of CALL, the classroom research centered on understanding the cognitive and social processes of classroom L2 learning seems more directly relevant to CALL. In particular, the classroom task appears to be a useful unit of analysis, because tasks direct methodologists to look toward how learners are expected to learn through their interactions with the materials and other learners. Since hypotheses tested in this research are developed not solely on the basis of how the teacher should teach but on the basis of how learners are believed to acquire the language, findings are useful for CALL.

The study of cognitive processes has developed hypotheses related to the need for learners to comprehend linguistic input and to notice gaps between their knowledge and the target language. Motivation is seen as essential for making the cognitive effort to engage the processes of comprehension, which sometimes requires asking for help, and sometimes results in noticing a gap in knowledge. Gap noticing is also prompted by requiring learners to produce the target language, and it is enhanced when learners have time to plan their production and when they are offered correction. The study of social processes comes to similar conclusions, but with emphasis on the role of the context in which processes occur. For example, collaboration between learners is seen as a key to development because of the scaffolding provided by an interlocutor during task completion. Other social perspectives point to the importance of the context in constructing the identity of the learner as either a participant with the right to speak, or a marginal person feeling the need to remain silent. These perspectives and their foundation are outlined in introductions to SLA (e.g., Ellis 1994; Larsen-Freeman & Long 1991), and suggested implications for

CALL have begun to be explored (Chapelle 1998; Doughty 1987; Doughty & Long 2002).

If research on cognitive and social processes helps to identify good opportunities for learning, then how can CALL tasks help create such learning conditions? A useful way of considering this question is to work with a small unit of analysis. Rather than talking about a concordancer activity, or a CMC activity, for example, I will consider CALL tasks from the perspectives of the cognitive and social processes they create, particularly the input they provide learners, the interactions they offer, and the opportunities for linguistic production.

Enhanced input

A central concept in cognitive approaches to SLA is that learners have the opportunity to acquire features of the linguistic input that they are exposed to during the course of reading or listening for meaning. Moreover, the likelihood of learners' acquiring linguistic input increases if their attention is drawn to salient linguistic features (Robinson 1995; Schmidt 1990; Skehan 1998). One way that learners can be directed to notice some aspects of the linguistic input is through explicit "input enhancement" (Sharwood Smith 1993). In research on classroom learning, input enhancement can be accomplished by, for example, underlining text on a page, or stressing lexical phrases in aural input, as summarized in Table 2.1 under three general types of enhancement. Such enhancements of the linguistic input are intended to transform the language that the learner reads or hears into a potential language lesson.

Table 2.1 Types of enhanced input expected to be beneficial to learners

Input Enhancement	Description
Salience	Marking a grammatical form on the screen or phonologically through stress
	Repeating a grammatical form or lexical phrase
Modification	Making the input understandable to the learner through any means that gets at the meaning (e.g., images, L1 translation, L2 dictionary definitions, simplification)
Elaboration	Increasing the potential for understanding the input through addition of plausible, grammatical L2 elaborations to the original text (e.g., defining relative clauses)

Input salience

Linguistic input can become salient for a learner for many reasons. For example, when I read French, I notice the expression *s'agit* because I know that I do not understand exactly how to use it, *ennuyeux* because I know exactly what it means and I like having a word that combines the meaning of "boring" and "annoying," and *cadre* because I used it and its collocates as an example of lexical phrases in a lecture one time. These examples of input which is salient to me illustrate cases that are not easily within the control of CALL authors or teachers. They are salient to me for my own particular reasons. The concern for developing good CALL tasks is how to design materials that can direct learners' attention to particular linguistic forms within the input. The suggestions that come from the research on instructed SLA are to mark the forms that learners should attend to in some way or to provide for repetition of the forms of interest.

Marked input
Input can be made salient by highlighting the structures that the learners are supposed to attend to while they are reading the text. Figure 2.3, for example, shows a text marked to draw learners' attention to the form of the verb complements. The idea is that the learner would be reading the text for meaning, but would simultaneously notice the infinitive complements. In other words, the overall task in which this text is used would have to engage the learner in learning about the rabbit problem in the garden. The learner would be expected to notice the grammatical point and might even be able to depart from the rabbit text for a brief grammar lesson. This principle does not work so neatly for aural input, but it is possible to stress some aspects of the input, particularly if it is part of a dialogue in which misunderstanding occurs.

The research assessing the effects of marked input on acquisition indicates that this technique is worth considering, but only in combination with other techniques. In a study investigating the effects of marked third person singular and possessive adjectives in English, White (1998) found some evidence that the marked input helped learners to acquire the forms, but large within-group variation was found as well. She identified a number of other factors including the tasks and the chosen forms that probably contributed to the small difference between the groups. In particular, she noted that when the point to be acquired was difficult because of L1 interference, the learners probably needed more explanation than what they got from highlighted forms in a text.

Input without any forms marked:	Input with to-complements made salient:
Rabbits like to eat many different types of garden flowers, particularly when the plants are young. People attempt to save their plants by placing substances in the garden that the rabbits do not like. Moth balls, human hair, and marigolds may help to deter hungry rabbits. However, the only certain method is a good fence.	Rabbits <u>like</u> **to eat** many different types of garden flowers, particularly when the plants are young. People <u>attempt</u> **to save** their plants by placing substances in the garden that the rabbits do not like. Moth balls, human hair, and marigolds may <u>help</u> **to deter** hungry rabbits. However, the only certain method is a good fence.

Figure 2.3 Texts with (on the right) and without (on the left) highlighted forms

Research investigating marked input for vocabulary in CALL materials has drawn consistent conclusions. In a study by DeRidder (2002) four versions of a reading were given to students – one with the glossed words highlighted, one with glossed words and no highlighting, one with highlighted words without glosses, and the other with no highlighting or glosses. Results indicated that highlighting alone was not related to acquisition of vocabulary (DeRidder 2002); in order to make a difference the highlighted words also needed to be glossed. These results are consistent with those of Doughty (1991) who found that highlighting relative clauses in written text for ESL learners helped them acquire the forms; the learners also had access to explanations of the relative clauses. In view of the fact that computer mark-up languages offer sophisticated tools for marking up text, audio and video (Mills 2000), the specific conditions and tasks that can work with the highlighting of target linguistic forms are worthy of further investigation. In the meantime, the principle that should be taken from the existing research is that highlighting linguistic forms and vocabulary in a normal text is useful, but alone it appears to be insufficient for learners to acquire the forms. Additional glossing or explanation appears to be needed.

Repetition
A second way of making input salient is through repetition of the target linguistic forms because input frequency is among the factors that figures prominently in theories of the factors that affect noticing of target language input (e.g., Skehan 1998). Like salience, repetition can be viewed from the perspective of the materials or from the learner's perspective, but the message for materials

Click to hear the underlined words.	Choose the best answer based on the text.
Rabbits like to eat many different types of garden flowers, particularly when the plants are young. People attempt to save their plants by placing substances in the garden that the rabbits do not like. Moth balls, human hair, and marigolds may help to deter hungry rabbits. However, the only certain method is a good fence.	Rabbits like ☐ young plants ☐ substances ☐ marigolds The best way to deter rabbits is with ☐ moth balls ☐ marigolds ☐ fences

Figure 2.4 A task prompting vocabulary repetition

developers is that forms need to be sufficiently numerous and important for the learner to notice them. The exact number of repetitions will be determined by the role the forms play in the input in addition to their quantity. Moreover, repetition can be achieved in a number of ways, such as building multiple instances of the target form into the input, providing an option allowing the learner to choose to see or hear the input multiple times, and constructing the learning task in such a way that the learner will need to revisit the linguistic form in the input. For example, the two screens illustrated in Figure 2.4 are designed to prompt the learner to repeat the vocabulary three times: (1) read it in the passage, (2) listen to it, and (3) read it in the question.

Several studies of CALL have suggested that vocabulary repeated in the input is more likely to be acquired by the learner (e.g., Duquette, Desmarais, & Laurier 1998; Kon 2002), but results on repetition in CALL materials are difficult to disentangle. First, in CALL tasks, even more so than paper and tape-based tasks, the provision for repetition in the materials is not the same as the learners' choosing to access the available repetitions. One learner may click to listen to the input one time, whereas another may choose to hear four repetitions of one segment. Research investigating the effects of the repetition would need to record what each learner actually listened to. Results of research examining learners' choices have offered some insights, but have not singled out repetition as a key factor in retention. Researchers tend to investigate the combined effects of help, which might include glosses and images in addition to repetition, with just a few exceptions (e.g., Hsu 1994). In fact, it may be that repetition alone (i.e., without any modifications such as definitions) is beneficial for learners who already have some knowledge of the linguistic form

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Dear Extension Officer:

Could you please give me some advice on how to keep the rabbits out of my garden. Every time I buy some new flowers, the rabbits must be sitting and watching while I plant them. The following night they come in and have a feast, devouring any of the new flowers that they like. I am getting really frustrated – like I have a cafeteria in my front yard rather than a garden. I planted some marigolds. The rabbits found them delicious, I suppose. None were left the next day.

I would be most grateful for any advise.

Sincerely,

Frustrated

Figure 2.5 Example letter with requests for advice highlighted

in question; whereas for teaching new forms, repetition might work best in combination with other input enhancements. For the time being, it seems reasonable to continue to follow the theoretically and practically sound advice of building in opportunities for repeated presentation of input.

But how can this be accomplished in CALL tasks? In CALL tasks, the options for prompting repetitions throughout a task need to be explored beyond the use of the repeat button in audio and video input because these devices rely on the learner to recognize the need for repetition. Some possibilities include the use of comprehension questions such as the example in Figure 2.4, and more extensive tasks based on the input material. For example, if the learner is asked to read some letters asking for advice as a pretask for ultimately composing a request for advice, the "request language" such as "could you please help me" might be repeated within the task through highlighting this and other forms so the student can review these while composing. The author will have marked segments of text to display in different colors when the student asks to see various forms such as the language showing politeness, the tense marking, the formulaic parts of the letter, etc. Through the use of dynamic presentation of text, repetition can be controlled to help address the learner's needs in composing a text. In this case the learner would have to request to see the highlighting rather than having all of these features on at the same time. Therefore, the task would need to build in reasons for looking at these features.

Other form-focused tasks requiring learners to search for examples of structures and lexical patterns in texts might be explored further. One of the

potential benefits of concordancer activities is presentation of repetitions of examples of a particular lexicogrammatical pattern, in a way that, as Cobb (1999) puts it, should combine the advantages of list learning and learning from exposure to words in contexts. Figure 2.6 shows ten of the examples that were obtained when a search was done for the lexical bundle "from the perspective of" in a corpus containing academic writing about history. For the advanced-level ESL writer, the results demonstrate the diverse roles that this commonly-used bundle can play. The examples show that a person is not the only one with a perspective. "From the perspective of" can be used with countries and groups of people, large ideological units, and concrete nouns (a map) as well. This intensive presentation of examples obviously provides many repetitions of the lexical bundle. This activity can be modified to request the learner to find examples of a lexical item on a Web page, or set of Web pages, and it can include the requirement that the learner conduct an analysis of the structural patterns and functions of the bundle.

Cobb's (1999) research on the use of concordancing for acquisition of vocabulary by students beginning their academic reading in an EFL context has shown that well-structured concordancing activities integrated into an academic reading course can produce better results than list learning and dictionary use. Whereas vocabulary gains for word knowledge alone are not significantly different, the important aspect of word learning – being able to use the word in context – does improve more and persist better when learners study words with the concordancer. Cobb's research also points to the importance of the construction of the corpus, the direction that the learners receive in using the concordancer, and the regular accountability for learning the words. In other words, it is clear that much is involved in concordancer pedagogy beyond offering learners a means of seeing repetitions of words in use.

Input modification

Input modification refers to the provision of an accessible rendition of the L2 input. In CALL materials, modifications appear as hypertext or hypermedia links that help the learners to comprehend the input. This definition of modification expands the construct that has been used in research on classroom tasks, where modifications can be any form of simplification, repetition, clarification, or L1 translation – anything that an interlocutor does during the course of a conversation to clarify meaning in order to continue a conversation (Larsen-Freeman & Long 1991). In CMC tasks similar types of modifications can occur as students work together in collaborative tasks. In such tasks, research and ex-

Viewed **from the perspective of** France, the sine qua non of that success lies, first, in the inheritance practices of the English landed elite, where male primogeniture was the rule, thereby legitimizing both royal dynasticism and the House of Lords.

But **from the perspective of** most of its 9 million Muslims, Algeria belonged to the Middle East and Africa beyond the Sahara.

The worst-case scenario, **from the perspective of** allied policymakers, was an international lineup pitting "the West against the rest" with Moscow in the lead.

Billings's real estate company subdivided land into parcels, uniform and, **from the perspective of** a map, interchangeable because it made for efficient marketing and sales, especially from remote offices in St. Paul and Chicago.

And the beauty of the system, **from the perspective of** its officials, was that all of that money came from delinquent husbands-not the public coffers.

This is a historical essay written **from the perspective of** political science, with an interest in looking backward to explain current conditions.

The most striking and consequential development **from the perspective of** international relations has been the extraterritorial extension of United States criminal jurisdiction, most notably the extension of its judicial capacities in the 1980s.

And yet, **from the perspective of** the border society rather than that of Mexico City or Washington, D.C. what we find is an army of invasion negotiating with local and regional actors whose loyalties did not always conform to simple national lines.

Essentially, many people were discovered to be living a life that they believed was Christian, that often their local priests and friars believed was Christian, but that was at best **from the perspective of** a newer stricter orthodoxy incorrect and at worst a breeding ground for heresy.

But, of course, even in his telling of the case, Pietro was only a doctor, and as he moved into the area of magical male and the use of relics (which implied a spiritual cure), he was **from the perspective of** the church out of his league.

Figure 2.6 Example from a concordancer search of *from the perspective of*

perience suggest that the extent to which modifications actually occur depends on the task that the learners are completing in addition to the characteristics of the interlocutors (e.g., Lee 2001). For example, proficiency level, seriousness about the task, comfort with each other, and politeness probably all come into

play in the extent to which a learner receives the needed modifications in such tasks. These issues are all of concern to the teachers and researchers developing such tasks, but here the focus is on the more technical issues of the types of modifications that can be built into CALL materials.

Images

One form of modification that gives learners access to the meaning of some vocabulary or other textual meaning is an image or a video depiction of what is expressed in the language. Research investigating the effects of images on vocabulary retention has indicated that images and video can be effective. A study was conducted on second year German learners' vocabulary retention after reading a story in which 82 of the 762 words had been glossed either with English text and an image, or with video, or with English text alone (Plass, Chun, Mayer, & Leutner 1998). The words for which both visual and verbal information had been accessed by the learners received the highest posttest scores, those for which learners had looked up only verbal information received the second highest, and visual information the third. Words for which no information had been looked up received the lowest scores. The differences on the posttest were statistically significant ($p < .05$) between the words for which nothing had been looked up and those for which verbal or verbal plus image had been looked up. Also statistically significant ($p < .05$) were the differences between the verbal vs. the verbal plus image words, thus suggesting that images may be used effectively for enhancing learners' access to the meanings of words in the input.

   This finding is useful for the design of materials to the extent that words can be illustrated, as in the example in Figure 2.7. When the input is confined to topics that are concrete and easy to depict, illustrations seem to offer one good method of providing access to meaning, but when meanings are abstract, complex, or culturally bound, illustrations may be either impossible or open to interpretation. In a text about political processes used as an example ESL task in a methodology paper (Chapelle & Jamieson 2002), for example, the input was full of words such as those in the following sentence that probably could not be defined through images: "Several influential studies of the public's foreign policy beliefs have found that the public is rational in its foreign policy views and that its beliefs are consistent and stable over time." However, even when images provide one potential form of modification, the research finding appears to be that the more types of modifications that are chosen, the more likely the chances of retention. It therefore seems worthwhile to explore the use of images that attempt to depict a variety of words even if creativity
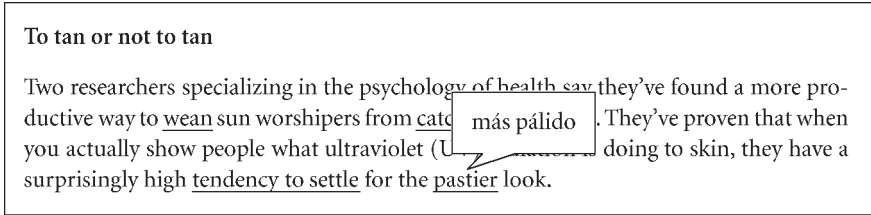
| On the weekend, Martha liked to stop by to see her father at work where she was greeted by the <u>Dalmatian</u> that lived at the station. Lunch was served at 12:30 every day so she tried to get there in time to eat if she could. But last Saturday, when lunch was served, Martha was not there. Her . . . | On the weekend, Martha liked to stop by to see her father at work where she was greeted by the <u>Dalmatian</u> that lived at the station. Lunch was served at 12:30 every day so she tried to get there in time to eat if she could. But last Saturday, when lunch was served, Martha was not there. Her . . . |

Figure 2.7 Before (left) and after (right) the learner clicks on a hypermedia link containing an image depicting the word "Dalmatian"

and imagination are required for connecting words and images. Particularly in these cases, L1 translations may help too.

L1 translation
In the German reading study, as in many language learning materials, L1 translations were used as a means of providing access to the meaning of the input. Similarly, in studies of conversation with language learners, L1 translation is among the frequent forms of modification that learners receive as help. Nevertheless, for many years, in English language teaching the common wisdom seemed to suggest that learners should develop their strategies for figuring out the meaning or guessing the right word rather than relying on the first language, and therefore the argument was that the modification such as the instant link to meaning for the Spanish speaker offered by "más pálido" after he or she clicks on "pastier" in the text in Figure 2.8 should be off limits in the design of materials. Recently, however, the origins and interests served by this common wisdom have been exposed, and the use of the L1 is regaining its legitimate place as a means for providing modified input (e.g., Cook 1999). It should therefore be possible to take a fresh look at the value of translation in CALL where it can serve well as a means of input modification.

To tan or not to tan

Two researchers specializing in the psychology of health say they've found a more productive way to <u>wean</u> sun worshipers from catc̲ más pálido . They've proven that when you actually show people what ultraviolet (U̲   doing to skin, they have a surprisingly high <u>tendency to settle</u> for the <u>pastier</u> look.

(by Bridget Bailey, *Inside Iowa State*, August 30, 2002)

Figure 2.8 Modifications through L1 translation in Spanish

L2 definitions
In English learning, authors often choose to include definitions in English, and some research suggests that such L2 definitions can improve comprehension (e.g., Hegelheimer 1998). Even when the definitions appear in English, issues remain as to the best way to present them. A study conducted with paper materials helps to illustrate the issues. Watanabe (1997) constructed paper reading materials using three experimental formats. One embedded word definitions into the text as appositives, a second supplied marginal glosses, and a third offered the correct gloss alongside an incorrect alternative, requiring the reader to guess the meaning. The first method operationalized the principle of "elaboration" discussed further below. The second was a straightforward provision of help outside the text, and the third operationalized a principle suggesting that words would be more likely to be remembered if the learner had to make some mental effort to figure out what they mean. Results favored the second condition, the straightforward gloss. The finding of no significant advantage for the multiple choice condition runs counter to the theory that the mental effort might aid retention and to other research findings. Watanabe suggested that perhaps the multiple choice condition simply failed to clarify meaning because the learners sometimes chose the incorrect meaning and continued reading without knowledge of the correct meaning. Of course, in CALL, the problem of not knowing if one's response is correct can be easily solved, so it may be possible to have the best of both worlds, i.e., the mental effort required by the multiple choice format, and knowledge of the correct definition. This possibility, however, has not yet been investigated.

Simplification
Simplification refers to the modification of a text that changes aspects of the syntax and vocabulary to make it accessible for the learner. One can identify a number of areas in which language can be simplified, as illustrated in Figure

Original text:	Simplifications:
To tan or not to tan	Should people get a tan?
Two researchers specializing in the psychology of health say they've found a more productive way to wean sun worshipers from catching some rays. They've proven that when you actually show people what ultraviolet (UV) radiation is doing to skin, they have a surprisingly high tendency to settle for the pastier look.	Two psychology professors said that they made an important discovery. They found out how to keep people away from the sun. The professors show the people pictures of the effects of the sun on their skin. Then these people choose to stay out of the sun.

(by Bridget Bailey, *Inside Iowa State*, August 30, 2002)

Figure 2.9 An authentic text (left) and a simplified version (right)

2.9, where the simplified version contains shorter sentences, more common vocabulary, a minimum number of idiomatic expressions, and transparent syntactic structures. As Chaudron (1983a) pointed out, however, what actually constitutes a simplification for a particular learner depends on the learner and what he or she knows. The research on simplification indicates that for comprehending the basic information from text, simplified language is sufficient, but it is not the most effective means for helping learners to get inferential meaning (Yano, Long, & Ross 1993). Moreover, if one looks at the simplification, it should be evident that the process of simplification deprives the learners of the linguistic complexity that they need to be exposed to. It would be impossible to learn to interpret subordination in English sentences if sentences (such as the second one on the left side of Figure 2.9) are simplified into single clause units! For this reason simplification has not been favored by researchers attempting to identify the ideal input for learners even though learners seem to be able to access the explicitly stated information in the text from simplified text.

Simplification and all of the methods of input modification described above share the characteristic of attempting to offer access to the meaning of the input through any means that might work. Researchers have contrasted this set of techniques with one that deliberately attempts to elaborate the input with grammatical L2 additions to the text that fit within the flow of the meaning and syntax of the text.

Input elaboration

Input elaboration is intended to help learners gain access to the meaning of the text by adding grammatical phrases and clauses such as defining appositives, relative clauses, and restatements. Rather than removing the forms that learners should be exposed to in the input, the process of elaboration adds to the input in a way that should help to clarify meaning while maintaining the structural and lexical complexity that provides learners with input for acquisition. Figure 2.10 illustrates an elaborated version of the same text that was simplified in Figure 2.9. The simplified version has lost the author's attempted borrowing from Shakesphere for the structure of the title, whereas the elaboration maintains the structure, but attempts more transparency by adding a more common verb, get, and using "tan" in its more common function as a noun. The simplified version omitted the idiom "catch some rays" and the difficult vocabulary "wean" whereas the elaborated version simply rephrases the meaning in an elaborating gerund phrase, "keeping them away from the sun." The simplified text broke down the complex second sentence containing many embeddings into two sentences, replacing noun clauses with phrases. In contrast the elaborated version changed pronouns that may obscure meaning, changed the contraction to a full form, and added a defining phrase for "pastier." In Figure 2.10 the changes made to elaborate the text have been underlined, but in the elaborated text for the learners they would not be.

Original text:	Elaborated text:
To tan or not to tan	To get a tan or not to get a tan
Two researchers specializing in the psychology of health say they've found a more productive way to wean sun worshipers from catching some rays. They've proven that when you actually show people what ultraviolet (UV) radiation is doing to skin, they have a surprisingly high tendency to settle for the pastier look.	Two researchers who specialize in the psychology of health say they've found a more productive way to wean, or prevent, sun worshipers from catching some rays, keeping them away from the sun. The researchers have proven that when they actually show people what ultraviolet (UV) radiation is doing to skin, the sun lovers have a surprisingly high tendency to settle for the pastier look rather than getting a tan.

(by Bridget Bailey, *Inside Iowa State*, August 30, 2002)

Figure 2.10 Elaborated input (right) developed from an authentic text (left)

The research investigating the effects of elaboration compared to the original text and to the simplification has yielded relatively clear conclusions. "When extraction of explicitly stated factual information is called for in a reading task, syntactic and lexical simplification may be sufficient as aids for nonnative readers... Our findings suggest that elaborative modification provides semantic detail that foreign language learners find helpful when making inferences from texts" (Yano, Long, & Ross 1993: 214–215). This was also the finding in another study comparing elaboration and simplification; elaboration was consistently superior for deeper degrees of comprehension across proficiency levels in contrast to simplification, which helped only the more advanced-level students (Oh 2001). These findings, along with the rationale that learners need to be exposed to the more elaborated language, offer compelling evidence that English teaching materials should offer input elaboration.

This research and the theory behind it provide a useful basis for development of CALL, but the implementation in electronic learning materials is different. In a hypermedia environment, input highlighting, repetitions, modifications, and elaborations do not need to be fixed on the screen, but rather the input can be highlighted, repeated, modified, or elaborated upon request. Figure 2.11 illustrates how elaborations or simplifications might be added to a text when the reader clicks on a sentence. Examination of the example should raise questions about the relevance of the strict distinction between elaboration and simplification that was important for paper and aurally presented texts. In a hypermedia environment, the learner can have access to the authentic text in addition to whatever form of help is needed to clarify the meaning. Since the help is provided dynamically *in addition to the text rather than instead of it*, it would seem appropriate for CALL pedagogy to reinterpret results from classroom research to investigate principles of input enhancement for CALL.

Enhanced input for CALL

What are the best ways for enhancing written and aural input in CALL materials? The research on enhanced input in the classroom offers some principles and observations that seem relevant despite the fact that CALL offers significant new options for input enhancement. The original written or aural text does not need to be permanently modified, but rather the learner can get access to the meaning through temporary additions to the screen or the aural input, leaving the original intact. The research on CALL is just beginning to look at some of the options, by comparing different means of presenting interactive vocabulary annotations (e.g., Chun & Plass 1996; DeRidder 2002; Lomicka

Elaborations as hypertext:

Simplifications as hypertext:

To t
> Two researchers who specialize in the psychology of health say they've found a more productive way to wean, or prevent, sun worshipers from catching some rays, keeping them away from the sun.

To
> Two psychology professors said that they discovered how to convince young people to stay out of the sun.

Two researchers specializing in the psychology of health say they've found a more productive way to wean sun worshipers from catching some rays. They've proven that when you actually show people what ultraviolet (UV) radiation is doing to skin, they have a surprisingly high tendency to settle for the pastier look.

Two researchers specializing in the psychology of health say they've found a more productive way to wean sun worshipers from catching some rays. They've proven that when you actually show people what ultraviolet (UV) radiation is doing to skin, they have a surprisingly high tendency to settle for the pastier look.

(by Bridget Bailey, *Inside Iowa State*, August 30, 2002)

Figure 2.11 Text with elaboration or simplification upon demand

1998). The design and interpretation of such research as well as development of pedagogical materials might benefit from the following observations.

First, different aspects of the language are likely to require different forms of enhancement. Chaudron's (1983a) study of a variety of ways of providing syntactic enhancements for aural text offers a good starting point for considering the issues. Finding that simple repetition of nouns used as topics in lectures helped comprehension, he pointed out that this result did not suggest that repetition should universally be considered the best form of input enhancement but rather that various aspects of language may be suited to different types of modification. In the text in Figure 2.11, for example, it may be that the best enhancement of the first sentence would be neither the elaboration nor the simplification shown in Figure 2.11, but instead would be some combination of syntactic elaboration (e.g., "who specialize" to elaborate "specializing") and semantic modification (e.g., "getting a tan by sitting in the sun" for "catching some rays").

Second, an observation from the study of incidental vocabulary learning by Watanabe (1997) provides a useful principle as well. In Watanabe's comparison of techniques for vocabulary annotation, he asked learners to give L1 definitions of what they had understood the words to mean. He found that "[e]ven if

explanations are inserted for unfamiliar words [i.e., through elaborative anno-
tations], and the explanations are comprehensible, unless the students notice
the connections between the two, effective learning cannot be expected" (p.
303). This conclusion – that there needs to be a clear link between the form
in the text and the enhancement – is consistent with Chaudron's research on
modifications of aural input, which found that it was the most straightforward
type of modification, the simple repetition for nouns used as sentence top-
ics, that made a difference in listener comprehension (Chaudron 1983a). For
hypermedia, this may suggest the need for local word and phrase level annota-
tions in many cases, and exploration of ways of representing complex syntactic
information in a way that is clarifying to learners.

Third, enhancement should be offered interactively. An important find-
ing is summarized in a study comparing different forms of modified input in
a listening text. "...[L]earners who are allowed to negotiate interaction while
listening to the target language have a higher probability of comprehending
what they hear – a point with important classroom implications" (Loschky
1994: 319). It seems that hypermedia may offer an ideal means of providing
help with comprehension interactively because learners can listen or read and
request input enhancement as they need it. Various forms of this type of listen-
ing with interactive help are routine in multimedia-based ESL materials such as
ELLIS and *Longman English Interactive*. The issue of access to enhanced input
through interaction has been the source of great interest in classroom research.

Interaction

Throughout the above discussion of enhanced input in CALL, it was impossible
to concentrate solely on the input without raising issues of the manner in which
the input is provided to the learners. One of the key features of enhanced in-
put in CALL is that it is almost always provided interactively. The discussion of
enhanced input also focused on tasks based on learner-computer interactions.
The discussion of CALL tasks is expanded here to include those entailing learn-
ers' communication with English speakers. Interaction is the term used in both
cases, as well as to refer to many other types of interactions that learners engage
in. The term "interaction" is used in a variety of ways. For example, both a con-
versation at a bookstore between an ESL learner and a clerk, as well as a set of
questions and responses in a CALL drill on the correct use of "teach" vs. "learn"
are referred to as interaction. This single term for such a wide range of interac-
tions has been the source of great concern for applied linguists attempting to

understand the relationship between CALL and research on classroom interaction (e.g., Harrington & Levy 2001; Salaberry 1999). The meanings of interaction obviously need to be clarified or at least explored if this construct is to be useful for understanding how interaction might benefit language development and ultimately to apply that understanding to interaction in CALL.

Theoretical perspectives on interaction

A useful theory of interaction in CALL needs to define broadly what interaction consists of, what kinds of interaction are believed to be important for SLA, and why. This general understanding provides an essential basis for conceptualizing and evaluating the new types of interaction made available through CALL. R. Ellis' (1999) broad view of the construct offers an excellent starting point because he theorizes interaction beyond the concrete activity of the visible interactions occurring in a two-way, face-to-face classroom task, for example. Ellis (1999) points out that interaction is generally "used to refer to the interpersonal activity that arises during face-to-face communication. However, it can also refer to the intrapersonal activity involved in mental processing" (p. 3). In view of the need to include the variety of interactions in CALL, however, interpersonal interaction takes place not only in face-to-face conversation but also electronically over a computer network. Moreover, interaction needs to include what takes place between a person and the computer.

Ellis outlines three perspectives from which researchers have conceptualized and studied the value of interaction for language development: the interaction hypothesis, sociocultural theory, and depth of processing theory. The interaction hypothesis derives from the study of face-to-face conversation and the psycholinguistic benefits it affords learners by directing their attention to language, particularly during communication breakdowns (Hatch 1978; Long 1996; Pica 1994). Sociocultural theory can be applied to the same types of data – face-to-face conversation – but theorizes the value of the interlocutor's help in accomplishing meaning making through language. At the same time it suggests that the learner's internal mental voice plays a role in learning through a constant internal dialogue (Lantolf & Appel 1994). Depth of processing theory hypothesizes the importance of the level of cognitive processing that new input to the learner undergoes for recall and learning. The depth of processing idea is similar to that which has been advocated for teaching syntax (VanPatten 1996) and vocabulary (Laufer & Hulstijn 2001). It is what Watanabe was getting at by providing learners a choice between two meanings. However, Ellis'

Table 2.2 Benefits of three types of interaction from three perspectives

Basic types of interactions		Perspectives on the value of interaction		
		Interaction hypothesis	Sociocultural theory	Depth of processing theory
Inter-	between people	Negotiation of meaning	Co-constructing meaning	Prompting attention to language
	between person and computer	*Obtaining enhanced input*	*Obtaining help for using language*	*Prompting attention to language*
Intra-	within the person's mind	Attending to linguistic form	Stimulating internal mental voice	Cognitive processing of input

focus is on interaction as one means of helping the learner to engage in deep mental processing of the L2.

