Psychology Press

THE PSYCHOLOGY OF LANGUAGE

FROM DATA TO THEORY

TREVOR A. HARLEY

FOURTH EDITION

THE PSYCHOLOGY OF LANGUAGE

Now in full color, this fully revised edition of the best-selling textbook provides an up-to-date and comprehensive introduction to the psychology of language for undergraduates, postgraduates, and researchers. It contains everything the student needs to know about how we acquire, understand, produce, and store language.

Whilst maintaining both the structure of the previous editions and the emphasis on cognitive processing, this fourth edition has been thoroughly updated to include:

- the latest research, including recent results from the fast-moving field of brain imaging and studies
- updated coverage of key ideas and models
- an expanded glossary
- more real-life examples and illustrations.

The Psychology of Language, Fourth Edition is praised for describing complex ideas in a clear and approachable style, and assumes no prior knowledge other than a grounding in the basic concepts of cognitive psychology. It will be essential reading for advanced undergraduate and graduate students of cognition, psycholinguistics, or the psychology of language. It will also be useful for those on speech and language therapy courses.

The book is supported by a companion website featuring a range of helpful supplementary resources for both students and lecturers.

Trevor A. Harley is Dean of Psychology and Chair of Cognitive Psychology at the University of Dundee, Scotland. He was an undergraduate at the University of Cambridge, where he was also a PhD student, completing a thesis on slips of the tongue and what they tell us about speech production. He moved to Dundee from the University of Warwick in 1996. His research interests include speech production, how we represent meaning, and the effects of aging on language.

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PREFACE TO THE FOURTH EDITION

I started writing this fourth edition with mixed feelings. On the positive side, it is an honor and a delight to be able to write the fourth edition of something. It must also mean that someone is reading it. I also welcomed the chance to make the book better in every way. On the less positive side, it is a huge amount of work.

Apart from updating references and key ideas and models, I have two main aims in this new edition.

Students often find cognition in general difficult and say it is the part of their psychology degree that they like least, but the psychology of language in particular is feared and disliked. I have, I'm almost ashamed to say, only really come to appreciate how much many students dislike it over the last few years. I can't help feeling a bit responsible for this fear: one fair criticism of previous editions of this book is that students find it difficult. It contains a lot of material, perhaps too much. (For those struggling I am biased, but I recommend reading my own book *Talking the Talk* (Harley, 2010) first.) What is more there is a balance to be had between making texts informative with respect to sources (and of course avoiding plagiarism and giving due credit) but making them so reference dense it puts the student off. I fear earlier editions have been reference dense, so I've tried to be lighter in this edition. (This strategy is not without its risk, so if any author or researcher feels I have slighted them, please let me know.)

Therefore my first aim is to make this edition easier and more approachable, and to try to stimulate students into finding psycholinguistics interesting and important. I try to do this explicitly in the first chapter, but you can't persuade someone something is good just by telling them; you have to show it. The resulting book is a compromise between making the subject fun and relevant and depth and perhaps even rigor of coverage. I have learned that you can't please all reviewers, so though some teachers will approve the easier approach, others might bemoan the lack of detail that was in the earlier editions.

Why do students dislike the subject and find it difficult? I think there are several reasons. First, it seems very abstract. I have tried to point out as many applications of the subject as possible, and to give as many concrete examples as I can. Second, they think the subject is full of jargon—which it is. I am surprised to discover how many students are unclear what a noun is, so no wonder they find parsing difficult. I have therefore tried to reduce the jargon and make sure all terms are explained. There is a glossary that should help. Third, perhaps most oddly, they don't like or see the point in models, and psycholinguistics has more models per square page than any other discipline I know. Fourth, psycholinguists rarely come to definitive conclusions—usually at any one time in any one area there are two opposing models out there battling it out. I've tried to stress why models are important, and point out that in cutting-edge science we sometimes have to live with uncertainty.

The field has changed a great deal over the last few years as a result of results from brain imaging, particularly fMRI studies. My second aim therefore is to incorporate as much as is possible of this exciting new research into the book where relevant. Some might know that I am skeptical about what brain imaging can offer cognitive

psychology; I have tried not to let this skepticism affect this revision. Most researchers believe that brain imaging has greatly advanced our understanding of psycholinguistics over the last decade.