Table 2.2 summarizes the types of interaction that Ellis described, but whereas Ellis included only "interpersonal," meaning "between people," I have added "between person and computer." The cells in the table suggest the hypothesized benefits to be attained through interaction from each of the theoretical perspectives. For example, from the perspective of the interaction hypothesis, interaction between people is expected to promote negotiation of meaning, and if it does so, this should be beneficial for language acquisition. Since the three theories do not specifically address learner-computer interactions, I have filled in the logical predictions in italics.

The three perspectives on two types of interaction (i.e., interpersonal and intrapersonal) offer a starting point for considering the value of the interactions that learners can engage in through the use of technology. To extend this productive line of inquiry to technology-mediated tasks, the value posited for interaction might be expressed as a means for getting better input, for receiving the assistance needed to advance in knowledge and understanding, and for activating deep processing of input. These three benefits of interaction represent three perspectives, rather than distinct categories. For example, during interaction, assistance might be provided by an interlocutor in the form of improved input for the learner, or receiving elaborated input might activate processing of input. All three types of interaction apply to various forms of CALL tasks, but it is important to keep in mind that these are the current hypotheses about the

benefits to be attained through interaction that stand as applied linguists seek evidence for the extent to which they are justified.

Interaction in CALL

These three perspectives on the various forms of interaction provide plenty of suggestions for CALL pedagogy, some of which have been the object of investigation in research.

Interpersonal communication
The benefits to be obtained through interaction among learners from the three theoretical perspectives are negotiation of meaning, co-constructing meaning, and prompting learners' attention to form. Researchers have identified some instances of negotiation of meaning in synchronous communication such as the example from a classroom chat that is shown in Table 2.3.

Table 2.3 Negotation of meaning in synchronous communication

Participant	Language
Instructor	What do you think about sustaining life artificially?
Student 1	What is "sustaining artifically"? Anyone answer me.
Student 2	what's that???
Student 3	Artificcally support someone's life!
Student 4	Don't ou understand artifically?
Student 3	For example using machines!

(from Rodriguez 1998)

Negotiation of meaning can be seen in these interactions among a teacher and learners during an exchange in an ESL class where learners were participating in a discussion on a local area network. In the first move, the instructor asked a question containing two words that the student did not understand. Student 1's question, "what's that???," interrupts what would be the normal interaction (i.e., a response to the question such as "I believe it is wrong."). The purpose of the interruption, which is echoed by Student 2, is to find out what two unknown words mean. In move 4, Student 3 attempts an explanation of one word, "sustain," but then Student 4 interrupts with a question about the other word,

"artifically." Again Student 3 provides a definition. This type of negotiation has been documented in a number of studies of synchronous on-line communication in the classroom (e.g., Blake 2000). Moreover, in some classroom on-line communication tasks, researchers have found that learners actually negotiate the form of the language as well as the meaning, perhaps because the interactive written communication provides more time and opportunity for learners to attend to the form and make corrections and the motivation to do so because their language is being apprehended immediately by an interlocuter (Pellettieri 2000).

Other studies of synchronous and asynchronous communication have been concerned with the co-construction of meaning among learners who work together in classrooms and in project-based virtual collaborations. In these settings the concern has been to get learners interested in the communication and the collaboration so that they spend a lot of time engaging in interaction (e.g., Swaffar, Romano, Markley, & Arens 1998). Conferences and journals are full of success stories about collaborative learning through the Internet. At the same time, however, careful research reveals the many sociocultural and personal factors involved in the success of such projects – factors over which the teacher does not have complete control (Belz 2001).

Learner-computer interaction
The discussion of enhanced input above began to look at how learners obtain enhanced input, how they obtain help for using language, and how their attention to language can be prompted. Many language users in the 21st Century are accustomed to initiating interactions when they click on a hypertext link to receive help with comprehension or seek dictionary help. Research has also investigated the effects of learners' focusing attention through modification of what might be considered the normal interaction in the CALL task, e.g., continuing to read or listen without stopping for help. The most prevalent of these studies investigates vocabulary acquisition through reading tasks which are supported with on-line glosses. Figure 2.12 illustrates the interaction as the learner reads a text about the introduction of the monetary unit, the Euro, and requests a definition for the word "recalcitrant." In such tasks the learner is expected to read the text for its meaning, to answer comprehension questions, or to engage in other activities which call on knowledge gained from the text. The option to receive definitions of the words on-line is provided in support of the meaning-focused reading task.

The potential for such modifications is often seen in published CALL materials which provide input that the learner can request to have modified. Ta-

First move: Computer shows text	Second move: Learner clicks on word	Third move: Computer shows definition
		recalcitrant – Definition: formal adjective; refusing to obey or be controlled, even after being punished: recalcitrant behavior
BRUSSELS, Belgium – They had to struggle a bit to open some recalcitrant bottles of champagne, but finance ministers from 11 countries celebrated New Year's Eve Thursday by launching the euro as the continent's new unified currency.	BRUSSELS, Belgium – They had to struggle a bit to open some **recalcitrant** bottles of champagne, but finance ministers from 11 countries celebrated New Year's Eve Thursday by launching the euro as the continent's new unified currency.	BRUSSELS, Belgium – They had to struggle a bit to open some **recalcitrant** bottles of champagne, but finance ministers from 11 countries celebrated New Year's Eve Thursday by launching the euro as the continent's new unified currency.

Figure 2.12 Three moves in an interaction requesting a word definition (see Hegelheimer & Chapelle 2000 for an interactive on-line version)

ble 2.4 illustrates the types of interactions that occurred in an activity in which the learner listened to a story delivered by the computer. The normal interaction in this case was for the learners to continue through the story by clicking on *continue* after listening to each page. The data show that the learner interrupted the normal interaction by requesting help with the aural input – first by requesting a repetition (move 3) and then by requesting a written transcription (move 6). In other words, the computer program created the opportunities for modified interaction by offering modified input to the learner upon demand. The data documented that the learner actually engaged in modified interactions and received the modified input, thereby constructing potentially beneficial interaction.

Obviously, this type of interaction is a means of receiving some form of enhanced input, and therefore the two critical issues are (1) the quality of the input enhancements, and (2) the extent to which the learners actually engage in the interactions and thereby availing themselves of the possibility of benefiting. Issues concerning the quality of the enhancements were discussed above, coming to the conclusion that different approaches to enhancement may be necessary for various aspects of language, but that enhancements should clarify links between form and meaning of the target language, and that they are

Table 2.4 Learner-computer interactions in a listening comprehension activity

Participant	Language and Behavior
Computer	(aural) Would you like to hear the story I wrote for my English class while we were waiting for dinner?
Computer	Offers REPEAT, TEXT, DICTIONARY
Learner	Chooses REPEAT
Computer	(aural) Would you like to hear the story I wrote for my English class while we were waiting for dinner?
Computer	Offers REPEAT, TEXT, DICTIONARY
Learner	Chooses TEXT
Computer	(written) Would you like to hear the story I wrote for my English class while we were waiting for dinner?

(from Hsu 1994)

best provided interactionally. The second issue, whether the learners choose to engage in the interactions, is critical. The research that has compared more vs. less interaction in CALL tends to support the value of interaction (Plass, Chun, Mayer, & Leutner 1998:30), but the question for pedagogy of course is how to prompt learners to engage in the interactions that are offered by the task. This has to be answered in view of the complete task rather than simply a decontextualized provision for interaction. In particular, learners need to be sufficiently interested and motivated to engage in interaction.

Intrapersonal interaction
Intrapersonal interaction, taking place in the learner's mind, is expected to be valuable because it prompts learners to focus on linguistic form, it stimulates the learners' inner voice, and entails deep cognitive processing of input. Because input is typically enhanced interactively in CALL, the learner-computer interaction that is hypothesized to be of value in delivering enhanced input should simultaneously focus on linguistic form and perhaps engage the other valuable processes as well. Other approaches to the issue of intrapersonal interaction in CALL is evident in classrooms where learners are taught particular strategies for processing on-line text. For example, Kol and Schcolnik (2000) were able to help their academic English learners to read as well on line as they were able to read on paper. It seems that ideally in CALL, however, the intrapersonal interaction might best be implemented in concert with learner computer

interaction with the hope that the additional interaction will strengthen any possibility for intrapersonal interaction.

Linguistic production

Theoretical perspectives from classroom research suggest that linguistic production (i.e., speaking and writing) is important for the learners' development of morphosyntactic knowledge. Some overlap exists between this theoretical knowledge about linguistic production, or *output*, and interaction because interaction entails some type of production by the learner. In interaction theory, the primary concern is the input that the learner can receive or dialogue that the learner participates in. In turning to production, the focus is on the potential for learning through the process of attempting to construct grammatical language.

Theoretical perspectives on production

Like interaction theory, theory and research on linguistic production can be framed according to more than one perspective. From a cognitive perspective, Swain (1985) suggested that ideally the learner would have the opportunity to produce "comprehensible output," which refers to language that the learner produces to express a message. This is important, it is suggested, particularly because during production of comprehensible output, the learner may get stuck and have to come to grips with unknown grammatical forms.

> [I]n producing the L2, a learner will on occasion become aware of (i.e., notice) a linguistic problem (brought to his/her attention either by external feedback (e.g., clarification requests) or internal feedback). Noticing a problem 'pushes' the learner to modify his/her output. In doing so, the learner may sometimes be forced into a more syntactic processing mode than might occur in comprehension.   (Swain & Lapkin 1995:373)

More recently, Swain (1998) has reframed the value of linguistic production in sociocognitive terms, focusing on the way the learners' language develops through the help they give and receive as they co-construct meaning during pair work (e.g., Ohta 2000). Research offers some support for the value of tasks requiring the learners to produce and correct their linguistic output during interaction in face-to-face group work in class (He & Ellis 1999; Nobuyoshi & Ellis 1993; Swain 1998).

Production in CALL tasks

Technology-mediated tasks afford a wide variety of opportunities for producing comprehensible output or co-constructing meaning. At least three aspects of production theory are useful to consider for CALL pedagogy. First, from a cognitive perspective, the benefits of producing language may be enhanced when learners have the opportunity to plan before speaking or writing. Second, the cognitive view also emphasizes the importance of opportunities to correct linguistic output, which can be prompted by feedback from others or from self-evaluation. Third, the sociocultural perspective suggests the value of the learners' use of the help of the interlocutor to allow for production beyond what the learner could accomplish alone. A close look at the theoretical position concerning linguistic production indicates that it refers to particular types and conditions for useful production, and these would require particular aspects of task design.

Planning
One of the benefits cited for tasks constructed through computer-mediated communication is that learners have the opportunity for planning before producing the language. But the benefit of planning, the cognitive work done to produce grammatically correct language, is not always evident in CMC. The example on page 36 of the contribution to the bulletin board in Dave's ESL Café, for example, did not show signs of careful planning:

> Do you know the EATON center in downtown toronto? There are many ATMs,which we can find pretty close to the entrance. one day i tried to withdraw $300,however i got the only $140. The receipt said the withdraw ammount was $240.????

Nor should it. The point for the learner no doubt was to have fun producing language in a context in which adherence to prescriptive grammar rules was not required. However, in some studies of classroom chatting, similar findings are made with respect to lack of concern on the part of the learners for grammatical accuracy (e.g., Kern 1995). For instruction, it seems pedagogy should suggest ways for using CMC tools in a manner that allows the learners to receive the grammatical benefit of the planning time afforded by the written communication.

In a study of classroom chatting explicitly intended to help learners practice production of grammatical forms, the researcher found that the task design seemed to affect their concern for grammaticality and the language produced.

Looking particularly for negotiation of meaning in the data, Pellettieri (2000) concluded that tasks with a pedagogical function should be goal-oriented, have few possible outcomes, and require participants to request and supply information. These task features had been suggested based on a synthesis of research on communication tasks for SLA (Pica, Kanagy, & Falodun 1993). She noted the level of vocabulary and concepts also affected the quality of the production and interaction. "Furthermore, this study suggests that if the language goal is to promote an even higher level of learner focus on grammatical form, those tasks that require learners to produce and then reflect on the language produced might be fruitful avenues to pursue" (p. 83). Of course, not all tasks are intended to help learners develop grammatically, but in the language classroom such tasks are needed, and therefore principles for realizing the benefits of planning should be included in CALL pedagogy.

Correcting linguistic production
Correcting linguistic production refers to the learners' own correction of errors in the language they have produced. The recognition of the existence of errors may come from the learners' self evaluation, or it may come from the signals received by other interlocutors or the computer. Self evaluation of linguistic production requires tasks that allow planning time and that set expectations for grammatically correct language. In Pellettieri's (2000) study, for example, tasks succeeded in focusing the learners on correct production, as was evident from the learners' self-correction. The learners, working in a written chat environment to compose short utterances, were sometimes observed composing a contribution to the discussion, and then stopping to reread it, and correcting the grammar before sending it. These results, apparently prompted by the way she had defined the task for the learners, offer a striking contrast to other studies of production in chat environments. She also found learners correcting each other and engaging in negotiation of both form and meaning; moreover, learners sometimes incorporated corrections prompted by others into their production.

An enduring hope or endless frustration (e.g., Brock 1995), grammar checkers built into word processing programs should ideally help to prompt learners to consider potential errors in their linguistic production. Recently, Burston (2001) has reported some success in French learners' use of the imperfect analysis that is provided by French grammar checkers. Such success has come only with careful examination of the types of errors that he could count on the grammar checker to find, by exploring different products available, and training the students to use the software effectively. Nevertheless, if

the results of the process include students who can use the feedback of the grammar checker to notice the errors in their comprehensible linguistic output and make corrections, the exploration was well worth the time spent. Results with English grammar checkers for English language learners have not been as positive, although the most successes reported seem to have been when the error analysis software was developed particularly to target the errors of learners from a particular language background and when the software was used as one component in the context of writing instruction (Liou 1991). In view of the evolving capabilities of error correction in word processing and e-mail programs, however, learners in and out of English classes are receiving error correction. The challenge appears to be in helping them to learn how to best interpret the messages they receive, thereby raising their awareness of grammar and their need to evaluate their own language.

Some success has been found in this regard, particularly if the point is to flag learners' attention and point them to areas of the text that they should reflect on. For example, Liou (1993) observed in one study that an error message "though misleading, raised the subject's consciousness of form and finally caused her to replace *successful* with *success* [in the expression 'does not guarantee successful']." Importantly, this type of error correction occurred when the learner was primarily focused on the meaning of what he was writing. In this case the interruptions to focus on form occur in the appropriate context for potential acquisition, according to the theory of comprehensible output. In contrast, many other studies of error correction have taken place in a more controlled exercise in which one might question the extent to which the learner was actually focusing on the meaning of the language (e.g., fill in the correct form of the verb). Although the linguistic production in such tasks would not really fit within the comprehensible output theory, it seems that the general principle that the learner benefits from correcting his or her own language might be fruitfully applied to these as well.

Help during production
Error correction prompted by the teacher, other learners, or the computer comprises one type of help that a learner might receive in producing linguistic output, but other types are the preemptive seeking of guidance during linguistic production or the collaborative conversation directed at building a joint product. The former types of learner-prompted focus on form occur regularly when learners consult a dictionary while writing. Research has found that learners used the dictionary to check on spelling, meaning, the existence of a word, synonymy, grammar, register, collocation, and inflection (Harvey

& Yuill 1997). The attention, mental effort and evaluation of potential words prompted by looking in the dictionary are among the features that Laufer and Hulstijn (2001) suggest are factors that increase the probability that words will be remembered. One might hypothesize that this process would be at least equally valuable when queries are made to an on-line dictionary, but research results concerning the value of on-line dictionaries during linguistic production are needed. In software, such as Système-D (Noblitt, Solà, & Pet 1987) designed for learners of L2 French, research by Bland, Noblitt, Armington, and Gay (1990) and by Scott (1990) documented that learners tended to interrupt their writing to consult an on-line dictionary while writing; the value of this continual process over the course of a semester for acquisition of the words has not been investigated.

The value of help received during collaboration in on-line tasks also requires further investigation; however, one might speculate that, like Watanabe's findings for comprehending input, the linguistic results might be best for collaboratively obtained help when the learner receives good, accurate help. This suggestion is supported by classroom research, which has found that learners tend to remember the help they receive on linguistic forms – whether or not the help was accurate (Swain 1998).

Integrating input, interaction, and production into tasks

The suggestions outlined in this chapter focus on the micro level where learners' attention is engaged with the language of a pedagogical task, but they need to be orchestrated into larger fabric of classroom or CALL tasks. Moreover, with the focus on learning process, the actual linguistic features to be learned remained somewhat in the background. Any attempt to use these micro process-oriented pedagogical practices will need to consider vocabulary, syntax, and pragmatic aspects of the language to be learned, and the interest engaging qualities of the tasks in which these features play a role. Focusing on vocabulary acquisition within L2 tasks, Laufer and Hulstijn (2001) have synthesized results from a number of studies to suggest the critical characteristics of tasks that are likely to promote vocabulary retention; these are need, search, evaluation, and knowledge of correct meaning (see Table 2.5). These features are consistent with the micro practices outlined above. For example, a word that is needed is very likely to become salient during a task. However, they are stated from a level of analysis that is useful for planning tasks. Extending this approach to syntax, one might summarize the important task features as

indicated in Table 2.5. The features of vocabulary and syntax are not mutually exclusive, but they have arisen from different considerations and studies. Much more research is needed to refine these suggestions in the future.

Although vocabulary and syntax are critical and central to language development, one would hope that further evolution of CALL pedagogy would be able to speak more definitively to the development of pragmatic knowledge

Table 2.5 Task characteristics believed to induce acquisition of vocabulary and syntax

Aspect of language	Critical task feature	Explanation
Vocabulary	Need	The learner feels the need to know the word because he or she wants to understand the input or to be able to use the word in production of meaningful language. Need for knowledge of a particular word can also be imposed by a teacher, but this is not considered as positive for acquisition.
	Search	The learner attempts to find the meaning of the word (e.g., in a dictionary or by asking someone).
	Evaluation	The learner judges the extent to which the word is similar to another or appropriate in a context.
	Knowledge of correct meaning	The mental effort expended in considering the word needs to result in a clear understanding of the meaning.
Syntax	Opportunities for production and correction	The learner has opportunities for producing comprehensible output and correct its form.
	Provision for feedback about success in comprehension and production	The learner has on-going knowledge of whether or not the interpretation of input is accurate.
	Provision for clear form-meaning relationships	The learner obtains word or phrase level interpretation for the input that he or she can understand.
	Access to repetition in the input	The learner experiences the grammatical form in the input and/or production multiple times.
	Time for planning for production	The learner is not under time pressure for immediate production.
	Encouragement to draw on help for production	Help is available for production.

(Based on Chaudron 1983a; Laufer & Hulstijn 2001; Loschky 1994; Swain 1985; Watanabe 1997)

and strategic competence as well. Kasper and Rose (2001) identify the critical questions for classroom teaching of pragmatics:

> In order to investigate how the learning of L2 pragmatics – both the learning processes and the outcomes – is shaped by instructional context and activities, three major questions require examination: what opportunities for developing L2 pragmatic ability are offered in language classrooms; whether pragmatic ability develops in a classroom setting without instruction in pragmatics; and what effects various approaches have on pragmatic development.
>
> (Kasper & Rose 2001: 4)

Some work in CALL has explored teaching pragmatics (Brett 2000; Levy 1999) as well as the study of pragmatic aspects of on-line communication for learners (Belz & Kinginger 2002; Lam 2000), and these appear to provide a good start for considering if and how Kasper and Rose's questions might begin to guide thinking about CALL. What are the examples of pragmatic performance that learners experience in the various forms of CALL tasks and how do these provide opportunities for developing pragmatic ability? What are the pragmatic abilities that learners may pick up implicitly through participation in on-line learning? And how does the variety of opportunities in on-line learning affect pragmatic development?

Conclusion

This chapter reviewed some of the principles drawn from theory and research on instructed second language learning that have implications for the way that technology might most effectively be used in language teaching. It focused on the linguistic aspect of instruction and learning, which is one important aspect of the broader pedagogical concerns, such as authenticity (Chapelle 2001a). Ideally, research will continue to seek evidence concerning the value and usability of the pedagogical suggestions outlined in this chapter, but in the meantime they offer a basis for designing and using CALL tasks. Therefore, these suggestions should be of interest for language teachers, software developers and learners.

Research on CALL use and learners' unsupervised work on the Internet underscore the need for learners to understand and act in accordance with pedagogical guidelines. This chapter has focused on classroom CALL, but in view of the widespread interest in developing CALL intended for learner autonomy (e.g., Blin 1999), the learner needs to be aware of approaches that are

likely to be successful. For example, the software developer can build materials with extensive hypertextual elaboration, but if the learners fail to take advantage of these elaborations, they hold no promise for helping. Moreover, the implementations illustrated assume a CALL author or teacher task designer, but the basic ideas can be implemented in other ways as well. For example, another way of focusing on language in interesting texts is to have learners themselves highlight linguistic input that they see as relevant to their learning. Learners might, for example, be assigned to find a text of interest on the Web, summarize the text for the class, and highlight and define the expressions that he or she did not know in the text. A series of such assignments might result in a portfolio of texts with personalized highlighted linguistic forms. These and other strategies for learners are suggested in teacher handbooks on the Internet (Warschauer, Shetzer, & Meloni 2000; Windeatt, Hardisty, & Eastment 2000), but these suggestions might be considered critically in view of the cognitive and sociocultural perspectives outlined in this chapter.

Evaluating language learning

> Up to this point, system design has proceeded on the basis of a series of hunches and guesses. For us to put foreign language tutor design on a firmer basis, we will need to have real tests of these hunches... The only way to evaluate these various common-sense-based hunches is by detailed evaluation of the instructional effectiveness of the principles being proposed.
>
> (MacWhinney 1995: 320–322)

This observation was made several years ago by Brian MacWhinney, a professor of psychology specializing in language acquisition. He was writing about CALL projects that had applied the most advanced software technologies to language teaching. The observation that such software is designed on the basis of hunches and guesses will resonate with any one who has designed or carefully examined such systems. While some developers will probably be satisfied with the idea that software must be constructed on the basis of intuition alone, many more people would agree with MacWhinney that detailed evaluation is needed. But what kind of evaluation?

Despite the need for evaluative research on the effectiveness of technology for language learning, in general, questions of what kind of research should be conducted, and how the results of research should inform theory and practice remain the source of continuing uncertainty. When MacWhinney suggested the need for evaluation of effectiveness, what did that mean? Would he be considering the same type of evaluation as would a teacher who is using the Internet for teaching English in Japan? Academic journals focusing on technology for language learning are full of research articles, but do these papers address the evaluation concerns that MacWhinney raises? Do they suggest different concerns for evaluation, and if so what are these? This chapter addresses these questions about evaluation of technology for English language learning. In the first section, I argue that the issues involved in research on technology and language learning begin to make sense in view of the audiences that such research is intended to serve and their purposes. This analysis reveals contradictions between my experience and the expressed need of some to make a case for technology. I then focus on what I see as the evaluation priorities for En-

glish language teachers and applied linguists, offer examples of useful research approaches, and comment on research methodology as it pertains to applied linguists' needs.

Reconsidering research

When I give lectures about CALL research, I typically find, among the many perspectives in the audience, some people who assume that the only serious way of conducting research on CALL is through comparison studies testing the differences in learning outcomes of students who have used CALL with those who have been taught in traditional classrooms. This segment of the audience, which represents part of the larger population, will readily agree that such research is subject to the same confounding factors as any experimental or quasi-experimental study in education, but nevertheless sees such studies as the legitimate way of evaluating instructional effectiveness and therefore the way to evaluate CALL. A second group within the audience assumes that very little if anything can be gained by conducting CALL vs. classroom comparison studies because the genuine questions about CALL cannot be addressed through such gross comparisons. Despite all that has been written and said about the CALL vs. classroom comparison over the past 20 years, these two adamant perspectives are represented in every lecture audience, and I believe that they will always continue to be. I find these contrary perspectives intellectually healthy, but at the same time they are frustrating – particularly for those who are trying to begin their work in CALL evaluation. I therefore must begin discussion of CALL research with an attempt to explain these two perspectives. I do so by looking at the purpose of research from the perspective of those seeking studies comparing CALL and classrooms. These people seem to be seeking research results that can be used to develop a convincing case for using technology.

Making a case for technology

People wishing to see results of research comparing CALL with classroom study seem to assume that a case needs to be made for using technology in English language teaching. This interest is shared by some language teachers, administrators responsible for budgeting decisions, and commercial publishers even though their ultimate use of research results might differ. In considering the use of research by these three constituencies, I also comment on my own experience and observations.

The language teacher

Figure 3.1 shows an excerpt from a listserv for discussion of technology and language learning. This and its response in Figure 3.2 were particularly articulate contributions to what is an ongoing conversation about research in CALL in the profession. They mirror conversations that go on regularly on e-mail discussion lists, in faculty meetings, at conferences, in graduate classes, and on thesis committees. Here is a teacher who seems to be using technology in what most of us would consider a satisfactory classroom situation. His description, "If I can see my students improve their learning of a language by using a CALL program..." portrays a classroom situation which most language teachers would not try to probe more deeply. But this teacher wants more. He is looking for some evidence that can be used to convince someone else that CALL is useful for language learning. He wants something more definitive than his impression that CALL works for his class, and so he is looking for "a statistically valid test." He is not alone. It is not unusual to find papers in the professional literature reporting studies that teachers have conducted to compare CALL with classroom instruction (e.g., Adair-Hauck, Willingham-McLain, & Youngs 2000; Nutta 1998).

Arguing for the value of CALL vs. classroom comparisons, an EFL teacher in Japan suggests that comparative research in CALL is needed for two reasons: "First, the teacher and classroom provide the best known yardstick by which to judge other means. Secondly, it is important to distinguish at what stage the effectiveness of the human delivery of instruction is crucial, and to show as

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...one of the more exciting workshops at the Oxford 1999 Calico conference was devoted to research evaluating CALL. It seems clear that much of current "research" in the effectiveness (or lack thereof) of CALL is mainly anecdotal. That may be fine for individual classes. If I can see my students improve their learning of a language by using a CALL program but I don't want to condemn another class of students to be a "control group" that is expected to do less well so that I can prove my "gut feeling", then fine, but my experience is invalid for predicting how another class, with another teacher, might benefit from using the same CALL program. My enthusiasm for a CALL program can affect how my students benefit from using the program. What may be happening, however, is not that the CALL program is effective but that students are influenced by my enthusiasm.

My question, then, is how can we test any CALL system with a statistically valid test?

Figure 3.1 A comment and question about CALL research from the Calico-l list, September 30, 1999

clearly when that is the case as when it is not" (Allum 2002: 161–162). In view of the fact that Allum conducted the research on his own class, it may be that he is intending to "show" only himself; in other words, he wanted to decide whether or not to continue to construct CALL exercises using *Hot Potatoes* authoring tools. In reflecting on the value of his comparative study, he wrote that because it was conducted in his own classroom rather than an experimental setting, others should "feel confident that the results are relatively robust" (p. 161).

Unlike the contributor to the e-mail list, then, Allum does not appear to be trying to convince anyone else of the value of CALL for teaching particular aspects of what he is doing in his class, although the publication of the results in an international journal might suggest that others were indeed interested. But more pertinent than the actual research results was the argument for the value of the comparisons for individual teachers. Unlike some English teachers, he did not question the need for comparison studies on the grounds that the technology no longer imposes extra cost or inconvenience. Instead, he noted that "computers are widely diffused, especially in higher educational settings. In many circumstances, the introduction of CALL would involve little or no hardware costs, and relatively minor software costs. This should have changed the focus of much comparative research. There is a need to show whether and how CALL is just as effective at delivering instruction as conventional means" (Allum 2002: 146–147). The assumption, however, is that one is attempting to achieve precisely the same results with both approaches.

The administrator

Administrators or groups within educational settings that are responsible for decision-making beyond the classroom, according to one response to the message in Figure 3.1, are interested in the outcomes obtained in CALL vs. classroom comparisons. The response, shown in Figure 3.2 indicated that the reason for conducting such studies had to be seen in connection with the administration's action that would result from knowledge of findings.

The idea that CALL might win or "lose out" on the basis of results of research seemed to be supported by faculty at one university where I gave a lecture during a period when CALL vs. classroom research was being conducted. Participants confirmed that their administrators were interested in learning that the CALL sections of the language classes did in fact perform just as well as those in the classroom to show that the money-saving tactic was not disadvantaging the language study of those who were assigned to it. I wondered what would have happened if the researchers had found that the CALL sections were disadvantaged. After the many thousands of dollars that had been spent

Indeed, one troublesome aspect of second language pedagogy is that experimental protocols like [the CALL vs classroom study] are at the same time quite feasible and quite rare. I suspect that the reason is that the odds of a *successful* outcome are not good. That is, a controlled experiment like this has three possible outcomes: (1) there are no differences between the two methods, (2) the traditional method is superior, or (3) the CALL method is superior. The problem is that if you are committed ahead of time to a particular method (let's say the CALL method), then you will know ahead of time that two of the three possible outcomes will reflect badly on what you're doing. If the most you can say is that CALL is no different than the traditional method, then CALL will lose out because it's generally more expensive (unless you envisage an instructor-free CALL method, in which case it's hard for me to imagine CALL ever winning out in language instruction).

Figure 3.2 An answer from the Calico-l list, September 30, 1999

acquiring equipment and reconfiguring classrooms, would CALL have been abandoned in the summary manner in which it had been studied? At the same time that CALL was being studied, e-learning was being argued for as the only reasonable solution for the lack of human and space resources for the growing number of students enrolling in classes for one language.

At my own university it is difficult to imagine what it would take to divert the definitive march toward technologizing all aspects of learning and teaching. Whenever I hear the argument that computer vs. classroom studies are needed to inform decisions about investment in computer labs, I cannot help but think of my own campus. As far as I can tell, it was the president of the university who decided that the English Department should have approximately 12 computer labs as part of an effort to make the university have a high tech look. It seems very unlikely that he first weighed the research results on teaching English in computer labs before making this decision. The key event in the computer lab expansion was the decision to charge a small "computer fee" in addition to regular tuition to all students. In exchange for this fee, which the students themselves approved, students were able to expect to have access to computers for teaching and learning. The university now has a replenishing resource which is dedicated to computers for classrooms and computer labs; no shortage of computer hardware appears to exist on our campus. Any department can build and update computer labs if a faculty member is willing to write proposals every year to an internal committee that decides how to hand out the money.

The situation I observe in my everyday life, which is similar to many other universities in the United States, is interesting in light of an analysis of

computer-mediated communication by Murray (2000). As part of her critical analysis of computer-mediated communication she notes the following: "Much discussion of computer-based technology speaks to its inevitability, making its consequences, such as CMC, a foregone conclusion rather than a tool under the control of human intention or accountability" (Murray 2000: 404). In my department, because building computer labs entailed remodeling classrooms into computer labs, many of the instructors and teaching assistants who teach writing classes are assigned to computer labs to teach. As far as I can tell, they are simply told, along with the course they will be teaching, that it will be held in a computer lab. I do not think that these teachers see the computer as under *their* intention and accountability!

In a situation such as the one at my university, the observation that CALL vs. classroom studies are not undertaken because CALL may lose out does not make sense. I do not see any indication that the steadfast march of technology through society is likely to hesitate, let alone lose out, on the basis of research results indicating that learners do better with classroom instruction alone. In the face of such results, if they were considered relevant and valid, I believe the solution would be seen as a need to improve CALL rather than to restore classrooms.

The publisher

I have been approached more than once by professional developers and publishers of technology-based English language learning materials because they want advice and help on how to evaluate the materials. I find such requests both fascinating and frustrating. Fascinating because research and evaluation of CALL is exactly my area of academic interest, and the apparent interest in the topic by those with the resources to conduct significant evaluation projects seems to open new possibilities for better understanding CALL and research. But it is frustrating because professional developers tend not to want to spend money on research unless the investment will provide outcomes that can be used for marketing. The motive of generating marketing data, in my view, undermines the idea of research.

The use of research as marketing data is evident on Web sites of ELT software publishers, such as CALI which displays the results of a research study comparing the test score gains of students using ELLIS (English Language Learning and Instruction System) vs. those using classroom instruction (http://www.cali.com/ accessed September 7, 2002). These are included in the section called *case studies* which is featured under *News and Events* along with links to *press room, events, awards, case studies, reviews, testimonials, success sto-*

ries, and *industry information.* The CALL vs. classroom study fits well within the genre of positive news about software products. Functioning in the same role on WebCT's Web site are results from another "research" study: "WebCT customers are overwhelmingly satisfied with their WebCT experience and plan to significantly expand their use of the company's software to deliver and manage higher education e-learning, a new customer survey indicates" (accessed from www.webct.com, September 4, 2002). The article goes on to explain that 9 out of 10 of those who completed the survey were satisfied or extremely satisfied. The placement of these research results among the (other) promotional materials for the software is consistent with my perception of this kind of research being of interest to those wishing to make a convincing case for technology.

Publishers' desire to make a case for electronic learning sometimes seems like overkill to me in view of the fact that the professional literature in English language teaching delivers the same message for free. For example, a book published by the professional association in the United States, Teachers of English to Speakers of Other Languages (TESOL) as a teacher's resource book begins by explaining the benefits of e-learning: "In our view, there are five main reasons to use the Internet for English teaching" (p. 7). They go on to explain how the Internet is conducive to developing "authenticity, literacy, interaction, vitality, and empowerment (Warschauer, Shetzer, & Meloni 2000). The enthusiastic endorsement is followed by "one caveat": that the Internet is only a medium, and therefore that teaching matters. This stance suggesting the intrinsic value of the appropriate use of the Internet seems to me to help create a climate specifically for English language teaching in which publishers of Internet materials need not be overly concerned about producing their own classroom vs. CALL comparisons. If part of the professional knowledge of English teachers includes the need to incorporate the benefits of the computer into their teaching but not to expect the Internet to do it alone, what commercial publishers have to offer seems to fill a need.

The contradictions
I have considered the motives and interests of those who are interested in CALL vs. classroom research, but have done so in view of my own perceptions and experiences. Contradictions are evident between the perceived benefits of CALL vs. classroom research and my experience suggesting that the putative audiences for such research really have interests that may override the potential value of such research. Table 3.1 summarizes the contrasts between my experience and the view that a case needs to be made for using technology through

Table 3.1 The contradictions in discourse about CALL vs. classroom research

A case must be made for CALL	My experience
Language teachers need to be convinced about whether to use CALL and for what purpose.	The results of research comparing "the computer" to "the classroom" are not conducive to developing principles of language learning and teaching.
Administrators need CALL vs. classroom comparisons to be convinced to fund computer labs.	Administrators seem to make decisions about funding computer labs on the basis of societal or institutional factors rather than of comparison research.
Publishers need positive results from CALL vs. classroom research to sell their software.	Current professional discourse teaches teachers that they need the software that publishers produce.

CALL vs. classroom comparisons. These contradictions may not exist in other settings where a case needs to be made in a particular classroom or at an institution for the use of technology in English teaching but in my department some teachers would have to make a case for *not* using technology. In addition to the academic arguments I have outlined elsewhere (e.g., Chapelle 2001a), the contradictions I feel in the motives of those wishing to present a case for technology and the actual need for such a case have turned my interest to questions that hold potential for increasing professional knowledge of CALL.

Increasing professional knowledge

In view of my experience suggesting technology does now and will in the future play a significant role in teaching and learning, it seems that the priority in the field should be research that addresses questions that can inform teachers and learners about the best ways to design and use technology. Research results are needed to strengthen the empirical basis for software developers and applied linguists working in teacher education, pedagogy, and technology. In the first chapter, I mentioned the concern that courses in teacher education are notorious for their preoccupation with the technology to the exclusion of theoretically or empirically based principles about learning through technology. The critical analyst suggested that the shallow treatment of the issues could be attributed to a cycle of preoccupation with technology and the process of its use. But if teacher education is to include more than technique, knowledge about learning through technology needs to be constructed. The detailed type of knowledge called for by applied linguists requires a more delicate set of

research methods than a research design that compares CALL and classroom teaching. But what are the relevant questions and how can they be addressed?

Advice from the field

Surely applied linguists who have spent their careers studying technology for language learning have some ideas about how to add the needed depth through successful research. In fact, the issue of research on CALL has recently received quite a bit of attention. Part of the impetus has come from the feeling of many faculty in higher education that the work they have accomplished in CALL has been undervalued when they are evaluated for promotion and tenure. I know that I am not the only faculty member who has been told by a department chair that the review committee did not know how to evaluate the development work I had done in CALL. In too many cases, the devaluation of work in CALL has resulted in faculty failing to get tenure, and therefore loss of faculty positions. This tragedy has implications for development of the profession because if faculty in higher education almost by definition are considered ineligible for tenure if they work in CALL, the entire field remains the unwelcome stepchild of the larger profession of language teaching, or worse, linguistics or literature.

As a consequence of this concern, professional organizations have drafted a statement about research in CALL. The purpose of the document is stated as follows:

> This document has been drafted by a group of twenty CALL theorists, researchers, developers and practitioners from Europe and the USA in order: (i) to establish a clearer understanding for departments, institutions, professional associations and decision-making bodies of the range of activities represented in the field, and (ii) to provide an organised and consistent perspective on the rubrics under which these activities should be evaluated.
>
> (EUROCALL, CALICO, IALL Joint Policy Statement 1999)

Whereas the document does outline what is considered important research and development work by the profession, it should be noted that the audience for the document is intended to be those outside the profession, and therefore the brief statement does not contain an extensive discussion of the issues or guidelines.

For discussion of the issues one might consult a number of papers addressing research in CALL (e.g., Chapelle 1997, 1998, 1999; Chapelle & Jamieson

1989, 1991; Debski 2001; Dunkel 1991a; Harrington & Levy 2001; Levy 2000; Salaberry 1999, 2001; Warschauer 1998). However, as a collection, they do not offer clear guidance about legitimate evaluation methods. I find that students who have studied these and other discussions of CALL research return to me with the most basic questions about where to begin. In fact it may be difficult to summarize any single point upon which all professionals agree except that the issue is worthy of discussion. Although it is difficult to identify areas of consensus, it is possible to lay out some of the general points of current controversy concerning research within the field.

What is research?

The topic of the professional document for university administrators, what is research in CALL, is also a topic within the academic literature. A recent paper attempting to shed some data on this issue reports results of a study that conducted an analysis of the types of research papers published in 1999 in journals and edited books on CALL (Levy 2000). The research foci include a diverse set including the following: CMC, artifact, hybrid, environment/comparative evaluation, teacher education, hypertext/reading, and other (p. 177). Finding that only about a third (28%) of the new research had anything to do with measuring learning gains, Levy suggested that researchers conducting new research "appear to be gauging various aspects concerning the design of their programs. Typically, the investigation of learning gains may follow, or may be the ultimate goal" (p. 186). Despite the very broad diversity of research objectives and no clear focus on learning gains, Levy nevertheless points out that "CALL does have its own research agenda with legitimate and distinct problems that CALL researchers wish to address" (p. 190). However, in the end the "distinct thread" that is identified is the fact that "[f]or the CALL researcher, technology always makes the difference; the technology is never transparent or inconsequential" (p. 190).

   As I pointed out in Chapter 1, technology has disappeared throughout many aspects of society, but the CALL researcher continues to see it, to manipulate it, to study it, in hopes of improving it and how it is used in language teaching. But the question remains: How does one best study it? In papers that I have written on methodological issues (e.g., Chapelle 1997; Chapelle & Jamieson 1989, 1991), I have been interested in research that hopes to offer some insight on how the technology can help to promote language acquisition through CALL, and therefore I have been concerned with a narrower set of research aims relative to all that can be and is done as research. In the examples

below, I will continue along this path, discussing not all types of studies that have been conducted, but some that appear to add important findings to the professional knowledge by informing the types of pedagogical issues discussed in the previous chapter.

General vs. specific knowledge

The idea that research can inform general professional knowledge is itself controversial. In explaining arguments against "checklists" for evaluating language learning software, for example, Susser (2001) cites the argument that evaluation is too context specific to be left to a general check list. The argument, which he does not agree with, suggests that knowledge about language learning and teaching needs is very specific to a particular setting and may therefore not be something that is amenable to development as a professional body of knowledge. If all knowledge about CALL is context specific, are any research results worthy of dissemination?

In my view, research should be able to seek some general knowledge – knowledge that can serve in the construction of better technology-based language tasks in the future, knowledge that we can pass on to future CALL experts, and knowledge that we can share with the profession as a whole. For example, the pedagogical suggestions outlined in Chapter 2 are useful only to the extent that CALL developers and users are willing to assume that guidance about making input salient, for example, can be taken from prior research. In the examples of studies I describe below, each offers some findings that are of interest beyond the research setting. In describing these studies, I have focused on the positive, i.e., what they have to offer, with the assumption that the results of any research that seeks an understanding of principles are strengthened through critical analysis and subsequent research aimed at the same principles.

Research methodology

How does the researcher decide on a methodology? Kern and Warschauer (2000) suggest that research methods are tied to the theoretical approach of CALL, arguing that three basic approaches to CALL can be identified – structural, cognitive, and sociocognitive. They suggest that these three approaches correspond to experimental methods, both quantitative and qualitative methods, and qualitative methods including discourse and context analysis, respectively. The connections they make between theory and research method clarify some conceptual links in the research process, but at the same time they are of-

fered in very broad strokes, leaving questions about details. For example, even if one can identify a CALL activity of interest as fitting within a sociocognitive theoretical perspective, the specific methodology is ultimately guided more strongly by the research questions to be investigated, and therefore the problem of setting up the research depends on what those questions are.

I have suggested that research methods need to be tied to the research questions that are posed by the researcher, and have laid out a number of questions that correspond to the type of evidence that the researcher seeks about CALL (Chapelle 1997, 2001b). Like the teacher, administrator, and publisher who were seeking evidence that would make a convincing case for technology, the CALL researcher can benefit from having a particular argument in mind while composing the research design. I have suggested that a worthwhile argument can be made by seeking evidence for a number of factors (Chapelle 2001a), and that evidence can come from a variety of sources. From this perspective, the focus is not a single theoretical orientation but a quality of the CALL task (e.g., language learning potential) for which the research seeks evidence. In the examples of studies I review in this chapter, the studies focus on the qualities of language learning potential or positive impact.

Theory-research links

Kern and Warschauer's (2000) approach shows links between research methods and theoretical approaches, but it does so in general terms, bypassing the question of whether or not theory in second language acquisition (SLA) might be useful in structuring research questions. This issue has been the source of debate (Chapelle 1999; Harrington & Levy 2001; Salaberry 1999; Warschauer 1998). In a paper in 1997, in response to the existing research that appeared to be grasping for theoretical grounding, I suggested that priorities in CALL use be clarified around the most important issues for language teaching and learning. Specifically, I suggested that

> because the purpose of CALL activities is L2 learning, the most critical questions to be addressed about CALL are the following: What kind of language does the learner engage in during a CALL activity? How good is the language experience in CALL for L2 learning? The first question requires description of the language that learners hear/read and produce during the CALL activity. It is critical because its answer provides the instructor a means of deciding the role that the CALL activity should play relative to other potential assignments. For example, to decide whether or not to assign a regular e-mail pal with whom students are to correspond during the course of a semester, the

> instructor needs to have an idea of the language that the learners are likely to
> engage in during the activity... The second question is evaluative. Evaluating
> the quality of learner language in an L2 task requires that some assumptions
> be held concerning the types of language use expected to be beneficial for L2
> development.   (Chapelle 1997: 22)

In particular, I argued that theory from research on instructed SLA should be
informative, and I will return to the issue of how theory comes into play in the
examples I discuss in this chapter and in the following.

These four general points of current controversy represent just one way
of summarizing the issues raised in the literature in this area. In many ways
they are reminiscent of discussion in SLA from ten or more years ago (e.g., see
TESOL Quarterly, 24(4)). Since these discussions are somewhat familiar, one
might hope for help from history, but if any lesson can be learned from his-
tory, it is that fundamental issues about the what and why of research are the
site of ongoing struggle in which participants have to constantly examine their
own theoretical understanding and purposes. In the rest of the chapter, I will
assume answers to the first two questions, what is research, and does it have
general relevance. I am going to consider only empirical research attempting
to learn about the use of CALL, and I will assume that such research has some
contribution to make to the profession. The second two questions about re-
search methods and theory-research links will serve as the source of discussion
as I look at some examples of useful research.

Examples of useful CALL research

The examples of research that I find most useful are those that provide some
evidence about the design of the software, the learners' use of CALL, or the way
that the teacher has organized the task. These kinds of results seem important
because to be able to move forward as a profession, we need to be able to ar-
gue that some of the possible software and tasks one might develop are good
whereas some are not. We also need to be able to offer suggestions to teach-
ers and students about how to use CALL tasks successfully. In other words, the
profession needs principles that can be applied, studied, and developed. Taking
these three foci – software, learners, and task pedagogy – and the correspond-
ing three audiences shown in Table 3.2 as a point of departure, I have chosen
some examples of research of each type.

Table 3.2 Three approaches to developing useful research questions about CALL

Focus on...	Results	Primarily for
The software	Indicate the most successful software design strategies	Software developers and lab coordinators
The learner	Indicate successful strategies for using software	Teachers and students
The task	Indicate the best ways to structure learning tasks	Teachers

Focus on software

In the previous chapter, I discussed several studies that focused on software because in developing a pedagogy relevant to the specific details of software design it is useful to draw comparisons between results obtained from different software designs. For example, Brett (2000) cited the following two studies as influencing the design of a multimedia program for learners of business English.

Subtitles for listening

One was the study of an interactive listening task for learners of L2 French, in which Borrás and Lafayette (1994) investigated the effectiveness of optional subtitles as a means of modifying the input. They compared performance on a speaking task of learners who had used the computer-assisted video materials with and without subtitle options. Learners who participated in the subtitle condition had the option of choosing to see subtitles for the aurally-presented French when they had difficulty in comprehending. The control group heard the video under exactly the same conditions but without the subtitle option. Results of the speaking task, which required all learners to address questions about the content of the video, clearly favored the subtitle condition. They concluded that the higher oral communicative performance of the experimental group suggests that "when learning from 'authentic video' in a multimedia environment, having the opportunity to see and control subtitles, as opposed to not having that opportunity, results in both better comprehension and subsequent better use of the foreign language" (Borrás & Lafayette 1994: 70).

Intelligent feedback for grammar

A second study cited by Brett investigated the feedback that learners received in software designed for the study of Japanese (Nagata 1993). The question was whether a program that offered "intelligent" feedback to learners about their errors would be found to produce better grammatical performance than

that of learners who had completed the same instruction but without intelligent feedback. From the software developer's perspective this is an important question because software with intelligent feedback is much more costly to produce than is software that only locates an error, or offers only feedback indicating correctness or incorrectness. Intelligent feedback for a particle error in the learner's sentence would look like this: "In your sentence, GAKUSEE is the 'subject' of the passive (the one that is affected by the action), but it should be the 'agent' of the passive (the one who performs the action and affects the subject). Use the particle NI to mark it." The unintelligent feedback message for the same error would consist of 'NI is missing,' requiring the learner to remember, guess or find out how, why, and where 'NI' was to be used in the sentence (Nagata 1993: 335). During the research, an intelligent version and an unintelligent version of the program were provided to an experimental and comparison group respectively, and the learners who received intelligent feedback about their use of particles performed significantly better on both posttests and end-of-semester tests than did those students who had received only an indication of where they had made an error. The intelligent feedback did not make a difference for all aspects of the lexicogrammar that were taught, and the explanation for the inconsistent findings is not clear (Salaberry 2001).

Nevertheless, because these studies focused on a feature of the software as an explanatory variable for successful performance, they speak directly to questions about software design. Is it better to have optional subtitles or not? Is it worth developing intelligent feedback, or not? Both of these studies were set up with two groups for comparison like the CALL vs. classroom study, but unlike CALL vs. classroom comparisons, the results are useful for subsequent software design because they isolated the features of the software that helped the students and therefore the results can contribute to the professional knowledge about CALL. The next example, which investigated the use of a parallel concordancer did not use a comparison group (i.e., it used a within subjects design) and therefore any positive results would have to be considered more tentative, but the researcher did not get positive results.

Parallel concordancer
This study examined improvement in French learners' lexicogrammatical knowledge of two words in French (Bodin 2002). The two words, *dont* and *matin/matinée*, were chosen because they do not map directly to equivalent English words, and consequently their use is something that requires an understanding of the grammatical/semantic contexts in which they are used. Bodin saw this as a particularly good use for a concordancer activity, which was in-

Table 3.3 Example output from a search of "dont" in a French-English parallel corpus

French	English
Je suis accompagné aujourd'hui d'une personne qui sait exactement ce **dont** je parle.	I have someone here today and he knows what I am talking about.
Nous retrouvons dans la Loi sur la santé cinq grands principes **dont** celui de l'accessibilité.	We have in the health act five major principles, including that of accessibility.

(from Bodin 2002: 62, 65)

tended to display examples for the learners and ask them to infer rules of use. Table 3.3 illustrates two examples from the output obtained from a search for *dont*.

Beyond Bodin's idea that the concordancer would be good for this type of learning and the general idea of data-driven learning developed by Johns (1994), the theoretical basis for this study was drawn from research on acquisition of the lexicon, and in particular three concerns that have been raised in recent theory and research.

> The first is the relationship between lexical items and grammar, the second is the relationship between lexical items and their frequent occurrence with other lexical items (collocation), and the third is the need for lexical items to be encountered by the student in a variety of contexts.   (Bodin 2002: 12)

These issues which are discussed extensively by Nation (2001) were used to justify the use of the concordancer, and specifically the parallel concordancing task for teaching these lexicogrammatical features. Pretest and posttest comparisons were made using grammaticality judgment tests containing grammatical and ungrammatical uses of the target words. Differences were not statistically significant, indicating that the parallel concordancer – at least as it was used in the research – was not effective in promoting a detectable change in learners' knowledge of the word use. Data were also gathered on learners' attitudes and their strategies in using the parallel concordancer. These additional data helped to shed light on the nonsignificant findings. Learners' attitudes were very positive toward the task, despite the fact that it was not part of their regular class work, and their strategies showed effective engagement with the process of finding examples and completing the grammatical inferencing process, but apparently they would have needed more time with the task. Based on the positive findings concerning attitudes and strategies, the researcher concluded that parallel concordancer activities might be able to increase lexicogrammatical competence if more time had been devoted to the concordancer tasks.

Focus on the learners

In the second set of examples, researchers focused on how learners work on software and tasks. The need to focus on what learners actually do when they participate in CALL tasks is evident if one considers the potential gaps between the options that the software offers and those that learners actually use, or between what the teacher intends for learners to do compared to what they actually do when they work on a task in or out of the classroom.

Looking up words

In the previous chapter, I suggested that CALL pedagogy should include the principle that more forms of vocabulary annotations are better than fewer. This suggestion is based on a study that provides a good example of useful research methods. It was conducted by Plass, Chun, Mayer, and Leutner (1998), who recorded the requests learners made for the various forms of lexical help. Explaining their methodology, they noted "[b]ecause the student's look-up behavior may change from word to word, the only way to test the hypothesis [about when look up behavior results in acquisition of vocabulary] is to use vocabulary items, not students, as the units of observation" (Plass, Chun, Mayer, & Leutner 1998: 30). The results are therefore expressed in terms of which words were more likely to have been acquired. These were words that the students had looked up using more rather than fewer forms of annotations. Since these findings are not based on group comparisons, but on word comparisons, the independent variable is not the group membership of learners, but behaviors of learners. These results are particularly compelling, and add to general principles of CALL pedagogy, because the research design does not assume that all learners who are given the annotations actually use them. Instead it is based on the performance that was actually observed.

Asking for help

In a study of learners using on-line listening materials for ESL, Hsu (1994) conducted a focused analysis of interactions between learners and the computer to identify their requests for modified input of segments they listened to. In addition, she assessed outcomes through pretests and posttests which had been constructed specifically for the research to include lexical phrases in the input. Similar to Plass, Chun, Mayer, and Leutner (1998), Hsu used the lexical phrases as the unit of analysis in a within subjects design. For each learner, she selected only those lexical phrases that an individual had been unable to recognize on the pretest. For those lexical phrases, she correlated the independent variable –

whether or not the learner had requested help – with the dependent variable – whether or not the learner was able to comprehend the phrase on the posttest. This procedure produced a correlation for each learner, so a mean correlation expressed a summary statistic for the group. Overall, she found a relationship between improved comprehension and requests of help. Again in this study, the fact that the results are based on observation of precisely what the learners did gives credence to the results, which suggest that help is good for learners *if* they use it.

Participating in telecollaboration

A third study examined learners' participation in classes linked between the United States and Germany, in which students were matched to complete several phases of projects (Belz 2001). Through the use of a variety of data including transcripts of the learners' interactions, their projects, interviews, and observations, Belz identified factors in the sociocultural setting that affected the critical aspects of the language practice that the learners were expected to engage in. The telecollaborative projects were intended to provide good opportunities for extended meaning-based interaction with a native speaker of English for the Germans and German for the Americans. It was also intended to provide opportunities for "peer-assisted language development, negotiation of meaning, and intercultural awareness" (Belz 2001:214). She found that these goals were met, but only to some extent and she identified the three sociocultural factors that negatively affected them. The German students' knowledge of English and awareness of its importance was unequal to the level of appreciation that the Americans had for German. The Germans had less opportunity to have access to the technology that they needed to complete the projects. The Americans and Germans held different expectations about classroom learning and the role of projects. These findings, based on qualitative data from a small number of learners, add an important perspective to knowledge about cross-cultural team work over the Internet. Specific and clear links to pedagogy are not drawn in the paper, but some considerations to take into account in the design of such tasks can be inferred. For example, efforts to convince American students of the value of communicating successfully with Germans in German might be enhanced in the future. In view of the role of English in the world today, this is a principle that is worthy of serious consideration for any two-way collaboration in which one of the partners is an English speaker.

Focus on the learning task

Studies examining the learning task have investigated how a learning task was structured to produce ideal language practice for learners.

Web-based listening

Focusing on a Web-based listening task, the first study investigated incidental vocabulary acquisition (Kon 2002). The researcher attempted to discover whether incidental vocabulary acquisition would take place through a Web-based listening activity which required learners to listen to an academic lecture with visual support consisting of a talking head, overhead transparency slides, picture slides, and multiple-choice questions. A variety of descriptive and evaluative data were examined pertaining to listening comprehension, strategies, and vocabulary. Theory guided the investigation in part through the definition of incidental vocabulary acquisition from Laufer and Hulstijn (2001: 10): "learning without an intent to learn, or as the learning of one thing, e.g., vocabulary, when the learner's primary objective is to do something else."

Within-group, pretest-posttest comparisons on listening comprehension for vocabulary were performed to assess improvement. As a follow up to these overall comparisons, the researcher attempted to identify vocabulary that had been acquired during the listening activity, and to see to what extent their acquisition could be accounted for by aspects of the input and interaction. The interaction in this case would have consisted of dictionary look-ups, but there had been very, very few of these. The input was more interesting. In addition to the overall positive finding of incidental vocabulary acquisition (as measured

Table 3.4 Analysis of input modes and success of acquisition for vocabulary (from Kon 2002: 52)

Mode of presentation	Number of modes	% of words acquired*	Quality of the input for acquisition
Audio-video	1	25	OK
Audio-video & written comprehension questions	2	32	Better
Audio-video & overhead transparency notes	2	39	Better
Audio-video, written comprehension questions, and overhead transparency notes	3	67	The best

* Based on delayed posttest performance

by improvement in listening comprehension for the words), the modes of presentation of the input also seemed to make a difference. The conclusion was that a Web-based listening activity can facilitate incidental vocabulary acquisition, but that characteristics of the input appear to be related to the likelihood that a word will be acquired – the more modes of presentation the better, as summarized in Table 3.4. This finding is consistent with the principle suggested in Chapter 2 that repetition in the input is beneficial for acquisition of lexical knowledge.

Communication tasks

The second study investigated the use of voice chat for tasks that learners could complete with native or proficient English speakers at a remote location (Sauro 2001). Sauro developed two types of tasks based on previous classroom-based research, and then she investigated the amount of talk that participants engaged in, and the number of instances of negotiation of meaning. The principles for task design came directly from previous SLA research on instructional tasks as summarized by Pica, Kanagy, and Falodun (1993), but the actual tasks took advantage of the Internet. Looking for negotiation of meaning as one criterion for a good task, Sauro recorded, transcribed, and examined the language that the learners produced as they completed the communication tasks she had designed.

Through this analysis she found that the tasks she had developed could be considered good by the criterion of prompting negotiation of meaning. The analysis did not indicate whether the points of negotiation resulted in acquisition or how these tasks would compare with the negotiation of meaning in face-to-face tasks. One would not necessarily expect the short duration of the experimental task to result in acquisition. From a practical perspective, she was not interested in a comparison with face-to-face tasks because her interest was in teaching English in Japan, where face-to-face tasks are not readily available. Moreover, these tasks drew on other characteristics of Internet communication that made them different, so there was really no great interest in comparing the tasks with face-to-face ones.

These findings are similar to those mentioned in Chapter 2 from Pellettieri (2000), who investigated the language of L2 Spanish learners in the synchronous written communication of a chat. Pellettieri (2000) concluded that the tasks that she had designed in a manner similar to Sauro's had succeeded in prompting some of the positive aspects of negotiation of meaning. In contrast, other studies in which the task had not been explicitly set for ideal negotiations to occur were not able to draw conclusions about tasks. For example, in a study

of text chatting, Lee found "communication strategies similar to those used during face-to-face communication," and focus on meaning, but "the students needed to be reminded to write correctly to maintain a balance between function, content, and accuracy" (Lee 2001:242). From these and other studies, we can begin to develop some principles for task design if the tasks are intended to prompt negotiation of meaning.

Text chat as rehearsal

The third study that was focused on tasks investigated a text chat-based task as a means of increasing students' willingness to communicate through oral language in the classroom (Compton 2002). The construct of "willingness to communicate" (MacIntyre, Clément, Dörnyei, & Noels 1998) was developed from research on individual differences in SLA and is intended to account for the important observation that communicative competence alone does not mean that learners will be successful at using the target language. Social, psychological, and situational factors also seem to enter into willingness to communicate. Compton was particularly interested in the suggestion that situation-specific anxiety and (lack of) self confidence negatively affect willingness to communicate, which in turn diminishes opportunities for participating in beneficial interaction. Compton was interested in exploring a means of increasing learners' willingness to communicate in her ESL class on oral communication, but she looked at a range of data to evaluate the success of the task including the degree of transfer from the text chat to the oral language in the classroom. Compton asked learners to participate in a text chat several times over the semester, and used a questionnaire, journal entries, and the chat and classroom dialogue to gather evidence for willingness to communicate. Table 3.5 shows an example from a chat and classroom session during which the topic was the most important qualities of a roommate.

Interaction analysis tabulating the number of turns taken, analysis of journal entries, and questionnaire responses showed mixed results. Some of the learners made extensive use of the text chat opportunity whereas others did not. Similarly, some of the journal entries question the usefulness of the chat whereas others make precisely the point that one would hope to see: "It is a excellent form for us to speak. Because we have already write down the words. We can also easily to speak it out" (Compton 2002:64). The questionnaire data also show a mix of responses. The tentative finding from this study revealing a great deal of within subject variation was that text chat can increase willingness to communicate, but not for all learners. The data contain clear indications that some of the learners are benefiting from the opportunity to engage in the text

Table 3.5 Data from learners' text chat and oral report on the same topic

Text chat	Oral report
Student 1: …second, I do not think so. I need a chinese guy Student 2: Because here is American, I think you'd better accept an American…	The second one is that he must be a <u>Chinese guy</u>…
Student 1: We can improve out english by many other ways, no, I will refuse your second point…. I think if he like to play the PC games. I think that's the best.	At the last time we think if he can <u>play the PC games</u>, I think that's the most – <u>that's the best</u> character that he must have.

(Compton 2002: 115)

chat before engaging in oral classroom work. This suggests the potential for the text chat used to increase willingness to communicate, but at the same time the individual variation indicates the need to carefully consider the tasks, and the learners' comments to try to see how the task might be improved.

Summary

Each of these examples of empirical research appears to have implications for professional knowledge. What makes these studies useful? Not one of them attempted to compare a classroom lesson with CALL. All three types look at learners' performance during or after the CALL activity (or both), but they differ in the variable they look at to explain performance. In the first set, an aspect of the software was hypothesized to be responsible. The second type focused on learners' strategies, choices, and perspectives as a means of explaining performance. The third focused on the task that the teacher set up for the learner. Despite the fact that the interpretations of these small-scale studies are tentative, these are the kinds of results that begin to contribute to a knowledge base, and therefore it is useful to look more closely at their research methods and theoretical grounding.

Research methods

An analysis of the examples in Table 3.6 demonstrates that a variety of research methods have been used fruitfully to obtain useful information about software, learners, and learning tasks. Some of the interpretations are better supported than others, but each offers some tentative guidance while pointing to the need

Table 3.6 Summary of research questions, methods, and interpretations

Research	Question	Method	Interpretation
Subtitles for listening	Can optional subtitles for aural French help learners acquire the L2 input?	Quasi-experimental comparison of groups using subtitles and not using subtitles.	Optional subtitles may be good for L2 acquisition.
Intelligent feedback for grammar	Can intelligent grammar feedback on syntactic particle placement help acquisition of particle placement rules?	Quasi-experimental comparison of a group with intelligent feedback vs. a group with error identification.	Intelligent grammar feedback on syntax may help acquisition.
Parallel Concordancer	Can a parallel concordancer increase the lexicogrammatical competence of intermediate learners of French?	Within-group pretest-posttest comparisons on lexicogrammatical judgments.	Parallel concordancer activities might increase lexico grammatical competence but increase was not statistically significant in this study.
Looking up words	Is learners' look-up behavior related to their subsequent knowledge of words?	Recording look-up behavior and correlation with word knowledge in a within group pretest posttest design.	The more forms of lexical annotation consulted, the greater the likelihood of the word being acquired.
Asking for help	Are learners' requests for help related to their improved comprehension?	Recording help requests and correlating these with posttest comprehension in a within-group pretest-posttest design.	Help requests are related to improved comprehension.
Participating in Telecollaboration	How do sociocultural factors relate to learners' participation and language experience in telecollaboration?	Discourse analysis, interviews, and observations.	Sociocultural factors affect learners' participation.

Table 3.6 (*continued*)

Research	Question	Method	Interpretation
Web listening task	Can a CALL listening activity facilitate incidental vocabulary acquisition?	Within-group pretest-post comparisons on listening comprehension for vocabulary.	A CALL activity can facilitate incidental vocabulary acquisition.
Communication task	Can good voice-chat tasks for communication at a distance be developed for L2 acquisition?	Discourse analysis looking for negotiation of meaning.	Good tasks can be developed to prompt negotiation of meaning.
Text Chat	Are learners more willing to communicate in oral class groupwork after engaging in text chat?	Interaction analysis tabulating number of turns taken, analysis of journal entries, and a questionnaire.	Text chat can increase willingness to communicate, but not for all learners.

for additional studies to replicate findings, or expand them (e.g., to English learning, or different grammatical forms, or other learning contexts). In the meantime, however, these types of findings need to be identified and synthesized as our professions' tentative knowledge while research on these issues continues.

The role of theory

How does theory come into play in formulating research questions, choosing methods, and making interpretations? In some studies theory has helped from the beginning to conceptualize what should be investigated and how, whereas in other cases, I have drawn on theory in a post hoc fashion to help explain findings. In either case, theory acts as a resource to make sense of the object of investigation in terms that allow for an understanding of the results that extends beyond the data of a particular study to speak to the issues of relevance beyond the research, and perhaps to the broad field of language teaching.