Technology has changed for the better, too, making writing books much easier. Writing the first edition involved constant trips to the library and much photocopying. In this edition I could read every reference I wanted at the luxury of my desk thanks to Google and electronic journals. I wrote the first draft of this book using the wonderful Scrivener 2.0 on a Mac, and then finished it in Pages.

There is a website associated with this book. It contains links to other pages, details of important recent work, and a "hot link" to contact me. It is to be found at: http://www.psypress.com/cw/harley. I still welcome any corrections, suggestions for the next edition, or discussion on any topic. My email address is now: t.a.harley@dundee.ac.uk. Suggestions on topics I have omitted or under-represented would be particularly welcome. The hardest bit of writing this book has been deciding in what to leave out. I am sure that people running other courses will cover some material in much more detail than has been possible to provide here. I would be interested to hear, however, of any major differences of emphasis. If the new edition is as successful as the third, I will be looking forward (in a strange sort of way) to producing the fifth edition in five years' time.

I would like to thank all those who have made suggestions about one or more of the previous editions, particularly Jeanette Altarriba, Gerry Altmann, Elizabeth Bates, Paul Bloom, Helen Bown, Peer Broeder, Gordon Brown, Hugh Buckingham, Annette de Groot, Lynne Duncan, the Dundee Psycholinguistics Discussion Group, Andy Ellis, Gerry Griffin, Zenzi Griffin, Francois Grosjean, Evan Heit, Laorag Hunter, Lesley Jessiman, Barbara Kaup, Alan Kennedy, Kathryn Kohnert, Annukka Lindell, Nick Lund, Siobhan MacAndrew, Nadine Martin, Randi Martin, Elizabeth Maylor, Don Mitchell, Wayne Murray, Lyndsey Nickels, Jane Oakhill, Padraig O'Seaghdha, Shirley-Anne Paul, Martin Pickering, Julian Pine, Ursula Pool, Eleanor Saffran, Lynn Santelmann, Marcus Taft, Jeremy Tree, Roger van Gompel, Carel van Wijk, Alan Wilkes, Beth Wilson, Suzanne Zeedyk, and Pienie Zwitserlood. I would also like to thank several anonymous reviewers for their comments; hopefully you know who you are. Numerous people pointed out minor errors and asked questions: I thank them all. George Dunbar created the sound spectrogram for Figure 2.1 using MacSpeechLab. Lila Gleitman gave me the very first line; thanks! Katie Edwards, Pam Miller, and Denise Jackson helped me to obtain a great deal of material, often at very short notice. This book would be much worse without the help of all these people. I am of course responsible for any errors or omissions that remain. If there is anyone else I have forgotten, please accept my apologies. Many people have suggested things that I have thought about and decided not to implement, and many people have suggested things (more connectionism, less connectionism, leave that in, take that out, move that bit there, leave it there) that are the opposite of what others have suggested.

In particular the writing of this edition was made immeasurably easier by spending time in the glorious environment of the University of California, San Diego. I wish to thank everyone there from the bottom of my heart, particularly my hosts Tamar Gollan and Vic Ferreira.

I would also like to thank Psychology Press for all their help and enthusiasm for this project. Finally, I would like to thank Brian Butterworth, who supervised my PhD. He probably doesn't realize how much I appreciated his help; without him, this book might never have existed.

Finally, I hope that any bias there is in this book will appear to be the consequence of the consideration of evidence rather than of prejudice.

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HOW TO USE THIS BOOK

This book is intended to be a stand-alone introduction to the psychology of language. It is my hope that anyone could pick it up and finish reading it with a rich understanding of how humans use language. Nevertheless, it would probably be advantageous to have some knowledge of basic cognitive psychology. (Some suggestions for books to read are given in the "Further reading" section at the end of Chapter 1.) For example, you should be aware that psychologists have distinguished between short-term memory (which has limited capacity and can store material for only short durations) and long-term memory (which is virtually unlimited). I have tried to assume that the reader has no knowledge of linguistics, although I hope that most readers will be familiar with such concepts as nouns and verbs. The psychology of language is quite a technical area full of rather daunting terminology. I have defined technical terms and italicized them when they first appear. There is also a glossary with short definitions of the technical terms.

Connectionist modeling is now central to modern cognitive psychology. Unfortunately, it is also a topic that most people find extremely difficult to follow. It is impossible to understand the details of connectionism without some mathematical sophistication. I have provided an appendix that covers the basics of connectionism in more mathematical detail than is generally necessary to understand the main text. The general principles of connectionism can, however, probably be appreciated without this extra depth, although it is probably a good idea to look at the appendix.