Theory as a resource

In developing and interpreting research, a number of formal and informal theories come into play, but I have attempted to identify specific aspects of theoret-

ical perspectives that I think are particularly relevant to the useful interpretations that I have outlined above. Table 3.7 summarizes theoretical perspectives drawn upon and how these theories were used as a resource. This analysis is not intended to offer an exhaustive treatment of all aspects of the theory-research interface in these particular studies. In fact, others might choose to focus on different aspects of theory as it relates to these studies for other purposes. Instead, I have attempted to identify the salient theoretical perspectives either that the authors chose or that I would choose to interpret the research in a way that speaks to general principles in CALL.

In the first two studies, I have drawn on interactionist SLA theory to explain findings in a way that allows them to speak to broader concerns in CALL methodology. If we consider subtitles as a form of input modification, the research fits within the bigger question of the extent to which opportunities for input modification are helpful. The second addresses issues about the type of negative feedback that is most effective for acquisition and therefore fits within the broader research agenda in second language studies about negative feedback. The third study relies on construct theory concerning lexicogrammatical knowledge in addition to the conditions under which explicit vocabulary learning can take place.

The fourth and fifth studies can both be interpreted in view of the interactionist theory suggesting the value of interaction for increasing the likelihood of comprehension and acquisition of linguistic forms. In fact, the study of looking up words was conceived under another theoretical framework, but the results are consistent with interactionist theory. The sixth study drew on sociocultural theory to conceive the questions under investigation, identify the relevant data and make interpretations.

> The use of social realist tenets as an explanatory tool for the social action of German-American telecollaboration has enabled a broadening of the analytic lens from micro-interactional descriptions of online communication to include the meanings of societal and institutional dimensions of telecollaboration for aspects of electronically-mediated communication in telecollaboration. (Belz 2001:229)

The seventh study was influenced by interactionist theory which suggests that acquisition is facilitated by particular aspects of the input – in this case repetition – that make it salient as well as by interaction. The eighth study also drew on interactionist theory. The researcher started out interested in the potential of voice chat technology for her teaching in an EFL setting in Japan, but she wanted a way of evaluating the extent to which she would be able to

Table 3.7 The role of SLA theory/research in four CALL studies

CALL Tasks	Theoretical perspectives informing evaluation	The use of theory
Subtitles for listening	Input modification	Explanation of results
Intelligent feedback for grammar	Negative feedback with explanation	Explanation of results
Concordancer	The nature of lexicogramma- tical competence	Task design and methodology: Iden- tifying what should be acquired; De- signing a measure
Looking up words	Input modification through interaction	Explanation of results
Asking for help	Input modification through interaction	Research methodology: Recording help requests and correlating these with posttest comprehension in a within-group, pretest-posttest design
Participating in telecollaboration	Sociocultural theory	Research methodology: Discourse analysis, interviews, and observations
Listening vocabulary	Incidental learning; Interactionist hypothesis – Input and interaction	Task design and research methodology; identifying factors in the input and interaction
Communication task	Interactionist hypothesis – negotiation of meaning	Task design and research methodology: Defining "good tasks" through the empirical data obtained in one task administration
Text chat	Willingness to communicate	Task design and research methodology; designing questionnaire and interview questions; examining journal entries

argue both to herself and to her colleagues and students that their time spent on this activity would indeed be time well spent for language learning. She drew on a theoretical perspective that would help her define the interaction that would be evident in a good task.

The final study drew on the theory of willingness to communicate, which is hypothesized to be important for SLA. This theory was used in conceptu-

alizing the problem, designing the tasks, collecting the data, and analyzing them. The theory was that engaging in the interaction in writing which afforded more of an opportunity for reflection and practice with the language would increase confidence, decrease anxiety and therefore increase willingness to communicate in the classroom task.

It should be evident from this analysis that theory plays multiple roles: from conceptualizing the studies and developing the questions and methodology of the studies to explaining results. Moreover the theoretical knowledge that can be seen to interface with these studies is typically more specific than broad perspectives such as "cognitive" or "sociocognitive." Designing tasks, constructing a research methodology, and interpreting results typically require a more delicate theoretical construction about the nature of language and language acquisition.

Theory as a limitation

Some researchers have suggested that the use of theory from second language classroom research is constraining or limiting for exploring the full range of learning that might take place through CALL. This issue is being discussed particularly by those second language classroom researchers interested in expanding the scope of SLA research beyond cognitive and interactionist approaches. For example, van Lier has attempted what he calls an "ecological approach to second language acquisition," and in so doing he runs up against the problem he describes as follows:

> ...the ecological approach faces a considerable challenge. By studying the interaction in its totality, the researchers must attempt to show the emergence of learning, the location of learning opportunities, the pedagogical value of various interactional contexts and processes, and the effectiveness of pedagogical strategies. No ready-made research procedures exist for this sort of work..., but it is my assumption that it is worthwhile to look for such an approach...
> (van Lier 2000: 250)

He goes on in this paper to describe the intellectual foundations and outline the main features of the ecological approach. The ecological approach offers a good reminder that the set of factors worth looking at in any technology-mediated learning environment is greater than what the research has focused on. But at the same time, any researcher is limited by time, resources, capabilities, and interests. Therefore, he or she is only going to see certain parts of the whole ecology.

Conclusion

Chapter 2 outlined some of the tentative recommendations that can be drawn from past research results on technology and language learning. However, such results will remain tentative until they can be further supported through additional studies that support their conclusions or help to limit their applicability. In this chapter, I moved beyond the principles outlined in the previous chapter that were limited by a lack of research results to suggest that if research is to be designed and interpreted in a way that can inform theory and practice, it is necessary to revisit the basic motivations for conducting research on technology and language learning including the purpose of the research and the audiences that it might serve. This analysis revealed contradictions between the prevalent idea that a case needs to be made for technology and my own experience as a professor at a public university in the United States.

Professionals in the field need to better understand which specific software features and computer-based tasks may enhance language learning potential both generally and for specific learners, and therefore research seems central. In this and the previous chapter, I have focused on the research methods and results that have helped to offer a better understanding of the language learning potential of technology for language learning and its impact. I have concentrated on these two criteria because they are probably the most important ones, but that is not to say that these are the only criteria worthy of study. In fact, I have suggested that the evaluation of CALL should ideally integrate evidence from a number of different perspectives on several criteria (Chapelle 2001a). In the following chapter, I will expand on research methods as I focus in more detail on the unique research potential of technology through discussion of the analysis of process data recorded while learners work on CALL.

Investigating learners' use of technology

The previous chapters pointed toward the need to better understand technology as it comes into play for English language learning and teaching. One approach to understanding technology use is to carefully observe learners at work. Documenting learners' work on CALL tasks reveals a rich sequence of data showing the process of task completion; however, such data are more fine-grained than what researchers studying second language learning processes typically work with, and therefore methodological issues arise in their analysis. Goodfellow and Laurillard sum up the problem as follows:

> The attraction [with process data in CALL] is that the computer's ability to record complex processes accurately and unobtrusively means that we can use it to tell us exactly what learners do. However, whilst the general principle is clear, precisely what we should do with this information is not.
>
> (Goodfellow & Laurillard 1994: 19)

This comment written several years ago might be considered somewhat of an overstatement today, as the number of published studies making use of such data increases. At the same time, however, researchers and critics alike would probably agree that basic principles underlying such research remain difficult to grasp. Whereas other types of records of linguistic and behavioral performance, such as transcripts of face-to-face conversation or multiple-choice test responses have been extensively gathered, investigated, and theorized from a number of perspectives, data yielded from computer-mediated linguistic performance have been the object of much less attention.

In part because of the uncertainty about how one might make the best use of CALL process data, researchers often rely on assessment of learning outcomes even though many believe that process data should have a critical role to play in the study of CALL (e.g., Desmarais 1998). After all, what could be more informative for software developers than the moment-by-moment description of how learners chose or failed to choose sections of the material or help options, how they responded to questions, and the length of time they spent on various parts of a multimedia environment. What could be better for a teacher

than to be able to observe, reflect on, and respond to the language that learners engaged in during an on-line discussion. At the same time, if these data are to be used by software developers or teachers, methods are needed for analyzing them. The purpose of this chapter is to outline three broad analytic perspectives – description, interpretation, and evaluation – intended to help researchers to understand data documenting computer-learner interactions, computer-mediated communication among humans, and other communication in which the computer plays a role. I begin by illustrating the variety of data included in the discussion before exploring the analytic perspectives.

Technology-related process data

The process data that constitute the observable record of learners' work on CALL tasks have been called "working style data – consistent, observable behavior displayed by students as they worked on [computer-based] L2 tasks" (Jamieson & Chapelle 1987:529) and "CALL texts" (Chapelle 1994a). These terms as well as others such as "tracking data," "computer logs," and "process data" can all be used to refer to records of learners' language and behavior documented while they are working on computer-mediated tasks. Such records might include the following sequences of interaction: production of an error and receipt of intelligent feedback, a request for and receipt of translation, a linguistic production and a self-correction. These types of sequences can be carried out through language or through a combination of language and mouse clicks; they can be enacted through computer-human interactions or through human-human interactions.

Examples of process data

The first example is a kind of labspeak as I defined it in the first chapter. It is the language of the students who are sitting in front of the computer talking about topics and problems that are posed by the computer program. Text 1 illustrates oral communication of ESL learners who are working collaboratively with a computer program that engages them in a business simulation (Mohan 1992).

Text 1. Oral face-to-face text from a business simulation task

Irid: Take out a loan?
Marta: We borrow money from the bank for whatsits.
Irid: But maybe they charge some money.

Marta: No. You want to borrow money?
Irid: From the bank?
Marta: Okay, no.
Irid: Open for business.
Marta: We already did open.   (Mohan 1992:117)

The example in Text 2 comes from a chat room in which the learners were engaged in conversation through written language. The chat was used as part of a class assignment in which the learners in a class in Italy were asked to log in and participate in an Internet chat, where they also found chatters who were not in the class. The conversation consists of introductions and verbal play as the short sample below shows.

Text 2. Learners engaging in a chat through written language

Alloy (07:41:08):   Hi, Arosio, have you been to Malaysia & Borneo Island.
Naghib (07:41:18): What about YOUR men Carmilla?
Alloy (07:42:01):   I am from Kuohing city, in Sarawak in Borneo Island. It's part of Malaysia.
Richard M.   (joined the chat at 7:42:08)
Arosio (07:42:26): Speed: wake up!!!
Naghib (07:42:36): Sppe is right: it is getting very boring here.
                           Let's speak of sth more interesting. . .
                                                        (Negretti 1999: Appendix A)

Text 3 is constructed through learner-computer interactions relying on non-linguistic moves. The task consisted of aural and written input that learners needed to comprehend in order to answer questions (Park 1994). The learners were responsible for initiating interaction consisting of sequences in which they listened or read until running into an unknown word or grammatical construction, for example, and then clicked to receive additional information.

Text 3. A Text from a listening comprehension task

Computer: I'm looking for a job as a waiter
Learner: <clicks on "waiter">
Learner: <clicks on the vocabulary button>
Computer: waiter
                 DEFINITION
                 a person who serves customers at tables in a restaurant.
                 EXAMPLE
                 Ned worked as a waiter before going into acting.   (Park 1994:200)

These three examples look relatively simple, in part because they are so short. With the exception of the third, they look like the types of texts that classroom researchers have been working with for many years. However, important differences exist, one of which is the fact that many more teachers and researchers are inclined to gather such data relative to the number who conduct classroom-based studies or examine learner think-aloud data. As a consequence, it is useful to explore the issues.

Implementing process research

In each of the examples the data consist of the running documentation of the interactions that occur between the interlocutors or between the computer and the learner. The capture and transformation of such data require some knowledge of the options as well as technical ability. In the first case, the transcription is made from an audio or video, thereby requiring the researcher to decide about the level of detail to be captured in the transcription, the inclusion of the text, audio, and image from the computer screen, and the amount of other contextual information and interpretation to include. The second example, because it is a text chat which is recorded during the course of the conversation, entails a different set of issues. Again, questions arise about the amount of contextual information and observation to include, but so do technical issues of storing and working with the file that is created through the chat.

In all cases, the researcher needs to ask for participants' permission to use their data, in accordance with professional guidelines for working with research participants. The fact that the data on-line are gathered routinely without introduction of obvious research equipment such as audio and video recorders may cause researchers to wonder if the learners even need to know that the data are being recorded. They do need to know, and if their data are to be used for research, they need to give their permission. These nuts and bolts issues of practice are fundamental to this type of research. Problems arise if researchers design a study intending to gather process data, but fail to verify that their computer equipment will store the large files created. Problems also result if teachers observe and store the fascinating discussion of their students in a chat room and then want to present the data at a conference but have not obtained permission from the students. These practical impediments can halt the research process from the start. In this chapter, however, I will concentrate on the conceptual issues that Goodfellow and Laurillard (1994) raise – what researchers do with such data, assuming learners have given permission and the data have been successfully obtained.

Notation for the data

The process data I discuss in this chapter need to be conceptualized as a sequential record of observable behavior. Each unit of behavior, called a move, can consist of either language or behavior, and can be performed by either the learners or the computer. To denote the sequential character of the data, I will

Text 1

Irid	Marta	Irid	Marta	Irid	Marta	Irid	Marta
Take out a loan	We borrow money from the bank for whatsit	But maybe they charge some some money	No. You want to borrow money?	From the bank?	Okay, no.	Open for business.	We already did open

Text 2

Alloy	Naghib	Alloy	Richard M	Arosio	Naghib
07:41:08	07:41:18	07:42:01	7:42:08	07:42:26	07:42:36
Hi, Arosio, have you been to Malaysia & Borneo Island.	What about YOUR men Carmilla?	I am from Kuohing city, in Sarawak in Borneo Island. It's part of Malaysia.		Speed: wake up!!!	Sppe is right: it is getting very boring here. Let's speak of sth more interesting. . .

Text 3

Computer	Learner	Learner	Computer
I'm looking for a job as a waiter <printed on screen>	<clicks on "waiter">	<clicks on the vocabulary button>	Waiter; DEFINITION a person who serves customers a tables in a restaurant; EXAMPLE Ned worked as a waiter before going into acting.

Figure 4.1 Text 1, Text 2, and Text 3 in sequence notation

use the notion illustrated in Figure 4.1, which shows the three examples, Text 1, Text 2, and Text 3, each as a left to right sequence of moves.

Both the notations given in the original texts and the sequence notation as they are used in the examples, fail to reflect the complexity inherent in deciding what should be included in the record. Romano-Hvid and Krabbe (2002) point out that in the interest of developing a better understanding of sequences of computer-learner data, common units of analysis used across research projects would be very useful. They suggest the sequences proposed by Hubbard (2001), who catalogued the possibilities in order to extend thinking about how these might be improved in tutorial CALL programs. Any discussion of such units would benefit from consideration of the analytic perspectives that can be applied to their analysis. Even the most basic description assumes a choice among theoretical perspectives.

Description

The authoritative *Handbook of research for educational communications and technology* (Jonassen 1996) includes a chapter on descriptive research methodologies which begins by justifying itself:

> It is rare to find a research methods class or even a chapter that focuses strictly on descriptive research. Indeed, the term is often given a paragraph or two of importance or ignored altogether. Yet a review of the leading journals related to the field of educational technology shows that descriptive research holds an important place in the study of human interaction and learning. . .
>
> (Knupfer & McLellen 1996: 1196)

Their chapter includes methods such as surveys and interviews in addition to description of observations obtained from learners' language and behavior as they participate in technology-based tasks. Our concerns in attempting to understand description of CALL process data fit within this general perspective. Description is indeed important and therefore methodologies for conducting useful description need to be understood. Several such methodologies have been suggested and illustrated through research on CALL, in particular, interaction analysis, discourse analysis, and conversation analysis.

Interaction analysis

Interaction analysis is used to document the particular moves that the learner makes while working with technology. This perspective is consistent with the classroom research tradition described by Chaudron (1988) who explained its use in studies which investigate the behavior of learners in the classroom, often in hopes of showing how the teacher's behavior influences it. Like the interaction of the language classroom, the interaction analysis of CALL requires choice of a coding scheme, such as the *Communicative Orientation of Language Teaching* observation instrument (Spada & Fröhlich 1995), which was developed over years of investigation to capture the behaviors of interest to researchers investigating the interactions of teaching and learning in the communicative classroom. The basic problem is the same for description of CALL texts, as Romano-Hvid and Krabbe (2002) have pointed out: Units of analysis are needed that can be used across CALL programs and that will capture the interaction of interest.

Although the basic problem is the same for the classroom and CALL interaction analysis, the specific issues are different. The COLT observation scheme consists of two parts: one which is intended to be filled out by the classroom observer while sitting in the classroom, and the other which is to be completed by the observer from transcripts of recordings retrospectively because the level of detail that it requires would prohibit concurrent observation and coding. What is particularly interesting in the description of the chosen categories for both levels of description is that each is supported by a rationale that justifies the value of the particular category in view of theory and research in communicative language teaching. For example, one category in the second part of the coding scheme is "incorporation of student/teacher utterances." The rationale that follows includes the fact that L2 researchers have argued that building on the learners' utterances can contribute to their language development.

Such theoretically-prompted interaction analysis in CALL has been centered primarily on the investigation of interactions occurring when learners consult an on-line dictionary during on-line reading. In an increasing number of studies, interactions captured are the mouse clicks indicating choice of whatever the program provides, which can be a dictionary definition or an L1 translation, for example. The most usual examples of interaction analysis are those which investigate the use of help, particularly dictionary access during comprehension activities. The study by Plass, Chun, Mayer, and Leutner (1998) discussed in Chapters 2 and 3 documented the choices learners made for dictionary, audio, and visual help as they were reading. The data in this case con-

Computer	Learner	Computer
BRUSSELS, Belgium – They had to struggle a bit to open some **recalcitrant** bottles of champagne, but finance	<clicks on "recalcitrant">	recalcitrant – Definition: formal adjective; refusing to obey or be controlled, even after being punished: recalcitrant behavior

Figure 4.2 Sequence of interaction for a dictionary look up (from Hegelheimer & Chapelle 2000)

sisted of a set of particular interactions that the learners had initiated during reading. In another study, Chun (2001) tracked learners' choice of the glossary that was part of the reading software and their choice of a bilingual dictionary external to the program. The descriptive research question addressed through interaction analysis was "How frequently do learners consult the internal glossary (where they simply click on built-in hyperlinks), and how frequently do they consult the external bilingual dictionary (where they must copy and paste or type words into an on-line dictionary)?" The data in such cases consist of the sequence shown in Figure 4.2.

In other studies, researchers have attempted to plot out the entire sequence of interactions that a learner engages in while working through a program. This record in addition to the learners' commentary is central to the work in CALL that is approached from the perspective of human-computer interaction (HCI) studies (e.g., Hémard 1999). The idea is to observe the learners' use of an environment under development in hopes of improving navigation options such as placement and content of help options. In the same spirit, researchers have also developed approaches and notation for recording learners' moves throughout an entire multimedia environment (Desmarais, Duquette, Renié, & Laurier 1998; Desmarais & Laurier 2000). Whether the interactional description is done before or after the environment is complete, it is an essential tool for identifying individual differences in learners' behavior that have implications for design and use of the environment. For example, a consistent finding in this work is the variation in the degree to which learners take advantage of the options when they are left to choose on their own. This was evident, for example, in Kon's study in which very few interactions with the dictionary occurred during on-line reading, as mentioned in Chapter 2. This finding is not unusual (e.g., Chapelle & Mizuno 1989; Hsu, Chapelle, & Thompson 1993). The implication is the need to consider how task design can prompt more extensive use of what is available.

Discourse analysis

Discourse analysis can refer to a number of different analytic perspectives, but what they should share is a functional description of the linguistic choices and moves that the participants make to construct a text. For example, the sequence of moves plotted in Figure 4.2 might be considered by the interaction analyst as mouse clicks and glosses whereas the discourse analyst would attempt to consider the functional meaning of each of the moves. Functional descriptions of learner-computer interactions have not been used extensively, although some have been suggested (Chapelle 1990). For example the computer offers help, gives help, judges responses, etc; the learner requests help, responds, declines offers, etc. This perspective adds a pragmatic dimension to HCI that opens the possibility for comparison with the types of functions that learners can engage in across different learning environments, including a variety of programs for learner-computer interactions, those for learner-learner interaction and classroom interaction, as well. I became interested in a functional description of HCI in the middle of the 1980s when many applied linguists were so categorically opposed to CALL relative to classroom instruction. It seemed evident then as it does now that any meaningful comparison would have to be made on the basis of the type and amount of interactions that the learners engage in, and that a common set of terms would be needed for such comparisons.

Discourse analysis has been much more widely used in describing the syntactic and functional characteristics of the language of CMC. Ferrara, Brunner, and Whittemore (1991) characterized the language of CMC as a register which they called "interactive written discourse." Their research identified features of simplified or reduced registers such as omission of subject pronouns, articles, and the copula. Other features they found characteristic of this register were a large number of contractions and abbreviations, many words such as "you" and "I" in the texts, and a large number of WH and yes/no questions. Almost ten years later, and with a greatly expanded corpus of interactive written discourse available to researchers, Murray's (2000) summary of research on CMC supports these findings about the simplified or reduced registers, but also points out the variety of registers that appear in CMC as it is used by many people for a variety of purposes.

These descriptive data showing reduced registers, however, remain at the heart of the discussion about the use of interactive written discourse for learners' language practice. The example shown in Text 4 from a study of chat room communication by Werry (1996) demonstrates the concern. The language here is characterized by a number of variations on standard English spelling, ref-

erents to American cultural figures (Linus is a cartoon character; Rosanne Roseannadanna is a TV character), and the pidgin-like syntax that has been described in other studies. One does not have to go any farther than a description of this example to raise questions about its use in language teaching.

Text 4. A segment of dialog from an Internet chat group (Werry 1996: 58)

\<ari\> whutta dowk
\<ari\> hewwo?
\<bomer\> Linus: No wories... ;-)
\<ari\> vewy intewestin
\>bomber\> ari ????
\<ari\> rosanne roseannadanna hea
\<ari\> yup yup?
\<ari\>\<–in a goofy mood

In part because of the results of analysis of interactive written discourse found outside the classroom, researchers concerned with language teaching have been eager to obtain descriptions of how language learners would perform this register, and as a consequence a number of discourse analytic studies have been done to describe interactive written discourse in the classroom. Consistent with the aims of discourse analysis, Chun (1994) investigated the functions used by first-year German learners in computer-mediated communication in the classroom, finding a number of interactional speech acts, for example, asking questions and requesting clarifications. She concluded that the computer-assisted class discussion format created a context which was positive for the acquisition of these acts. Focusing on learners' use of syntax, Kern (1995) noted students' lack of concern for correctness, consistent with what had been found outside the classroom, but on the other hand that learners participated enthusiastically relative to their oral classroom participation. The latter, positive finding seems consistent with the overwhelming majority of the descriptions of interactive written classroom discourse (Beauvois 1992; Kelm 1992; Kern 1995; Ortega 1997; Warschauer 1997).

Conversation analysis

Interactive written discourse has also been investigated from the descriptive perspective of conversation analysis. Unlike the umbrella term of discourse analysis, conversation analysis refers to a relatively well-defined philosophy and set of procedures. As a microethnographic approach, conversation analysis at-

tempts to capture the language users' utterances and intentions and describe how the language in discourse is used to accomplish communicative intent. In a study of ESL learners' performance in an ESL chat, Negretti (1999) argued as follows:

> Given the present state of SLA [second language acquisition] research in Internet-based environments and computer-mediated communication, a heuristic-inductive approach such as CA is the most useful and fruitful because such a hypothesis-generating method is a good way to begin the study of new interaction/acquisition situations.   (Negretti 1999:76)

Negretti's description, rather than beginning with functional or syntactic categories, discovered the conversational routines that the learners used to accomplish openings, closings, topic shifts, and cohesion, for example. The most detailed of the perspectives on interactive written discourse, this approach appears to hold the potential for discovering the language abilities that are needed to participate successfully in this setting. Gaining an understanding of these abilities was one of the challenges laid out in Chapter 1.

Issues in description

To make the best use of process data such as those shown in Texts 1, 2, and 3, the first challenge is deciding how to describe them. In transcribing these texts, the researcher had to make decisions about which aspects of the interaction to represent. By including only the language produced by the learners in Text 1, for example, the researcher decided not to document what was on the screen and the amount of time the learner spent composing at the screen. But how does one decide what to describe and how much detail to include?

What to describe

CALL process data consist of multiple, simultaneous, continuous strands of meaning from which the researcher must isolate, record, and name the pieces of interest. Text 1 is a transcription of the spoken language of the students sitting at the computer screen, but why not include the written language that appeared on the screen as well? Surely this language plays an important role in the sequence of the interaction. Why does such a text not also include the key presses that the students make as they "communicate" with the program expressing their decisions and moving from page to page? The second text contains the language and the timing of the utterances in the chat, but what about the moves that the learners might have made as they were composing

each utterance? Any pauses, corrections or reformulations of language that occurred before the completed utterance was sent are missing from this description. In the third instance, the description includes what was on the screen, but does so in a reduced manner. The first move includes only one sentence of the longer text that was on the screen. Before the learner clicked on the word, he or she undoubtedly moved the cursor, either directly or indirectly to the word, within some time frame. These moves were not included in the description. These examples illustrate the types of decisions that the researcher makes in deciding on a descriptive method for recording and describing the data. Ultimately, decisions have to be made on the basis of the purpose of the research and therefore issues of interpretation and evaluation arise even as decisions about description are made.

How to describe

Even questions relying solely on description require decisions to be made about the descriptive perspective. What are the advantages of interaction analysis, discourse analysis, and conversation analysis for various types of interactions, and purposes for analysis? Each of the approaches to using CALL process data was useful for a particular purpose, and yet one would hope to develop more language-oriented methodologies that describe the language of CALL tasks from the perspective of the language that learners engaged in. The researchers investigating the language of CMC for the past decade have used the concept of register (e.g., interactive written discourse) to denote a discourse analytic perspective, and their research addresses questions about some aspects of register in various CALL activities. The tendency has been to concentrate on selected functional or grammatical characteristics of the language. Todd (1998) argues that the content of the discourse is equally important because content influences how discourse is used in the classroom, affecting, in particular, the consistency of the discourse. He suggests that "consistently structured classroom interaction" in terms of topics is best for learning (p. 309), and points out the need to investigate the topics of discourse in two ways: through identification of what "topics are involved in a particular stretch of discourse" (p. 304), and "how topics develop and change through the discourse" (p. 304). The conversation analytic approach addresses this to some extent through analysis of the ways that language is used to accomplish conversational moves such as changing topic. Interaction analysis is neutral to the content of the interactions, but it does seem to capture some of the important moves within learner-computer interaction. In all, the three approaches that have been taken offer complementary perspectives.

Use of description

Description is useful to both teachers and researchers interested in knowing exactly what learners are doing in a CALL task. Teachers may want to know what students are talking about as they work in groups or whether the learners are using the on-line dictionary provided to enhance their opportunities for vocabulary learning through reading. Researchers interested in better understanding computer-mediated communication are interested in comparisons across different types of CMC. In a paper arguing for descriptive research, Harrington and Levy (2001: 21–22) suggest the following questions should be targeted in research:

1. How are texts "created and modified in various CMC modes, for example distinguishing an email text from an IRC text."
2. What is the "difference between electronic texts and traditional [face-to-face] interactions"?
3. How do "learner interactions vary according to mode and audience"?

All comparisons require selection of an analytic perspective for describing the interactions. For example, if Text 1, Text 2, and Text 3 are to be compared, it does not seem very productive to use discourse analysis for Text 1, conversation analysis for Text 2, and interaction analysis for Text 3! There is an advantage to analytic perspectives that are close to the data, but at the same time they may preclude comparative analysis across types of data. An alternative approach begins with a theory of register that encompasses an analytic perspective for studying the linguistic and nonlinguistic moves through which participants construct meaning. For example, an analytic perspective such as systemic functional linguistics centers on a definition of the context of situation comprised of three interrelated aspects, each of which influences the register. Register analysis, then, is conducted through examination of the language related to each of the aspects of context as explained by Halliday (1978), Halliday and Hasan (1989), Halliday (1994), Martin, Matthiessen and Painter (1997), Hasan (1996), and Butt, Fahey, Spinks, and Yollop (1995). Table 4.1 summarizes a comparison of the three texts from a systemic functional perspective.

In Text 1 the experiential (or ideational) meanings include the students themselves as participants, money, and the business of borrowing and lending. These are the concrete things, people, and actions expressed in the language. Interpersonal meanings include the question-answer sequences that display the engagement of the learners, the use of personal pronouns referring to participants in the conversation and the uncertainty ("maybe"). These are the aspects

Table 4.1 Comparison of the functional meanings across three CALL texts

Example text	Language in the text reflecting...		
	Experiential Meanings	Interpersonal Meanings	Textual Meanings
Text 1 (Business Simulation)	The students themselves (although playing the role of business people), the business of borrowing and lending	Questions and statements; personal pronouns in first and second person; uncertainty and negatives	"But," "ok," and "no" to signal turn-taking
Text 2 (Chat)	State of boredom, location of city in Malaysia, and travel there, men in Carmilla, arrival	Questions, imperatives, and statements; personal pronouns in first and second person, names and feelings	Sequences marked by sending message; cohesion though topic repetition and question-answer sequences
Text 3 (Listening dialog)	"I," "Ned" (students); looking; waiter job; restaurant	Statements about others; requests for help <through clicks>	Sequences of input-interruption for help

of the language that construct the relationships among the participants and show the participants' stance toward the topics and other participants. Textual meanings include the cohesive "but," "no," and "Okay," some of which may have helped to signal turns. Other signals, not recorded here, would have been given non-verbally. The researcher's further analysis of the spoken language, not shown in this text, identified some cohesive words, deictic reference (e.g., the pronouns *this* and *that*), and he concluded that the conversation in which the computer was present was relatively "context-embedded." Through examination of the functional sequences in the texts documenting interaction among the learners, he also identified "episodes of choice, decision-making or problem-solving" consisting of sequences of proposal, agreement, and supporting reasons – sequences which he interpreted as use of cognitively demanding language (Mohan 1992).

In Text 2, the experiential meanings are realized through language expressing boredom, the city location, etc. The experiential language jumps from one topic to the next, introducing a variety of actors and actions within a short text. Just as the first researchers of interactive written discourse found, the interpersonal functions are expressed through personal first and second person pro-

nouns, and questions. The cohesion is evident through some question-answer pairs even though there is little repetition of semantically related expressions.

In Text 3, the language was used as linguistic input for the learner rather than for communication with the learner. The input illustrated in the example and through the rest of the dialog (not shown) allows the learner to observe the use of experiential functions of "job hunting" done by students introduced in the dialog. As an observer, the learner is exposed to the language used to conduct dialogue about job searches. However, the learner does not himself use the language of the job search to discuss job searches or engage in a job search. The learners' mode for participation in the text is non-linguistic and invariant, realizing the interpersonal function of "requesting" input modification from the computer. The computer's response provides modification as information and examples.

This comparison of the linguistic features fills in some meaning-related aspects of the concept of register by drawing on existing linguistic analytic perspectives. It seems that this approach to register holds potential for understanding the register-specific language ability required for working in computer-mediated English learning contexts. For example, the way that the experiential meanings are developed in Text 2 shows the need for strategies that do not rely on building a text schema from a single semantic field. Because coherence is developed through question-answer pairs that may be separated by turns containing other topics, language users must look for signals of these question-answer pairs across several turns.