In my opinion and experience, the material in some chapters is more difficult than others. I do not think that there is anything much that can be done about this, but to persevere. Sometimes comprehension might be assisted by later material, and sometimes a number of readings might be necessary to comprehend the material fully. Fortunately, the study of the psychology of language gives us clues about how to facilitate understanding. Chapters 7 and 11 will be particularly useful in this respect. It should also be remembered that in some areas researchers do not agree on the conclusions or on what should be the appropriate method to investigate a problem. Therefore it is sometimes difficult to say what the "right answer," or the correct explanation of a phenomenon, might be. In this respect the psychology of language is still a very young subject.

The book is divided into sections, each covering an important aspect of language. Section A is an introduction. It describes what language is, and provides essential background for describing language. It should not be skipped. Section B is about the biological basis of language, the relationship of language to other cognitive processes, and language development. Section C is about how we recognize words. Section D is about comprehension: how we understand sentences and discourse. Section E is about language production, and also about how language interacts with memory. It also examines the grand design or architecture of the language system. This final section concludes with a brief look at some possible new directions in the psychology of language.

Each chapter begins with an introduction outlining what the chapter is about and the main problems faced in each area. Each introduction ends

with a summary of what you should know by the end of the chapter. Each chapter concludes with a list of bullet points that gives a one-sentence summary of each section in that chapter. This is followed by questions that you can think about either to test your understanding of the material, or to go beyond what is covered, usually with an emphasis on applying the material. If you want to follow a topic up in more detail than is covered in the text (which I think is quite richly referenced, and should be the first place to look), then there are suggestions for further reading at the very end of each chapter.

One way of reading this book is like a novel: start here and go to the end. Section A should certainly be read before the others because it introduces many important terms, without which later going would be very difficult. I certainly recommend starting with Chapter 1. After that, alternative orders are possible, however. I have tried to make each chapter as self-contained as possible, so there is no reason why the chapters cannot be read in a different order. Similarly, you might choose to omit some chapters altogether. In each case you might find you have to refer to the glossary more often than if you just begin at the beginning. Unless you are interested in just a few topics, however, I advise reading the whole book through at least once. Each chapter looks at a major chunk of the study of the psychology of language.

OVERVIEW

Chapter 1 tells you about the subject of the psychology of language. It covers its history and methods. Chapter 2 provides some important background on language, telling you how we can describe sounds and the structure of sentences. In essence it is a primer on phonology and syntax.

Chapter 3 is about how language is related to biological and cognitive processes. It looks at the extent to which language depends on the presence and operation of certain biological, cognitive, and social precursors in order to be able to develop normally. We will also look at whether animals use language, or whether they can be taught to do so. This will also help clarify what we mean by language. We will look at how language is founded in the brain, and how damage to the brain can lead to distinct types of impairment in language. We will look in detail at the more general role of language, by examining the relation between language and thought. We will also look at what can be learned from language acquisition in exceptional circumstances, including the effects of linguistic deprivation.

Chapter 4 examines how children acquire language, and how language develops throughout childhood. Chapter 5 examines how bilingual children learn to use two languages.

We will then look in Chapter 6 at what appear to be the simplest or lowest level processes and work towards more complex ones. Hence we will first look at how we recognize and understand single words. Although these chapters are largely about recognizing words in isolation in the sense that in most of the experiments we discuss only one word is present at a time, the influence of the context in which they are found is an important consideration, and we will look at this also.

Chapter 7 looks at how we recognize words and how we access their meanings. Although the emphasis is upon visually presented word recognition, many of the findings described in this chapter are applicable to recognizing spoken words as well. Chapter 8 examines how we read and pronounce words, and looks at disorders of reading (the dyslexias). It also looks at how we learn to read. Chapter 9 looks at the speech system and how we process speech and identify spoken words.

We then move on to how words are ordered to form sentences. Chapter 10 looks at how we make use of word order information in understanding sentences. These are issues to do with syntax and parsing. Chapter 11 examines how we represent the meaning of words. Chapter 12 examines how we comprehend and represent beyond the sentence level; these are the larger units of discourse or text. In particular, how do we integrate new information with old to create a coherent representation? How do we store what we have heard and read?

In Chapter 13 we consider the process in reverse, and examine language production and its

disorders. By this stage we will have an understanding of the processes involved in understanding language, and these processes must be looked at in a wider context (Chapter 14).