Such comparative analyses are only one use of descriptive research. Hubbard (2001) gives an example of an interaction analysis suggesting that an understanding of these units of analysis can be used to evaluate programs, train learners, identify new CALL research issues, and ultimately develop better programs. Whether the goal is comparison or the suggestions Hubbard makes, the first step is description.

Interpretation

I isolated description to address some of the fundamental issues that it raises, but in fact most research that includes description goes beyond description alone, at least to make some inferences – a process which involves interpretation of the data in a way that makes them meaningful and useful for research. Even the most adamantly descriptive research methodologies, such as conversation analysis, are often used in research to infer typical or characteristic be-

havior in the data, and therefore a careful look at the objectives of, and claims made in, studies using descriptive methodologies reveals that in fact the researcher is actually attempting some interpretation beyond the description of the data. For example, Negretti (1999) used a conversation analysis because it "allows the researcher to approach the data without preconceived theories, free to discover, describe, and analyze the conversation and SLA peculiarities in this context, in other words, to study how *social actions* are organized and locally produced, in the *here and now*" (p. 76, emphasis in original). Consistent with the tenets of conversation analysis, the purpose is description. However, the research is framed within, and generalized to, broader questions about the nature of communicative competence in a chat environment, with the opening paragraph pointing out that "the types of language skills and communication competencies" required by each type of context are likely to be different. The implication is that the examination of the "here and now" should speak to a broader understanding of communicative competence in a chat environment, and indeed the here and now analysis resulted in generalizations about the turn-taking, basic sequences, and paralinguistic features found in the chat data and it interpreted some of the sequences as influenced by the chat medium.

In short, process data themselves are seldom of interest to researchers. Instead, what is of interest is what they reveal about the learner's language competence or about the nature of the language learning task. This is not to criticize the practice of extending beyond the intended scope of conversation analysis, but rather to point out that this is exactly what most researchers wish to do. The problem, then, is both to recognize when inferences are being attempted in research on learners' use of CALL and to theorize such extensions beyond description of the data in such a way that they can be understood and justified. For instance, when the learner is observed asking for the definition of *waiter*, as illustrated in Text 2, we may want to infer that the learner does not know its meaning (i.e., an inference about language competence). The same behavior may be used to infer that the task is succeeding in offering the right help at the right time (i.e., an inference about the task). In many studies the researcher is interested in either one or the other of these inferences, and I will therefore discuss each one in isolation. I will then argue that the two need to be considered simultaneously.

In discussing these inferences, I will rely on the notation introduced above to signify the sequence of moves that comprise the data of interest. Text 2 is repeated in Figure 4.3 within Notation A. Notation B is a short-hand way of summarizing the six moves documented in Notation A. In the example given in Figure 4.3, nothing has been filled in, but it could contain the sequence of

Notation A: Multiple layers containing information about each move in sequence

Alloy	Naghib	Alloy	Richard M	Arosio	Naghib
07:41:08	07:41:18	07:42:01	7:42:08	07:42:26	07:42:36
Linguistic turn	Linguistic turn	Behavior	Linguistic turn	Linguistic turn	Linguistic turn
Hi, Arosio, have you been to Malaysia & Borneo Island.	What about YOUR men Carmilla?	I am from Kuohing city, in Sarawak in Borneo Island. It's part of Malaysia.		Speed: wake up!!!	Sppe is right: it is getting very boring here. Let's speak of sth more interesting…

Notation B: A single layer with space for one or a summary of the multiple layers shown in Notation A.

Figure 4.3 Two notations for capturing a sequence of interactions

times, the sequence of participants, their texts, their mouse clicks, or a functional description of their moves, depending on the purpose and the method of analysis. Notation B does not show the four layers of data captured in Notation A, but instead it is intended to include the behavior that is relevant for making the inference. In other words, depending on the inference, all or some of the layers will be relevant. Since the relevant information to be filled into Notation B depends on the purpose of the specific research, it has been left blank in Figure 4.3.

Inferences about capacities

Inferences about learners' capacities are made from process data when researchers draw conclusions concerning what the learner knows about the target language including its rules for use and their processes and strategies for using the language. These types of inferences are described most clearly in work on assessment, particularly from a positivist perspective which sees the mind as separate from observed data, and seeks to theorize causes for observed phenomena. Observed performance on a task is treated as evidence for particular
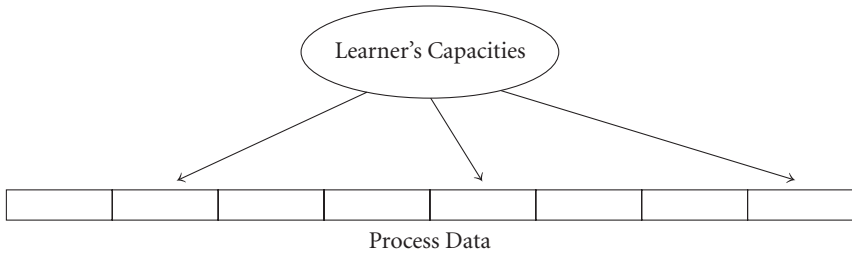
Figure 4.4 Learner's capacities as responsible for process data

underlying capacities of the learner, or more forcefully put, the learners' capacities are seen as causes of the observed behavior. Of course, observed behavior does not come already marked to indicate the capacities responsible for it. Therefore, the process of inference is used to make the interpretation. Figure 4.4 illustrates the causal assumption about learners' capacities being responsible for aspects of the process data. For example, if the process data in Figure 4.4 were instances of dictionary checking in an electronic text, the capacities responsible might be a mental lexicon lacking the particular words that were checked.

I have discussed these types of inferences elsewhere (Chapelle 1996; Chapelle 2001a: Chapter 5), but several examples will demonstrate the idea. In a study of learners' use of an on-line bilingual dictionary, researchers recorded what the learner typed into the computer to request a word (Bland, Noblitt, Armington, & Gay 1990). What was typed in could be either the learners' L1 or the L2, and based on the form of the request, the researchers made inferences about the learners' interlanguage. The process data in this study consisted of what the learner typed in to request a definition; the capacity assumed to be responsible for that performance was interlanguage lexical knowledge. A second example comes from studies investigating automaticity by recording the amount of time it takes learners to respond to an item in an on-line grammar task (DeKeyser 1997; Hagen 1994). In this case the response times for each item are the process data and the inference is about automaticity, which in some cases assumes efficiently stored (or restructured) language knowledge. In other studies, requests made to an on-line dictionary were used to make inferences about learners' strategies during reading (Hulstijn 1993). In each of these studies the object under investigation was not the observed process data themselves, but the unobservable knowledge, process, or strategy that was inferred to be responsible for the process data.

Inferences about tasks

The second type of interpretation CALL researchers often wish to make concerns how the task influences learners' interaction. Such interpretations are similar to those made in task-based language learning research in which a task is constructed with characteristics (such as having only one outcome) expected to influence the process of interaction (e.g., Pica, Kanagy, & Falodun 1993). Based on the researchers' observation of the interaction, conclusions are drawn about the success of the task for promoting the desired interactions. In this sense the interactions are assumed to be a product of the task, as illustrated in Figure 4.5.

My description of this type of interpretation is stated in stronger terms than many researchers might be inclined to do. After all, tasks do not cause interaction; people in situations do. However, the idea that particular task characteristics are responsible for the interactions observed in CMC tasks underlies the large majority of studies of CMC. The idea is evident in the researchers' language indicating, for example, that an aspect of the technology "fostered," or "created an opportunity." In describing the process data documented in his research, Warschauer wrote, "...the electronic discussion featured language that was both more formal and more complex than the face-to-face discussion...the results do suggest that electronic discussion can be a good environment for fostering use of more formal and complex language, both lexically and syntactically" (Warschauer 1995/1996: 21–22). Further he summarized, "The findings of this study suggest that electronic discussion may create opportunities for more equal participation in the classroom" (Warschauer 1995/1996: 22). A paper by Shield, Davies and Weininger (2000) investigating the language and behavior in MOO [i.e., Multi-user Object Oriented] environments is entitled, "Fostering (pro)active language learning through MOO." The paper summarizing past work investigating the processes of CMC includes additional terms
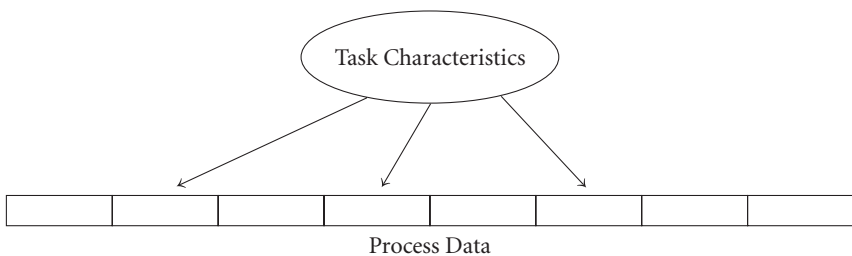
Figure 4.5 Task characteristics as responsible for process data

such as "learning environments encourage thoughtful reflection," "creating conditions for" and "promoting" various processes.

None of these researchers would suggest that the technology alone caused the aspects of interaction of interest. In this sense, Figure 4.5 is an exaggeration. But it is a useful one. These types of inferences about tasks on the basis of process data are fundamental to the widespread idea that comparative research is needed to understand the way that the characteristics of various synchronous and asynchronous tools for electronic discussion influence aspects of the process data such as length and frequency of learners' turns or syntactic quality.

Inferences about capacities and tasks

The two types of inferences – about learners and about tasks – tend to be made by researchers with two different perspectives. Kern and Warschauer (2000) might attribute the differences to the different theoretical approaches each researcher works within. The researcher who makes inferences about the learner is working within a cognitive approach whereas the researcher making inferences about the task is working within a sociocognitive approach. This analysis is useful, but only to the extent that the cognitive researcher does not need to worry about tasks and to the extent that the sociocognitive researcher does not need to consider the learner. Of course, tasks are important for making inferences about interlanguage knowledge, cognitive processes, and strategies, just as learners' capacities play an important role in tasks. Therefore, a more complicated but accurate way of theorizing inferences based on process data is to consider them as the result of a combination of learners' capacities and tasks, as illustrated in Figure 4.6.

Researchers frequently take account of learner-task combinations in reporting results of research. For example, when Hulstijn (1993) investigated learners' vocabulary look up strategies during reading, the "during reading" defined to some extent the task characteristics of the relevant task. When Warschauer examined participation in CMC tasks, he considered results in view of learners' L2 proficiency, their L1, and their attitudes to discussion in face-to-face and electronic discussion. The conceptualization of inferences as a combination of capacities and tasks is a useful heuristic for making inferences from CALL process data because it more accurately captures the factors affecting the data.
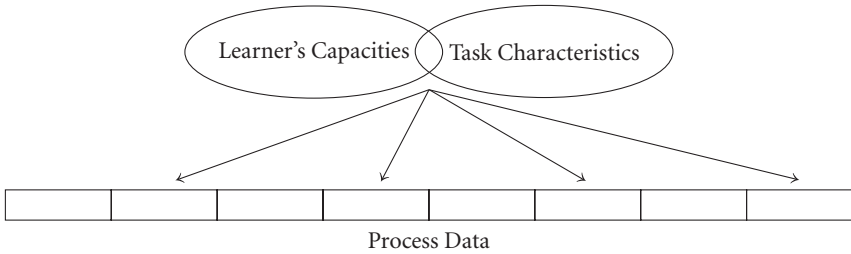
Figure 4.6 The interaction of learner capacities and task characteristics as responsible for process data

Critical discourse analysis

Another type of inference falls outside the learner-task conceptualization. Inferences about influences outside the classroom are made by researchers who approach process data from the perspective of critical discourse analysis. Applying this perspective to the learning and teaching of English, Kumaravadivelu (2000) defined critical classroom discourse analysis (CCDA) as follows:

> CCDA, with its transformative function, seeks to play a reflective role, enabling practicing teachers to reflect on and cope with sociocultural and sociopolitical structures that directly or indirectly affect the shape, character and content of classroom discourse.   (Kumaravadivelu 2000: 473)

The first time I remember hearing a critical discourse analysis of the process data from CALL was in a colloquium at TESOL in 1987 in which Donna Johnson included discussion of society's perspectives on ESL and issues of power in her analysis of how learner-computer interactions may dominate computer-using time for ESL learners, if teachers fail to take steps (see Johnson 1991). Early studies of CMC were also interested in inferences about how the socially-constructed gender roles, for example, played out in a different medium of communication. Outside the classroom, Self and Meyer (1991) looked for patterns of domination by males and by participants perceived as holding a role of authority through examination of the textual features, and number and length of turns. Within classroom tasks, researchers have been interested in examining the ways in which socially-constructed identities play out in various tasks.

I consider CCDA as a type of inference rather than as description because the analysis extends beyond the data to make inferences about causes, in this case concerning the impact of ideology and power relations on the struc-

ture and content of discourse. As such, Kumaravadivelu describes CCDA as a departure from other types of analyses:

> CCDA does not represent a seamless and sequential progression of events and thoughts from classroom interaction analysis to classroom discourse analysis to CCDA; rather it represents a fundamental shift in the way that the field conceives and conducts the business of L2 learning and teaching.
>
> (Kamaravadivelu 2000: 480)

Texts constructed through CMC, which themselves represent a fundamental shift seem an intriguing object for such analysis.

Validity issues for inferences

No discussion of inferences is complete without mentioning the need to justify them. Researchers in language assessment and educational measurement recognize principles and procedures for justifying such inferences. These are the principles and procedures of validation, which is defined as the process of justifying the interpretations and uses of test scores. Without attempting to review this area, I can at least note that the central validity issues associated with making inferences from data are the following: What are the appropriate aspects of the process data for making inferences about the learner or the task? For example, when inferences are made about automaticity, is response time the only relevant aspect of the data? How can process data best be summarized to reflect the construct of interest? For example, in making inferences about amount of participation in a chat, should the number of turns be counted, the number of words, the number of idea units, or some other summary statistic? How can inferences about learners and tasks be justified? For example, what evidence should the researcher present if he or she wishes to argue that the short turns are the result of the synchronous conditions of a chat?

Methods of justification entail making an argument consisting of more than one source of data supporting the inference that one wishes to make. Existing work, particularly in language assessment (e.g., Bachman 1990), provides a basis for addressing these questions, but the nature of process data presses researchers to look beyond accepted procedures in language testing to underlying principles and to explore new ways of thinking about inference in language assessment. I will return to these issues in Chapter 6.

Evaluation

Description and inference-based interpretation form the basis for much of the existing research that relies on process data. My experience in working with these data is that they provide one small window on learners' processes, and in doing so they offer a valuable perspective on CALL. However, my experience also suggests that researchers who are not involved with CALL can find description and interpretation empty unless they are accompanied by evaluative criteria. I have attended many presentations of thesis research in which some people in the room were fascinated to see the learners' participation in the chat task or the number of times that the learners had requested particular types of help, while others were saying "So what? Did they learn anything? How do you know?" These are not unreasonable questions for researchers of CALL to address. In this section, I will discuss the problem of evaluation of some process data and some of the approaches that are being used to address the problem, even though much remains to be done in this area.

The problem of evaluation

Evaluation should reveal the degree to which data provide evidence that the goals of CALL activities have been met. Goals in CALL activities may include objectives other than linguistic results when activities are designed to increase the learners' understanding of the culture or give them experience in using technology. Researchers may seek evidence that such goals have been achieved in CALL process data, but I am going to concentrate on goals focusing on language development in particular. The problem of using process data for evaluation for language goals is that such goals are typically stated in terms of learning outcomes. For example, if the goal is for learners to improve their knowledge of the vocabulary presented in the lesson, this needs to be evaluated through assessment of vocabulary knowledge after instruction which naturally leads to product-oriented research on CALL effectiveness.

As I discussed in Chapter 3, most people consider evidence of mastery after instruction the most direct and convincing evidence to be used in CALL evaluation; however, it poses problems for CALL researchers. First, CALL is typically used as one source of language practice for learners in a larger program of instruction, so the idea that learners would "master" the language of the CALL activity is not realistic. Rather the CALL activity might be intended to introduce or to provide practice. Interlanguage development is a gradual process through which learners become aware of linguistic form, gain partial and

fragile knowledge, and ultimately gain mastery through repeated exposure and practice. CALL might be used as one part of this process, and therefore the idea of evaluating CALL on the basis of the criterion that learners should master the linguistic form as a result of a CALL task alone often does not make sense.

Second, it is difficult for software developers, teachers, and learners to interpret findings indicating mastery or failure in a way that can inform and improve software development. Faced only with a finding that learners' vocabulary knowledge of the words in the program improved somewhat after working with the CALL tasks, what substantive knowledge does that offer the profession? Does it mean that software should be designed exactly like that in the study? If the finding had been very little improvement, would the implication be that the software design was ineffective? Assessment of outcomes alone gives a very gross summary of results of CALL use rather than the more delicate analysis that holds promise for improving CALL tasks. All three of the studies focusing on learners (pp. 87–89) are based on data documenting learners' processes while they worked on CALL tasks. The study documenting learners' requests for various forms of vocabulary help, for example, looked at relationships between requests and improved vocabulary knowledge, thus offering an evaluation of the relationship between use of the software and improved vocabulary knowledge.

Third, the idea behind the communication tasks that are suggested for language development is that the learners, not the teachers, are to select the linguistic points that will be the focus of attention. In this situation, the idea of a pretest and posttest design does not make sense. One approach has been to develop posttests for individuals based on the linguistic points that they focused on during the task (Swain 1998), but the researchers' knowledge of what those points were for individual students depends on analysis of process data.

Process-based approaches

In view of the problems entailed by attempting to assess linguistic outcomes in CALL tasks, evaluation of process data is essential for CALL research. Relying on assessment of mastery alone is too limiting because it offers neither the detail nor the scope needed for an informative evaluation. Viewing process data only from the perspectives of description and interpretation is a worthy research objective on its own but fails to offer a judgment about the quality of the observations for language acquisition, and is therefore difficult to use in drawing conclusions about CALL. Evaluation of CALL process data requires that learning goals be stated in terms of desired learning processes. Much work

remains in this area, but in the meantime, three examples illustrate how process goals are used to evaluate process data.

Negotiation of meaning

Several studies of learners' use of CMC for communication tasks have set process-oriented goals for the learners. By relying on interactionist SLA theory (e.g., Gass 1997; Pica 1994) which hypothesizes benefits from interaction as described in Chapter 2, particularly if it helps learners to negotiate meaning (Long & Robinson 1998), researchers have been able to set the goal as negotiation of meaning, and then to seek evidence for this goal in the process data as Sauro did in the study described in Chapter 3. A study by Blake (2000) offers another example of the use of the data in this way. In a study of fifty intermediate learners of Spanish, Blake (2000) assigned the learners several different types of communication tasks that were designed within the guidelines of research investigating face-to-face tasks (Pica, Kanagy, & Falodun 1993).

Consistent with these researchers, Blake assigned jigsaw tasks (requiring learners to piece together a solution with information they did not share) and decision-making tasks (requiring learners to make a decision based on shared information). Figure 4.7 shows an example of some of the results using the notation described in Figure 4.3 for the description and the inferences. The inference was that these sequences consisting of "trigger, indicator, response, reaction" were considered as evidence of negotiation of meaning within the jigsaw task. Negotiation of meaning was the particular strategy of interest and it was inferred from the process data consisting of the learners' request for help with a word meaning. The jigsaw task features, concerning who had what information and what the communication goal of the task was, for example, were inferred to be connected to the observed strategy, and thus it was the interaction of the two – i.e., negotiation of meaning and the jigsaw task – for which the CALL process data offered evidence.

Results were consistent with those from research on face-to-face tasks – the jigsaw tasks resulted in the most negotiation of meaning. This finding on its own is interesting because it is consistent with that of the previous research. Moreover, it suggests the quality of the jigsaw task relative to the other types. At the same time additional interpretation is needed to answer questions about whether or not the amount of observed negotiation of meaning should be considered adequate for the amount of time spent on the task.
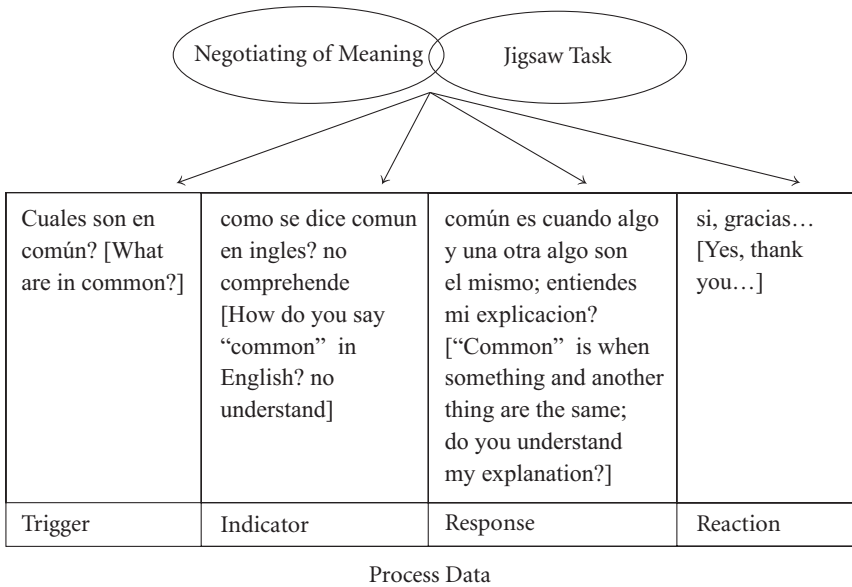
Process Data

Figure 4.7 Inference about negotiation of meaning from "trigger, indicator, response, reaction" sequence in process data (from Blake 2000: 125)

Noticing gaps

Based on the argument that noticing is essential for acquisition (Schmidt 1990, 2001), researchers have suggested that CALL process data might be examined for evidence of noticing (Hegelheimer & Chapelle 2000). The value of noticing is that it allows the learner to identify areas of his/her interlanguage where gaps occur. Hegelheimer and Chapelle (2000) suggest that evidence that the learner has noticed a gap occurs in CALL process data such as the example from Figure 4.2 when the learner reads an unknown word, and clicks on it to receive a definition. Figure 4.8 illustrates the inference that is made from these data: That the sequence of presentation and clicking consists of evidence of noticing a gap when it occurs in a task requiring reading for meaning. When evaluation of these tasks is conducted through posttests assessing vocabulary acquisition, gains are not typically dramatic, but in view of the limited exposure such tasks offer relative to what it takes to acquire a word, the posttest perspective may be too demanding. As a consequence, evaluation might better be conducted in terms of the extent to which the learner notices linguistic gaps through reading, rather than the extent to which he or she acquires words through reading.
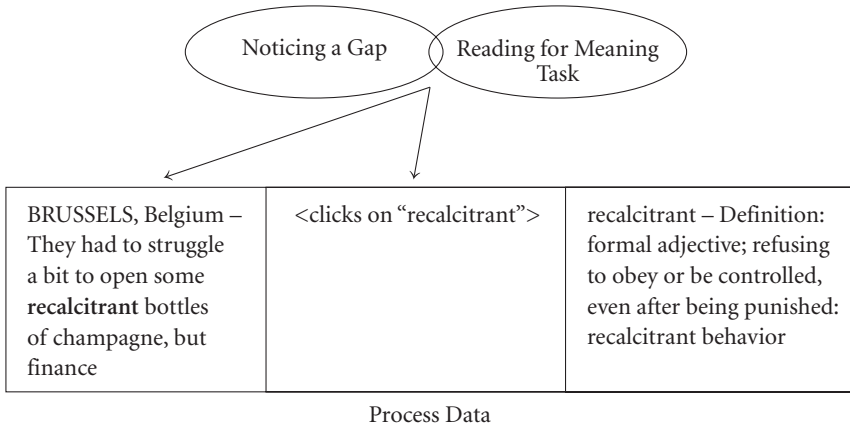
Process Data

Figure 4.8 Noticing a gap in linguistic knowledge during reading for meaning as responsible for process data

Strategic discourse management

A third example of the use of process data for evaluation was developed by Swaffar (1998) in an attempt to evaluate the quality of the writing that learners engage in through on-line communication. The problem she identified was the need for a measure that would be delicate enough and would address the aspects of writing that instructors felt benefited from CMC. She suggested an approach for assessing learners' strategic discourse management, which is intended to provide evidence for "level of thinking" (p. 155) through a coding system that awards points to speech acts in the learner's text if they represent four rhetorical types: (1) "descriptive sentences, (2) sentences that express opinions, (3) sentences that have logical features to substantiate opinion, and (4) sentences that establish a logical argument for a point of view" (p. 155). The process data would consist of the learner's text, which would be analyzed for the appearance of the four levels of features, as shown in Figure 4.9. The analysis would award a score to each unit depending on the raters' judgement of its level. The unit scores would be added (and divided by the total number of units) to yield an average score used as an indicator of level of thinking in the writing tasks.

Whether or not one agrees with the scoring system, it serves as an example of an approach that can be applied to evaluation of CMC tasks which are intended to help learners develop their writing. One such study compared the strategic discourse management of learners in e-mail vs. chat

Level of thinking	Writing tasks		

But the Television is the greatest cure	And I always watch TV	The soap opera is nonetheless the worst	Because they are so addictive.
1 point – a general opinion	2 points – general description	1 point – a general opinion	3 points – qualifies soap operas

Process Data
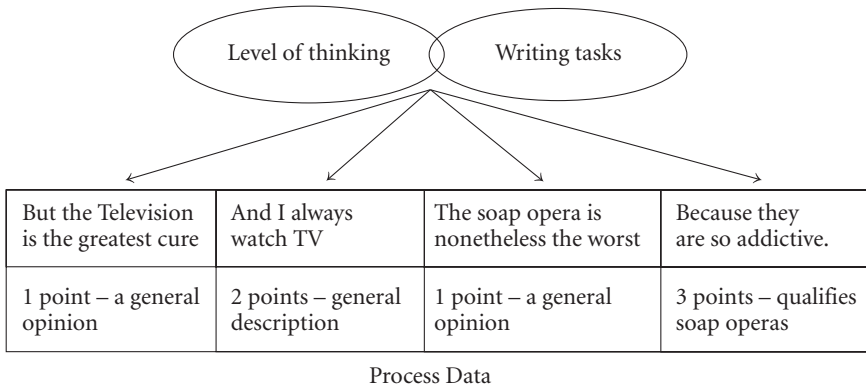
Figure 4.9 Level of thinking on writing tasks as responsible for linguistic characteristics of the text (from Swaffar 1998: 171)

tasks to document the substantive difference between the discourse of each (Rodriguez 1998).

Other process perspectives on evaluation
The three examples of evaluation through analysis of process data are obviously only a small beginning if the data from many different tasks are to be evaluated. Other suggestions have been offered by researchers working with process data. For example, Renié and Chanier (1995) suggested that learner-computer interaction might be evaluated in terms of exolingual interaction theory, which hypothesizes benefits for second language learners from the process of interaction between the learner and a proficient speaker of the language. The benefits are evident, according to the theory, through text sequences, called "potentially acquisitional," which are characterized by learners' simultaneous focus on content and form, conversational adjustments, information given by the proficient speaker and subsequently used by the learner, repairs, and self-repairs. Renié and Chanier (1995) adapted the hypothesis, which is consistent with those of the interactionist hypothesis, to the study of a learner-computer dialogue in order to seek evidence for these potentially acquisitional sequences.

Taking into account the content of the texts in evaluation, Lamy and Goodfellow, (1999) developed the process-oriented construct of "reflective conversation" to refer to on-line discussion among learners about language and issues of language learning. They contrast social conversation, which requires little negotiation of meaning or stretching of competence, with reflective conversation in which learners talk about the target language and the learning task, thereby

obviously focusing their attention on the language. These authors claim that the latter processes are worthy goals because such exchanges provide an opportunity to negotiate understanding, to make explicit reference to language, and to engage in a context where control is negotiated.

Promising perspectives have also been developed by Skehan (1998, 2001), who analyzes the language produced during pedagogical tasks in terms of its fluency, accuracy and complexity. Arguing that these constitute the key dimensions in target-like performance, Skehan points out that tasks should give learners the opportunity to develop in at least one during task performance, and therefore that these are the key processes to look for in task evaluation. For example, a task comprised of written interactive discourse that is intended to allow the learner time to reflect on the accuracy of the language should be evaluated on the basis of the extent to which accurate language is evident in performance. These methods have not yet been applied to CALL process data, but they complement process-oriented constructs such as negotiation of meaning in a useful way, and therefore offer potential.

All of the process approaches described are, of course, only as good as the theory they are derived from. Observations of learning processes cannot be equated with evidence about learning outcomes. They provide a different and useful perspective, but they do not replace evidence for learning based on assessment of outcomes. Important areas of research in this area, then, include studies that link theorized valuable aspects of process to learning outcomes.

Conclusion

This chapter outlined analytic issues that arise in attempting to move constructively from the observation that one can use process data to investigate learning in CALL to research that has done so. Fortunately, the conceptual challenges raised by process-oriented CALL research have been dealt with to some extent in classroom research, assessment, and SLA research. Classroom researchers have struggled with how best to define units and choose theoretical perspectives in interaction, discourse, and conversation analysis. These principles transfer well to problems of description for the data obtained in CALL tasks, even though the data themselves are different. Researchers of language assessment have developed relevant principles for understanding and justifying inferences about learners' capacities. Researchers of classroom learning tasks work with task characteristics and make inferences about tasks based on analysis of learner performance. Researchers in SLA and CALL have attempted to

identify some of the evidence that they would consider positive for language development in learners' process data. Other possibilities need to be explored, but for the meantime, it should be useful to identify the need for developing process goals that can be observed in the types of data that are gathered in CALL tasks.

The process-oriented data that are readily obtained from CALL activities, and attempts to analyze these data in a way that speaks to classroom language acquisition, have sharpened my view of the issues and provided a mechanism for experimenting with my understanding of description, interpretation, and evaluation of language learning tasks. In the following chapters, I will amplify the idea that tackling such issues through the precise and plentiful data obtained in CALL tasks holds potential for expanding on perspectives in applied linguistics.

Advancing applied linguistics

L2 learning tasks

Computationally inclined psychologists ... recognize that AI's emphasis on rigour encourages psychologists to be more precise, often pointing to theoretical lacunae.

(Boden 1988: 6)

Hand-waving is impossible when one's arms are in a straightjacket.

(Shieber 1985: 191)

In the first chapter, I outlined three perspectives on technology and the future, suggesting that professionals in applied linguistics might be well served to consider all three. This means that applied linguists should be aware of developing technologies that can affect their work, such as Kurzweil's (1999) predictions about widespread use of sophisticated learning materials, translating telephones, and communication with machines. Applied linguists need to consider these current and future technologies as they are actually used in the profession and for the impact they are having and may have in the future. Many job notices for positions in English language teaching and applied linguistics specify knowledge of technology as an essential or desirable qualification. Warschauer (2000) predicts even more sweeping changes in job requirements for teachers in the future, whereas Cribb (2000) speculates a diminished need for English teachers in a world where language users can employ convenient translation technologies rather than engaging in time-intensive language study! Critical perspectives warn applied linguists not to accept the technologizing of the profession as inevitable.

While each perspective emphasizes a different aspect of technology, all three seem to share an ominous undercurrent – as if technology were something that needed to be grappled with in one way or another, or as if it were a bother or a distraction from the real work of applied linguistics. In this chapter and the following one, I would like to turn the tide on the annoying technology that distracts applied linguists, and consider the attraction of technology as a tool for doing applied linguistics. I will develop the idea expressed by so

many psychologists and linguists like Boden and Sheiber about their respective disciplines – that the computer can be used as a tool for doing work in applied linguistics. Whereas in both psychology and linguistics, arguably, the computer has been successfully used as a tool to extend, constrain, and test theoretical ideas, in applied linguistics, considerably less research has used technology in these ways, except in corpus linguistics. Much of the computationally-inspired thinking (e.g., about information processing and connectionism) has been borrowed at the theoretical level by second language acquisition (SLA) researchers from psychology. However, computational models of L2 acquisition are rare, computational analysis of L2 language is seldom used as a means of formalizing L2 grammar (e.g., Huiskens, Coppen, & Jagtman 1991), and until recently L2 tasks in research were seldom delivered through interactive technologies (e.g., Doughty 1991). The two volume special issue of *Language Learning & Technology* in 2000 was the first set of papers to collectively address the issue of SLA research and technology!