In Chapter 15 we will look at the structure of the language system as a whole, and the relation between the parts. Finally, Chapter 16 looks at some possible new directions in psycholinguistics.

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SECTION A

INTRODUCTION

This section describes what the rest of the book is about, discusses some important themes in the psychology of language, and examines some important concepts used to describe language. You should read this section before the others.

Chapter 1, The study of language, looks at the functions of language and how the study of language plays a major role in helping to understand human behavior. We look at what language is and what it is used for. After a brief look at the history and methods of psycholinguistics, the chapter covers some current themes and controversies in modern psycholinguistics, including modularity, innateness, and the usefulness of brain imaging, and studies involving people with brain damage, for looking at language.

Chapter 2, Describing language, looks at the building blocks of language—sounds, words, and sentences. The chapter then examines Chomsky's approaches to syntax and how these have evolved over the years.

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CHAPTER 1

THE STUDY OF LANGUAGE

INTRODUCTION

What's the best joke you've heard? I find it difficult to remember any (and very few that can be put into print), but a search through Google of "best joke in the world" throws up this gem:

> *A couple of New Jersey hunters are out in the woods when one of them falls to the ground. He doesn't seem to be breathing, his eyes are rolled back in his head. The other guy whips out his cell phone and calls the emergency services. He gasps to the operator: "My friend is dead! What can I do?" The operator, in a calm soothing voice, says: "Just take it easy. I can help. First, let's make sure he's dead." There is a silence, then a shot is heard. The guy's voice comes back on the line. He says: "OK, now what?"*

Well, I must admit that one did make me laugh. Why is it funny? Notice how much the joke depends on language, in every way.

What was the last thing you said? The last thing you heard? The last thing you read? And the last thing you wrote? How did your brain do these things?

Think of the steps involved in communicating with other people. We obviously must have the necessary biological hardware: We need an articulatory apparatus that enables us to make the right sort of sounds, and of course we also need a brain to decide what to say, how to say it, and to make the components of the articulatory apparatus move at just the right time. We also need a language complex enough to convey any possible message. We need to know the words and how to put the words in the right order. Young children somehow acquire this language. Finally, we have to be aware of the social setting in which we produce and understand these messages: We need to be aware of the knowledge and beliefs of other people, and have some idea of how they will interpret our utterances. The subject matter of this book is the psychological processing involved in this sort of behavior.

Although we usually take language for granted, a moment's reflection will show how important it is in our lives. In some form or another it so dominates our social and cognitive activity that it would be difficult to imagine what life would be like without it. Indeed, most of us consider language to be an essential part of what it means to be human, and it is largely what sets us apart from other animals. Our culture and technology depends on it. Crystal (2010) describes several functions of language. The primary purpose of language is of course to communicate, but we can also use it simply to express emotion (e.g., by swearing), for social interaction (e.g., by saying "bless you!" when someone sneezes), to make use of its sounds (e.g., in various children's games), to attempt to control the environment (e.g., magical spells), to record facts, to think with, and to express identity (e.g., chanting in demonstrations). We even play with language. Much humor—particularly punning—depends on being able to manipulate language (Crystal, 1998).

It is not surprising then that understanding language is an important part of understanding human behavior, with different areas of scientific study emphasizing different aspects of language processing. The study of the *anatomy* of language emphasizes the components of the articulatory tract, such as the tongue and voice box. Neuroscience examines the role of different parts of the brain in behavior. *Linguistics* examines language itself. **Psycholinguistics** is the study of the psychological processes involved in language. **Psycholinguists** study understanding, producing, and remembering language, and hence are concerned with listening, reading, speaking, writing, and memory for language. They are also interested in how we acquire language, and the way in which it interacts with other psychological systems. Many people think that "psycholinguistics" has a rather dated feel, emphasizing the role of linguistics too much. Although the area might once have been about the psychology of linguistic theory, it is now much more. Still, there is currently no better term, so it will have to do.