One has to question why all related fields have seen technology as a tool for better understanding important issues of theory and practice whereas in applied linguistics attempts to think through technology are so rare. Is it that applied linguistics problems are not the type that technology tools can fix? That is likely to be the case in some areas, but in this chapter and the next I will discuss some of the issues that I believe benefit from using technology as a tool to extend, constrain, and test theoretical ideas about L2 learning and assessment. In my view, the key to positioning technology as a tool for expanding conceptual scope, is to expose and set aside the idea that applied linguists' only interest in computers should be to make their work more efficient. If we begin with the assumption that technology is not only intended to help accomplish the same work more efficiently but also positioned to extend and strengthen the analytic and conceptual infrastructure in applied linguistics, we will be in a position to move forward. The idea is that technology is not only for solving practical problems, but also for posing theoretical ones. Rather than trying to sell technology as proven, efficient, or cost effective for implementing instruction and assessment, I will focus on the ways in which technology can serve as a conceptual and intellectual tool.

The study of L2 learning tasks

Applied linguists investigating L2 acquisition and teaching conduct research attempting to reveal how and why instruction contributes to development of

L2 ability. Over the past twenty years an increasingly promising approach to instructional activities and research methods has focused on tasks that learners engage in rather than methods that teachers teach. What qualifies as a "task" differs from one researcher to another, but across definitions it is generally agreed that tasks must have goals, and that they are carried out through participants' engagement in goal-oriented behavior that relies at least in part on language. Some researchers have focused exclusively on "communication tasks" in which accomplishing the task goal requires communication in the target language (Pica, Kanagy, & Falodun 1993), while others see tasks as any goal-directed behavior in the language classroom (e.g., Breen 1987). Communication tasks are constructed to provide learners with opportunities to use the target language for accomplishing the types of objectives that language is used for in the real world – deciding on a class schedule through conversation with classmates or finding the most efficient transportation to the art museum through querying a tourist information person, for example.

How can technology help to push forward the study of L2 learning tasks? To address this question, I will begin by summarizing the key elements of the research on L2 tasks in terms of task evaluation and task description. I will then describe two examples of L2 tasks developed through the use of technology and explain how these tasks and the questions they raise add to the study of L2 tasks by providing tools for operationalizing current task theory, expanding the constructs that task theory needs to account for, and expanding the scope of task evaluation.

Task evaluation

In the previous chapter, I looked at how CALL process data can be evaluated. Some of the approaches have been developed directly from research on face-to-face tasks in the classroom. Three approaches have been used for evaluation of such tasks.

Outcomes

The first is to assess the learning outcomes of learners who have worked on the tasks. Throughout the studies reported in R. Ellis (1999), for example, the learners are exposed to various task conditions from which they were to acquire vocabulary and then they were explicitly tested on their knowledge of the target vocabulary afterwards. Assessment of outcomes in such research typically requires that the task target particular vocabulary or syntactic structures in the input or that the researcher observe learners' interaction to identify the

Table 5.1 Example of texts from the house description "Jigsaw" L2 task

Texts[1]	Function	Significance for SLA[2]
Taro: the house has maybe two stone steps	Describe	Use L2 for communicating meaning
Ichi: two stone steps?	Signal	Focus attention on language
Taro: yeah steps its a entrance	Response	Expand on previous language (modified output)
Taro: its wall is completely white	Describe	Use L2 for communicating meaning
Ichi: completely white?	Signal	Focus attention on language
Taro: yeah completely white	Response	
Ichi: it looks not wood it looks ah concrete	Describe	Expand on previous language (modified output)

[1] From Pica, Lincoln-Porter, Paninos, and Linnell (1996).
[2] These are believed to be good for L2 development according to the perspective outlined in Pica (1994) and Gass (1997), for example.

sources of difficulty and negotiation for subsequent testing (Swain 1998). Development of such individualized tests requires that a record of the learners' interaction during task completion be kept and used.

Negotiation of meaning

The second approach looks for instances of negotiation of meaning in the language of task participants. The logic of assessing negotiation of meaning is based on the theory that the L2 is acquired when learners' attention is drawn to the language during a communication breakdown. The sequence of drawing the learner's attention to a linguistic gap, and then resolving the problem is taken as evidence that input has had the opportunity to be acquired. The data in such investigations are comprised of the sequences of linguistic and non-linguistic moves learners make while working on classroom tasks. For example, in classroom research, texts are the linguistic data (as shown in Table 5.1) that result when participants interact during a task. This interaction provides opportunities for learners to (1) comprehend message meaning, which is believed to be necessary for learners to acquire the L2 forms that encode the message, (2) produce modified output, which requires their development of specifics of morphology and syntax, and (3) attend to L2 form (Pica 1994), which helps to develop their linguistic systems (Gass & Madden 1985; Krashen 1982; Larsen-Freeman, & Long 1991; Nobuyoshi & R. Ellis 1993; Pica, Holliday, Lewis, & Morgenthaler 1989; Swain 1985; Swain & Lapkin 1995).

Three dimensions of proficiency

A third approach for evaluating language tasks is through the criteria of accuracy, complexity, and fluency (Skehan 1996, 1998; Skehan & Foster 2001). Skehan argues that the goal of task-based instruction should be for learners to develop an effective balance between fluency and accuracy and to become able to increase the complexity of their linguistic production by using language which they have integrated into their linguistic systems through restructuring. The ideal balance among these qualities depends on where the task is sequenced in instruction and what the specific pedagogical goals are at that point, but the idea is that an instructor would be able to set pedagogical goals and assess the extent to which they had been achieved by examining learners' language.

L2 task description

Regardless of the method of evaluation for tasks, the objective of L2 task research is to describe tasks in such a way that teachers and researchers can choose and develop tasks that can be expected to produce the desired results when they are used in research studies or in class. The key to this enterprise is to describe the tasks in such a way that their important characteristics are accounted for, and so the issue for both theory and practice is deciding upon the important task characteristics.

Research over the past 20 years has attempted to identify the task features that appear responsible for the observed linguistic performance of L2 learners as they participate in the task. Some of the first observations included, for example, the differences in the language produced when tasks required a "two-way" information exchange for goal completion rather than requiring information to travel only "one-way" (Long 1985). Based on a review of empirical studies of tasks, Pica, Kanagy, and Falodun (1993) summarized the features that had proven significant in previous research and organized them under the variables, interactional activity, interactant roles, and communication goal. Table 5.2 shows how these task descriptors can be used to analyze the type of jigsaw task which produced the texts shown in Table 5.1. The features included under interactional activity and communication goal are intended to define the characteristics of an L2 task which can be expected to influence learners' texts in significant ways. The "significant ways," within the tradition of interactionist research refers to production of signals and modified output, for example, which are evident during negotiation of meaning, as illustrated in Table 5.1. These particular texts were produced by native speaker-learner dyads while they were working on a "jigsaw task" in which each was to "reproduce

Table 5.2 Two categories and five features for L2 tasks and their values for an example jigsaw task

Categories
    Features
	Jigsaw task example
	    Features

Interactional activity	Exchange information about pieces of a picture
Interactant roles[1]	Both participants hold, request, and supply information
Interactant relationship[2]	Information flows two ways
Interaction requirement [3]	Interaction required to meet goal
Communication goal	Reproduce the picture
Goal orientation[4]	Convergent
Outcome options[5]	One

(Pica, Kanagy, & Falodun 1993)

[1] roles relative to the information that must be exchanged
[2] relationship in terms of how information flows toward task outcomes
[3] requirement for activity of request-suppliance directed toward task outcomes
[4] in using information requested and supplied in attempting to meet goals
[5] number of outcome options

an unseen sequence of pictures of houses by exchanging verbal descriptions of their own uniquely held portions of the sequence." Tasks such as this are called "jigsaw" because each participant holds a piece of a puzzle and this particular one was intended to "engage learners in describing attributes, states, and conditions in their pictures" (Pica, Lincoln-Porter, Paninos, & Linnell 1996:69). However, as the jigsaw definition indicates, the houses, the description of attributes, states, and conditions, and the pictures were not essential for making the task a jigsaw.

This feature approach to task definition is theoretically important because it provides a mechanism for constructing a theoretical task description that is at a different level of analysis than the concrete specific task. Such an abstract perspective is necessary for developing a professional knowledge about L2 tasks that can be informed by research. If each task used in a classroom or research study is considered as a totally unique task configuration, then is it impossible to accumulate any knowledge about tasks aside from the intuitions that each individual might gain from his or her own observations. In this sense, the theoretical task perspective offered by the task feature approach takes great strides forward.

Pica, Kanagy, and Falodun's analysis of task features relied on "negotiation of meaning" as the criterion for task evaluation. Skehan's three dimen-

Table 5.3 Categories and features for a cognitively-oriented definition of task characteristics

Categories Features	Definitions
Code complexity	Syntactic and lexical complexity/load and variety
Cognitive complexity	The complexity of the topical content
Cognitive familiarity	Familiarity of topic, discourse genre, and task
Cognitive processing	Information organization, amount of "computation" required
	Clarity and sufficiency of given information
Communicative Stress	Degree of pressure in communication
Time pressure	How quickly the task must be done
Scale	The number of participants and length of texts
Modality	The speaking/writing vs. reading/listening contrasts
Stakes	How important it is to complete the task correctly
Control	Amount of influence participants have on the task

(Skehan 1996; Skehan & Foster 2001)

sions of proficiency, fluency, accuracy, and complexity, require another look at task features because task features are theorized as a way of accounting for different aspects of performance. When the performance of interest changes, the task features are likely to as well. Skehan was interested in identifying the task features accounting for fluency, accuracy, and complexity, because from a practical perspective, if one is to design instruction to foster a balance in development of these three dimensions of proficiency, knowledge of how to adjust tasks to favor one or another of the three competing aspects is needed. Skehan suggested three general categories in his task framework, code complexity, cognitive complexity, and communication stress. The features included under the final two and the definitions are listed in Table 5.3.

Skehan suggested the broader collection of task features along with a review of studies that have shown that such features affect one or more of the dimensions of proficiency. At the same time he pointed out that in this area of research, few empirical data exist and a number of operational issues need to be resolved to move forward. One is the need to take into account individual differences in the analysis of task-generated language. As illustrated in the previous chapter, any observed performance is not fostered by the task alone; instead it must be interpreted as an interaction of both the individual and the task. This point is particularly salient in view of task characteristics that are actually defined partly in terms of the learners' knowledge, such as "cognitive familiarity." However, the point is equally apt for task characteristics such as "information

Task condition: pre-task activity		Task features: • Code complexity • Cognitive complexity • Communicative stress		Task condition: post-task activity
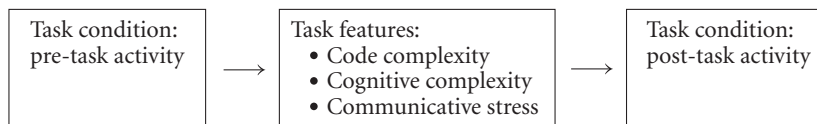
Figure 5.1 A three-part task process

organization," that are likely to depend on learners' need for structure in the information, which is a dimension of cognitive style.

A second issue is how to empirically evaluate overall task difficulty. If the task characteristics are to be used to foster particular types and levels of language performance, one way of evaluating the task theory comprised of such factors is to calculate a correlation between task features and levels of performance. However, doing so requires a means of quantifying the task features, and summarizing both task features and dimensions of performance. A process of quantifying and summarizing these variables has not been worked out.

A third issue is the need to take into account not only the features of the task itself but also the "conditions under which the tasks are done" (Skehan & Foster 2001: 198). "Conditions" here refers to what the learner does before and after the task that may affect the way the task features are operationalized during task performance. For example, as mentioned in Chapter 2, if the learner is given time to plan performance before beginning the task, the language used in the task may be more accurate than if the task is done spontaneously. If the learner knows that a product that will be presented to others will result from the task, more accurate language may be elicited. This view of influences on tasks suggests that the task might best be theorized as a three-part process consisting of a pre-task activity intended to set up the cognitive conditions for the focal task, the task of interest, and a post-task activity also intended to set up conditions during the main task. The pre-task and post-task activities could themselves be characterized by a set of features, but Figure 5.1 is intended to illustrate the use of the pre- and post-task activity as conditions for the main task rather than as separate tasks. Design of CALL tasks, for example, might include a brief pre-task that allowed learners to examine a picture and learn some vocabulary associated with it before moving to the CALL task which would draw on that preface in some way.

The work on L2 tasks constitutes a theoretically rich and practically useful perspective on instructed L2 development. Researchers and teachers can use these categories to analyze existing tasks, construct new ones, and critically examine learners' performance on the tasks that they try out. These task features

were developed and studied almost exclusively through the use of classroom or research tasks in which participants communicate through face-to-face, oral language. Ideally, in the interest of both theory and practice, the scope of this basic approach to task theory can be expanded beyond the types of tasks that have been examined in the past to the types of CALL tasks of interest to teachers and learners today.

Technology-mediated L2 tasks

To what extent can the results observed in these settings be expected if learners are working with synchronous written language through computers connected through a local area network? Would texts be similar if learners were communicating asynchronously with written language while at different locations? These are the types of questions that are raised when attempts are made to expand the tenets of task-based language learning beyond the oral, face-to-face types of tasks. If we move the communication task to the Internet, do the same principles of task construction hold?

Examples from the chat room

In the previous chapter, I discussed the method that Blake (2000) used to analyze the negotiation of meaning in communication tasks he developed for the Internet. In this study he relied on the methods of task definition outlined by Pica, Kanagy, and Falodun (1993), as did Sauro (2001) in developing the tasks described in Chapter 3 that used voice chat for learners completing communication tasks from a distance. Consistent with the approach to task design, both studies investigated negotiation of meaning as one means of operationalizing task success. In discussing these previously, the focus was on how the theory developed for studying the classroom tasks had been useful as a starting point for task design and as a means for identifying evaluative criteria. I now consider the theory-practice interface from the other side by looking at the ways in which the use of technology for the tasks might push task theory.

To review, Sauro's (2001) tasks were designed for ESL learners to practice English in a chat room that allowed communication at a distance with one other English speaker through oral and written language. The ESL learner was at Iowa State University, and he was talking to a proficient speaker of English at the University in Georgia. The task was to discuss and decide on a recommendation for graduate school for their friend in Japan. They were both given in-

formation about the friend, but each participant had found information about one of the universities under consideration and so they were to share the information in order to make a decision. This was designed to fit within the theoretical definition of a jigsaw task, and as Text 1 from the oral conversation illustrates, negotiation of meaning took place.

Text 1

Sumiko: Alright. So about our friend Harry.

Andy: Yeah, I'm a little concerned about him. I don't know, I'm a little concerned about him. I think he should take some leadership courses so he can gain some confidence. It looks like he's got a choice. He's interested in either Stanford or MIT.

Sumiko: Pardon?

Andy: It looks like Harry is interested in Stanford and MIT.

Sumiko: Yeah.

Andy: I don't know exactly how much you know about Harry, but I do know some things about Harry. And ah, I think he's got a great personality, but ah he's got himself some challenges to deal with. He's having a difficult time trying to pick a university to, to study at. And, ah, I do know some things about him. Maybe if we work together on this problem, we go ahead and solve the issues, maybe we can give a recommendation to Harry.

A second example comes from the study by Pellettieri (2000), which was mentioned in Chapter 2. She designed L2 tasks for learners of Spanish to complete through a chat room in which written language was the only mode of communication. She found a number of interesting things when she looked at the language that learners had used. One thing in particular that struck me was that learners actually corrected the morphosyntactic features of their language before sending messages. For example a learner who first typed "Si, el tiene" [Yes, he has.] went back to add the object pronoun "los" to change the message to the more target-like version, "Si, el los tiene" [Yes, he has them.]. The data shown in Pellettieri's report of her research are full of sequences in which learners interrupt their concentration on the meaning to self-correct or correct each other on grammar, in sequences of focus on form, before continuing with the task. In this sense, the use of the written mode in the interactive written discourse proved to be significantly different from the types of negotiations that typically occur in oral face-to-face tasks, in which learners tend to negotiate when a key lexical item is not known.

Because of the task characteristics that are constructed using the technology, both of the tasks are different from the jigsaw tasks of the classroom with two

learners sitting face-to-face. In Chapter 1, I sketched in broad strokes some of the differences between current classroom tasks and new technology-mediated tasks. I noted that the new types of tasks can move beyond the pedagogical texts and learners' opinions (i.e., the materials on hand in the classroom) to draw on a variety of information, opinions, current news, technical topics, or topics of particular interest to the learners. Classroom face-to-face tasks are limited to the learners and the teacher in the room whereas the Internet can bring in many more language users. The mode in classroom tasks has tended to be oral face-to-face conversation, whereas technology mediated tasks can be done in either oral or written language including interactive written discourse.

Studying technology-based tasks

The differences in technology-based tasks make them worth examining a little more closely from the perspective of task theory and the existing frameworks for describing task features. The two examples begin to hint at some of the other features of tasks that may be important for L2 learning. For example, in the Spanish chat we saw correction of morphosyntactic errors – perhaps because learners were writing to each other instead of speaking, and perhaps because they had less time pressure than they would feel in face-to-face communication. Perhaps these features – writing and timing – are important as well. In the first example, we saw relatively long turns in some cases. Perhaps because of the interestingness and complexity of the problem, learners were willing to communicate. We saw clear signals for repetitions. The researcher indicated that many of these repetitions seemed to be related to the quality of the audio as it was transmitted over the Internet, as well as the learners' playing around with it. It seemed that the oral mode over the Internet and the way that it distorted the sound made the repetition kind of fun rather than irritating as it might be in face-to-face communication. These and other performance factors in the oral chat suggest the possibility that additional task features may be useful for the analysis and design of L2 learning tasks.

The experience of constructing technology-mediated tasks and examining the performance data obtained from learners using these tasks suggests some additional task features beyond those proposed by Pica, Kanagy, and Falodun (1993) and by Skehan and Foster (2001). Under four general categories (topics and actions, participants, mode, and evaluation in column one), Table 5.4 outlines a set of task features that includes those from Pica, Kanagy, and Falodun, from Skehan, and from the additional features that the technology-mediated tasks suggested.

Table 5.4 Task framework accounting for factors in Pica et al. and Skehan's frameworks in addition to those suggested by research on technology-based tasks

Task Aspect	Task Feature	From Pica et al.	From Skehan	From technology research
Topics and actions	What is the task goal?	Communication goal: goal orientation and outcome option		
	What are the topics?			Range, interestingness, and currency of topics
	What processes are used to develop the topics?	Interactional activity: interaction requirement	Communicative stress: control	+ Types of interaction; level of control in searching and gathering information
	How cognitively complex are the topics and processes?		Cognitive complexity: cognitive familiarity and processing	Familiarity with genre processes
	Where does the task take place?			Physical location of communication
Participants	Who are the participants?	Learners		+ Teachers, other language users, computers
	What are their interests with respect to language learning?			Reasons for studying English
	What is their experience in using technology?			Knowledge of computer use including typing
	How many participants are engaged?		Communicative stress: scale (number of participants)	+ Potential audience not immediately participating

Table 5.4 (*continued*)

Task Aspect	Task Feature	From Pica et al.	From Skehan	From technology research
	What is the relationship among the participants?	Relationships relative to information: interactant roles, interactant relationship		+ Relationship relative to cultural background, interests and authority of others
Mode	What are the modes of language use?		Communicative stress: reading/writing/speaking/listening	+ Non-linguistic moves
			Communicative stress: scale (length of texts)	
	How quickly must the language be processed?		Communicative stress: time pressure for task	+ Time pressure for moves during interaction
Evaluation	How important is it to complete the task and do it correctly? How will the learners' participation be evaluated?		Communicative stress: stakes	

Topics and actions

The first aspect of the task is defined by five features: goal, topics, processes, cognitive complexity, and location. The task goal refers to what the learner is trying to accomplish in the task. Pica, Kanagy, and Falodun (1993) distinguish communication tasks on the basis of whether the participants are working toward the same goal or not and whether the task has one or more possible outcomes. They also distinguish between task processes requiring conveyance of information and those which require no conveyance of information. From a cognitive perspective, Skehan also suggests important characteristics of process: the degree of control the participants have over the execution of the task and how that control is carried out. The

cognitive perspective also includes the cognitive complexity of the task processes and topics.

Research and practice involving technology-based tasks suggests at least four additions to the analysis of the topics and actions of L2 tasks. First, an important aspect of Internet communication tasks in particular is what the topics are, how interesting they are, and how current. In Compton's (2002) research, one of the main conclusions was that the topics of the chat discussions needed to be considered more carefully because the ones chosen seemed to spark negative attitudes in some of the participants. In the research of Sauro (2001), for example, among the most important decisions to be made in developing the tasks was to decide from the enormous range of available materials, what should be used for the tasks. In deciding this, she considered who the learners were, what they were interested in, and what Web sites could be accessed that would have current information. These issues are important to all language teachers, of course, but the use of the Internet and the choices that this afforded pushed the issue of topics to the forefront of the task design process. In adding topics as a feature, we might further specify them as field specific vs. general because these distinctions have been found to be important for performance (e.g., Alderson & Urquhart 1985; Clapham 1996). Content topics can be distinguished as personal vs. non-personal on the basis of Duff's (1993) identification of this as a relevant task variable. Pica, Holliday, Lewis, and Morgenthaler (1989) have suggested that how precisely the topic is defined is also an important variable.

Both the interactionist and cognitive perspectives include aspects of the task process that are also important in technology-based tasks: whether or not the task requires interaction, and the degree of control it requires. The interaction requirement has been seen as essential by many, who argue that if the task requires no interaction it need not be implemented by computer. Degree of control that learners have over the task process has also been a key area of concern in CALL tasks. The technology perspective adds, importantly, the types of interaction and level of control in searching for, and gathering information. Research and experience with technology-based tasks suggest that the various potential forms of interactions are important, whether they be between learners through asynchronous communication, between the learner and the computer through hypermedia, or between the learners and other language users through synchronous communication. Moreover, tasks can include more than one of these interaction types as part of the task process, and therefore the selection of the interaction processes adds to the process feature. For example, tasks intended to develop incidental vocabulary acquisition have tended to use at least some interaction between learner and computer to offer the provision of finding particular word meanings during the course of the task.

The task process refers to what the learners are engaged in during the process of completing the task. Task processes can be described in everyday terms such as listening to a lecture, or making an airline reservation. The task process might also be characterized as a genre such as a lecture or a service encounter, i.e., a culturally recognized type of discourse for accomplishing particular functions (Martin 1985; Halliday & Hasan 1989). Familiarity of the genre of oral chat communication with written text support over the Internet seemed to affect some aspects of task performance in Sauro's study, as learners became accustomed to it.

The location of the task is perhaps assumed to be within the boundaries of the classroom from both the interactionist and cognitive perspectives because such research has been conducted on oral face-to-face communication in which the location has not been considered a variable. However, in designing technology-mediated tasks, one of the variables that is open to manipulation is location because the learner can be in class, in a lab, at home, in a library, or in an Internet café. Whether or not the task is completed in real time, other participants can be in the same room or at remote locations if other participants are involved.

The participants

Both the interactionist and cognitive perspectives assume the participants are learners or learners and native speakers. However, from the interactionist perspective, the relevant factor for the participants is their relationship with regard to their knowledge of the task information. From the cognitive perspective, the relevant feature is how many of them are acting as audience to the learner. Designers of technology-mediated tasks need to consider more types of participants including a learner and, optionally, other learners, an instructor, and a computer. Other learner factors seem to be important in designing technology-mediated tasks: their reasons for studying English, and their knowledge about how to use a computer including typing skills. In addition to the number of participants, technology-mediated tasks need to be designed with the potential audience in mind as well because participants' discussion and products can be included as the object for a larger audience than those participating in the task. After a chat task within a small group, for example, the learners' production might be used as a lesson or for a group, or the source of ideas for a subsequent task.

The relationships among participants, in addition to who holds what information, should also refer to the level of comfort the participants feel with each other. Relevant to this issue in technology-mediated tasks, research by Plough and Gass (1993) suggested that a significant relationship variable might be whether or not participants are from the same cultural background. Another prior relationship variable is the status each participant holds relative to the other. Relationship variables pertaining directly to the task include the extent to which they have clear

and accurate expectations about each other's task role and knowledge relevant for engaging in the task. A third aspect of participants' relationships is whether they themselves have common or differing task goals – convergent or divergent goals in Duff's (1986) terms. This refers to the participants' actual goals as distinct from the assigned goal(s) for the task. For example, Belz (2001) found that despite the assigned collaborative tasks learners were given, the understanding they held concerning the importance and urgency of task completion was different for Germans and Americans.

The mode refers to the language of the task. The interactionist features assume oral face-to-face communication, whereas the cognitive perspective adds the written mode by including discussion of reading, writing, listening, and speaking. The technology perspective adds non-linguistic moves to include the most typical ways of communicating with the computer (e.g., pressing ENTER, pointing, and mouse clicking) that is part of on-line communication. The cognitive perspective includes scale, which refers to the length of the texts. The cognitive perspective includes the time pressure during task completion, and the technology perspective adds time pressure for moves occurring during the interaction.

Evaluation

The cognitive perspective includes an evaluation feature as a fourth category. This would be equally important in the technology conditions, where evaluation might include both a formal evaluation by the teacher and also by peers or an outside audience when work is done on the Internet. The idea in both cases is that the learners' knowledge of subsequent evaluation of a work product may help to focus attention on the quality of the language. From the cognitive perspective, the evaluation priority is accuracy. An evaluation process that considers content as well might also include creativity, style, and self expression.

The expanded task framework directs the task designer to a range of choices that need to be made in constructing tasks – choices that can influence task performance. In fleshing out the task framework, I can see that the technology has helped to display the range of possibilities in both technology-mediated and classroom tasks, and to prompt consideration of their implications for learners' task performance. This appears to be an attraction of technology.

The attraction of technology

The attraction of technology in this context becomes evident if it can be seen as a means for expanding theoretical exploration of L2 tasks. In order to do this, I will

consider the tools that technology offers, how it points out theoretical lacunae, and how it raises issues for assessment of task performance.

Tools for building tasks

With respect to methodology for task research, technology offers tools for testing out hypotheses about task performance prompted by different configurations of task features in a controlled environment. The only collection of papers on technology and SLA, *Language Learning & Technology* (*2001, Numbers 1 and 2*), contains papers in which some authors have used technology to design tasks that learners complete for instruction and assessment. The idea is that the computer can accomplish what is so difficult in classroom instruction: it assures that each participant is exposed to the same instruction, such as explicit vs. implicit presentation of grammar. These types of tasks are discussed in Chapelle (2001a: Chapter 5).

Less has been done to expand an understanding of tasks through the use of task features. As I outlined above, the idea of task features is that they provide a means of examining potential consequences of task characteristics for performance. Several of the studies described in this and previous chapters used the interactionist task features to define jigsaw Internet tasks, for example, and then looked for negotiation of meaning in the data. That set of task characteristics was neutral, however, with respect to many of the task features that Internet task designers had to attend to, such as the use of written language, spoken, or both; the location of the participants, and their familiarity with the genre; and the interest of the topic. The cognitive set of task features hypothesizes the importance of some of these features, including the mode of the language. However, to obtain empirical results pertaining to the effects of various task features, technology is almost essential for constructing the tasks and administering them in a uniform way. It is difficult to imagine within a typical classroom or research context administering tasks requiring individual learner control over timing or help requests, requiring interactive writing, or public display of products. From the few Internet jigsaw tasks reported so far, it seems evident that additional task features are important for their design and implementation, and therefore to investigate the effects of these factors, technology must again be called on.

Task theory

In considering ways of describing technology-mediated tasks over the past twenty years, I have found that the different options technology offers have helped to stretch my theoretical perspective on tasks. The approach to tasks that uses task features (e.g., one-way vs. two-way communication) rather than concrete task names

such as Whodunit mystery, or WebQuest seems essential for developing an understanding of tasks that extends beyond one classroom and one task at a time. I call this more general understanding of tasks *task theory*. In my view, task theory faces several challenges if it is to serve the study of technology-mediated tasks.

Criteria for features

In my view, a theory of L2 tasks should include at least the types of features that appear in Table 5.4. However, this chapter has presented three views of potential features with little discussion of criteria for including features. In looking at the shift in features from interactionist to cognitive perspectives, it was evident that the change in task evaluation from negotiation of meaning to fluency/accuracy/complexity prompted the changes and additions that Skehan proposed for task features. The features suggested on the basis of experience with technology-based tasks did not become evident because of a new method for evaluation; instead other concerns, such as decisions the task planner makes, hypotheses about factors affecting performance, and observation of performance raised other issues.

The process of examining and potentially revising task features raises the important issue of what the criteria should be for task features in a task theory. Is the most parsimonious set of task features to be preferred? If so, perhaps task theory should include only those features that could be shown to affect the aspects of performance that are evaluated. This was Pica et al's original approach, and one could argue that the only reason for modifying that would be to change evaluation methods from looking for negotiation of meaning to another method. For example, when evaluation includes accuracy, the amount of communicative stress placed on the learners by timing constraints might be important whereas it is not if negotiation of meaning is the only concern. The problem with relying on evaluation methods to drive task characteristics for technology-mediated tasks, at least at the moment, is that it would be difficult to argue for a single method of evaluation. Even the task research that starts out investigating negotiation of meaning has found that other factors appear to come up. For example, Pellettieri (2000) found plenty of negotiation of *form* in the written interactive discourse she studied; Sauro (2001) found input modification of the oral channel through the use of the text in her study. Moreover, as I pointed out in Chapter 4, much of the research on technology-mediated tasks is descriptive, not attempting any evaluation at all. Descriptive research that focuses on performance with no systematic means of describing the relevant features of the task is difficult to interpret and build upon. It seems that a means for defining technology-mediated tasks is needed; moreover, this need presses the theoretical issue of how task features should be chosen.

If L2 learning task theory can learn anything from L2 assessment task theory, the lesson may be that a complete set of features is useful for some purposes, but

that in including features, one might wish to distinguish different types of features. Whereas some features may be expected to affect performance (e.g., amount of time allotted for a task), others would not be expected to have a discernable affect (e.g., whether a man or woman is speaking). Some would argue that task features that cannot be shown to have statistical effects on performance are extraneous in an assessment task theory whereas others will argue that such task features are useful for task developers to take into account during the development of test tasks. In other words, they cannot be left to chance during task development despite the fact that statistical evidence has not supported their effects on performance. Moreover, a complete set of task features allows developers of assessment tasks to see new possibilities for tasks, so the features serve as a kind of conceptual toolbox for task development (Bachman 1990). Another use for the features, in the view of those who argue for a more complete set of features, is for assessing the degree of authenticity of test tasks relative to tasks learners need to perform beyond the testing context.

A formal means of assessing authenticity is also relevant to learning tasks. One wants to be able to generalize, on the basis of results obtained on one particular task, to a class of tasks which can be expected to behave in a similar way. For example, Pica, Lincoln-Porter, Paninos, and Linnell (1996) implicitly made this type of "class" definition when they chose two "different" tasks which they assumed would be "the same" with respect to the features of negotiation that were of interest.

> The reason that two separate jigsaw tasks were used was that we believed that their different emphases would allow the subjects to produce a broad range of input, feedback, and output modifications during their negotiation. The house sequence task would engage learners in describing attributes, states, and conditions in their pictures. Such description might lead to negotiation involving names and features of objects, individuals and contexts. The story task, on the other hand, with its emphasis on a sequence of events, might lead to negotiation over actions and experiences, with reference to time sequences and relationships among events.
>
> (Pica, Lincoln-Porter, Paninos, & Linnell 1996: 69)

In other words, while the task was defined according to a few formal criteria (e.g., number of task goals), the researchers also considered other factors in task design in order to take into account how their task choices would affect the linguistic choices of the participants. This concern for register inevitably points to features that have been used in register theory to describe contexts outside the instructional setting.

Register theory and features

Linguistic register theory offers a top-down perspective on the feature question rather than identifying features that appear to describe performance in a post hoc

fashion. Historically, this was the approach taken by researchers of both human-computer interaction and of CMC. Winograd's (1972) computer program that conversed with people about the colored blocks on the table was constructed through the developer's anticipation of the specific linguistic choices that people might make to express the experiential, interpersonal, and textual meanings allowed in the context of the blocks world. Ferrara, Brunner, and Whittemore (1991) and Werry (1996) analyzed the linguistic choices participants made within the context of synchronous chats. Moreover, as Hasan and Perrett (1994) pointed out, ideally, approaches to task-based learning would be informed by linguistic theory equipped to provide insight into observed relationships between texts and contexts. They argue that systemic-functional linguistics offers a relevant register theory because it articulates interdependencies between contextual features and linguistic features of texts (Halliday 1977; Halliday & Hasan 1989). For example the descriptive analyses of the three texts in the previous chapter in terms of (1) experiential, (2) interpersonal, and (3) textual meanings would correspond to the three first aspects of tasks in Table 5.4, (1) topics and actions, (2) participants, and (3) mode. In order to be useful for the study of technology-based tasks, however, this general register theory needs to be filled in with the specifics that are relevant for construction of technology-based L2 learning tasks and for analysis of performance.

Expanding task and register theory
An expanded set of conceptual tools for task construction prompted by the expanded configurations of contextual features that the technology can create seems to press researchers to express knowledge about language teaching and learning as principles rather than as concrete specific cases. In Chapter 2, my approach to getting at principles for CALL tasks based on theory and research from language teaching was to draw on such principles from cognitive and sociological approaches to SLA research. In this sense, the needs of designers and researchers of technology-mediated tasks help to choose from all the approaches that one can take to SLA those that actually inform language teaching. Within the findings from such research, the technology again presents questions about definitions. For example, in discussing the robust results concerning elaboration of written texts for L2 learners on paper, I noted that the principle of elaboration in CALL texts would play out differently because input provided to learners through CALL can be modified/elaborated interactively. Whereas simplification of a paper text means removing the linguistic features that learners may benefit from in the input, an electronic text can offer the more complex text and the simplification can be standing by behind and shown on request. The issue becomes how to link input modification as closely as possible to the complex text rather than how to elaborate the text. Trans-

fer of the concrete results of the paper-based research to the electronic texts does not offer the necessary guidance.

A second example of the push to better understand the principles underlying the specifics of concrete tasks comes from a question I received in e-mail that looked something like this:

> I am a PhD student. . .. My thesis is investigating interaction in [computer] environments here in Australia. The lit review identifies through SLA research those features that have been identified as promoting interaction. Secondly I look at the technology literature and determine the interaction that occurs in that mode . . . I have hit a brick wall and would like some advice. . . . I guess I need a means of identifying the difference between *interaction* and *interactivity* and need to come up with a way of distinguishing between the type of interaction that occurs with computers as compared with the more communicative interaction that occurs in SLA.
>
> (adapted from e-mail received, June 2000)

This question is particularly well-articulated, but it is somewhat typical of the questions I receive in e-mail and in class from my students. In other words, the next generation of applied linguists is attempting to tease out theoretical and practical issues in part by applying the insights of past work to current teaching options, which include technology.

Some applied linguists may think that a question such as the definition of "interactivity" really fits within the domain of instructional technology. But just as yesterday's language classroom researchers found the interaction analysis protocols from education to be insensitive to the critical issues of classroom language learning, my experience is that instructional technology offers today's researchers almost nothing with respect to the specifics of language learning, despite the very valuable perspectives, expertise and practices it offers at a more general level. In Chapter 1, I summarized the position of the critical analysts, who found treatment of technology and learning somewhat superficial in education. Rose (2000) pointed out that in addition to the preoccupation with process that Bowers criticized, the language used by educational technologists to discuss pedagogical constructs is empty. She described her epiphany as a critical examiner of educational technology when she, as a designer of educational software, realized the emptiness of the language used to paint a positive image of the technologies she was presenting to clients. The anecdote centers around precisely the term that the research student in Australia asked me about: "interactivity." Rose and her sales team had just given a successful presentation to a client in which they had displayed a program, showcasing its interactivity.

"But you know," admitted one of my colleagues, "even after all that, I'm not really sure what interactivity is myself." There was a moment of silence as we all looked at each other and then sheepishly agreed that we were all somewhat unclear on the subject. A senior member of the company, overhearing our conversation, hastened to assure us that we should not worry: "There are," he said cavalierly, "as many definitions of interactivity as there are people in this business." From that moment on, the language of educational computing became my covert, and eventually overt, object of study.   (Rose 2000: xii)

Rose cited "interactivity" as the beginning of her preoccupation with the language of educational computing, just as "interactivity" might mark the entry for a PhD student in applied linguistics into a preoccupation for operational definitions of terms used to describe constructs in language teaching. It reminded me of R. Ellis' (1999) useful definition of the meanings and use of "interaction" described in Chapter 2, and Hulstijn's (2001) clarifying discussion of "incidental" and "intentional" from the perspectives of research and teaching. Interactivity in applied linguistics will probably have to be defined in view of the theoretical and operational conditions for technology-mediated interaction. This includes the contexts created through computer-mediated communication among humans in addition to human-computer interaction. The process of developing such a definition will be useful for both theory and practice.

Revisiting assessment

Task theory prompts reconsideration of the methods for evaluating the learning that takes place in technology-mediated tasks. In the previous chapter, I discussed some of the approaches that have been taken so far to evaluation of the process data from CALL tasks, and some of the studies discussed in Chapter 3 conducted evaluation of outcomes. Task theory, however, motivates a more careful look at the issues involved in evaluation and raises questions about how evaluation of learner performance can be improved. It is useful to distinguish evaluation of learners' task performance from outcomes, but both perspectives require that the constructs of language ability targeted in the task be conceptualized.

Research in second language testing offers three general approaches for defining language ability (Chapelle 1998). It can be defined as a general trait with terms such as "general language proficiency," "speaking ability," or "reading comprehension." This perspective treats ability as an unobservable trait which will affect performance across a broad range of contexts which call on the trait. A second approach, which is in opposition to the first, is for the construct of interest to be defined as language performance which occurs in a particular setting. This would be the observable language that learners display. Such constructs are described in

terms of successful completion of a task such as "describing a house," "greeting previously unknown international guests," or "summarizing a reading passage about the development of Euclidean geometry." An intermediate approach defines language ability as a complex of unobservable traits which come into play within a defined set of contexts. The construct of interest would be for example "the vocabulary and syntax required for describing buildings to visitors in Chicago," "the pragmatic knowledge required for formal greetings at a reception on a college campus," or "the rhetorical knowledge required for comprehending and summarizing historical writing about Canada."

For studying the abilities developed in technology-mediated tasks, the first method of defining language ability is too general. If, for example, we attempt to see the house description task as developing learners' general language proficiency, and we therefore assess their general language proficiency after they have completed it, we will be very unlikely to detect any overall improvement because the design of a proficiency test samples across a wide domain of language not necessarily the areas that the learner developed. If, on the other hand, the learners' description of houses (i.e., the second approach) is assessed, improvement is much more likely to be evident. However, there are two problems with taking such a narrow view of what the task prepares learners to do. One is that we are interested in understanding the specific linguistic knowledge and strategies that the learner develops in the house task rather than simply whether the learner succeeds in getting the meaning across on this occasion. Messages can be conveyed through the use of a combination of gestures and lexical utterances, but in most language classes the goal is for learners to develop their ability to use the target lexical, syntactic, and pragmatic systems. This is Skehan's point in asserting the need to assess fluency, accuracy, and complexity of the language. Second, we want to know the extent to which work with the house task will develop the learner's competence in other communication tasks, particularly outside the classroom.

The third way of conceptualizing language ability attempts to address these problems by defining specific linguistic abilities (e.g., syntactic and pragmatic knowledge) within a set of contexts. In other words, it defines "situated language ability." This third approach requires that the language ability framework include specification of language knowledge, strategies, and the context in which they are used. This perspective of language ability outlined by Bachman (1990) and Bachman and Palmer (1996) is intended to express the following: language knowledge is put to use through strategies, which serve as the interface between the learner's language knowledge and the context of language use. This third way of conceptualizing language ability offers a fruitful approach, but to be fully explored, it would be useful to have more precisely focused instruction that can record the language experience learners engage in. In other words a detailed construct theory

needs to be tested through equally precise operational means. I will expand on this issue in the following chapter.

The attractions of technology I have outlined in this chapter have nothing whatsoever to do with conducting English language teaching and research in a more cost effective or efficient manner. An ultimate aim of theory and research is to improve knowledge about language teaching and learning, and ultimately this would hopefully move in the direction of better teaching. But the attraction does not necessarily entail applying technological solutions to problems in practice. Rather I have argued that conducting practice through technology provides a novel perspective on theoretical issues and new tools for researching those issues.

Conclusion

The idea of the computational psychologist and computational linguist that technology should serve as a tool to press theory was explored in this chapter relative to one of the concerns of applied linguists: studying tasks for L2 learning. I therefore began by outlining the issues of task evaluation and description as they are studied by researchers of L2 classroom tasks. Focusing on task description, I introduced some of the descriptive categories that seemed to be implied when technology-mediated tasks are developed and investigated. Finally, I explained the ways in which the study of technology-mediated tasks contributes to this area by (1) adding tools for use in task development so existing task constructs can be operationalized, (2) challenging current task theory, and (3) prompting reconsideration of assessment issues. I have argued that the perspectives offered here are useful for theory in this area of applied linguistics, and that such perspectives are not accessible to those whose vision is set only as high as the attainment of greater efficiency in practice.

Advancing applied linguistics
Assessment

> Living in the information age can occasionally feel like being driven by some-
> one with tunnel vision. This unfortunate disability cuts off the peripheral vi-
> sual field, allowing sufferers to see where they want to go, but little besides.
>
> (Brown & Duguid 2000: 1)

Brown and Duguid, the social pragmatists from the first chapter, spark the im-
age of people moving quickly through long tubes, blind to everything outside.
The extreme picture of mindless, fast motion hardly characterizes the thought-
ful hard-won accomplishments in language assessment over the past fifty years.
Arguably the most empirically rigorous, theoretically sophisticated, and intel-
lectually cohesive area of applied linguistics, language assessment is anything
but mindlessly speed-oriented. But with the introduction of technology into
second language testing practices, the tunnel seems to begin to close in.
This chapter continues the theme of the previous one but shifts to issues
of English language assessment. Without diminishing the accomplishments of
research and practice that have resulted in an impressive array of computer-
assisted English language tests, I suggest that computer-assisted language as-
sessment should also help researchers to identify and explore theoretical issues
in assessment, but that doing so requires reaching beyond the terminal goal of
more efficient tests. I argue that technology can help to offer unique perspec-
tives on two central theoretical issues in language assessment, construct defini-
tion, and validation, but that to offer such perspectives, research aims have to
target goals other than efficiency.

The tunnel of efficiency

Guided primarily by practical motivations of speed and efficiency, research
and development in computer-assisted language testing (CALT) appears to
aim toward the picture that the technologists paint of a faster, more efficient

life through the widespread use of technology. On the basis of claims that computer-adaptive tests can more efficiently measure the same constructs as paper and pencil tests, by 2000 the large majority of effort on CALT had been directed toward developing computer adaptive tests (see for example papers in Chalhoub-Deville 1999; Dunkel 1991b; and Stansfield 1986). As Brown (1997) explained, a computer-adaptive test uses a delivery algorithm for selecting items on the basis of an examinee's prior performance, and for terminating when examinees have consistently answered items correctly within a narrow range of difficulty. Because the final score is assigned on the basis of the difficulty of items consistently answered correctly, examinees need only respond to enough items to receive a score, thereby minimizing testing time, and maximizing efficiency.

To a lesser extent, the theme of increased efficiency in practice is developed in other ways in papers on CALT. In Stansfield's 1986 volume, for example, papers on topics other than computer-adaptive testing addressed the feasibility of computer analysis of oral language, a computer-assisted cloze-elide test, and computer analysis of essays. Each of these practices holds the potential for improving the efficiency of language assessment if perfected. Alderson (1991) suggested a number of ways in which technologies can expand the capabilities of language tests by, for example, measuring time and navigation patterns during test taking, storing and presenting information in a variety of ways, and analyzing learners' language. Discussion of today's Web-based language tests extends this list of potential improvements for practice to include accessibility of delivery. Burstein, Frase, Ginther, and Grant's (1996) summary of the uses of computers in language testing is similarly focused on the capabilities of computers for practice. Corbel's (1993) review of the state of the art of CALT included many concerns for efficiency but at the same time hinted at other issues such as "Can the concept of communicative task-based tests be operationalized more adequately by computer" (p. 53)? In two rare papers, Meunier (1994) and Laurier (2000) each set aside efficiency to consider how CALT practice might be improved by increasing the authenticity of CALT tasks. Overall, however, in the work on CALT of the past 20 years, these papers discussing issues other than efficiency are the exception to the rule.

This exception is worth considering in greater detail. When improvement of CALT practice is viewed from perspectives other than efficiency, applied linguists can begin to identify the ways in which the use of technology extends language testing theory. Bachman's (2000) review of the state of the art of language testing at the turn of the century includes a segment on the contribution of technology in language testing, which notes "the new task formats and

modes of presentation that multi-media, computer-based test administration makes possible raise all of the familiar validity issues, and may require us to re-define the very constructs we believe we are assessing" (p. 9). What are the va-lidity issues raised by CALT? What is to be gained by raising validity issues? Can CALT practice provide fresh insight to the familiar validity issues? To convey an idea of what Bachman might be referring to, I need to begin with a brief discus-sion of theoretical issues in language assessment that might be probed through CALT research if it is considered from perspectives other than efficiency.

The panorama of theory

Chapter 4 discussed some of the theoretical ideas that come from language assessment including the principles for making inferences based on observed performance. Related issues central to language assessment include how in-ferences are justified, how test scores are computed, and how they are used, as well as questions about the best ways of defining language constructs. The theoretical issues in language assessment grow out of practical needs for devel-oping tests and justifying their use, but are not limited only to those questions of immediate relevance for particular tests. Nevertheless, language assessment theory is theory for practice and as a consequence an appropriate place to be-gin discussion of the theoretical issues is by noting the practical questions that come up in designing computer-assisted tests, as summarized in Table 6.1. The first two deal with how the construct that a test measures is defined, and the remaining three address the process of validation.

Construct definition

The first two issues, decisions about degree of learner choice during test-taking and scoring constructed responses, rest on the test developers' precise defini-tion of what the test is intended to measure. These problems probe critical issues because specification of what a test is intended to measure is fundamen-tal for language test design and validation. Test tasks must be designed on the basis of what inferences are to be made from learners' performance on them and therefore standard texts on test development discuss the language abilities (i.e., the constructs) that underlie test performance (Bachman & Palmer 1996). Validation research is described as a form of hypothesis-testing which exam-ines hypotheses concerning the relationship between test scores and inferences associated with those scores, which typically include inferences about the theo-

Table 6.1 Issues in CALT with implications for language testing theory

Issue in CALT practice	Question for language testing theory
On what basis should decisions about test design affecting examinee choice be made?	How can a language test construct be defined to include specification concerning the appropriate level of choice to give examinees?
How can examinees' constructed responses be scored meaningfully by a computer program?	How can a language construct be defined to provide guidance for a detailed response analysis?
Is it valid to measure language abilities using a computer delivered test?	How can validity inquiry be conceptualized to address the question of whether inferences and uses of computer-delivered language tests are valid?
Can constructs such as noticing be assessed on the basis of process data from CALL tasks?	How can inferences about learners' capacities be justified in SLA research?
How can negative affect from computer-delivered tests be minimized?	How can testing consequences be investigated to reveal the effects of computer-delivered tests?

retical construct definition intended to help explain performance (Kane 2001; Kane, Crooks, & Cohen 1999; Messick 1989). Given the centrality of construct definition in language testing, researchers have regularly struggled with theoretical issues concerning what language constructs consist of and perspectives for defining them (e.g., Bachman 1990; Canale & Swain 1980; Chapelle 1998; McNamara 1996), but these issues remain slippery.

Just as a computer formalism can act as a "straightjacket" for testing a grammar, as Shieber (1985) put it, so can an English test act as a straightjacket for testing construct theory. This has proven to be the case in applied linguistics so far, and if an English test is to serve as straightjacket for theory, then a technology-mediated English test is a particularly well-fitting one because of the range and detail of elements in computer-assisted test design. In designing a test of reading, for example, the designer has to make such decisions as whether the examinee should have the option of accessing the reading passage while answering the questions. This decision has to be made in view of the fact that some examinees will take the option and look back, and others will not, and thus the strategic competence of navigating back and forth across the pages of the test will contribute to the examinees' overall test performance. The design question that pushes the construct theory is whether or not to give

the examinee the option of looking back. Addressing the question requires a construct theory that articulates the construct of reading comprehension more specifically than simply "reading comprehension." This design question, and others, might be discussed in designing a paper and pencil reading test, but it cannot be treated as a serious issue with pressing consequences because in a group setting it is very difficult to keep track of exactly what an individual is doing, and therefore really the only issue of control is the timing for the overall group. Computer-assisted testing, in contrast, repeatedly raises questions about the effects of design choices on the theoretical construct to be measured because the test designer has to make specific decisions about the design of the interface.

Particular issues of construct definition are also raised by decision points encountered in the design of procedures for computer-assisted scoring of constructed response items. Since test scoring is to be guided by the construct that the test measures, holistic scoring of essays, for example, requires little analysis of the construct of interest. For raters to assign an overall score on a six-point scale, for example, they do not have to develop a sophisticated, explicit definition of writing quality. Analytic scoring requires the test designer to be more precise about the aspects of performance that should be valued, a requirement that has proven to help test designers clarify the aspects of the construct measured, but a practical limit in the process of analytic score development is defined by the capacity of human raters. If a computer program is used to score constructed responses the resulting analysis can contain very detailed information, and so the test designer has to call on construct theory to decide what aspects of the detailed information are relevant to the construct theory and how it should be summarized to best reflect the construct the test is intended to measure. Without computer-assisted response analysis, research in language testing has been unable to probe construct theory in this way because, despite the complex performance that may result from learners' responses to test tasks, the methods for scoring responses have not been sensitive enough to document its complexity. For example, if speaking ability is defined as consisting of abilities for use of particular types of lexicogrammatical forms and illocutionary functions within a particular register, but the scoring of performance on a speaking test consists of a single rating based on a judgment of overall performance, the resulting performance data offer no means for testing the construct theory.

Validation

The other three issues raised by the use of computer-assisted language assessment are related to validation theory and practice. The first calls for a means of conceptualizing validity inquiry to address the question of whether inferences and uses of computer-delivered language tests are valid. But how can this question about test method bias push validation methods beyond current perspectives? After all, the significance of test method in influencing examinees' performance is well-documented in the research on second language testing (e.g., Bachman, Lynch, & Mason 1995; Bachman & Palmer 1982; Chapelle & Abraham 1990; Douglas 1998; Fulcher 1996; Wigglesworth 1997). By and large, the assumption in this research is that any influence of the test method on scores should be considered undesirable. This assumption fits ideologically with the commonsense notion that test users should be worried if examinees' test scores are affected by the fact that a test is computer-delivered. If taking a language test on a computer would result in examinees obtaining a different score (either higher or lower) that what they would have obtained if the test were delivered by paper and pencil, the argument goes, the difference between the two scores should be used as evidence that the computer-delivered test is not a valid measure of language ability. However, examination of this common sense argument needs to be made in view of the observations in Chapters 1 and 5 about the possibility that language ability for engaging in technology-mediated communication should be expected to be different than what is required for performance in other registers. This reconsideration of the argument probes the logic underlying this accepted approach to validation.

A second validation issue becomes evident when researchers use technology-mediated methods for research in second language acquisition (SLA). Their use appears to spotlight questions about the meaning of inferences made from performance. In SLA studies, measurement is typically not the focal concern, and therefore measures are often chosen on the basis of the fact that they have been used in previous studies of the same phenomenon. It is not until objections are raised or a new form of measurement is proposed that discussion about validation takes place, and exactly what might comprise such discussion is somewhat unpredictable. As assessment concepts evolve through developments in educational measurement, there is a growing disparity between how they are used in SLA compared to how they are used in the measurement literature. Should the standards for educational and psychological measurement pertain to the validation of SLA measures? I believe that new measures constructed through the use of technology will pose this question repeatedly.

A third validation issue raised by computer-assisted language assessment comes from the concern about negative affects that such assessments might have on learners. Throughout the 1980s, language testing researchers have increasingly been concerned with the effects of language tests on test takers and on other aspects of the instructional setting. The textbooks on language testing reflect this gradual trend by first including *affect* – the extent to which the test causes undue anxiety – as a test quality to be investigated along with reliability and validity (Madsen 1991). By the end of the 1980s, *washback* – the effect of the test on the process of teaching and learning, had been added as well (Hughes 1989). By 2000 few questioned the role of consequences in a validation argument. In other words, validation of a test use should take into account not only the technical characteristics of the test (such as reliability) but also the consequences that it has on those who use it. However, evaluation of testing consequences presents a problem for testing practice because it involves research directed beyond the test and test scores to the ways in which the test impacts people involved with it. A study investigating consequences of the TOEFL on teaching in an intensive English program illustrated the complexity of the issue: Consequences of the TOEFL could be identified, but they were mediated by other factors in the language program (Alderson & Hamp-Lyons 1996). Despite apparent agreement that testing consequences are important, the type of consequences that should be investigated and the manner in which consequences might best be identified remain topics for further investigation (Alderson & Wall 1993; Bailey 1996; Wall 1997). I believe that concern about the consequences of computer-assisted language assessment will be one impetus for continued research on consequences and that such research will expand perspectives on validation theory.

Having introduced the theoretical issues at stake, I will add a little more detail about how I see the work in technology-assisted language assessment prompting theoretical progress. In doing so, I am drawing on hints that I detect in current discussion in the field and my own experience with and analysis of problems in language assessment.

Probing construct definition

Issues related to construct definition are at the same time a central area of concern in language assessment and an area that will not develop on the basis of theoretical perspectives alone. The two practical issues of test design and prin-

cipled scoring contribute important perspectives on construct definition that need to be recognized and elaborated.

The test design-construct connection

When a group of applied linguists sits in a room and discusses the design of a computer-assisted listening test, the conversation circles around from specifics of the interface design, to the meaning of the construct of listening comprehension, to the use of the test, to the practicalities of test delivery. As the circle spins, what happens is that the participants keep calling on the construct theory of listening comprehension to answer questions posed by options in test and interface design. Each time they consider listening comprehension as the construct underlying the test, they have to try to squeeze more guidance out of it than it can offer. So the next stop is test use. How will the test scores be used and what does that mean for test design? A few years ago on the international listserv for discussion of language assessment, L-TEST, such a discussion took place. The specific issue was whether or not examinees should be allowed to listen to the aural input on a test more than one time. It is an issue that can and does come up in any listening test, but the issue is more salient in a computer-assisted language test because if examinees are given the option of listening more than once, some will take the option, and some will not. Some will listen repeatedly, and others only once. In short, the computer-assisted test can allow examinees more or less freedom in how they access the input, and the question is whether such freedom will help or hinder in obtaining performance that will reflect the construct. The answer depends on precisely what the construct is.

The comments that came up during the course of this e-discussion represented all of the four stops on the circle and more. Specific operational suggestions were offered such as giving a bit of the aural input for examinees in advance of the test to get them familiar with it. Advice about the construct included the warning that the listening test should not be made into a test of memory. The test use was discussed, bringing in the idea that if examinees will need to listen to the news on TV or the radio, they will have only one opportunity to listen, and that test design choices should reflect an analysis of such factors. Practical tips included the warning that only particular types of materials would be appropriate to include on a language test. In short, the international conversation consisting of dozens of comments, struggled with the familiar issues – the inadequacy of the conceptualization of both the listening comprehension trait and the contexts of listening of interest to the test users. These two approaches to construct definition – trait and context – fall

<table>
<tr><td align="center">Analysis of the trait
the test is intended to
measure</td><td align="center">←————————→</td><td align="center">Analysis of the
contexts in which
English will be used</td></tr>
</table>
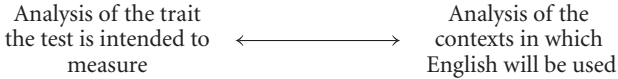
Figure 6.1 Approaches to construct theory

at two ends of a continuum illustrated by the two-headed arrow in Figure 6.1. One end is the trait definition of listening comprehension that is based on the learner capacities involved in listening and the other consists of the situations in which examinees would be doing their listening.

The middle ground between the trait and situation approach is not well understood in language assessment theory. Historically in educational measurement, the trait approach predominated because of the concern that test performance (and test scores) should be interpretable as relevant beyond the test setting. A construct definition expressed as simply as "listening comprehension" is intended to be relevant across many different contexts of language use. At the same time, however, the construct definition "listening comprehension" does not provide enough detail about the construct to make decisions about detailed issues of test design. Defining listening in such a general way provides no guidance in answering the question about whether examinees should be allowed to listen more than once. It is this test design decision that pushes away from the general construct definition toward something with more detail. In looking for more detail, decisions have to be made about whether the trait end of the continuum should be probed, adding to the psycholinguistic detail of the construct, or whether the contexts perspective is more fruitful.

If test developers try to answer the test design question through a careful psycholinguistic description of the listening process, including how repetitions under varying conditions affect attention, memory, and recall, they will have more information than they know what to do with. Moreover, the psycholinguistic information does not directly imply the best construct definition for a particular test. At the contexts end of the continuum, if test developers consider relevant listening situations, what appears on the surface to be a narrow range of situations (classroom lectures, for example) turns out to contain a lot of variation: not all lectures offer the same opportunities for repetition, students are free to tape record and play back lectures, and so on. Again, the facts are useful as a starting point, but they don't offer a direct answer about the construct definition. The tugging from each end of the continuum – in addition to the desire to keep the construct as simple as possible – is what forces applied

linguists into figuring out how to work within the middle ground. We are not there yet, but I believe that approaching carefully the test design questions that are raised in computer-assisted testing offers a way forward.

These detailed questions about test design present themselves to anyone who develops computer-assisted language tests, and therefore the issues are coming into the mainstream of language testing where they are more likely to find solutions if language testing researchers look beyond efficiency alone. The discussion on the L-TEST listserv suggested that many researchers and practitioners are interested in such issues. Just as other questions in language testing have become better understood through the multiple perspectives of language testers internationally, I believe that technology will play an important role in expanding interest in construct definition.

The test scoring-construct connection

On a few rare occasions, computational linguists, whose job it is to write computer programs for analyzing language, have been called upon to assist in developing software for analysis and scoring of ESL examinees' constructed test responses. Typically such responses consist of essay-length written input, but a few tests are attempting automatic scoring of examinees' shorter written responses and even oral language. The computational linguists, who know nothing about language assessment, are given examples of what scores should be derived for some example responses, and sent off to do their job. When they have a test version of the program, a data set with novel examinee responses is tested to see if the program's scores achieve acceptably high correlations with those given by human raters. This process of constructing an efficient copy of human rating can be completed without questioning what the test is intended to measure. Therefore, throughout the process the test developer remains blind to the questions about how the detail of the examinees' responses speaks to the construct that the test is intended to measure. Very little of the research on language assessment has attempted to link the construct definition to the scoring procedure, but two examples begin to hint at the issues.

Scoring dictation
When efficiency is not the only goal of test development, the interesting problem becomes evident, as it did in a study investigating the use of language recognition software for response analysis in an ESL dictation test intended to measure listening comprehension. Coniam (1998) examined a detailed scoring algorithm for its accuracy and usefulness in evaluating examinees' perfor-

mance. To illustrate the issue, he provided an example of how the scoring algorithm would evaluate a phrase such as what a test taker wrote for the phrase "which needed to be typed in" in a dictation test. The test taker who wrote "which are needing to be typing" should be given a partial score for that response, which the program does. But the question is, what should that partial score be and why? Should a score for this response be the same as the score awarded for "that needs to be typed" or "which needs typing" or "which needle to eyed"? This question can be addressed most adequately in view of a more refined definition of listening comprehension than what is required to evaluate responses as correct or incorrect dichotomously. A right/wrong decision requires only a simple match of the response to the target linguistic forms, and therefore circumvents the useful questions such as what makes the response correct, which responses are more correct than others, and on what basis should the test developer make such decisions?

Coniam's attempt to develop the more precise scoring method prompted him to notice the absence of a clear rationale for assignment of partial scores. "It will be noticed, though, that the scoring algorithm is, to an extent, unprincipled: 'which are needing to be typing' as the answer scores 42% while 'which are needly to be typest' scores 33%, although the latter is arguably much more incoherent" (Coniam 1998: 44). Future work attempting to score examinees' dictation responses more accurately will need to define the construct that the test is intended to measure more accurately.

Scoring vocabulary
The problem can be seen even more clearly by examining a construct more narrow than listening comprehension – vocabulary. Some researchers (e.g., Singleton & Little 1991) have attempted to assess vocabulary on the basis of examinees' responses to items on a C-test, which is constructed by deleting the second half of every other word in a text. For example, the C-test used by Chapelle and Abraham (1990) contained the following phrase containing item numbers 54, 55, and 56: "re_____ the spr_____ of infec_____". On a limited constructed response test such as this one, it is possible to anticipate and score a variety of responses that the examinees make, many of which involve errors in spelling and morphology, which are considered aspects of vocabulary knowledge. If the analysis and scoring of examinees' responses attempts to capture the relevant aspects of vocabulary knowledge, it is possible to use learners' responses to identify areas of the construct in which learners' knowledge is incorrect, incomplete, or unanalyzed, in other words, to identify aspects

Table 6.2 Responses indicating aspects of vocabulary knowledge for deriving diagnostic scores (i.e., several diagnostic scores from relevant clusters of items) (Chapelle 1993)

Type of incorrect, incomplete, or unanalyzed knowledge	Observable error	Example
Orthographic	Misspelling	diseses (# 35) (ok = diseases)
Morphemic	Inflectional error	disease (# 35) (ok = diseases)
Incorrect but analyzed morphemic[*]	Derivational error	rejuvenized (# 24) (ok = rejuvenated)
Combinatory[**]	Combinatory error	respond (# 54) (ok = resist)
Semantic	Semantic precision	spray (# 55) (ok = spread)
Derivational morphemic	Derivational error	Installing (# 22) (ok = installation)

[*] Creates a "new" word using target language morphemic rules
[**] Fits semantically but not syntactically

Table 6.3 Credit lost for errors to derive partial vocabulary item scores ranging from 0–5

Errors	Credit lost	Example
None	–0	diseases (# 35)
Misspelling	–1	deseases (# 35) (ok = diseases)
Inflectional error	–2	disease (# 35) (ok = diseases)
Derivational error (innovation)[*]	–2	rejuvenized (# 24) (ok = rejuvenated)
Semantic or combinatory[**] error	–3	spray (# 55) (ok = spread)
Derivational error (grammatically incorrect)	–3	installing (# 22) (ok = installation)

[*] Creates a "new" word using English morphemic rules
[**] Fits semantically but not syntactically

of responses that would inform diagnostic scoring, such as that illustrated in Table 6.2.

If the same aspects of vocabulary knowledge are considered in terms of how fundamental each is to the construct definition of vocabulary, the type of rationale-based partial scores that Coniam sought for listening comprehension might be explored for vocabulary ability. Table 6.3 outlines a scoring procedure whereby a score of "5" would be assigned to a completely correct response, but a particular number of points would be deducted from each item score depending on the importance of the error for the construct of vocabulary ability.