One reason why we take language for granted is that we usually use it so effortlessly, and most of the time, so accurately. Indeed, when you listen to someone speaking, or look at this page, you normally cannot help but understand what has been said or what is printed on the page in front of you. It is only in exceptional circumstances that we might become aware of the complexity involved: if for example we are searching for a word but cannot remember it; if a relative or colleague has had a stroke that has affected their language; if we observe a child acquiring language; if we try to learn a second language ourselves as an adult; or if we are visually impaired or hearing impaired, or if we meet someone else who is. And, of course, if you find this book so difficult to understand that you have to keep reading and rereading it to make any sense of it. As we shall see, all of these examples of what might be called "language in exceptional circumstances" reveal much about the processes involved in speaking, listening, writing, and reading. But given that language processes are normally so automatic, we also need to carry out careful experiments to understand what is happening. Modern psycholinguistics is therefore closely related to other areas of cognitive psychology, and relies to a large extent on the same sort of experimental methods. We construct **model**s of what we think is going on from our experimental results; we use observational and experimental data to construct theories. This book will examine some of the experimental findings in psycholinguistics, and the theories that have been proposed to account for them. Generally the phenomena and data to be explained will precede discussion of the models, but it is not always possible to neatly separate data and theories, particularly when experiments are tests of particular theories. I'll be talking a bit more about models and theories later.

This book has a cognitive emphasis. It is concerned with understanding the *processes* involved in using and acquiring language. This is not just my personal bias; I believe that all our past experience has shown that the problems of studying human behavior have yielded, and will continue to yield, to investigation by the methods of cognitive psychology and neuroscience.

WHY STUDY LANGUAGE AND WHY IS IT SO DIFFICULT?

Even before I get on to saying what language is, I want to ask why we should study it. Some people (mostly psycholinguists) think the answer is obvious, but in practice many students are often perplexed as to why so much of their psychology course is devoted to the subject. What's more I've noticed that students often find the psychology of language the most difficult part of psychology. It's often the part they like least (and often actively dislike). So why should we study language?

Well, you're reading this book right now, aren't you? Reading words and sentences and making sense of them (or trying to); that's part of psycholinguistics, for starters. It's a good bet that you're pretty good at reading, but you probably know someone who has had some difficulty in learning to read, or even now finds reading and spelling difficult (that is, they have dyslexia). Perhaps you know someone who has had a stroke and now finds reading difficult. More psycholinguistics!

But I bet you've listened to the radio or TV today, or listened to music with words (talking,

more psycholinguistics). I'll be a little surprised if you've not talked to anyone at all (speaking, listening; even yet more psycholinguistics). You've probably written something too (you get the idea).

But even if by some miracle you haven't, I bet you've heard a voice in your head. The voice in your head probably uses words. In fact it's hard (I find impossible) to think about human thought without thinking about language. So thinking, the essence of being human, is completely intertwined with language.

What is more we transmit our learning and culture by language. The major reason civilization has reached its heights, that we live in centrally heated houses with thin computers and cell phones, using social networking sites, is because we have built up a culture and a technology that would have been completely impossible without language. For this reason the evolutionary biologist Martin Nowak (2006) says that language is "the most interesting invention of the last 600 million years" (p. 250). He says that the impact of language is comparable with only a few other events in biological history, such as the evolution of life and the evolution of multi-celled animals.

So here is my list of reasons of why the study of the psychology of language is so important:

1. We use language nearly all the time; technology and our cultures would be impossible without it.
2. We usually think in language.
3. Some people have difficulty learning spoken or written language (developmental disorders), or have difficulty with language as a consequence of brain damage (acquired disorders).

We can agree then that studying language is important; but why do so many students find it hard? I think there are several reasons. First, the importance and applications of language are not always made as clear as they might be. If I told you that I could teach you to read a textbook in a way that would guarantee you'd remember it and understand it and get an A in an exam, you'd probably pay attention. (Sadly I can't, otherwise I would be very rich, although later I will give you some tips.) So in this book I've tried to emphasize the importance of the applications of the psychology of language. Second, the subject seems to have a lot of jargon in it, and teachers sometimes forget this or underestimate their students' knowledge. How can you be expected to understand what a reduced relative clause is when you don't know what a clause is? Or even aren't that clear what a noun is? I've tried to make life as easy as possible by defining all technical terms, trying to keep jargon to a minimum, and providing a glossary which contains a simple definition of every technical term I can think of. Third, psycholinguists are an argumentative bunch, and rarely seem to agree on anything. Sometimes they can't even agree whether they agree or not. So there are few situations when we can say "now THAT's the answer." And people like answers. They don't like to be left with the conclusion "it could be this or it could be that and it all depends," and that's going to be my conclusion most of the time. But life is full of uncertainties, so get over it and live with it. And the final reason that people find psycholinguistics difficult is because it's full of models. A colleague once told me that she overheard some students talking in front of her (yes, we love to eavesdrop) and one said to the other "language—it's just all these models." Models are the most important thing in science; they're the closest we get to an explanation. I'll talk about models below.