For example, word spelling is explicitly reflected in the scoring as a part of vocabulary knowledge, but as the least important relative to other areas.

Devil in the detail

The hypothetical solution for the vocabulary example exemplifies how thinking through the response analysis problem raises questions about construct definition because the rationale for the diagnostic or partial score algorithms would have to be based on the construct definition. Linking the specifics of the scoring algorithm to the construct definition offers a means of empirically tying down the theoretically unwieldy question of how detailed a construct definition should be, regardless of the aspect of vocabulary ability of interest. For example, is "reading comprehension" sufficient as a construct specification for test development, or should the definition articulate the knowledge and processes involved in reading comprehension? Most reading researchers would say that the construct should be defined in greater detail, but how much more? Discussion of the construct of reading comprehension by Bernhardt, by Grabe, and by Alderson in the volume edited by Chalhoub-Deville (1999) would suggest that the construct can be elaborated substantially beyond "reading comprehension." But how does the test developer decide how detailed the construct definition should be? The push and pull among the options for construct definition ultimately leads one back to the basic theoretical question: What is a construct?

A construct can be defined as a *meaningful interpretation of performance* (Chapelle 1998). At one level, this answer is useful because it links the construct to observable performance; a construct that fails to interpret performance or that is not meaningful, is of little interest for language testing. The link between the construct definition and performance appears to offer some grounding to an issue that might otherwise remain an open and ongoing philosophical question (i.e., what is language?). The question about detail can thus be framed not simply as how detailed a construct definition should be, but how detailed the construct needs to be in order to explain the performance on a given language test. This formulation of the question reveals test performance as a tool for exploring theoretical issues concerning construct definition. But performance serves as a tool for probing construct questions only to the extent that performance can be analyzed and evaluated in all of its relevant detail. In order for a test developer to define a construct that can be operationalized, it is necessary to have the capability to record the detail of examinees' performance. In measuring language ability, the degree of potentially relevant detail

surpasses the ability of human raters, who are best capable of making holistic judgments about overall performance level. Computer-assisted scoring is therefore essential for investigating the issues of detail for construct definition.

To date few language testing researchers have reported on attempts to develop and evaluate computer-assisted scoring of constructed responses in L2 tests although recently some research has begun in projects such as *WebLAS* at University of California at Los Angeles in the United States. Extensive research at Educational Testing Service has gone into producing an operational program, called e-rater, for rating L1 essays, and some other projects have discussed use of L1 language analysis software for rating L2 learners' writing (e.g., Reid 1986) or L1 constructed responses (Jamieson, Campbell, Norfleet, & Berbisada 1993). This work makes it clear that evidence concerning the value of computer-assisted scoring of constructed responses needs to be considered on grounds other than the efficiency-oriented research that compares reliability of scores from computer-assisted partial scoring with those of dichotomously-scored items and that relies on correlations between the two scoring methods (e.g., Henning, Anbar, Helm, & D'Arcy 1993). Instead, validation research would include theoretical rationales deriving from construct definition in addition to empirical evidence such as correlations and comparisons of reliability.

In contrast to efficiency-oriented research, scientifically-oriented research needs to be designed in a way that explicitly attempts to reveal the detail of a construct definition. This type of research is what Embretson (1983) called the study of "construct representation" which she contrasted with studies of nomothetic span, the latter of which are usually carried out through correlational studies. Studies of construct representation begin with a carefully-defined theoretical construct and seek a variety of empirical evidence to support the construct definition. These methods are the basic ones in validation research, some of which comes from cognitive psychology (e.g. Snow & Lohman 1989), but the important difference in studies of construct representation is that the primary focus of inquiry is the nature of the construct itself rather the quality of the test for measuring what is, in practice, often assumed to be the construct. In other words, like much research in linguistics with the objective of studying the nature of language, computer-assisted research on construct representation in language assessment should be a mainstay in language testing research.

Validation

The second set of issues that is highlighted through the use of computer-assisted language assessment is related to theory and practice in validation research. In educational and research testing alike, the introduction of new test methods suggests the need for validation, and requires researchers to revisit assumptions and methods associated with validation research.

Educational assessments

The question of whether or not examinees perform comparably on computer-delivered and paper-and-pencil tests is probably the most public and commonsense issue raised concerning computer-assisted testing. It has been posed and investigated as a routine, efficiency-oriented issue. When testing programs change to computer-based tests they typically take the responsibility of justifying the equivalence of new computer-assisted tests with paper-and-pencil ones. The underlying concern is expressed by researchers investigating the computer-assisted TOEFL: "If examinees are required to use a computer to take the test, their scores might reflect not only their level of English proficiency but also their level of computer proficiency" (Taylor, Kirsch, Eignor, & Jamieson 1999: 220). The threat of the computer as a potential contaminant for a genuine score of language ability is introduced in virtually any discussion of computer-assisted testing (e.g., Brown 1997; Henning 1987) and studies investigating this question are summarized by Sawaki (2001).

The problem can be addressed by a well-articulated research design that investigates the extent to which examinees score the same on a computer-delivered and a paper-and-pencil version of the same test. This design addresses whether the same construct measured in paper-and-pencil format can be measured just as well through a computer-assisted format. Framing the question this way circumvents the real issues: What should the computer-assisted language test best be designed to measure for its intended use? Do test developers really intend to use the capabilities of new technologies to measure the same language constructs as the unsophisticated language tests of the past did? As Bachman (2000) put it, in what ways does the computer-assisted test "require us to redefine the very constructs we believe we are assessing"? In previous chapters, a recurring theme has been that the constructs associated with computer-mediated language use are probably *not* the same as those required for language use in face-to-face and paper-and-pencil modes, and therefore,

one has to look beyond a validation approach that seeks to find equivalence between methods.

The challenge to this paradigm has been presented most definitively by theory in language for specific purposes (LSP) testing. Based on his research on LSP, Douglas saw the problem with the assumption that method effects on test performance should always be considered a source of error in language performance and that it should always be minimized:

> Rather than attempting to minimize method effects, ...we need to capitalize on them by designing tests for specific populations – tests that contain instructions, content, genre, and language directed toward that population.
>
> (Douglas 1998: 153)

Investigating the LSP constructs that such tests are intended to measure requires developers to look beyond the canonical view of test method as creating a negative effect. Computer-assisted test methods require an even more delicate understanding of the problem, particularly when the examinee-computer interactions are considerably different than those used to interact through other modes. In practice, few people would complain about an ESL test for flight attendants that asked examinees to use English in a role play about serving dinner while holding a tray and a pot of coffee. Yet, when a test of ESL for prospective students at North American universities requires examinees to manipulate a mouse to interact with a reading test, for example, some people worry about the potential test bias of the computer-based methods.

The potential problem for practice is an opportunity for theory: The difference between constructs measured by CALT and by other formats has to be considered from the view that computer-mediated communication may call on a different construct of communicative competence than language testing research has focused on in the past. Deconstruction of the canonical perspective of test method opens new possibilities for research on CALT methods. The most critical question for language testing research is not whether such methods reveal the same abilities as those revealed by paper-and-pencil tests, but instead whether such methods help to reveal the abilities that are valid for making the desired inferences about examinees.

Inquiry concerning desired *inferences* would focus on more clearly defining the constructs and contexts associated with computer-mediated communication. Research should investigate more fully the electronic literacy experiences of L2 users. Critical to this work is the "target language use" (TLU) context as defined by Bachman and Palmer (1996), who suggest a method for analysis of TLU contexts through the investigation of authenticity. The study of authen-

ticity focuses on the degree of match between conditions of performance on the test and those in the context of interest, i.e., the TLU context. For example, computer-assisted reading tests provide opportunities for constructing tasks which require learners to identify and highlight information in the text, or to select and rearrange information from a text. The question for an empirical authenticity study is to what extent are test takers' processes in working on such tests similar to those they use in reading in the foreign language in the contexts of interest outside the classroom. Ideas about electronic literacies abound (e.g., Haas 1996; Kern 2000; Rassool 1999; Warschauer 2000), but more basic work on second language electronic literacies from the perspective of construct validation in assessment would help to better define this construct, and provide essential conceptual work for validation theory.

Assessment in second language research

Many researchers investigating SLA rely on measures for assessing examinees' interlanguage knowledge, language processes, and strategies for language use. Results of such research form the basis of our professional knowledge, and therefore the assessments used to obtain research results are critical, yet research intended to justify the validity of inferences from such measures is relatively uncommon. Examples of papers containing the rare discussion of measurement issues are summarized in Table 6.4. They reveal some thoughtful consideration of measurement issues, but at the same time they leave one wondering exactly what the rules of the game are for measures used in SLA research. What are the accepted procedures for validation of assessment tasks in L2 research? This is an important issue for all measures used in SLA research, but in my experience, the use of technology for constructing such tasks helps to draw attention to it.

Assessments that raise questions about validity, and therefore validation methods, are those built into computer-assisted L2 tasks, which assess learners' knowledge of the language or their strategies in working with the task. Some computer-based assessments used in SLA research are the same as those implemented in paper-and-pencil format. For example, you can ask learners to respond to a grammaticality judgment task by either circling Yes or No on paper or by clicking Yes or No on the computer screen. These seem to be less controversial. The assessment tasks that seem to attract a critical eye are those that assess a construct such as a strategy while the learner is working on something else. I referred to this assessment process in Chapter 4 as making inferences about learners' capacities on the basis of their process data.

Table 6.4 Examples of measures whose validity has been discussed in the SLA literature

Construct	Measurement	Discussion
Syntactic knowledge	Grammaticality judgements	Birdsong 1989; Chaudron 1983b; Davies & Kaplan 1998; Gass 1994; Goss, Ying-Hua, & Lantolf 1994; Munnich, Flynn, & Martohardjono 1994
Syntactic knowledge	Elicited Imitation	Bley-Vroman & Chaudron 1994; Kruse, Pankhurst, & Sharwood Smith 1987; Munnich, Flynn, & Martohardjono 1994
Organization of mental lexicon	Word Association Test	Meara 1978, 1984; Sharwood Smith 1984;
Vocabulary processes	C-test	Chapelle 1994b; Singleton & Little 1991
Affect	Attitude/Motivation Test Battery	Gardner & Glicksman 1982; Oller 1982
Field independence/dependence	Group Embedded Figures Test	Chapelle 1992; Chapelle & Green 1992; Griffiths & Sheen 1992; Sheen 1993; Skehan 1998

Such a measure is described by Hegelheimer and Chapelle (2000), who suggest the use of data recorded on learners' mouse clicks on vocabulary as a measure of their noticing particular words in the text. In a study of acquisition of vocabulary from on-line reading materials, one might hypothesize that those words that the learner clicked to see annotations might be more likely to be learned over the course of the semester, in keeping with noticing theory. Such a study would gather data such as the hypothetical data in Table 6.5. In the second column, a "1" would be recorded if learners requested to see an annotation on the word "Dalmatian" while reading a text, and "0" would be recorded if they did not. The summary in the third column would consist of a "1" if a learner had clicked to see an annotation in any one of the four passages, and in the fourth column is the score on the post-test item testing knowledge of that word. We would then like to see if there is any relationship between clicking on the words and their knowing the word on the posttest – and these data would allow for that.

When people see this suggested measure, they want proof that the mouse clicks really mean noticing, despite the fact that other assessments of noticing have offered no such proof! The technology-mediated task seems to attract more suspicion and therefore require proof. Noticing has been assessed in SLA

Table 6.5 Records of mouse clicks for 6 learners on "Dalmatian" over four weeks, a summary score, and post test scores for the "Dalmatian" item

Learner ID	Mouse clicks on Dalmatian in four readings[1]	Summary of mouse clicks[2]	Post-test item score for Dalmatian[3]
Reader01	1, 1, 0, 0	1	1
Reader02	0, 0, 0, 0	0	0
Reader03	1, 0, 0, 0	1	1
Reader04	0, 0, 1, 1	1	1
Reader05	1, 1, 1, 1	1	1
Reader06	0, 0, 0, 0	0	0

[1] A "1" indicated that the learner clicked on "Dalmatian" at least once while reading a passage; a "0" indicates that the learner did not click on "Dalmatian." The four entries consist of one for each of the passages containing the word "Dalmatian."

[2] Mouse clicks across the four readings are summarized using the same notation.

[3] On the posttest, if the learners answered the question asking the meaning of "Dalmatian" correctly, they would receive an item score of "1." An incorrect response would receive a score of "0."

studies by having learners underline on paper to indicate lack of comprehension or give retrospective accounts of what they noticed, for example (Izumi & Bigelow 2000; Jourdenais, Ota, Stauffer, Boyson, & Doughty 1995). These assessments as well as others used in SLA research are based on this same inferential process – observed data are used to make an inference about something unobserved. What is interesting about novel technology-based assessments is that they seem to sharpen our critical eye for questioning the justification of the inference.

In short, an expanded set of methods for gathering SLA data raises the question of what the data measure, which in turn problematizes the issue of what should be accepted as validity evidence. I believe that this line of thinking will prompt more and more researchers to look toward current perspectives in measurement – and this is a good thing.

Validation and consequences

Researchers and teachers worry that examinees with little or no experience with computers will suffer from heightened test anxiety when they are asked to take a computer-based test. This was part of the reason for assessing the degree of computer experience of TOEFL examinees prior to the launch of the computer-based version in the late 1990's (Taylor, Jamieson, & Eignor 2000). The results of this research suggested that ESL learners world-wide were not

without computer experience, but that such experience was not uniform across regions. The data showed differences in computer experience, but they also invited further investigation of the meaning and significance of these differences – investigation that entails examination of the consequences arising from computer-assisted testing.

Research on consequences is recommended by current validation theory, which is concerned with consequences on individuals as well as on language classes and programs. Research on the consequences of technology should seek to document and investigate some of the concerns that have been raised about negative effects of technology. It is one thing to speculate on the effects of technology on examinees who have little experience with computers, but it is another thing to demonstrate through empirical research that such negative effects actually exist. Some researchers have included anecdotal evidence concerning anxiety and the use of CALT, but like research on computer-assisted learning, research might incorporate more systematic examination of anxiety toward technology-mediated tests.

Validation theory suggests that consequences should include not only the negative effects that might result from CALT but the potential positive influences as well. An example of the positive influence would be the idea that technology should play an important role in instructional contexts because it can increase computer literacy in addition to literacy in English, and that both literacies are important. Those who focus their CALL research on the impacts of CALL emphasize the need to examine "how computer-mediated language and literacy practices are shaped by broader institutional and social factors, as well as what these new practices mean from the perspective of the learner" (Warschauer 1998:760). Questions about the impact of computer-assisted practices in testing might also consider such questions. In short, validation theory prompts future research not only to document negative consequences of CALT but also to envisage and investigate its potential positive consequences. Positive consequences of using technology in language assessment may also include the advantage learners could gain from being prompted to learn to use computers. The need to prepare learners for a high-stakes, computer-assisted test might encourage teachers to help learners become computer literate, and may encourage language programs to maintain up-to-date computers and opportunities for computer literacy (Chapelle 2001a).

Conclusion

The panorama of theoretical issues departs dramatically from the efficiency-oriented tunnel that has typically been associated with computer-assisted language testing. Table 6.6 summarizes paths for research that might fruitfully use technology as a tool for investigating theoretical approaches to construct definition, as a motivation for questioning validation methods and uses, and as a starting point for considering the potential positive consequences of tests for learners.

All of the issues that technology-mediated language assessment raise can be swept aside by the broom of efficiency. If design issues are considered on the basis of the most expedient way to test and score with the only criterion being correlations with other measures, there is no time or place for the theoretical issues of construct definition. If validation is conducted on the basis of correlations between computer-based tests and paper and pencil tests intended to measure the same construct (defined in a summary fashion), no progress will be made in refining validation theory. If technology based tests – or any tests – are accepted or dismissed without considering their validity, no progress will be made in SLA research. In short, researchers and test developers who apply twenty-year old knowledge of the basics of testing to the poten-

Table 6.6 Summary of implications for language testing research from CALT practice

Validity issue	Implications for research from CALT practice
Defining language constructs	Explore the design of technology-mediated tasks in connection with construct definition.
	Design research that reveals the detail hypothesized in a construct definition.
	Explore methods for estimating the reliability of components of a construct.
	Develop a validity argument using theoretical as well as empirical rationales.
Investigating validity	Design research to clarify the constructs associated with computer mediated communication.
	Investigate how and when language users engage in computer-mediated communication beyond the test setting.
	Question how validity is justified in SLA research.
Exploring consequences	Investigate the extent to which anxiety is an important factor for examinees who take computer-delivered tests.
	Explore critical approaches to investigating a larger range of positive and negative testing consequences.

tials of technology-mediated language testing are likely to only achieve more efficient tests.

This achievement would fulfill what Canale (1986) described as the threat of computer-adaptive language testing almost 20 years ago. He described the threat as an efficiency-oriented path for research and development, which would be potentially "trivializing," "compromising" and "reductionist" because it would treat language constructs as unanalyzeable and unidimensional in order to create shorter, reliable tests (Canale 1986: 34–35). Many years later, it would *not* be accurate to say that the worst form of this threat has become a reality. At the same time, the promise Canale sketched remains almost beyond current sights. He suggested that CALT should be able to take advantage of research on intelligent tutors to develop tests that provide teachers and learners with informative feedback about performance. Today, as in 1986, much theoretical and empirical work is needed to bridge from current technological capabilities to progress in language assessment. The first step, it appears, is to set aside efficiency as the primary criterion in CALT research in order to seek solutions to the substantive issues of construct definition and validation.

The imperative for applied linguistics and technology

> Dear Prof. Chapelle,
>
> I am a student just beginning my thesis on the topic of using computer for language teaching. I have read some articles about this, but maybe you can help me by suggesting a specific topic that I could study for my research.
>
> I do hope it's not too much to ask if you could spare some time and let me know what you think. It would be so helpful.

To begin this final brief chapter, I return to my e-mail, where messages such as the one above appear regularly. Unlike many of the messages I receive daily, this type of message is not annoying, but like many of the messages I receive, it is frustrating. This type of message is frustrating because I would like to be able to start a student like this on a path of fruitful inquiry in applied linguistics, but I do not have any illusion of being able to do so in the amount of time I have available to respond to the question. At the same time, I understand completely the motivations and frustration of that student who sent the question. Having read a variety of articles on CALL in the professional journals, he or she would be likely to feel extremely confused about what the issues are and what the appropriate methods are for investigating them.

In this book, I have attempted to outline some productive directions for future inquiry into issues at the intersection of applied linguistics and technology with emphasis on English language learning. The primary message throughout the book has been that technology is changing practices of applied linguists in ways that prompt the need to conceptualize them and study them explicitly. The sense of urgency and imperative for English language teachers and researchers echoes the voices of authors over the past 20 years in the many books and edited collections that have appeared on this topic. While the urgency should seem comfortably familiar to those with knowledge of CALL, the direction of the imperative is somewhat different. Whereas much of the previous work on technology for English learning and assessment has proudly focused on issues of practice – such as building an authentic multimedia pro-

gram, a motivating collaborative activity, or a shorter test – future work needs to embrace with at least equal conviction issues of theory.

I have discussed only some of the many theoretical issues underlying applied linguistics that might be probed more deeply through inclusion of technology into existing research agendas. In particular, I have highlighted the need to consider the theoretical issues of language use with technology, language acquisition through technology, and language assessment through technology. I have also emphasized the need to do so by setting aside (without losing sight of) the practice-oriented issues of efficiency and the immediate needs of the classroom and language learners. The theme of the need for theory-focused research to complement practice-focused research is stated most forcefully in the final two chapters, where the emphasis is on how technology is used as a tool for developing new theoretical insights, but this theme should be evident throughout.

English language use

In the first chapter, I noted the multifaceted issues raised through examination of English language learners' use of technology for communication in English. The practice-oriented message in this chapter might be construed as a warning that practitioners keep up-to-date with technology to keep up-to-date with their students and the profession. This is a message that one can find motivating almost every book on language teaching and technology over the past 20 years. The complementary theory-focused message is that the intersection of technology and language may change important concepts underlying work in applied linguistics such as communicative language ability, grammatical analysis, and registers of English language use, as well as the tools available to teachers. To begin to study these issues, however, one has to move beyond the assumption that issues associated with language and technology are normal and unworthy of investigation.

If one moves beyond this assumption, other assumptions can underlie research on technology and English language issues. Table 7.1, summarizing the perspectives mentioned in Chapter 1, includes the technology-as-normal idea in addition to the three perspectives described in Chapter 1. As shown in the table, each approach to technology entails a different assumption about technology, and in turn is likely to produce a particular type of results.

Research focusing on L2 English use in the high-tech world of the future has not been evident in applied linguistics. Such work would use of qualita-

Table 7.1 Assumptions about technology and results of four approaches to technology and language use

Approach	Assumption about technology and language use	Results
Research without any focus on technology	The issues at the intersection of language and technology are normal, unremarkable, and not worthy of investigation.	No insights about technology and language use
Focus technological possibilities	Learners will have the opportunity and need to interact with linguistically very sophisticated technologies.	Knowledge about how learners interact with sophisticated technology that might inform future technology
Focus on pragmatic reality	Current technologies and their use should be the object of investigation.	Knowledge about how learners interact with existing technology
Focus on critical analysis	The technology agenda of business, government, and universities should be questioned.	Insight about what aspects of linguistic and cultural knowledge are amplified and diminished through the intersection of language and technology

tive methods to describe the way that English learners interact with technology through language, for example. More prevalent has been the study of learners' English use through existing widespread technologies that learners have easy access to at the moment. The example of this type of work that I described in Chapter 1 was a study by Lam (2000) that examined a learner's language practices in an Internet community that he himself had chosen and that had nothing to do with any formal instruction in English. Despite this illuminating type of ethnographic work, plenty of questions remain concerning how current technologies change the English language use and experience that learners engage in, and how technology-mediated registers of language use affect communicative language ability. The assumption underlying the critical perspective – that technology and those who promote it should be questioned – opens the door to a range of research issues whose investigation might lead to a better understanding of the ways in which technology shapes the English language experience of learners.

In short, the range of potential research issues associated with technology and language learning is very broad, and the questions differ depending on the

perspective of the researcher, but none of the potential research questions is evident unless technology is viewed as, on the one hand, a choice that learners can make and, on the other hand, as significantly shaping the linguistic choices that they can make. In view of the potential importance of the intertwined language-technology resource, applied linguists should not let the changes in the profession's fundamental concepts pass by unnoticed. In many places in which English is spoken, technology risks becoming invisible unless applied linguists attempt to expose it, and subject it to study. I have argued that fruitful approaches to its study require weighing multiple perspectives on the fundamental changes in technology-using society as they affect English language teaching and research.

Second language acquisition

Chapters 2, 3, and 4 are built on the assumption that language learning through technology can best be designed and evaluated through the perspectives that are used to study instructed SLA. Detailed perspectives on how learning is most likely to take place are needed if specific decisions about learning tasks are to be developed. Chapter 2 presented a number of specific implications for designing opportunities for input, interaction, and production in CALL tasks. These were based primarily on theory and research from second language classroom research, but some support for these specific decisions was also found in studies of CALL. The use of theory, hypotheses, and methods from SLA research was again evident in Chapters 3 and 4, in which analytic and evaluative perspectives helped to move beyond simplistic notions that technology should be evaluated solely through comparisons with outcomes attained through classroom instruction.

Alternatives to CALL-classroom comparison

Chapter 3 revisited the well-worn conversation about the value of research comparing CALL with classroom instruction. Rather than making the academic argument again, I considered why the idea of such research dies so hard, the reason apparently being that some people seem to think that a case needs to be made for technology in language teaching. Without questioning the possibility that such a case might sometimes be needed, I pointed out observations from my own experience of working in higher education in the United States that suggests that decisions about the availability of technology for lan-

Table 7.2 Assumptions about technology and results of four approaches to research on technology and language learning

Approach	Assumption about research on technology for language learning	Results
Classroom comparison	Need to make a case for technology	Comparison of outcomes from two unanalyzed modes of instruction
Focus on software	Need to identify effective instructional strategies	Evidence about differential effects of two instructional design choices
Focus on learners	Need to investigate what learners do while they work on an L2 task	Evidence about how fully and successfully the learner engaged in the L2 task
Focus on tasks	Need to investigate the effects of task design choices	Evidence about how successful various task design choices are

guage teachers and learners have more to do with other matters than with a case that might be made from the results of CALL research. If the audience for CALL research is seen as our own profession of applied linguistics rather than as someone who needs to be convinced of the value of technology (relative to classroom instruction) for language learning, more fruitful paths for research can be developed.

Table 7.2 outlines the assumptions and potential results associated with what I would consider to be more pertinent research areas than the CALL-classroom comparison that assumes a case needs to be made for technology. I argued that the CALL designer, learner, and teacher require different kinds of research results in order to make the best use of technology. I illustrated how one might usefully conceptualize such research for focusing on software, learners, and tasks, and therefore, this chapter was intended to offer a way forward to the student whose e-mail appears at the beginning of the chapter. Chapter 4 expanded on how one might focus on the learner to examine ways of investigating learner performance through records of learners' work on L2 learning tasks. Again, in this chapter the intention was to explore potential methods with an eye to clarifying the analytic alternatives. The point in both of these chapters was to articulate the conceptual issues, and therefore I highlighted what can be gained from the positive aspects of the design of such studies.

Improving the alternatives

One might also look at the same studies from the other perspective – what they fail to do methodologically. Not only were many of the studies very small scale, but each was limited by the extent to which it drew fully on applied linguistics. This is where enormous scope exists for extending our understanding to technology for language learning. In Chapter 1, I mentioned the research of Cowan, Choi, and Kim (2003) who had drawn on contrastive analysis of linguistic structures followed by corpus analysis of learners' ESL writing to identify aspects of syntax for which learners need additional instruction. This process of identifying what needs to be taught to specific learners would add significantly to research on CALL. The research described in Chapter 3 relied on pretests, teachers' intuition, and learners' linguistic choices to identify areas for instruction. Although these methods are valid to some extent, a more rigorous, and more theoretically interesting design would target areas of instruction in a more systematic and justifiable way.

Chapter 5 argued that research with theoretical implications for applied linguistics is a worthy goal for researchers investigating technology and language learning. It illustrated the ways in which the study of technology-mediated tasks (1) adds tools for task development so that existing task constructs can be operationalized, (2) challenges current task theory, and (3) prompts reconsideration of assessment issues. These three advances were intended to illustrate the benefits to be gained by conceptualizing technology-mediated learning through the constructs and methods of applied linguistics. However, these are obviously not the only constructs in applied linguistics that are relevant. The grammatical principles underlying contrastive analysis, psycholinguistic factors central to interactionist theory, and social, historical and identity concerns associated with sociocultural theory can all play out in interesting and theoretically revealing ways if research is designed with them in mind.

Only through explicitly drawing connections between CALL research and applied linguistics is technology likely to serve as a tool to press theory in a way that strengthens synergy between theory and practice. Synergy is desperately needed today and will be even more so in the future. Any one who has spent enormous amounts of time developing CALL software can attest to the empty feeling of uncertainty he or she feels about the tentative basis upon which instructional design decisions are made. CALL needs to be studied for the purpose of increasing knowledge in this area rather than solely for developing and using CALL in the immediate future. Drawing connections between CALL and

Table 7.3 Assumptions about technology and results of tunnel, comparison, and innovation approaches

Approach	Assumption about technology in assessment	Results
Tunnel	It is an efficiency	Short tests with automatic scoring and delivery of results for existing test uses
Comparison	It should be considered suspect	A variety of types of tests for existing test uses; knowledge about how technology affects traditional tests when they are delivered on-line
Innovation	It should be considered a resource	A variety of types of tests and new test uses; knowledge about the intersection of technology with a variety of assessment issues

applied linguistics is unlikely to be accomplished by people whose sights are set only to the attainment of greater efficiency in practice.

Second language assessment

Chapter 6 argued that research in computer-assisted second language assessment is at least equally in need of steering clear of the tunnel of efficiency which threatens to bypass the serious questions about language ability and technology. In language assessment in particular, technology can clearly amplify issues and provide tools needed to better understand the central theoretical questions. Kurzweil's idea of the law of increasing chaos, introduced in Chapter 1, suggested that as the order in understanding our domain increases, time speeds up. This was his way of saying that the amount of time between significant discoveries decreases. If any area of applied linguistics holds potential for speeding up understanding of the constructs central to the field as a whole, it is language testing. To make such advances, however, the approaches that can be taken to investigation of technology for language assessment need to be recognized. Table 7.3 outlines three approaches, with their associated assumptions, and potential results.

The tunnel approach refers to Brown and Duguid's characterization of the technologist's world in which technologies work toward efficiency. The results obtained through such an approach would be expected to be short tests with automatic scoring and delivery of results for existing test uses. A comparison

approach in contrast treats the technology as suspect, investigating the extent to which real performance differences are evident across different modes of test presentation. Such research begins to investigate the important issues of language testing; moreover, it prompts researchers to consider the issues more carefully. For example, the researcher who finds differences in performance across testing modes has to decide what such differences mean for the quality of measurement of both tests.

Finally, an innovation approach treats technology as a resource that opens new possibilities for testing practice and tools for research. The innovation-oriented questions that Corbel (1993) laid out years ago have barely begun to adressed: "Can the use of . . . [computer-generated] profiles provide some way of reflecting the multidimensionality of language proficiency? Can information of diagnostic value be captured? Is it usable and relevant to internal and external audiences? How reliable are the components of profiles" (Corbel 1993: 53)? Moreover, it is evident that steps toward addressing these questions require carefully-articulated links between practice and construct theory.

Every chapter of this book has touched on the importance of our understanding of the nature of the language abilities in the age of technology. In no other area of applied linguistics is the discussion about the best ways of conceptualizing language ability discussed in such a pointed and empirically-based way as it is in language assessment (e.g., Bachman 2002a, 2002b; Norris, Brown, Hudson, & Bonk 2002). As a consequence, it appears that the most promising means of increasing knowledge of these constructs is through theory and research guided by language assessment, at least insofar as language testing researchers heed the warning of the social pragmatists who were worried about tunnel vision: "The way forward is paradoxically to look not ahead, but to look around" (Brown & Duguid 2000: 8).

Conclusion

Fruitful investigation of all three of these areas requires the researcher to step back from the obvious, and to reconsider the assumptions underlying popular, common-sense perspectives. Use of language through technology needs to be recognized as significantly and interestingly different if learners' technology use is to be studied. CALL vs. classroom comparison studies need to be recognized as reductionist attempts to make a case for technology in societies where technology has already been sold many times over. Research targeting more efficient tests needs to be exposed as undermining the broader, at least

equally important agenda of language testing research. When I receive a message like the one at the beginning of this chapter, I suspect that the writer has not begun to reconsider the issues. Most likely he is writing to me because he took an instructional technology course in addition to the required courses for a degree in TESOL and applied linguistics. The TESOL courses did not touch on technology, and the instructional technology course did not deal with issues in CALL.

This reality sits strangely alongside predictions about the pervasive role of future generations of technology – predictions implying that great strides are expected to take place in software design and use. In view of current knowledge and research, it is not immediately evident how such big steps are likely to be taken. It seems that significant, focused work needs to be undertaken if sophisticated software for language learning and assessment is to become the new reality in the future. The vision of such progress will pull researchers into the detail of operational definitions and theoretical constructs, and it will prompt them to use technology to help to think about the issues.

Popular discourse, common sense, and commercial interests add confusing noise to what can and should be a clearly focused path of complementary theory and research. I hope these chapters have successfully argued that the issues at the intersection of applied linguistics and technology are both important for the profession and unlikely to be probed, understood, and developed by those who study either applied linguistics or technology separately. Rather it is necessary to develop this area of inquiry through a combination of knowledge about applied linguistics and technology.

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