WHAT IS LANGUAGE?

It might seem natural at this point to say exactly what is meant by "language," but to do so is much harder than it first appears. We all have some intuitive notion of what language is; a simple definition might be that it is "a system of symbols and rules that enable us to communicate." Symbols are things that stand for other things: Words, either written or spoken, are symbols. The rules specify how words are ordered to form sentences. However, providing a strict definition of language is not straightforward. Consider other systems that many think are related to human spoken language. Are the communication systems of monkeys a language? What about the "language" of dolphins, or the "dance" of honey bees that communicates the location of sources of nectar to other bees in the hive? How

Are these elephants communicating using a language?

does the signing of people with hearing impairment resemble or differ from spoken language? Because of these sorts of complications, many psychologists and linguists think that providing a formal definition of language is a waste of time. We look at whether animals have language and at the characteristics of language in more detail in Chapter 2.

We can describe language in a variety of ways: for example, we can talk about the sounds of the language, or the meaning of words, or the grammar that determines which sentences of a language are legitimate. These types of distinctions are fundamental in linguistics, and these different aspects of language have been given special names. We can distinguish between **semantics** (the study of meaning), **syntax** (the study of word order), **morphology** (the study of words and word formation), **pragmatics** (the study of language use), **phonetics** (the study of raw sounds), and **phonology** (the study of how sounds are used within a language) (see Figure 1.1).

Syntax will be described in detail in the next chapter, and semantics in Chapter 11. Morphology is concerned with the way that complex words are made up of simpler units, called **morpheme**s. There are two types of morphology: **inflectional morphology**, which is concerned with changes to a word that do not alter its underlying meaning or syntactic category, and **derivational morphology**, which is concerned with changes that do. Examples of inflectional changes are pluralization (e.g., "house" becoming "houses," and "mouse" becoming "mice") and verb tense changes (e.g., "kiss" becoming "kissed," and "run" becoming "ran"). Examples of derivational changes are "develop" becoming "development," "developmental," or "redevelop." The distinction between phonetics and phonology, which are both ways of studying sounds, will also be examined in more detail in Chapter 2.

The idea of "a **word**" also merits consideration. Like the word "language," the word "word" turns out on closer examination to be a somewhat slippery customer. The dictionary definition of a word is "a unit of language," but in fact there

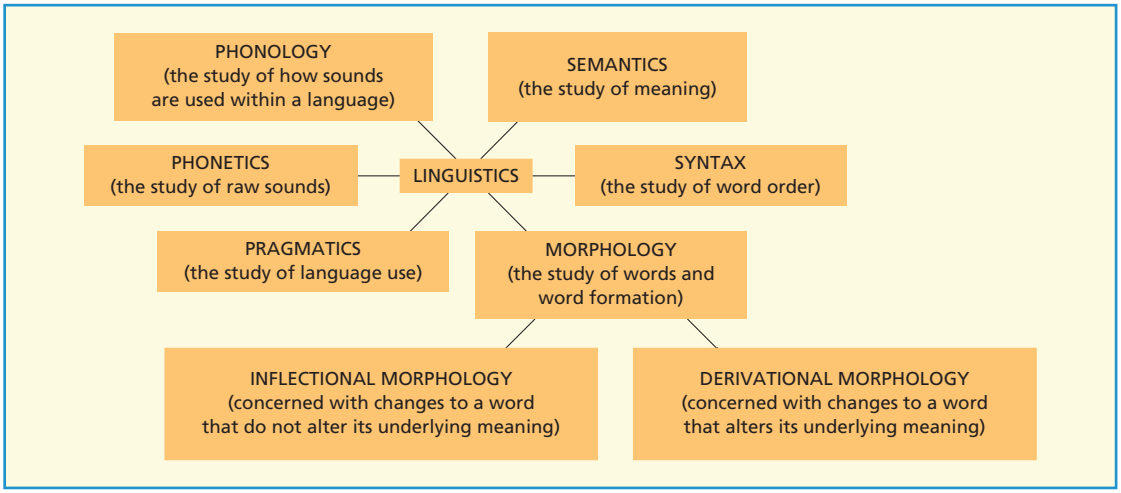

FIGURE 1.1

are many other language units (e.g., sounds and sentences). Crystal (2010, p. 461) defines a word as "the smallest unit of grammar that can stand on its own as a complete utterance, separated with spaces in written language." Hence "pigs" is a word, but the word ending "-ing" by itself is not. A word can in turn be analyzed at a number of levels. At the lowest level, it is made up of sounds, or letters if written down. Sounds combine together to form syllables. Hence the word "cat" has three sounds and one syllable; "houses" has two syllables; "syllable" has three syllables.

Words can also be analyzed in terms of the morphemes they contain. Consider a word like "ghosts." This is made up of two units of meaning: the idea of "ghost," and then the plural ending or **inflection** ("-s"), which conveys the idea of number: in this case that there is more than one ghost. Therefore we say that "ghosts" is made up of two morphemes, the "ghost" morpheme and plural morpheme "s." The same can be said of past tense endings or inflections: "Kissed" is also made up of two morphemes, "kiss" plus the "-ed" past tense inflection which signifies that the event happened in the past. There are two sorts of inflection, regular forms that follow some rule, and irregular forms that do not. Irregular plurals that do not obey the general rule of forming plurals by adding an "-s" to the end of a noun, or forming the past tense by adding a "-d" or "-ed" to the end of a verb, also contain at least two morphemes. Hence "house," "mouse," and "do" are made up of one morpheme, but "houses," "mice," and "does" are made up of two. "Rehoused" is made up of three morphemes: "house" plus "re-" added through mechanisms of derivational morphology, and "-ed" added by inflection. Every child's favorite word "antidisestablishmentarianism" is made up of six morphemes.

Psychologists believe that we store representations of words in a mental dictionary. We call this mental dictionary the **lexicon**. The lexicon contains all the information (or at least pointers to all of the information) that we know about a word, including its sounds (phonology), meaning (semantics), written appearance (orthography), and the syntactic roles the word can adopt. The lexicon must be huge: estimates vary greatly, but a reasonable estimate is that an adult knows about 70,000 words (Nagy & Anderson, 1984; but by "greatly" I mean that the estimates range between 15,000 and 150,000—see Bryson, 1990). Recognizing a word is rather like looking it up in a dictionary; when we know what the word is, we have access to all the information about it, such as what it means and how to spell it. So when we see or hear a word, how do we access its representation within the lexicon? How do we know whether an item is stored there or not? What are the differences between understanding speech and understanding visually presented words? Psycholinguists are particularly interested in the processes of lexical access and how things are represented.

HOW HAS LANGUAGE CHANGED OVER TIME?

Language must have changed enormously over time, and one obvious consequence of these changes is that there are now many different languages in the world. Depending on exactly how something counts as a separate language, there are now thought to be around 5,000–6,000 (but the number is getting smaller as languages, like species, become extinct), although estimates vary between 2,700 and 10,000. We do not even know whether all human languages are descended from one common ancestor, or whether they are derived from a number of ancestors (my bet is on one). However, it is apparent that many languages are related to each other. This relation is apparent in the similarity of many of the words of some languages (e.g., "mother" in English is "Mutter" in German, "moeder" in Dutch, "mère" in French, "maht" in Russian, and "mata" in Sanskrit). More detailed analyses like this have shown that most of the languages of Europe, and parts of west Asia, derive from a common source called proto-Indo-European. All the languages that are derived from this common source are called Indo-European. We can gather ideas about where the speakers of the ancestral language came from, by looking at the words that are shared in the descendant languages. For example, all Indo-European languages have similar words for horses and sheep, but not for palm tree or vine. Hence the

original language must have been spoken somewhere where it was easy to find horses and sheep, but where palms and vines could not be found. Such observations suggest that the speakers of proto-Indo-European probably spread out from Anatolia (approximately modern-day Turkey) with the expansion of agriculture about 9,000 years ago (Bouckaert et al., 2012). Indo-European has a number of main branches: the Romance (such as French, Italian, and Spanish), the Germanic (such as German, English, and Dutch), and the Indian languages (see Figure 1.2). There are some languages that are European but that are not part of the Indo-European family. Finnish and Hungarian are from the Finno-Ugric branch of the Uralic family of languages. There are many other language families in addition to Indo-European, including Afro-Asiatic (covering north Africa and the Arabian peninsula), Niger-Congo, Japanese, Sino-Tibetan, and families of languages spoken in and around the Pacific and in north and south America. Altogether linguists have identified over 100 language families, although a few languages, such as Basque, do not seem to be part of any family. The extent to which these large families may be related further back in time is unknown.

Languages also change over relatively short time spans. Chaucerian and Elizabethan English are obviously different from modern English, and even Victorian speakers would sound decidedly archaic to us today, my dear old bean. Even listening to 1970s sitcoms can be disconcerting at times. We coin new words or new uses of old words when necessary (e.g., "computer," "television," "internet," "rap"). Whole words drop out of usage ("thee" and "thou"), and we lose the meanings of some words, sometimes over short time spans—rather sadly I can't remember the last time I had to give a measurement in rods or chains. We borrow (or perhaps steal is a better word) words from other languages ("café" from French, "potato" from Haiti, and "shampoo" from India). Sounds change in words ("sweetard" becomes "sweetheart"). Words are sometimes even created by error: "pea" was back-formed from "pease" as people started to think (incorrectly) that "pease" was plural (Bryson, 1990).

We most definitely should not gloss over differences between languages. Although they have arisen over a relatively short time compared with the evolution of humans, we cannot assume that speakers of different languages process them in the same basic way. Whereas it is likely that most of the mechanisms involved are the same, there might be some differences, particularly in the processing of written or printed words. Writing is a recent development compared with speech, and as we shall see in Chapters 7 and 8, there

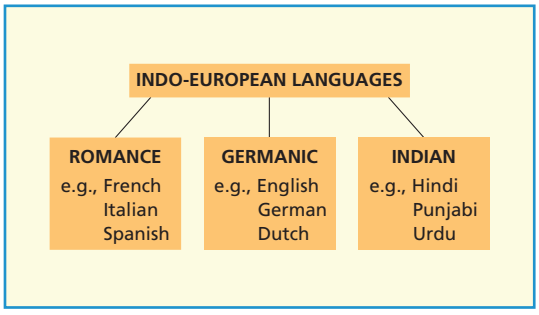

FIGURE 1.2

Chaucerian language seems archaic and verbose in comparison to modern English.

are important differences in the way that different written languages turn written symbols into sounds. Nevertheless, there is an important core of psychological mechanisms that appear to be common to the processing of all languages.

WHAT IS LANGUAGE FOR?

The question of what language is used for now is intimately linked with its origin and evolution. It is a reasonable assumption that the factors that prompted its origin in humans are still of fundamental importance. Primary among these is the fact that language is used for communication. Although this might seem obvious, we can sometimes lose sight of this point, particularly when we consider some of the more complicated experiments described later in this book. Nevertheless, language is a social activity, and as such is a form of joint action where people collaborate to achieve a common aim (Clark, 1996). We do not speak or write in a vacuum; we speak to communicate, and to ensure that we succeed in communicating we take the point of view of others into account. We look at this idea in detail in Chapter 14.

Although the primary function of language is communication, it might have acquired (or even originated from) other functions. In particular, language might have come to play a role in other, originally non-linguistic, cognitive processes. The extreme version of this idea is that the form of our language shapes our perception and cognition, a view known as the Sapir–Whorf hypothesis. Indeed, some have argued that language evolved to allow us to think, and communication turned out to be a useful side effect. As I noted above, technology and culture would be impossible without language. I examine these ideas in more detail in Chapter 3.

THE HISTORY AND METHODS OF PSYCHOLINGUISTICS

Now we know something about what language is, let us look at how modern psycholinguistics studies it. We will begin by looking briefly at the history of the subject.

Spoken words can have a powerful influence on the listener's state of mind.

A brief history of psycholinguistics

Given the importance of language, it is surprising that the history of psycholinguistics is a relatively recent one. The beginning of the scientific study of the psychology of language is often traced to a conference held at Cornell University, USA, in the summer of 1951, and the word "psycholinguistics" was first used in Osgood and Sebeok's (1954) book describing that conference. Nevertheless, the psychology of language had been studied before then. For example, in 1879 Francis Galton studied how people form associations between words. In Germany at the end of the nineteenth century, Meringer and Mayer (1895) analyzed slips of the tongue in a remarkably modern way, and Freud (1901/1975) tried to explain the origin of speech errors in terms of his psychodynamic theory (see Chapter 13). If we place the infancy of modern psycholinguistics sometime around the American linguist Noam Chomsky's (1959) review of Skinner's book *Verbal Behavior*, its adolescence would correspond to the period in the